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- short abstract -

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

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Short abstract of full Mistra Future Fashion report

Titel: Impact assessment of policies promoting fiber-to-fiber recycling of textiles (2017)
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Images: Pixabay
Layout: Charlotte Neckmar, Sigrid Barnekow

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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.

policy 1: swedish mandatory extended producer responsibility (EPR) for textiles

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

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overall policy effects

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:

• Take-back requirements •Financing mechanisms that reflect the actual cost of re-cycling 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

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

Policy goals:	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

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.

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.

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.

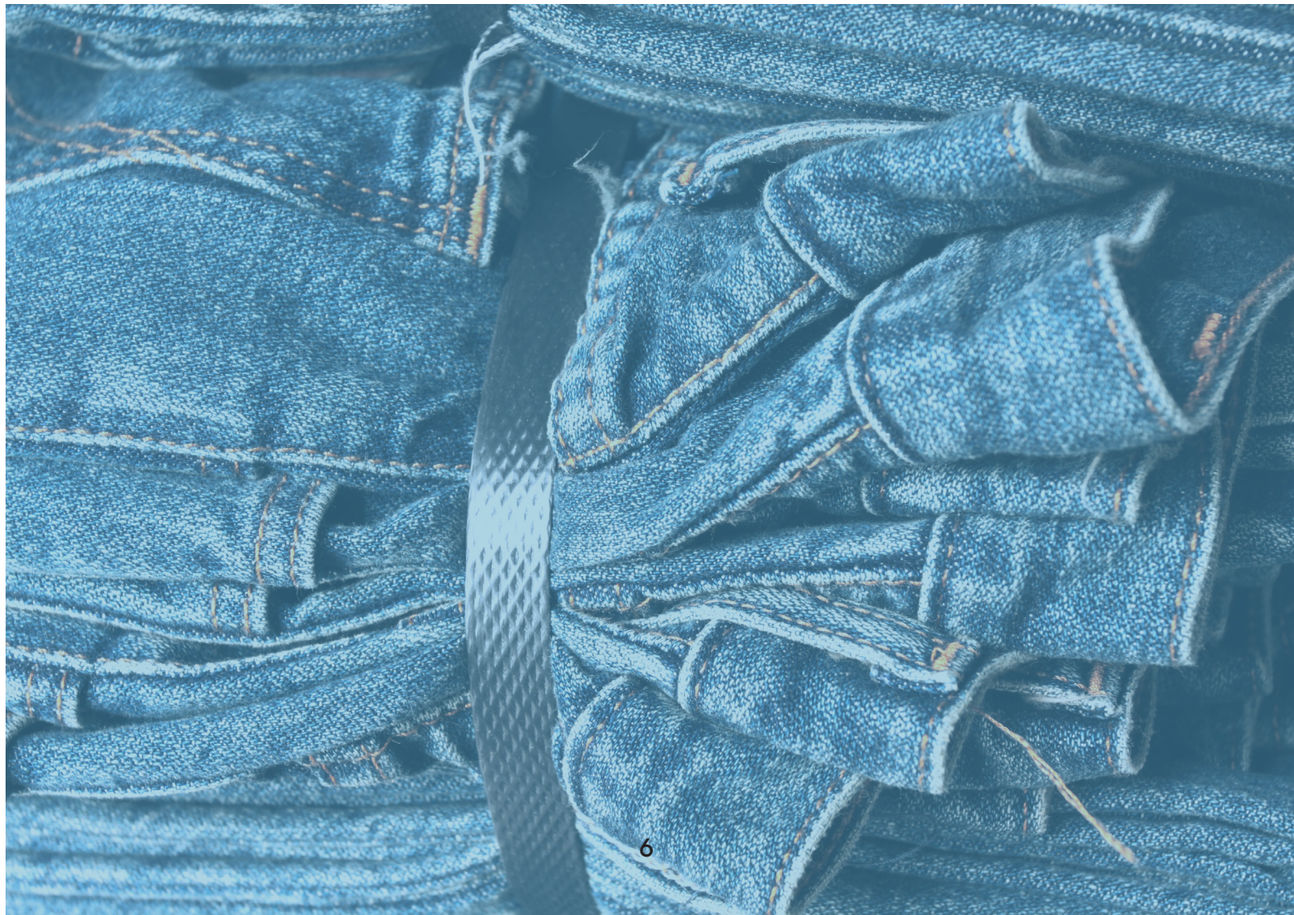
In order to close the material loops, the essential first step is capturing sufficient amount of used textile products. This is especially important in order to provide enough incentives and signals to the market to invest further on technologies enabling fiber-to-fiber recycling. In addition to take-back 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, Producer responsibility organizations (PRO) 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.



policy 2: refunded virgin payments (RVP)

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

overall policy effects

The expected impacts on the eight identified policy goals:

Policy goals:	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*

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.

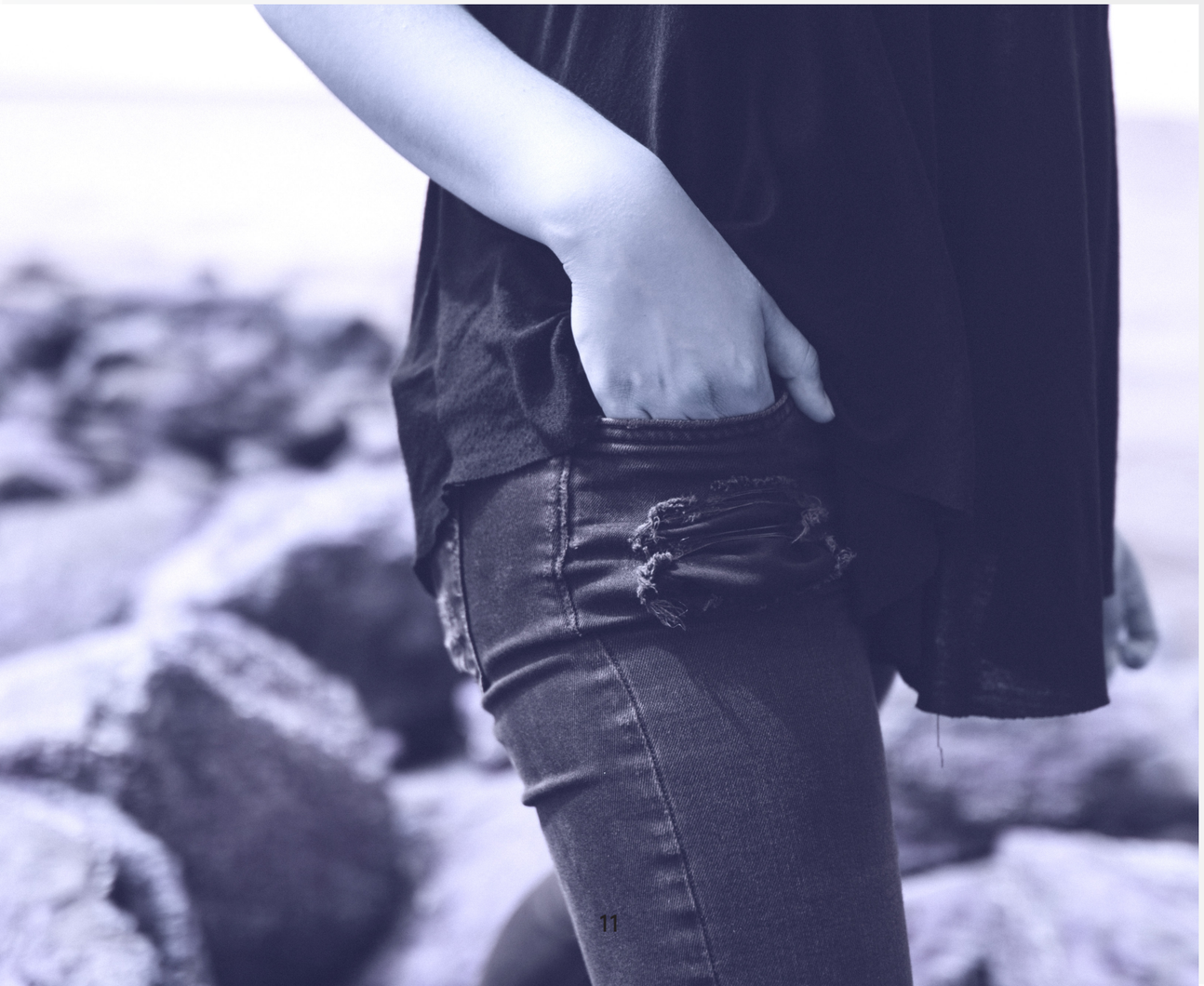
Available data regarding textiles put on the Swedish market is based on Statistic Sweden's data on foreign trade (exports and imports of goods) and on industrial production of goods. These data are roughly collected based on textile fiber types, but do not differentiate different mixed of fiber types 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 (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.



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. 19 respondents answered the questionnaire, representing a response rate of 30 percent.

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.

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.

overall 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. 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.

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, the RVP system must be complemented by additional policy measures in order to contribute to all stated policy goals.

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.

MISTRA is the initiator and primary funder covering the years 2011-2019. It is hosted by RISE Research Institutes of Sweden in collaboration with 13 research partners.

FUNDED BY
MISTRA
The Swedish Foundation for Strategic Environmental Research

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