

Project praxpack

CAN REUSABLE PACKAGING CONTRIBUTE TO MAKE E-COMMERCE MORE SUSTAINABLE?

An overview of challenges and potential
selected results from the project „praxPACK“ -
two+ years of research in Germany

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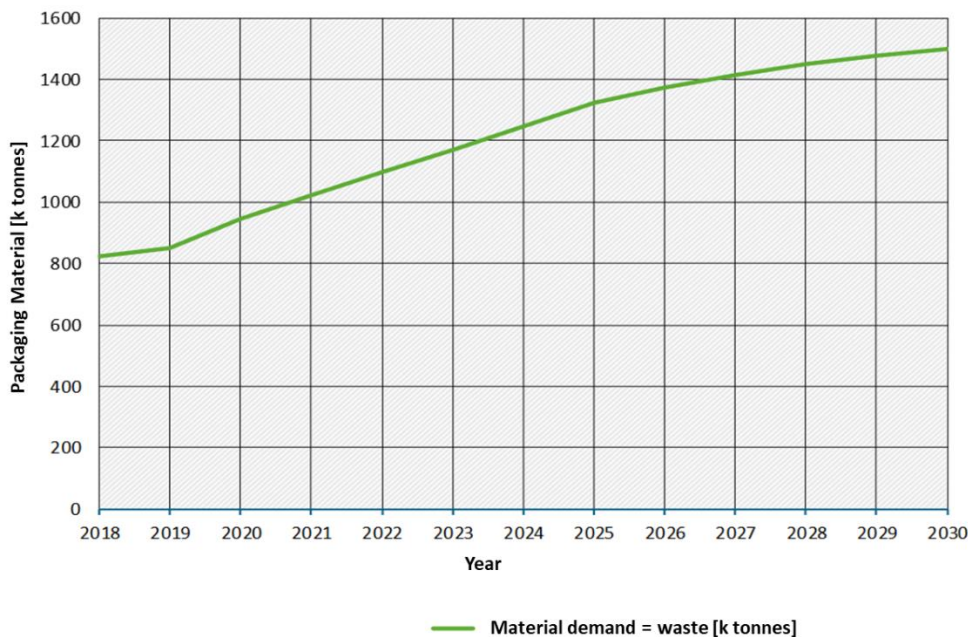
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1 Introduction

E-Commerce in Germany and Europe has been showing continuous growth for years. Products sold in e-commerce are mostly packed in single-use shipping packaging, which is disposed of upon receipt of the goods. This linear packaging system leads to a high consumption of resources and corresponding amounts of waste. Current studies on e-commerce (Zimmermann et al. 2021; Reitz 2021, 2020) show that private end consumers in Germany produced over 750,000 tonnes of paper, cardboard or paperboard packaging and over 50,000 tonnes of plastic packaging in 2018. In 2021, the threshold of one million tonnes of shipping packaging waste is likely to have been exceeded, as shown in Figure 1.

Figure 1: Development of shipping packaging waste in Germany



(Zimmermann et al. 2021; Reitz 2021)

From 2020 onwards, the growth has accelerated due to the Corona pandemic. If the trend of steadily increasing resource consumption and corresponding amounts of waste in this area is to be broken, innovative solutions at the logistics system level and adjustments to business models will be required.

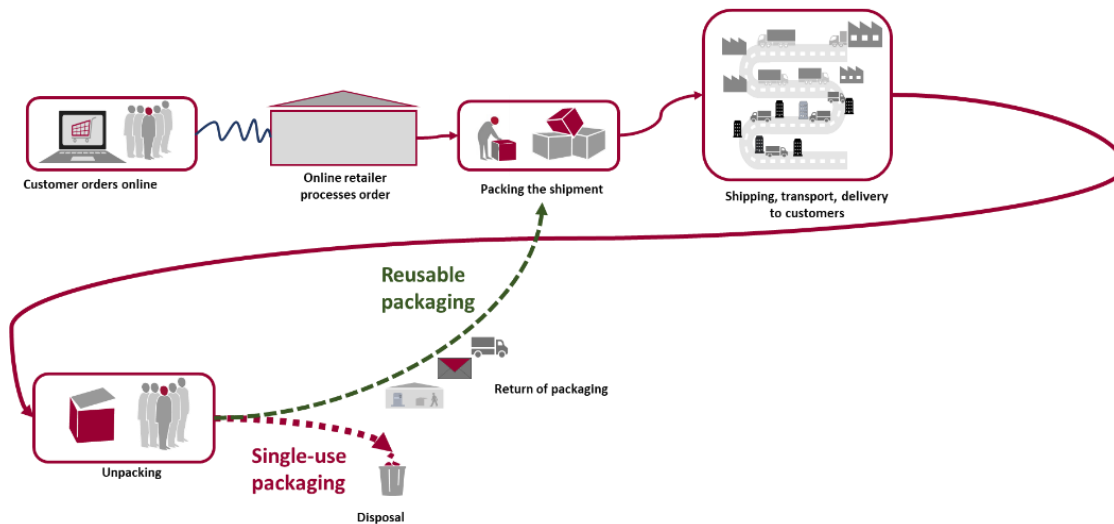
Here the “praxPACK” project comes in: The aim of the project is to contribute to the establishment and distribution of reusable systems in e-commerce in order to achieve a substantial reduction of packaging-related resource consumption – and associated waste quantities. For this purpose, practical reusable concepts in e-commerce have been developed, tested and evaluated environmentally as well as economically.

Based on the last two years of research, this article provides insights into key findings from the project praxpack regarding the economic and environmental perspectives as well as the customer perspective of reusable packaging in e-commerce.

1.1 Situation

As outlined above, the packaging practice in e-commerce is almost exclusively linear. The products are packed in single-use packaging, delivered to the customer who unpacks the products and disposes of the packaging, as illustrated in Figure 2. For reusable packaging the packaging needs to be returned to (depending on the system) the same or another online retailer who will reuse it.

Figure 2: Packaging models in e-commerce- single-use vs. reusable



So far, there is a limited number of reusable packaging solutions available differing in the complexity of the solution (Zimmermann and Falkenstein 2021a, 2021b, 2021d, 2021e; Rödiger et al. 2020; Mission Reuse 2021). Only a few solutions are not limited to the provision of packaging but also provide a system for return logistics of the packaging. RePack is an example for such a system (RePack 2020; Zimmermann and Falkenstein 2021d) which is so far the most used B2C reusable packaging solution in Germany in terms of the number of online retailers using it. RePack is a pay-per-cycle system meaning the online retailer pays for the service which comprises the provision of packaging, return and reprocessing. Other examples of reusable packaging solutions currently used in e-commerce are the online retailers Memo (Zimmermann and Falkenstein 2021c) and FairFox (Zimmermann and Falkenstein 2021a) which use their own reusable plastic box. However, all these examples are of a negligible order of magnitude in relation to the market as a whole.

1.2 Project design and approach

The study scope is on B2C e-commerce, and specifically on clothing textiles and products with similar packaging requirements.

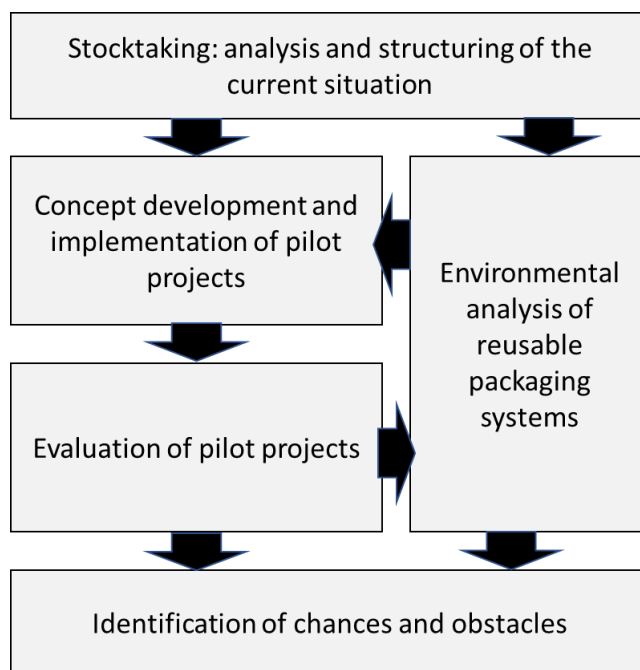
The main phases of the project are shown in Figure 3. In an in-depth analysis of the situation, available reusable packaging solutions as well as solutions currently in development have been identified (Rödiger et al. 2020), the current packaging practice in e-commerce has been analyzed (Reitz 2020, 2021) and available alternatives have been identified (Rödiger et al. 2020; Zimmermann and Falkenstein 2021b, 2021d, 2021e). Based on this, concepts were developed for the pilot testing of reusable packaging together with three participating online retailers, OTTO, Tchibo and AvocadoStore. The pilot tests ran between August and October 2020, during which time around

14,000 shipping bags were sent out (Tchibo 2020; Otto 2020; Avocadostore 2020). While all three online retailers used RePack's shipping bag for these tests, the test design was varied in each case. Different shipping options (unsolicited shipping to customers versus active choice with additional costs) as well as return options (return shipping via mailbox versus drop-off at parcel stores) were tested. At the same time, customer surveys were conducted to look into the customer's perspective.

Environmental evaluations of different variants of the use of reusable packaging in e-commerce were carried out both in advance of the pilot tests, during and after the tests.

Following the pilot tests, they were evaluated, taking into account the findings from the environmental evaluation. Challenges for online retailers were identified and economic evaluations were carried out.

Figure 3: Main phases of the project "praxPACK"



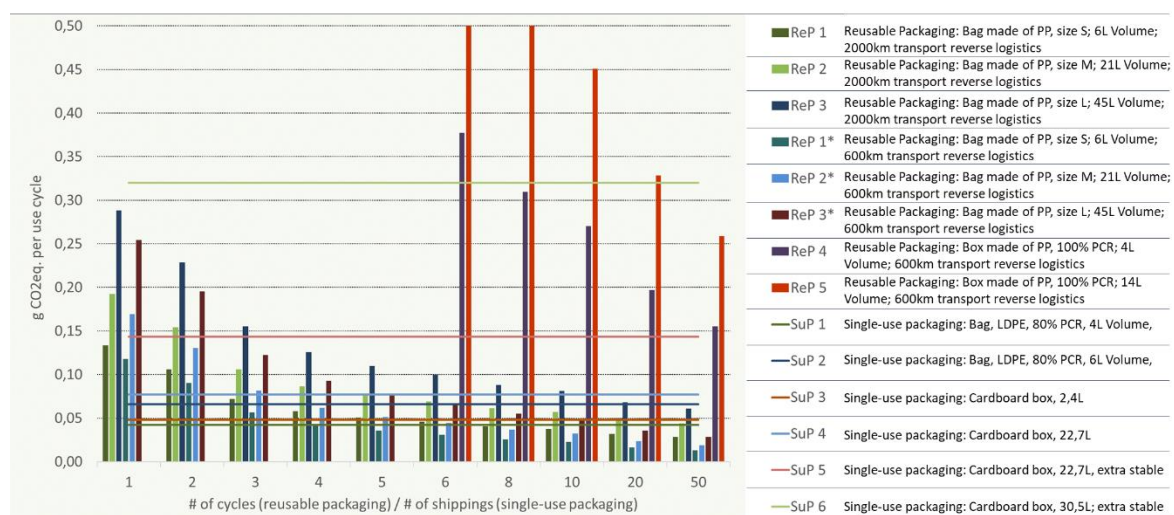
This article presents selected key findings from the project. In particular, it addresses the question of the extent to which reusable packaging in B2C e-commerce can contribute to future sustainable development. In addition to the environmental sustainability, economic aspects of reusable packaging and the customer perspective are considered.

2 Environmental perspective

With regard to the comparative environmental assessment of reusable versus disposable (single-use) shipping packaging in e-commerce, two main aspects come into play: firstly, reusable packaging is typically more material-intensive to manufacture as there are greater requirements for durability. Secondly, reusable packaging that is not disposed of by the customer but requires further transport and processing. On the other hand, in a functioning reusable system, the packaging can be used for a large number of shipments, so that the additional production effort is distributed accordingly.

In the specific case, the comparison depends on what kind of single-use packaging is compared with what kind of reusable packaging and how the return logistics of the reusable packaging are designed. In the project, we compared a variety of different cases, focusing on the resulting greenhouse gas emissions (as CO₂ equivalents) (Zimmermann and Rödig 2021b; Zimmermann et al. 2021; Zimmermann and Bliklen 2020a). Figure 4 shows a comparison of various reusable and disposable shipping packaging options. For the reusable packaging, the CO₂_{eq}-emissions resulting from the use are shown as pillars. The environmental performance improves as the number of usage cycles increases. In contrast, single-use packaging naturally causes the same emissions with every shipment. These emissions are shown as horizontal lines.

Figure 4: Comparison of GHG-emissions per use of reusable and single-use shipping packaging



Based on: (Zimmermann and Bliklen 2020a; Zimmermann et al. 2021; Zimmermann and Rödig 2021b)

Depending on the specific case, reusable shipping packaging needs to reach a certain number of use cycles to result in lower emissions than the different single-use packaging option considered in this comparison. By reducing the transport distances within the reusable packaging systems further improvements are possible.

Based on the comparison shown above as well as the additional analyses done in the project (Zimmermann and Bliklen 2020a, 2020b; Zimmermann and Rödig 2021b; Zimmermann et al. 2021), it can be concluded that reusable packaging has the potential to contribute to reducing the environmental impacts of e-commerce. This is well in line with findings from other studies (Coelho et al. 2020; van Loon et al. 2015; Weber et al. 2008; Zimmermann et al. 2020). However, in this regard, it is crucial to ensure the functioning of the reusable system with regard to high numbers of reuse cycles for the reusable packaging.

3 Economic perspective

There is enormous cost pressure in e-commerce. Shipping costs are often not passed on to the customer (in a transparent manner) because of fears of competitive disadvantages. Returned goods are often disposed of if the costs for inspection and resale are higher than the achievable trade margin (Zimmermann et al. 2021; Uni Bamberg 2019).

Against this background, the additional costs associated with reusable packaging are of decisive importance for their potential for a more widespread use. As with the environmental performance, there is no one-size-fits-all answer. Nevertheless, it can be stated that the use of reusable packaging in online retailing has so far always been associated with additional costs compared to the use of disposable packaging. Together with the project partners from e-commerce, we have developed a series of exemplary cost cases and made comparisons with disposable packaging.

The economics of reusable packaging systems in e-commerce are characterised by a number of differences compared to single-use packaging systems (Zimmermann and Rödiger 2021c):

- Reusable packaging is usually more expensive to buy.
- At their introduction
 - adjustments to the existing packing and further commissioning processes are usually required, which are initially associated with additional costs and
 - additional communicative measures towards customers are necessary.
- There are still clear limits to an automated picking and packing process with the current reusable shipping packaging available.
- The necessary return shipment of the empty reusable packaging by the end customer is associated with costs which are not necessary in the case of one-way shipping packaging.
- Furthermore, cleaning, checking and making the reusable packaging available again for a further cycle of use involves additional costs.

Licensing fees, such as those paid to the dual systems (EPR scheme) for the collection, sorting and recycling of single-use shipping packaging, do not apply to reusable packaging. The prerequisite for this, however, is the recognition as a reusable system (including the existence of return logistics for the packaging and an incentive system for the return of reusable packaging by consumers).

Together with project partner from e-commerce and further market actors, we developed a set of different cases and the resulting cost structure from using single-use and reusable packaging:

Case A: A reusable plastic box is used instead of a single-use cardboard box. The complete organisational handling of the reusable system is the responsibility of the online retailer. The online retailer purchases the reusable packaging. The product is sent to the customer in the reusable packaging. The return shipment takes place via a parcel service provider. Processing, cleaning, etc. are organised by the online retailer.

Taking into account the data on real existing systems for the reusable packaging, a high return rate of 99.5 % is assumed for the comparison.

Case B: A flexible reusable plastic shipping bag is used instead of a single-use polyprop bag. The reusable packaging is used within a pay-per-cycle system, i.e. the online retailer purchases usage cycles for the packaging. The pay-per-cycle costs typically include making the reusable packaging available, returning it and preparing it (cleaning, testing) for a usage cycle and, optionally, connecting it to an IT system (for tracking, incentive systems, etc.). Taking into account data from market actors, a return rate of 75 % is assumed.

Case C: Analogous to case B, but a return of the ordered product is assumed here. Instead of returning the empty reusable packaging to the pay-per-cycle system operator, the goods are returned to the online retailer's returns centre along with the packaging. The packaging is then available to the online retailer (after inspection and cleaning) for reuse.

The cost structure for the cases is shown in Table 1.

Table 1: Cost structure for different packaging cases

Position	Case A		Case B		Case C	
	Reusable	One-way	Reusable	One-way	Reusable	One-way
Acquisition costs per packaging	10,00 €	0,15 €	0,00 € ¹⁾	0,02 €	0,00 € ¹⁾	0,02 €
Licensing fee per cycle	0,00 €	0,02 €	0,00 €	0,00 € ²⁾	0,00 €	0,00 € ²⁾
Additional costs in commissioning	0,10 €	0,00 €	0,10 €	0,00 €	0,10 €	0,00 €
Communicative measures per cycle	0,03 €	0,00 €	0,03 €	0,00 €	0,03 €	0,00 €
Other additional costs per circulation	0,03 €	0,00 €	0,00 € ¹⁾	0,00 €	0,00 € ¹⁾	0,00 €
Shipping to the customer per cycle	3,31 €	3,31 €	3,31 €	3,31 €	3,31 €	3,31 €
Return shipment per cycle	3,31 €	0,00 €	2,75 € ¹⁾	0,00 €	3,31 €	3,31 €
Cleaning/inspection per cycle	0,10 €	0,00 €	0,00 € ¹⁾	0,00 €	0,10 €	0,00 €
Costs per cycle/consignment	6,95 €	3,46 €	6,19 €	3,33 €	6,85 €	6,64 €
Difference reusable/single-use	3,47 €	-3,47 €	2,86 €	-2,86 €	0,21 €	-0,21 €
Shipping costs paid by customer	4,95 €	4,95 €	3,95 €	3,95 €	3,95 €	3,95 €
Gap to shipping costs	-2,00 €	1,47 €	-2,24 €	0,62 €	-2,90 €	-2,69 €

¹⁾ Included in pay-per-cycle fee

²⁾ Included in acquisition cost.

In all cases, using reusable packaging results in higher costs compared to using single-use packaging. In case A and B (no return shipping), the additional costs amount to 3,47 € and 2,86 €, respectively. In case C, in which a product return is assumed, the cost gap is significantly smaller with 0,21 € as here, also for single-use packaging, the return shipping needs to be paid.

So, there are notable additional costs due to the use of reusable packaging, which essentially result from the return logistics.

If shipping charges are paid by customers, the cost gap can be closed. If shipping costs of 4,95 € (case A) and 3,95 € (Case B/C) are assumed, which corresponds to costs applied by some online retailers, however, this covers not the total costs resulting from the use of the reusable packaging, while for single-use packaging there is a net revenue in case A and B.

4 Customer perspective

Various requirements are placed on packaging in general (UBA 2015; Jepsen et al. 2019) which also apply to shipping packaging in e-commerce:

- They are intended to protect the product from mechanical influences
- They are designed to protect against moisture
- They should support logistics in the best possible way
- They may be an advertising medium
- They are intended to provide some protection against theft

Along with the discussions about growing amounts of packaging waste (see Reitz 2020) and environmental impacts (see Zimmermann and Bliklen 2020a, 2020b), a further core requirement has emerged alongside these packaging design requirements:

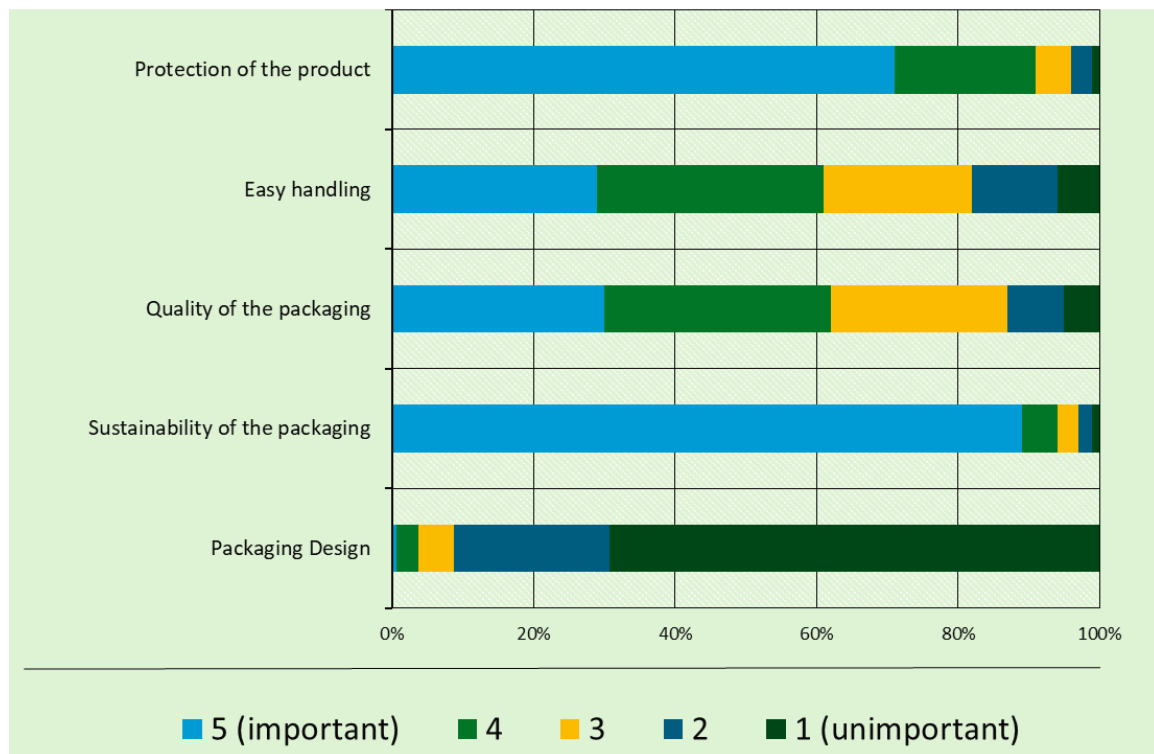
- Minimising environmental impacts

This requirement is also perceived and demanded by customers. In particular, the sustainability of the packaging and the protection of the products were rated as especially important by customers in a survey conducted as part of the praxpack pilot tests (cf. Figure 5). According to this, around 90 % of customers consider the sustainability of the packaging to be particularly important.

Figure 5: Important aspects of packaging, results of a survey part of the praxpack pilot test in 2020

How important are the following aspects when you think of packaging in general?

Results of a survey conducted as part of the praxpack pilot tests, from 5 =important to 1 = unimportant



According to further customer surveys, between 50 % and 90 % of the customers consider its reusability as an important element of sustainable packaging (KANTAR 2021; PWC 2018; Zimmermann and Rödig 2021a) besides its recyclability and the use of recycled material.

In the introduction of reusable shipping packaging systems, customers play a decisive role in establishing and maintaining the reusable systems:

- First of all, the customers of the respective online retailer must be open to receiving their products in reusable packaging. This means that they must be at least willing to accept this new form of packaging practice and choose reusable packaging instead of disposable packaging (provided that shipping in reusable packaging is only done at the explicit request of the customer).
- Customers must be prepared to accept additional practical effort. This additional effort includes, on the one hand, a minimum of involvement and examination of the functioning of the respective reusable system in order to ensure the proper use and return of the reusable packaging, as well as the return shipment itself. For example, reusable packaging differs from (the usual) one-way packaging in terms of the way it is (allowed to be) opened. On the other hand, the necessary return shipment results in additional expenses for the customer. Depending on how the return shipment is made (via letterboxes, delivery to the parcel carrier, delivery to the parcel shop, ...), this effort varies.
- Customers may have to be prepared to accept additional costs. Up to now, the use of reusable packaging has been associated with additional costs for online retailers compared to single-use packaging (as described in the previous section). These costs may be passed on to the customers.
- Customers may need to be prepared to pay a deposit. Deposit systems can help to achieve high return rates. If deposit systems are used, this must be accepted by the customers.
- The clients must be prepared to accept the additional financial or behavioural effort mentioned above not only once, but repeatedly.
- Customers may need to be prepared to learn not only how a particular supplier's returnable shipping packaging works, but also how other systems work, as different mail order companies currently use different systems.

4.1 Acceptance for deposits and additional costs

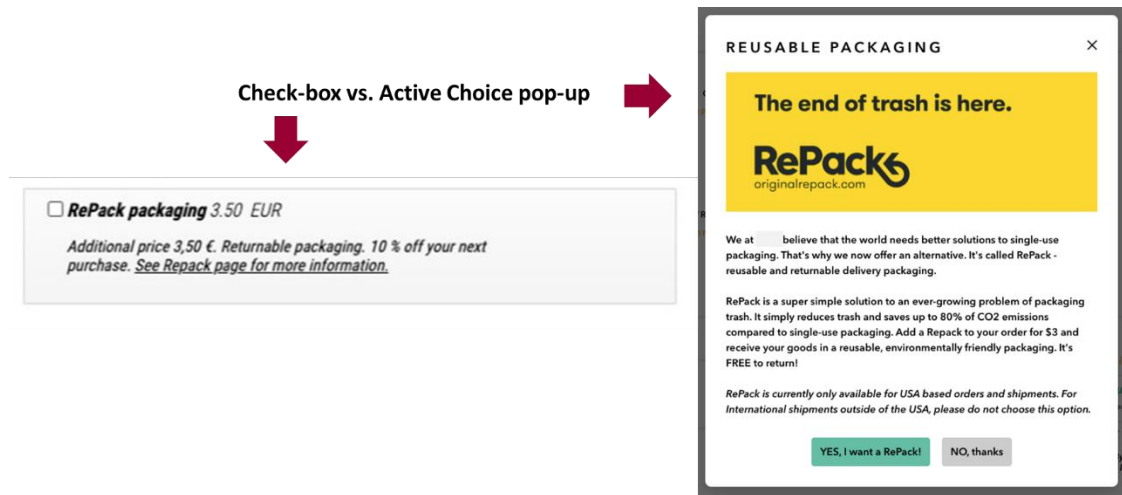
Against this background, in the survey conducted along with the pilot tests (Otto 2020; Tchibo 2020; Avocadostore 2020), customers were asked about their willingness to pay a deposit for the reusable packaging as well as about their willingness to contribute to the additional costs: While a deposit between 2 and 5 € appears to be quite acceptable for customers, the readiness to accept additional costs is significantly less clear-cut. Here, the answers vary from less than 0,2 € to up to 5 €.

In one of the pilot tests (Avocadostore 2020), the customers were asked if they wished to receive their order in a reusable packaging for which they would be charged 3,95 €. In this pilot test, about 36 % of the customers chose to receive the reusable packaging. Here, it needs to be noted, that Avocadostore is an online marketplace for sustainable products and targets a sustainably oriented customer group. Accordingly, it is hardly possible to extrapolate these results to all customers.

In cooperation with RePack, a more detailed analysis in this regard has been made based on their customer base (>30 online shops) (Trowitz and Zimmermann 2021). It has been shown that the willingness of customers to receive reusable packaging and to accept additional costs depends to a relevant extent on the type and manner of the query, the so-called onboarding. Significant

differences exist here between a check box, which is displayed below the selection of shipping options, and a pop-up window, which requires an active choice by the customer, as illustrated in Figure 6. In the case of the check-box variant, the selection rate for the reusable packaging typically varies between 3 and 8 %. In the case of the active choice, the selection rate is between 20 and 35 %.

Figure 6: Different types of onboarding/ front-end integration for reusable packaging



(Trowitz and Zimmermann 2021)

4.2 Return channels

As described, the return of reusable packaging is both a cost driver, but also requires additional effort on the part of the customer.

Currently, two return systems can be found in practice (Zimmermann and Trowitz 2021):

1. Return shipment as a parcel (via a parcel service provider)
2. The return shipment as a letter (via letterboxes, postal service providers)

When returned as a parcel, the empty reusable packaging is sent back as a "normal" parcel. This can be done via parcel shops and similar channels. The costs correspond to those of "normal" parcel delivery or the cost agreements between the sender (online retailer) and the service provider. Examples of reusable systems that use this return route are the MemoBox (cf. Zimmermann and Falkenstein 2021c) or the Foxbox (cf. Zimmermann and Falkenstein 2021a).

Compared to return shipping via parcel service providers, return shipping as a letter generally has cost advantages. However, this type of return shipment is only possible for packaging that is suitable for letterboxes; flexible packaging and small-format packaging, in particular, are suitable for this. RePack is an example of a reusable packaging that uses this return channel.

Besides influencing the costs, there is also a connection between the choice of return channels and the return rate, which in turn influences the environmental performance of the reuse system.

In the praxpack pilot tests (Avocadostore 2020; Otto 2020; Tchibo 2020), both return channels have been tested without using a deposit as an additional incentive. For the return via letterboxes, the return rate for the empty packaging was above 70 %, while for the return via parcel shops, the return rate was below 50 %. Although these figures are very likely to change as soon as a deposit scheme or other additional incentives are implemented, it provides an indication that the return channel should minimize the required effort in order to increase the return.

5 Conclusions

Based on the findings from our research, we can conclude that in principle reusable packaging can contribute significantly to the reduction of environmental impacts resulting from e-commerce. So far, however, major obstacles stand in the way of its wider use.

First of all, the customers have to be taken along. While principally customers show a high demand for sustainable packaging solutions in e-commerce such as reusable packaging, this relates to the design of the return channels and the reduction of the economic and practical effort for the customers. Although an increase in the selection rate can be achieved by appropriately designing the front-end of the online shop (active choice), this should go hand in hand with the required further developments to the return system.

The reduction of additional costs resulting from the return logistics will be a key factor in the uptake of reusable solutions in e-commerce. Pooling solutions in particular can potentially contribute to a reduction in costs in the future. To some extent, a hen-and-egg problem can be observed here. As long as the reusable packaging is only used by a very limited number of online retailers, the amounts are too low to efficiently build up and operate a pool system. On the other hand, without a working pool system, it is unlikely the costs will significantly be reduced.

Additional regulatory impulses could potentially stimulate a development of the situation here.

6 Publication bibliography

Avocadostore (2020): Praxpack-Pilot. Ergebnisse. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/materialien/praxpack_Ergebnisse_Pilottest_Avocadostore_2020_webversion.pdf, checked on 8/11/2021.

Coelho, Patricia Megale; Corona, Blanca; Klooster, Roland ten; Worrell, Ernst (2020): Sustainability of reusable packaging—Current situation and trends. In *Resources, Conservation & Recycling: X* 6, p. 100037. DOI: 10.1016/j.rcrx.2020.100037.

Jepsen, Dirk; Zimmermann, Till; Rödiger, Lisa (2019): Eco Design von Kunststoff-Verpackungen. Der Management-Leitfaden des Runden Tisches. Edited by IK - Industrievereinigung Kunststoffverpackungen. Runder Tisch Eco Design von Kunststoffverpackungen. Bad Homburg. Available online at https://ecodesign-packaging.org/wp-content/uploads/2019/06/ecoDesign_Kernleitfaden_WEBpdf.pdf.

KANTAR (2021): Befragung von Online-Shoppern zur Wahrnehmung von ökologischen Versandverpackungen und zum Informationswert von Umwelteigenschaften einer Verpackung. im Auftrag des VDW. München, checked on 6/24/2021.

Mission Reuse (2021): Herbruikbare verzendverpakkingen in e-commerce. With assistance of Emmy van Daele. Available online at https://missionreuse.com/wp-content/uploads/2021/12/Herbruikbare-verzendverpakkingen-in-e-commerce_MissionReuse_2021.pdf, checked on 12/21/2021.

Otto (2020): Praxpack - Pilotprojekt mit Repack. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/materialien/praxpack_Ergebnisse_Pilottest_Avocadostore_2020_webversion.pdf, checked on 8/11/2021.

PWC (2018): Wege aus dem Paketdilemma. Flexibel, schnell, umweltfreundlich. With assistance of Prümm. Dietmar, Peter Kauschke, Hanna Peiseler. Edited by Price Waterhouse Coopers GmbH. Available online at <https://www.pwc.de/de/transport-und-logistik/pwc-paketpreisstudie-2018.pdf>, checked on 4/23/2020.

Reitz, Alexander (2020): Versandverpackungen: Bestandsaufnahme von Mengen und Materialdaten. Werkstattpapier, Projekt praxPACK. GVM. Available online at https://www.praxpack.de/fileadmin/user_upload/materialien/praxPACK_Werkstattpapier_Bestandsaufnahme_Versandverpackungen_Mengen.pdf, checked on 9/23/2020.

Reitz, Alexander (2021): Verbrauch von Versandverpackungen in Deutschland. In *Müll und Abfall* (4). DOI: 10.37307/j.1863-9763.2021.04.04.

RePack (2020): Reusable packaging service for ecommerce | RePack. Available online at <https://www.originalrepack.com/?lang=de>, checked on 12/21/2021.

Rödiger, Lisa; Zimmermann, Till; Reitz, Alexander (2020): Mehrwegversandverpackungssysteme im Business-to-Consumer und Business-to-Business Bereich. Werkstattpapier. Projekt praxpack. Edited by Ökopool Institut für Ökologie und Politik. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/materialien/praxPACK_Werkstattpapier_Bestandsaufnahme_MWS_Januar_2020.pdf, checked on 9/29/2021.

Tchibo (2020): RePack - Pilot Mehrwegversandtasche. Edited by Tchibo. Available online at https://www.praxpack.de/fileadmin/user_upload/materialien/praxpack_Ergebnisse_Pilottest_Tchibo_2020_webversion.pdf, checked on 6/4/2021.

Trowitz, Christof; Zimmermann, Till (2021): Mehrwegversandsysteme - Frontendintegration und Onboarding. Situation und Erfahrungen aus der Perspektive von RePack. praxPACK - Werkstattpapier. RePack; Ökopool. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/Werkstattpapier_Frontend_Onboarding.pdf, checked on 12/21/2021.

UBA (2015): Leitfaden für umweltgerechte Versandverpackungen im Onlinehandel. Grün verpacken und versenden. With assistance of Gerhard Kotschik Kotschik. Edited by Umweltbundesamt. Umweltbundesamt. Available online at

https://www.umweltbundesamt.de/sites/default/files/medien/378/publikationen/fachbroschuere_leitfaden_fuer_umweltgerechte_versandverpackungen_im_versa.pdf.

Uni Bamberg (2019): Hintergruende der Retourenentsorgung - Studie ausgewertet. Available online at <http://www.retourenforschung.de/info-hintergruende-der-retourenentsorgung---studie-ausgewertet.html>, checked on 2/5/2020.

van Loon, Patricia; Deketele, Lieven; Dewaele, Joost; McKinnon, Alan; Rutherford, Christine (2015): A comparative analysis of carbon emissions from online retailing of fast moving consumer goods. In *Journal of Cleaner Production* 106, pp. 478–486. DOI: 10.1016/j.jclepro.2014.06.060.

Weber, Christopher L.; Hendrickson, Chris T.; Matthews, H. Scott; Nagengast, Amy; Nealer, Rachael; Jaramillo, Paulina (2008): Life cycle comparison of traditional retail and e-commerce logistics for electronic products: A case study of buy. com. Edited by Green Design Institute, Carnegie Mellon University.

Zimmermann, Peter; Rödig, Lisa (2021a): Rolle der Kund*innen in Mehrwegversandsystemen. Werkstattpapier. Projekt praxpack. Edited by Ökopol Institut für Ökologie und Politik. Hamburg.

Zimmermann, Till; Bliklen, Rebecca (2020a): Single-use vs. reusable packaging in e-commerce: comparing carbon footprints and identifying break-even points. In *GAIA - Ecological Perspectives for Science and Society* 29 (3), pp. 176–183. DOI: 10.14512/gaia.29.3.8.

Zimmermann, Till; Bliklen, Rebecca (2020b): Vergleichende ökologische Betrachtung von Mehrweg- und Einweg-Versandverpackungen. Werkstattpapier. Projekt praxpack. Ökopol. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/Werkstattpapier_OEkoologische_Bewertung_von_MWVP_REV2.pdf, checked on 8/17/2021.

Zimmermann, Till; Falkenstein, Anna (2021a): Fairfox. Erfolgreiche Beispiele für den Einsatz von Mehrwegverpackungen im Onlinehandel. Projekt praxpack; Ökopol Institut für Ökologie und Politik. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/praxpack_Kurzsteckbrief_FairFox.pdf, checked on 9/30/2021.

Zimmermann, Till; Falkenstein, Anna (2021b): hey circle. Erfolgreiche Beispiele für Mehrweg(system)anbieter für Versandverpackungen im Onlinehandel. Kurzsteckbrief. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/praxpack_Kurzsteckbrief_HeyCircle.pdf, checked on 9/2/2021.

Zimmermann, Till; Falkenstein, Anna (2021c): Memo/Memolife. Erfolgreiche Beispiele für den Einsatz von Mehrwegverpackungen im Onlinehandel. Projekt praxpack; Ökopol Institut für Ökologie und Politik. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/praxpack_Kurzsteckbrief_Memo.pdf, checked on 8/30/2021.

Zimmermann, Till; Falkenstein, Anna (2021d): RePack. Erfolgreiche Beispiele für Mehrweg(system)anbieter für Versandverpackungen im Onlinehandel. Kurzsteckbrief. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/praxpack_Kurzsteckbrief_RePack.pdf, checked on 9/2/2021.

Zimmermann, Till; Falkenstein, Anna (2021e): xPack Green logistics. Erfolgreiche Beispiele für Mehrweg(system)anbieter für Versandverpackungen im Onlinehandel. Kurzsteckbrief. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/praxpack_Kurzsteckbrief_xpack_FINAL2.pdf, checked on 9/2/2021.

Zimmermann, Till; Hauschke, Fynn; Memelink, Robin; Reitz, Alexander; Pelke, Nane; John, Rene et al. (2021): Die Ökologisierung des Onlinehandels. Neue Herausforderungen für die umweltpolitische Förderung eines nachhaltigen Konsums. Teilbericht II - UBA-Texte 142/2021. Edited by Umweltbundesamt. Ökopol Institut für Ökologie und Politik. Dessau-Roßlau, Hamburg, checked on 3/22/2021.

Zimmermann, Till; Memelink, Robin; Rödig, Lisa; Reitz, Alexander; Pelke, Nane; John, Rene; Eberle, Ulrike (2020): Die Ökologisierung des Onlinehandels. Neue Herausforderungen für die umweltpolitische Förderung eines nachhaltigen Konsums. Teilbericht I; UBA-Texte 227/2020. Edited by Umweltbundesamt. Ökopol Institut für Ökologie und Politik. Dessau-Roßlau, Hamburg. Available online at

https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2020_12_03_texte_227-2020_online-handel.pdf, checked on 3/22/2021.

Zimmermann, Till; Rödiger, Lisa (2021b): Das Projekt praxPACK. Auf dem Weg zu praxistauglichen Mehrwegversandverpackungen für den Onlinehandel. In *Müll und Abfall* 53 (4), pp. 196–200. Available online at [10.37307/j.1863-9763.2021.04.05](https://doi.org/10.37307/j.1863-9763.2021.04.05).

Zimmermann, Till; Rödiger, Lisa (2021c): Ökonomische Bewertung von Mehrwegsystemen. Betrachtung von drei Beispielfällen. Werkstattpapier. Projekt praxpack. Edited by Ökopol Institut für Ökologie und Politik. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/Werkstattpapier_OEkonominische_Betrachtung.pdf, checked on 9/28/2021.

Zimmermann, Till; Trowitz, Christof (2021): Rückführung von Mehrwegverpackungen. Grundsätzliche Situation und Ausblick aus der Perspektive von RePack. praxPACK - Werkstattpapier. Ökopol; RePack. Hamburg. Available online at https://www.praxpack.de/fileadmin/user_upload/Werkstattpapier_Ru__ckfu__hrung_RePack.pdf, checked on 12/21/2021.