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Impact assessment of policies promoting fiber-to-fiber recycling of textiles

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MISTRA
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foreword

As a part of Mistra Future Fashion Phase 2 IVL Swedish Environmental Research Institute (IVL)", the International Institute of Industrial Environmental Economics (IIIEE) and PlanMiljø have selected and assessed policy measures promoting fiber-to-fiber recycling of textiles. Stakeholders were invited to contribute to this work, e.g. by participating in a workshop and responding to a questionnaire. On behalf of Mistra Future Fashion we would like to thank all companies and organizations that have contributed with input to our work. Thank you for your interest and participation! Your inputs and reality checks are very important for us in creating research with stakeholder value.

Stockholm, December 21st 2016

Maria Elander

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abbreviations

CN	Combined nomenclature
DKK	Danish crowns
EEE	Electrical and electronic equipment
EPA	Environmental Protection Agency
EPR	Extended producer responsibility
EU	European Union
GPP	Green public procurement
ICT	Information and communications technology
IIIEE	International Institute for Industrial Environmental Economics
IVL	IVL Swedish Environmental Research Institute
NOx	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
PRO	Producer responsibility organization
R&D	Research and development
REP	Refunded emission payments
RVP	Refunded virgin payments
SEK	Swedish crowns
US	United States (of America)
WEEE	Waste electrical and electronic equipment

summary

As part of the Mistra Future Fashion Research Program, IVL Swedish Environmental Research Institute (IVL), the International Institute for Industrial Environmental Economics (IIIEE) and PlanMiljø have investigated policy options promoting (fiber-to-fiber) recycling of textile waste. The ambition was to contribute to and broaden the discussion regarding potential policy measures in the textile field as well as potential elements that can be included in such policies.

Ten policy measures promoting fiber-to-fiber recycling of textiles, contributing to circular flows of textile waste, were identified and described. Two policy measures were selected for impact assessment: mandatory extended producer responsibility (EPR) and refunded virgin payments (RVP). The policy evaluation was carried out as an ex-ante assessment with regard to eight policy goals. Stakeholder views on the identified and assessed policy measures were collected in a policy workshop and via an online questionnaire.

There is a potential to broaden the scope of policy measures promoting fiber-to-fiber recycling of textiles compared to the policy recommendations made by the Swedish Environmental Protection Agency (EPA). New policy measures in the textile field should embrace potentials to generate upstream improvements and increasing the demand for recycled textile fibers.

Although the Swedish EPA suggests a mandatory EPR for textiles as one of two alternative policy options for handling of textile waste, the proposal focuses almost exclusively on downstream improvements. The mandatory EPR assessed in this report includes additional elements, embracing also the potential of an EPR system to generate upstream improvements.

Economic instruments have shown to be successful measures to reduce environmental externalities. The RVP system assessed in this report adds a new perspective on potential ways and means to promote recycling of textiles complementing the investigation on how public bodies can contribute to more reuse and recycling of textiles by green public procurement suggested by the Swedish EPA.

Both a mandatory EPR and a RVP system have potentials to have large positive impacts on fiber-to-fiber recycling as well as overall recycling of textiles. A mandatory EPR system has the same or larger positive impacts on all eight policy goals defined in this report compared to a RVP system. A mandatory EPR system embodies the potential to integrate a range (combination) of complementing policy measures whereas an RVP system should be complemented by additional policy measures.

1 introduction

The Swedish Environmental Protection Agency (EPA) has proposed two targets regarding textile waste aiming at reducing the amount of textile waste in the mixed municipal waste and at increasing reuse and recycling of collected textiles, see section 1.1.3 (Naturvårdsverket, 2016). Reaching the targets would more than double the amount of separately collected textiles in Sweden and more than quadruple the recycling of textiles (Hultén et al., 2016; Elander et al., 2014; Palm et al., 2014). In order to reach the proposed target for treatment of textile waste, policy measures promoting fiber-to-fiber recycling of textiles are considered necessary.

The goal of the report is to provide information and guidance regarding policy options promoting (fiber-to-fiber) recycling of textile waste in the current political discussion. The research was carried out overlapping the extensive work of the Swedish EPA within the governmental assignment *Handling of textiles*. The recommendations of the Swedish EPA were reported in September 2016 and include (alternative) policy proposals for handling of textile waste. The goal of this report includes the ambition to broaden the discussion regarding potential policy measures in the textile field as well as potential elements that can be included in such policies.

1.1 background

1.1.1 current recycling of textiles

121 000 tons new clothes and household textiles were put on the Swedish market in 2013 (Elander et al., 2014). The same year about 30 000 tons of used textiles were separately collected, of which 23 000 tons were reused and 4 000-6 000 tons recycled (Elander et al., 2014; Palm et al., 2014). This corresponds to a reuse rate of 19 percent and a recycling rate of 3-5 percent. The most common waste management treatment for used textiles in Sweden is incineration. In 2014 72 000 ton of textiles were discarded and incinerated together with the mixed municipal waste (Hultén et al., 2016).

Textile products cause large environmental impacts that can be reduced by increasing reuse and recycling of textiles (Schmidt et al. 2016; Östlund et al., 2015; Zamani, 2014). Schmidt et al. show that recycling is for the most part a better environmental option than incineration for most types of textile fibers and recycling methods. Increased recycling of textiles therefore contributes to increasing resource efficiency and circularity of the textile value chain. Schmidt et al. also show that the benefits of reuse exceed by far the environmental

benefits of recycling. The increased textile recycling should therefore not come at the expense of reuse.

1.1.2 critical aspects for fiber-to-fiber recycling

Previous work in Mistra Future Fashion has identified critical aspects for increased fiber-to-fiber recycling of textiles in interviews with textile collectors, textile recyclers and textile producers (brands). In total 43 critical aspects in the four categories *Material input to recycling*, *Markets*, *Technology* and *Information* were identified (Elander & Ljungkvist, 2016). The identified aspects for increased fiber-to-fiber recycling of textiles address the textile waste entering the recycling process, the recycling process itself and the recycled textile fibers leaving the recycling process.

The following aspects were rated having medium to large impact on fiber-to-fiber recycling:

- Availability of textile recycling technology
- Lack of economic viability of textile sorting and recycling
- Lack of guidance on ownership of used textiles / textile wastes
- Lack of information regarding content in textiles for recycling
- Market prices for recycled textile fibers
- Presence of non-textile materials in textile products
- Quality of textile fibers for recycling
- Trade barriers for textile waste
- Use of mixed textile fibers in textile products

The interviews and the subsequent analysis indicated strong dependencies and interconnections along the value chain and revealed a need for increased coordination and exchange of information across the textile value chain. The challenge of increasing fiber-to-fiber recycling of textiles cannot be met by a single stakeholder group or on a single place in the textile value chain. Effects on the whole value chain, like connections between stakeholders and market mechanisms should be considered when introducing policy measures with the objective to increase fiber-to-fiber recycling of textiles (Elander & Ljungkvist, 2016).

1.1.3 the swedish environmental protection agency's proposal for handling of textiles

The Swedish EPA was asked to develop a proposal how to handle textiles by the Swedish Government in 2014 (Regeringen, 2014). The result of the assignment was presented and formulated as proposal regarding the handling of textiles in September 2016 (Naturvårdsverket, 2016a).

The Swedish EPA suggests two new targets for textile waste:

1. The amount of textile waste in the mixed municipal waste shall be reduced by 60 percent by 2025 (compared to 2015)

2. 90 percent of separately collected textile waste shall be prepared for reuse or recycled by 2025. The waste hierarchy shall apply and textile recycling shall primarily be carried out as recycling into new textiles.

The Swedish EPA also suggests four proposals for a more sustainable production and consumption of textiles and two alternative proposals for textile waste management:

Proposals for a more sustainable production and consumption of textiles

1. Dialogue with representatives from the textile industry

2. Support for sustainable business models

3. Reuse and recycling of textiles in the public sector

4. Consumer information

Two alternative proposals for textile waste management[1]

5a Requirements for separate collection of textiles

5b Mandatory extended producer responsibility (EPR)

Both the two proposed targets and several of the policy proposals are relevant for increasing (fiber-to-fiber) recycling of textiles. Where applicable, the work carried out in the governmental assignment on handling of textiles by the Swedish EPA has therefore been used as important background information for the work presented in this report.

1.2 objectives

The objectives of the report are to:

1. Identify and describe different policy measures promoting fiber-to-fiber recycling of textiles, contributing to circular flows of textile waste

2. Collect stakeholder views regarding such potential policy measures

[1] According to the Swedish EPA both alternative proposals for textile waste management can fulfil the desired environmental benefits proposed in the two targets for textile waste (Naturvårdsverket, 2016a).

3. Select two policy measures with potential to contribute to the proposed targets for textile waste, complementing the proposed policy options proposed by the Swedish EPA

4. Carry out an impact assessment (ex-ante policy evaluation) of the two selected policy measures with regard to eigth policy goals

The report documents reserach carried out in in Mistra Future Fashion Phase 2 and builds upon previous reserach carried out in Mistra Future Fashion in regard of identifying and assessing critical aspects for fiber-to-fiber recycling of textiles (Elander & Ljungkvist, 2016).

1.3 scope and delimitations

This report describes and assesses policy measures promoting (fiber-to-fiber) recycling of textiles. An important aspect of increasing textile recycling is to increase separate collection of textiles, i.e. the amount of used textiles available for recycling. However, separately collected textiles include both reusable and recyclable textiles. Studies show that separately collected textiles include reusable textiles even if they are specifically collected for recycling (Avfall Sverige, 2013). Similarly used textiles specifically collected for reuse include textiles that are not suitable for reuse, but could be recycled (Watson et al., 2016). The environmental benefits of reusing textiles exceed the environmental benefits of textile recycling (Schmidt et al., 2016). Policy measures promoting textile recycling should therefore be designed in a way that they have no or minimal adverse effects on reuse. The policy measures considered in this report therefore also include some aspects promoting reuse. Policy measures primarily or exclusively promoting reuse, collective use and prolonged (active) life time of textiles are covered by complementing research carried out in Mistra Future Fashion and are therefore not considered in this report.

In the Governmental assignment *Handling of textiles*, the Swedish EPA was specifically given mandate to investigate a system for extended producer responsibility (EPR) for textiles (Regeringen, 2014). As a result of the Governmental assignment the Swedish EPA has proposed (as one of two options) a mandatory EPR in order to increase separate collection of textiles (Naturvårdsverket, 2016a). In this research, special attention has therefore been given to EPR for textiles. However, the scope of a potential EPR system for textiles in this report includes explicitly both upstream and downstream effects. The scope has been set wider than in the Swedish EPA's proposal, primarily focusing on downstream effects. Within the scope of the proposed EPR system in this report, it was also specifically assessed how an EPR system for textiles can be designed to increase financing for recycling.

The screening and description of different policy measures are carried out in general terms, whereas the impacts assessment of two selected policy options *Mandatory extended producer responsibility (EPR)* and *Refundable virgin payments (RVP)* are carried out with regard to Sweden and the Swedish fashion industry.

The impact assessment carried out in this report is an ex-ante assessment of potential policy goals and outcomes. The impact assessment carried out does not include assessment of socio-economic aspects. Neither does it include legal assessment of the described and assessed policy measures.

1.4 structure of the report

The structure of this report reflects largely the main activities carried out. It starts with a general overview of the research approach in section 2, followed by a short overview of the Swedish textile market in section 3. Section 4 gives an overview of different policy measures considered to potentially promoting (fiber-to-fiber) recycling of textile waste, including stakeholders' views on ten pre-selected policy measures. Section 5 describes the reasoning for choosing mandatory EPR and RVP for the impact assessment in this report. The mandatory EPR system is described and assessed in section 6. The RVP system is described and assessed in section 8. Section 10 documents stakeholder inputs regarding the EPR and RVP systems collected via a questionnaire. The findings and next steps of this research are summarized in section 11.

2 research approach

The research carried out in this report was divided into four main activities as illustrated in Figure 1.

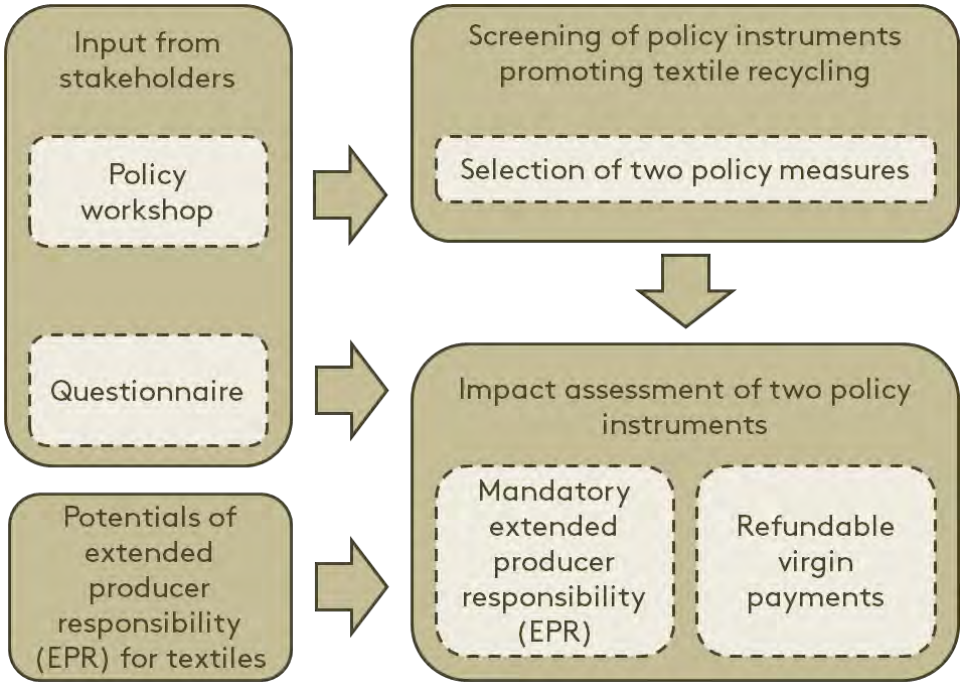

Figure 1 Main activities of the research presented in this report

2.1 screening and pre-selection of policy measures

A screening of different policy measures promoting recycling of textiles was carried out. In total 27 different potential policy measures were collected in a longlist, comprising six administrative, ten economic, seven informative and four other policy measures (including EPR systems for textiles). The inclusion of policy measures in the longlist was based on a literature review of existing policy measures and initiatives in the textile field and complemented with policy measures adapted from other areas. Five policy experts from IVL Swedish Environmental Research Institute (IVL), the International Institute for Industrial Environmental Economics (IIIEE) and PlanMiljø were involved in the screening process.

Based on the expert opinions from IVL, IIIEE and PlanMiljø the 27 policy measures in the longlist were ranked according to their potentials to contribute to the following criteria (on a scale from one to five respectively):

- Ability to increase reuse[2]
- Ability to increase recycling in general and fiber-to-fiber recycling in particular
- Ability to develop new and more sustainable markets and business models for (recycling of) textiles
- Ability to develop new technologies for sorting and (fiber-to-fiber) recycling of textiles
- Ability to address / target critical factors identified by Elander&Ljungkvist (2016)
- Ability to affect/target multiple stages in the value chain, e.g. production, consumption, collection, sorting, recycling

The ranking resulted in a pre-selected shortlist of ten policy measures. These policy measures were discussed by stakeholders from textile producers (brands), textile collectors, authorities and research institutions in a policy workshop.[3] The stakeholders did not have any wish to complement the shortlist with other, in their views missing, policy measures. Stakeholders were asked to contribute with their views regarding contribution to fiber-to-fiber textile recycling, important aspects in design, main challenges/barriers for adoption, ability to tackle and interconnect both upstream and downstream improvements and, finally, interconnections and dependences in the textile value chain.

2.2 selection of policy measures for impact assessment

Two policy measures, *Mandatory extended producer responsibility (EPR)* and *Refundable virgin payments (RVP)*, were selected for an ex-ante assessment of potential outcomes in terms of potential policy goals.

The selection was made taking different aspects into account, including input from stakeholders (see section 5.1), ability to complement the proposed policy measures by the Swedish EPA and ability to broaden the current discussion regarding new policy measures for textiles, including larger focus on upstream effects (see sections 5.2-5.3).

A prerequisite for the selection of policy measures for impact assessment in this report was to include both pull and push strategies (Mistra Future Fashion, 2015). In this context, a pull strategy is a policy measure increasing the demand for recycled textile fibers (output from the recycling process), whereas a push

[2] The objectives of the policy instruments in this report primarily focus on promoting (fiber-to-fiber) recycling of textiles. However, reuse of textiles was considered as an aspect in the selection to make sure that the policy instruments do not have any major negative effects in reuse of textiles.
[3] 27 stakeholders participated in the workshop. The stakeholders represented the following stakeholder groups: textile collectors (3), brands/textile producers (9), authorities (5) and research institutions (10).

strategy includes policy measures promoting material flows into the recycling process, e.g. increased collection. Whereas a mandatory EPR can be designed to integrate both pull and push strategies, the RVP system represents a pull strategy.

2.3 impact assessment of two policy measures

The methodology used for the impact assessment of the mandatory EPR and RVP system described in this report was an ex-ante assessment regarding potential policy goals and outcomes. The impact assessment was carried out making use of experiences made in other and/or similar policies, while taking textile specific issues into account. The impact assessment was carried out in regard to the Swedish context and the Swedish fashion industry.

Starting point for the impact assessment is a more detailed description of the two selected policy measures (see sections 6.2 and 8.4). The descriptions cover aspects to include in the policy measures taking textile specific issues and the Swedish context into account. They also include reasoning about suitable levels for targets, fees and charges, scope, exceptions, responsibilities, expansion and development, financing, administration, monitoring and sanctions.

Based on the descriptions a qualitative assessment was carried out regarding expected outcomes related to the following eight policy goals:

1) increased collection of used textile products (post-consumer textiles)
2) increased reuse of used textile products
3) increased overall recycling of used textile products
4) increased fiber-to-fiber recycling of used textile products
5) prevention of hazardous / unwanted chemicals
6) development of technologies for sorting and (fiber-to-fiber) recycling of textiles
7) increased transparency of material flows
8) improved design for fiber-to-fiber recycling

The practical design of the policy measures, e.g. scope, exemptions, level of fees etc., influences the expected outcomes of the policy measures and can also lead to conflicts between different policy goals, i.e. promoting one policy goal at the expenses of another. Such critical design aspects can be seen as a set of adjustment screws as visualized in Figure 2.

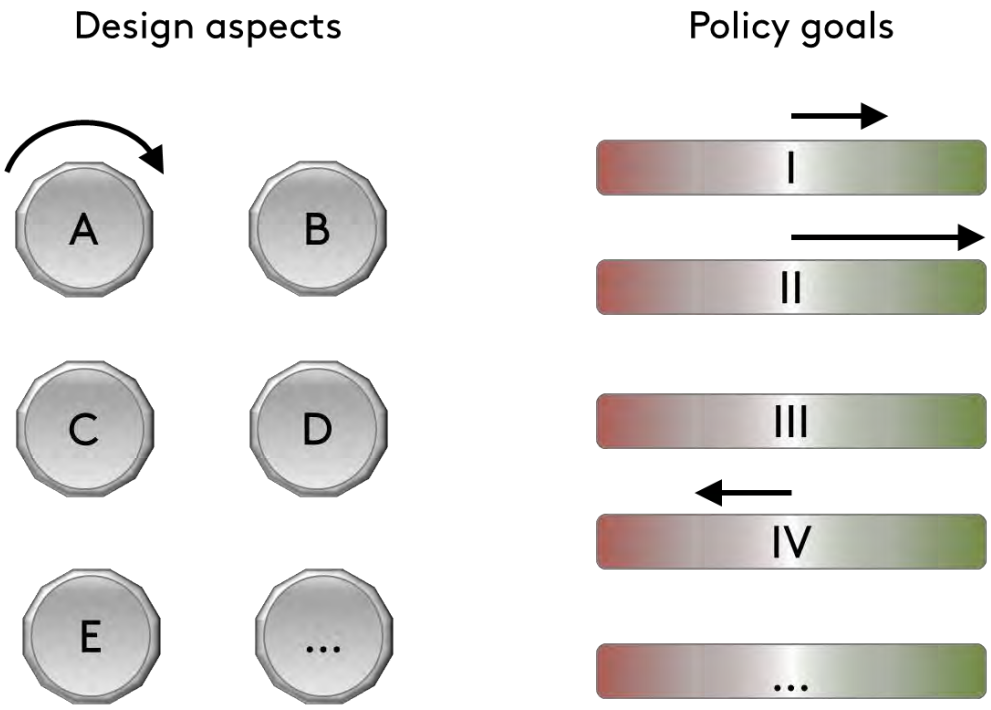

Figure 2 Different design aspects of a policy measure (A-E in the figure) may influence different policy goals (I to IV in the figure) to different degrees

The analysis of the impact assessment included consideration of critical design aspects and their influences on the policy goals, including conflicts and tradeoffs in design. The degree of impacts was indicated in five levels: large negative, small negative, no/little, small positive and large positive impact.

The two policy measures selected for the impact assessment, mandatory EPR and RVP system, are very different. Whereas the mandatory EPR system has a broader approach for textiles and textile waste, including a range of different elements and policy measures, the RVP system is targeted specifically at increasing the use of recycled textile fibers in new textile products. This has the consequence that the impact assessment of the two different policy measures partly differs, although the main structure (ex-ante assessment regarding the above stated eight policy goals, identification of main elements/critical design aspects etc.) was the same.

2.4 stakeholder views on mandatory EPR and RVP

Stakeholders were specifically invited to provide their views on the two assessed policy measures mandatory EPR and RVP system in the form of a questionnaire.

The questionnaire was sent out to the invitees for the Mistra Future Fashion policy workshop (see section 2.1). The objective of the questionnaire was to get feedback on some of the main elements in the described and assessed mandatory EPR system and in the RVP system (reality check) and to make sure that the research carried out in Mistra Future Fashion regarding potential policies promoting fiber-to-fiber recycling of textiles is relevant for stakeholders.

The questionnaire contained eight questions, half of which addressed a RVP system and the other half a mandatory EPR system (see appendix 6). The questionnaire was developed as an online survey using the Apsis Pro software (APSIS, 2016). It was sent to 62 respondents, representing 45 different companies and organizations from the following stakeholder groups: textile collectors, brands/textile producers, authorities and research institutions. 19 respondents (30 percent) answered the survey.

3 the swedish textile market

The impact assessment in this report is carried out with regard to Sweden and the Swedish fashion industry (see section 1.3). This section therefore gives short insights to the Swedish textile market regarding amounts of clothes and household textiles put on the market, different textile fiber types put on the market and the market structure.

3.1 new textiles put on the swedish market

The amount of textiles put on the Swedish market is the sum of the net inflow of textiles to Sweden (imports minus exports) and domestically produced textiles. The scope used for the impact assessment is limited to clothes and household textiles. Clothes and household textiles are almost exclusively imported; in 2013 domestic production corresponded to less than 0.4 percent (Elander et al., 2014). Due to reasons of simplification, the data on clothes and household textiles put on the Swedish market in this section therefore only includes data on the net inflow (not domestic production).

In 2015 the net inflow of clothes and household textiles to Sweden was 126 000 tons, with 99 000 tons clothes and 27 000 tons household textiles (SCB, 2016).[4] Figure 3 shows the distribution of textile fiber types in the net inflow of clothes and household textiles according to the descriptions of the used CN codes. Note that when a fiber type is referred to, e.g. cotton, wool, synthetic fibers etc., the textiles included in this category are either full or to more than 50 percent produced from this fiber type. When no fiber type exceeds 50 percent, the textile product is considered made from mixed fiber types. According to the collected data, cotton represents about half (53 percent) of the textile fibers in clothes and household textiles put on the Swedish market; man-made textile fibers constitute 32 percent, of which synthetic fibers (e.g. polyester and acrylic fiber make 16 percent, cellulose regenerated fibers (e.g. viscose and modal fibers) 1 percent and undefined man-made fibers 15 percent. Textiles with mixed fiber composition constitutes 10 percent, wool and fine animal hair 2 percent, unspecified virgin and recycled textile fibers 3 percent and silk 0.1 percent of clothes and household textiles put on market (SCB, 2016). Based on experiences from separately collected textiles for reuse and recycling, the share of mixed textile fibers seems low (Rosinski, 2016). It is possible that the distinction of textile fibers of clothes and household textiles according to the CN code descriptions are not always consistent. The distribution of textile fiber types in clothes and household textiles put on the Swedish market in Figure 3Figure 1 therefore rather gives an order of magnitude than absolute numbers.

[4] Data includes clothes and household textiles included in chapters 61 (61011010-61179000), 62 (62011100-62179000) and 63 (63011000-63049900) in the combined nomenclature (CN).

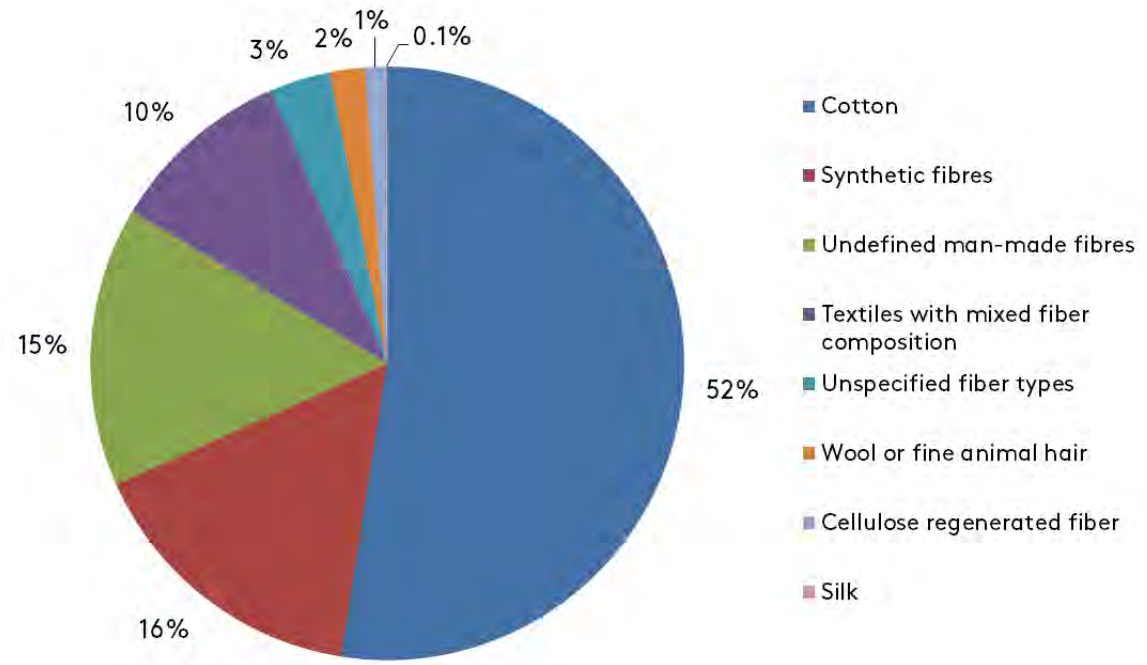

Figure 3 Different types of textile fibers in clothes and household textiles put on the Swedish market in 2015 (based on SCB, 2016)

3.2 structure of the swedish textile industry

In 2013 total sales for the Swedish fashion industry were 237 billion SEK, of which 90 billion SEK were earned on the domestic market (Tillväxtverket, 2015). H&M's total sales corresponded to 54 percent of the total Swedish fashion industry in 2013 (Ibid). According to a market survey carried out by Habit 12 fashion companies (H&M, Kappahl, Lindex, Åhlens, RNB, Gina Tricot, Dressman, MQ retail, IC Company, Gant, Stadium and Intersport) represent ca 60 percent of the Swedish market (Naturvårdsverket, 2016a). 95 percent of the Swedish fashion companies have less than 10 employees; small companies (10-49 employees) represent 4 percent, medium sized companies (50-249 employees) 1 percent and large companies (more than 250 employees) 0.1 percent of all companies in the Swedish fashion industry (Tillväxtverket, 2015). Except H&M, there are 625 small companies, 95 medium sized companies and 23 large companies in the Swedish fashion industry; together representing 70 percent of the domestic market (Ibid).

Five companies, IKEA, Hemtex, Jysk, Åhléns and Indiska, are supposed to represent 80-90 percent of the Swedish market for household textiles (Naturvårdsverket, 2016a).

4 policy measures promoting fiber-to-fiber recycling

A screening of potential policy measures promoting reuse and fiber-to-fiber recycling of textiles was carried out. Focus of the policy measures was to increase (fiber-to-fiber) recycling of textiles without decreasing or jeopardizing reuse of textiles. Ten policy measures were described in general terms and discussed with stakeholders in a workshop.

The screening of potential policy measures promoting fiber-to-fiber recycling, see section 2.1, resulted in a longlist with brief descriptions of 27 policy measures, see appendix 1. The policy measures in the longlist were evaluated according to six criteria, see section 2.2. The ten highest ranked policy measures in the longlist resulted in a pre-selection (shortlist) of policy measures promoting textile recycling. The shortlist is illustrated in Table 1.

Table 1 Shortlist of policy measures promoting textile recycling (A: Administrative instrument; E: Economic instrument; I: Informative instrument; O: Other instrument).

	A	E	I	O
Bonus malus system for recycled/virgin fibers in new textile products		X		
Consumer information on reuse and recycling			X	
Enhanced use of EU and Nordic (Type I) labelling for new textile products[5]			X	
Labelling requirements for new textile products regarding recycled content			X	
Mandatory system for Extended Producer Responsibility (EPR system)				X
Material exchange platform for used textiles for recycling				X
Public procurement supporting minimum recycled content of new textile products	X			
Refunded virgin payments for new textile products with recycled content		X		
Requirements on customer convenience for return of used textiles	X			
Voluntary system for Extended Producer Responsibility (EPR system)				X

The essence of each of the ten policy measures is summarized in sections 4.1-4.10 in relation to the obstacles addressed, critical factors in design, risk factors, conflicts and synergies as well as (primarily) affected stakeholders. More information is included in appendix 2. Stakeholders' views on the ten pre-selected policy measures in the shortlist, collected during a workshop, are summarized in section 4.11.

[5] Type I labelling is the strongest designation label according to the three broad types of voluntary labels identified by the International Organization for Standardisation (ISO). It includes a voluntary, multiple-criteria based, third party program that awards a license that authorises the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations (Global Ecolabelling Network, 2016).

4.1 green public procurement

Public procurement supporting minimum recycled content of new textile products	
Description	Green Public Procurement (GPP) is a process to procure goods, services and works with a reduced environmental impact throughout their life cycle (European Commission, 2008). The use of GPP by public bodies can provide producers with incentives to develop textile products with recycled fibers. In Japan GPP criteria has been used for textile products such as uniforms, hats and curtains (Tojo et al., 2012). Current EU guidelines already include recycled content as a way of gaining points rather than as a minimum requirement. Instead of giving points for recycled content, the public sector can leverage the market share of recycled textiles by introducing a minimum requirement for recycling content in the national green procurement guidelines.
Obstacle(s) addressed	Market prices for virgin textile fibers are low. It is therefore hard for textile products with recycled content to compete on price with textile products using only virgin fibers. Textile recyclers see a lack in demand for recycled textile fibers.
Critical factor(s) in design	The level of minimum requirement must be sufficiently high in order to have an effect. A (predefined) stepwise approach for including new product groups with the minimum requirements can be used in order to allow for new product development in areas with limited supply of textile products with recycled content. If justified, some areas application can be excluded from the minimum requirements on recycled content.
Risk factor(s)	Lack of knowledge among the procurement officers regarding how to stipulate minimum requirements. General perception that environmentally friendly products are more expensive. Limited supply of textile products with recycled content in certain product groups.
Conflicts and synergies	For some areas of application, special quality requirements might interfere with the minimum requirement on recycled content. With increasing share of recycled content, other factors such as durability and life time of product, might be influenced.
Affected stakeholder(s)	Public bodies (procurement officers), textile producers, textile recyclers

4.2 convenience requirements for collection

Requirements on customer convenience for return of used textiles	
Description	A prerequisite for increasing reuse and recycling of textiles is increased collection of used textiles. In order to increase the separate collection of textiles, it is essential that the possibility to return end-of-life products become more accessible (Tekie et al., 2013). Requirements could be put on public and/or private actors to enhance the convenience of the consumers when returning end-of-life textile products (e.g. proximity from the house, mandating retailers, etc.).
Obstacle(s) addressed	Consumers discard most used textiles in the mixed household waste. This may partly be the result of a (perceived) lack of availability and accessibility (convenience) of the separate collection of used textiles. Consumers lack knowledge about the markets for reuse and recycling of textiles, which often results in them discarding used textiles that could have been reused or recycled instead of incinerated.
Critical factor(s) in design	The situation should be avoided, where collection effort is concentrated in urban areas and rural areas are dismissed (Watson et al., 2015). Different consumers have different preferences and needs regarding separate collection of textiles. Offering differentiated solutions for return of end-of-life textile products (e.g. in stores, in public places, at recycling centers, at the workplace, in schools etc.) might increase collection rates.
Risk factor(s)	Consumers can decide not to deliver used textiles separately in spite of improved accessibility and convenience regarding return of end-of-life textile products. Different collection systems in different areas might confuse consumers moving from one area to another.
Conflicts and synergies	A well-developed infrastructure, in combination with information, is essential for consumers (households) to participate in separate waste collection (Hage et al., 2008; Swedish EPA, 2008). It is therefore important that other measures, e.g. informative instruments, are implemented in conjunction to improved convenience. Certification schemes can increase transparency in collection and handling of used textiles and reduce the risk of cherry-picking.
Affected stakeholder(s)	Consumers and stakeholders providing the infrastructure for separate textile collection (e.g. municipalities, stores, producers, accredited organizations).

4.3 bonus malus for recycled/virgin textile fibers

Bonus malus system for recycled/virgin fibers in new textile products	
Description	Bonus malus is a general term for an instrument that has both positive and negative incentives (SOU, 2013). Bonus malus system for recycled/virgin fibers in new textile products is a policy measure which aim to provide incentives to produce recycled textiles. A bonus is given to producers that use recycled textile fibers for production of new textile products and a malus (e.g. a tax) is levied on producers using virgin textile fibers. This may differentiate the price between new textile products made from virgin and recycled materials.
Obstacle(s) addressed	Currently, it is challenging for reused and recycled textiles to compete with textiles using virgin fibers. Textile recyclers see a lacking demand for recycled textile fibers (Elander & Ljungkvist, 2016). The bonus malus system provides economic incentives for textile producers to use recycled textile fibers. Stakeholders see a lacking consumer demand for textile products with recycled content (Elander & Ljungkvist, 2016). The bonus malus system may differentiate the price between new textile products made from virgin and recycled materials and increase the demand for textile products with recycled content.
Critical factor(s) in design	Transparent, measurable and appropriate criteria to assess recycled content in and quality of new textile products. Certification and registration of companies and products that are to be included in the scheme. Due to the variety of different textile products, several smaller bonus malus systems might be introduced in order to make the scheme more accurate. The level of the bonus and the malus respectively must be high enough to differentiate the price between new textile products made from virgin and recycled materials.
Risk factor(s)	Potential undesirable effects if the system is not well designed. The textile industry has complex global value chains. This can make it hard to assess which products or companies that should receive a bonus and which products or companies that are imposed with a malus
Conflicts and synergies	With increasing share of recycled content, other factors such as durability and life time of textile products, might be influenced.
Affected stakeholder(s)	Producers, importers, the state and governmental agencies, consumers

4.4 refunded virgin payments

Refunded virgin payments for new textile products	
Description	Refunded Virgin Payments (RVP) is a two-part measure in which polluters first pay a charge for the use of virgin textile fibers. The revenues are then refunded back to the producers who use high proportions of recycled textile fibers in relation to their total production. Producers surpassing their peers, i.e. using more recycled textile fibers, become net receivers of the refund, while producers underperforming, i.e. using more virgin textile fibers, become net payers in the system.
Obstacle(s) addressed	Market prices for virgin textile fibers are low. There is therefore a lack of incentives for producers to use recycled textile fibers in the production of new textile products. RVP stimulate producers to use recycled textile fibers in the production of new textile products by providing economic incentives for producers to reduce their use of virgin textile fibers and invest in e.g. recycled materials.
Critical factor(s) in design	One of the main challenges is to set the right level of the charge so it provides incentives for producers to change their sources of raw materials from virgin to recycled textile fibers. Setting boundaries for the RVP is important due to the complexity of the (global) textile value chains (e.g. production waste, markets etc.). Transparency regarding reporting of use of virgin textile fibers and total textile product put on the Swedish market is necessary within the system. Reporting from all companies must be carried out in the same way. There are possibilities to introduce RVP as a stepwise approach, e.g. starting with net use of virgin textile fibers for a company and subsequently differentiating the system for different textile fiber types and potentially even different product categories.
Risk factor(s)	Large and small producers might have different opportunities to influence suppliers and to shift production to higher recycled content. Producers might choose not to compete for the refunds and simply forward the increased costs from the charge to consumers instead of shifting production to higher recycled content.
Conflicts and synergies	With increasing share of recycled content, other factors such as durability and life-time of textile products, might be influenced.
Affected stakeholder(s)	Producers, importers, the state and government agencies, consumers

4.5 consumer information

Consumer information on reuse and recycling of textiles	
Description	An effective policy requires consumers to be informed about the impacts of their actions, their opportunities to influence these impacts and their role in the system. The benefits of reuse and recycling are aspects that must be considered in order to change consumer behavior, both in the public and private sector. Consumer information on reuse and recycling of textiles should include general information about textile consumption and use of textiles as well as information regarding collection, sorting, reuse and recycling of used textiles. The information aims to increase demand for reused and recycled textiles (Watson et. al, 2015).
Obstacle(s) addressed	Consumers lack knowledge about textile recycling and the environmental benefits that can be achieved from reuse and recycling of textiles (Elander & Ljungkvist, 2016).
Critical factor(s) in design	The information must be adjusted to the needs of different target groups. For the policy to be effective it is important that the information is recurred over a period of several years.
Risk factor(s)	Information has shown to merely having small effects on consumer behavior. Consumer knowledge and attitudes regarding environmental issues do not automatically lead to changed behavior (Mont et al., 2013). However, changed attitudes can create acceptance for policies and economic incentives for more sustainable consumption (Hennlock et al., 2015).
Conflicts and synergies	In order for information to have an impact and for consumers to actually use their knowledge and take action, other policies have to be implemented in conjunction to information, e.g. in securing better infrastructure for separate collection of textiles. Otherwise there is a possibility that consumers get frustrated which can lead to distrust of both the information provided and the actor behind the information.
Affected stakeholder(s)	Consumers and stakeholders providing the information, e.g. municipalities, governmental agencies and producers

4.6 type 1 eco-labelling of textile products

Enhanced use of EU and Nordic (Type I) labelling for new textile products	
Description	A label provides consumers with information about a specific textile product. The market for eco-labelled products has developed and existing eco-labels like the EU Flower, the Nordic Swan and the Swedish Bra Miljöval, have textiles as one of the product groups. The Type I labels at EU and Nordic levels already encourage the use of recycled materials.
Obstacle(s) addressed	The uptake of Type I labels at EU and Nordic levels by textile producers has been rather limited. An enhanced use of EU and Nordic Type I labels could increase the demand for reused and recycled clothes, (Tekie et. al, 2013). It is hard for consumers to know which textile products contain recycled content. The aim is to get more producers to label their materials that are made from reused or recycled materials.
Critical factor(s) in design	The use of the labels must be made in a way that is clear and visible to consumers. Consumers also need to be aware of the information contained in the Type I label.
Risk factor(s)	Consumers have previously shown low interest and low general knowledge about eco-labeled textiles. An enhanced use of labelling may therefore have limited effects on these consumer groups. Consumers may not know what the labels stand for. Textile producers might prioritize developing their own brands before Type I eco-labels. They also might consider the costs associated with labeling a product exceed the expected benefits from it.
Conflicts and synergies	Type I labels for textile products at EU and Nordic levels include additional criteria (not only recycled content). Enhanced use of EU and Nordic Type I eco-labels in combination with information and communication on the environmental damages caused by textile products could increase consumer demand for reused and recycled textile products (Tojo et al., 2012;Tekie et al., 2013).
Affected stakeholder(s)	Consumers, producers, importers

4.7 recycled content labelling

Labelling requirements for new textile products regarding recycled content	
Description	A label provides consumers with information about a specific textile product. By placing labelling requirements for new textile products regarding recycled content, consumers can make a more informed decision. The labeling can be made using a simple logo, stating the percentage (or range) of recycled textile fibers in the textile product.
Obstacle(s) addressed	Inadequate information about textiles made from recycled fibers makes it difficult for consumers to find and demand these types of products. Labelling requirements provide consumers with easily understandable information and can change consumer behavior (Ekvall & Malmheden, 2012). A label for recycled textiles is intended to serve as a framework that ensures that the label follows the promised qualities.
Critical factor(s) in design	A labelling scheme needs to be visible and communicated to the public to have an effect. Few consumers take the time to look for more information than that stated on the product. Advertising of the label is crucial to ensure that consumers understand and recognize the label.
Risk factor(s)	Recycled content in textile products is seldom a consumer preference with high priority. In practice, many consumers are inclined to purchase new products regardless of the availability of recycled textiles or if recycled textiles are labeled. Changing consumption patterns is a time consuming process.
Conflicts and synergies	Consumer knowledge on the environmental impact from textile products is limited. Labeling in combination with information and communication on the environmental damages caused by textile products could increase consumer demand for textile products made from recycled fibers (Tojo et al., 2012; Tekie et al., 2013).
Affected stakeholder(s)	Consumers, producers

4.8 material exchange platform

Material exchange platform for used textiles for recycling	
Description	An efficient market requires good access to information about both supply and demand. Making information regarding collected, sorted and recycled textiles as well as input-specifications for different recycling processes practically available for potential suppliers and buyers could therefore contribute to a better functioning market. An efficient flow of information between suppliers and buyers might be established through a web-based material exchange site. This would allow suppliers to find a wider number of buyers. It would also enable suppliers to collect, sort and/or recycle the used textiles in a way that it better meets the expectations and needs of the buyers, potentially increasing the value of the produced materials. The material exchange platform should include information both on quantity and quality, e.g. tonnage, origin, level of sorting, fiber type.
Obstacle(s) addressed	The lack of information between sorters and the fashion industry creates market inefficiencies. There is a need for increased coordination and exchange of information across the textile value chain. A market exchange platform can help stakeholders achieve a more circular value chain for textiles.
Critical factor(s) in design	An important aspect for a market exchange platform to facilitate the exchange and resale of collected, sorted and recycled used textiles is the proof of quality of traded materials. Buyers need to be assured that materials are matching their demands and needs. To ensure this third party assurance is fundamental to allow this system to function.
Risk factor(s)	There is little experience with this type of market and could thus create a situation where the intended actors do not want to participate. The observed difficulties from other material exchange sites have shown that companies have been reluctant to provide information regarding their volumes (Swedish Transport Administration, 2011). It will likely take time to build and operate an information exchange scheme. The service also has to be advertised in order to reach a critical mass of users.
Conflicts and synergies	A wide use of the market exchange platform can contribute to better statistical data for authorities, although this is rather a side effect of the primary aim.
Affected stakeholder(s)	Collectors, sorters and recyclers as potential suppliers and sorters, recyclers and producers as potential buyers.

4.9 mandatory EPR

Mandatory system for extended producer responsibility (EPR) for textiles	
Description	Extended Producer Responsibility (EPR) is a concept where producers (including importers) should bear a significant degree of responsibility for the environmental impacts of their products throughout the product life-cycle. The concept of EPR addressing specifically the environmental improvement of the end-of-life phase of products seeks to achieve improvements both upstream and downstream. A mandatory EPR system provides a level playing field for all producers and can include the following components: 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, information to consumers, consultation with existing actors and monitoring and control.
Obstacle(s) addressed	Design of textile products to reduce their end-of-life environmental impacts at source (upstream). Improvement of the resource efficiency of textile products via effective collection, increased reuse and recycling and more environmentally sound treatment of textile waste (downstream).
Critical factor(s) in design	Clarification of responsibilities and ownership; Preparation for reuse/recycling targets (and responsibilities for achieving them); Financing mechanisms (including cost differentiation depending on the ease of conducting fiber to fiber recycling); Mechanisms to enhance waste diversion; Monitoring the implementation of relevant actors; Existing collection and second-hand actors and producers should be able to “co-exist” in a sustainable manner
Risk factor(s)	The value of end-of-life textiles must be considered. There is a risk, e.g. in the case of theft from textile collection containers, that textiles, with low or no value in the second hand market, are discarded and that in those cases the opportunity for fiber-to-fiber recycling is lost. Lack of available used textiles for recycling would discourage producers’ investment in enhancing fiber-to-fiber recycling.
Conflicts and synergies	A mandatory EPR system contains a number of elements that could have synergies with other measures, e.g. labelling schemes for recycled fibers and elements of consumer information.
Affected stakeholder(s)	Producers, importers, second-hand market actors, municipalities, consumers, authorities

4.10 **voluntary EPR**

Voluntary system for extended producer responsibility (EPR) for textiles	
Description	Extended Producer Responsibility (EPR) is a concept where producers (including importers) should bear a significant degree of responsibility for the environmental impacts of their products throughout the product life-cycle. The concept of EPR addressing specifically the environmental improvement of the end-of-life phase of products seeks to achieve improvements both upstream and downstream. Potential elements of a voluntary EPR system are take-back initiatives, financing mechanisms that reflect the actual cost of specific fibers, R&D budget to enhance sorting of textile waste and recycling textile fibers, means to enhance collection from consumers, voluntary preparation for reuse and recycling targets, consultation with existing actors and communication platform between producers, policy makers and other relevant actors on phasing out unwanted substances in production and design for recycling.
Obstacle(s) addressed	Increased waste diversion of end-of-life textiles (prerequisite for closure of the textile material loop) Lack of information exchange among various actors involved in the reuse and fiber-to-fiber recycling Improvement of the resource efficiency of textile products (both upstream and downstream)
Critical factor(s) in design	Preparation for reuse/recycling targets (and responsibilities for achieving them); Financing mechanisms (including cost differentiation depending on the ease of conducting fiber to fiber recycling); Existing collection and second-hand actors and producers should be able to "co-exist" in a sustainable manner; Clear consumer information
Risk factor(s)	As the participation in the EPR system is voluntary, participants may face some financial disadvantage. Non participants may enjoy the benefit of, for example, the development of sorting and recycling technology without having to pay for it.
Conflicts and synergies	The voluntary EPR system could contain a number of elements that can enjoy synergies with other measures, such as labelling schemes for recycled fibers and consumer information.
Affected stakeholder(s)	Producers, importers, second-hand market actors, municipalities, consumers, authorities

4.11 stakeholders' views on the shortlist

During a policy workshop carried out in Stockholm on 12th October 2016 attending stakeholders judged the following five policy measures as having the largest potential contributions for increased fiber-to-fiber recycling: material exchange platform for used textiles for recycling, public procurement supporting recycled content in textile products, mandatory system for extended producer responsibility (EPR), requirements on customer convenience for return of used textiles and consumer information on reuse and recycling. The four policy measures with the highest average scores for feasibility of introduction/ acceptance were: public procurement supporting recycled content in textile products, refunded virgin payments (RVP) for new textile products, requirements on customer convenience for return of used textiles and labelling requirements regarding recycled content.

The stakeholders discussed what aspects of the ten different policy measures in the shortlist would be "nice to have", i.e. beneficial to include in the policy measure, and "deal breaker", i.e. if this is not addressed the policy measure falls. Some of the aspects that the stakeholder consider important to cover in regard of the policy measures are listed in appendix 3.

When asked about their favorite policy measure to increase fiber-to-fiber recycling of textiles, all groups in the workshops gave the highest priority to a mandatory EPR system for textiles. Second priority policy measures mentioned were material exchange platform for used textiles for recycling; public procurement supporting recycled content in textile products; consumer information on reuse and recycling; and enhanced use of Type I labelling for new textile products.

In regard of a mandatory EPR system, the stakeholders stressed the importance to include the full range of stakeholders in the value chain (including existing collectors and sorters) in a process for introduction and operation of the EPR system; communication, considering a step-wise approach for introduction as a tribute to the complexity of the textile market; using experience from – but not copying – other existing EPR systems; inclusion of e-commerce; customer convenience; differentiation of producer fees; labelling; and logistics for collection and sorting.

As for an (online) material exchange platform for used textiles for recycling stakeholders stressed the importance to define quality requirements for the textiles placed on the platform; securing continuous material supply (volumes) traded on the platform; defining the producer of secondary raw material (due to legal obligations for the producers); and inclusion of European and international actors in the platform.

When it comes to green public procurement, the stakeholders stressed the importance of developing good criteria (including recyclability, durability and quality); clearly defining recycled content, including information on hazardous substances; and guidance and support to procurement officers weighing different criteria against each other.

Regarding consumer information on reuse and recycling stakeholders mentioned as important aspects the provision of information that is intuitive, accessible and easy to implement; personal feedback and concrete information of the consequences of own actions; avoiding green washing; and additional policy measures combining consumer convenience and incentives.

Regarding increased use of Type I labelling the stakeholders stressed the importance of developing global and/or EU wide labelling schemes as a tribute to the global value chains in the textile industry; focusing on one labelling scheme instead of several competing schemes; considering different type of labels for industry and consumers; and inclusion of additional (with respect to recycled content) aspects in the labeling scheme, e.g. social dimension and animal welfare.

General views expressed by stakeholders in the workshop:

- It is crucial that all relevant stakeholders are included in the process of developing policy measures for increased reuse and recycling of textiles
- In order to handle the complexity of textiles and the textile industry, it would be beneficial to create an adaptive system. Such a system could e.g. include stepwise increase of target and successive differentiation of different product groups and fiber types
- Possibilities of differentiation should be used to give incentives to improve both upstream and downstream
- In the creation of policy measures for textiles, both positive and negative experiences from similar policy measures should be taken into account, replicating positive aspects and avoiding negative aspects, in order to create both effective and efficient policy measures for textiles

5 selection of policy measures for impact assessment

Two policy measures were selected for impact assessment: *Mandatory extended producer responsibility (EPR system)* and *Refunded virgin payments for new textile products (RVP system)*. This section gives an overview of why these two measures were selected from the shortlist.

5.1 considering stakeholder input for the selection

Stakeholders selected five policy measures to discuss in more detail at the policy workshop: mandatory EPR system, material exchange platform for used textiles for recycling, public procurement supporting minimum recycled content of new textile products, consumer information on reuse and recycling and enhanced use of Type I labelling for new textile products.

The Swedish EPA has, as one of two options for improved handling of textile waste, proposed a mandatory EPR system for textiles (see section 1.1.3). The design of a mandatory EPR system can be made in different ways, including different aspects in different ways. In the policy workshop, stakeholders highlighted aspects regarding the design of a mandatory EPR system that are not included in the Swedish EPA's proposal. It was therefore considered interesting to add new dimensions to the political discussion regarding a mandatory EPR system for textiles and select this policy measure for the impact assessment.

The aspects of consumer information, eco-labelling and exchange of information regarding collected, sorted and recycled textiles can be included in a mandatory EPR system. It was therefore decided to consider these aspects as part of the impact assessment of a mandatory EPR system.

The proposal from the Swedish EPA includes a recommendation that the Swedish government appoint a commission to overcome legal obstacles in order for public actors to be able to use public procurement to contribute to increased reuse and recycling (Naturvårdsverket, 2016a). In order to add new perspectives to the discussion regarding more resource efficient handling of used textiles it was decided to select another policy measure for the impact assessment.

5.2 mandatory EPR system

As described in section 4.11 stakeholders in the policy workshop unanimously gave the highest priority for a mandatory EPR system when asked about their favorite policy measure to increase fiber-to-fiber recycling of textiles. This gave a strong signal that it is an approach that many consider as important and interesting for further investigation.

A mandatory EPR system was also proposed by the Swedish EPA as a potential policy measure to address management of textile waste. The Swedish EPA's proposal was developed based on a thorough set of studies and assessments of potential policy measures. However, the EPR proposed by the Swedish EPA is primarily designed as a policy measure to address efficient waste management, whereas its potential to address upstream effects (e.g. provision of incentives for producers to consider reuse or fiber-to-fiber recycling at the design phase of product's life) was not included to any larger degree. In addition, an EPR system typically consists of a number of administrative, economic and/or informative policy measures (Tojo N. , 2004), and it is possible to supplement the proposed EPR measure with additional measures.

In order to widen the discussion regarding introduction of a mandatory EPR system for textiles in Sweden, the assessment in this report includes the potential of a mandatory EPR system that addresses not only downstream but also upstream of textile products.

5.3 refunded virgin payments for new textile products

The proposal from the Swedish EPA regarding handling of textiles does not include economic policy instruments as means to increase reuse and recycling of textiles (see section 1.1.3). Nevertheless, economic instruments have shown to be successful measures to reduce environmental externalities (European Commission, 2007). Assessing an economic policy, such as a RVP system (see section 4.4), therefore adds another perspective on potential ways and means to promote recycling of textiles.

In a RVP system all producers pay a charge for using virgin textile fibers and all producers get refunded for above average use of recycled materials. The use of a charge system allows funds to be refunded back to the companies, in contrast to a tax which is set aside to the national budget as public revenue. In 1992 a refunded emission payments program (REP) was introduced in Sweden with the aim to control emissions of nitrogen oxides (NOx) from large combustion plants (see section 8.1). The policy is considered to have been successful for abatement of NOx (Sterner & Isaksson, 2006). Inspired by the Swedish NOx policy a Refunded Virgin Payment (RVP system) was selected for impact assessment in this report.

Due to currently low market prices for virgin textile fibers, there is lack of incentives for producers to use recycled textile fibers in the production of new textile products (Elander & Ljungkvist, 2016). The RVP system has the potential to stimulate producers to increasingly demand and use recycled textile fibers in the production of new textile products (pull strategy).

A tax on virgin fibers is the first best solution, but due to different political aspects a tax is difficult to implement (Gersbach & Requate, 2004). A charge is considered a second best solution and experiences from the REP for NOx and other policies have shown that a charge may be more politically acceptable than a tax (Sterner & Isaksson, 2006). A tax implies both abatement and tax costs and is therefore often resisted by polluters though powerful lobbies (Sterner & Isaksson, 2006). There is also a risk that a tax may distort the relative competitiveness between large and small producers and therefore difficult to implement. If small firms are exempted it can lead to a situation in which it becomes more motivated to run small plants and thus the regulation loses its intended effects (Sterner & Höglund, 2000). If small firms are not exempted it can lead to a situation where firms have to close down production because they cannot cover their costs. Additionally, authorities may have difficulties facing the threats of relocation. These aspects create complications to implement a tax system. When taxes are not desirable or feasible a refund scheme may be more acceptable (Sterner & Isaksson, 2006). The possibility of receiving income though the fund system can provide higher possibilities to prevent closures compared to a tax system. Refunding could thus, in principle, lead to a lower degree of exit compared with a tax system (Hagem et al., 2015).

6 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.

6.1 why is extended producer responsibility relevant for textiles?

appendix 4 includes a short introduction to extended producer responsibility (EPR) as a general policy approach. 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.*

6.2 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 6.2.1-6.2.9:

- 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 6.2.10 provides a summary of the discussions on reasons and concrete means of implementation.

6.2.1 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)[6] 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, distributers) 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 6.2.5 and 6.2.7), to have

[6] 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.

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 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 6.2.6, 6.2.8 and 6.2.9.

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 (see section 6.2.2 for further elaboration).

6.2.2 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 (see appendix 4).

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 (see appendix 4). 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.[7]

6.2.3 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 6.2.6), 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 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

[7] 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).

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 distributers of textile and footwear products[8], 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.

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

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

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 6.2.1), 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 batteries[9] 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 6.2.1), 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.[10] We propose an interim goal of 2020 to promote the development of collection infrastructure and information provisions to citizens as early as possible.

[9] 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.
[10] 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.

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 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.

6.2.5 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 m^2 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,[11] the main PRO managed to negotiate with the municipalities who take care of collection 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

[11] 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 replace 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).

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.

6.2.6 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)[12] defines the two concepts as follows:

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

'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 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.

6.2.7 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 6.2.1. 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.[13]

[13] 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).

6.2.8 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 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 (see section 3), 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.

6.2.9 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 deem to be insurmountable.

6.2.10 Summary of the system discussed

In this section, we provide the short description of each of the nine elements suggested in Section 6.2.1 to 6.2.9 (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 6.2.1), 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 6.2.6, 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 achiving 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 disicentives 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 6.2.9 and appendix 4.

7 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 6.2 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 (see section 2.3). The functions of the nine different elements of the Swedish mandatory EPR system for textiles, as described in details in section 6.2, is assessed in regard of the eight policy objectives.

7.1 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 6.2 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").

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

As discussed in section 6.2, 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 6.2.4), 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 2 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 2 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

7.1.2 increased reuse of used textile products

Although reuse is not the main focus of the policy measures in this study (see section 1.3), 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 3 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 3 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	

7.1.3 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 4 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 4 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

7.1.4 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 6.2.6) 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 5 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 5 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

7.1.5 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 6 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 6 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	

7.1.6 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 7 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 7 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	

7.1.7 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 6.2.7), 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 6.2.2), 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 8 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 8 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	

7.1.8 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 9 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 9 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

7.1.9 overall policy effects

Table 10 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 7.1 and found at the bottom row of Table 3 to 10 respectively.

Table 10 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.

7.2 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 7.1.9, 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.

8 refunded virgin payments (RVP): background and description

This section includes description, impact assessment and analysis of refunded virgin payments (RVP) for new textile products.

8.1 inspired by the swedish no_x charge

Of the 121 000 tons new clothes and household textiles put on the Swedish market in 2013 only 3-5 percent was recycled. There is large potential to increase the amount of recycled textiles. Inspired by the Swedish NO_x system with the objective of reducing emissions of nitrogen oxides (NO_x) from large combustion plants (see appendix 5), the RVP system is assessed as a policy measure to promote the use of recycled textile fibers in new textile products.

In 1992 a refunded emission payments program (REP) was introduced in Sweden with the aim to control NO_x emissions from large combustion plants. The policy was designed to affect technology adoption and was considered to achieve this at a faster and more cost-efficient way (Naturvårdsverket, 2003). In this system funds are refunded back to the regulated plants in proportion to energy output.

The plants submit a declaration of NO_x emissions and receive a bill for the NO_x charge according to their NO_x emissions. The money is distributed to those who have low emissions relative to their energy production. Apart from a small administrative cost of about 0.2–0.3 percent, the entire revenue is refunded back in proportion to output of useful energy.

The scheme is managed by the Swedish EPA that also conducts audits of the plants included in the scheme. An evaluation of the policy shows that emissions of NO_x per unit of energy produced has continued to decrease since the introduction of the charge in 1992 (Naturvårdsverket, 2012).

8.2 aspects adding complexity compared to the no_x system

Compared to the NO_x charge (see section 8.1 and appendix 5), a range of aspects adds complexity in the RVP system. Whereas the NO_x charge is levied upon Swedish combustion plants operating and emitting NO_x in Sweden, the textile value chain is global. The lion share of textiles put on the Swedish market is imported, i.e. the production is located abroad (see section 3). The market for recycled textile fibers is global and most of today's textile recycling is carried out in Asia. Furthermore, textile recycling includes both recycling of pre-consumer (industrial) and post-consumer textile waste.

Textiles compose a broad and heterogeneous product group, consisting e.g. of clothes, household textiles, bags, shoes, carpets, upholstered furnishings, sails, tents, interiors of cars etc. Even within one subgroup, such as clothes, the variety of different products is high, e.g. socks, raincoats, jeans, workwear, knitwear etc. Textile products are composed of different (combinations of) textile fibers from different origins, e.g. animal-based fibers such as wool and silk, cellulosic fibers such as cotton and lyocell and synthetic fibers such as polyester and polyamide. Different textile fibers can be recycled to different degrees and by using different mechanical and chemical recycling processes, reaching different qualities of the recycled textile fibers.

8.3 goal for the RVP system

Currently, three to five percent of clothes and household textiles put on the Swedish market are recycled. The majority of the recycled textiles is used for lower quality recycling, e.g. for insulation or padding (Östlund et al., 2015). The goal of the RVP system is to stimulate the demand for producers to use recycled textile fibers and to increase the proportion of recycled textile fibers in new textile products put on the Swedish market. This goal is in line with and contributes to reaching national environmental goals and proposed targets for textile waste.

The proposed targets by the Swedish EPA for textile waste (see section 1.1.3) are relevant for both increased collection of used textiles, which is a prerequisite for increased textile recycling, and increased recycling of the collected used textiles. The phrasing "[...] textile recycling shall primarily be carried out as recycling into new textiles." specifically aims to increase use of recycled fibers in new textiles.

The overall goal of Swedish environmental policy is to hand over to the next generation a society in which the major environmental problems in Sweden have been solved, without increasing environmental and health problems outside Sweden's borders, the so called generation goal (Naturvårdsverket, 2016b). Within the Swedish environmental objectives system 16 environmental quality objectives describe the quality of the environment that Sweden wishes to achieve by 2020. The RVP system primarily links to the national environmental quality objective *A good built environment* with the specification "waste management is efficient for society and easily used by consumers, waste is diminished, while the resources in waste are better used, and the impact of waste on health and environment are minimized". The RVP system contribute to this environmental quality objective and the generation goal by creating incentives for increased share of recycling of used textiles and more sustainable use of natural resources.

The above goals and targets point to a direction of a desired social transformation and in which the RVP system could contribute to achieve by

stimulating producers to use recycled textile fibers in the production of new textile products.

8.4 description of the RVP system

There are a range of different aspects that need to be included in designing a policy measure. This section provides a description of these aspects for the chosen RVP system.

Each sub section starts with a short description of the aspect we propose, followed by the reasons behind the selection.

8.4.1 benchmarks

The average share of recycled textile fibers should amount to at least ten percent by weight by 2020 and at least 15 percent by weight by 2025. The fulfilling of the benchmarks should be evaluated at certain pre-defined points in time, e.g. 2020 and 2025.

Defining benchmarks for average use of recycled textile fibers in clothes and household textiles gives a clear signal to textile producers and brands regarding the desired developments and effects in the area of fiber-to-fiber recycling of textiles. The benchmarks can also be used for evaluation of the effects from the RVP system. If e.g. the benchmarks are not reached, the level of virgin payment (charge) can be increased to create larger incentives to use recycled textile fibers in the production of new clothes and household textiles (see section 8.4.4), or additional (complementing) policy measures introduced (see also section 8.4.8).

The benchmarks should be defined as a percentage of recycled textile fibers of the total clothes and household textiles put on the market based on weight. They should be defined in time, i.e. until when they should be fulfilled.

There is no available data on the average share of recycled textiles fibers in new clothes and household textiles currently put on the Swedish market. There are, however, examples of companies that use a high percentage of recycled textile fibers in their new textile products. Garments from Houdini Sportswear are on average to 58 percent made from recycled fibers (Karlsson, 2016). Another example is Nudie Jeans, that had a collection of jeans with 18 percent recycled cotton (Brinkberg, 2016).

Different types of textile products have different preconditions for increasing the recycled textile fiber content, e.g. used textile fiber types, limitations of currently available recycling techniques etc. This could argue in favor of introducing

differentiated benchmarks, e.g. depending on textile fiber type. However, the benchmarks described in this report apply for all textiles included in the scope (see section 8.4.2) regardless of use, product type and used textile fibers. Additionally, no differentiation is made between recycled textile fibers from pre-consumer textile waste (industrial waste) and post-consumer textile waste. There are two main reasons for this: firstly to lower the initial complexity for a so far untested policy measure and, secondly, to make concessions to stakeholders' wishes expressed at the policy workshop (see section 4.11) to find a stepwise approach when introducing new policy measures for textiles and textile waste.

The benchmarks for the RVP system described in this report are:

- The average share of recycled textile fibers should amount to at least ten percent by weight by 2020 and at least 15 percent by weight by 2025

The fulfilling of the benchmarks should be evaluated at certain pre-defined points in time, e.g. 2020 and 2025. There is a possibility that the initial benchmarks need to be revised, e.g. depending on breakthroughs or unforeseen developments in the recycling market.

8.4.2 scope of textile products

The scope of the textile products included in the RVP system is textile products containing at least 80 percent (by weight) textile fibers in the form of clothes and household textiles. All types of textile fibers e.g. cotton, wool, polyester etc. are included.

There is a large range of textile products and products containing textiles, e.g. clothes, working clothes, towels, curtains, bedlinen, blankets, shoes, geotextiles, bags, sacks, tents, air mattresses, upholstery, sails and tarpaulins and other technical textiles.

The scope of the RVP system described in this report is based on the same scope of textile products as the proposals of the Swedish EPA for textile waste management, i.e. textile products containing at least 80 percent (by weight) textile fibers in the form of (Naturvårdsverket, 2016a):

- clothes (including working clothes and accessories), in the following simplified as "clothes", or

- household textiles, e.g. table cloths, curtains, bedlinen, blankets, covers and towels, in the following simplified as "household textiles".

All types of textile fibers e.g. cotton, wool, polyester etc. are included in the RVP system.

If there are special reasons to why some clothes or household textiles need to be exempted from the RVP system, exceptions can be made but exemptions should be kept to a minimum.

8.4.3 scope of companies

Large companies (more than 250 employees) putting clothes and household textiles on the Swedish market are automatically part of the RVP system. In addition, smaller companies can on a voluntary basis chose to be included in the RVP system.

The vast majority of companies in the fashion industry are small. 95 percent of the Swedish fashion companies have less than 10 employees and 62 percent of the companies in the fashion industry are sole proprietors. The number of large companies (more than 250 employees) is relatively small (0.1 percent). However, these companies (H&M not included)[14] employ a third of the entire fashion workforce and 30 percent of the total turnover (Tillväxtverket, 2015).

In general, the RVP system, just like the REP, brings incentives for a few large companies with monopolistic power on the final goods markets to act strategically and influence the size of the refund. In the RVP system, companies then realize that the increase in recycling rates also reduces the magnitude of the refund that is returned to companies. This distortion implies that the increase in recycling rate can be either faster or slower than with a virgin tax. The more concentrated the scope (i.e. fewer companies in the RVP system) the more likely it is that the refunding will distort incentives so that the increase in recycling rates is slower than under a virgin tax. This difference between RVP and a virgin tax becomes smaller as the number of firms increases and the market equilibrium comes closer to the outcome under perfect competition (Coria & Mohlin, 2017). To strengthen the individual incentives from the RVP system one should therefore consider bringing in as many companies from the sector as possible, initially having large differences in recycling rates. For this reason it is important to keep the administrative costs for companies low for introducing also smaller companies in the system.

The RVP system described in this report includes large companies (more than 250 employees in Sweden) in the scope. Such companies putting clothes and household textiles on the Swedish market are automatically part of the RVP

[14] The data from Tillväxtverket do not include data from H&M as the single company influences the result to a very large extent (Tillväxtverket, 2015).

system. In addition, smaller companies can on a voluntary basis chose to be included in the RVP system. This scope is an attempt to balance the need to include as many companies as possible in the RVP system and stakeholders' wishes expressed at the policy workshop (see section 4.11) to find a stepwise approach when introducing new policy measures for textiles and textile waste.

In terms of household textiles there a few companies that have a large share of the market (see section 3). These companies are automatically part of the RVP system. Smaller household textile companies can on a voluntary basis chose to be included in the RVP system.

Experience from the Swedish NO_x scheme shows that monitoring and control costs were too high to motivate the inclusion of small producers. In the RVP system it is likely that large and small producers have different opportunities to influence suppliers and to shift production to higher recycled content. Including smaller firms in the RVP system will require too large administrative costs. This may lead to a situation where they have to close down production because they cannot cover their costs. To avoid this situation small companies are exempted from the RVP system. It would, however, be possible to expand the scope of companies covered by the RVP system over time, to also include smaller companies (see section 8.4.8). However, some smaller companies on a voluntary basis uses a higher than average share of recycled textile fibers in their new textile products. Generally these companies already document the share of recycled textile fibers. Since they would benefit from the RVP system, they might be willing to pay increased administrative costs and, on a voluntary basis, choose to participate in the RVP system.

A producer within the RVP system described in this report is based on the same definition as that of the Swedish EPA for textile waste management. A producer is someone who professionally produces, or for the first time sells or imports textiles products containing at least 80 percent (by weight) to Sweden (Naturvårdsverket, 2016a).

8.4.4 level of virgin payment

The level of the virgin payment (charge) will be calculated based on the companies' share of virgin textile fibers used for production of new textile products (proportionate relationship). The virgin payment corresponds to 10-20 percent of the textile product's list price (i.e. independent of sales, promotions, discounts, reductions etc.). The same level of charge applies independently of product type and textile fiber type.

Two different designs have been deliberated for calculating the level of the virgin payment, i.e. the charge in the RVP system.

Design 1

Design 1 fully mimics the design of the Swedish NO_x charge system (see section 8.1). The design contains a payment constituted by a fixed marginal charge (SEK/ton) multiplied by the total weight (ton) of virgin textile fibers used by the company for the production of new textile products. The total revenue collected in the RVP system is refunded in proportion to each company's market share in terms of total weight of textiles (see section 8.4.5). The net effect is that the system reallocates money from companies with lower shares of recycled textile fibers in their new textile products (recycling rates) than average to companies with higher recycling rates than average. Design 1 is described with the components as follows:

- Total use of textile fibers in company *i*: $q_i = r_i + v_i$ (ton)
- Use of recycled textile fibers in company *i*: r_i (ton)
- Use of virgin textile fibers in company *i*: v_i (ton)
- Share of virgin textile fibers in company *i*: v_i / q_i (%)
- Share of recycled textile fibers in company *i*: $1 - v_i / q_i$ (%)
- Marginal charge: T (SEK/ton)
- Administrative costs within authorities: C_a (SEK)

Design 1 mimics the design of the Swedish NO_x charge system by replacing amount of NO_x emissions per year with total weight of virgin textile fibers used per year. The net payment by company *i* per year is then:

$$Tv_i - \frac{q_i}{\sum_{j=1}^{n} q_j} T\left(\sum_{j=1}^{n} v_j - C_a\right) \qquad (10.1)$$

The first term contains the marginal charge (SEK/ton) multiplied by the total weight (ton) of virgin textiles in company *i*. The second term is the refund to company *i,* which is a share (determined by the company´s share of total use in the RVP system) of the total revenue collected in the system from $j = 1,\ldots,n$ companies minus the costs of administration within authorities.

From the design in equation (10.1) it is clear that the entire revenue will, after deduction of administrative costs, be refunded to the companies included in the RVP system (see section 8.4.5).

It can easily be shown from the design in equation (10.1) that a company that has a lower recycling rate than average in the RVP system will be a net payer and *vice versa*. To see this, assume that administrative costs are close to zero and rearrange the right-hand-side of equation (10.1), which yields the criteria:

Company *i* net receiver: Company *i* net payer:

$$\frac{v_i}{q_i} - \frac{\sum_{j=1}^{n} v_j}{\sum_{j=1}^{n} q_j} < 0 \quad (10.2a) \qquad \frac{v_i}{q_i} - \frac{\sum_{j=1}^{n} v_j}{\sum_{j=1}^{n} q_j} > 0 \quad (10.2b)$$

The first fraction in (10.2a) is the share of virgin textiles of company *i* and the second fraction the average share of virgin textiles of all companies as a group. In other words, the RVP design in equation (10.1) reallocates money from companies with lower recycling rates than average to companies with higher recycling rates than average. Thus the RVP system incentivizes a race among the companies to become, and stay, better than average.

Design 2

Design 2 has the same structural design as equation (10.1), however, instead of measuring each unit of virgin textile fibers used it is based on recyclability classes divided by thresholds for recycling rates. In its simplest form there exists two classes divided by a minimum threshold for the level of recycled textile fibers used for production of the new textile product. Textiles not meeting this threshold will face a fixed virgin charge per weight (ton). Textiles meeting, or exceeding, the minimum threshold will not face a charge. To meet the criteria that the entire revenue should (after deduction of administrative costs) be refunded to the companies, total revenue collected is refunded to companies in proportion to their market share (now the sum of “virgin-classified” textiles and “recycled-classified” textiles).

The design would be identical to design 1 in equation (10.1), however, the variables r_i and v_i would now instead measure the total weights (ton) of textiles classified as either above and below the minimum threshold, respectively. With rational agents in the system this design would reduce the allocative efficiency compared to design 1 since it lacks incentives to increase recycling rates *within* each recyclability class but only *between* classes. Increasing the number of classes would reduce this inefficiency though. Furthermore, the behavioral effects with design 2 compared to design 1 is not yet clear within research. Design 2 therefore poses several questions when it comes to estimating the effects that it has on companies' response behavior, which in turn determines the effects on shares of recycled textile fibers in new textile products (recycling rates).

The loss in allocative efficiency from introducing recyclability classes with design 2 can, however, be balanced against its lower administrative burden. Still, textiles are recovered in varying degrees, with design 2 there will be difficulties to increase the use of different textile fibers. To provide incentives for other type of fibers, differentiated levels for different types of textile fibers can be used in the future. Design 2 is, on the hand easier to operate and less administratively demanding.

Design 1 is chosen as the model for the RVP system described in this report. Refunds will be paid to all companies included in the RVP system (see section 10.3.5) and for all clothes and household textiles (see section 10.3.2). Likewise to the NOx-scheme, the RVP system will be managed by the Swedish EPA (see section 8.4.6).

There are different options to develop the RVP system over time, increasing the level of ambition and making it more specific and targeted. The charge can be increased over time in order to create further economic incentives to use recycled textile fibers in new textile products (see section 8.4.8). The increases of RVP charges will follow inflation levels and be increased accordingly. The RVP charge may be adjusted even further after evaluation.

In the Swedish Chemical Agency's assessment (2013) of a chemical tax for textiles, a tax level equivalent to 7-20 percent of the product's final price was considered a reasonable benchmark (Kemikalieinspektionen, 2013). According to rough estimations conducted by the Swedish Chemical Agency (2013) clothes in Sweden cost about 700 SEK per kilo. Given that the tax would be levied on the basis of the weight of clothes, a tax rate of 75 SEK per kilo would on average correspond to eleven percent of the price, which is within the desired range (7-20 percent). An example to put this in perspective: In Denmark a tax of 3.6 DKK per kilogram is levied on rainwear (Kemikalieinspektionen, 2013). A raincoat that weighs 400 gram and costs 300 SEK would with a tax rate of 75 per kilo kilogram

add up to a tax of 30 SEK. In Denmark the same jacket would cost 1.44 DKK in tax. A tax such of that in Denmark has little regulating effect (Kemikalieinspektionen, 2013).

The incentive for abatement with an RVP is principally the same as with a tax, as long as there are a sufficient number of companies making market shares small. Compared to a tax system, the RVP system results in lower average cost due to the availability of the refund (Sterner & Coria, 2012). Moreover, in a RVP system all companies will pay less (compared to a tax system) and some will even make money, and therefore the system will not be met with the same level of political resistance. The charge can, in addition, be set at a higher level and create stronger abatement incentives compared to a tax. A RVP system is cost neutral which means that it can be applied to a sub-group of producers without significantly impacting the competition between the companies included in the RVP system and those not included. This trait can allow for some degrees of freedom to the decision maker.

When a company faces a certain charge, its rational response is to choose to use virgin textile fibers up to an amount where the marginal cost equals the charge level (Naturvårdsverket, 2005). As long as the cost to use virgin textile fibers is less than that of using recycled textile fibers for the production of new textile products, the company's rational choice is to choose to produce with virgin fibers. The higher the charge is, the more expensive it becomes for companies to use virgin textile fibers.

The RVP system described in this report will begin with an RVP charge of 10-20 percent of the textiles list price (i.e. independent of sales, promotions, discounts, reductions etc.). Initially, the same level of charge applies independent of product type and textile fiber type. After evaluation of the RVP system, the charge may be differentiated for different textile fiber types (see section 8.4.8).

8.4.5 level of refunds

The refund is paid back to companies in the RVP system based on the total amount (by weight) clothes and household textiles a company included in the RVP system put on the Swedish market during a calendar year.

The refund is based on the total amount (by weight) clothes and household textiles a company included in the RVP system put on the Swedish market during a calendar year. The refund to each company is a share of the total revenue from the RVP charge during one year determined by the company's share of total production in the system (see section8.4.4). Therefore, the entire revenue will,

after deduction of administrative costs, be refunded to the companies included in the RVP system.

In summary, the charge is paid per ton textile products sold on the Swedish market. A company that has a lower recycling rate than average in the RVP system will be a net payer and a company that has a higher recycling rate than average will be a net receiver in the RVP system. Thus, it can be said that money is reallocated from companies with lower recycling rates than average to companies with higher recycling rates than average.

8.4.6 administration

The RVP system is administrated by the Swedish EPA.

Similarly to the NO_x scheme (see section 8.1) the RVP system could be monitored by the Swedish EPA. The Swedish EPA will in that case provide regulations that specify the necessary requirements eligible for the RVP-system. However, verification of recycled content will be conducted by a third party (see appendix 5).

Within the NO_x scheme the funds are refunded back, in November or December, based on the previous year's production. The emissions are declared by January 25th, and those plants that have to pay the charge do this by October. When the bills are paid, the money is distributed out. A fine is levied on those who do not pay the fine in time. A similar approach is chosen for the RVP system described in this report.

It can be expected that the administrative costs for the Swedish EPA will be higher in the RVP system than in the NO_x scheme, since the RVP system is more complex. On the other hand, it is the companies that will see an increased administrative burden as they will have to retrieve and deliver data, manage transactions and ensure that the clothes contain recycled fibers.

The charge will be collected from the headquarters of the different companies and not from individual branches. This should provide simplification of the administrative burden and cutting red tape.

8.4.7 monitoring

Companies must report amount (by weight) of used virgin textile fibers in new textile products put on the Swedish markets as well as total amount (by weight) of new textile products put on the Swedish market. To secure transparency and gain acceptance for the RVP system, an authorized, independent certification system for this reporting is required. Such certification system needs to be developed.

For the RVP system to work and gain acceptance, transparency regarding the clothes and textiles put on the Swedish market and their shares of virgin textile fibers is crucial. Reporting from all companies included in the RVP system must be carried out in the same way. Design 1 was chosen for calculating the level of the virgin payment (see section 8.4.4). This means that all companies in the RVP system, regardless of their shares of virgin and recycled textile fibers, need to report amount (by weight) of used virgin textile fibers for new textile products put on the Swedish market as well as total amount (by weight) of new textile products put on the Swedish market.

Compared to the NO_x scheme verification in an RVP system will be much more complex. Within the NO_x scheme the emissions can easily be verified by measuring flue gas flow and NO_x concentrations. Additionally, the NO_x emissions take place within the Swedish borders. The production of clothes and household textiles put on the Swedish market, however, are almost exclusively imported (see section 3). To verify and ensure that all companies included in the RVP system use the same methodology for reporting of data will therefore be much more difficult. To achieve this, an authorized independent certification system is required. No such system exists today and must therefore be created.

The monitoring and verification are crucial and important aspects in designing the RVP system. The RVP system is rather complicated and would require a monitoring and verification system that covers suppliers abroad and verify their textiles. This will require the companies included in the RVP system (see section 8.4.3) to signal to their suppliers that a certification system will be set up and if the suppliers want to continue to produce clothes and household textiles for them, they must commit to participate in the monitoring and verification activities. The suppliers must uphold and meet the requirements that are set. The certification body would in that case monitor the production of the suppliers and conduct random audits. This will require an increased administrative burden for the companies to ensure this.

8.4.8 policy evolution over time

Stakeholders participating in the policy workshop (see section 4.11) argued for introducing new policy measures in the field of textiles using a stepwise approach using checkpoints along the way to secure practical and effective implementation. This enables collection of practical experiences while moving towards more specific and targeted design of the policy measures over time as well as adaption to market developments. This is particularly relevant when introducing a new, so far untested policy measure, such as the RVP system, in the evolving area of (fiber-to-fiber) recycling of textiles. There are different options to develop the RVP system over time, increasing the level of ambition and making it more specific and targeted.

Initially the RVP system does not differentiate between recycling of pre-consumer (industrial) textile waste and post-consumer textile waste. The reasoning behind this is that new recycling techniques suitable for increased fiber-to-fiber recycling of textiles are under development. Changing production patterns from only or primarily virgin textile fibers to increasing shares of recycled textile fibers will take some time and need adjustments in the textile value chain. It could make it easier for textile producers to get started on this journey if use of recycled textile fibers from pre-consumer textile waste is promoted in the RVP system. When new recycling technologies have been implemented in larger scale, it is suggested to only promote the use of recycled textile fibers from post-consumer textile waste in the RVP system.

Companies tend to orient their efforts around minimum targets (benchmarks), i.e. improvements are made until the minimum targets are met and after this, efforts to improve further slowdown or even stagnate. It is therefore important to increase the level of the benchmarks (see section 8.4.1) for use of recycled textile fibers in new textile products. Such changes can be pre-determined, i.e. with increasing targets over time according to pre-defined targets. They can also be adjusted after evaluation at certain pre-defined points in time.

The level of virgin payments (RVP charge) can be increased over time (in addition to inflation adjustments) in order to create further economic incentives to use recycled textile fibers in new textile products. As with the increased level of benchmarks, the increases of RVP charges can be pre-defined, e.g. as annual increases, or adjusted after evaluation at certain pre-defined points in time.

The scope of companies included in the RVP system can be expanded over time, including additional smaller companies in the mandatory scheme. Along the same line additional textile products can be included in the system over time.

The RVP system can start with a general RVP charge, independent of textile fiber type such as cotton, polyester etc., and then be differentiated for different

textile fiber types. This would allow for adjustments to market developments as well as introduction of stronger incentives for textile fiber types facing slower developments in the field of recycling. If developments regarding use of recycled fibers differ between different textile products, e.g. clothes, household textiles, carpets etc., a differentiation of the RVP charge could also be made for different textile products.

9 refunded virgin payments (RVP): impact assessment

This section provides a description of the impacts that the designed RVP system has on the policy goals described in section 2.3. The identification and analysis of these impacts enables the discussion on the anticipated effects of the RVP system as well as the need for complementing policy measures in order to achieve policy goals. The impact assessment is based on the description in section 8.3 regarding targets, scope, levels, mechanisms etc.

9.1 potential in achieving policy goals

9.1.1 interrelations of the eight policy goals in the RVP system

The overall goal of the RVP system is to stimulate the demand for recycled textile fibers and to increase the proportion of recycled textile fibers in new textile products put on the Swedish market (see section 3). This corresponds to one of the eight policy goals defined in section 2.3 that are used as base for this impact assessment: *Increased fiber-to-fiber recycling of textiles.* Additionally the RVP system impacts six of the other seven policy goals directly or indirectly, to larger or smaller degree. Figure 4 gives an overview of the interrelations between the different policy goas from the perspective of the RVP system. In the following sections the different policy goals are commented individually.

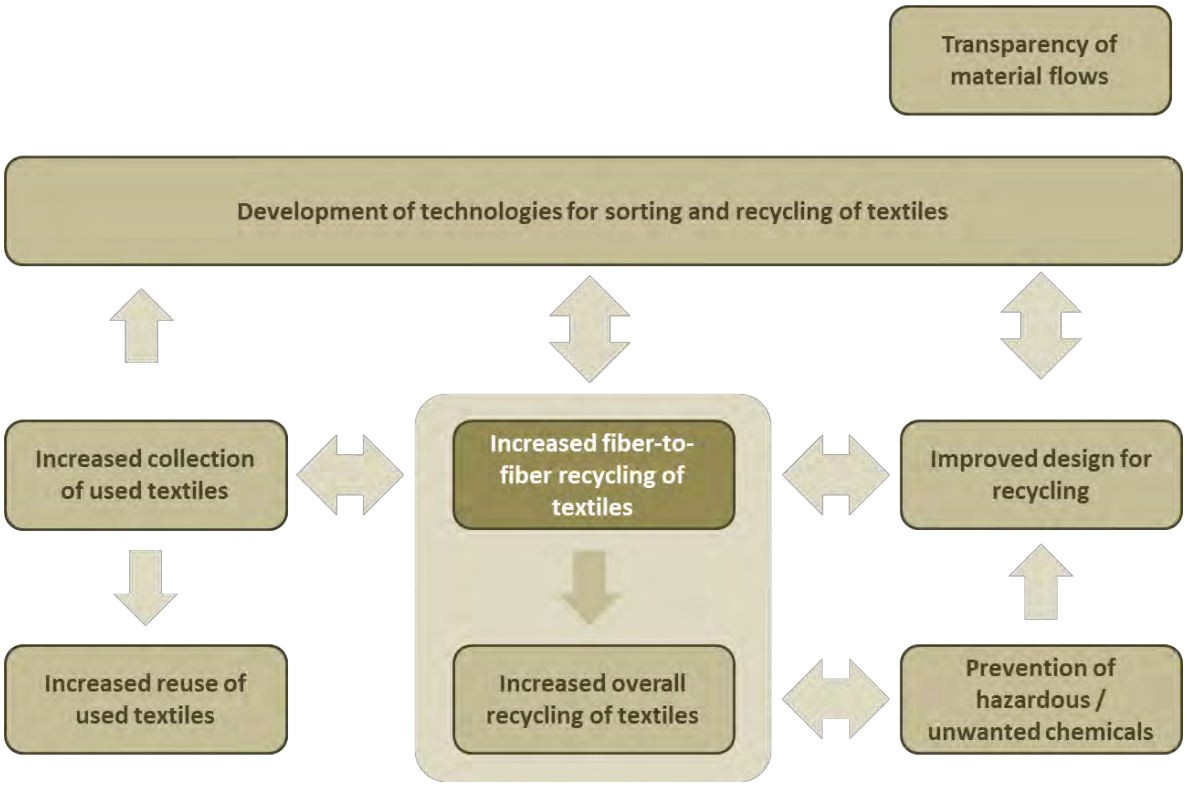

Figure 4 Interrelations between the eight defined policy goals in section 2.3 from the perspective of the RVP system with the general objective of increasing fiber-to-fiber recycling of textiles

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

The main objective of the RVP system is to increase fiber-to-fiber recycling of textiles (used textile products). The RVP system creates direct economic incentives for companies putting clothes and household textiles on the Swedish market to increase the use of recycled textile fibers in their new textile products.

The RVP system is expected to have a large positive impact on increased fiber-to-fiber recycling of textiles.

9.1.3 increased overall recycling of used textile products

Increased fiber-to-fiber recycling of textiles directly increases the overall recycling of used textile products. Additionally, the RVP system contributes indirectly to increased textile recycling in other applications than fiber-to-fiber recycling. As a result of increased collection (see section 9.1.4) the availability of recyclable textile waste that cannot be used for fiber-to-fiber applications

increases. Reasons for some recyclable textile waste not being suitable for fiber-to-fiber recycling, but for other recycling options, may e.g. be due to certain mixes of textile fibers and low quality of the textile fibers.

The RVP system is expected to have a large positive impact on increased overall recycling of textiles.

9.1.4 increased collection of used textile products

The policy goal increased collection of used textile products implies increased collection of used (post-consumer) textiles. The RVP system creates economic incentives to use more recycled textile fibers in the production of new clothes and household textiles (fiber-to-fiber recycling). The recycled textiles fibers can both origin from pre consumer textiles (industrial textile waste) and post-consumer textile waste (used textiles). It is assumed that the RVP system will contribute to increasing recycling of both types of textile waste.

Both fiber-to-fiber recycling and other recycling of used textiles require separate collection. Increased recycling of used textiles will therefore also create incentives to increase separate collection of used textiles. However, already with the existing collection levels, recyclable textiles are incinerated instead of recycled. This means that, initially, the incentives for increasing collection might be somewhat smaller than the incentives for increased recycling.

The RVP system is expected to initially have a medium positive impact and eventually a large positive impact on increased separate collection of textiles.

9.1.5 increased reuse of used textile products

Separately collected used textiles generally include both reusable and recyclable textiles regardless of if the collection primarily is aimed at collecting reusable textiles, recyclable textiles or both. The environmental benefits from reuse of textiles generally exceed the environmental benefits from recycling of textiles (Schmidt et.al, 2016). According to the waste hierarchy only used textiles not suitable for reuse should be recycled, requiring pre-sorting of the collected materials.

The separately collected textiles will include both reusable and recyclable textiles. With increasing collection there will be more reusable used textiles available for reuse. It is assumed that there will be a market demand for second-hand textiles from Sweden even if the collection is significantly increased.

There is a possibility that increased collection of used textiles (see section 9.1.4) might lead to reduced share of reusable clothes and household textiles in the collected material. This is based on the assumption that consumers currently

discard a higher share of used textiles not suitable for reuse in the mixed household waste than in the separate textile collection. However, the overall increases in collection are assumed to overcompensate for potentially lower share of reusable textiles in collection.

The RVP system is expected to have a medium positive impact on reuse of used clothes and household textiles.

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

Lack of technology for textile sorting and textile recycling as well as limitations of available textile recycling are critical aspects for increased fiber-to-fiber recycling of textiles (Elander & Ljungkvist, 2016). Stakeholders specifically see a lack of chemical recycling technologies and limitations of mechanical textile recycling as a problem, but also e.g. lack of recycling technologies for mixed fibers and lack of investments in technology development (Elander & Ljungkvist, 2016).

Efficient and high quality sorting and recycling of textiles are essential for textile producers to shift production and on a large scale using more recycled textile fibers in the production of new clothes and household textiles. By creating economic incentives for increased fiber-to-fiber recycling of textiles, the RVP system also creates incentives to improve and develop new technologies for sorting and recycling of textiles. Additionally, the availability of more recyclable textiles due to increased collection might act as another trigger to develop such technologies; recycling the materials instead of incinerating them and creating more circular textile value chains.

The RVP system is expected to have a medium positive impact on the development of technologies for sorting and recycling of textiles.

9.1.7 improved design for fiber-to-fiber recycling

Companies included in the RVP system are expected to increase their awareness of design for recycling. As the RVP system progresses and the demand for recycled fibers increases, the policy may encourage the companies to improve the design of their products enabling fiber-to-fiber recycling more easily (upstream effect). However, other factors, e.g. customer demand, trends, costs and quality, are expected to influence the design more than improved design for recyclability also with the RVP system.

The RVP system is expected to have only small (minor) positive impact on the design for improved recyclability of new textile products.

9.1.8 prevention of hazardous / unwanted chemicals

Studies have shown that there is a knowledge gap on chemical content of textile products (Lexén, Loh Lindholm, Youhanan, & Stenmarck, 2016). For instance, some chemicals that are prohibited by European legislation are still used in other markets which make it difficult for suppliers to follow. Additionally, the supply chains are often long and complex and the transparency of the chemical industry supplying the chemicals is often rather limited (Klarén, 2016; Larsson, 2016). This lack of knowledge is an obstacle for both pre- and post-consumer recycling of textiles.

Imported and/or old used textiles may contain chemicals that are prohibited and unwanted in the recycled textile fibers used for production of new textile products. Enhancement of recycling textiles may conflict with the reduction of unwanted chemicals in products. It is important that an assessment is made of the content in recycled materials in order not to accumulate unwanted substances via recycling.

There is a possibility that increased fiber-to-fiber recycling to some extent influence the choice of chemicals used in new textile products from textile companies under the RVP system by phasing out of chemicals that causes obstacles in the recycling process and in use of recycled textile fibers. This might reflect increased knowledge and awareness of problematic chemicals. However, the textile value chain is global as is the textile recycling market which makes individual contributions for phasing out unwanted chemicals in new products less effective. Finally it can be assumed that the choice of chemicals in new textiles has other primary decision parameters than removing chemicals that might lower the recyclability of textiles.

The RVP system is expected to have no (little) impact on prevention of hazardous / unwanted chemicals in new textile products.

9.1.9 increased transparency of material flows

The RVP system requires documentation on clothes and household textiles put on the Swedish market as well as virgin textile fibers used for production of these products. However, information on used textiles, e.g. regarding collection as well as sorting, reuse and recycling of collected used textiles, will not be required by the RVP system.

The RVP system is therefore expected to have large positive impact on transparency regarding recycled material used in new clothes and household textiles but no impact on transparency of used textiles.

9.1.10 overall policy effects

The expected impacts on the eight identified policy goals are summarized and illustrated in Table 11.

Table 11 Overview of the expected impacts of the RVP system on the eight policy goals defined in section 2.3

	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*		X**
Improved design for fiber-to-fiber recycling	X		

** Used textiles ** Textile products and textile fibers put on the Swedish market*

9.2 sensitivity analysis

This section provides a sensitivity analysis of critical design aspects of the RVP system. Three critical aspects have been identified as the most important factors impacting the eight policy goals described in section 9. These are: Scope of textile products, Scope of companies, and Level of virgin payment. The design aspects can be seen as a set of adjustment screws and by turning the screw in a certain direction the impacts on the policy goals will differ. If the design aspect has a large impact on the policy goals, in relation to the impact assessment, {++} are given, if the impact is small {+} is given, if there is no impact {+/-} is given and if it has a negative impact {-} is given.

9.2.1 scope of textile products

The scope of textile products in the RVP system includes clothes and household textiles and all types of textile fibers (see section 8.4.2). Clothes and household textiles generally have a large share (by weight) of textile fibers.

The types of textile fibers as well as the types of textile products included in the RVP system can be considered to be adjustment screws. By turning the screw to the right, i.e. adding more types of textile groups such as shoes, carpets, upholstered furnishings etc., the adjustment is considered to have a positive impact on the defined policy goals. This because the larger share of textile products that are covered by the RVP system the larger the volume of textiles to produce recycled fibers from. Thus, even if some materials may be unsuitable for recycling or difficult to separate the overall impact would be positive.

This increase, in the amount of textile products, is expected to have a small positive impact {+} on increased fiber-to-fiber recycling of textiles. This will directly increase the overall recycling rate of textiles and indirectly the share of collection (see section 9.1). Currently, almost all reuse of used textiles are reuse of clothes and household textiles. Increasing the scope of textiles (including more textile products in the RVP system) is expected to have a small positive impact {+} on textile recycling and collection rates and no (little) impact on reuse {+/-}. Reducing the scope of textiles i.e. turning the screw to the left will have a negative impact {-} on these policy goals, since it would reduce the amount of textile products covered by the RVP system.

An increased flow of textile products will require better technology for sorting and recycling and might trigger the development of such technologies. The change is expected to have a small positive impact {+} on the development of technologies for sorting and recycling of textiles. Reducing the scope of textiles will, on the other hand, reduce availability of more recyclable textiles and thereby incentives to develop technology for sorting and recycling of textiles {-}.

Furthermore, the RVP system is expected to increase the awareness of design for recycling aspects for the included companies. Including more textile products i.e. turning the screw to the right, means that we can impact the design of more textile products. Whereas turning the screw to the left will have contrary impacts. However, other factors (see 9.1) are expected to influence the design more than the RVP system. The impact of an extended scope of textiles in the RVP system is expected to be positive but insignificant {+/-} on the design for improved recyclability of new textile products; the impact of a reduced scope of textiles is expected to be negative but insignificant {+/-}.

The overall impact of the RVP system on prevention of hazardous/ unwanted chemicals in new textile products is expected to be low. Including or reducing textile products in the RVP system is not expected to impact this significantly in any direction {+/-}.

The RVP system requires documentation on clothes and household textiles put on the Swedish market as well as virgin textile fibers used for production of these products. If more textiles are covered by the RVP system, this documentation will

include a larger amount of textile fibers put on the Swedish market. Documentation of used textiles will not be influenced by the scope of textiles as there are no reporting requirements regarding used textiles in the RVP system. Therefore the overall transparency of textile flows (including used textiles) will be not or only little affected {+/-} by including more textile products in the RVP system, whereas the positive effects on transparency of the new textile fibers put on the market is expected to be small {+}.The

The results of the sensitivity analysis for the scope of textiles are summarized in Table 12.

Table 12 Sensitivity analysis of the critical design aspect *Scope of textile products*

	More textile products 	Less textile products 
Increased collection of used textile products (post-consumer textiles)	+	-
Increased reuse of used textile products	+/-	-
Increased overall recycling of used textile products	+	-
Increased fiber-to-fiber recycling of used textile products	+	-
Prevention of hazardous / unwanted chemicals	+/-	+/-
Development of technologies for sorting and (fiber-to-fiber) recycling of textiles	+	-
Increased transparency of material flows	+*	-*
Improved design for fiber-to-fiber recycling	+/-	+/-

** For new textile fibers put on the market*

9.2.2 scope of companies

The RVP system includes large companies i.e. companies with more than 250 employees. Despite the fact that only 0.1 percent of the Swedish fashion companies fall into this category, the large companies employ a third of the entire fashion workforce (Tilläxtverket, 2014). The RVP system hence covers a large share of the market and as such creates incentives for a large share of the market to produce clothes and household textiles with recycled textile fibers. The corresponding adjustment screw for the critical design aspect *Scope of companies* is the size of the companies included. The inclusion of only large companies corresponds to a rather tightened setting to the right, i.e. including only few, large companies.

Decreasing the scope of companies, i.e. turning the adjustment screw even further to the right and including only even larger companies, would most likely have a negative impact on several policy objectives as there would be even less companies included in the RVP system. Excluding more companies, would also reduce the share of the market that is affected by the policy and thus only provide economic incentives to a smaller share of companies. Without the economic incentive we are likely to see a continued production of textiles from virgin fibers by the large share of companies excluded in the RVP system. Consequently, this will have a negative impact on most policy goals, as illustrated by Table 13.

On the other hand, if the scope of companies is increased and additional smaller firms are included, a larger share of the market will be included in the RVP system. Thereby a larger share of the market will have incentives to use recycled textile fibers. This will increase the use of recycled textile fibers in new textile products and overall recycling of textiles. Even though, the produced amounts by the smaller firms may not be significant, the total production of recycled fibers would still increase.

The change in scope of companies is expected to have a large positive impact {++} on increased fiber-to-fiber recycling and a small overall positive impact {+} on recycling of textiles. This will indirectly increase collections rates, as demand for recycled fibers increases. With increasing collection rates the amounts of textiles available for reuse will also increase. The change in scope of companies is expected to have a small positive impact {+} on the development of the increased collection and reuse rates of textiles.

By creating economic incentives to more companies fiber-to-fiber recycling of textiles will increase demand even further. This increase will in turn create incentives to improve and develop new technologies for sorting and recycling of textiles. The change in scope of companies is expected to have a small positive impact {+} on the development of technologies for sorting and recycling of textiles.

Moreover, including more companies means that a larger share of the market can be expected to increase their awareness of design for recycling and encouraged to improve the design of their products. However, this impact is expected to be insignificant {+/-} on the design for improved recyclability of new textile products.

As describe above, the transparency of material flows will be positive for new textile fibers put on the market {+} but not for used textiles. Also the prevention of hazardous/unwanted chemicals in new textile products will be unaffected {+/-} by including more companies in the RVP system.

The results of the sensitivity analysis for the scope of companies are summarized in Table 13.

Table 13 Sensitivity analysis of the critical design aspect *Scope of companies*

	Including more (also smaller) companies	Including less (only larger) companies
Increased collection of used textile products (post-consumer textiles)	+	-
Increased reuse of used textile products	+	-
Increased overall recycling of used textile products	+	-
Increased fiber-to-fiber recycling of used textile products	+	-
Prevention of hazardous / unwanted chemicals	+/-	+/-
Development of technologies for sorting and (fiber-to-fiber) recycling of textiles	+	-
Increased transparency of material flows	+*	-*
Improved design for fiber-to-fiber recycling	+/-	+/-

** For new textile fibers put on the market*

9.2.3 level of virgin payment

Stakeholders see lacking incentives to use virgin textile fibers in the production of new textile products (low prices for virgin fibers, high prices for recycled textile fibers etc.) and also limitations for doing so (e.g. availability of recycled textile fibers and lack of available recycling technologies) (Elander & Ljungkvist, 2016).

As described in section 8.4.4 the higher the charge is, the more expensive it becomes for companies to not produce new textile products from recycled textile fibers. As such, higher charges can contribute to higher fiber-to-fiber recycling and recycling rates and indirectly to higher collection and reuse rates. The impact is expected to be higher for fiber-to-fiber recycling and recycling rates {++} and slightly lower {+} for collection and reuse rates.

Reducing the charge may on the contrary, provide less encouragement to produce textiles from recycled content, and thereby have a negative impact on these four policy goals. Thus, if companies behave as expected, they will use recycled textile fibers as long as the marginal cost is less than the charge. The availability of more recyclable textiles will also, to a higher degree than if a low charge is introduced, contribute to faster technology development {+}.

A higher charge will not impact, the transparency of material flow, the prevention of hazardous/ unwanted chemicals and design for recycling in a significant way (see section 9.2.1). This is illustrated in Table 14.

Table 14 Sensitivity analysis of the critical design aspect *Level of virgin payment (charge)*

	Increase of charge	Decrease of charge
Increased collection of used textile products (post-consumer textiles)	+	-
Increased reuse of used textile products	+	-
Increased overall recycling of used textile products	++	-
Increased fiber-to-fiber recycling of used textile products	++	-
Prevention of hazardous / unwanted chemicals	+/-	+/-
Development of technologies for sorting and (fiber-to-fiber) recycling of textiles	+	-
Increased transparency of material flows	+/-	+/-
Improved design for fiber-to-fiber recycling	+/-	+/-

9.3 discussion and recommendations

The current low market prices for virgin textile reduce incentives for producers to use recycled textile fibers in the production of new textile products. The RVP system aims to level the current price difference between virgin and recycled fibers. The impact assessment has shown that the RVP system has a large positive impact in promoting fiber-to-fiber recycling and overall recycling of textile. It has also shown the RVP system to indirectly have positive impacts on collection rates.

From an economic and environmental point of view reuse is better than recycling (Schmidt et al., 2016). The increased textile recycling should therefore not come at the expense of reuse. Although the RVP system promotes the use of recycled fibers (recycling), it does not have adverse effects on reuse granted that the waste hierarchy is applied. Instead the impact assessment shows that the overall reuse rates will increase as a result of increased collection rates. The sensitivity analysis also shows that these aspects increase with a larger scope of textiles and companies as well as with higher charges. In order to secure that the waste hierarchy is applied, promoting reuse before recycling, additional policy measures securing sorting of collected materials according to quality specifications are recommended.

A critical factor for increasing fiber-to-fiber recycling of textiles is the development of new and improved sorting and recycling technologies. Finding a way to achieve more fiber-to-fiber recycling without impairing quality will become a game changer. The impact assessment implies that the RVP system may trigger the technology development as a result of increased incentives for fiber-fiber-recycling and increased collection rates. The impact becomes stronger as the scope of textiles and companies increases. Even though the RVP system will be helpful to trigger this, it is not sufficient to have a large impact. Therefore additional policies supporting R&D for new and efficient sorting and (fiber-to-fiber) recycling technologies are important.

In conjunction to this it is also important that textiles are designed for recycling. Achieving this type of upstream effect requires large behavioral changes – both among textile producers designing for improved recycling and among consumers accepting potential changes in design due to improved recyclability. Therefore additional (informative) policy measures are required to improve the design for recycling of textile products, for instance through education of designers and consumer information.

Available data regarding textiles put on the Swedish market is based on Statistic Sweden's data on foreign trade (exports and imports of goods) and on industrial production of goods. These data are roughly collected based on textile fiber types, but do not differentiate different mixed of fiber types and do not include any information on shares of virgin and recycled textile fibers. Available data regarding used textiles, e.g. separately collected textiles, reused textiles and (to some extent) recycled textiles, are primarily collected by Swedish Environment Emission Data [Svenska MiljöEmissionsData, SMED] on behalf of the Swedish EPA and based on interviews with charitable organizations, companies involved in second-hand sales and providers of consumer to consumer trading platforms. In order to monitor and verify the RVP system companies must annually report both the amount (by weight) of virgin textile fibers in new textile products put on the Swedish market and the total amount (by weight) new textile products put on the Swedish market. The impact assessment has shown to improve the transparency of textiles and textile fibers put on the market. However, not all textile producers will be included in the RVP system and will therefore be covered by this reporting requirement. Also, not all textile products are included in the scope of the RVP system. In addition, the RVP system does not include any reporting on used textiles. As long as the actors are not compelled to provide data on used textiles, they have no immediate incentive to provide these data. To achieve a better transparency of flows of used textiles, additional, more directed policies are required.

The RVP system does not provide sufficient incentives for textile producers to phase out hazardous substances and/or substances potentially causing problems

in (fiber-to-fiber) recycling processes. In order to secure hazardous free material loops for textiles additional policy measures targeting this specific issue are necessary. As with all economic policy instruments, there are certain limitations. For instance, it is difficult to set an optimal payment level; in the case of the RVP system the level of the virgin payment (charge). However, a tax of the size proposed by the RVP system would most likely not be politically feasible. Additionally, the RVP system is targeted at a relatively few companies to avoid too large administrative burdens for (smaller) textile producers. The fact that the virgin payments are refunded to the same cooperative of textile producers is increasing acceptance of the policy measure. To only include a rather limited number or companies would not have been perceived as reasonable in a tax scheme.

Furthermore, the RVP system will also cause administrative costs for the involved companies in order for them to verify and control that their suppliers uphold and meet the requirements that are set by the Swedish EPA. Ideally, it is advocated according to economic theory, to include as many companies from the sector as possible in order to strengthen the individual incentives from RVP. However, including small companies also entails large risk as the RVP system may require too large administrative costs and thus cause small companies to close down their production because they cannot cover their costs. To avoid this situation small companies where therefore exempted from the RVP system.

Generally, a refund system with full refund of the charges is not socially optimal i.e. it is not the first best solution (see section 5.3) (Gersbach & Requate, 2004). However, it has been shown that RVP system can increase the demand for and use of recycled textile fibers for the production of new textile products. Evaluation of the Swedish NOx system has also showed that a refund system can be more politically feasible and successful.

The RVP system is primarily focused on achieving higher recycling rates and more fiber-to-fiber recycling and by doing these other policy goals are impacted indirectly. However, to attain more policy goals the RVP system must be supplemented with other directed policies.

10 input from stakeholders on mandatory EPR and RVP

This section summarizes stakeholders' views on crucial elements in a mandatory EPR system and in an RVP system. Stakeholders' input was collected and documented via an online questionnaire (see section 2.4). 19 respondents answered the questionnaire, representing a response rate of 30 percent.

10.1 views on the mandatory EPR system

Only two out of 19 respondents think that it very realistic to charge producers based on the actual cost of fiber-to-fiber recycling of specific fibers (e.g. cotton, wool, polyester, nylon, mixed fibers) in the coming five years; seven respondents think that it is fairly realistic and seven respondents find it unrealistic.

Two thirds of the respondents with stated opinions think that the overall level of reuse and fiber-to-fiber recycling must be 50 percent (or more) in order to induce innovation in product design (e.g. types of fibers used, composition) and in end-of-life technologies (e.g. fiber identification, sorting, recycling). The stated necessary reuse and recycling levels are higher for textile products made of cotton, polyester, wool and polyamide than for textile products made of mixed fibers and acrylic.

When asked who should be responsible for organizing the collection of clothes and household textiles in a mandatory EPR system answered with a tendency to existing second-hand market actors (e.g. charity organizations) when it comes to collection of textiles for reuse and to municipalities regarding collection of textiles for recycling. However, in the free comments section, many stakeholders pointed out that a variety of solutions are possible for collection of textiles e.g. a standard fee where all actors are able to collect clothes for both reuse and recycling. This also better reflects the reality, where collected textiles generally include both reusable and recyclable textiles, regardless if they were collected for reuse, recycling or both.

The majority (55-64 percent) of the respondents with stated opinions think that it is essential that a mandatory EPR system includes the following components: waste diversion targets (60 percent by 2025), collection convenience requirements, reuse and recycling targets, mandatory information provision to consumers, consultation with existing actors engaged in reuse/recycling of textiles and monitoring and control by government. In addition, the majority (50-70 percent) of the respondents with stated opinions think that it would be good to include the following components: take-back requirements on producers and

financing mechanisms that reflect the actual cost of fiber-to-fiber recycling of specific fibers.

10.2 views on the RVP system

Only one of the respondents with stated opinions (representing a textile recycling company) thinks that the RVP system has a high potential to contribute to increased fiber-to-fiber recycling of textiles; 53 percent of the respondents with stated opinions see a medium potential and 40 percent no or little potential.

When asked about realistic target levels (ambition levels) for recycled content in clothes and household textiles by 2025 the most common answers were 50 percent for textiles made from cotton, polyester, wool and polyamide and 30 percent for textiles made from acrylic respectively.

Three times as many respondents with a stated opinion preferred a differentiated RVP charge according to different fiber types, i.e. different charges for textiles made from different textile fibers, to a general RVP charge independent of textile fiber type, i.e. same charge for all textiles.

Almost 60 percent of the respondents with stated opinions think that a realistic RVP charge that would give textile companies sufficient incentives to use more recycled fibers in new textile products would be between 10-20 percent of the list price for new textile products.

11 findings and recommendations

There is a potential to broaden the scope of policy measures promoting fiber-to-fiber recycling of textiles and better compared to the policy recommendations made by the Swedish EPA. New policy measures in the textile field should embrace potentials to generate upstream improvements and increasing the demand for recycled textile fibers.

The impact assessments of a mandatory EPR system and a RVP system aims to broaden the discussion regarding potential policy measures in the textile field as well as potential elements that can be included in such policies. The policy recommendations made by the Swedish EPA focus on sustainable consumption of textiles and handling of textile waste. Although the Swedish EPA suggests a mandatory EPR for textiles as one of two alternative policy options for handling of textile waste, the proposal focuses almost exclusively on downstream improvements. The impact assessment of the mandatory EPR suggested in this report includes additional elements, embracing also the potential of an EPR system to generate upstream improvements. The Swedish EPA suggests an investigation on how public bodies can contribute to more reuse and recycling of textiles by green public procurement. Economic instruments have shown to be successful measures to reduce environmental externalities. The RVP system described in this report therefore shows another, complementing possibility to increase the demand for recycled textile fibers, adding another perspective on potential ways and means to promote recycling of textiles.

Both a mandatory EPR and a RVP system have potentials to have large positive impacts on fiber-to-fiber recycling as well as overall recycling of textiles. A mandatory EPR system has the same or larger positive impacts on all eight policy goals defined in this report compared to a RVP system. A mandatory EPR system embodies the potential to integrate a range (combination) of complementing policy measures whereas an RVP system should be complemented by additional policy measures.

The impact assessment carried out in this report shows that both the mandatory EPR and the RVP system have good potential to have large positive impacts on fiber-to-fiber recycling as well as overall recycling of textiles, see Table 15. Both policy measures also have medium to large positive impacts on collection and reuse rates of textiles (directly and indirectly). Whereas the broader approach of the mandatory EPR results in medium and high positive impacts on the prevention of hazardous / unwanted chemicals and improved design for fiber-to-fiber recycling, the RVP system does not impact these aspects to any larger degree. The mandatory EPR includes a financing mechanism that contributes to the development of fiber-to-fiber recycling technologies. In the RVP system increased demand for recycled textile fibers are expected to incentivize

development of such technologies. In combination with other policy elements in the mandatory EPR the impact assessment shows larger positive impacts on the development of technologies for sorting and (fiber-to-fiber) recycling of textiles for the mandatory EPR system (large positive impacts) than for the RVP system (medium positive impact). The impact assessment shows that the RVP system has large positive impact on increased transparency of flows of new textiles put on the Swedish market, but no impact on increased transparency of flows of used textiles. The mandatory EPR, on the other hand, has medium positive impact on increased transparency of flows of both new and used textiles.

Table 15 Comparison of the positive impacts of the mandatory EPR and RVP systems described in this report in regard to eight policy goals

Policy goal		Positive impact on policy goal		
Increased collection of used textile products (post-consumer textiles)	EPR			large
	RVP		medium	
Increased reuse of used textile products	EPR		medium	
	RVP		medium	
Increased overall recycling of used textile products	EPR			large
	RVP			large
Increased fiber-to-fiber recycling of used textile products	EPR			large
	RVP			large
Prevention of hazardous / unwanted chemicals	EPR		medium	
	RVP	small		
Development of technologies for sorting and (fiber-to-fiber) recycling of textiles	EPR			large
	RVP		medium	
Increased transparency of material flows	EPR		medium	
	RVP	small*		large**
Improved design for fiber-to-fiber recycling	EPR			large
	RVP	small		

** Used textiles ** Textile products and textile fibers put on the Swedish market*

Whereas the mandatory EPR includes a wider range of elements, contributing to a larger degree to the eight policy goals defined in section 2.3, the RVP system must be complemented by additional policy measures in order to contribute to all stated policy goals.

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appendix 1

longlist of potential policy measures promoting fiber-to-fiber recycling of textiles

Table 16 shows the longlist of 27 potential policy measures that were considered in this project. The policy measures include administrative, economic, informative and other policy measures.

Table 16 Longlist of policy measures promoting fiber-to-fiber recycling of textiles

Policy measure	Short description
Administrative instruments	
1. **End of waste criteria for used textiles and/or textile fibers**	Previous research in Mistra Future Fashion identified import regulations for waste and definition of used textiles as waste as critical aspects for increased fiber-to-fiber recycling (Elander & Ljungkvist, 2016). End-of-waste criteria specify when certain waste ceases to be waste and obtain the status of a product (or a secondary raw material). End of waste criteria for used textiles and/or textile fibers could contribute to decreased trade barriers and better functioning markets for used textiles.
2. **Performance standards on chemicals and hazardous substances**	A performance standard is an expression of the performance threshold, requirement, or expectation that must be met to be appraised at a particular level of performance. A performance standard can be used on chemicals and hazardous substances.

Policy measure	Short description
3. **Public procurement supporting minimum recycled content of new textile products**	Green Public Procurement (GPP) is a process to procure goods, services and works with a reduced environmental impact throughout their life cycle. By promoting and using GPP, public authorities can provide industry with real incentives for developing green technologies and products. The increased point scores for minimum recycled content could be made for selected textile products, e.g. uniforms. It could also be introduced in a stepwise approach (adding new product groups over time). The procurement of textile products which are completely or partly produced from recycled textile fibers could increase demand for textile products made with recycled textile fibers. The objective would be to create a better functioning market for recycled textile fibers.
4. **Regulation banning specific persistent hazardous chemicals**	Some of the chemicals used in textiles can be persistent and remain in the product even after many washes. In some cases such as easy-care, waterproofing, fire hindering the persistence is fully intended. These chemicals/treatments can potentially contaminate products using recycled fibers. Particularly if the new textile products are intended for sensitive groups, e.g. children, pregnant women etc. Some of the more hazardous could potentially be banned.
5. **Regulation demanding labelling of products which contain persistent chemical treatments**	Same background as policy measure number 3 (above). Rather than banning the treatments, however, the labeling of products which contain persistent chemical treatments can assist in reducing the risk of cross contamination, i.e. products with these labels are excluded from recycling processes. The policy measure may need some kind of additional measure which ensures that these products are not recycled.
6. **Requirements on customer convenience for return of used textiles**	Along with information, a crucial element to enhance consumer participation regarding separate collection of textiles is convenience. Requirements could be put to enhance the convenience of the consumers for returning end-of-life products (e.g. proximity from the house, mandating retailers, etc.)

Policy measure	Short description
Economic instruments	
7. Bonus malus system for recycled/virgin fibers in new textile products	A bonus is given to consumers that purchase (new) textile products produced from recycled textile fibers. A malus is levied on consumers purchasing (new) textile products produced from virgin textile fibers. The objective is to differentiate the price between (new) textile products made from virgin and recycled textile fibers and to create incentives to buy textile products with recycled textile fibers. A bonus-malus scheme has been used for passenger cars.
8. Chemicals tax on textiles	Previous research in Mistra Future Fashion identified the presence of chemicals and hazardous substances in textile products as a critical factor for increased fiber-to-fiber recycling of textiles (Elander & Ljungkvist, 2016). A chemicals tax could be used to reduce chemicals and hazardous substances in textile products. Economic instruments have proven to be effective in reducing sale of products that contain unwanted chemicals.
9. Deposit and refund schemes on (new) textile products for consumers	A deposit (surcharge) is put on new textile products when purchased and a refund (rebate) is given upon return of the product. Deposit schemes generally increase collection of end-of-life products (depending of the level of the deposit fee). Increased collection could contribute to creating markets and business models for recycling of textiles.
10. Finance for (technical) R&D regarding efficient sorting and recycling of textile fibers	Previous research in Mistra Future Fashion identified ten critical aspects regarding (lacking) technology for sorting and recycling of textiles (Elander & Ljungkvist, 2016). Increased finance to (technical) R&D project could contribute to finding more resource efficient solutions for textile waste.

Policy measure	Short description
11. Financial support to textile sorting in Sweden	The sorting process of used textiles generates a value from the separately collected textiles. Currently used textiles are primarily sorted for reuse, since textiles for reuse are main product in economic terms. Textiles for recycling have a low economic value and the revenues can barely pay for the transport. Most used textiles from Sweden (and the other Nordic countries) are sorted in Eastern Europe where wages are lower. Financial support to Swedish textile sorting (e.g. per ton of sorted material) could contribute to generate the value in Sweden and to make textiles available for recycling in Sweden.
12. Recycling certificates	Producers/importers that use a certain amount of recycled materials (textile fibers) in new textile products get a certificate issued, equal to the weight of the recycled materials used. The government determines a quota on the user side, which indicates the share of the total material usage that shall be based on recycled materials. This creates economic incentives to use recycled materials.
13. Reduced VAT for new textile products made from recycled textile fibers	One possibility to change the relative price of goods made of recycled textile and goods made to virgin textile would be by applying reduced value added tax (VAT) for goods made of recycled textile fibers. Within certain limits, the VAT Directive (2006/112/EC) opens up for member countries to introduce a differentiated VAT scheme.
14. Refunded virgin payments to new textile products with recycled content	Refunded virgin payments (RVP) is a scheme in which textile producers (polluters) pay a charge for the use of virgin fibers in new textile products (e.g. per kg). The revenues are returned to the same collective of producers as refunds in proportion to the use of recycled textile fibers for production of new textile products. The scheme is designed to affect investment in recycling textiles. This type of measure (refundable emissions payments) is considered to have been successful when applied to the abatement of nitrogen oxide (NO_x) in Sweden.

Policy measure	Short description
15. Resource tax on virgin textile fibers	Resource taxes, in this case a tax on virgin fibers that are used for the production of new textiles, aim to change price systems and thereby set incentives for increasing resource efficiency and reducing resource consumption (Eckermann et al., 2012). An extraction tax that leads to a price increase of a resource will increase incentives to more recycling as the virgin material becomes more expensive in relation to the recycled material. A resource tax on virgin textile fibers has the potential to support recycling of textiles and to make recycling more competitive compared to virgin fibers.
16. Tax on new textile products made from mixed textile fibers	The use of mixed fiber types in (new) textile products was identified as one of the most critical factors for increased fiber-to-fiber recycling (Elander & Ljungkvist, 2016). A tax could be used to limit the number of different kinds of textile fibers used for the production of new textile products in order to ease the recycling process. The tax could be designed so that the tax would be higher the more mixed fiber that is used.
Informative policies	

Policy measure	Short description
17. Consumer information on reuse and recycling	An effective policy measure (or combination of policy measures) requires that consumers are informed about the measures and their intended effects. Consumers also need to be informed about their role is in the system, e.g. regarding separate collection of used textiles. The consumer information could therefore include general information about textile consumption, reuse and recycling as well as information regarding the need for separate collection, where and how to collect etc.
18. Enhanced use of EU and Nordic (Type I) ecolabelling for new textile products	The EU and Nordic Type I labels[15] for new textile products already encourage the use of recycled materials. However, their uptake by producers has been rather limited. Enhancement of its uptake (or understanding why it has not been used much) could therefore be useful. Enhanced use of Type I labelling could visualize the supply of new textiles products produced with recycled fibers better.
19. EU certification of textile products regarding chemical content	Several of the critical aspects for increased fiber-to-fiber recycling of textiles concerns lacking information regarding chemicals and hazardous substances in textile products (Elander & Ljungkvist, 2016). An EU certification scheme providing information on the content of chemical substances used in (new) textile products could contribute to better information exchange.

[15] Type I labelling is the strongest of the three broad types of voluntary labels identified by the International Organization for Standardisation (ISO). It is a voluntary, multiple-criteria based, third party program that awards a license that authorizes the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations (Global Ecolabelling Network, 2016). Examples of Type I ecolabels are the EU flower, the Nordic Swan and Bra Miljöval.

Policy measure	Short description
20. EU certification on recycled textile fibers (including chemical content)	There is an information gap between sorters and recyclers as well as between recyclers and textile producers (fashion companies) and a need for increased coordination of information and flows of used textiles (Elander & Ljungkvist, 2016). An EU certification scheme on recycled textile fibers to better signal potential quality of recycled textile materials on the recycling market (including chemical content) could contribute to fill this information gap. The objective of such labelling scheme would be to create a better functioning market for sorted used textiles and recycled textile fibers.
21. Increase weight given to recycled content in Type I ecolabels for textile products	The EU flower, the Nordic Swan and Bra Miljöval already give points for recycled content (cotton and polyester). However, this point score could be increased or a minimum share of recycled content included as a criteria. Certain products, e.g. operating room textiles, could potentially be excluded from the minimum share of recycled content.
22. Labelling requirement for chemical substances in new textile products (consumers)	Several of the critical aspects for increased fiber-to-fiber recycling of textiles identified in previous research in Mistra Future Fashion concerned lacking information regarding chemicals and hazardous substances in textile products (Elander & Ljungkvist, 2016). A labelling scheme to provide information on the content of chemical substances in textiles would enable consumers to choose new textile products containing less or no chemical and hazardous substances that affect the textile recycling processes and the markets for the recycled textile fibers less.

Policy measure	Short description
23. Labelling requirement for recycled textile (sorters / recyclers)	Previous research carried out in Mistra Future Fashion identified an information gap between sorters and recyclers as well as between recyclers and textile producers (fashion companies) and a need for increased coordination of flows of used textiles (Elander & Ljungkvist, 2016). A labelling scheme providing information on origin, quality etc. of sorted and recycled textiles could contribute to fill this information gap. The objective of such labelling scheme would be to create a better functioning market for sorted used textiles and recycled textile fibers.
Other instruments	
24. Mandatory extended producer responsibility (EPR)	Mandatory Extended Producer Responsibility (EPR) puts specific legal requirements on producers for the improvement of the environmental performance of the entire life-cycle of their products, with special focus on the end-of-life phase.
25. Material exchange platform for used textiles for recycling	Previous research in Mistra Future Fashion identified asymmetric information between recyclers and sorters and fashion industry as a critical factor for increased fiber-to-fiber recycling (Elander & Ljungkvist, 2016). An efficient market requires good access to information about the supply and demand. An efficient flow of information between potential suppliers and buyers might be established through a web-based material exchange site for unsold textiles, used textiles (sorted and unsorted) and recycled textiles.

Policy measure	Short description
26. Voluntary agreements/dialogue between producers and policy makers on phasing out unwanted substances in production and design for recycling	There is an ongoing dialogue between producers and policy makers regarding phasing out unwanted substances in production and design for recycling.[16] These issues could potentially also be a part of the stakeholder dialogue proposed by the Swedish EPA regarding a more sustainable production and consumption of textiles. Enhancement of this could influence the supply chain to supply textiles that are more suited for recycling.
27. Voluntary extended producer responsibility (EPR)	The idea is the same as for Mandatory EPR (see policy measure number 24 above). However, voluntary initiatives are typically introduced by the producers themselves or via negotiated agreements with government, driven by pressure from the market.

[16] The so called Textildialogen was initiated by the Swedish Chemicals Agency and is now hosted by Swerea IVF (Swerea IVF, 2016).

appendix 2

description of ten policy measures

public procurement supporting minimum recycled content of new textile products

Green Public Procurement (GPP) is a process to procure goods, services and works with a reduced environmental impact throughout their life cycle (European Commission, 2008). The use of GPP by public bodies can provide producers with incentives to develop e.g. recycled textiles. The procurement of textile products which are completely or partly made up of recycled fibers can contribute to reduce the use of virgin textile fibers and to support new technologies. In Japan GPP criteria has been used for textile products such as uniforms, hats and curtains (Tojo et al, 2012).

The current EU guidelines already include recycled content as a way of gaining points rather than as a minimum requirement. The public sector can use its purchasing power and increase the level of environmental requirements. Instead of giving points for recycled content, the public sector can leverage the market share of recycled textiles by demanding minimum requirement.

obstacles addressed

Currently, it is challenging for reused and recycled textiles to compete with textiles using new fibers. Contracting authorities have an obligation to get the best value for taxpayers' money for everything they procure. However, choosing the most inexpensive offer does not mean that the most cost-effective tender has been chosen. Procurement aims to find a solution which meets the identified requirements, including environmental aspects in the most cost-effective way (European Commission, 2008). Including environmental aspects in procurements should be an equal consideration amongst others for the award of the contract.

Textile recyclers see a lacking demand for recycled textile fibers (Elander & Ljungkvist, 2016). Stakeholders also see a lacking consumer demand for textile products with recycled content. The supply of textile products with recycled content is limited for a range of product groups. Using the purchasing power of public bodies to increase demand of textile products with recycled content could trigger the development of more textile products with recycled content and higher recycled content.

critical factors in design

The level of the minimum requirement must be sufficiently high in order to have an effect. If the minimum requirement level is set too low it will not have any impact.

A stepwise approach for including new product groups with the minimum requirements can be used in order to allow for new product development in areas with limited supply of textile products with recycled content. The timing for such stepwise inclusion should be predefined.

If justified, some application areas can be excluded from the minimum requirements on recycled content.

risk factors

There might be a lack of knowledge among the procurement officers regarding how to stipulate minimum requirements. There might also be a perception that environmentally friendly products are more expensive.

There might also be a limited supply of textile products with recycled content in certain product groups.

conflicts and synergies

Public textile procurements have a large potential to make a difference, depending on the requirements they set up for their products regarding material type, quality and durability. For instance, some county purchasers of hospital textiles are moving away from using cotton due to large environmental impacts.

For some areas of application, special quality requirements might interfere with the minimum requirement on recycled content.

With increasing share of recycled content, other factors such as durability and life time of product, might be influenced.

affected stakeholders

The affected stakeholders in this policy are procurement officers and their customers (textile producers) as well as textile recyclers.

requirements on customer convenience for return of used textiles

Along with information, a crucial element to enhance consumer participation is convenience. Requirements could be put to enhance the convenience of the consumers when returning end-of-life products (e.g. proximity from the house, mandating retailers, etc.).

A prerequisite for increasing reuse and recycling of textiles is increased collection of used textiles. The lack of accessible collection systems can be perceived as time consuming and tedious. This creates a situation where it becomes easier for consumers to throw away textiles rather than returning them. In order to increase the reuse and recycling of textile waste, it is essential that the possibility to return end of life products become more accessible (Tekie et al., 2013).

obstacles addressed

Lack of availability, time and knowledge about the possibilities of returning textiles reduces households' willingness to collect used textiles separately. This leads to consumers rather discarding used textiles that could have been reused or recycled in the mixed municipal waste rather than collecting them separately. More adjusted and convenient collection opportunities are necessary to increase the collection of textiles.

In some cases it may also be hard for consumers to judge whether a used textile product is reusable or recyclable. This creates an obstacle by complicating the decision-making process for consumers and thereby resulting in households ignoring to return end-of-life products. Consumers should not have to make distinction between reusable or recyclable textiles.

critical factors in design

It is crucial that good infrastructure (i.e. easily accessible) for collection is secured. Caution should be taken to avoid the situation where collection effort is concentrated in urban areas and rural areas are dismissed (Watson et al., 2015).

Different consumers have different preferences and needs regarding separate collection of textiles. "Making it right" must be made easy considering different needs. Offering differentiated solutions for return of end-of-life textile products (e.g. in stores, in public places, at recycling centers, at the workplace, in schools etc.) might increase collection rates.

risk factors

Waste separation (by consumers) has proven successful in several areas even though it is a relatively new phenomenon. However, for some waste, e.g. plastic waste, separate collection has not been as successful and there is a risk that

improved convenience alone may not be enough to reach the intended results for textiles.

Different collection systems in different areas might confuse consumers moving from one area to another.

conflicts and synergies

A well-developed infrastructure, in combination with information, is essential for consumers (households) to participate in separate waste collection (Hage et al., 2008; Swedish EPA, 2008). In order for this policy measure to be successful it is important that other measures, e.g. informative instruments, are implemented in conjunction to improved convenience.

Certification schemes can increase transparency in collection and handling of used textiles and reduce the risk of cherry-picking.

affected stakeholders

The affected stakeholders are, besides the consumers, those providing the infrastructure e.g. municipalities, and producers. Accredited organizations, Producer Responsibility Organizations, can also organize the collection and management of post-consumer products.

Requirements for more convenient collection will likely lead to increased costs for stakeholders, who today are not involved in these activities (Watson et. al, 2015).

bonus malus system for recycled/virgin fibers in new textile products

Bonus malus is a general term for a measure that has both positive and negative incentives (SOU, 2013). Bonus malus system for recycled/virgin fibers in new textile products is a policy measure which aim to provide incentives to produce recycled textiles. A bonus is given to producers that use recycled textile fibers for production of new textile products and a malus (e.g. a tax) is levied on producers using virgin textile fibers. This may differentiate the price between new textile products made from virgin and recycled materials.

A bonus malus scheme has been used for passenger cars, in which cars with good environmental performance (lower carbon emissions) receive a bonus in the form of a premium and cars with poorer environmental performance (higher carbon emissions) receive a malus (SOU, 2016).

obstacles addressed

Currently, it is challenging for reused and recycled textiles to compete with textiles using virgin fibers. Textile recyclers see a lacking demand for recycled textile fibers (Elander & Ljungkvist, 2016). The purpose of an implementation of the bonus malus in the field of textiles is shifting consumption from products with virgin textile fibers to products with recycled textile fibers. The bonus malus system provides economic incentives for textile producers to use recycled textile fibers.

Stakeholders see a lacking consumer demand for textile products with recycled content (Elander & Ljungkvist, 2016). The bonus malus system may differentiate the price between new textile products made from virgin and recycled materials and increase the demand for textile products with recycled content.

critical factors in design

For a bonus-malus scheme to be implemented and successful it is crucial that there are appropriate and measurable criteria to assess recycled content in and quality of new textile products. Certification and registration of companies and products that are to be included in the scheme are also required in order to make it clear as to which textile products or which companies that will receive a bonus and which that are imposed with a malus.

A study conducted by Gustavsson (2015) analyzed a system of bonus malus for textiles; the results show that the fact that textiles are such a heterogeneous product it might be problematic to implement a bonus malus scheme. In order to implement a bonus malus scheme several smaller systems must be introduced. If the system can be divided into smaller systems for different types of textile products, the scheme can be more accurate.

The level of the bonus and the malus respectively must be high enough to differentiate the price between new textile products made from virgin and recycled materials.

risk factors

One disadvantage of an economical instrument as a bonus malus system is that it can lead to undesirable effects if the system is not well designed. A bonus-malus system in the textile industry may be problematic as it is a large industry with several and long supply chains. This can make it difficult to assess which products that can receive a bonus and which products that are imposed with a malus.

conflicts and synergies

With increasing share of recycled content, other factors such as durability and life time of textile products, might be influenced.

affected stakeholders

The actors who are affected by a bonus malus system for recycled/virgin fibers in new textile products are producers, the state and government agencies. Consumers are also affected in that they can benefit from more textiles produced from recycled material.

refunded virgin payments for new textile products

Refunded Virgin Payments (RVP) is a scheme in which textile producers pay a charge for the use of virgin textile fibers in their new textile products. The charge is to be paid per ton textile products sold on the Swedish market. The revenues are (after deduction of administrative costs) returned to the same collective of producers as refunds in proportion to their use of recycled textile fibers. The scheme is designed to increase the use of recycled textile fibers in the production of new textile products. The policy applies for textiles sold in Sweden i.e. produced and exported for sale in Sweden.

RVP is a two-part measure in which polluters first pay a charge for the use of virgin textile fibers. The revenues are then refunded back to the producers who use low amounts of virgin materials in relation to their total production. Producers surpassing their peers, i.e. using more recycled textile fibers, become net receivers of the refund, while producers underperforming, i.e. using more virgin textile fibers, become net payers in the system. As opposed to a bonus malus system, where some producers get a bonus and a malus is levied on other producers, all producers pay the charge for the use of virgin textile fibers.

Each year producers must report how much virgin textile fibers and how much recycled textile fibers were used for production of their textile products sold on the Swedish market (in ton). They also report how much textile products they have sold on the Swedish market in total. The total charge for one company is calculated from the total use of virgin textile fibers for production of its textile products sold on the Swedish market. The refund is calculated by dividing the revenues from the charge with the total amount of textile products sold on the Swedish market. This provides a refund expressed as SEK/ton sold textile (Swedish EPA, 2016). For more detailed information se section (8.4.4).

When the charge is paid, a refund is given to those who have low shares of virgin textile fibers relative to their total sale of textiles. In this way some producers will make a net profit and others will make a net payment (Swedish EPA, 2016).

The system of Refunded Emission Payments is considered to have been successful when applied to the abatement of nitrogen oxides (NO_X) in Sweden (Sterner & Isaksson, 2006).

obstacles addressed

Market prices for virgin textile fibers are low. There is therefore a lack of incentives for producers to use recycled textile fibers in the production of new textile products. RVP stimulate producers to use recycled textile fibers in the production of new textile products by providing economic incentives. A charge on virgin textile fibers in combination with a refund for above average use of

recycled materials provides incentives for producers to reduce the use of virgin fibers and invest in e.g. recycled materials.

critical factors in design

One of the main challenges is to set the right level of the charge so it provides incentives for producers to change their source of raw materials from virgin to recycled textile fibers. The charge should be set to increase the competitiveness of recycled textiles, and thereby level the playing field and correct the market failure.

Setting boundaries for the RVP is important due to the complexity of the (global) textile value chains (e.g. production waste, markets etc.).

Transparency regarding reporting of use of virgin textile fibers and total textile product put om the Swedish market is necessary within the system. Reporting from all companies must be carried out in the same way.

There are possibilities to introduce RVP as a stepwise approach, e.g. starting with net use of virgin textile fibers for a company and subsequently differentiating the system for different textile fiber types and potentially even different product categories.

risk factors

Large and small producers might have different opportunities to influence suppliers and to shift production to higher recycled content.

Producers might choose not to compete for the refunds and simply forward the increased costs from the charge to consumers instead of shifting production to higher recycled content.

conflicts and synergies

A charge primarily supports recycling of textiles, since it is intended to increase the demand for recycled textile fibers in the production of new textile products. There might be a conflict between a RVP scheme and other policy objectives such as e.g. promoting reuse, durability and extended life of textiles.

affected stakeholders

Stakeholders affected by refunded virgin payments to new textile products with recycled content are producers, the state and government agencies. Consumers are affected indirectly, inter alia in that they can benefit from more textiles produced from recycled material.

consumer information on reuse and recycling of textiles

An effective policy requires consumers to be informed about the impacts of their actions, their opportunities to influence these impacts and their role in the system. The benefits of reuse and recycling are aspects that must be considered in order to change consumer behavior, both in the public and private sector.

Consumer information on reuse and recycling of textiles should include general information about textile consumption and use of textiles as well as information regarding collection, sorting, reuse and recycling of used textiles. The information aims to increase demand for reused and recycled textiles (Watson et. al, 2015).

obstacles addressed

Consumers lack knowledge about textile recycling and the environmental benefits that can be achieved from recycled textiles (Elander & Ljungkvist, 2016). Consumer information on reuse and recycling of textiles is expected to correct externalities and incomplete information and thereby lead to reduced environmental impact from the textiles. The increased knowledge is expected to lead to changes in consumer behavior and as such increased demand on reused and recycling textiles.

critical factors in design

The need for information measures varies between different target groups. For the policy to be effective it is important that the information is recurred over a period of several years.

risk factors

Information has shown to merely having small effects on consumer behavior. Consumer knowledge and attitudes regarding environmental issues do not automatically lead to changed behavior (Mont et al., 2013). However, changed attitudes can create acceptance for policies and economic incentives for more sustainable consumption (Hennlock et al., 2015).

conflicts and synergies

In order for information to have an impact and for consumers to actually use their knowledge and take action, other policies have to be implemented in conjunction to information, e.g. in securing better infrastructure for separate collection of textiles. Otherwise there is a risk that consumers get frustrated which can lead to distrust of both the information provided and the actor behind the information.

affected stakeholders

The affected stakeholders are, besides the consumers, those providing the information e.g. municipalities, agencies or producers.

enhanced use of EU and nordic (type 1) labelling for new textile products

A label provides consumers with information about a specific textile product. The market for eco-labelled products has developed and existing eco-labels like the EU Flower, the Nordic Swan and the Swedish Bra Miljöval, have textiles as one of the product groups.

obstacles addressed

Environmental considerations and eco labeling have risen in popularity when it comes to textiles. The Type I labels at EU and Nordic levels already encourage the use of recycled materials. However, their uptake by producers has been rather limited.

The aim is to get more producers to label their textile products that are made from reused or recycled materials. Consumers need information on how to identify sustainable textiles in general and textile products containing recycled textile fibers in particular. Without such information it becomes time consuming and dreary to find such products. Enhanced use of the label will make reused and recycled textiles more visible to consumers and help those interested in purchasing these types of textiles.

critical factors in design

The lack of uptake of Type I labels among textile producers makes it challenging for consumers to find and demand textile products, potentially made from recycled material. An enhanced use of EU and Nordic Type I labels could increase the demand for reused and recycled clothes, (Tekie et. al, 2013).

The use of the labels must be made in a way that is clear and visible to consumers. Consumers also need to be able aware of the information contained in the Type I label.

risk factors

Consumers have previously shown low interest and low general knowledge about eco-labeled textiles. An enhanced use of labelling may therefore have limited effects on these consumer groups. There might also still be a perception among producers that demand is low for labeling reused and recycled of textiles.

Consumers may not know what the labels stand for.

According to Svensk Handel (2014) the clothing industry, primarily works on developing its own brand, and therefore does not use eco-labels to a large extent. This is mainly due the nature of the industry where fashion and short-

term consumption are prioritized, making it difficult to eco- label individual products due to the high costs associated with labeling a product.

conflicts and synergies

Type I labels for textile products at EU and Nordic levels include additional criteria (not only recycled content).

Enhanced use of EU and Nordic Type I eco-labels in combination with information and communication on the environmental damages caused by textile products could increase consumer demand for reused and recycled textile products (Tojo et al., 2012;Tekie et al., 2013).

affected stakeholders

The affected stakeholders are consumers who will be provided with labels for reused and recycled textiles. Producers of recycled textiles will also become more visible for their intended target group, but may also see increased costs due to high costs associated with labeling a product.

labelling requirements for new textile products regarding recycled content

Consumers choose a textile product based on different factors, e.g. price, availability, size, personal preferences and environmental performance. In the current market situation, it is challenging for consumers to know if a textile product contain recycled textile fibers. Labelling of a product provides consumers with relatively easily accessible information about the product.

The purpose of the labelling scheme would be to guide consumers on new textile products containing recycled textile fibers. The labeling can be made using a simple logo with the percentage of recycled textile fibers in the textile product.

obstacles addressed

Inadequate information about textiles made from recycled fibers makes it difficult for consumers to find and demand these types of products. Labelling requirements provide consumers with easily understandable information and can change consumer behavior (Ekvall & Malmheden, 2012). A label for recycled textiles is intended to serve as a framework that ensures that the label follows the promised qualities.

Studies have shown that consumers are not aware of the environmental impact from production of new textiles (Elander & Ljungkvist, 2016). However, also consumers, who are aware of the environmental impact, need information on how to identify sustainable textiles. Labelling requirements for recycled textiles can help consumers interested in purchasing sustainable textiles and potentially contribute to changing consumer preferences.

critical factors in design

A labelling scheme needs to be visible and communicated to the public to have an effect. Few consumers take the time to look for more information than that stated on the product.

Advertising of the label is crucial to ensure that consumers understand and recognize the label.

risk factors

Recycled content in textile products is seldom a consumer preference with high priority. For some consumer groups, preferences regarding textiles are very much linked to current trends in fashion. This means that many consumers are inclined to purchase new products regardless of the availability of recycled textiles or if recycled textiles are labeled. Changing consumption patterns is a time consuming process.

conflicts and synergies

Consumer knowledge on the environmental impact from textile products is limited. Labeling in combination with information and communication on the environmental damages caused by textile products could increase consumer demand for textile products made from recycled fibers (Tojo et al., 2012; Tekie et al., 2013).

affected stakeholders

The affected stakeholders are consumers who will be provided with be better information about recycled textiles. Producers of recycled textiles will also become more visible for their intended target group, but may also be affected by increased costs associated with labelling products. Favorable response in markets would lead to long-term supply contracts for high-quality recycled textiles.

material exchange platform for used textiles for recycling

Elander & Ljungkvist (2016) identified a lack of coordination and exchange of information in the textile value chain as a critical factor for increased fiber-to-fiber recycling. An efficient market requires good access to information about both supply and demand. Making information regarding collected, sorted and recycled textiles as well as input-specifications for different recycling processes practically available for potential suppliers and buyers could therefore contribute to a better functioning market for these materials.

An efficient flow of information between suppliers and buyers might be established through a web-based material exchange site. This would allow suppliers to find a wider number of buyers. It would also enable suppliers to collect, sort and/or recycle the used textiles in a way that it better meets the expectations and needs of the buyers, potentially increasing the value of the produced materials.

The material exchange platform should include information both on quantity and quality, e.g. tonnage, origin, level of sorting, fiber type, etc.

The policy aims to increase the use of recycled textile fibers for the production of new textile products.

obstacles addressed

Textile sorters consider the low demand for recyclable textiles as a major critical factor for increased fiber-to-fiber recycling as they have problems finding buyers and achieving high value for their sorted textiles for recycling. Fashion companies, on the other hand, need large volumes of recycled textile fibers with high and homogenous quality in order to use recycled fibers to a larger degree. Put in other words, the fashion industry state that there exists a high demand for recycled fibers, the problem is the supply and sorters argue the contrary (Elander & Ljungkvist, 2016).

This lack of information between sorters and the fashion industry creates market inefficiencies. A website for material exchange can be effective in reducing this inefficiency an increasing the use of recycled textiles. This policy measure can address both surplus and post user textile waste.

There is a need for increased coordination and exchange of information across the textile value chain. A market exchange platform can help stakeholders achieve a more circular value chain for textiles.

critical factors in design

An important aspect for a market exchange platform to facilitate the exchange and resale of collected, sorted and recycled used textiles is the proof of quality of traded materials. Buyers need to be assured that materials are matching their demands and needs. To ensure this third party assurance is fundamental to allow this system to function.

risk factors

There is little experience with this type of market and could thus create a situation where the intended actors do not want to participate. The observed difficulties from other material exchange sites have shown that companies have been reluctant to provide information regarding their volumes (Swedish Transport Administration, 2011).

It will likely take time to build and operate an information exchange scheme. The service also have to be advertised in order to reach a critical mass of users. The lack of experience with this type of measure requires that there is enough resources to provide information (e.g. trough marketing) about the availability of the market exchange platform. The lack of resources may otherwise hinder the market from having enough users to get enough volumes of recyclable textiles (Swedish Transport Administration, 2011).

conflicts and synergies

A wide use of the market exchange platform can contribute to better statistical data for authorities, although this is rather a side effect of the primary aim.

affected stakeholders

Affected stakeholders are collectors, sorters, recyclers and producers (fashion industry); collectors, sorters and recyclers as potential suppliers of material and sorters, recyclers and producers as potential buyers of material.

The exchange site can e.g. be initiated by national authorities but could potentially be taken over by private interests later.

mandatory system for extended producer responsibility (EPR) for textiles

The concept of extended producer responsibility (EPR) addressing specifically the environmental improvement of the end-of-life phase of products seeks to achieve two goals:

1. *Upstream improvements*
   Improvement of the design of products and product systems, to reduce products' end-of-life environmental impacts at source

2. *Downstream improvements*
   Enhanced resource efficiency via effective collection, better reuse and recycling as well as environmentally sound treatment of end-of-life products

A mandatory EPR system can be designed having in mind these goals, as well as the characteristics of textile products. It can include the following elements:

- *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.

- *Financing mechanisms that reflect the actual cost of recycling specific fibers*
  In case the system for take-back (collection, sorting, preparation for reuse and recycling) is run collectively in collaboration with other 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).

- *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.

- *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, we propose that 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.

- *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 also by other actors involved in collection.

- *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 b) 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.

- *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.

- *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.

- *Mandatory Nature*

  In order to establish a level playing field for all the involved actors, we propose a mandatory system, instead of a voluntary system.

obstacles addressed

Compared to a voluntary approach (se section 4.10), a mandatory EPR system provides a level playing field for all the producers. Take-back requirements starting from collection, waste diversion targets, collection convenience and information requirements, as well as requirements to consult with existing actors, seek to enhanced collection of used textile products, a prerequisite for closure of material loop. Preparation for reuse/recycling targets and suggested financial mechanisms that reflect the actual cost of recycling specific fibers address both upstream improvements and downstream improvements.

critical factors in design

A crucial element of an EPR system is to clarify the responsibility as well as the ownership of used textile products/textile waste. One of the recurring issues in existing EPR system is who should be responsible for collection. A typical entity coming into collection is municipalities, who had the “monopoly” over municipal solid waste. While municipalities are suited for collection of EPR products for various reasons (e.g. citizens’ familiarity to municipality’s waste collection systems, their expertise in collection), existing examples – most notably “blue-

box system" in Ontario, Canada – indicates that systems that leave only physical responsibility to municipalities while having producers responsible for financing the collection either fully or partially has faced various challenges. In this proposal, therefore, we put the whole responsibility for collection on producers, who also have a stake in recovering fiber in light of scarcity of virgin materials.

Preparation for reuse/recycling targets, as well as financing mechanisms that reflects the actual cost of recycling specific fibers, is another critical element, in order to address both upstream improvements and downstream improvements. If producers become responsible for the achievement, they have a natural reason to invest in both areas. Important is the cost differentiation depending on the ease of conducting fiber to fiber recycling, as found in the system for recycling of packaging in some countries. Government plays an important role in ensuring that rules are written clearly and in monitoring the implementation of relevant actors.

risk factors

Reflecting upon experiences with EPR systems for other products such as electrical and electronic equipment and packaging, as well as existing collection systems for textiles, an issue that requires consideration is the value of end-of-life textiles. Textiles collected in, for instance, containers set up by charity organizations have already experienced thefts. If all the stolen end-of-life textiles are reused, it is not per se a problem from the environmental point of view. However, if some of the stolen textiles, with low or no value in the second hand market, are simply discarded, the opportunity for fiber-to-fiber recycling will be lost. In addition, lack of availability of fibers potentially recovered would discourage producers' investment in enhancing fiber-to-fiber recycling.

conflicts and synergies

A mandatory EPR system contains a number of elements that could have synergies with other measures, such as labelling schemes for recycled fibers, which enhances achievement of recycling target. It contains elements of information provision to consumers regarding recycling.

Care should be made so that existing actors and producers have various venues to discuss how to "co-exist" in a sustainable manner.

affected stakeholders

Producers, municipalities, second-hand market actors, municipalities, consumers, authorities.

voluntary system for extended producer responsibility (EPR) for textiles

The concept of extended producer responsibility (EPR) addressing specifically the environmental improvement of the end-of-life phase of products seeks to achieve two goals:

1. *Upstream improvements*
   Improvement of the design of products and product systems, to reduce products' end-of-life environmental impacts at source

2. *Downstream improvements*
   Enhanced resource efficiency via effective collection, better reuse and recycling as well as environmentally sound treatment of end-of-life products

A voluntary EPR system can, as a mandatory EPR system, be designed having in mind these goals, as well as the characteristics of textile products. Potential elements of a voluntary EPR system are:

- *Take-back initiatives*
  Producers (manufacturers and importers who put the product on the market in question for the first time) will set up a system for collection, sorting, preparation for reuse and recycling of textiles. This can be done either individually, or in collaboration with other producers and other entities in society.

- *Financing mechanisms that reflect the actual cost of specific fibers*
  In case a system is run collectively in collaboration with other producers, the financial mechanisms could be set in such a way to reflect the actual cost of conducting fiber-to-fiber recycling of specific fiber.

- *R&D budget to enhance sorting of textile waste and recycling textile fibers*
  If producers would agree as a common benefit, with or without having a collective system, they could work jointly to support R&D to find new solutions for sorting various types of end-of-life textiles, as well as for recycling textile fibers, including the detection of materials, chemicals and combination of materials in the recovered textiles.

- *Means to enhance collection from consumers*
  Producers will find solutions to enhance collection of end-of-life textiles from consumers. A number of producers who already set up a system have their collection system in their shops. Whether there are other ways of collecting end-of-life textiles could be discussed, especially when producers set up a system in collaboration with other producers. Some

producers who have a collection system in place also provide some financial incentives to the consumers who bring back the products in the form of, for instance, vouchers. Information that enhance the participation of consumers in collection and sorting (e.g. location of collection sites, what needs to be sorted), as well as why they are working on the initiatives, should be provided to the consumers.

- *Voluntary preparation for reuse/recycling targets*
  As a way of measuring the progress of product reuse as well as recycling technology producers can set a preparation for reuse/recycling targets, which consist of reuse of the whole products or its part and fiber-to-fiber recycling. The recycling targets should be increased over time to enhance the innovation in the product design (e.g. types of fibers used, composition), as well as in the end-of-life technologies (e.g. fiber identification, sorting, recycling). Rules regarding how to count the reuse/recycling targets must be agreed upon among the producers.

- *Consultation with existing actors*
  When setting up collection and recycling systems, producers are strongly encouraged to consult with existing actors who have been carrying out collection of reusable textile products as well as textile waste. Such actors include, among others, second-hand shops and municipalities.

- *Communication platform between producers, policy makers and other relevant actors on phasing out unwanted substances in production and design for recycling*
  In order to enhance communication between actors and share knowledge and experiences, producers can initiate a communication platform where producers can discuss with policy makers as well as other related stakeholders (e.g. producers of chemicals, material suppliers) means to phase out unwanted substances in production and enhance design for recycling.

obstacles addressed

Various means are suggested to enhance collection of end-of-life textiles, which is a prerequisite for closure of the textile material loop. The communication platform addresses lack of information exchange among various actors involved in the reuse and fiber-to-fiber recycling, which is identified as one of the major shortcomings of the current situation. Reuse and recycling targets, together with the suggested financial mechanism, would help enhance both upstream improvements and downstream improvements.

critical factors in design

Similarly to the mandatory EPR system (see section 4.9), one of the important issues to consider is actors currently involved in collection. In addition to the municipalities who have been collecting textile waste (though not sorted from the rest of the waste stream in most cases), actors in second hand market are also collecting the end-of-life textile for reuse and, in some cases, recycling. Communication with these actors so as to – probably most importantly – not to confuse consumers and bring forward real environmental gains, is critical.

Preparation for reuse/recycling targets, as well as financing mechanisms proposed, is another critical element, in order to address both upstream improvements and downstream improvements. If producers become engaged in achieving the targets, they would see reasons to invest in both areas. Important is the cost differentiation depending on the ease of conducting fiber to fiber recycling, as found in the system for recycling of packaging in some countries.

risk factors

As the participation in the EPR system is voluntary, participants may face some financial disadvantage. Non participants may enjoy the benefit of, for example, the development of sorting and recycling technology without having to pay for it.

Care should be made so that existing actors and producers have various venues to discuss how to "co-exist" in a sustainable manner.

conflicts and synergies

The voluntary EPR system could contain a number of elements that can enjoy synergies with other measures, such as labelling schemes for recycled fibers and consumer information.

affected stakeholders

Producers, second-hand market actors, municipalities, consumers, authorities.

appendix 3

stakeholders' view on important aspects to consider in the design of policy measures promoting fiber-to-fiber recycling of textiles

At the policy workshop carried out as part of the research stakeholders discussed what aspects of the ten different policy measures in the shortlist (see section 4) would be "nice to haves", i.e. beneficial to include in the policy measure, and "deal breakers", i.e. if this is not addressed the policy measure falls. Some of the aspects that the stakeholder consider important to cover in regard of the policy measures are listed below:

1. **Green public procurement**
   - Information in/from the supply chain (deal breaker)
   - Reduce costs for labelling to ease defining demands
   - Changes to the EU regulation on textile fiber names and related labelling and marking of the fiber composition of textile products (1007/2011/EU)

2. **convenience requirements for collection**
   - consultation and involvement of existing collectors (deal breaker)
   - responsibility for high standards in handling of the collected used textiles (deal breaker)
   - distribution of costs for collection (deal breaker)

3. **bonus malus for recycled/virgin textile fibers**
   - monitoring and control
   - reporting

4. **refunded virgin payments**
   - definition of recycled content (deal breaker)
   - distinction between pre- and post-consumer recycling
   - transparency of the environmental impacts of using recycled textile fibers compared to virgin textile fibers

5. **consumer information**
   - quality standards for communicated information based on science and data (deal breaker)
   - need for additional policy measures (deal breaker)

6. **type 1 eco-labelling of textile products**
   - inclusion of recyclability and durability criteria (deal breaker)

- guidance and support for achieving the labelling standards
- financial support for labelling costs

7. **recycled content labelling**
   - control of the accuracy and correctness of the recycled content stated on the labels (deal breaker)
   - ease of reading the tag (deal breaker)

8. **material exchange platform**
   - define clear application area for the platform (deal breaker)
   - transparency in the supply chain (deal breaker)
   - model for financing the platform
   - handling chemical content

9. **mandatory EPR**
   - Minimum quality criteria for producer responsibility organizations (deal breaker)
   - Certification of involved actors (deal breaker)
   - Logistics for collection and sorting (deal breaker)
   - Cooperation between different actors in the value chain

10. **voluntary EPR**
    - Clarity regarding the ownership of the collected used textiles (deal breaker)

appendix 4

extended producer responsibility as a general policy approach

This appendix gives a short introduction to extended producer responsibility (EPR) as a general policy approach.

what is extended producer responsibility?

The concept of EPR was first coined and defined by Lindhqvist & Lidgren (1990) in a report submitted to the Swedish Ministry of Environment (Miljödepartement, 1991). Reflecting upon the view of, among others, Davis (1994) who suggested EPR as a policy principle – positioned higher than an approach in the hierarchy of governmental policy making – Lindhqvist (2000) further developed the original definition, as

> *"a policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the product's life cycle, and especially to the take-back, recovery and final disposal of the product"*

The development of the concept was stimulated by several existing policy measures, e.g. packaging waste legislation in Germany and the Netherlands, the deposit refund system in Sweden and some states in the United States. It reflects general trends in environmental policy making, such as prioritization of preventative measures over end-of-pipe solutions, life-cycle thinking, shift from command-and-control approaches to non-prescriptive, goal-oriented policy making and incorporation of incentive mechanisms (Tojo N. , 2004).

The Organisation for Economic Co-operation and Development (OECD), in their renewed guidance manual for EPR released in 2016, retained its definition in its original guidance published in 2001, as "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle." It further clarifies that EPR carries two objectives: "i) to shift responsibility upstream to the producer and away from municipalities and ii) to incentivize producers to incorporate environmental considerations in the design of their products" (OECD, 2016a)

To date, the concept has been applied predominantly to the end-of-life phase of products, the weakest link to the producers in the product chain (Kroepelien, 2000). These EPR-based policies have potential to improve the end-of-life

environmental performance of products by inducing changes both *upstream* (design of products and systems surrounding the products) and *downstream* (effective collection, increased reuse and recycling and more environmentally sound treatment). By making producers responsible for their own products, the EPR-based policies seek to provide *incentives and feedback* to the producers so that products they put on the market have better potential for material loop closure and are environmentally less burdensome.

Reflecting on the nature of the current production and consumption system, EPR programs consider both *domestic manufacturers and importers* of products – those who put the products on the market the first time in the given market – as producers.

concrete design and implementation of EPR programs vary significantly

Starting from packaging in the 1990s, a number of OECD countries, and increasingly non-OECD countries, have introduced EPR programs for end-of-life management of products such as cars, electrical and electronic equipment (EEE), batteries and the like. Other products subject to EPR include tires, pharmaceuticals, used oils and the like. Meanwhile, the actual formulation and implementation of the programs can vary significantly, from one product to another and from one country to another. Differences are e.g. found in the extent to which the responsibilities of the producers are extended, policy measures incorporated in an EPR program, level of coerciveness, concrete means for producers to carry out their responsibility etc.

The extension of responsibilities given to the producers can be considered based on the types of responsibilities extended and various activities constituting end-of-life management. Responsibilities can be categorized into physical responsibility, economic (financial) responsibility, informative responsibility and liability (Lindhqvist, 1992). Regarding end-of-life management activities, it can be divided into collection, sorting, reuse/recycling, treatment of the residues and transport between the activities (Tojo N. , 2004). One of the most common discussion points regarding the extension of responsibility (and who should be responsible for the other activities necessary for the system to function) is the physical and financial responsibility for collection.

The concept of EPR could be implemented via administrative, economic, or informative instruments (Lindhqvist, 1992), and an EPR program typically comprises of a number of them (Tojo N. , 2004). Table 17 below provides examples of three different types of policy measures which have been used in existing EPR systems.

Table 17 Examples of EPR-based policy measures (Tojo N. , 2004)

Administrative instruments	• Collection and/or take-back of discarded products • Substance and landfill restrictions* • Achievement of collection • Reuse (refill) and recycling targets • Fulfilment of environmentally sound treatment standards • Fulfilment of minimum recycled material content standards • Product standard, utilization mandates**
Economic instruments	• Material/product taxes • Subsidies • Advance disposal fee systems • Deposit-refund systems • Upstream combined tax/subsidies • Tradable recycling credits
Informative instruments	• Reporting to authorities • Marking/labelling of products and components • Consultation with local governments about the collection network • Information provision to consumers about producer responsibility/source separation • Information provision to recyclers about the structure and substances used in products

* *Some exclude substance and landfill bans from EPR-based policy measures.*

** *Utilization mandates refer to the situation where producers should achieve certain reuse and /or recycling targets, but do not have to use them within their own activities.*

While the vast majority of the existing EPR programs includes take-back requirements (OECD, 2016a), the combination with the rest of the policy measures differs from one EPR program to the other.

In terms of coerciveness, most existing EPR programs have been mandatory. Even when a program started as a voluntary program, introduction of a mandatory system was requested by industry to secure a level playing field (e.g. EPR for EEE in Switzerland, see Tojo (2004).

The degree of collaboration between producers in fulfilling their responsibility is another important point where differences are found in the implementation of EPR programs. The difference is often termed individual vs. collective responsibility. It is a question of whether "a producer takes responsibility for the end-of-life management of their own products (individual responsibility) or producers in the same product group together fulfill their responsibility for the end-of-life management of their products regardless of their brands (collective responsibility)" (Tojo N. , 2004). In many of the existing EPR systems today,

producers manage end-of-life products jointly through a so-called Producer Responsibility Organization (PRO), which carry out producers' responsibility related to end-of-life management on their behalf (OECD, 2016a). However, while there are economic and environmental advantages of managing the physical flow of end-of-life products collectively in many cases, in order to provide incentives for upstream changes, it is crucial to find a mechanism in which individual producers to pay for the end-of-life management of their own products (Tojo N. , 2004). In this regard, how to establish a financial mechanism within a collectively organized system plays a very important role.

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appendix 5

overview of the swedish NOx charge

The RVP system described in section 8 is inspired by the Swedish NO_x charge. This annex gives a short overview and introduction to the NO_x charge.

In 1992 a refunded emission payments program (REP) was introduced in Sweden with the aim to control NOx emissions from large combustion plants. The REP was a complementary policy to the individual emission standard for NOx emission, which was introduced in 1988 (Bonilla et al., 2015). The policy was designed to affect technology adoption and was considered to achieve this at a faster and more cost-efficient way (Naturvårdsverket, 2003). In this system funds were refunded back to the regulated plants in proportion to energy output.

In order to implement the NOx charge a measurement of the flue gas was required by the plants. However, the installation of the measuring equipment was deemed too costly for smaller plants (Sterner & Isaksson, 2006). The scheme included all large combustion plants producing at least 50 GWh of useful energy per year. In 1992, this included 124 plants and 181 boilers. In 1996, the scheme was broadened to include plants producing at least 40 GWh and in 1997 the charge system was expanded even further to include plants producing at least 25 GWh. By 2015 there were 272 plants and 401 boilers included in the scheme.

The declaration of NOx emissions is submitted by January 25th of the year following production. The plants that have to pay the charge receive a bill at the end of August and have to pay by the end of October. When the bills are paid, the money is distributed out to those who have low emissions relative to their energy production. The funds are usually paid out in November or December. A fine is levied, according to the Swedish tax law, on those who do not pay the fine in time. The fine has rarely been used as the companies usually pay in time. In cases when the bills have not been paid in time, there have been administrative problems e.g. the Swedish EPA may not have had the correct address to the companies.

When the policy was introduced the tax was set to 40 SEK/kg NOx and it remained at this level until 2008 when it was increased to 50 SEK/kg NOx. The scheme is managed by the Swedish EPA at a small administrative cost of about 0.2–0.3 percent (ca 6 million SEK in 2015) of the revenues (Sterner & Isaksson, 2006). The entire, remaining, revenue of about 560 million SEK, in 2015, is refunded back in proportion to output of useful energy.

An evaluation of the policy shows that emissions of NOx per unit of energy produced has continued to decrease since the introduction of the charge in 1992 (Naturvårdsverket, 2012). However, the evaluation also shows that the increase of the charge, to 50 SEK/kg NOx, has not contributed to an accelerated reduction of NOx emissions. Rather the results show that emissions have increased since 2008. This is mainly due to an overall increase in the Swedish economy which as a result increased energy production. In addition, although the NOx charge and refund system provides firms to reduce NOx emission, it also stimulates the production of energy in the plants, which in turn increases total NOx emissions.

Furthermore, the increase of the charge (to 50 SEK/kg NOx) was not according to inflation. In real terms the charge had decreased over time and the increase was in practice a restoration of the charge to the real level in 1992. Thus, the increased charge was not an increase in the real value of the charge.

A fair and transparent system requires that all firms use the same method and provide their data in the same way. The Swedish EPA provided regulations that specified the necessary requirements for a measuring device to be approved as a continuous measurement of NOx emissions. This includes recording, processing and storing data from the measurements. The plants conduct the measurements and calculations and then report these to the Swedish EPA.

To guarantee that the system is fair, the Swedish EPA conducts audits of 20-50 plants each year. During the audits the Swedish EPA controls that the visited plants conduct their measurements and calculations correctly. Furthermore, at least once a year the quality of the measuring equipment is checked. This is conducted by comparing the plants measurements with measurements performed by an accredited laboratory.

The annual cost of operation, maintenance, data acquisition and data processing for the measurement systems is approximately 100 000 SEK for an average plant. Investment cost of measurement equipment for NOx emissions are between 250 000 and 300 000 SEK (Naturvårdsverket, 2003)). In addition, there are costs for devices such as computers, software, etc. For many plants, the installation of measuring equipment also requires reconstruction, which can lead to significantly higher costs. Sterner (2003) estimates the costs of measuring NOx emissions to be about three percent of the total amount of fees paid by the collective plants.

appendix 6

stakeholder views on policy measures promoting reuse and recycling of textiles

introduction

As part of Mistra Future Fashion IVL Swedish Environmental Research Institute (IVL), International Institute for Industrial Environmental Economics (IIIEE) and PlanMiljø are carrying out impact assessment of policy measures promoting reuse and recycling. Two policy measures have been selected for impact assessment:

- Refunded virgin payment system
- Mandatory extended producer responsibility system

This questionnaire aims at collecting stakeholder views on aspects relevant for the design of these two policy measures (reality check).

refunded virgin payment (RVP) system

Companies putting clothes and household textiles on the Swedish market pay a charge (virgin payment) for all textiles that do not have a minimum content of recycled fibers. The sum of the virgin payments is refunded back to the same collective of companies based on the total amount of textiles they put on the Swedish market. Companies using over average recycled content in their products become net receivers of refunds whereas companies using less than average recycled content in their products become net payers in the system.

The policy measure is an economic instrument providing incentives for companies to increase the use of recycled textile fibers in the production of new textile products. The objective is to increase the demand for and use of recycled textile fibers.

1. How do you generally evaluate the potential of the RVP system to contribute to increased fiber-to-fiber recycling of textiles (independent of specific design criteria)?

No / low potential	Medium potential	High potential	I have no opinion

2. What level of targets (ambition levels) do you consider realistic regarding recycled content in clothes and household textiles by 2025?

	0 %	5 %	10 %	15 %	20 %	25 %	30 %	35 %	40 %	45 %	50 %	I have no opinion
Cotton												
Polyester												
Wool												
Acrylic												
Polyamid (nylon)												

3. If a RVP system was introduced for clothes and household textiles, how should it in your opinion be introduced in terms of the structure?

A general RVP charge independent of textile fiber type, i.e. same charge for all textiles	A differentiated RVP charge according to different fiber types, i.e. different charges for textiles made from different textile fibers	I have no opinion

4. If a RVP system was introduced for clothes and household textiles, what level of RVP charge would in your opinion be realistic and give textile companies sufficient incentives to use more recycled fibers in new textile products?

10-20% of product price	21-30% of product price	31-40% of product price	More than 40% of product price	I have no opinion

comments

Do you have any comments and reflections regarding the RVP system?

mandatory extended producer responsibility (EPR) system

The mandatory system for extended producer responsibility (EPR) envisioned in this project includes all companies and brands (including importers) putting clothes and household textiles on the Swedish market. It provides a level playing field for all producers and consists of the following components:

- *take-back requirements*
- *financing mechanisms that reflect the actual cost of fiber-to-fiber recycling of specific fibers*
- *waste diversion targets*
- *collection convenience requirements*
- *reuse and recycling targets*
- *information to consumers, consultation with existing actors and monitoring and control.*

Note that this EPR system contains more elements than the EPR system proposed by the Swedish EPA. In line with the original aspiration of the EPR concept, the suggested system seeks to enhance closure of material by inducing changes both upstream (i.e. design and production phase) and downstream (i.e. end-of-life phase).

5. In your view, how realistic it is to charge producers based on the actual cost of fiber-to-fiber recycling of specific fibers (e.g. cotton, wool, polyester, nylon, mixed fibers) in the coming five years?

No realistic	Fairly realistic	Very realistic	I have no opinion

6. What level of reuse/recycling (consist of reuse of the whole products or its part and fiber-to-fiber recycling) is needed for 2025, in order to induce innovation in the product design (e.g. types of fibers used, composition), as well as in the end-of-life technologies (e.g. fiber identification, sorting, recycling)?

	0 %	5 %	10 %	15 %	20 %	25 %	30 %	35 %	40 %	45 %	50 %	I have no opinion
Overall target												
Cotton												
Wool												
Polyester												
Polyamid												
Acrylic												
Mixed fibers												

7. In a mandatory EPR system in Sweden, who should be the main entity responsible for organizing the collection of clothes and household textiles whose current owner from households wishes to give away or discard? In the system suggested by the research team, organization of collection also involves fulfillment of convenience requirements (i.e. the collection sites are situated within 1 km from the households, and if 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, collection via vehicle several times a year). Collection should be at least free of charge for households.

	clothes and household textiles for REUSE	clothes and household textiles for RECYCLING
Suppliers of the product (producers, importers, retailers)		
Municipalities		
Existing second-hand market actors (e.g. charity organization)		
Other (please specify)		

8. The Mandatory EPR system in Sweden suggested by the research team includes a number of components. What is your view on the inclusion of the respective components?

	Essential	Good to include	Not necessary	Should not included	I have no opinion
take-back requirements on producers					
financing mechanisms that reflect the actual cost of fiber-to-fiber recycling of specific fibers					
waste diversion targets (60% by 2025)					
collection convenience requirements					
reuse and recycling targets					
Mandatory information provision to consumers					
consultation with existing actors engaged in reuse/recycling of textiles					
monitoring and control by government					

comments

Do you have any comments and reflections regarding the mandatory EPR system?

Thank you!

We really appreciate the time you spent on this survey. THANK YOU!

We will use your input as a reality check of the research on potential policy measures for increasing resource efficiency in the textile value chain carried out

so far in Mistra Future Fashion. It will also be used for the development of policy scenarios with respect to Sweden and the Swedish fashion industry. This work will start in January 2017.

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Mistra Future Fashion is a research program that focuses on how to turn today's fashion industry and consumer habits toward sustainable fashion and behavior. Guided by the principles of the circular economy model, the program operates cross disciplinary and involves 50+ partners from the fashion ecosystem. Its unique system perspective combines new methods for design, production, use and recycling with relevant aspects such as new business models, policies, consumer science, life-cycle-assessments, system analysis, chemistry, engineering etc.

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