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Identification and assessment of opportunities and threats for the Circular Economy arising from E-commerce

Draft Final Report

WORKING DRAFT - NOT FOR PUBLICATION

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42 **Abstract**

43

44 The present study identifies, describes and assesses in detail opportunities and threats
45 for the Circular Economy arising from E-commerce.

46

47 A broad literature research and direct stakeholder input led to the identification of 18
48 opportunities and 23 threats for the Circular Economy, allocated to 7 different clusters.
49 Most of the identified threats refer to "Logistics and transport", while opportunities
50 refer mainly to the topics "Accessibility of information" and "Digitalisation".

51

52 By means of a comparative assessment in the current situation and future optimistic
53 and pessimistic potential developments, the direct and indirect effects of the
54 opportunities and threats have been evaluated, with specific focus on 7 selected
55 product categories.

56

57 In total, 11 opportunities and 16 threats have been assessed as either medium or
58 highly relevant. The assessment revealed that most of the threats classified as highly
59 relevant belong to the cluster "Logistics and transport", including induced parcel
60 transport, parcel return and inefficient transport, while most of the highly relevant
61 opportunities are to be found in the cluster "Accessibility of information", as in the
62 case of second-hand commerce or product portfolio.

63

64

65 **Executive Summary**

66 **Objective of the study and background**

67 The study falls within the framework of the current two top priorities of the Juncker
68 Commission: "Jobs, growth and investment" and the "Digital Single Market", and in
69 particular the policy areas "Towards a circular economy" and "Better access for
70 consumers and businesses to on-line goods".

71 In principle, the Digital Single Market offers substantial opportunities to the
72 development of a true Circular Economy. At the same time, threats may also exist
73 from unbridled developments that disregard the planet's resources, the environment
74 and human health. This study aims to shed a better light on both these opportunities
75 and possible threats.

76 The objective of the present study, launched by the Joint Research Centre of the
77 European Commission and carried out by Ramboll Environment and Health in
78 cooperation with Ramboll Management Consulting and the Technical University of
79 Denmark (DTU) is to identify, describe and assess in detail important opportunities
80 and threats that E-commerce constitutes for the Circular Economy, based on a
81 selection of relevant physical products.

82 In order to fulfil this objective, the study envisages the following main phases:

- 83 ▪ selection of 7 products based on a specifically developed methodology;
- 84 ▪ identification of a set of opportunities and threats for the Circular Economy
85 arising from E-commerce;
- 86 ▪ in-depth assessment of the influence of the identified opportunities and threats
87 on the Circular Economy aspects of the selected products, taking into
88 consideration both the current and future situation in the traditional retail and
89 E-commerce scenario; and
- 90 ▪ grouping of opportunities and threats according to their relevance in three
91 categories of low, medium and high relevance.

92

93 **Selection of relevant products for assessment of opportunities/threats**

94 The assessment of the opportunities and threats for the Circular Economy arising from
95 E-commerce focused on the following **7 product categories** that are either sold
96 online or in traditional "brick-and-mortar" stores:

97 1. Accessories

98 2. Apparel

99 3. Major furnishings

100 4. Major household appliances

101 5. Media and entertainment products/services

102 6. Non-perishable food

103 7. Small information and communication technology

104 The methodology for the selection of the above-listed product categories was based on
105 a set of quantitative and qualitative criteria and on the results of an online stakeholder

106 survey carried out in order to close existing data gaps and provide a direct input on
107 relevant characteristics of specific product categories sold online.

108 The following criteria have been used: product category diversity, online/offline
109 market relevance, return rates, amount of packaging required for shipping, purchase
110 frequency and consumer preferences, with respect to online and “in shop” purchases.
111 The criteria have been applied to an initial range of 26 product categories defined on
112 the basis of the European integrated system of statistical activity and product
113 classifications and after a preliminary screening of available data, based on available
114 reports and databases.

115 As a starting point for the data availability check and data collection on the initial set
116 of product categories and screening criteria, the selection of 5 main European
117 countries was carried out with the aim of exploring possible regional differences in
118 Europe that may affect opportunities/threats and to identify the countries that could
119 be used as a reference in the different stages of the study in case Europe-wide data
120 would not be available. Considering factors such as population, share of online buyers,
121 overall consumer spending, overall E-commerce growth rate and actual spending in
122 the E-Commerce, the following countries were selected as representatives for each of
123 the 5 subregions of Europe according to the Eurovoc classification:

- 124 • Central and Eastern Europe: Poland;
 - 125 • Northern Europe: Sweden;
 - 126 • Southern Europe: Spain; and
 - 127 • Western Europe: France and Germany.
- 128

129 **Identification and description of opportunities and threats for the** 130 **Circular Economy arising from E-commerce**

131 The study identified an overall number of **41** opportunities and threats for the Circular
132 Economy arising from E-commerce, of which **19 opportunities** and **22 threats**.

133 The 4-steps methodology applied consisted in an initial broad literature research that
134 led to the identification of a first range of opportunities and threats, followed by a
135 systematic classification based on two orders of environmental effects (direct and
136 indirect) and evaluation of relevance with regard to selected product categories.
137 Subsequently, relevant stakeholders were consulted by means of an online survey and
138 a dedicated workshop was held in order to validate the final list of opportunities and
139 threats to be assessed in the third part of the study.

140 The different opportunities and threats have been allocated to **7 groups or clusters**,
141 identified thanks to the direct input of the stakeholders, which are expected to act on
142 the same or similar Circular Economy aspects.

143 The final list of identified opportunities and threats grouped by cluster is reported in
144 the Table below.
145

146 **Opportunities and threats for the Circular Economy arising from E-commerce**

| Cluster | O/T | Opportunities and Threats |
|-------------------------------------|--------------------|--|
| Accessibility of information | O | Availability of information |
| | O | Big data/ meta data |
| | O | Innovation |
| | O | Market access to online aftermarket |
| | O | Product portfolio |
| | T | International market access |
| Consumer needs and behaviour | T | Ubiquity |
| | O | Nudging |
| | O | Sharing models and services |
| | T | Cross-selling and up-selling |
| | T | Ease of shopping |
| Digitalisation | T | Personalised design |
| | T | Shopping frenzy |
| | O | Digital goods |
| | O | Reduction of retail space |
| End of life | O | Substitution of printed marketing material |
| | T | Operation of network infrastructure |
| | O | Extended product selling cycle |
| | O | Product take-back |
| | O | ReCommerce: Second-hand E-commerce /online auctioning |
| Legal framework | O/T | Food waste |
| | T | End-of-Life challenges |
| | T | Difficulty to monitor |
| | T | Enforcement |
| Logistics and transport | T | EPR free-rider effect |
| | T | Lack of compliance with common market regulation |
| | O | In-House Fulfilment |
| | O | Collaboration between companies and partnering with waste management suppliers |
| | O | Optimisation of supply chain |
| | O | Substitution of individual shopping trips |
| | T | Damage on delivery |
| | T | Individual product delivery |
| | T | Induced freight traffic to remote locations |
| | T | Induced parcel transport |
| | T | Inefficient transport |
| | T | Inferior types of transportation |
| | T | Parcel return |
| T | Waste from returns | |
| Packaging | O | Development of dedicated optimised packaging solutions |
| | T | Excessive protective packaging |
| | T | Secondary Packaging |

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151 Each of the opportunities and threats identified has been further investigated and
152 described in detail. The information provided includes a presentation and discussion of
153 the opportunity/threat, the identification of the value chain differences between the
154 traditional sales channel and online distribution, the current and the future relevance,
155 the identification of factors that act as catalysts on the development of the respective
156 opportunity or threat (supporting factors) or that slow it down (mitigating factors)
157 and, eventually, a list of possible initiatives/solutions to mitigate the effects of the
158 threat or further promote the opportunities, divided by Producers/Platform providers,
159 Regulators and Scientific Community.

160

161 **In-depth assessment of opportunities and threats for selected product**
162 **categories**

163 An in-depth assessment of the effects of the identified opportunities and threats on
164 the Circular Economy has been carried out by means of a comparative analysis of the
165 traditional retail channel and E-commerce.

166 In order to compare the effects of the opportunities and threats between traditional
167 brick-and-mortar retail and E-commerce for the current state as well as future
168 scenarios, representative Circular Economy aspects/indicators were identified for each
169 of the selected clusters. All quantitative and qualitative effects within the respective
170 cluster were assessed against those representative indicators relating to the functional
171 unit "one fulfilled unit".

172 The Table below provides an overview of the indicators associated with the identified
173 clusters.

174 **Overview of effect clusters and representative indicators (Circular Economy aspects)**

| Cluster | Representative Indicator | Unit(s) |
|-------------------------------------|--|---|
| Accessibility of information | Qualitative assessment. Identification of specific indicators not applicable - various effects, with complex interactions. | |
| Consumer needs and behaviour | Qualitative assessment. Identification of specific indicators not applicable - various effects, with complex interactions. | |
| Digitalisation | "(Primary) Energy demand and global warming potential" | <ul style="list-style-type: none"> • kWh • CO₂-equivalents |
| End-of-Life | "Fraction that is effectively brought into a second or prolonged life cycle and product waste per fulfilled unit" | <ul style="list-style-type: none"> • percentage (%) • absolute (waste per fulfilled unit) |
| Legal framework | Qualitative assessment. Identification of specific indicators not applicable - various effects, with complex interactions. | |
| Logistics and transport | "Transport requirements per fulfilled unit" | <ul style="list-style-type: none"> • km/unit & CO₂e/unit |
| Packaging | "Amounts of plastic and cardboard packaging demand per fulfilled unit" | <ul style="list-style-type: none"> • kg plastic packaging/unit*, • kg cardboard packaging/unit <p><i>*Plastic is represented by LDPE foil</i></p> |

175

176 Within each cluster, the current situation, the baseline scenario as well as the future
177 scenario (optimistic and pessimistic) have been assessed.

178 As regards the cluster "**Packaging**", the study revealed that most of the suggested
179 mitigation-oriented packaging solutions are not expected to result in actual
180 environmental benefits for the Circular Economy compared to the traditional retail
181 channel. Although dedicated packaging solutions for E-commerce have the potential to
182 reduce amounts of plastics and cardboard per fulfilled unit, the positive net effect of
183 these solutions could be diminished or (over-)compensated due to inherently higher
184 demands of protective packaging for the shipping of products.

185 The assessment of the cluster "**Logistics and Transport**" revealed that, in general,
186 parcel deliveries to personal residences increasingly replace private shopping trips
187 while increasing the degree of the utilisation of the means of transport, leading to less
188 energy demand per fulfilled unit. Looking at induced parcel transport and individual
189 shopping trips, there is a tendency towards less environmental impact for E-commerce
190 on the "last mile". Nevertheless, the increase of failures in delivery attempts might
191 play a greater role due to the total increase of packages. Additionally, in urban areas
192 the opportunity to deliver within 24 hours could also increase the probability of more
193 delivery attempts. Eventually, the increase of faster delivery options, with the risk of
194 empty runs and inefficiency, is expected to be highly significant and assumed as the
195 most relevant indirect effect.

196 As regards the cluster "**End of Life**", the assessment highlighted that E-commerce
197 facilitates the reuse of certain goods and therefore potentially positively affects a
198 Circular Economy. Nevertheless, future trends indicate that positive effects from reuse
199 may be overcompensated by a disproportional increase in consumption. Indications
200 have been found that E-commerce value chains could potentially generate more
201 product waste due to higher return rates than traditional channels. Yet, potential
202 negative effects from highlighted end-of-life issues or wasted products from returns in
203 E-commerce channels have to be weighed against impacts associated with unsold
204 products, considered a predominantly bigger concern in traditional supply chains. It is
205 argued that a hypothetical switch to digital markets could reduce manufacturing waste
206 and reduce overproduction in the future, ultimately leading to fewer unsold products.

207 The study revealed that sharing models and services evaluated within the cluster
208 "**Consumer needs and behaviour**", support eco-conscious consumer behaviour.
209 Environmental nudging is concluded to contain great potential for the Circular
210 Economy through the promotion of eco-conscious consumer behaviour, though
211 expected to be of minor significance, unless incentives or growing public pressure
212 increase economic interests in environmental efforts. On the other hand, shopping
213 frenzy is the most significant and highly relevant effect with negative impacts on the
214 Circular Economy, due to its promotion of purchasing additional and not necessarily
215 required products and the associated high return rates. Personalised design was also
216 found to promote additional, initially unintended purchases, while a rather neutral
217 effect has been observed for the increased ease of shopping, resulting in consumers
218 spending rather online than offline and an assumed tendency for negative impacts
219 from impulse purchases.

220 A summarised "net effect", valid for certain product categories or across all of them,
221 could not be determined for the cluster "**Accessibility of information**", although
222 being a central theme when comparing E-commerce and traditional commerce. Better
223 information can in fact be assumed to lead to less product returns and longer keeping
224 of products at users, contributing to decreasing environmental impact, but on the
225 other hand more devices used globally – driven by shorter innovation cycles on
226 device-level – can be assumed to lead to increasing environmental impact potentials,
227 globally and at the EU-level.

228 The effects of opportunities and threats identified for the cluster “**Legal framework**”
229 are not clear. The lack of full transparency with regard to the involved economic
230 operators and their modes of interaction in the traditional economy due to, for
231 instance, complex global supply chains does not seem to be improved in the E-
232 commerce as practiced today – although it in principle could do so – due to several
233 constraints. No direct or indirect opportunities have been identified during the
234 research, and no data on effects-damping factors has been identified either, such as a
235 rising critical end-user awareness towards origins of a product, or substantial
236 spreading of Blockchain-like technologies that would allow full traceability of products
237 and money flows. Overall it is therefore considered more likely, that E-commerce
238 would lead to more challenges for the legal framework than the current traditional
239 commerce does, resulting in rising environmental impact potentials.

240 The effects within the cluster “**Digitalisation**” are mainly expressed in energy
241 demands and/or associated carbon footprints. Although energy demands and
242 associated environmental impacts arising from operations and advertisement in E-
243 commerce due to operations and advertisement deserve attention, a positive net
244 effect on the Circular Economy can only be expected when traditional value chain
245 processes (e.g. physical retail space) are substituted. In the future, several trends
246 (e.g. increasing data traffic, changes in physical retail stores, further growth of digital
247 goods sector, energy efficiency and renewable energy sources for network and data
248 centre operations) will affect E-commerce and traditional value chains jointly.

249 **Relevance of opportunities and threats**

250 Based on the findings from the in-depth assessment all opportunities and threats were
251 grouped according to their estimated relevance for a Circular Economy in Europe in
252 comparison to the traditional (brick-and-mortar) channel.

253 In total, 13 opportunities/threats have been assessed as highly relevant, 14
254 opportunities/threats were found to have a medium relevance and 13 were assessed
255 as being of little relevance¹.

256 Most of the threats classified as highly relevant belong to the clusters “Logistics and
257 transport”. In particular, from a Circular Economy perspective secondary packaging
258 and direct effects within this cluster deserve special attention. Moreover, certain
259 effects relating to “consumer needs and behaviour” as well as facilitated second-hand
260 E-commerce within the cluster “end-of-life” are of high relevance.

261 The cluster “Accessibility of information” includes most of the highly relevant
262 opportunities, although related effects could not be translated into specific Circular
263 Economy aspects or indicators, as for the cluster “Legal framework”.

264 The opportunities and threats relating to the cluster “Digitalisation” are of medium to
265 low relevance. This is not least due to the cascading effects from digitalisation which
266 cannot exclusively be allocated to E-commerce.

¹ The identified potential opportunity of “collaboration between companies and partnering with waste management suppliers”, could not be ranked as it could not clearly be assigned to a single cluster or expressed in terms of a certain Circular Economy aspect. This opportunity was inherently assessed as part of the opportunities “product-take back” and “development of dedicated packaging solutions”.

267 **Disclaimer**

268 *The information and views set out in this report are those of the author(s) and do not*
269 *necessarily reflect the official opinion of the Commission. The Commission does not*
270 *guarantee the accuracy of the data included in this study. Neither the Commission nor*
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273 *intended for distribution or publication. It has been elaborated to provide a feedback*
274 *opportunity to stakeholders that were involved during the execution of the study*
275 *described in this document.*

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349 **1 Introduction**

350 **1.1 Objective and main phases of the study**

351 The objective of the present study, launched by the Joint Research Centre of the
352 European Commission and carried out by Ramboll Environment and Health in
353 cooperation with Ramboll Management Consulting and the Technical University of
354 Denmark (DTU) is to identify, describe and assess in detail important opportunities
355 and threats that E-commerce constitutes for the Circular Economy, based on a
356 selection of relevant physical products.

357 In order to fulfil this objective, the study envisages the following main phases:

- 358 ▪ selection of 7 products based on a specifically developed methodology;
- 359 ▪ identification of a set of opportunities and threats for the Circular Economy
360 arising from E-commerce;
- 361 ▪ in-depth assessment of the influence of the identified opportunities and threats
362 on the Circular Economy aspects of the selected products, taking into
363 consideration both the current and future situation in the traditional retail and
364 E-commerce scenario; and
- 365 ▪ grouping of opportunities and threats according to their relevance in three
366 categories of low, medium and high relevance.

367 The outcomes of the study are based on actual data and also on the individual
368 expertise of stakeholders. Relevant stakeholders of all types, from big multinational
369 companies to national businesses were identified with regard to each main stage of
370 the study and consulted via online surveys, e-mail questionnaires and a dedicated
371 workshop in order to guarantee the validation of the methodology used and provide
372 essential insights along with specific data and information.

373 During the data collection and the stakeholder consultation processes, throughout the
374 different stages of the study, the existing divergences between E-commerce in the EU
375 Member States of different subregions of Europe and the influence that these exert on
376 the definition of opportunities and threats for the Circular Economy were considered.
377 In particular, the coverage of at least 5 EU Member States from at least 3 out of 4
378 subregions of Europe² is guaranteed throughout the study.

379 **1.2 Background**

380 The study falls within the framework of the current two top priorities of the Juncker
381 Commission: "Jobs, growth and investment" and the "Digital Single Market", and in
382 particular the policy areas "Towards a circular economy" and "Better access for
383 consumers and businesses to on-line goods".

384 In principle, the Digital Single Market offers substantial opportunities to the
385 development of a true Circular Economy. At the same time, threats may also exist
386 from unbridled developments that disregard the planet's resources, the environment
387 and human health. This study aims to shed a better light on both these opportunities
388 and possible threats.

² Eurovoc classification.

389 E-commerce, with its capacity of bringing opportunities to consumers to access a
390 wider range of goods, services and digital content as well as the possibility to compare
391 prices and look for better deals across the Digital Single Market has grown rapidly in
392 recent years. Today the EU is one of the largest E-commerce markets in the world:
393 the percentage of people aged between 16 and 74 that have ordered goods or services
394 over the internet has grown year-on-year from 30% in 2007 to 55% in 2016
395 (European Commission, 2017b) and online retail continues its double-digit growth,
396 since the European E-commerce turnover increased by 12.75% to €540 billion in 2017
397 (ECommerce Europe, 2018).

398 The rapid growth of online commerce, while seen in principle as an opportunity for
399 fostering sustainable development under many aspects, triggers inevitable discussion
400 on the possible opportunities and threats that it will bring along to the international
401 trade and the environment; currently, there is no substantial data to support either
402 position (Gori, 2016).

403 The effects of the growing importance of the E-commerce on the global trade system
404 are of different types. Economic effects include change in supply chain, company
405 decentralisation, transport modes, changes in competition and in price structure,
406 whilst environmental effects comprise changes in material flows, land use,
407 transportation, energy use and dematerialisation. Along with the economic and
408 environmental effects also social consequences are to be expected, which can include
409 social isolation, change of income disparities and loss of individuality (Sharma, 2005).

410 The Circular Economy Action Plan defined by the Commission in 2015 identifies the
411 path to be followed in order to move towards a sustainable and competitive economy.
412 To this day, the Circular Economy concept has been taken up, studied and developed
413 by many organisations, and a broad range of sustainable solutions have been
414 developed with the aim of "closing the loop", maintaining the value of materials and
415 minimising waste generation and energy consumption along the value chain.

416 At European level, since 2009 the retail sector has committed to join forces and
417 cooperate for contributing to the implementation of the EU Action Plan on Sustainable
418 Consumption and Production and Sustainable Industrial Policy. In this context, the
419 Retail Forum for Sustainability was launched in March 2009 by the European
420 Commission together with EuroCommerce and the European Retail Round Table
421 (ERRT). Concurrently, a number of progressive retailers decided to proactively
422 contribute to the process and launched the Retailers' Environmental Action Programme
423 (REAP) that today focuses precisely on the Circular Economy (EuroCommerce, 2018).

424 The commitment of the retailers on working in the direction of a Circular Economy is
425 now facing the challenges arising from the fast growth of online-based commerce,
426 putting the retailers in an even more difficult position when it comes to balance the
427 market and economic needs to those of the planet. Opportunities and threats for the
428 Circular Economy arising from E-commerce are not easy to classify and assess, since
429 the different and often cascading aspects can have both positive and negative impacts
430 that need therefore to be clearly identified and – if possible - measured. An example
431 can be described with regard to the aspect of transport. A recent study estimates that
432 E-commerce will bring a reduction of 2% in all passenger transport CO₂ emissions in
433 2030 compared to total emissions in 2012 (Smidfelt Rosqvist and Hiselius, 2016). This
434 is due to the fact that consumers use the car less, and generally tend to use
435 alternative transport modes. On the other hand, transport-related emissions might
436 increase due to high return rates of products. In fact, 80% of the index's retailers
437 included in the InternetRetailing Europe (IREU) Top500 index enable shoppers to
438 return items via post (IREU, 2017).

439 Another interesting example is related to the ease with which E-commerce can make
440 products available to people all around the globe. If on the one hand this can allow for

441 a better and easier circulation of sustainable products (in terms of sustainably
442 sourced, manufactured and so on), it can on the other hand facilitate also the diffusion
443 of dangerous materials. Today, in fact, more and more of the dangerous products
444 notified in the Rapid Alert System are sold online (European Commission, 2016a), and
445 this inevitably creates the need for increased control measures to guarantee the safety
446 of consumers and of the environment.

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447 **2 Selection of relevant products for assessment of** 448 **opportunities/threats**

449

450 The assessment of the opportunities and threats for the Circular Economy arising from
451 E-commerce focuses on 7 relevant physical product categories, that are either sold
452 online or in traditional “brick-and-mortar” stores.

453 The final 7 product categories are identified based on a specifically developed
454 methodology with the aim to assess the overall key elements of a product category
455 and to select a final set that allows for a solid and representative assessment of
456 opportunities and threats.

457 The study focuses on product categories (e.g. apparel, furnishings etc.) rather than
458 specific products (e.g. cotton T-shirt, wooden desk etc.) in order to extend the
459 applicability of the analysis of the opportunities and threats to a broader spectrum of
460 products.

461 **2.1 Methodology**

462 The methodology for the selection of the 7 product categories is based on a set of
463 quantitative and qualitative criteria that ensure the inclusion of the following key
464 elements:

- 465 ▪ significant diversity in the type and different impacts on various aspects of the
466 Circular Economy;
- 467 ▪ high relevance on the market, based on purchases’ current data and future
468 trends;
- 469 ▪ different return rates, which can be linked to various factors such as the
470 susceptibility to damage by transport or the need for physical/visual testing;
- 471 ▪ impact of the packaging on different types of products for the shipping of goods
472 sold online, depending on the number of items usually included in a single
473 parcel;
- 474 ▪ data availability from techno-scientific literature;
- 475 ▪ reflection of the consumers’ preferences regarding online and traditional
476 (offline) shopping; and
- 477 ▪ different purchase frequencies.

478 The identified criteria belong to two different groups, one identifying the relevance of
479 the criterion for a specific product category, based either on quantitative or qualitative
480 available information and data (relevance criteria), and the other identifying the
481 differences within the product categories assessed (diversity criteria).

482 Table 1 provides a methodological guidance for the assessment of each criterion,
483 including the following information:

- 484 ▪ the set of criteria developed in relation to the specific key product categories’
485 elements;
- 486 ▪ the information sources used to apply the criterion; and
- 487 ▪ the scoring system, describing how the information or available data covered
488 by the single criteria is transferred into a score on the defined range for each
489 criterion.

490 **Table 1: Methodological guidance for the assessment of the criteria defined for the selection of the final seven product categories**

| Screening criterion | Information source | Explanation | Indicator | Scoring system |
|---------------------------------------|---|--|--|---------------------|
| 1. Product type | | | | |
| 1.1 Product category diversity | <ul style="list-style-type: none"> ▪ CPA ver. 2.1 - Statistical classification of products by activity, category C – Manufactured products ▪ Expert input | <p>To which of the following groups does the product category belong?</p> <ul style="list-style-type: none"> • Accessories and eyewear: A • Apparel and footwear: B • Cultural and recreational goods: C • Food, beverages and tobacco: D • Furnishings: E • Household appliances: F • Information and communication technology: G • Luxury goods: H • Personal and home care: I • Pet foods and supplies: J | <p>Type of indicator: <i>diversity</i></p> <ul style="list-style-type: none"> • Accessories and eyewear <ul style="list-style-type: none"> ○ Accessories ○ Eyewear • Apparel and footwear <ul style="list-style-type: none"> ○ Apparel ○ Footwear • Cultural and recreational goods <ul style="list-style-type: none"> ○ Musical instruments ○ Sports and leisure equipment ○ Toys and games ○ Media and entertainment products/services • Food, beverages and tobacco <ul style="list-style-type: none"> ○ Beverages ○ Fresh fruits and vegetables ○ Non-perishable foods ○ Chilled foods ○ Deep-frozen foods ○ Fresh bakery products ○ Tobacco products • Furnishings <ul style="list-style-type: none"> ○ Major furnishings ○ Small furnishings • Household appliances | A/B/C/D/E/F/G/H/I/J |

| Screening criterion | Information source | Explanation | Indicator | Scoring system |
|------------------------------|---|---|---|---|
| | | | <ul style="list-style-type: none"> ○ Major household appliances ○ Small household appliances ● Information and communication technology <ul style="list-style-type: none"> ○ Major information and communication technology ○ Small information and communication technology ● Luxury goods ● Personal care and home care: <ul style="list-style-type: none"> ○ Cosmetics and personal care ○ Non-prescription pharmaceuticals and healthcare ○ Home and laundry care ● Pet foods and supplies | |
| 2. Market relevance | | | | |
| 2.1 Current purchases | <ul style="list-style-type: none"> ▪ Statista ▪ Destatis ▪ Eurostat ▪ Market reports: e.g. Postnord E-commerce in Europe 2018 | Which are the most relevant product categories based on the total and online market volume? | <p>Type of indicator: <i>relevance</i></p> <p>Relevant product categories Identification, for each product categories and sub-categories the revenue for the off- and online market.</p> | <p>Ranking from 1-26 (numbers of product categories) based on the share of the market volume – for on- and offline.</p> <p>High: ≥ 16 Medium: < 7 to 16 Low: ≤ 7</p> |

| Screening criterion | Information source | Explanation | Indicator | Scoring system |
|--------------------------------|--|--|--|--|
| 2.2. Growth rate | <ul style="list-style-type: none"> Statista Eurostat | Which are the product categories there are increasingly relevant on the online market? | <p>Type of indicator: <i>relevance</i></p> <p>Online growth rate</p> <p>For each product categories and sub-categories, the revenue for the online market is identified and compared to the data from the current purchases. Based on this, the growth rate for each product category for the online market has been identified.</p> | <p>Ranking from 1-26 based on the identified growth rates for the online market.</p> <p>High: ≥ 1.38</p> <p>Medium: <1.38 to 1.2</p> <p>Low: ≤ 1.2</p> |
| 3. Level of circularity | | | | |
| 3.1 Return rates | <ul style="list-style-type: none"> Market reports: e.g. Postnord E-commerce in Europe 2018 Expert/team input | <p>How often do consumers return products purchased online?</p> <p>This criterion covers the return of online purchased goods related to the total amount of online purchased goods.</p> | <p>Type of indicator: <i>diversity</i></p> <p>Return rates</p> <p>Return rate $<10\%$: A</p> <p>Return rate $>10\%$: B</p> | A/B |
| 3.2 Packaging | <ul style="list-style-type: none"> Stakeholder input | <p>During transportation to end users, several secondary or even tertiary types of packaging may be employed, containing one or several smaller items to be shipped together to the same address. How does this reflect on different product categories?</p> | <p>Type of indicator: <i>diversity</i></p> <p>Number of items contained in each parcel</p> <p>1-2 items per parcel: A</p> <p>3-4 items per parcel: B</p> <p>5-6 items per parcel: C</p> <p>> 6 items per parcel: D</p> | A/B/C/D |
| 4. Consumer behaviour | | | | |
| 4.2 Purchase frequency | <ul style="list-style-type: none"> Statista Surveys Expert input | <p>How often do consumers typically purchase certain products or items of a specific product category?</p> <p>Slow Moving Consumer Goods (SMCG): A</p> <p>Fast Moving Consumer</p> | <p>Type of indicator: <i>diversity</i></p> <p>Slow Moving Consumer Goods (SMCG): A</p> <p>This classification refers to products with a typical life time >1 year (e.g. household equipment, furniture,</p> | A/B |

| Screening criterion | Information source | Explanation | Indicator | Scoring system |
|--------------------------|--|---|---|---|
| | | <p>Goods (FMCG): B This is a determining factor for the rotation of products, describing how fast products are sold to the customer.</p> | <p>consumer electronics, etc.) Fast Moving Consumer Goods (FMCG): B This classification refers to products with a typical life time <1 year (e.g. food, beverages, personal care, cleaning and household items, apparel, shoes, tobacco, etc)</p> | |
| 4.3 Consumer preferences | <ul style="list-style-type: none"> Statista Consumer Market Outlook | Do consumers prefer online over traditional retail for certain product categories? | <p>Type of indicator: <i>relevance</i> Average ratio between online and traditional (offline) retail channels in EU-MS per product category. Average ratios are determined by available statistics for EU-MS and refer to the projected reference year 2019 and are based on the share of total revenues of respective market segments.</p> | <p>High: >= 25% purchased online Medium: <25% to 10% purchased online Low: <=10% purchased online</p> |

492 The criteria identified and described in Table 1 have been applied to an initial range of
493 26 product categories selected after a preliminary analysis of information and data
494 availability, as described in Section 2.1.3.

495

496 **2.1.1 Screening criteria used for the selection of the product categories**

497 **Product category type**

498 Product category diversity (*Diversity indicator*)

499 The initial range of 26 product categories has been clustered in 10 groups which
500 aggregate the product categories with similar characteristics (see Table 1). The
501 product categories were assigned with a letter (A to J) which identifies the respective
502 group.

503

504 **Market relevance**

505 The goal of the analysis was to identify relevant product categories in terms of overall
506 share. Therefore, current market data for each of the identified categories (see
507 example in Table 2) were analysed. However, to gain a holistic view on the market the
508 expected online growth rate per product category is also of interest. Due to limited
509 and sources on market development that are either not officially confirmed or not
510 peer-reviewed, data for 2021 rather than 2030 has been chosen to reduce
511 uncertainty.

512 Current purchases (*Relevance indicator*)

513 Data on current purchases reflects the latest information between 2017 and 2019.
514 European databases (Eurostat) and the commercial data service (Statista) were used
515 to identify the market value and share on European level for each product category. In
516 addition, a market report on E-commerce (Postnord, 2018) provided supplementary
517 data. To identify the currently most relevant product categories a ranking was carried
518 out for the total market volume.

519

520 Online purchases growth rate (*Relevance indicator*)

521 To determine the product categories with the highest online sales growth rates the
522 absolute market shares of the online market for 2019 and 2021 are compared. The
523 growth rates are classified as high, medium or low, as described in Table 1.

524 **Table 2: Example of market relevance data on EU-28 level for the year 2019 and 2021**

| Product | 2019 | | | 2021 | | |
|----------|-------------------------|-------------------------|--------------------------|-------------------------|-------------------------|--------------------------|
| | Total revenues [mio. €] | Offline revenues [in %] | Online revenues [mio. €] | Total revenues [mio. €] | Offline revenues [in %] | Online revenues [mio. €] |
| Apparel | 393,946 | 81 | 74,850 | 407,826 | 79 | 85,643 |
| Footwear | 100,196 | 81 | 19,037 | 105,978 | 79 | 22,255 |
| ... | | | | | | |

525

526 **Level of circularity**

527 In currently widely suggested and applied definitions, e.g. in (Pauliuk, 2018), the
528 "circularity" of products is based on e.g. their weight share of recycled material

529 content of the entire product and/or on their material recyclability. Assuming,
530 however, that the tangible products sold via E-commerce vs. via conventional
531 commerce are the same, i.e. remain unchanged, differences in the circularity of either
532 type of commerce can only arise from the systems surrounding the products, i.e. from
533 the efforts for transportation, storage, packaging, etc. For the screening of product
534 categories, particular interest is thus set on the return rate of products and on the
535 amounts of packaging used, since both are considered to be drivers for the circularity
536 of the surrounding systems.

537

538 Return rates (*Diversity indicator*)

539 The return rate is the rate at which products that had physically arrived at an end user
540 are returned back towards the retailer. For the product category screening, no
541 distinction is made how far the product reaches back and thus what transport work is
542 involved – e.g. just back to a central storage facility or even all the way back to e.g. a
543 remanufacturing site. Interesting is rather the diversity of return rates among the
544 screened product categories in order to identify most relevant ones.

545 Main data source for the return rate is the latest PostNord report 2018 (PostNord,
546 2018). It provides return rates for 12 European countries. The category “apparel &
547 footwear” has the highest average return rate, at more than 19%, and “home
548 electronics” at some 6.5%. Lowest average return rates are below 2%, e.g. for “sports
549 equipment”.

550 For the screening, return rates were grouped and ranked into “up to 10%” and “above
551 10%”.

552

553 Packaging (*Diversity indicator*)

554 Necessary packaging efforts vary in principle depending on the robustness of the
555 product itself, e.g. a TV set requiring shock-proof packaging while a pair of jeans does
556 not. Also, the type of packaging and employed material types differ since some
557 products come with primary packaging, e.g. a printed, glossy cardboard box for a TV
558 or a plain cardboard box for a pair of shoes, and some don't need packaging at all,
559 e.g. books or clothes. During display in physical shops and transportation to end
560 users, several secondary or even tertiary types of packaging may be employed, e.g.
561 polystyrene chips inside a large corrugated cardboard box containing one or several
562 smaller items to be shipped together to the same address.

563 It is indeed interesting to identify this diversity in (i) the packaging as such and (ii)
564 the generic packaging differences between the two types of commerce. Due to the
565 lack of available robust data, though, assessing this criterion in the screening is
566 limited to the information received from the stakeholder survey (Section 2.2).
567 Additionally, a stakeholder dialogue was conducted later in the detailed assessment
568 process, providing the opportunity to identify more robust data for the selected
569 product categories.

570

571 **Consumer Behaviour**

572 Purchase frequency (*Diversity indicator*)

573 The frequency with which a product is purchased by the consumer is one of the factors
574 that influences the magnitude and type of impacts on the Circular Economy of a
575 certain product. The distinction between products with a longer or shorter life time
576 reflects in different ways on aspects such as transportation, packaging, end-of-life etc.

577 In order to take this into account the identified product categories have been classified
578 as belonging to one of the following groups, describing how fast products are sold to
579 the customer:

- 580 ▪ Slow Moving Consumer Goods (SMCG): this classification refers to products
581 with a typical life time >1 year (e.g. household equipment, furniture, consumer
582 electronics, etc.); and
- 583 ▪ Fast Moving Consumer Goods (FMCG): this classification refers to products with
584 a typical life time <1 year (e.g. food, beverages, personal care, cleaning and
585 household items, apparel, shoes, tobacco, etc.).

586 The classification was based on available data from the commercial Statista database.

587

588 Consumer preferences (Relevance indicator)

589 The consumer preference indicator's aim is to take into account the relevance of a
590 certain product category on the online market and therefore to identify those product
591 categories that consumers prefer to purchase online. The indicator identifies the
592 average ratio between online and traditional (offline) retail channels in EU Member
593 States per product category. Average ratios are determined by available statistics for
594 EU Member States (Statista Consumer Market Outlook), refer to the projected
595 reference year 2019 and are based on the share of total revenues of respective
596 market segments. Product categories have been classified as having high, medium or
597 low relevance as described in Table 1.

598 **2.1.2 Criteria excluded from the application of the methodology**

599 The first concept of the methodology for the selection of the 7 products initially
600 included two diversity criteria, "niche or common product" and "basket size", that
601 have been subsequently excluded from the screening, due to the following reasons:

- 602 ▪ Common or niche product (Diversity indicator): This diversity criterion aimed at
603 including in the final selection product categories that count not only common
604 goods but also product categories which include goods or services with features
605 that appeal to a particular market subgroup (niche market). Nevertheless, the
606 broad spectrum of products covered by each of the product categories
607 identified in the initial set made the classification into common or niche product
608 not feasible for most of the product categories, since they could contain both
609 common and niche products, depending on the type, brand and specific
610 characteristics; and
- 611 ▪ Basket size (Diversity indicator): An average basket size refers to the number
612 of unique items purchased by a customer in one visit, online or at a traditional
613 store, and correlates with corresponding revenues. Due the lack of available
614 data from literature, databases and stakeholder input (see Section 2.2 for the
615 results of the stakeholder survey), this criterion has been excluded from the
616 final screening.

617 **2.1.3 Selection of the initial range of product categories**

618 The criteria identified for the selection of the final 7 product categories have been
619 applied on an initial range defined on the basis of the European integrated system of
620 statistical activity and product classifications. Based on the availability of statistical
621 data on a European and country level, the category C "Manufactured products" of the
622 Classification of Products by Activity (CPA, ver. 2.1) was selected as main reference
623 for the identification of the initial range of product categories.

624 In order to obtain an initial range of product categories with a non-negligible relevance
625 on the online market and with a sufficient data availability to allow for the
626 implementation of the subsequent stages of the study, a preliminary screening of
627 available data and information was done based on available reports and databases.

628 As a starting point for the data availability check and the actual collection of data and
629 information on the initial set of product categories and screening criteria, the selection
630 of 5 main European countries was carried out. The aim was to explore possible
631 regional differences in Europe that may affect opportunities/threats and to identify the
632 countries that could be used as a reference in the different stages of the study for
633 data gathering in case Europe-wide data is not available. For each of the 5 subregions
634 of Europe according to the Eurovoc classification (Central Europe, Eastern Europe,
635 Northern Europe, Southern Europe and Western Europe), a country was selected as a
636 representative for that specific subregion. The following factors, all weighted equally,
637 were taken into account: share of online buyers, overall consumer spending, overall E-
638 commerce growth rate and actual spending in the E-commerce. E.g. the population
639 data was gathered for all countries (see second column in Table 3). Each country was
640 ranked (1-27) and the individual rank divided by the total sum of the ranks
641 (1+2+...27=378). The ranking calculation was conducted for each parameter
642 separately and an overall average was formed from the results (e.g. Bulgaria with
643 0.039). To derive the actual overall rank of each country, the country with the lowest
644 sum as per the calculation described above was assigned with the overall rank number
645 1.

646 **Table 3: Example of factor and data considered to identify the relevant countries**

| Country | Population [mio. €, 2017] | Share of online buyers [in %] | Consumer spending [mio. €] | E-commerce Growth [% , 2017] | E-GDP [mio. €] | Rank |
|-----------------------------------|---------------------------|-------------------------------|----------------------------|------------------------------|----------------|------|
| Central and Eastern Europe | | | | | | |
| Bulgaria | 7.06 | 11 | 31,251 | 22 | 359 | 18 |
| Croatia | 4.15 | 21 | 27,250 | 11 | 243 | 26 |
| ... | ... | ... | ... | ... | ... | ... |

647 By this approach the following five countries were identified:

- 648
- 649 • Central and Eastern Europe: Poland;
 - 650 • Northern Europe: Sweden;
 - 651 • Southern Europe: Spain; and
 - 652 • Western Europe: France and Germany.

653 The list of the 26 initial product categories selected is provided by Table 52 in Annex
654 1, together with an overview of the different products included in each category with
655 respect to different sources of statistical and market data.

656

657 **2.1.4 Selection of the final 7 product categories**

658 The selection of the final 7 product categories was performed via a cascade process
659 made up of consecutive screening rounds. The first two rounds were based on the two
660 relevance criteria "current market relevance" and "consumer preferences", while the
661 following ones took into consideration the diversity criteria in order of diversity degree

662 (number of sub-categories identified by the criterion). The selection of a final number
663 of 7 products was reached after a total of 5 screening rounds:

- 664 1. Current market relevance (relevance indicator): assessment performed on the
665 first 10 product categories for current market relevance in terms of total (online
666 and offline) revenues;
- 667 2. Consumer preferences (relevance indicator): assessment performed on the
668 product categories with current (2019) high share of online purchases based on
669 total revenue;
- 670 3. Consumer preferences (diversity indicator): assessment performed on the product
671 categories with current (2019) medium share of online purchases based on total
672 revenues;
- 673 4. Product diversity (diversity indicator): assessment performed on the product
674 categories selected after the previous screening rounds; and
- 675 5. Packaging (diversity indicator): assessment performed on the product categories
676 selected after the previous screening rounds.

677 In each of the first 3 screening rounds, the selection, exclusion or dragging on to the
678 next screening round of the product categories has been based on the combined
679 assessment of the three criteria "current market relevance", "growth rate" and
680 "consumer preferences" and as illustrated in Table 53 in the Annex.

681 Eventually, the selected product categories have been screened against the two
682 remaining diversity indicators "return rates" and "purchase frequency".

683

684

685 **2.2 Stakeholder consultation for the selection of relevant product** 686 **categories**

687 During this first stage of the study, relevant stakeholders have been selected and
688 consulted in order to close existing data gaps and provide a direct input on relevant
689 characteristics of specific product categories sold online.

690 The stakeholder consultation was carried out via an online survey providing 5
691 multiple-choice core questions. The core questions focused on the online market
692 relevance, the basket size, the packaging and the return frequency of the first gross
693 set of product categories (see Table 52 in the Annex):

- 694 1. Do you agree with the following statement: Today, the following products are
695 mainly sold online?
- 696 2. Do you agree with the following statement: In 2030, the following products are
697 mainly sold online?
- 698 3. The average basket value of online purchases compared to offline (in a physical
699 store) purchases is...
- 700 4. How many items does one parcel contain on average?
- 701 5. What is the average ratio between returned parcels and delivered parcels?

702 The stakeholders were requested to answer the questions only with regards to the
703 product categories for which they had confirmed, at the beginning of the
704 questionnaire, to have specific experience.

705 The invitation to participate in the online survey was sent out to 40 stakeholders,
706 including:

- 707 ▪ E-commerce platforms;
708 ▪ consumers associations;
709 ▪ omni-channel retailers;
710 ▪ producers associations;
711 ▪ retailers associations;
712 ▪ trade associations;
713 ▪ NGOs; and
714 ▪ manufacturers.

715 35% of the stakeholders invited to the survey accepted to participate and filled in the
716 questionnaire. Respondents belong to associations, omni-channel retailers, online
717 platforms and other sectors, with experience in all the product categories included in
718 the initial set. Most of the respondents have a turnover higher than 500 million euros
719 and provide a comprehensive geographical coverage, operating not only in Europe but
720 also in other continents (see Figure 1).

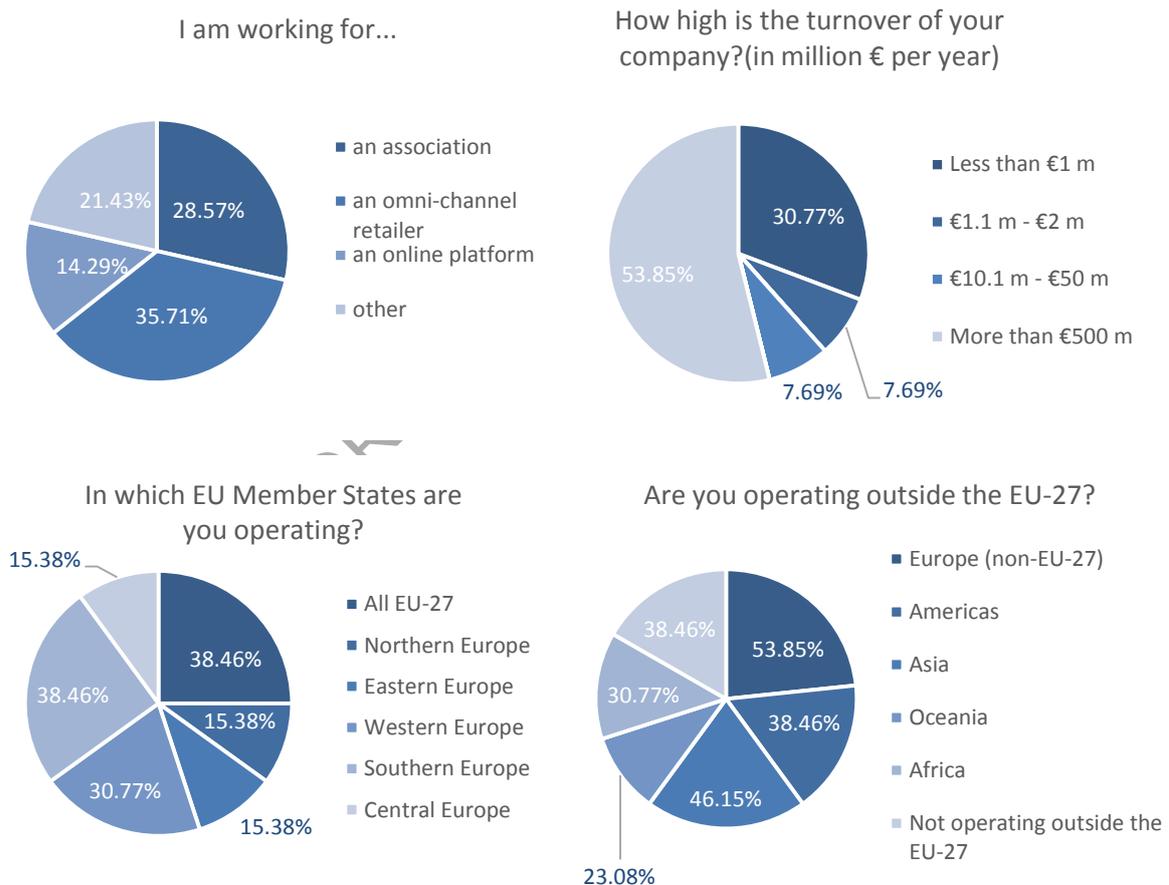


Figure 1: Key facts about respondents of the stakeholder online consultation.

721

722 The stakeholders' answers on questions number 1 and 2 about the current and future
723 share of products sold online were mostly in line with the information and data

724 collected with regard to the criterion "Market relevance" (see Section 2.1.1), although
725 some contrasting feedbacks were registered.

726 As regards question number 3 on the average basket size, most of the respondents
727 were not able to provide a specific answer. Due to the lack of data, this criterion has
728 therefore been excluded from the application of the methodology for the selection of
729 the final 7 product categories, as already described in Section 2.1.2.

730 The respondents provided a good feedback on questions 4 and 5 regarding parcel
731 composition and return ratio, allowing to close data gaps on various product
732 categories and to use the information provided for the final selection of the product
733 categories.

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734 **2.3 Results**

735 The final 7 product categories selected are reported in the **Table below**. A more
736 comprehensive and detailed table is provided in the Annex (Table 51).

737 **Table 4: Overview of the selected product categories.**

| Product categories | Current market relevance (total mio €) | Growth rate (online) | Consumer preferences (% for online purchases) | Packaging (Nr. of items per parcel) | Product type | Returns rates (%) | Purchase frequency (SMCG/FMCG) | |
|--|--|----------------------|---|-------------------------------------|--------------|-------------------|--------------------------------|--------------|
| Accessories | 53,209 | 1.15 | 22% | n/a | A | n/a | SMCG | Value |
| | medium | low | medium | | | | A | Score |
| Apparel | 393,946 | 1.14 | 19% | 3-4 | B | 19.3% | FMCG | Value |
| | high | low | medium | B | | B | B | Score |
| Major furnishings | 252,140 | 1.25 | 9% | > 6 | E | 1.9% | SMCG | Value |
| | high | medium | low | D | | A | A | Score |
| Major household appliances | 32,532 | 1.18 | 37% | 1-2 | F | 6.5% | SMCG | Value |
| | low | low | high | A | | A | A | Score |
| Media and entertainment products/services | 18,870 | 1.55 | 60% | 1-2 | C | 1.3% | FMCG | Value |
| | low | high | high | A | | A | B | Score |
| Non-perishable food | 247,157 | 1.30 | 3% | > 6 | D | < 10% | FMCG | Value |
| | high | medium | low | D | | A | B | Score |
| Small information and communication technology | 120,570 | 1.16 | 36% | 1-2 | G | 6.5% | SMCG | Value |
| | high | low | high | A | | A | A | Score |

738

739

740

741

742 **3 Identification and description of opportunities and**
743 **threats for the Circular Economy arising from E-**
744 **commerce**

745 The present section focuses on the identification and description of opportunities and
746 threats for the Circular economy that are arising from E-commerce, with the objective
747 to achieve the best possible balance between positive and negative aspects. A threat
748 is defined here as an aspect that potentially negatively influences the Circular
749 Economy, while an opportunity has a potential positive impact.

750 The approach used for identifying relevant opportunities and threats is described in
751 Section 3.1.

752 The identified threats and opportunities are described in detail in Section 3.2.

753 **3.1 Methodology**

754 To identify opportunities and threats for the Circular Economy arising from E-
755 commerce, different steps were applied:

756 Step 1: Literature research;

757 Step 2: Systematic classification of identified opportunities and threats;

758 Step 3: Evaluation of relevance of identified opportunities and threats with regard to
759 selected product categories; and

760 Step 4: Stakeholder consultation.

761 **3.1.1 Step 1. Literature research**

762 As a first step, a literature research of primary and secondary sources as well as
763 relevant market reports dealing with the topic in scope, was carried out with the aim
764 of identifying potential threats and opportunities of E-commerce for the Circular
765 Economy and system boundaries.

766 A list of literature used for the identification and description is provided at the end of
767 each threat and opportunity in Section 3.2. A complete literature overview is included
768 in Section 7 of this report.

769 The literature research further included the identification of so-called E-commerce
770 features, which can be seen as the point of origin of potential threats and
771 opportunities and identify certain peculiarities that distinguish E-commerce from
772 traditional commerce. The E-commerce features can roughly be grouped into technical
773 features and more general features. Examples of technical features are the search
774 engine function, which enables a fast search for certain products, or the e-payment,
775 content management, data analytics, product visualisation, but also the ubiquity of E-
776 commerce which mainly stems from mobile connectivity and high data rates (Junglas
777 and Watson, 2003). Some characteristics of E-commerce, however, are not directly
778 linked to its technical implementation and are therefore referred to as general
779 features, such as parcel delivery or return of parcels.

780 **3.1.2 Step 2. Systematic classification of identified opportunities and threats**

781 As a second step, a systematic 4-stage classification was carried out for each of the
782 threats and opportunities to ensure a clear differentiation between each other. The
783 classification included the assignment of opportunities and threats to:

784 1. environmental effects of E-commerce (direct and indirect effects);

- 785 2. life-cycle stages within system boundaries set;
786 3. E-commerce features; and
787 4. additionality of opportunities and threats.

788

789 **Environmental effects (direct and indirect) of E-commerce**

790 In the context of this assessment, E-commerce is primarily understood as the
791 possibility to support, change or replace certain commercial and economic processes
792 in the domain of sales and procurement through the application of information and
793 communication technologies (ICT). In essence, E-commerce encompasses many of the
794 potential and typical ICT effects, such as virtualisation of products, dematerialisation
795 of transport, reduction of warehouse spaces, and shortening of supply chains
796 (Börjesson Rivera *et al.*, 2014). Yet, it is crucial to differentiate between parallel and
797 often not clearly separable effects arising from other applications of ICT, such as
798 overriding digitalisation effects.

799 Environmental effects of ICT are commonly classified into first (direct)-, second
800 (enabling)-, and third (systemic)-order effects (Hilty and Aebischer, 2015). This
801 classification scheme has been evolved in academia as to facilitate holistic
802 assessments of specific ICT applications. While this approach was adopted by several
803 studies (Fichter, 2001, 2002; Berkhout and Hertin, 2004; Dost and Maier, 2018) to
804 assess environmental effects of E-commerce, it can be argued that this detailed
805 distinction is sometimes difficult and not necessarily useful (Börjesson Rivera *et al.*,
806 2014). Moreover, environmental effects arising from E-commerce are not solely
807 related to the application of ICT but may be the result of accompanying developments
808 within other domains (e.g. transport, packaging, digitalisation of services).

809 Due to the potential of ICT applications, and E-commerce in particular, to exhibit
810 cascading environmental effects – both negative and positive – this study seeks to
811 differentiate between direct and indirect effects. This methodological approach allows
812 for a holistic assessment and enables decision-making at different levels of society.
813 Hence, opportunities and threats are classified following the distinctive attribution
814 criteria in Table 5. It is evident that all effects are interdependent and interwoven
815 which sometimes makes an unambiguous classification impossible (Börjesson Rivera
816 *et al.*, 2014). Nevertheless, this methodological choice is crucial in the light of
817 subsequent in-depth assessments of those effects (see Section 4).

818 **Table 5. Attribution criteria of direct and indirect environmental effects arising from E-commerce**

| Direct Opportunities/Threats | Indirect Opportunities/Threats |
|--|--|
| Consequential and immediate effects: <ul style="list-style-type: none"> • intended positive effects • anticipated or existing negative effects | Hypothetical and/or long-term effects (negative or positive) |
| Effects can be allocated to one fulfilled unit or the purchase of a single product | Effects are rather systemic and cannot be allocated to the purchase of one single product (rather the result of cumulated purchases) |
| Inherent E-commerce features with high relevance for E-commerce business models | Supplementary (secondary) developments due to E-commerce features and evolving business models |

| Direct Opportunities/Threats | Indirect Opportunities/Threats |
|---|--|
| Effects are mainly within the sphere of influence of E-commerce providers | Effects are mainly outside the sphere of influence of E-commerce providers and/or in the sphere of both E-commerce providers and other actors/stakeholders |
| Characteristic of current situation and further persistence in future scenarios | Emerging or ongoing effects with potentially high relevance in the future |

819

820 **Life-cycle stages within system boundaries**

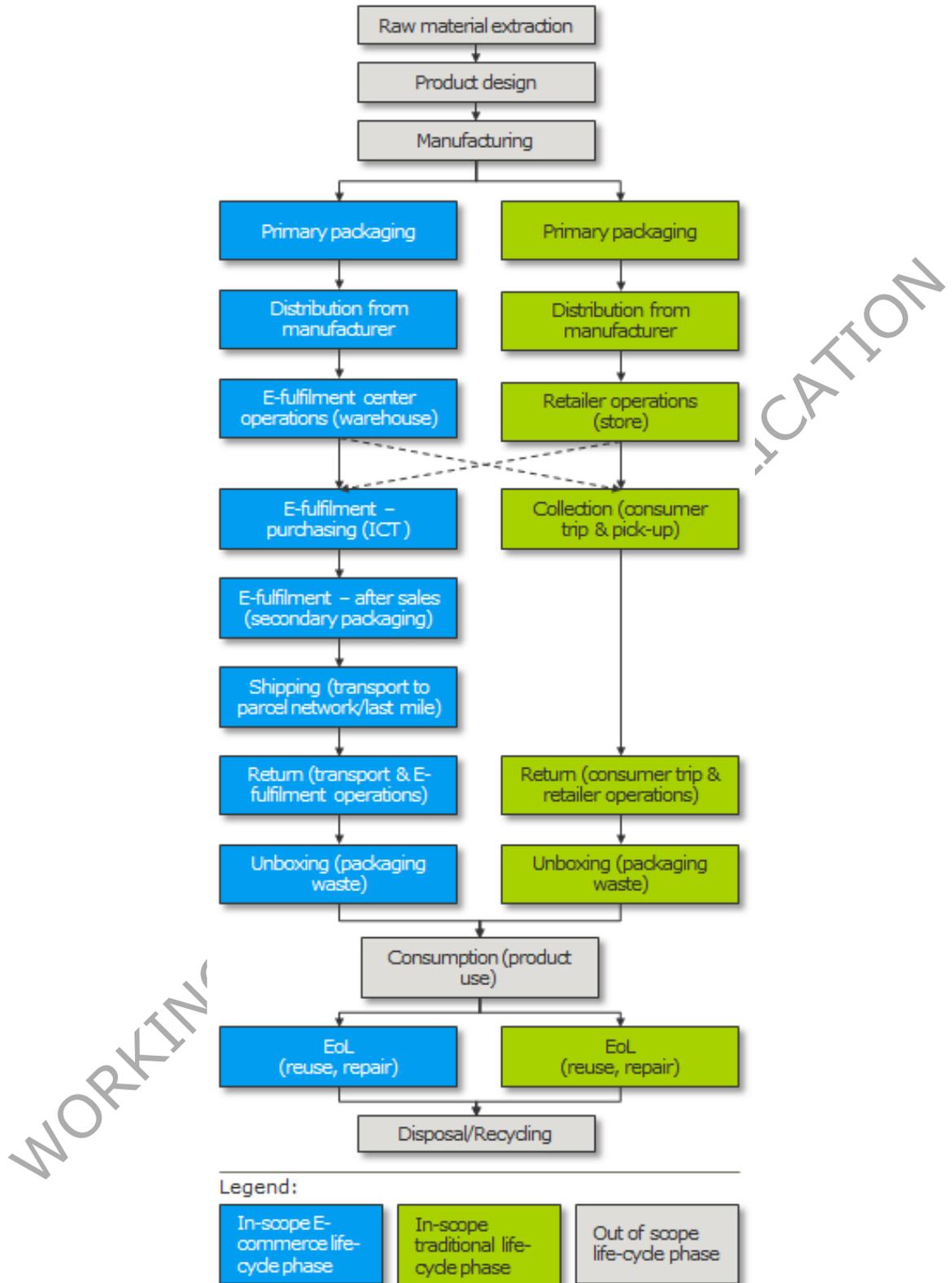
821 Typically, environmental impacts or Circular Economy aspects associated with the
822 fulfilment of a purchased item are compared from the point of divergence (e.g.
823 manufacturer’s outbound operation) to the point of consumption (Van Loon et al.,
824 2015). Consequently, impacts related to the production and actual consumption or use
825 of the products or services are excluded as those are generally not affected by the
826 chosen fulfilment channel. The same argumentation generally applies to primary
827 packaging which is considered an indistinguishable part of the products and thus not
828 assessed in this study. However, the adoption by online platforms in collaboration with
829 manufacturers of specific initiatives aimed at reducing the layers of packaging needed
830 for the shipping (e.g. Amazon’s Frustration Free Packaging Program) are taken into
831 account within the relevant opportunities and threats as factors that may influence the
832 impacts of secondary and tertiary packaging.

833 Given the circumstance that many of the changed or substituted processes are similar
834 throughout the product categories, a universal and modular reference model was
835 adopted (see Figure 2). A common reference model ensures a consistent and efficient
836 assessment of numerous E-commerce effects – both opportunities and threats – on
837 relevant Circular Economy aspects related to the various life-cycle stages attributable
838 to E-commerce.

839 Inevitably, a comparative analysis of the traditional retail channel and E-commerce
840 necessitates to draw somewhat artificial boundaries between these often-overlapping
841 domains (e.g. flag ship stores offering shipping services to customers). While in reality
842 E-commerce clearly intersects with established structures and processes, the proposed
843 reference model tries to untangle dedicated processes and attribute them to one or
844 the other channel. For this purpose, the dominating flow of products through the value
845 chain is assumed for both channels, as visualized in Figure 2. It is evident though, that
846 there are numerous alternative supply chain options within both scenarios (e.g. online
847 purchase and subsequent pick-up in a nearby store, also referred to as “click &
848 collect”) (Van Loon *et al.*, 2015). Such deviations to the assumed flows of products
849 may be the subject of certain opportunities and threats.

850 The product life-cycle stages are included in the following description of opportunities
851 and threats in order to highlight where certain threats and opportunities potentially
852 exert a positive or negative impact.

853



854

855

856

857

Figure 2. System boundaries and value chain differences for the identification of opportunities and threats and the in-depth assessment (own depiction).

858 **E-commerce features**

859 The identified opportunities and threats have been assigned to one or more of the E-
860 commerce features, as described above and identified during Step 1. The list of E-
861 commerce features identified is provided in Table 6 below.

862 **Table 6: E-commerce features**

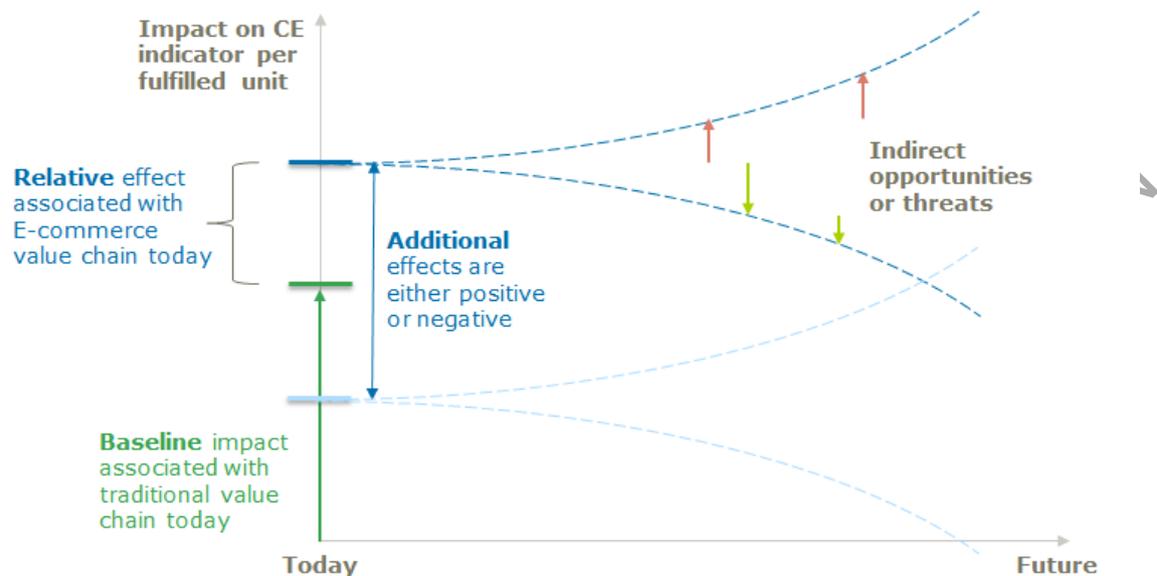
| E-commerce features | Examples |
|---|---|
| Online shops and platforms | Operation of ICT infrastructure, substitution of physical shops |
| Automatisation of processes | Market transparency, just in time (JIT) manufacturing, additional data centre capacities |
| Automatisation of data analytics | Increased availability of data on purchases |
| Availability of information | Availability of information on specific product's features, immediate price and features comparison |
| Availability of products | Increased availability of products coming from distant countries, sustainable products etc. |
| Digital and mobile connectivity | Simplicity of user interface and ease of use |
| Digital purchasing and transaction process | Availability of diverse online purchasing options, preset options |
| Easier/broader market access | Low barrier to market entry, low transactions costs |
| Shipping of products | Use of packaging, induced parcel transport, return policies, take-back programmes |

863

864 **Additionality of opportunities and threats arising from E-commerce**

865 By acknowledging evident intersections between E-commerce and traditional brick-
866 and-mortar channels as well as highly dynamic developments within both value
867 chains, a methodological choice was deemed necessary in order to make fair
868 comparisons and draw valid conclusions. For this purpose, the traditional value chain
869 was assumed to be static and therefore being applicable as a point of reference for
870 identifying, describing, and assessing opportunities and threats. Consequently, all
871 opportunities or threats are understood as additional. This means that any direct
872 opportunity or threat arising from E-commerce results in either a reduction or an
873 increase of a given Circular Economy indicator compared to the baseline which is
874 generally determined by simultaneously occurring impacts associated with the
875 traditional value chain (see Figure 3). Due to highly complex structures and
876 uncertainties it is, however, often not possible to quantify this baseline. As a
877 consequence, the absolute effect or extent of impact a certain direct opportunity or
878 threat poses to the baseline may remain unclear or vague. Future developments are
879 considered at least equally vague and are by definition highly speculative, in particular
880 within E-commerce value chains. Such hypothetical and rather long-term effects are
881 subsumed under the category of indirect opportunities or threats (see also Table 5).
882 Moreover, these indirect opportunities and threats are expected to influence the future
883 development of a given Circular Economy indicator within E-commerce value chains.
884 Indirect opportunities and threats are often rather systemic, which in many cases
885 prohibits comparisons to a static remaining baseline.

886 Figure 3 illustrates how direct opportunities and threats are generally positioned
887 relative to the baseline (brick-and-mortar) as well as how indirect opportunities and
888 threats may influence the future development of a given Circular Economy indicator.
889



890

891 **Figure 3. Illustration of additional opportunities and threats and influencing factors on**
892 **future development (indirect threats symbolised by red arrows, indirect opportunities by green**
893 **arrows) (own depiction).**

894

895 **3.1.3 Step 3: Evaluation of relevance of identified opportunities and threats** 896 **for selected product categories**

897 Step 3 of the methodology consisted in evaluating the relevance of each threat and
898 opportunity for the 7 product categories selected (see Section 2). It should be noted
899 that the approach was to identify threats and opportunities in relation to a specific
900 product category and therefore to allow for a meaningful in-depth assessment.
901 However, a large number of opportunities and threats apply simultaneously to several
902 product categories, sometimes with different intensity. The threat “parcel return”, for
903 example, occurs for nearly all product categories in scope (excluding digital media)
904 but is more pronounced for e.g. the category apparel than for large household
905 appliances (Statista, Retouren im Online-Handel, 2018).

906

907 **3.1.4 Step 4: Stakeholder consultation for the definition of the final list of** 908 **opportunities and threats**

909 **Second online stakeholder survey**

910 After having defined the list of opportunities and threats followed by the evaluation of
911 relevance described in Step 3, a second online stakeholder survey was launched with
912 the following objectives:

- 913 ▪ obtaining feedback on the relevance of the individual opportunities and threats
914 identified, with particular focus on the selected 7 product categories; and

915 ▪ gathering suggestions on potential additional opportunities and threats deemed
916 relevant by the stakeholders but not yet included in the list.

917 The invitation to participate in the online survey was sent out to 85 stakeholders
918 belonging to different sectors. Compared to the first survey, a higher number of
919 stakeholders was invited, due to the broader scope of the consultation.

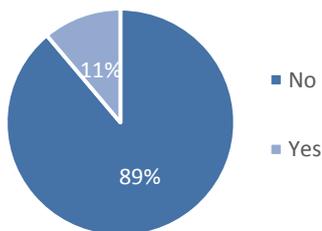
920 The stakeholders were provided with the following 4 core open questions:

- 921 1. Do you miss one or more important opportunities in the provided list?
922 2. Do you have any comments to one or more opportunities from the provided
923 list?
924 3. Do you miss one or more important threats in the provided list?
925 4. Do you have any comments to one or more threats from the provided list?

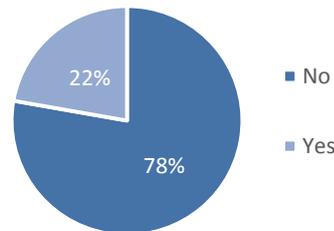
926 59% of the stakeholders invited participated in the survey and 68% of them provided
927 comments to at least one of the 4 core questions, for a total of 48 comments
928 provided. Respondents belong to associations, omni-channel retailers, online
929 platforms, manufacturers, NGOs and logistics service providers. Most of the
930 respondents have a turnover higher than 500 million euros and provide a
931 comprehensive geographical coverage, operating not only in Europe but also in other
932 continents.

933 The answers to questions no. 1 and 3 about the identified opportunities and threats
934 showed an overall agreement of the stakeholders with the proposed list, with 89% of
935 the respondents satisfied with the provided list of opportunities, and 81% satisfied
936 with the list of threats.

Do you miss one or more important **opportunities** in the provided list?

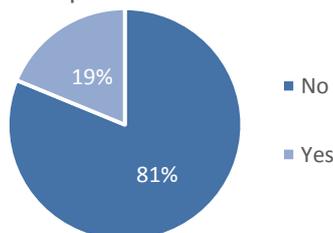


Do you have any comments to one or more **opportunities** from the provided list?

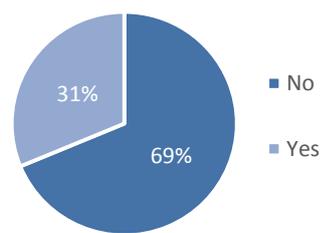


937

Do you miss one or more important **threats** in the provided list?



Do you have any comments to one or more **threats** from the provided list?



938

939 **Figure 4: Overview of stakeholders' answers to the 4 core questions of the second stakeholder**
940 **online consultation**

941 The 48 comments provided aimed mostly at clarifying relevant aspects of the
942 identified opportunities and threats, i.e. highlighting possible drawbacks of certain
943 opportunities or providing information on the context and background of specific
944 threats. All the comments have been screened and taken into consideration for the
945 Stakeholder Workshop and in the final selection and description of the opportunities
946 and threats.

947 In particular, two new opportunities and one new threat for the Circular Economy
948 arising from E-commerce have been identified thanks to the survey:

- 949 ▪ Extended product selling cycle (Opportunity);
- 950 ▪ Optimisation of packaging (Opportunity); and
- 951 ▪ Plastic packaging (Threat).

952 The newly identified opportunities and threats have been added to the initial database
953 and have been directly discussed with the stakeholders during the Stakeholder
954 Workshop in Seville.

955

956 ***Stakeholder Workshop (Seville, 20-21 May 2019)***

957 The present study was further presented to the relevant stakeholders during a
958 dedicated workshop which took place in Seville on 20-21 May 2019. Aim of the
959 workshop was to provide the stakeholders with further details on the study, including
960 the background, the methodology used for the different work steps and the set
961 boundaries and limitations, and to gather their feedback on the proposed list of
962 opportunities and threats.

963 13 stakeholders belonging to online platforms, trade and retail associations, NGOs,
964 producer responsibility organisations, collection and recycling associations and product
965 category associations participated in the workshop³.

966 The stakeholders, which were divided into 2 groups and supported by the members of
967 the project team, were guided through a discussion on the proposed list of
968 opportunities and threats during 3 breakout sessions and one plenary session
969 throughout the 2 workshop days.

970 On the first day the stakeholders were asked to comment and discuss each of the
971 identified opportunities and threats, while on the second day they were invited to
972 group the opportunities and threats by topic (cluster) and to rank them by relevance.
973 While the clustering was done by group, the stakeholders were asked to rank the
974 opportunities and threats individually. The results of the clustering and ranking of
975 opportunities and threats have been taken into account for the in-depth assessment
976 presented in Section 4.

977 The outcomes of the discussions showed a very high degree of interest and
978 engagement of the stakeholders in the study. In the following, the main outcomes of
979 the workshop are summarized by topic.

980 Topic: New opportunities and threats identified

981 Four new opportunities and three new threats were identified directly by the
982 stakeholders during the workshop, namely:

³ See Section 8 for the detailed list.

- 983 ▪ Big data / meta data (opportunity);
- 984 ▪ eWOM⁴ / Product reviews (opportunity);
- 985 ▪ Innovation (opportunity);
- 986 ▪ More services (opportunity);
- 987 ▪ End-of-life challenges (threat);
- 988 ▪ Difficulty to monitor (threat); and
- 989 ▪ Enforcement (threat);

990 All the above-listed opportunities and threats have been taken into account in the
991 following steps of the study. The two opportunities “eWOM / Product reviews” and
992 “More services” have been respectively described as part of the two opportunities
993 “Availability of information” and “Sharing models and services”, while the other ones
994 have been added in the final list as stand-alone opportunities/threats.

995 Topic: Proposed list of opportunities and threats

996 The proposed list of opportunities and threats was considered overall comprehensive,
997 although some opportunities/threats were ranked by different stakeholders with a
998 different level of relevance, in some cases even opposite. The most controversial
999 opportunities/threats were the following:

- 1000 ▪ Big data / meta data (new opportunity defined by some stakeholders directly
1001 during the workshop);
- 1002 ▪ eWOM / Product reviews (new opportunity defined by some stakeholders
1003 directly during the workshop);
- 1004 ▪ more services (new opportunity defined by some stakeholders directly during
1005 the workshop);
- 1006 ▪ Damage on delivery;
- 1007 ▪ Secondary packaging; and
- 1008 ▪ Try-and-buy outlets.

1009 Topic: Clustering of opportunities and threats

1010 The two stakeholder groups aggregated the identified opportunities and threats
1011 (including the 7 new ones identified during Day 1) into similar clusters, that were
1012 combined into the final list used for the in-depth assessment and for the presentation
1013 of the opportunities and threats in Section 3.2. The clusters proposed by the
1014 stakeholders and the final list are provided in the Table 7 below.

1015 **Table 7: Clusters proposed during the workshop and final list**

| Proposal Group 1 | Proposal Group 2 | Final clusters |
|------------------------------|-------------------|-------------------------------------|
| Accessibility of information | Access to data | Accessibility of information |
| Consumer needs and behaviour | Consumption | Consumer needs and behaviour |
| Others | Others | Digitalisation |
| Start-up | | |
| End of life | Increase of waste | End of life |

⁴ Electronic word-of-mouth: defined here as any informal communications directed at consumers through internet-based technology related to the usage or characteristics of a particular product or company.

| Proposal Group 1 | Proposal Group 2 | Final clusters |
|--------------------------------|------------------------------|--------------------------------|
| | Take-back (closing the loop) | |
| Legal framework | Compliance | Legal framework |
| | Enforcement | |
| Logistics and transport | Transport | Logistics and transport |
| Returns | Supply chain | |
| Packaging | Resources | Packaging |

1016

1017 Topic: Assessment of the effects of the identified opportunities and threats on the
1018 Circular Economy

1019 The assessment of the effects of the identified opportunities and threats on the
1020 Circular Economy was recognised as a delicate and challenging task, due to the
1021 number of actors involved in the E-commerce value chain, the subsequent
1022 fragmentation and the lack of available data.

1023

1024 ***Combined results of second stakeholder survey and stakeholder workshop:***
1025 ***relevance of the identified opportunities and threats***

1026 The inputs collected from the stakeholders via the second survey and the stakeholder
1027 workshop have been compared and combined in order to gather an overview of the
1028 relevance of the identified opportunities and threats from the stakeholders'
1029 perspective. The results are reported in the Table below as well as in Section 5.2
1030 where they are compared with the outcomes of the in-depth assessment.

1031 **Table 8: Relevance of opportunities and threats based on the combined stakeholders' input from**
1032 **the second survey and the workshop**

| O/T | Name of the opportunity/threat | Cluster | Relevance from stakeholder consultation |
|-----|--|------------------------------|---|
| T | Induced parcel transport | Logistics and transport | high |
| T | Parcel return | Logistics and transport | high |
| O | Product take-back | End of life | high |
| T | Waste from returns | End of life | high |
| T | Lack of compliance with common market regulation | Legal framework | high |
| T | Difficulty to monitor | Legal framework | high |
| T | Enforcement | Legal framework | high |
| T | EPR free-rider effect | Legal framework | high |
| T | Excessive protective packaging | Packaging | high |
| O | Market access to online aftermarket | Accessibility of information | medium |
| O | Innovation | Accessibility of information | medium |
| O | Sharing models and services | Consumer needs and behaviour | medium |
| O | Second-hand E-commerce /online auctioning | End of life | medium |
| T | EoL challenges | End of life | medium |

| O/T | Name of the opportunity/threat | Cluster | Relevance from stakeholder consultation |
|-----|--|------------------------------|---|
| T | Inefficient transport | Logistics and transport | medium |
| T | Inferior types of transportation | Logistics and transport | medium |
| T | Damage on delivery | Logistics and transport | medium |
| T | Individual product delivery | Logistics and transport | medium |
| O | Optimization of supply chain | Logistics and transport | medium |
| O | Digital goods | Digitalisation | medium |
| T | Operational energy demand for the network infrastructure | Digitalisation | medium |
| O | Substitution of printed marketing material | Digitalisation | medium |
| O | Substitution of individual shopping trips | Logistics and transport | low |
| O | In-House fulfillment | Logistics and transport | low |
| T | Induced freight traffic to remote locations | Logistics and transport | low |
| T | Personalised design | Consumer needs and behaviour | low |
| T | Shopping frenzy | Consumer needs and behaviour | low |
| T | Ease of shopping | Consumer needs and behaviour | low |
| T | Cross-selling and up-selling | Consumer needs and behaviour | low |
| T | Secondary packaging | Packaging | low |
| O | Development of dedicated packaging solutions | Packaging | low |
| O | Extended product selling cycle | End of life | low |
| T | Food waste | End of life | low |
| T | International market access | Accessibility of information | low |
| T | Ubiquity | Accessibility of information | low |
| O | Availability of information | Accessibility of information | low |
| O | Reduction of retail space | Digitalisation | low |
| O | Collaboration between companies and partnering with waste management suppliers | No cluster | low |
| O | Product portfolio | Accessibility of information | contrasting inputs from stakeholders |
| O | Nudging | Consumer needs and behaviour | contrasting inputs from stakeholders |
| O | Big data/ meta data | Accessibility of information | contrasting inputs from stakeholders |

1034 **3.2 Description of opportunities and threats**

1035 A total number of 41 opportunities and threats for the Circular Economy arising from
1036 E-commerce, of which 19 opportunities and 22 threats has been identified based on
1037 the methodology described in the previous section.

1038 Based on the direct input of the stakeholders during the workshop (see Section 3.1.4),
1039 the opportunities and threats have been allocated to seven clusters, which are
1040 expected to influence the same or similar Circular Economy aspects.

1041 Table 9 provides the final list of opportunities and threats grouped by cluster.

1042 In the following paragraphs, each threat and opportunity is presented in a uniform
1043 format:

- 1044 ▪ Description: identification of the opportunity/threat;
- 1045 ▪ Discussion: short description of the opportunity/threat, its correlation with the
1046 E-commerce features and the Circular Economy aspect;
- 1047 ▪ Classification: classification in direct and indirect effects (see Section 3.1.2);
- 1048 ▪ Current and future relevance: data and information of expected future
1049 developments;
- 1050 Supporting factors: factors that promote the development of the
1051 opportunity/threat, in the current situation and in the future;
- 1052 ▪ Mitigating factors: factors that slow down the development of the
1053 opportunity/threat, in the current situation and in the future;
- 1054 ▪ Options for action: possible initiatives/solutions to mitigate the effects of the
1055 threat or further promote the opportunities, divided by: Producers/Platform
1056 providers, Regulators and Scientific Community; and
- 1057 ▪ Sources of information.

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1058 **Table 9 :Final list of 41 opportunities and threats by cluster**

| Cluster | O/T | Opportunities and Threats |
|-------------------------------------|---------------|--|
| Accessibility of information | O | Availability of information |
| | O | Big data/ meta data* |
| | O | Innovation* |
| | O | Market access to online aftermarket |
| | O | Product portfolio |
| | T | International market access |
| | T | Ubiquity |
| Consumer needs and behaviour | O | Nudging |
| | O | Sharing models and services |
| | T | Cross-selling and up-selling |
| | T | Ease of shopping |
| | T | Personalised design |
| | T | Shopping frenzy |
| Digitalisation | O | Digital goods |
| | O | Reduction of retail space |
| | O | Substitution of printed marketing material |
| | T | Operation of network infrastructure |
| End of life | O | Extended product selling cycle* |
| | O | Product take-back |
| | O | ReCommerce: Second-hand E-commerce /online auctioning |
| | O/T | Food waste |
| | T | End-of-Life challenges* |
| | T | Waste from returns |
| Legal framework | T | Difficulty to monitor* |
| | T | Enforcement* |
| | T | EPR free-rider effect |
| | T | Lack of compliance with common market regulation |
| Logistics and transport | O | In-House Fulfilment |
| | O | Collaboration between companies and partnering with waste management suppliers |
| | O | Optimisation of supply chain |
| | O | Substitution of individual shopping trips |
| | T | Damage on delivery |
| | T | Individual product delivery |
| | T | Induced freight traffic to remote locations |
| | T | Induced parcel transport |
| | T | Inefficient transport |
| | T | Inferior types of transportation |
| T | Parcel return | |
| Packaging | O | Development of dedicated optimised packaging solutions* |
| | T | Excessive protective packaging |
| | T | Secondary Packaging |

1059 * Opportunity/threat identified by the stakeholders during the second online survey
1060 and the stakeholder workshop.

1061

1062 **3.2.1 Cluster – Accessibility of information**

1063

1064 **3.2.1.1 Opportunity – Availability of information**

1065 **Description**

1066 Extensive product information can be provided on-line, including technical information,
1067 demonstration videos and customer feedback (on-line reviews, Yan *et al.*, 2016),
1068 allowing consumers to have a detailed picture of the products in terms of usefulness,
1069 reliability or durability before the purchase.

1070 **Discussion**

1071 It is undisputed that, since its beginning, the internet has increased to an
1072 immeasurable degree the availability of information to a large part of the population.
1073 This does also apply to information provided to customers of E-commerce. It should
1074 be noted here that the abundance of information can be overwhelming to the user and
1075 can even hinder decision-making if inadequately provided. It is, however, seen as an
1076 opportunity for the Circular Economy, as it enables customers to make more informed
1077 purchasing decisions.

1078 The advice given by the salesperson in the physical shop is increasingly giving way to
1079 independent Internet research via laptop or mobile device. In addition to product
1080 information and price comparisons, it is in particular the independent evaluations of
1081 other buyers that are of interest during the research. The more trustworthy the source
1082 of the product recommendation, the more likely the product is to be purchased
1083 (Leitherer, 2017). So called user-generated content (UGC) should be mentioned here
1084 as a type of communication that gained significant importance over recent years. By
1085 giving personal recommendations to certain products, consumers support each other
1086 with product-related advice. This electronic word-of-mouth (Yan *et al.*, 2016)
1087 communication was found to be of more importance to the customer's purchasing
1088 choice than other means (e.g. recommendation from the shop) (Anastasiei and
1089 Dospinescu, 2019). It is differentiated here between online reviews on e-commerce
1090 websites and recommendations given via social media (Yan *et al.*, 2016). The latter
1091 can be attributed to digitalisation, while the focus of this study is purely on E-
1092 commerce. In practice, it is certainly difficult to clearly separate the different research
1093 channels that are used by a customer before the final purchasing decision is made
1094 (Anastasiei and Dospinescu, 2019).

1095 The availability of information is seen here as a clear opportunity of E-commerce for a
1096 Circular Economy as the consumer is enabled to get a clear picture and understanding
1097 of a product he or she is interested in, and therefore to make a differentiated purchase
1098 decision.

1099 **Classification**

1100 The availability of information lies within the sphere of influence of E-commerce
1101 providers and is an inherent feature with high relevance for E-commerce business
1102 models. It is described as one of the main characteristics of online shops and has an
1103 immediate effect on shopping behaviour and thus on consumption. It is therefore
1104 considered as a direct effect of E-commerce.

1105 **Current and future relevance**

1106 The relevance of information available in online shops increased in a similar way as E-
1107 commerce developed over time (Zhang *et al.*, 2015). Several studies show that

1108 especially user recommendations are used by a significant number of users of the
1109 platforms. Some of them reveal that around 90% of customers of E-commerce use
1110 some kind of UGC (such as online reviews) before purchasing a product (Yan et al.,
1111 2016). The current relevance of this aspect of E-commerce can be seen as already
1112 very high.

1113 In the future, it seems that the decision to buy a product will be increasingly
1114 influenced by one of the many social media platforms and recommendations provided
1115 by their users (e.g. from so called 'influencers'). Additionally, social media posts that
1116 recommend a certain product or label seem to have a potentially strong influence on
1117 the purchasing decisions of users (Zhang *et al.*, 2015; Leitherer, 2017).

1118 This opportunity is of cross-product relevance and affects all product categories in
1119 focus of this study.

1120 **Supporting factors**

1121 The amount of information presented to the customer in E-commerce can be
1122 overwhelming and sometimes distracting. The availability of information is therefore
1123 only seen as opportunity for the Circular Economy, if it is presented to the customer in
1124 a user-friendly way by applying E-commerce specific techniques:

- 1125 ▪ clear structure and presentation of available information (WebAlive, 2019);
- 1126 ▪ inclusion of user product reviews and ratings (WebAlive, 2019); and
- 1127 ▪ integration of different media (text, video, pictures, interactive 3D images,
1128 etc.) (WebAlive, 2019).

1129 **Mitigating factors**

- 1130 ▪ International trade, in which an information mediation adapted to the local
1131 culture is neglected, can have undesirable effects on the recipient of
1132 information (Barkai, 2008); and
- 1133 ▪ systematic problems that produce a distorted and biased image, such as:
 - 1134 ○ Overrepresentation of extreme views; and
 - 1135 ○ Fraudulent online reviews (Thornhill, 2019).

1136 **Options for actions**

1137 **Producers/Platform providers:**

- 1138 ▪ Pre-selection of most important information that supports the consumer in its
1139 purchasing decision.

1140 **Source of information**

1141 Anastasiei, B. and Dospinescu, N. (2019) 'Electronic word-of-mouth for online
1142 retailers: Predictors of volume and valence', *Sustainability (Switzerland)*, 11(3). doi:
1143 10.3390/su11030814.

1144 Barkai, J. (2008) 'What's a Cross-Cultural Mediator to Do? A Low-Context Solution for
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1147 Leitherer, J. (2017) *Social Commerce setzt neue Maßstäbe*. Available at:
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- 1150 Thornhill, J. (2019) 'Five stars or fake? How to beat fraudulent online reviews'. Last
1151 accessed: 01.10.2019, Available at:
1152 [https://www.theguardian.com/money/2019/jul/14/five-stars-or-fake-how-to-beat-](https://www.theguardian.com/money/2019/jul/14/five-stars-or-fake-how-to-beat-fraudulent-online-reviews)
1153 [fraudulent-online-reviews](https://www.theguardian.com/money/2019/jul/14/five-stars-or-fake-how-to-beat-fraudulent-online-reviews)
- 1154 Yan, Q. *et al.* (2016) 'E-WOM from e-commerce websites and social media: Which will
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- 1157 Zhang, P., Bin, S. and Sun, G. (2015) 'Electronic Word-of-mouth Marketing in E-
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1159 *Service, Science and Technology*, 8(8), pp. 253–262. doi:
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1161 3.2.1.2 Opportunity – Big data / meta data

1162 **Description**

1163 As E-commerce is part of the digital realm, big data automatically becomes a topic
1164 worth to discuss with regard to developments in the Circular Economy. Big data is
1165 described as the high-speed analysis of large amounts of data from multiple sources.
1166 It is seen here as opportunity for the Circular Economy as it enables the companies to
1167 leverage the available information and to provide personalised information to the
1168 consumers, therefore increasing the potential to influence their shopping behaviour.

1169 **Discussion**

1170 Big data is a concept that was already discussed in the 90s but became widely known
1171 since 2011 (Gandomi and Haider, 2015). The ever-faster growth in data that is
1172 collected via various sources is pushing the topic into the agenda of most companies
1173 and also public authorities. At the same time, Gandomi and Haider (2015) show that
1174 there is currently no common understanding of the term. While some see big data
1175 purely as the availability of vast amounts of unstructured data, others already include
1176 forms of information processing for decision making into the concept. For this study,
1177 we follow the definition and understanding of the European Union, which was
1178 established as part of its Digital Single Market Strategy:

1179 "Big data refers to large amounts of data produced very quickly by a high number of
1180 diverse sources. Data can either be created by people or generated by machines, such
1181 as sensors gathering climate information, satellite imagery, digital pictures and videos,
1182 purchase transaction records, GPS signals, etc. It covers many sectors, from
1183 healthcare to transport and energy." (European Commission, 2018c)

1184 In the context of E-commerce, companies typically collect both structured (e.g.
1185 demographic data such as name, age, etc.) and unstructured data (e.g. likes, clicks,
1186 etc.) (Akter and Wamba, 2016). As the number of E-commerce customers increased
1187 significantly together with the increase in people using the Internet (around 60% of
1188 people in the EU purchased at least once in 2018 something online, (Statista, 2019a)),
1189 large amounts of data are collected by respective companies. The challenge lies in
1190 applying advanced information processing (big data analytics) that extract useful
1191 information and to get meaningful insights (Akter and Wamba, 2016).

1192 The importance to make use of available data is not limited to a certain department,
1193 but rather of interest of most functional units of a company (e.g. marketing,
1194 production, finance).

1195 Studies show various areas in which big data analysis can bring added value to the
1196 company, such as personalisation, dynamic pricing, customer service, supply chain
1197 visibility, predictive analytics and security and fraud detection.

1198 From this list it becomes clear that the value of the application of big data is difficult to
1199 assess. As this study is focusing on the impact on the Circular Economy, some aspects
1200 can be highlighted.

1201 Supply chain visibility is focusing mainly on providing in-depth information about the
1202 delivery of a product to the customer. In order to provide this service to the buyer of a
1203 product, a large amount of data from different sources (e.g. involved delivery
1204 services, warehouses, etc.) must often be evaluated in real time. At the same time,
1205 this information about the current delivery status and location of the shipment is of
1206 course also used by the companies involved in the supply chain. The possibility to
1207 obtain a detailed overview of all current deliveries enables the entire supply chain to
1208 be optimised. This in return helps to reduce waste.

1209 Another aspect is predictive analytics, which enables firms to increase the accuracy of
1210 forecast and thus the requirements regarding inventory. It is an essential part of the
1211 Circular Economy to stop overproduction and to optimise stock levels.

1212 **Classification**

1213 Although already effectively used by some of the large players in the market,
1214 exploitation of big data is still seen as an emerging aspect with an estimated high
1215 relevance for the future. Its effects are rather systematic, and they cannot be
1216 allocated to individual products offered in the online store. It is therefore considered
1217 as an indirect effect of E-commerce.

1218 **Current and future relevance**

1219 The current relevance of big data is already very high. It is one of the top five IT
1220 trends of the year 2018 according to a survey conducted by Bitkom, which surveyed
1221 companies in Germany in 2018 (Bitkom, 2018). This can also be verified by the
1222 worldwide market size of big data, which reached around 35 billion U.S. dollars in
1223 2017.

1224 The future relevance of big data is expected to further increase. On the one hand, this
1225 has to do with the ever-increasing amount of data that is collected. Sensor
1226 technology, further expansion of the mobile data network, increasing number of
1227 Internet and E-commerce users are only a few of the driving factors. On the other
1228 hand, it is expected that new technologies will increase the possibilities of big data
1229 analytics. These include artificial intelligence and machine learning to evaluate the
1230 data. Some forecasts estimate an increase of the big data market by nearly 300% in
1231 the next decade (around 103 billion US dollars till 2027) (Statista, 2018a). Although it
1232 is difficult to quantify the share of big data in e-commerce exactly, it is foreseeable
1233 that the importance of big data will continue to increase here as well.

1234 This opportunity is of cross-product relevance and affects all product categories in
1235 focus of this study.

1236 **Supporting factors**

1237

- 1238 the European Commission announced several Communications in recent years
1239 to establish a common European data space (European Commission, 2018d),
which is expected to increase transparency of data security and data usage.

1240 **Mitigating factors**

1241

- 1242 still insufficient understanding of big data for companies dealing with
1243 voluminous data amounts, making it currently unfeasible for them to gain value
from collected data;

1244

- 1245 uncertainty in investing in big data and its analysis, as the market is not
1246 consolidated yet and as there are various possibilities to extract useful
information from big data (uncertainties for selecting a big data technology);

1247

- 1248 data security issues, such as leakage of sensitive information leading to loss of
trust in data collection and evaluation; and

1249

- 1250 lack of knowledge on how to convert big data into valuable insights into one's
business.

1251

1252 **Options for actions**

1253 **Producers/Platform providers:**

- 1254 ▪ collaboration with data analysis vendors to add value to large volumes of data
1255 and, most importantly, to comply with data security and privacy regulations.
1256 The latter is especially important to maintain customer trust.

1257 **Regulators:**

- 1258 ▪ guidelines for companies should be provided to establish a common playing-
1259 field and to ensure fair competition in use of big data. E.g. the Commission
1260 Staff Working Document 'Guidance on sharing private sector data in the
1261 European data economy' (European Commission, 2018d)
- 1262 ▪ digitisation is moving extremely fast with constant new developments and
1263 technologies (advanced algorithm analysis, machine learning, etc.). This rapid
1264 development might be in contrast with legislation, which requires
1265 comprehensive examination and factual content to be effectively developed and
1266 defined. It therefore requires a dynamic process of continuously aligning
1267 current and future developments with legislation in order to identify possible
1268 backlog requirements.

1269 **Source of information**

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1296 3.2.1.3 Opportunity – Innovation

1297 **Description**

1298 The internet with its interconnected users across the globe offers an excellent platform
1299 to present and promote innovative ideas to a broad audience. E-commerce can play a
1300 vital role in fostering innovation in combination with concepts such as crowdfunding.
1301 These online platforms make it possible to overcome common hurdles such as high
1302 investment costs and allow the creation of an interest group. It is seen as an
1303 opportunity for a Circular Economy to enable small companies and start-ups to easily
1304 promote and put on the market their ideas, thus supporting the transition to a
1305 sustainable development.

1306 **Discussion**

1307 Crowdfunding is not a new concept but has become widely known in its “digital form”
1308 through the development of the internet and internet platforms (Gurd, 2014). It is
1309 defined by BigCommerce as “a method of raising money online through the support of
1310 many different donors. Owners of crowdfunding pages announce a specific amount of
1311 money they need to raise in order to fulfil a goal or begin an enterprise.”
1312 (BigCommerce, 2019). It can be added that especially start-ups often aim at
1313 developing and pitching a new type of product or service. FinalStraw can be given
1314 here as one of many examples, which is a start-up that promotes its idea of a
1315 sustainable straw on the platform Kickstarter (Kickstarter, 2018).

1316 Whether crowdfunding is a type of E-commerce can surely be debated. It is evident
1317 that the rise of digitalisation with interconnected networks of millions of people
1318 enabled the development of platforms on which ideas, products, services can easily be
1319 promoted to a wide audience of potential investors and supporters. Visiting one of the
1320 many crowdfunding platforms show a structure and offering of ideas similar to typical
1321 E-commerce websites.

1322 The combination of low barriers to entry, low costs for marketing and presentation of
1323 the idea, enormous reach and the possibility to build up a loyal customer base during
1324 the application process are considered to promote innovation.

1325 **Classification**

1326 The effects of innovation emerging from E-commerce activities are hypothetical and
1327 certainly long-term. Additionally, the allocation to individual products is not possible.
1328 Innovation is therefore considered an indirect effect of E-commerce.

1329 **Current and future relevance**

1330 It is not possible to estimate the exact impact of E-commerce on innovation, especially
1331 as the field of innovation is very broad and affects many different areas at the same
1332 time. Looking at the aspect of crowdfunding allows at least to estimate an increase or
1333 decrease in importance.

1334 The global crowdfunding market increased steadily over the past years and is
1335 predicted to reach a transaction value of nearly US\$7 billion in 2019 (Statista, 2019c).
1336 The growth rate for coming years is estimated at around 15% per year. In 2019, a
1337 total of 8.72 million campaigns were financed (Statista, 2019c). BigCommerce
1338 estimated the number of crowdfunding platforms at 450 (BigCommerce, 2019).

1339 This opportunity is of cross-product relevance and affects all product categories in
1340 focus of this study.

1341 **Supporting factors**

- 1342 ▪ low barriers to be eligible (both from a legal and economic perspective) for the
1343 crowdfunding platforms, thus enabling small entrepreneurs and start-ups to
1344 present and promote their ideas.

1345 **Mitigating factors**

- 1346 ▪ although there are currently low barriers to enter one of the many
1347 crowdfunding platforms, there might be a consolidation of the market with an
1348 increase in focusing on the chance of success of ideas in the future. Innovation
1349 cannot flourish if ideas are excluded at a very early stage of development.

1350 **Options for actions**

1351 **Producers/Platform providers:**

- 1352 ▪ the platforms should be kept open to all types of companies in order to offer a
1353 stage to a wide audience.

1354 **Source of information**

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1370

1371

1372 3.2.1.4 Opportunity – Market access to online aftermarkets

1373 **Description**

1374 E-commerce can promote the possibility for consumers to extend the lifetime of a
1375 product by facilitating the access to online aftermarket where consumers can purchase
1376 spare parts to repair their product.

1377 **Discussion**

1378 Access to a physical market is strongly limited by the shops within reach of the
1379 consumer. Particularly in less densely populated areas and for special products, the
1380 probability that spare parts are available to repair items by oneself is rather low. E-
1381 commerce enables access to a large number of additional products and markets and
1382 thus also to spare parts. This is seen as an opportunity for E-commerce to increase
1383 the longevity of products.

1384 A spare part is a duplicate part used to replace a lost or damaged part of a machine or
1385 other good. It is typically associated with the automotive industry, but there are
1386 aftermarkets for spare parts for almost all product categories in this study. The focus
1387 lies here on replacing damaged parts of machines, making this opportunity associated
1388 with small ICT and major household appliances.

1389 **Classification**

1390 Market access to online aftermarkets is seen as a direct effect as it enables the
1391 consumer to extend his product's life time. It is therefore associated with the End-of-
1392 Life stage of the product life-cycle, as it is described in this study.

1393 **Current and future relevance**

1394 It is challenging to make substantiated statements about the maturity of the existing
1395 aftermarket and how far it is used by people for the product groups in the focus of this
1396 study. There are no reliable sources for this. By searching the market, however, one
1397 will encounter a large number of suppliers of spare parts for household appliances and
1398 ICT.

1399 The Behavioural Study on Consumers' Engagement in the Circular Economy by the
1400 European Commission (2018b) sought to evaluate, among other things, to what
1401 extent consumers are willing to repair their broken product instead of replacing it with
1402 a new one. The study shows that consumers tend to repair products (or attempt to
1403 repair them) and that the majority of them is aware of the longevity and reparability
1404 of purchased products. At the same time, the study further highlights that although
1405 consumers are typically interested in repair options, the process for doing so is often
1406 too complex or expensive.

1407 The European Commission has announced adjustments in the eco-design regulations
1408 for a series of products. The following new requirements on the reparability and
1409 recyclability of appliances have been introduced in the eco-design measures
1410 (European Commission, 2019c):

- 1411 ▪ availability of spare parts;
- 1412 ▪ easy replaceability; and
- 1413 ▪ access to repair and maintenance information for professional repairers [...].

1414 This indicates that the relevance of spare parts markets, which are also accessible to
1415 the end consumer, will increase in the future.

1416 Spare parts are only relevant for those product categories where the repair of a
1417 product is an option at all. This excludes the categories non-perishable foods and
1418 media & entertainment products / services.

1419 **Supporting factors**

- 1420 ▪ reparability of products (non-destructive and easy disassembly of key
1421 components);
- 1422 ▪ small and independent repair shops, repair cafés and similar. In just a few
1423 years, the Repair Café movement has grown to an impressive size in Western
1424 Europe, with a total of 1,128 local organisations (Ellen Macarthur Foundation,
1425 2016);
- 1426 ▪ wiki-based platforms such as iFixit that teaches people how to repair various
1427 products by allowing anyone to create or edit a repair manual for a device;
- 1428 ▪ European Eco-design directive and product-specific regulations; and
- 1429 ▪ diffusion of home repair insurances (home warranties) that cover the cost to
1430 repair or replace an appliance or system.

1431 **Mitigating factors**

- 1432 ▪ highly consumer-oriented society and business models, with focus on
1433 profitability rather than longevity of a product;
- 1434 ▪ limited access to repair and maintenance information as well as spare parts for
1435 consumers and independent repair shops; and
- 1436 ▪ expensiveness and excessive time needed for the repair.

1437 **Options for actions**

1438 **Scientific Community:**

- 1439 ▪ strengthening the application of 3D print of spare parts as innovative
1440 alternative to the current situation; and
- 1441 ▪ repair culture: promoting the “right to repair”.

1442 **Regulators:**

- 1443 ▪ strengthening the eco-design related regulation and initiatives with clear
1444 requirements in regard to reparability per product category.

1445 **Source of information**

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1459

1460 3.2.1.5 Opportunity – Product portfolio

1461 **Description**

1462 A pronounced and at the same time well sorted and easily accessible selection of
1463 products enables customers to make more targeted purchases. This aspect is certainly
1464 ambiguous, since a larger selection of products does not necessarily lead to better
1465 purchasing decisions in the sense of sustainability. However, it should be emphasised
1466 here that the customer is less tied to small product portfolios and has the opportunity
1467 to select the most suitable product from a comprehensive selection.

1468 **Discussion**

1469 It might not be necessary to go online to find a large selection of specific products.
1470 Supermarkets are an excellent example, as the number of articles can reach between
1471 2,000 and 25,000 in German supermarkets – number dependent on type of
1472 supermarket: discounter, large supermarket, etc. (Handelsforschung und V., 2018).
1473 Several studies have pointed out that such a wide choice of options does not
1474 necessarily lead to an increased sense of freedom for customers, but on the contrary
1475 can be overwhelming and frustrating (Süddeutsche Zeitung, 2014). A relatively newly
1476 initiated research area that deals with the problem of wrong decisions is the so called
1477 Regret research (Süddeutsche Zeitung, 2014).

1478 It is seen here as a chance for E-commerce to combine a large product selection with
1479 an easy and fast search. Online shops are usually designed in a way that allows a
1480 user-friendly navigation, comparison of certain products, breadcrumb navigation,
1481 detailed product information, user reviews, product filtering and sorting. Especially the
1482 latter enables the customer to break down the seemingly infinite selection of products
1483 to a few that meet his or her requirements best. A society that is increasingly aware of
1484 the environmental impact of its behaviour and consumption demands innovative,
1485 sustainable products.

1486 **Classification**

1487 While building a product portfolio is an ongoing process, it is also one of the first key
1488 decisions of any online business. It clearly characterises the current situation and will
1489 persist in future scenarios. Although its consequential positive effects are not that
1490 obvious, it is still considered a direct effect of E-commerce.

1491 **Current and future relevance**

1492 Online retailers recognised the potential of their online shops early on. Since the
1493 products offered do not have to be physically advertised to the customer, physical
1494 retail space is saved, and a large number of additional products can be offered. Large
1495 players in the field can nowadays easily offer hundreds of thousands or even millions
1496 of products within one online shop. Especially the combination of an online retailers'
1497 own portfolio in addition to an integrated marketplace with third-party providers
1498 increases the portfolio immensely (Retail Touch Points, 2019).

1499 Large product portfolios can be found for each of the product categories in focus. In
1500 general, cell phones and accessories, electronics, home and kitchen, and apparel are
1501 showing an extreme variation in brands and sellers. A consolidation of the market is
1502 currently not yet to be expected as globalisation continues to progress.

1503 This opportunity is of cross-product relevance and affects all product categories in
1504 focus of this study.

1505 **Supporting factors**

- 1506 • modern, user-oriented and user-friendly search functions, which allow the
1507 customer to use a large number of products meaningfully; and
- 1508 • customer reviews allow the buyer to quickly and easily identify proven
1509 products. However, the possibilities of fraud (see e.g. fictitious customer
1510 reviews; (Thornhill, 2019)) should also be pointed out, as well as the difficulties
1511 for new brands and products to enter the market.

1512 **Mitigating factors**

- 1513 • poorly organised product ranges overwhelm customers and lead to frustration.

1514 **Options for actions**

1515 **Producers/Platform providers:**

- 1516 • the possibility should not be understood to mean that suppliers offer as wide an
1517 assortment as possible. The combination of large product selection and easy
1518 access (search, sort function, etc.) is necessary to offer added value to the
1519 customer; and
- 1520 • to support the transition towards a Circular Economy, platforms providers and
1521 companies could promote products with a proven longer service life or
1522 reparability.

1523 **Source of information**

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1538

1539 3.2.1.6 Threat – International market access

1540 **Description**

1541 The (easy) access to markets around the world allows consumers to purchase
1542 products from everywhere. This has an impact on the international traffic of
1543 commodities and might increase the emissions due to international trade.

1544 **Discussion**

1545 Together with technological progress, digitalisation and cross-border networks, access
1546 to international markets also gained in importance. Whereas previously this was only
1547 accessible to individuals via traditional retails, E-commerce now allows direct trading
1548 with suppliers from the remotest regions (Nassrullah Mzwri and Altinkaya, 2019). A
1549 number of platforms have made it their business to bring together both domestic and
1550 international companies from different countries (Nassrullah Mzwri and Altinkaya,
1551 2019). Thus, E-commerce has had a decisive influence on the development of new
1552 value chains, on costs, efficiency and business types.

1553 At the same time, various new challenges arise by cross-border trade in conjunction
1554 with E-commerce, some of which are discussed in other chapters of this report, such
1555 as Difficulty to monitor (see section 3.2.5.1), Enforcement (see 3.2.5.2), EPR Free-
1556 Rider Effect (see 3.2.5.3), Lack of compliance with common market regulations (see
1557 3.2.5.4). In this section, on the other hand, the focus will be on the aspect of
1558 distance. The large distances alone give rise to a multitude of potential problems.
1559 Even when purchasing a product abroad that is more sustainable in its production
1560 process than a domestic version, its transport distance (product kilometres) causes
1561 pollution that might outweigh other environmental effects.

1562 This aspect is further negatively reinforced if one takes into account other common
1563 challenges of E-commerce. Delivery of damaged products, individual product delivery,
1564 inferior types of transportation, or parcel return are all aspects that decrease
1565 transportation efficiency immensely and put considerable pressure on international
1566 logistics (E-commerce Europe, 2018; PWC, 2016). It is a challenge for the transition
1567 to a Circular Economy to integrate international trade into its concept.

1568 **Classification**

1569 The international market access is inherent to E-commerce with certain environmental
1570 impacts. However, arising effects are rather systematic and hypothetical. It is
1571 estimated that the effects have a very high relevance for future scenarios.

1572 **Current and future relevance**

1573 The relevance of international market access in E-commerce is already high.
1574 E-commerce Europe state in their 2018 report that 38% of all EU online shoppers
1575 ordered abroad in 2017, with 13% that ordered goods from outside the EU (E-
1576 commerce Europe, 2018). The number of so called cross-border e-purchases differ
1577 significantly between the EU Members States – from 6% in Poland up to 85% in
1578 Portugal (E-commerce Europe, 2018).

1579 Although online commerce in general will continue to gain importance (in terms of
1580 turnover), the associated international trade must be seen in a more differentiated
1581 way for the EU. Countries such as Greece, Austria and Belgium, for example, did not
1582 experience any growth in cross-border e-purchases between 2016 and 2017. At the
1583 same time, however, Slovenia, Germany, the Netherlands, Finland and Luxembourg

1584 experienced the highest growth rates with 5-6% increase within one year (E-
1585 commerce Europe, 2018).

1586 This threat is of cross-product relevance and affects all product categories in focus of
1587 this study.

1588 **Supporting factors**

1589 ▪ shopping events (see chapter 3.2.2.6) such as “Black Friday” or “Cyber
1590 Monday” encourage the focus on a low price. Where the product is coming from
1591 is often neglected.

1592 **Mitigating factors**

1593 ▪ highlighting the environmental impact of orders delivered from abroad to
1594 customers during the purchasing process (Nudging, see Section 3.2.2:1).

1595 **Options for actions**

1596 **Producers/Platform providers:**

1597 ▪ using the concept of nudging to highlight the environmental impact that is
1598 arising from deliveries coming from abroad.

1599 **Regulators:**

1600 ▪ implementation of rules incorporating the aspect of E-commerce and its impact
1601 on international trade as it was proposed by the EU to the World Trade
1602 Organisation in 2019 (European Commission, 2019a).

1603 **Source of information**

1604 E-commerce Europe (2018) ‘European Ecommerce Report 2018 Edition’. Available at:
1605 [www.haendlerbund.de/de/downloads/ecommerce-europe/european-ecommerce-](http://www.haendlerbund.de/de/downloads/ecommerce-europe/european-ecommerce-report-2018.pdf)
1606 [report-2018.pdf](http://www.haendlerbund.de/de/downloads/ecommerce-europe/european-ecommerce-report-2018.pdf).

1607 European Commission (2019a) *EU releases proposal on new WTO rules for electronic*
1608 *commerce*. Available at: <http://trade.ec.europa.eu/doclib/press/index.cfm?id=2016>
1609 (Accessed: 2 August 2019).

1610 Nassrullah Mzwri, A. M., Altinkaya, Z. (2019) ‘The Impact of E-Commerce on
1611 International Trade: Case of Turkey’, *Internationale Journal of Contemporary Research*
1612 *and Review*, 10(01), pp. 21190–21209. Available at:
1613 <http://ijcrr.info/index.php/ijcrr/article/view/641>.

1614 PWC (2016) *Bevölkerungsbefragung Grenzüberschreitender Online-Handel*. Available
1615 at: [https://www.pwc.de/de/handel-und-konsumguter/pwc-bevoelkerungsbefragung-](https://www.pwc.de/de/handel-und-konsumguter/pwc-bevoelkerungsbefragung-grenzueberschreitender-online-handel.pdf)
1616 [grenzueberschreitender-online-handel.pdf](https://www.pwc.de/de/handel-und-konsumguter/pwc-bevoelkerungsbefragung-grenzueberschreitender-online-handel.pdf) (Accessed: 2 August 2019).

1617

1618 3.2.1.7 Threat – Ubiquity

1619 **Description**

1620 Ubiquity describes the possibility for consumers to access E-commerce at any time
1621 and from almost anywhere (Wu and Hisa, 2004). It is an inherent peculiarity of
1622 nowadays E-commerce that clearly distinguishes it from the traditional market where
1623 customers have to physically enter a store and where they are bound to opening
1624 hours. It is relevant for all product categories in scope and is seen as a threat as it
1625 induces consumption.

1626 **Discussion**

1627 Ubiquity of E-commerce is directly linked to the technological development of recent
1628 decades. This includes in particular the progress in telecommunication technology with
1629 the expansion of and access to wireless and fast data networks and the increased use
1630 of portable devices such as tablets and smartphones. In recent years, numerous
1631 studies have dealt with the topic and its effects, thereby coining the term U-
1632 Commerce (“Ubiquitous Commerce”) (Wu and Hisa, 2004; Kumar *et al.*, 2015;
1633 Morrison *et al.*, 2015; Wang *et al.*, 2017). This new concept includes E-commerce and
1634 similar forms (such as Mobile Commerce and Television Commerce).

1635 Especially the application of online mobile shopping apps allows users to access web
1636 shops from basically anywhere. This differentiates U-Commerce significantly from
1637 web-based commerce (e.g. via a tower PC). The latter does not yet have the
1638 dimension of ubiquity (Wu and Hisa, 2004). Especially modern smartphones have
1639 become a permanent companion in daily life and combine a multitude of functionalities
1640 that have become indispensable for many people. E-commerce via these devices is
1641 therefore not only a ubiquitous possibility, but also a very simple one.

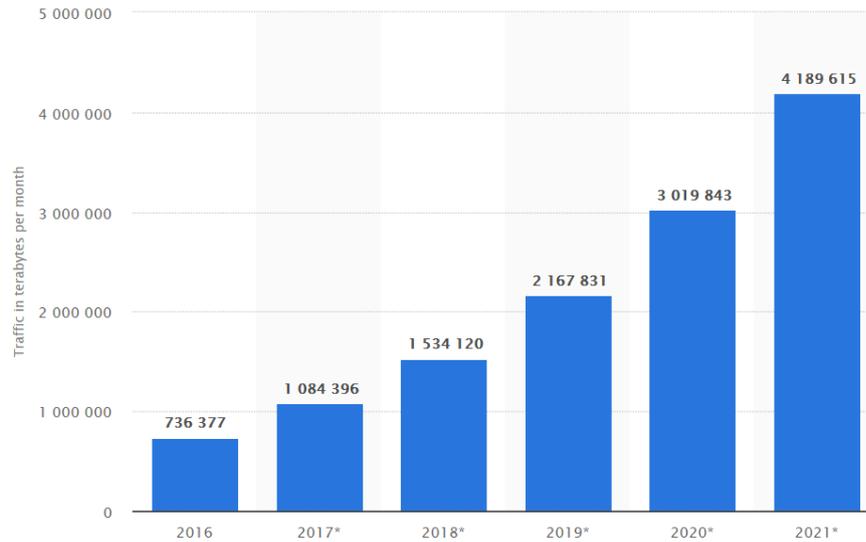
1642 On the one hand, it makes it much easier for consumers to search for, compare and
1643 buy products, which improves the purchase for some aspects significantly. On the
1644 other hand, however, the consumer also becomes more accessible for advertising and
1645 marketing initiatives of companies. Companies have positioned themselves much
1646 better in this mobile market in recent years. This includes mobile versions of existing
1647 websites as well as apps that are designed to specifically access some type of E-
1648 commerce, so that consumers can make numerous purchases already on their way to
1649 or from work, for example.

1650 **Classification**

1651 Ubiquity can be seen as an indirect effect as it has an impact on the long-term
1652 transition towards a Circular Economy. It originates from the digital and mobile
1653 connectivity of mobile devices to the Internet. The purchasing process is the phase of
1654 the product life cycle that is directly affected.

1655 **Current and future relevance**

1656 As mentioned before, ubiquity is relevant for all product categories in the scope of this
1657 study. It is linked directly to the usage of mobile devices to access the Internet and
1658 thus E-commerce. As smartphones and tablets are used by the majority of people
1659 nowadays (e.g. ~80% of people living in Germany in 2018), this aspect is already of
1660 high relevance. This is also reflected in the share of all visits to web pages coming
1661 from mobile devices – which was around 43% for Europe in 2018 (Statista, 2018c).
1662 Another indicator is the data volume of mobile Internet traffic, which more than
1663 doubled from 2014 till 2016 for Western Europe (see Figure 5).



1664

1665 **Figure 5. Data volume of mobile Internet traffic in Western Europe (from Statista, 2018c; Cisco**
1666 **Visual Networking Index: Global Mobile Data Traffic 2017)**

1667 For the coming years, a similar development in the increase in the used data volume
1668 for mobile Internet traffic is expected (Statista, 2018c).

1669 This threat is of cross-product relevance and affects all product categories in focus of
1670 this study.

1671 **Supporting factors**

- 1672 ▪ the implementation and penetration of new cellular network technologies (e.g.
1673 4G and 5G).

1674 **Mitigating factors**

- 1675 ▪ A number of studies have already been published on the impact that the use of
1676 digital media and mobile devices can have on people. These already influence
1677 the public discussion and thus the aspect of ubiquity. Thus, users of these
1678 media are at least partially made aware of the dangers of the media described.

1679 **Options for actions**

1680 **Scientific Community:**

- 1681 ▪ adequately with the ubiquity of E-commerce as a user is closely related to the
1682 challenge of dealing with digital media in general. Approaches in mitigating this
1683 threat should therefore also be seen in the overall context of 'use of digital
1684 media and mobile devices'. Although numerous publications dealing with this
1685 topic have appeared in recent years (e.g. see 'Mobile and Ubiquitous Media:
1686 Critical and International Perspectives', by Daubs and Manzerolle, 2017), there
1687 is a lack of long-time studies.

1688 **Producers/Platform providers:**

- 1689 ▪ make use of user interface design elements to draw attention to potential
1690 threats of extensive internet involvement (of which E-commerce is one part)

1691

1692 **Regulators:**

- 1693 ▪ realising and clearly formulating ubiquity of E-commerce and the internet as a
1694 substantial transformation of social practice and creating action plans to cope
1695 with that challenge at an early stage; and
- 1696 ▪ since the threat of ubiquity of E-commerce is seen here in the (assumed)
1697 increased consumption, one could address consumers' behaviour by awareness
1698 raising campaigns.

1699 **Source of information**

- 1700 Daubs, M. and Manzerolle, V. (2017) 'From Here to Ubiquity'.
- 1701 Kumar, S., Joshi, P. and Saquib, Z. (2015) 'Ubiquitous Commerce : The New World of
1702 Technologies', *International Journal of Life Science and Engineering*, 1(2), pp. 50–55.
1703 Available at:
1704 <http://www.publicscienceframework.org/journal/paperInfo/ijlse?paperId=382>.
- 1705 Morrison, S., Pitt, L. and Kietzmann, J. (2015) 'Technology and financial services:
1706 Marketing in times of U-commerce', *Journal of Financial Services Marketing*. Nature
1707 Publishing Group, 20(4), pp. 273–281. doi: 10.1057/fsm.2015.18.
- 1708 Statista (2018c) *Mobiles Internet in Europa*. Available at:
1709 [https://de.statista.com/statistik/studie/id/13136/dokument/mobiles-internet--statista-](https://de.statista.com/statistik/studie/id/13136/dokument/mobiles-internet--statista-dossier/)
1710 [dossier/](https://de.statista.com/statistik/studie/id/13136/dokument/mobiles-internet--statista-dossier/).
- 1711 Wang, S.-C. *et al.* (2017) 'The Effect of Affordance on Ubiquitous Commerce
1712 Consumption'.
- 1713 Wu, J. H. and Hisa, T. L. (2004) 'Analysis of E-commerce innovation and impact: A
1714 hypercube model', *Electronic Commerce Research and Applications*, 3(4), pp. 389–
1715 404. doi: 10.1016/j.elerap.2004.05.002.

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1716 **3.2.2 Cluster – Consumer needs and behaviour**

1717

1718 3.2.2.1 Opportunity – Nudging

1719 **Description**

1720 Nudging is a relatively new concept in behavioural science and economics. It is
1721 referred to as exerting a gentle “push” to alter an individual’s behaviour and decision
1722 making in a preferred (e.g. environmentally sound) way. This may be achieved by
1723 designing a specific situation of choice (choice architecture) without giving direct
1724 economic incentives. There are a variety of techniques as well as different phases of
1725 the product life cycle, where nudging can be applied. This opportunity focuses on the
1726 product selection phase, which is part of the overall purchasing process.

1727 **Discussion**

1728 In its essence, nudging is similar to existing marketing techniques as it capitalises on
1729 insights in human psychology. As such it proposes an effective alternative to
1730 conventional ways of achieving compliance or sustainable behaviour (e.g. legislation,
1731 education).

1732 There are different types of nudging techniques (Van Bavel *et al.*, 2013; Isley *et al.*,
1733 2016; Stefansdotter *et al.*, 2016):

- 1734 ▪ information: eco-labelling, information about products’ environmental footprint
1735 (e.g. carbon footprint);
- 1736 ▪ framing (prospect theory);
- 1737 ▪ pre-set (definition of a favourable default option);
- 1738 ▪ feedback and social norms: information about other people’s donations,
1739 smileys and colours (e.g. traffic lights); and
- 1740 ▪ changes in the physical/virtual environment: position effects (placement or
1741 ranking of products).

1742 E-commerce platforms act as unique interface between businesses and consumers
1743 which may be utilised in order to provide information on the circularity of products or
1744 the environmental impacts associated with intangible products such as streaming
1745 services or electronic books (Isley *et al.*, 2016). If possible and scientifically sound,
1746 comparisons between product or service alternatives could be displayed. Furthermore,
1747 sustainable alternatives may be presented at the time of purchase to help consumers
1748 act according to their latent preferences.

1749 In terms of the relevance for the Circular Economy, nudging is a powerful tool to
1750 stimulate the consumption of services instead of resource-intense products or to
1751 convince people of alternatives to new products (e.g. repair options).

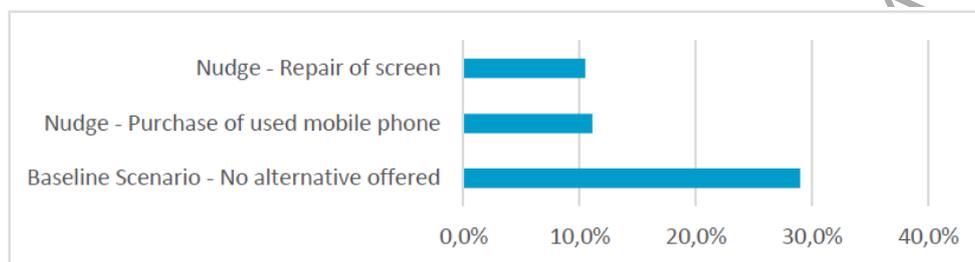
1752 **Classification**

1753 Nudging is classified as an indirect effect, depending on the applied technique and
1754 expected effect. Hence, nudging offers an opportunity to enable a behaviour in favour
1755 of Circular Economy strategies. It mainly takes place in the e-fulfilment stage during
1756 the purchasing process of a product. The underlying E-commerce feature can be seen
1757 in the seamless way nudging can be embedded in the digital process (e.g. by adding
1758 one or more questions/information that need to be read before the order can be
1759 completed).

1760 **Current and future relevance**

1761 Nudging is relevant for all product categories in scope. Currently, it is getting more
1762 attention in the Nordics as well as internationally. INudgeYou, a research network in
1763 Denmark, GreeNudge in Norway and a think tank in the UK are just a few examples of
1764 institutions or networks working on the implementation of the concept as a
1765 complementary tool in E-commerce. While consumers usually lack economical ways to
1766 access environmental information about specific product supply chains, producers or
1767 retailers are often in possession of valuable data such as carbon footprints.

1768 A recent pilot study provides an indication that nudging has the potential to change
1769 consumption behaviour among young people. With the option for two distinct Circular
1770 Economy approaches - buying a used mobile phone or repairing the screen -
1771 respondents refused statistically significant to buy a new mobile phone compared to a
1772 baseline scenario (see Figure 6).



1773

1774 **Figure 6. Proportions of respondents opting to buy a new mobile phone (own depiction based on**
1775 **data from Stefansdotter et al., 2016)**

1776 Next to above findings, pushing consumers towards leasing contracts instead of single
1777 purchases has also been found to be an effective means of fostering Circular Economy
1778 models.

1779 Another example illustrating the relevance of this opportunity refers to online video
1780 streaming. As a matter of fact, delivering contents in higher definition causes
1781 additional environmental impacts due to increased volumes of data inextricably linked
1782 to electricity demands in data transmission networks. In an experiment, the user
1783 interface has been modified to include information on carbon footprints associated
1784 with offered streaming resolutions. Furthermore, calculated carbon footprints have
1785 been expressed in metrics intelligible to users, such as light bulb days or miles driven.
1786 Disregarding the specific metric, this approach was effective in prompting participants
1787 to change to a lower-resolution stream. The most effective metric- miles driven - has
1788 resulted in a 24% reduction in the average carbon footprint associated with the
1789 conducted experiment (Isley et al., 2016).

1790 In general, nudging offers great potential to address all levels of a Circular Economy.
1791 It may be particularly powerful, however, to establish mechanisms as to implement
1792 what deemed to be the environmentally most effective principles of a truly Circular
1793 Economy: refuse, maintain, and reuse (Ellen Macarthur Foundation, 2017).

1794 This opportunity is of cross-product relevance and affects all product categories in
1795 focus of this study.

1796 **Supporting factors**

- 1797
- 1798 ■ increasing willingness to shift to sustainable products and services due political and societal discourse, often only hindered by a lack of information (e.g.

- 1799 information about emissions per purchase option) or awareness (Isley *et al.*,
1800 2016);
- 1801 ▪ synergies between reduction of environmental impacts as well as operational
1802 costs while maintaining or improving customer satisfaction can be unlocked
1803 (e.g. individuals may think better of companies that provide such
1804 environmentally- friendly options) (Isley *et al.*, 2016); and
- 1805 ▪ improved supply chain management and monitoring technologies, ultimately
1806 providing relevant data and information to be included in nudging techniques.

1807 **Mitigating factors**

- 1808 ▪ perception of the concept as paternalism;
- 1809 ▪ interference with the role of education and individual learning;
- 1810 ▪ adverse response to nudges due to the possible feeling to be manipulated;
- 1811 ▪ unpredictable outcomes resulting in sometimes no or adverse effects (e.g.
1812 rebound effects in which consumers feel entitled to consume more or additional
1813 products/services); and
- 1814 ▪ little research existing on long-term effects.

1815 **Options for actions**

1816 **Scientific Community:**

- 1817 ▪ evaluate certain nudging techniques and contexts; and
- 1818 ▪ communicate the concept as a potential tool.

1819 **Producers/Platform providers:**

- 1820 ▪ capitalise on established data collection efforts for environmental reporting or
1821 internal purposes;
- 1822 ▪ expand exchange of information between producers and E-commerce
1823 platforms; and
- 1824 ▪ align nudging techniques with Circular Economy strategies.

1825 **Regulators:**

- 1826 ▪ include nudging in the strategic discussions on sustainability and Circular
1827 Economy.

1828 **Source of information**

- 1829 Bavel, R. van et al. (2013) Applying behavioural sciences to EU policy-making, Joint
1830 Research Centre Scientific and Policy Reports. doi: 10.2788/4659.
- 1831 Ellen Macarthur Foundation (2017) Circular Economy System Diagram. Available at:
1832 <https://www.ellenmacarthurfoundation.org/circular-economy/infographic>.
- 1833 Isley, S. C. *et al.* (2016) 'Online purchasing creates opportunities to lower the life
1834 cycle carbon footprints of consumer products', in *Proceedings of the National Academy
1835 of Sciences*, pp. 9780–9785. doi: 10.1073/pnas.152211113.
- 1836 Stefansdotter, A. et al. (2016) Nudging for sustainable consumption of electronics.
1837 doi: 10.6027/ANP2016-728.

- 1838 Sui, D. Z. and Rejeski, D. W. (2002) 'Environmental impacts of the emerging digital
1839 economy: The e-for-environment e-commerce?', *Environmental Management*, 29(2),
1840 pp. 155-163. doi: 10.1007/s00267-001-0027-X.

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1841 3.2.2.2 Opportunity – Sharing models and services

1842 **Description**

1843 In recent years, a series of sharing models developed that allow consumers to share
1844 specific products, such as tools or devices. Although this type of sharing is possible
1845 without any online activity, E-commerce is seen here as a promoting factor. Online
1846 sales platforms significantly increase reach and visibility, making it easier for
1847 consumers to access relevant markets.

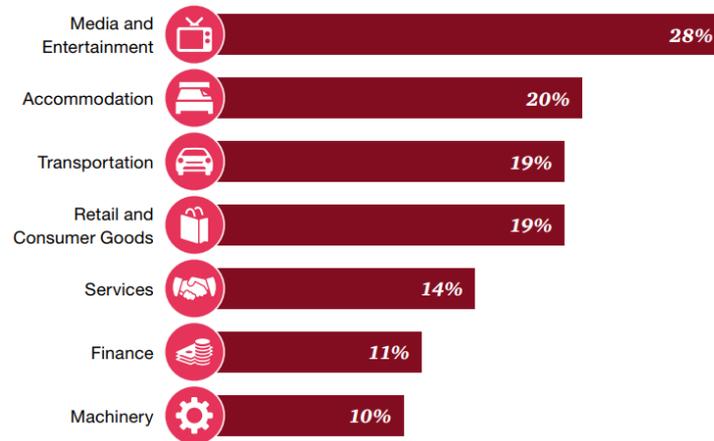
1848 **Discussion**

1849 The so-called sharing economy can be defined as “the peer-to-peer-based activity of
1850 obtaining, giving, or sharing the access to goods and services, coordinated through
1851 community-based online services” (Hamari *et al.*, 2016). Some sources include
1852 second-hand concepts such as provided by eBay or Craigslist and crowdfunding in its
1853 definition (Yaraghi and Ravi, 2011). For this study, however, these concepts are
1854 explicitly excluded, and they are discussed in separate sections (see “ReCommerce” in
1855 Section 3.2.4.1 and “Innovation” in Section 3.2.1.3).

1856 Its current success is partially due to technological developments (e.g. mobile
1857 connectivity, ease of access and communication), but also due to changing societal
1858 values. Several initiatives and start-ups emerged over the past recent years with a
1859 variety of services and ideas. Hopes are high that the sharing economy might change
1860 the overall consumption behaviour and patterns of whole societies leading to a
1861 reduction in resource use, strengthening of regional and local communities, enabling
1862 of consumption for lower income groups, and change in the perception of property
1863 (PWC, 2018c). However, recent research shows that some developments undermine
1864 this original idea of the sharing economy. It seems that only part of society is
1865 collaborating in respective concepts and services and it is transforming from a pure
1866 peer-to-peer (P2P) approach to a professional business-to-customer (B2C) approach,
1867 where large companies dominate the market.

1868 Another interesting aspect of sharing models is its impact on societal perception of
1869 property and the relevance of goods as status symbols. Some part of consumption,
1870 such as always buying the newest version of something, is driven by the desire to be
1871 part of a movement and to represent a certain status.

1872 Regarding product type, the following Figure 7 shows the industry segments which
1873 currently play the most vital role in the sharing economy.



1874

1875 **Figure 7. Share Economy usage within the different industry segments (Source: PWC, 2017;**
1876 **shares based on survey conducted with 4,500 consumers in 6 countries)**

1877 As seen in Figure 7, most product and service categories are not in focus of this study.
1878 The aspect media and entertainment as well as retail and consumer goods are of
1879 highest interest here. The latter is dominated by second-hand fashion, which is, as
1880 already mentioned, considered in another section of this report (see Section 3.2.4.1).

1881 **Classification**

1882 Sharing models can be successfully promoted by E-commerce and can substitute the
1883 purchase and possession of a product, thus having consequential and immediate
1884 positive effects. They are therefore considered as a direct effect of E-commerce.

1885 **Current and future relevance**

1886 The relevance of the sharing economy has rapidly increased in recent years. For
1887 Germany, around 39% of people surveyed by PWC in 2017 were using (to some
1888 extent) shared products or services (PWC, 2017). The global sharing economy market
1889 was around \$14 billion in 2014 and is estimated to reach even \$335 billion by the year
1890 2025 (Yaraghi and Ravi, 2011). For Germany alone, the market for 2018 was
1891 estimated to around 24 billion € (PWC, 2017). The sharing of products and services is
1892 widespread, especially among young people (PWC, 2017).

1893 **Supporting factors**

- 1894
- 1895
- 1896
- 1897
- 1898
- 1899
- 1900
- 1901
- 1902
- 1903
- 1904
- offers that promote the building of trust are essential for the successful operation of sharing models (PWC, 2018a);
 - the easy accessibility and thus usability (comfort) of the service is important for consumers to change from their previous possession-related behaviour (PwC, 2018) (PWC, 2018a);
 - realistically, in the near future, only offers that guarantee cost savings compared to ownership will prevail in the broad society (PwC, 2018) (PWC, 2018a); and
 - depending on the particular sharing model, there are numerous supporting factors for fostering it. For example, for car-sharing services:
 - an increase in parking fees for privately owned vehicles (Momo, 2010);

- 1905 • certain benefits, such as free parking, priority track, etc. for car-sharing
1906 vehicles (Momo, 2010); and
1907 • the use of public street space for car-sharing parking areas (Momo,
1908 2010).

1909 **Mitigating factors**

- 1910 ▪ relatively young market with a profoundly different understanding of ownership
1911 and use, and therefore with a current need for legal certainty to improve (PWC,
1912 2018c);
- 1913 ▪ the quality of some of the offers (e.g. some of the foreign bike sharing
1914 providers) is currently very low, which slows down the acceptance and further
1915 spread of sharing models (PWC, 2018c);
- 1916 ▪ the market has already partially begun to consolidate, and professional
1917 providers are taking over many areas. This can possibly have a positive effect
1918 on quality, legal certainty and, above all, widespread availability (PWC, 2018c).
1919 However, since it is usually a question of profit maximisation (especially in the
1920 long term), this contradicts the original idea of the models; and
- 1921 ▪ hidden subsidies for private and business use of cars (Momo, 2010), such as
1922 costs for road building, maintenance, traffic congestion, etc. (Smith, 2016).

1923 **Options for actions**

1924 **Producers/Platform providers:**

- 1925 ▪ since this type of market is only just developing, it is essential that customers
1926 have the possibility to give feedback. Its implementation requires an
1927 adaptability of the offered service.

1928 **Regulators:**

- 1929 ▪ establishment of a clear legal framework that does not only define a common
1930 understanding of respective sharing models, but also gives incentives to
1931 promote them in a sustainable way (Momo, 2010); and
- 1932 ▪ consolidating experience made in some of the Member States with national
1933 regulations and decisions with the objective to provide recommendations and
1934 guidelines.

1935 **Source of information**

1936 Momo (2010) *The State of European Car-Sharing*. Available at:
1937 [https://www.eltis.org/sites/default/files/trainingmaterials/the_state_of_carsharing_eu](https://www.eltis.org/sites/default/files/trainingmaterials/the_state_of_carsharing_europe.pdf)
1938 [rope.pdf](https://www.eltis.org/sites/default/files/trainingmaterials/the_state_of_carsharing_europe.pdf) (Accessed: 2 August 2019).

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1942 PwC (2018) *European Commission Proposals for Directives regarding fair taxation of*
1943 *the digital economy (" Digital Tax Package ")*.

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1950 Yaraghi, N. and Ravi, S. (2011) 'The Current and Future State of the Sharing
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1952 3.2.2.3 Threats – Cross-selling and up-selling

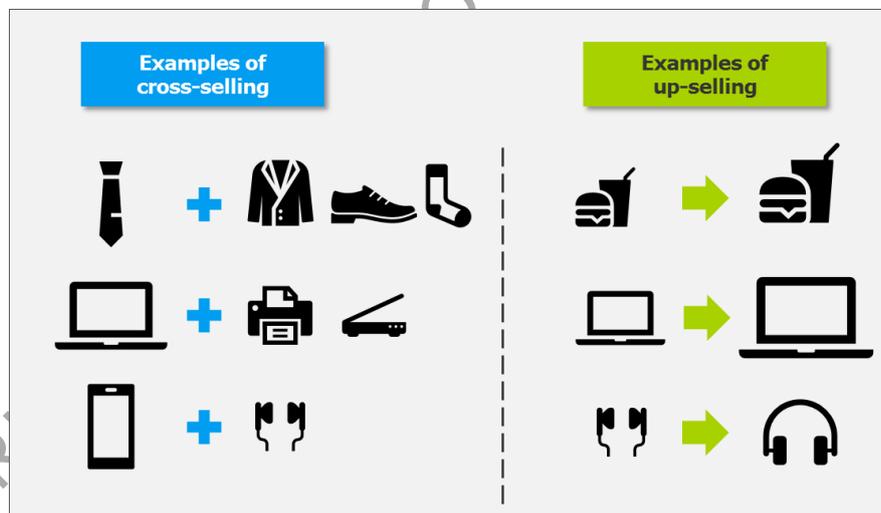
1953 **Description**

1954 Both cross-selling and up-selling are techniques used to promote additional products
1955 during the search for a product or during and after the purchase of a product. It is
1956 seen here as threat as it directly promotes consumption.

1957 Cross- and up-selling are two methods to generate more sales, which are used in
1958 traditional business as well as in E-commerce. In up-selling, the customer is sold a
1959 higher-value and more expensive product. Cross-selling offers the customer additional
1960 products to satisfy other related needs. The product offered through cross-selling
1961 often has complementary properties to the original desired product (Kamakura, W. et
1962 al., 2003).

1963 **Discussion**

1964 Although sometimes used as synonyms by different sources, cross-selling and up-
1965 selling are two distinct concepts. Cross-selling has the objective to convince the
1966 customer to purchase complementary items from a different product category which
1967 are somehow related to the "main" item of interest. This can be earphones to a
1968 smartphone, or a printer and scanner to a laptop (see Figure 8) (BigCommerce, no
1969 date). Up-selling, on the other hand, aims at encouraging customers to purchase a
1970 "better version" of the "original" item of interest. Better version should be understood
1971 here as providing more functionalities, higher performance, or simply more of a
1972 certain good, such as increasing the menu size of a meal (see Figure 8)
1973 (BigCommerce, no date). Both concepts can be applied to basically all product
1974 categories.



1975

1976

Figure 8. Differences in the practices of cross-selling and up-selling

1977 Sales has known this approach for a long time before the age of E-commerce, but it
1978 was clearly advanced by it. Digitalisation, advanced logarithms and (big) data analysis
1979 enable online retailers to automate and more accurately apply mentioned concepts
1980 (Knott et al., 2002).

1981 The threat is seen here in the main objectives of both concepts. Both up-selling and
1982 cross-selling might increase customer satisfaction and might lead to an additional
1983 purchase that increases the usability of the original product. The main objective,
1984 however, is an increased revenue for the provider, which clearly reflects an increased

1985 consumption. These techniques have proven to be extremely effective in increasing
1986 the purchase volume of individual customers and is heavily promoted for setting up an
1987 E-commerce platform (Suresh, 2019).

1988 **Classification**

1989 Effects arising from cross- and up-selling techniques are rather systematic and
1990 supplementary development due to certain E-commerce features. Their relevance is
1991 considered to be very high in the future. This aspect is considered an indirect effect of
1992 E-commerce.

1993 **Current and future relevance**

1994 No research paper evaluating the impact of cross- and up-selling from a scientific
1995 point of view could be found. However, there are some websites that provide
1996 information on sales of so-called auxiliary goods. The private flight sector can be given
1997 here as an example. Although the sales of tickets are the core business, the top ten
1998 airlines by ancillary revenue (revenue made by the sales of additional services or
1999 products such as assigned seats, extra legroom, special meals, etc.) reached more
2000 than \$28 billion in 2016 (Baskas, 2017). This surely includes aspects that are not
2001 falling in the category of cross- and up-selling but is still mainly driven by those two
2002 concepts.

2003 The overall relevance of these concepts is considered as very high as many E-
2004 commerce players see it as a crucial factor to increase their revenue. It is challenging
2005 to estimate its relevance for the different product categories as consolidated analysis
2006 is missing.

2007 This threat is of cross-product relevance and affects all product categories in focus of
2008 this study.

2009 **Supporting factors**

- 2010 ▪ combination of cross- and up-selling of certain products with the feature of
2011 pop-up ads, as they create higher visibility and have the intend to generate
2012 additional product sales; and
- 2013 ▪ some web shop platforms use techniques (especially up-selling) to put pressure
2014 on the customer to make a purchase that is not in the customer's interest.

2015 **Mitigating factors**

- 2016 ▪ customer awareness of such techniques and their impact on shopping
2017 behaviour as well as the associated impact on the environment:

2018 **Options for actions**

2019 **Scientific Community:**

- 2020 ▪ further research is required to understand the impact of cross- and up-selling
2021 techniques used in E-commerce on customer's purchasing behaviour; and
- 2022 ▪ a cross-industry evaluation of how much is additionally sold through the use of
2023 cross-selling and up-selling techniques would be helpful in evaluating these
2024 methods.

2025

2026

2027 **Producers/Platform providers:**

- 2028 ▪ it should be clear to the customer throughout the whole purchasing process to
2029 which extent his decisions to buy “auxiliary goods” is impacting the price to
2030 ensure transparency.

2031 **Source of information**

2032 Baskas, H. (2017) *Airlines reap \$28 billion from selling traveller ‘extras’ to flyers.*
2033 Available at: [https://www.cnbc.com/2017/07/28/airlines-reap-28-billion-from-selling-](https://www.cnbc.com/2017/07/28/airlines-reap-28-billion-from-selling-travel-extras-to-flyers.html)
2034 [travel-extras-to-flyers.html](https://www.cnbc.com/2017/07/28/airlines-reap-28-billion-from-selling-travel-extras-to-flyers.html) (Accessed: 2 August 2019).

2035 BigCommerce (no date) *What is the difference between upselling and cross-selling.*
2036 Available at: [https://www.bigcommerce.com/ecommerce-answers/what-difference-](https://www.bigcommerce.com/ecommerce-answers/what-difference-between-upselling-and-cross-selling/)
2037 [between-upselling-and-cross-selling/](https://www.bigcommerce.com/ecommerce-answers/what-difference-between-upselling-and-cross-selling/) (Accessed: 2 August 2019).

2038 Kamakura, W., A.; Wedel, M.; De Rosa, F.; Mazzon, J., A. (2003) ‘Cross-selling
2039 through database marketing: a mixed data factor analyzer for data augmentation and
2040 prediction’, *International Journal of Research Marketing*, 20, pp. 45–65. Available at:
2041 [http://wak2.web.rice.edu/bio/My Reprints/Cross-selling through database](http://wak2.web.rice.edu/bio/My%20Reprints/Cross-selling%20through%20database%20marketing.pdf)
2042 [marketing.pdf](http://wak2.web.rice.edu/bio/My Reprints/Cross-selling through database marketing.pdf).

2043 Knott, A.; Hayes, S.; Neslin, A. (2002) ‘Next-Product-to-buy Models for Cross-selling
2044 Applications’, *Journal for Interactive Marketing*, 16(3), pp. 59–75.

2045 Suresh, S. (2019) *Upsell and Cross-sell: Strategies to boost eCommerce Revenue.*
2046 Available at: <https://vwo.com/blog/use-upsell-cross-sell/> (Accessed: 2 August 2019).

2047

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2048 3.2.2.4 Threat – Ease of shopping

2049 **Description**

2050 The effort required to conduct a purchase is considered to be significantly decreased
2051 with E-commerce. Especially the combination of mobile connectivity and dedicated
2052 web store solutions makes online shopping both easily accessible and intuitive for
2053 users. Since this way of shopping is so convenient for the customer, impulse or
2054 stimulus purchases can increase. Consumption is generally encouraged, which is seen
2055 as a danger to the Circular Economy.

2056 **Discussion**

2057 It should be differentiated from the aspects of “Ubiquity” (see Section 3.2.1.7) and
2058 “Digital Goods” (see Section 3.2.3.1), which are discussed in other sections of this
2059 study. This section emphasises on the general ease with which customers can
2060 purchase products online:

- 2061 ▪ no physical travel to any shop is necessary;
- 2062 ▪ mostly platform- and device-independent;
- 2063 ▪ simplified processes (such as creating profiles and saving payment types for
2064 the next purchase); and
- 2065 ▪ simplicity of user interface and ease of use.

2066 There are countless providers offering online shop design as a service. Guidelines such
2067 as “72 Must-Have Features for Ecommerce Websites” show to which extent the whole
2068 shopping experience and purchasing process is optimised (WebAlive, 2019). Especially
2069 the creation of profiles with stored delivery address and payment data makes the
2070 purchase process considerably easier for the customer. The whole checkout process
2071 especially of large online retailers is optimised to such an extent that it takes only very
2072 little time for signed up users. Spontaneous purchases and general consumption are
2073 promoted in particular in connection with constant accessibility (e.g. mail). The
2074 necessity to create a profile enables companies to initiate special offers.

2075 Increased convenience of shopping, attractive on-line prices and performant
2076 marketing strategies based on an individual shopper's detailed digital profile may lead
2077 to faster renewal of still functional products (e.g. mobile phones) or impulse buying of
2078 products that will not be used (e.g. clothes).

2079 **Classification**

2080 The ease of shopping is a systematic aspect with a very hypothetical and long-term
2081 effect. It can be considered a supplementary development and therefore indirect effect
2082 of E-commerce.

2083 **Current and future relevance**

2084 The relevance of this aspect can be considered as already high. Most online shops are
2085 designed to streamline the shopping and purchasing process to a high extent.
2086 Especially user profiles and a very easy checkout process enable customers to
2087 purchase products very quickly.

2088 The development and dissemination of new technologies make it probable that his
2089 aspect will even further increase in relevance. These new developments include dash
2090 buttons, for example, which allow customers to reorder a certain product by simply
2091 pushing a button (Umweltbundesamt, 2018b). Although this concept is very

2092 controversial and corresponding providers take a step back for the time being, there
2093 are already similar developments and considerations with so-called virtual Dash
2094 Buttons (Warncke, 2019). Another example are smart speakers which are becoming
2095 increasingly popular. In Germany alone, around 13% of people has one type of smart
2096 speaker with voice assistant at home (Stern, 2018).

2097 Although legally extremely controversial or even prohibited, such developments show
2098 the extent to which the simplification of the purchasing process can be achieved
2099 (Gassmann, 2019). There is a danger that the customer will increasingly lose touch
2100 with the associated costs and environmental impacts. The latter in particular is already
2101 a potential threat. As there is usually no direct feedback on purchases and the
2102 associated environmental impacts, it is more difficult for customers to consider these
2103 aspects when making a purchase decision.

2104 This threat is of cross-product relevance and affects all product categories in focus of
2105 this study.

2106 **Supporting factors**

- 2107 ▪ modern technologies, such as virtual dash buttons, that minimise the
2108 customers "participation" in the purchasing process (Umweltbundesamt,
2109 2018b).

2110 **Mitigating factors**

- 2111 ▪ regulations requiring online shops to highlight certain aspects of the purchasing
2112 process clearly visible and easily understandable to the customer (such as
2113 price, value-added tax, transportation costs, etc.).

2114 **Options for actions**

2115 **Scientific Community:**

- 2116 ▪ although there is already comprehensive literature available on how marketing
2117 affects consumer behaviour, there is currently a lack of scientific research on
2118 modern E-commerce-related technologies and their impact on purchasing
2119 behaviour. Fast developments and a highly dynamic market make it difficult for
2120 the scientific community to provide elaborate analysis.

2121 **Source of information**

2122 Gassmann, M. (2019) *Amazons Bestellknopf bekommt eine Gnadenfrist*. Available at:
2123 [https://www.welt.de/wirtschaft/article186911746/Dash-Button-Amazons-Bestellknopf-](https://www.welt.de/wirtschaft/article186911746/Dash-Button-Amazons-Bestellknopf-bekommt-eine-Gnadenfrist.html)
2124 [bekommt-eine-Gnadenfrist.html](https://www.welt.de/wirtschaft/article186911746/Dash-Button-Amazons-Bestellknopf-bekommt-eine-Gnadenfrist.html) (Accessed: 2 August 2019).

2125 Stern (2018) *Wie unterscheiden sich die Sprachassistenten?* Available at:
2126 [https://www.stern.de/kultur/amazon-alexa-und-co---wie-unterscheiden-sich-die-](https://www.stern.de/kultur/amazon-alexa-und-co---wie-unterscheiden-sich-die-sprachassistenten--8345872.html)
2127 [sprachassistenten--8345872.html](https://www.stern.de/kultur/amazon-alexa-und-co---wie-unterscheiden-sich-die-sprachassistenten--8345872.html) (Accessed: 2 August 2019).

2128 Umweltbundesamt (2018b) *Konsum 4.0: Wie Digitalisierung den Konsum verändert*.
2129 Available at:
2130 [https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/fach](https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/fach_broschuere_konsum_4.0_barrierefrei_190322.pdf)
2131 [broschuere_konsum_4.0_barrierefrei_190322.pdf](https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/fach_broschuere_konsum_4.0_barrierefrei_190322.pdf).

2132 Warncke, S. (2019) 'E-Commerce Trends: Amazons Dash Button in der Kritik'.
2133 Available at: [https://wechseljetzt.de/nachrichten/e-commerce-trends-amazons-dash-](https://wechseljetzt.de/nachrichten/e-commerce-trends-amazons-dash-button-in-der-kritik/)
2134 [button-in-der-kritik/](https://wechseljetzt.de/nachrichten/e-commerce-trends-amazons-dash-button-in-der-kritik/) (Last accessed: 02.10.2019)

- 2135 WebAlive (2019) '72 Must-Have Features for Ecommerce Website', Available at:
2136 <https://www.webalive.com.au/ecommerce-website-features/> (Last accessed:
2137 01.10.2019)
2138

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2139 3.2.2.5 Threat – Personalised design

2140 **Description**

2141 The increased ease of ordering personalised products online might lead to decreased
2142 positive mass production effects, such as minimising waste arising during
2143 manufacturing processes, or optimisation of the product chain.

2144 **Discussion**

2145 Personalisation can describe two distinct features of E-commerce: (1) Promoting
2146 individualised offers and product recommendation and avoiding presumably irrelevant
2147 content to the customer to increase sales and (2) personalising products to some
2148 extent. The latter is discussed in this section and is based on the possibility to
2149 personalize and thus individualise, to a certain degree, numerous products traded in
2150 E-commerce. Individualisation can be as simple as changes in colour and material or
2151 to include the imprint of a desired name or logo on the final product. These operations
2152 delay completion of the product, which in turn affects the entire supply chain. In
2153 conjunction with fast delivery options, this can also increase the pressure on transport
2154 (Koch *et al.*, 2014).

2155 **Classification**

2156 The personalisation of products is a highly debateable and hypothetical effect whose
2157 relevance is currently difficult to evaluate. Potential effects might emerge in the
2158 future, but its relevance requires further research and analysis. It is considered an
2159 indirect effect of E-commerce.

2160 **Current and future relevance**

2161 No study could be found on the topic of individualisation of products which does not
2162 purely focus on the B2B sector (Koch *et al.*, 2014). It is estimated that there is no
2163 significant difference in the production cycle for some product groups (depending on
2164 the provider) and also no major differences between their environmental footprints.
2165 However, it should be emphasised here that the competition in the online trade as well
2166 as in the trade in general is very strong and therefore also the desire to stand out
2167 from competitors. A personalisation of products may be associated with increased
2168 costs for the customer, which he or she may be happy to pay to receive the additional
2169 service. However, the additional environmental impact might not be taken into
2170 account in this approach. Since many individual solutions have to interlock to achieve
2171 the goals of a Circular Economy, the possible disadvantage of this personalisation
2172 should be considered. One of the drawbacks of personalized products is related to
2173 their nature - they are personalised and thus tailored to a certain extent to an
2174 individual. This makes a possible resale considerably more difficult and thus reduces
2175 the benefit for a Circular Economy, where the aspect of reuse is of high importance.

2176 Personalised design is of little to no relevance for the product categories major
2177 household appliances, media & entertainment products / services, and non-perishable
2178 foods.

2179 **Supporting factors**

2180 *Due to the lack of available information, supporting factors could not be identified.*

2181 **Mitigating factors**

2182 *Due to the lack of available information, mitigating factors could not be identified.*

2183 **Options for actions**

2184 **Scientific Community:**

- 2185 • Scientific Community should expand their research approach on B2C offers of
2186 personalised design in E-commerce. Currently, no study focusing on this aspect
2187 have been identified.

2188 **Source of information**

2189 Koch, M., Butz, A. and Schlichter, J. (2014) 'Von der Massenware zu Individuellen
2190 Produktgestaltung', *Mensch und Computer*, pp. 29–32. Available at:
2191 [https://dl.gi.de/bitstream/handle/20.500.12116/8201/Braun_Siekmann_Wallenborn_](https://dl.gi.de/bitstream/handle/20.500.12116/8201/Braun_Siekmann_Wallenborn_Westphal-Furuya_Wolf_2014.pdf?sequence=2&isAllowed=y)
2192 [Westphal-Furuya_Wolf_2014.pdf?sequence=2&isAllowed=y](https://dl.gi.de/bitstream/handle/20.500.12116/8201/Braun_Siekmann_Wallenborn_Westphal-Furuya_Wolf_2014.pdf?sequence=2&isAllowed=y).

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2193 3.2.2.6 Threat – Shopping frenzy

2194 **Description**

2195 Shopping events, mostly on a fixed date, that attract customers with special offers,
2196 promote the so-called “shopping frenzy”. Such events are starting to have a significant
2197 impact on online shopping. Because of possible additional consumption, it could be
2198 seen as a threat to Circular Economy.

2199 **Discussion**

2200 From 2008 to 2018 the number of Internet users in the EU who bought or ordered
2201 goods or services online rose from less than 45% to more than 70% (Eurostat, 2018).
2202 Online retailers used this growth to launch a series of frequently returning sales
2203 events. During the time of a sales event, participating companies are promoting
2204 special offers to the customers. Extensive advertising of the events and a time
2205 restriction increase the sales figures, especially of large online retailers, enormously.
2206 According to information offered on blackfriday.com, in 2018 68% of the U.S.
2207 consumers were shopping online that day (BlackFriday.com, 2019a).

2208 Sales events are not a special characteristic of E-commerce alone, as traditional retail
2209 used them already for a long time. There is a large number of local special sales
2210 events that can be counted in this category. Events as Black Friday, however, are on a
2211 different scale since they are now advertised worldwide by companies in traditional
2212 and online retail. Some of such events are exclusively available in E-commerce –
2213 examples are the “Free Shipping Day”, a national shopping event in the U.S. or the
2214 Australian sale-event “Click Frenzy” (*Click Frenzy*, 2019).

2215 It is seen as threat to the Circular Economy as shopping events push consumption and
2216 lead to an increase in impulse and stimulus purchases (LaRose and Eastin, M., 2010;
2217 D’innocenzio, 2017; Red Point, 2019). Online shopping is already more driven by such
2218 impulsive buying decisions than in traditional retail, but such behaviour is even more
2219 pronounced during special sales events.

2220 **Classification**

2221 Sales events are (rapidly) evolving businesses, which can be considered a
2222 supplementary development to E-commerce. Their relevance has become high in
2223 recent years, and attached effects (e.g. consumption peaks, impulse purchases, etc.)
2224 are estimated to further increase. Arising effects are rather systematic and cannot be
2225 allocated to the purchase of one single product, which is why they are considered
2226 indirect effects of E-commerce.

2227 **Current and future relevance**

2228 The relevance of sales events increased immensely in recent years. Surveys
2229 conducted by McKinsey & Co indicate that Black Friday is becoming increasingly
2230 popular around Member States of the EU (Dispatches Europe, 2018). For 2015, 19%
2231 of respondents in the UK and 9% of respondents in Germany said they had
2232 participated in Black Friday. These figures rose to more than 50% for the UK and 43%
2233 for Germany in just two years (Dispatches Europe, 2018). It is not known how much
2234 exactly this led to an increase in the online sales for those regions.

2235 An indicator to the immense impact of sales events can be given by recent sales
2236 numbers of Amazon. In 2018, the company sold more than 100 million products
2237 during Amazon Prime Day, which surpassed the sales of Cyber Monday, Black Friday

2238 and 2017's Prime Day combined. The impact on consumption is high and this the
2239 potential impact on attached environmental burdens.

2240 Shopping frenzy is a cross-product threat.

2241 **Supporting factors**

2242 ▪ internet, social media and E-commerce platforms promote the dissemination of
2243 such events and increase the reach of advertising (see Sections 3.2.1.7 and
2244 3.2.2.3);

2245 ▪ social pressure of inclusion into social trends;

2246 ▪ mobile connectivity (see Section 3.2.1.7); and

2247 ▪ interconnection of global markets, through which a larger number of potential
2248 customers can be addressed, which in turn allow corresponding events to
2249 become enormously outreaching (see Section 3.2.1.4).

2250 **Mitigating factors**

2251 ▪ limited assortment of products included in the offer during shopping events.

2252 **Options for actions**

2253 **Scientific Community:**

2254 ▪ increasing the awareness of current results of shopping frenzy caused by sales
2255 events and affiliated impulse purchases among society.

2256 **Source of information**

2257 Red Points (2019). *Black Friday - are your costumers safe?* Available at:
2258 <https://www.redpoints.com/pdfs/ebook-millennials-on-black-friday/> (Accessed: 2
2259 August 2019).

2260 *Black Friday*. (2018a) *Black Friday*. Available at: <https://blackfriday.com/> (Accessed: 2
2261 August 2019).

2262 *Click Frenzy* (2019). Available at: <https://www.clickfrenzy.com.au/>.

2263 D'innocenzio, A. (2017) *Holiday shopping: Desire for deals, but some impulse buying*,
2264 *Phys Org*. Available at: <https://phys.org/news/2017-11-holiday-desire-impulse.html>
2265 (Accessed: 2 August 2019).

2266 Dispatches Europe (2018) *Black Friday 2018 (updated): Europe increasingly buys into*
2267 *American-style shopping frenzy*. Available at: [https://dispatcheseurope.com/black-](https://dispatcheseurope.com/black-friday-2018-europe-increasingly-buys-into-american-style-shopping-frenzy/)
2268 [friday-2018-europe-increasingly-buys-into-american-style-shopping-frenzy/](https://dispatcheseurope.com/black-friday-2018-europe-increasingly-buys-into-american-style-shopping-frenzy/)
2269 (Accessed: 2 August 2019).

2270 Eurostat (2018) *Internet users who bought or ordered gooss or services for private*
2271 *use in the previous 12 months by age group, EU-28, 2008-2018*. Available at:
2272 [https://ec.europa.eu/eurostat/statistics-explained/index.php/E-](https://ec.europa.eu/eurostat/statistics-explained/index.php/E-commerce_statistics_for_individuals)
2273 [commerce_statistics_for_individuals](https://ec.europa.eu/eurostat/statistics-explained/index.php/E-commerce_statistics_for_individuals) (Accessed: 2 August 2019).

2274 LaRose, R. and Eastin, M., S. (2010) *Is online buying out of control? Electronic*
2275 *Commerce and consumer self-regulation*. Available at:
2276 https://www.tandfonline.com/doi/abs/10.1207/s15506878jobem4604_4 (Accessed: 2
2277 August 2019).

2278 **3.2.3 Cluster – Digitalisation**

2279

2280 3.2.3.1 Opportunity – Digital goods

2281 **Description**

2282 Digital goods are predominantly relevant for the product category 'Media and
2283 entertainment products/services' and can be defined as goods that are stored,
2284 delivered and consumed in an electronic format. Consequently, digital goods are
2285 "shipped" electronically to the consumer through direct download from the Internet.

2286 **Discussion**

2287 Digital goods (also "e-goods") can be seen as a result of digitisation, which describes
2288 the process of transforming information available in a physical format into a digital
2289 format. In contrast to physical goods, digital goods can only be used as part of the
2290 digital realm by the use of specific devices that enable a consumer to access this
2291 digitised information (Watkins *et al.*, 2016). Common devices that are used for the
2292 consumption of e-goods are smartphones, tablets, computers, but also videogame
2293 consoles, TVs, MP3-players, or E-readers. In comparison to their physical
2294 counterparts, digital goods present certain characteristics: (1) They do not require any
2295 exclusive manufacturing process in the classical sense and hence do not require any
2296 immediate raw material extraction, (2) they do not require any physical warehouse
2297 space to be stored, and (3) they are provided or sent to the consumer electronically.
2298 Some examples of digital products are:

- 2299 ▪ writing: e.g. eBooks, magazines, templates, samples (e.g. cover letters, cv
2300 templates, copywriting templates), academic research papers, etc.;
- 2301 ▪ audio: songs, beats, jingles, ringtones, sound effects, audiobooks, podcasts,
2302 etc.;
- 2303 ▪ video: film, series, stock video, tutorial, documentary, etc.;
- 2304 ▪ design: wallpapers, posters, fonts, branding services, logo design, business
2305 card design, infographic design, comics, etc.;
- 2306 ▪ photography: stock photos, mock-up images;
- 2307 ▪ IT and tech: apps, games, browser plugins, software, domains, websites,
2308 online stores, hosting, etc.; and
- 2309 ▪ miscellaneous: virtual assisting, courses, nutrition plans, drawing lessons, paid
2310 newsletter, etc.

2311 There is, however, still a physical impact of digital goods in each of the life-cycle
2312 stages. ICT infrastructures with computers, servers and networks are necessary to
2313 develop and offer digital products. Although these products do not require physical
2314 space, they still require digital space that is provided by a physical storage unit.
2315 Networks of interconnected IT devices are used to transfer the digital information to
2316 the purchaser of the product without transmitting any physical object. And finally, IT
2317 devices are, again, necessary for consuming the purchased goods.

2318 The opportunity of digital goods lies in the described characteristics of such products.
2319 Avoiding a direct physical production reduces the amount of required raw materials as
2320 well as the demand for logistics – assuming that the digital version is replacing a
2321 physical one. This does most immediately apply to the differences in transportation
2322 modes, as no physical object has to be delivered to the consumer.

2323 **Classification**

2324 It can be argued that the delivery of digital products can be considered as an intended
2325 or anticipated effect, thus it can be classified as a direct effect arising from E-
2326 commerce. In fact, this effect is closely linked to or intersected with the operational
2327 energy demand for the network infrastructure (see Section 3.2.3.4). While the
2328 potential substitution of physical transport during the shipping stage of digital products
2329 is a consequential and immediate effect, further substitution effects relating to the
2330 production stage of physical counterparts are more speculative and, in any case, time-
2331 displaced. Consequently, this opportunity is predominantly assigned to the life-cycle
2332 stage "shipping" (the effect on raw material substitution is considered out of scope).

2333 **Current and future relevance**

2334 The market for e-goods has been growing continuously for years, for several reasons.
2335 More and more people have a suitable device (e.g. smartphone or computer) to access
2336 the Internet, while at the same time connection rates have risen significantly.
2337 Especially the latter allowed companies to design new services and products that are
2338 easily and immediately accessible for customers, even in relatively remote locations. A
2339 number of companies have benefitted from this development and positioned
2340 themselves strongly in the market. Companies such as Netflix (video streaming),
2341 Spotify (music streaming) or Amazon (multi-channel) are only a few well-known
2342 names in the branches which are used by millions of users on a daily basis.

2343 Europe belongs among the three largest markets for digital media worldwide with a
2344 market revenue of around US\$25 billion in 2018 – US being the largest and China
2345 being the second largest market (Statista, 2019f). The digital media market can be
2346 divided into 4 main segments:

- 2347 1. Video Games;
- 2348 2. Video-on-Demand;
- 2349 3. ePublishing; and
- 2350 4. Digital Music.

2351 The current relevance of digital goods varies between different products but is
2352 increasing considerably for most digital goods (music downloads being an example for
2353 a decreasing market due to the increasing relevance of music streaming). Revenue
2354 made from digital music in relation to total revenue of the music industry has risen
2355 from 5.8% in 2007 to 46.6% in 2017 for the market in Germany. A similar
2356 development can be seen in other digital segments, such as video games. The share
2357 of revenue made from selling downloads of video games increased from 3% in 2010 to
2358 29% in 2017. The relevance of this opportunity can therefore be seen as already
2359 significant today (Statista, 2019f), with a trend that clearly predicts an increase in the
2360 revenue made by selling digital goods throughout all digital segments. For Europe, an
2361 increase of revenues from currently 25.3 billion US\$ up to 31.5 billion US\$ is
2362 estimated (Statista, 2019f).

2363 Digital goods only concern the media and entertainment products/services and are
2364 irrelevant for the other product categories in the focus of this study.

2365 **Supporting factors**

- 2366 ▪ increasing willingness to shift from physical possession to digital availability;
- 2367 and

- 2368 ▪ current regulation, such as the Regulation (EU) 2015/2120, which
2369 "establish[es] common rules to safeguard equal and non-discriminatory
2370 treatment of traffic in the provision of internet access services".

2371 **Mitigating factors**

- 2372 ▪ cultural and societal meaning of (physically) possessing a product; perception
2373 of ownership differs between physical and digital goods;
- 2374 ▪ more distinct association of the human's self to a physical object and thus a
2375 higher value ascribed to the physical object;
- 2376 ▪ digital goods require an understanding of how to use digital media and devices
2377 in general and their use might thus not be feasible for everybody;
- 2378 ▪ forthcoming revision of current EU regulations regarding net neutrality with
2379 uncertainty on how to include the new (fifth) generation of cellular mobile
2380 communication (5G), as it provides the opportunity of "network slicing"⁵; and
- 2381 ▪ risk of losing access to purchased digital products (e.g. eBooks) in case of
2382 suspending the underlying service.

2383 **Options for actions**

2384 **Producers/Platform providers:**

- 2385 ▪ Strengthening the capacity to develop a social identity between consumer and
2386 digital good by personalisation and similar techniques; and
- 2387 ▪ providing information on the difference in environmental impacts between
2388 physical and digital format of a product.

2389 **Regulators:**

- 2390 ▪ Actively promoting and fostering through scientific literature and legal
2391 provisions the use of digital goods in fields that do not require a strong social
2392 bond. Studies show in fact a potential difference between the psychological
2393 ownership of physical and digital goods. In return, this could lead to physical
2394 products being preferred despite the availability of a digital version of the
2395 respective product – especially for goods that often trigger some type of social
2396 bond (such as books).

2397 **Source of information**

- 2398 Atasoy, O. and Morewedge, C. K. (2018) 'Digital goods are valued less than physical
2399 goods', *Journal of Consumer Research*, 44(6), pp. 1343–1357. doi:
2400 10.1093/jcr/ucx102.
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2406 content/EN/TXT/PDF/?uri=CELEX:32015R2120&from=EN

⁵ The definition of "network slicing" is provided in Section 6.1.

- 2407 Frias, R. and Martínez, J., P. (2018) '5G networks: Will technology and policy collide?',
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2411 *disappear too*, BBC. Available at: <https://www.bbc.com/news/technology-47810367>.
- 2412 Statista (2019f) *Digital Media Report 2019 The Digital Market Outlook provides all*
2413 *insights for a deep understanding of the Digital Media market*.
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2415 ownership and possession: observations from the context of digital virtual goods',
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2417 10.1080/0267257X.2015.1089308.
- 2418

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2419 3.2.3.2 Opportunity – Reduction of retail space

2420 **Description**

2421 Retail space is a necessity in traditional retail stores, with size demands depending on
2422 the kind of products sold. In contrast, an E-commerce enterprise only needs a
2423 warehouse to fulfil orders, something a brick-and-mortar store most likely has in
2424 addition to the retail space. The reduction of retail space is therefore considered as an
2425 opportunity for the Circular Economy with regard to its potential of eliminating the
2426 impacts on the environment due to the operation of the traditional stores.

2427 **Discussion**

2428 The true potential of E-commerce to reduce retail space depends on the products sold.
2429 Evidently, small and easily storable products show less potential to reduce retail
2430 space. At the same time, the importance of physical retail space differs between
2431 product categories. While some products need to be tried on or seen in real life (e.g.
2432 clothes, shoes), others can be purchased without any (or with little) risk by only
2433 relying on the information provided either online or offline.

2434 **Classification**

2435 The reduction of retail space is a systemic effect and cannot be allocated to the
2436 purchase of one single unit. Moreover, it is considered a hypothetical effect that
2437 cannot exclusively be linked to E-commerce but also depends on other societal
2438 developments such as urbanisation etc. Potential positive environmental effects can at
2439 best be realized with a significant time lag after cumulating purchases over E-
2440 commerce platforms which eventually forces (small) shop owners to close down.
2441 Consequently, it is classified as an indirect effect arising from E-commerce.

2442 **Current and future relevance**

2443 Considering the need to reduce environmental emissions, more efficient or “eco-
2444 stores” are and will become more and more important in the future. This aspect can
2445 affect the relevance of the potential savings in terms of environmental impacts
2446 originating from the elimination of the physical shops. Moreover, the actual
2447 contribution in terms of CO₂ emissions of the retail store on the overall CO₂ emissions
2448 associated with the retail system is considered as being of minor relevance (Weber *et*
2449 *al.*, 2009a).

2450 Reduction of retail space is a cross-product opportunity.

2451 **Supporting factors**

- 2452 ▪ cost savings that could be passed on to consumers; and
- 2453 ▪ newly founded businesses that first grow online.

2454 **Mitigating factors**

- 2455 ▪ people’s desire to go shopping as a pastime; and
- 2456 ▪ product’s properties that require the customer to try them, especially if they
2457 are large and need significant assembly (e.g. bicycles).

2458

2459 **Options for actions**

2460 **Producers/Platform providers:**

- 2461 ▪ sustainable operation of warehouses and attached logistic spaces to increase
2462 the potential environmental advantage.

2463 **Source of information**

2464 CANDRIAM (2017) *Environmental benefits of E-commerce versus brick-and-mortar*
2465 *retailing : reality or illusion ?*

2466 Fichter, K. (2001) 'Environmental Effects of E-Business and Internet Economy. First
2467 Insights and Environment-political Conclusions', (August), p. 26. Available at:
2468 [http://www.borderstep.de/Environmental_effects_of_e-](http://www.borderstep.de/Environmental_effects_of_e-business_and_Internet_economy.pdf)
2469 [business_and_Internet_economy.pdf](http://www.borderstep.de/Environmental_effects_of_e-business_and_Internet_economy.pdf).

2470 Pålsson, H., Pettersson, F. and Winslott Hiselius, L. (2017b) 'Energy consumption in e-
2471 commerce versus conventional trade channels - Insights into packaging, the last mile,
2472 unsold products and product returns', *Journal of Cleaner Production*. Elsevier B.V.,
2473 164, pp. 765–778. doi: 10.1016/j.jclepro.2017.06.242.

2474 Weber, C. L. *et al.* (2009) 'Life cycle comparison of traditional retail and e-commerce
2475 logistics for electronic products: A case study of buy.com', *2009 IEEE International*
2476 *Symposium on Sustainable Systems and Technology, ISSST '09 in Cooperation with*
2477 *2009 IEEE International Symposium on Technology and Society, ISTAS*, (June). doi:
2478 10.1109/ISSST.2009.5156681.

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2479 3.2.3.3 Opportunity – Substitution of printed marketing material

2480 **Description**

2481 Digital marketing is a natural aspect of E-commerce business models. However, it is
2482 not exclusive and, thus, not a unique feature to set this channel apart from traditional
2483 retail. It has the theoretical potential to substitute part of the printed advertising
2484 material, depending on the target audience.

2485 **Discussion**

2486 While being a large part of E-commerce, substituting printed marketing material does
2487 not necessarily result in any notable environmental benefits. This is due to the risk
2488 that evident gains from dematerialising marketing may be compensated by data-
2489 intense and numerous formats (e.g. E-mail newsletter, animated content, marketing
2490 videos) in the digital realm.

2491 **Classification**

2492 The substitution of printed marketing material cannot be allocated to the purchase of
2493 one single unit. Moreover, it is considered a long-term effect which necessitates the
2494 actual substitution of printed material. Consequently, this effect is classified as an
2495 indirect opportunity arising from E-commerce.

2496 **Current and future relevance**

2497 Online marketing is already a large factor and a substantial industry with further
2498 increasing importance in the future.

2499 The substitution of printed marketing material is of relevance for all product categories
2500 in focus of this study.

2501 **Supporting factors**

- 2502 ▪ increasing shift to digital media and online shopping.

2503 **Mitigating factors**

- 2504 ▪ reluctance of certain demographic groups to adopt new technology/ability to
2505 process information (target audience of advertisements).

2506 **Options for actions**

2507 **Scientific Community:**

- 2508 ▪ comparative studies on specific online-marketing technologies/concepts and
2509 their impact on shopping behaviour (especially regarding the younger
2510 generation) to avoid possible drawbacks.

2511 **Source of information**

2512 Pärssinen, M. *et al.* (2018) 'Environmental impact assessment of online advertising',
2513 *Environmental Impact Assessment Review*. Elsevier, 73(September 2017), pp. 177–
2514 200. doi: 10.1016/j.eiar.2018.08.004.

2515

2516 3.2.3.4 Threat – Operation of network infrastructure

2517 **Description**

2518 The underlying network infrastructure, which is necessary for creating and operating
2519 E-commerce activities, requires electricity to run. Although E-commerce is merely one
2520 of many features running on a specific network infrastructure, it still contributes to an
2521 increase in energy consumption of respective network devices and thus has
2522 implications for the Circular Economy.

2523 **Discussion**

2524 From an end-user perspective, E-commerce is essentially a user interface (usually web
2525 browser or an app) that allows to browse for and to buy products online. Also, from
2526 the perspective of an E-commerce merchant, the interface between potential
2527 consumer and one's own online shop is presumably of main importance for the
2528 provider of a product. Less focus is usually given to data traffic, data processing,
2529 storage means or the interconnectivity of network devices, all of which consume
2530 electricity to function (Rahimi and Alavi Rad, 2017; Aslan *et al.*, 2018). The demand
2531 for electricity that can be ascribed to E-commerce can be seen as a threat to the
2532 Circular Economy. Aspects such as raw material extraction to establish and maintain
2533 the infrastructure as well as toxicity of end-of-life devices are, however, considered
2534 out of the scope of this study.

2535 **Classification**

2536 Arising energy demands for the network infrastructure are a direct effect of E-
2537 commerce applications and occur immediately. Although these specific demands are
2538 difficult to quantify, they can theoretically be allocated to one fulfilled unit.

2539 **Current and future relevance**

2540 The energy demand caused by the network infrastructure applies to all product
2541 categories in scope but is of higher significance for product categories that make use
2542 of high quality and data intense content. Interactive content is used across industries
2543 to promote products as vividly as possible. The possibility to use a virtual model to try
2544 on clothes before the purchase, the flexible choice of colours, the presentation of
2545 numerous product photos from different perspectives, as well as zooming in and out
2546 are just a few of the many examples. All of these increases the amount of data that
2547 has to be transmitted between provider and user.

2548 Other factors may also play an important role in assessing the future relevance of this
2549 threat. For instance, an increase in available data transfer rates usually goes hand in
2550 hand with an increase in actual data transfer. Online shops are using more data
2551 transfer intense media such as video, audio and high-resolution photos to promote
2552 their products. Technological development in fixed broadband internet connection and
2553 mobile connection standards (e.g. from 2G in 1992 to 4.5G in 2016) facilitates high
2554 data traffic and thus also indirectly promotes E-commerce. Studies have shown that
2555 despite the increase in energy efficiency of modern technology, internet usage is
2556 estimated to have an enhancing effect on electricity consumption in the long-run. In
2557 other words, the more people are using the internet and the more intense it is used
2558 (in terms of data transfer), the more electricity is consumed (Rahimi and Alavi Rad,
2559 2017).

2560 This threat is relevant for all product categories, as it describes the underlying
2561 technology necessary for E-commerce, regardless of the product category.

2562 **Supporting factors**

- 2563 ▪ increase in cloud services that are used to establish and provide an E-
- 2564 commerce platform; and
- 2565 ▪ increase in available data transfer rates.

2566 **Mitigating factors**

- 2567 ▪ raising awareness on the relationship between internet usage and energy
- 2568 demand;
- 2569 ▪ increase in energy efficiency of devices and network infrastructure; and
- 2570 ▪ mitigation of associated environmental impacts due to adoption of renewable
- 2571 energy supplies for operating the network infrastructure.

2572 **Options for actions**

2573 **Scientific Community:**

- 2574 ▪ awareness raising on the relationship between surfing, e-shopping, data
- 2575 transfer, electricity consumption and impact on the environment (see Section
- 2576 3.2.2.1, opportunity "Nudging").

2577 **Producers/Platform providers:**

- 2578 ▪ smart use of content and media with an increased focus on data transfer (not
- 2579 every promotion video or photo necessarily needs to be of high resolution);
- 2580 ▪ more focus on results rather than on amount of content alone; and
- 2581 ▪ regular evaluation of how much traffic your online shop/website is generating
- 2582 per user and in total:
 - 2583 ○ number of expected visitors;
 - 2584 ○ expected page views by each visitor; and
 - 2585 ○ average size of pages including all media.

2586 **Hosting providers:**

- 2587 ▪ use of data transfer plans that include certain thresholds in agreement with the
- 2588 contractor; and
- 2589 ▪ coordination between hosting provider and platform operator/producer.

2590 **Source of information**

2591 Aslan, J. *et al.* (2018) 'Electricity intensity of internet data transmission untangling the

2592 estimates', *Journal of Industrial Ecology*, 22(4), pp. 785–798. doi:

2593 10.1111/jiec.12630.

2594 EMarketer (2017) *Number of digital buyers worldwide from 2014 to 2021 (in billions)*,

2595 *Statista*. Available at: [https://www.statista.com/statistics/251666/number-of-digital-](https://www.statista.com/statistics/251666/number-of-digital-buyers-worldwide/)

2596 [buyers-worldwide/](https://www.statista.com/statistics/251666/number-of-digital-buyers-worldwide/) (Accessed: 20 March 2019).

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2599 Morley, J., Widdicks, K. and Hazas, M. (2018) 'Digitalisation, energy and data

2600 demand: The impact of Internet traffic on overall and peak electricity consumption',

2601 *Energy Research and Social Science*. Elsevier, 38(February), pp. 128–137. doi:

- 2602 10.1016/j.erss.2018.01.018.Rahimi, M. and Alavi Rad, A. (2017) 'Internet Usage,
2603 Electricity Consumption and Economic Growth: Evidence from a Panel of Developing-8
2604 Countries', *International Journal of Energy Economics and Policy* |, 7(3), pp. 152–156.
2605 Available at: <http://www.econjournals.com>.
- 2606 Rahimi, M. and Alavi Rad, A. (2017) 'Internet Usage, Electricity Consumption and
2607 Economic Growth: Evidence from a Panel of Developing-8 Countries', *International
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2610 **3.2.4 Cluster – End of life**

2611 3.2.4.1 Opportunity – ReCommerce: Second-hand E-commerce / online auctioning

2612 **Description**

2613 “ReCommerce” encompasses the re-sale of used consumer goods via the internet.
2614 Fashion and electronic entertainment devices like smartphones and tablets are the
2615 primary focus for vendors (Restposten.de, 2016).

2616 **Discussion**

2617 ReCommerce, which used to be second-hand sales, is a large industry that primarily
2618 focuses on (but is not limited to) electronics and clothing. ReCommerce is essentially
2619 used by e-commerce customers in two different ways:

- 2620 ▪ the acquisition and resale of used and refurbished products; and
- 2621 ▪ platforms where people offer items that they want to give away.

2622 This business model has grown into a multi-billion-dollar industry. It enables
2623 consumers to save money, regain some of their spending, and it prolongs a product’s
2624 useful life, thus decreasing the environmental impact due to a reduced demand for
2625 new items (Janke, 2013; Umweltbundesamt, 2017; European Valuations, 2018).

2626 **Classification**

2627 ReCommerce is strongly facilitated through online services and applications. Some
2628 forms, however, existed before and became more accessible through the internet. In
2629 addition, the institutionalisation through dedicated companies gives the consumer
2630 security with their purchase. While the concept of reselling used items is not solely an
2631 effect of E-commerce, the improved accessibility and institutionalisation are
2632 considered direct effects of the online business model. Thus, resale of goods via
2633 dedicated online platforms is arguably an intended positive effect arising from E-
2634 commerce.

2635 **Current and future relevance**

2636 ReCommerce has grown significantly in the past ten years and with major companies
2637 entering the market the growth is expected to continue in the future (European
2638 Valuations, 2018). Therefore, ReCommerce is and will be an important cornerstone in
2639 digital market.

2640 Apart from non-perishable food, this opportunity can be seen as relevant for all
2641 product categories in focus of this study. The second hand market offers a wide range
2642 of products.

2643 **Supporting factors**

- 2644 ▪ large parts of the population are already actively buying and selling used
2645 products, which makes the ReCommerce market a relatively stable market;
- 2646 ▪ shorter product life cycles in electronics increase turnover on the second-hand
2647 market;
- 2648 ▪ ecological conscience is leading to increased interest in used items; one-time
2649 possession is regarded as “uncool”;
- 2650 ▪ platforms can develop into communities that not only serve business purposes,
2651 but also people’s need for social interaction; and

- 2652 ▪ online trade platforms with their rating systems have significantly improved the
2653 image of used products (Umweltbundesamt, 2017).

2654 **Mitigating factors**

- 2655 ▪ people's desire to own brand new products, especially with electronics and
2656 privacy concerns;
2657 ▪ limited availability and selection of used goods; and
2658 ▪ often lack of warranty for used goods.

2659 **Options for actions**

2660 **Producers/Platform providers:**

- 2661 ▪ offering of warranty; and
2662 ▪ proactive advertisement of environmental benefits of used products.

2663 **Regulators:**

- 2664 ▪ tax incentives for resale of used goods.

2665 **Source of information**

2666 European Valuations (2018) *Market sector insights november 2018: The Recommerce*
2667 *Industry*. Available at: [https://www.eurovals.co.uk/wp-content/uploads/Recommerce-](https://www.eurovals.co.uk/wp-content/uploads/Recommerce-Industry.pdf)
2668 [Industry.pdf](https://www.eurovals.co.uk/wp-content/uploads/Recommerce-Industry.pdf).

2669 Janke, K. (2013) *Der Second-Hand-Boom: Alle reden über Re-Commerce, e-tailment*.
2670 Available at: [https://etailment.de/news/stories/Der-second-hand-boom-alle-reden-](https://etailment.de/news/stories/Der-second-hand-boom-alle-reden-ueber-recommerce-1580)
2671 [ueber-recommerce-1580](https://etailment.de/news/stories/Der-second-hand-boom-alle-reden-ueber-recommerce-1580) (Accessed: 22 July 2019).

2672 Restposten.de (2016) *Geschäftsmodell ReCommerce - warum sich der Einstieg lohnt*.
2673 Available at: [https://www.restposten.de/pdf/Ratgeber-Geschaeftsmodell-](https://www.restposten.de/pdf/Ratgeber-Geschaeftsmodell-ReCommerce-Warum-sich-der-Einstieg-lohnt.pdf)
2674 [ReCommerce-Warum-sich-der-Einstieg-lohnt.pdf](https://www.restposten.de/pdf/Ratgeber-Geschaeftsmodell-ReCommerce-Warum-sich-der-Einstieg-lohnt.pdf).

2675 Umweltbundesamt (2017) *Schaffung einer Datenbasis zur Erfassung der Mengen von*
2676 *in Deutschland wiederverwendeten Produkten*. Available at:
2677 [https://www.umweltbundesamt.de/sites/default/files/medien/1968/publikationen/201](https://www.umweltbundesamt.de/sites/default/files/medien/1968/publikationen/2017-01-17_texte_04-2017_zwischenbericht_mengen-wiederverwendete-produkte_v2.pdf)
2678 [7-01-17_texte_04-2017_zwischenbericht_mengen-wiederverwendete-](https://www.umweltbundesamt.de/sites/default/files/medien/1968/publikationen/2017-01-17_texte_04-2017_zwischenbericht_mengen-wiederverwendete-produkte_v2.pdf)
2679 [produkte_v2.pdf](https://www.umweltbundesamt.de/sites/default/files/medien/1968/publikationen/2017-01-17_texte_04-2017_zwischenbericht_mengen-wiederverwendete-produkte_v2.pdf)

2680

2681 3.2.4.2 Opportunity – Extended product selling cycle

2682 **Description**

2683 Online retailers have nearly unlimited amount of (digital) retail space as well as larger
2684 warehouse capabilities to offer products to consumers on their websites. This makes it
2685 easier to offer old/out of trend products (especially in the field of fashion and
2686 electronics) for a longer time, mostly with a discount. Ultimately, less products may be
2687 destroyed or sold to developing countries.

2688 **Discussion**

2689 Pålsson (2018) notes that there is a trend in E-commerce towards fewer and larger
2690 warehouses, which may be due to the desire for greater energy efficiency. Respective
2691 E-commerce vendors operate large centralized warehouses that enable them to store
2692 more products for longer periods of time. This is enabled by the spatial advantage
2693 over traditional vendors that need distributed storage which means a redundancy in
2694 stocks and the risk of accumulating unsold products. Hence, the E-commerce vendor
2695 has the opportunity to hold on to products for longer and sell them, while traditional
2696 retail has to dispose of obsolescent products to free up space (Pålsson, 2018).

2697 **Classification**

2698 The extended product selling cycle is potentially facilitated by the centralized
2699 warehouses of E-commerce retailers. However, this effect is rather hypothetical and
2700 differences to traditional value chains are uncertain. Hence, this opportunity is
2701 considered an indirect effect which may arise from E-commerce.

2702 **Current and future relevance**

2703 E-commerce's ability to keep stock longer is already very relevant due to the
2704 increased relevance of E-commerce itself. The overall growing E-commerce market
2705 volume may result in an even bigger importance in the future.

2706 This opportunity is in general relevant for all product categories.

2707 **Supporting factors**

- 2708 ▪ consumer behaviour to increasingly shop online; and
- 2709 ▪ consumer's desire to save on their purchases.

2710 **Mitigating factors**

- 2711 ▪ fast paced developments in certain markets (e.g. tech, fashion); and
- 2712 ▪ desires to own the latest products in certain categories.

2713 **Options for actions**

2714 **Scientific Community:**

- 2715 ▪ investigations concerning the environmental implications of unsold products.

2716 **Producers/Platform providers:**

- 2717 ▪ collaboration with ReCommerce platforms; and
- 2718 ▪ proactive promotion of discounted products.

2719

2720 **Source of information**

2721 Pålsson, H. (2018) *Packaging Logistics - Understanding and managing the economic*
2722 *and environmental impacts of packaging in supply chains*. London: Kogan Page
2723 Limited.

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2724 3.2.4.3 Opportunity – Product take-back

2725 **Description**

2726 The development of reverse logistics allows for an efficient chain of re-use, repair and
2727 recycling possibilities. E-commerce has the potential to increase customer retention
2728 and thus also the producer's possibility to establish a profound reverse logistic.

2729 **Discussion**

2730 The take-back of products is regulated in European legislation in several Directives,
2731 such as the Packaging and Packaging Waste Directive (94/62/EC) or the WEEE
2732 Directive (2012/19/EU) and imposes the disposal of waste on the manufacturer of
2733 such products. This producer responsibility requires the manufacturer to incorporate
2734 take-back logistics to consumers and businesses. With regard to the product groups in
2735 focus of this study, this impacts especially producers of major household appliances
2736 and small ICT.

2737 Producers must contribute their share to meeting collection quotas set in the WEEE
2738 directive. E-commerce is seen here as an opportunity to improve the producers'
2739 possibilities to take-back WEEE directly from their customers, thus improving the
2740 opportunities to comply with respective quotas. A further incentive for producers to
2741 get back their own product at its end-of-life is that producers know exactly which
2742 substances and in which quantities have been processed in their products and how
2743 exactly they can be extracted.

2744 **Classification**

2745 Product take-back is seen as an indirect effect due to its potential positive impact on a
2746 long-term transition towards a Circular Economy. It becomes relevant at the end-of-
2747 life stage of the product life-cycle.

2748 **Current and future relevance**

2749 In general, the digital market offer great potentials to automate and streamline
2750 processes at the end of their first useful life, essentially making use of already existing
2751 infrastructures for reverse logistics (Umweltbundesamt, 2018b).

2752 The current relevance of this aspect is seen as high as the objectives set out in the
2753 WEEE Directive can be considered ambitious. This puts pressure on manufacturers,
2754 who already have a significant interest today in being able to achieve their quotas well
2755 at a reasonable expense.

2756 Several companies are already taking advantage of the opportunities and are actively
2757 involving consumers in their products. For example, Apple or HP can be mentioned
2758 here, both of which pursue an active take-back policy.

2759 This threat is not of relevance for the product categories non-perishable food and
2760 media and entertainment products/services. At the same time it is of particular
2761 importance for small information and communication technology and major household
2762 appliances due to existing take-back obligations for WEEE.

2763 **Supporting factors**

- 2764
- 2765 ▪ an existing close customer relationship increases the possibility that the
 - 2766 customer will return the product directly to the manufacturer at the end of its
life; and

- 2767 ▪ take-back programmes of producers.

2768 **Mitigating factors**

- 2769 ▪ Customer-to-customer (C2C) sales reduce the relationship between end
2770 consumer and producer of the product (e.g. in second-hand markets), which
2771 makes a return of the product at the end of its life to the producer less likely.

2772 **Options for actions**

2773 **Producers/Platform providers:**

- 2774 ▪ offering to the customer a return process that is as simplified as possible with
2775 clear instructions and information about the take-back programme; and
2776 ▪ providing incentives for returning End-of-Life products.

2777 **Source of information**

2778 Atasu, A., Van Wassenhove, L. N. and Sarvary, M. (2009) 'Efficient take-back
2779 legislation', *Production and Operations Management*, 18(3), pp. 243–258. doi:
2780 10.1111/j.1937-5956.2009.01004.x.

2781 Esenduran, G. and Kemahliolu-Ziya, E. (2015) 'A comparison of product take-back
2782 compliance schemes', *Production and Operations Management*, 24(1), pp. 71–88. doi:
2783 10.1111/poms.12213.

2784 Umweltbundesamt (2018) *Konsum 4.0: Wie Digitalisierung den Konsum verändert*.
2785 Available at:
2786 [https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/fach](https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/fach_broschuere_konsum_4.0_barrierefrei_190322.pdf)
2787 [broschuere_konsum_4.0_barrierefrei_190322.pdf](https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/fach_broschuere_konsum_4.0_barrierefrei_190322.pdf).

2788

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2789 3.2.4.4 Threat – End-of-Life challenges

2790 **Description**

2791 End-of-life challenges in E-commerce mainly arise from potentially hazardous waste
2792 groups, e.g. electronic equipment. The main issue presents itself in disposal of such
2793 products that need special collection points. Deutsche Umwelthilfe criticized major
2794 online retailers for their limited compliance with their duty to enable consumers to
2795 return their old devices (DVZ, 2018; Verbraucherzentrale, 2019).

2796 **Discussion**

2797 Generally, all retailers that offer electronic devices and that have a sales/storage
2798 space of more than 400 m² are obliged to take back WEEE devices, especially when
2799 the device's edge length is under 25 cm. Larger devices have to be taken back when
2800 selling a replacement unit and the retailer has to provide the logistics to do so (Weee
2801 Return, no date; Verbraucherzentrale, 2019). The difficulty arising with online retailers
2802 are the conditions under which they take back WEEE. Often, packaging requirements
2803 for the take-back schemes by vendors are difficult to meet by consumers, while larger
2804 devices have to be brought to local facilities provided/pointed out by the e-commerce
2805 retailer. Additionally, online retail often makes the return of WEEE difficult by requiring
2806 dedicated contact with customer support or hidden information (DVZ, 2018). This
2807 means online retail effectively hinders the proper disposal of devices, leading to
2808 improper treatment and resource loss.

2809 **Classification**

2810 It remains highly speculative whether E-commerce value chains actually constitute
2811 more severe barriers and challenges at the end-of-life stage of products compared to
2812 traditional channels. Hence, this effect is hypothetical and the processes as well as
2813 potential environmental implications lie mostly outside the sphere of influence of
2814 platform providers. Therefore, this threat is considered an indirect effect.

2815 **Current and future relevance**

2816 Disposal of WEEE is already relevant but will become more important in the future
2817 with more and more devices being sold for various purposes. This threat occurs in the
2818 product categories small information and communication technology as well as major
2819 household appliances.

2820 **Supporting factors**

- 2821
- 2822 ▪ insufficient monitoring of legal compliance with common market regulations
(see Section 3.2.5.4) (DVZ, 2018); and
 - 2823 ▪ with a rapidly increasing number of devices, the challenges of end-of-life are
2824 also likely to grow.

2825 **Mitigating factors**

- 2826
- 2827 ▪ implemented return logistics by producers and online retailers of respective
2828 devices and products, which is intended to be resource-saving and customer-
friendly.

2829

2830

2831 **Options for actions**

2832 **Regulators:**

- 2833 ▪ complete monitoring of legal obligations and sanctions in case of breach.

2834 **Source of information**

2835 DVZ (2018) 'Onlinehandel: Deutsche Umwelthilfe bemängelt Rücknahme von Elektro-
2836 Altgeräten', 3 April. Available at:

2837 [https://www.dvz.de/rubriken/logistik/detail/news/onlinehandel-deutsche-umwelthilfe-
2838 bemaengelt-ruecknahme-von-elektro-altgeraeten.html](https://www.dvz.de/rubriken/logistik/detail/news/onlinehandel-deutsche-umwelthilfe-bemaengelt-ruecknahme-von-elektro-altgeraeten.html).

2839 Verbraucherzentrale (2019) *Elektroschrott: Diese Geräte und Gegenstände gehören*
2840 *ins Recycling*. Available at: [https://www.verbraucherzentrale.de/wissen/umwelt-
2841 haushalt/abfall/elektroschrott-diese-geraete-und-gegenstaende-gehoren-ins-
2842 recycling-12861](https://www.verbraucherzentrale.de/wissen/umwelt-haushalt/abfall/elektroschrott-diese-geraete-und-gegenstaende-gehoren-ins-recycling-12861) (Accessed: 24 July 2019).

2843 Weee Return (no date) *I am an online retailer. In which way does the electrical*
2844 *equipment law (ElektroG) affect me?* Available at: [https://www.weee-
2845 return.de/services/online-retailer/?lang=en/#checkliste](https://www.weee-return.de/services/online-retailer/?lang=en/#checkliste) (Accessed: 24 July 2019).

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2846 3.2.4.5 Threat – Waste from returns

2847 **Description**

2848 Returns are commonly accepted for items sold online and constitute a necessary right
2849 of the consumer since there is no possibility to completely and realistically examine
2850 the product before delivery. The returned products might go towards different fates,
2851 one of which is the disposal as waste.

2852 **Discussion**

2853 Depending on the category between 5.9% and 21% of articles are returned in 5.5% to
2854 45.1 % of the shipments (Asdecker, 2019). The highest return rates are for clothing
2855 followed by entertainment products. However, in Germany, 92% of the products are
2856 sold as new or b-stock. The exact amount of destroyed returns is uncertain
2857 (Postpischil and Jacob, 2019).

2858 The destruction of products is the very last option especially for large retailers, but
2859 there are products that cannot be resold due to e.g. hygienic reasons (Asdecker,
2860 2019; Gsell, 2019). Smaller retailers that use platforms such as Zalando often also
2861 use the platform's warehouses in exchange for a fee. Depending on how high the fee
2862 is, sometimes it can be easier to draw back a product that does not sell and destroy it
2863 because the cost is lower than the fee to be paid for the warehouse space (Postpischil
2864 and Jacob, 2019).

2865 **Classification**

2866 The treatment and potential destruction of returned products is not an exclusive
2867 problem in E-commerce value chains. This makes a comparison with traditional
2868 channels challenging. Often this effect is also outside the sphere of control for
2869 platform providers. Consequently, it is considered an indirect effect.

2870 **Current and future relevance**

2871 Returns are a highly relevant current topic and are considered to have the potential to
2872 become even more relevant in the future, considering the growing E-commerce
2873 market.

2874 Especially clothing is usually less susceptible to damage than, for example, IT
2875 equipment or large household appliances, which require, among other things, a higher
2876 degree of shock protection (Statista Research Department, 2014a). In general, it is
2877 estimated that around 15-20% of purchases are sent back because the product
2878 arrived damaged (Statista Research Department, 2014b; Gallup Institut, 2018)

2879 This threat is of particular relevance for products that are (1) more likely to be send
2880 back and that are (2) more susceptible to damage (e.g. due to the necessity of a
2881 higher degree of shock protection), such as small information and communication
2882 technology. However, also other product categories are potentially affected.

2883 **Supporting factors**

- 2884 ▪ economic factors (cheaper to destroy than to resell); and
- 2885 ▪ legal requirements (security, hygiene) (Gsell, 2019).

2886

2887

2888 **Mitigating factors**

- 2889 ▪ dedicated platforms for the sale of refurbished, pre-owned or open-box
2890 products at a reduced price, such as "Amazon renewed" (Amazon, 2019a);
- 2891 ▪ adequate shipping costs for purchasing products online: when customers
2892 already have to pay a certain amount for home delivery, the incentive to pay
2893 more attention to whether the product will meet their expectations increases
2894 when choosing a product. In addition, purchases are prevented for which there
2895 is a very high probability that the product will be returned when the order is
2896 placed (such as "Just give it a try"-orders).

2897 **Options for actions**

2898 **Producers/Platform providers:**

- 2899 ▪ introduce incentives and systems (such as the integration of different media:
2900 text, video, pictures, interactive 3D images, virtual fitting rooms (Pachoulakis,
2901 2012)) to reduce returns.

2902 **Regulators:**

- 2903 ▪ mandatory and uniform fee for returns to level the playing field between larger
2904 and smaller retailers (Postpischil and Jacob, 2019).

2905 **Source of information**

2906 Amazon (2019a). Amazon Renewed. Available at:
2907 https://www.amazon.de/gp/help/customer/display.html/ref=s9_acss_bw_h1_desfhd_md1_w?language=de_DE&nodeId=202089470&pf_rd_i=10676131031&pf_rd_m=A3JWKAKR8XB7XF&pf_rd_p=9a104d53-2b7c-4e73-bc99-d416d180fd4f&pf_rd_r=GRGCF8PC2X6TS7WMFGS3&pf_rd_s=merchandised-search-2&pf_rd_t=101 (Last accessed: 10.10.2019)

2912 Asdecker, B. (2019) 'Herausforderungen des Onlinehandels für Umwelt- und
2913 Verbraucherschutz - Zerstörung neuwertiger, nicht verkehrsfähiger Ware', in
2914 *Herausforderungen des Onlinehandels für Umwelt- und Verbraucherschutz*. Available
2915 at:
2916 https://www.ioew.de/fileadmin/user_upload/DOKUMENTE/Veranstaltungen/WS_3_Zerstörung_Björn_Asdecker.pdf.

2918 Gsell, M. (2019) 'Verhinderung der bewussten Zerstörung neuwertiger Retour-Ware',
2919 in *Herausforderungen des Onlinehandels für Umwelt- und Verbraucherschutz*.
2920 Available at:
2921 https://www.ioew.de/fileadmin/user_upload/DOKUMENTE/Veranstaltungen/Vortrag_3__Martin_Gsell.pdf.

2923 Postpischil, R. and Jacob, K. (2019) *Kurzanalyse E-Commerce vs. stationärer Handel: Die Umwelt- und Ressourcenwirkungen im Vergleich*. Available at: <https://refubium.fu-berlin.de/handle/fub188/24797>.

2926 Wenk-Fischer, C. (2019) 'Zerstörung neuwertiger, nicht verkehrsfähiger Ware', in
2927 *Herausforderungen des Onlinehandels für Umwelt- und Verbraucherschutz*. Available
2928 at:
2929 https://www.ioew.de/fileadmin/user_upload/DOKUMENTE/Veranstaltungen/WS_3_Retouren__Wenk-Fischer.pdf.

2931

2932 3.2.4.6 Threat – Food waste

2933 **Description**

2934 In terms of the biological cycle of a Circular Economy, which emphasises on the value
2935 of biological materials within the system (MacArthur, 2015), food waste is a very
2936 important issue for both consumers and the food industry. To reduce environmental
2937 impacts associated with food, avoiding food waste is paramount.

2938 **Discussion**

2939 Although still a minor segment of the E-commerce market, (fresh) food delivery is
2940 gaining more focus and more customers each year. For Germany alone, the market
2941 has grown dramatically in recent years - from 618 million € in 2014 to 1.360 billion €
2942 in 2018 (Statista: [Quelle](#)). The delivery of food is not seen as a cause of food waste
2943 but can still contribute to it (e.g. in case of damage during delivery). On the other
2944 hand, it could reduce food waste by promoting a more targeted purchase (e.g.
2945 shopping-list focused purchase, no purchases induced by the display of food in the
2946 shop). Moreover, the actual effects will certainly depend on the specific business
2947 model (e.g. home delivery, click and collect) (ATKearney, 2012; López *et al.*, 2013).

2948 **Classification**

2949 Whether E-commerce induces additional food waste or even exhibits any potential to
2950 further reduce it, is very hypothetical and depends on systemic dynamics in the food
2951 market and the respective customer behaviour. Therefore, this is clearly an indirect
2952 effect potentially arising from E-commerce.

2953 **Current and future relevance**

2954 In the past, online grocery sales have grown much slower than the total E-commerce
2955 market (ATKearney, 2012). Moreover, the online grocery market is still in an emerging
2956 state in most European countries. For instance, the online grocery channel share in
2957 France was 4.5% in 2018. In Germany and Spain, this share was significantly lower at
2958 0.5% and 0.7%, respectively (Ecommerce News, 2018). While there is certainly a
2959 huge growth potential, the future development of this segment seems highly
2960 speculative. In particular, substantial differences in terms of adoption by customers
2961 between countries and geographical regions can be expected.

2962 This threat is only of relevance for the product category non-perishable foods,
2963 although it should be noted that especially perishable and fresh food is affected, which
2964 are not assessed in detail in this study.

2965 **Supporting factors**

2966 *Given inconclusive manifestation (opportunity or threat) of this effect, supporting*
2967 *factors could not be identified.*

2968 **Mitigating factors**

2969 *Given inconclusive manifestation (opportunity or threat) of this effect, mitigating*
2970 *factors could not be identified.*

2971

2972

2973 **Options for actions**

2974 **Scientific community:**

- 2975 ▪ additional research is necessary to evaluate environmental effects arising from
2976 E-commerce on food waste. Research should include different food categories
2977 (perishable and non-perishable).

2978 **Source of information**

2979 ATKearney (2012) A Fresh Look at Online Grocery. doi:
2980 10.1080/03060497.1993.11085326.

2981 Ecommerce News (2018) 4 European countries in top 10 online grocery markets by
2982 2023. Available at: [https://ecommercenews.eu/4-european-countries-in-top-10-](https://ecommercenews.eu/4-european-countries-in-top-10-online-grocery-markets-by-2023/)
2983 [online-grocery-markets-by-2023/](https://ecommercenews.eu/4-european-countries-in-top-10-online-grocery-markets-by-2023/).

2984 López, E. G., Gelante, N. and Monroe, S. (2013) *The future of online grocery in*
2985 *Europe, McKinsey*. doi: 10.1016/S0034-3617(11)70034-0.

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2986 **3.2.5 Cluster – Legal framework**

2987 3.2.5.1 Threat – Difficulty to monitor

2988 **Description**

2989 One of the major characteristics of E-commerce is the access to international markets
2990 which enables customers to easily purchase products from a multitude of sellers
2991 around the world. It results in an increase in complexity of international trade in
2992 comparison to traditional retail. This is also reflected by the difficulties to monitor
2993 product streams entering and leaving the EU via online trade. Such a lack of insight
2994 into the market impedes the analysis of effectiveness of current legislation as well as
2995 compliance with regulations.

2996 **Discussion**

2997 The Roadmap to the Circular Economy in Europe includes the transition towards a
2998 sustainable economy with sustainable value chains. This encompasses the regulation
2999 of products and certain substances (see e.g. Directive 2011/65/EU of the European
3000 Parliament and of the Council of 8 June 2011 on the restriction of the use of certain
3001 hazardous substances in electrical and electronic equipment). The development of E-
3002 commerce poses certain challenges regarding the protection of the health and safety
3003 of consumers and other end-users from dangerous non-food products and/or products
3004 that do not comply with the requirements set out in the EU harmonisation legislation
3005 on products ('non-compliant products'). In this respect, market surveillance authorities
3006 in the Member States are confronted with multiple obstacles compared to traditional
3007 retailing. The European Commission states in its notice on the market surveillance of
3008 products sold online the following (European Commission, 2017a):

- 3009 ▪ *"difficulties with regard to tracing products offered for sale online and*
3010 *identifying the responsible economic operators;*
- 3011 ▪ *the increase in the number of economic operators located outside the territory*
3012 *of the EU offering products for sale online; this includes sales directly to EU*
3013 *consumers and other end-users, which renders the enforcement of product*
3014 *rules challenging;*
- 3015 ▪ *challenges in conducting risk assessments or safety tests due to the lack of*
3016 *physical access to products;*
- 3017 ▪ *difficulties in sampling products for testing, as relevant laws in certain Member*
3018 *States do not permit purchases to be made online or anonymous purchases*
3019 *(such as mystery shopping);*
- 3020 ▪ *challenges in the application of Directive 2001/95/EC of the European*
3021 *Parliament and of the Council on general product safety (General Product*
3022 *Safety Directive) as well as of Regulation (EC) No 765/2008 of the European*
3023 *Parliament and of the Council setting out the requirements for accreditation*
3024 *and market surveillance relating to the marketing of products related to the*
3025 *online environment; and*
- 3026 ▪ *lack of awareness among consumers and businesses about buying and selling*
3027 *safe and compliant products online."*

3028 **Classification**

3029 Effects related to difficulties to monitor certain aspects of the market are clearly
3030 outside the sphere of influence of E-commerce providers. The described threat has

3031 long-term and rather systematic effects. As such, it can be defined as indirect effect of
3032 E-commerce.

3033 **Current and future relevance**

3034 E-commerce is directly linked to international trade and with rising numbers in
3035 consumers ordering from outside the EU, the relevance of monitoring is high and
3036 expected to grow. At the same time, more and more producers start to sell their
3037 products directly to end-consumer by setting up own online shops (European
3038 Commission, 2017b). Challenges with insufficient insights into the market are
3039 therefore likely to increase.

3040 Although this risk generally exists for all product categories, it is particularly
3041 pronounced for small information and communication technology, because these types
3042 of products usually contains an increased level of potentially hazardous substances
3043 and is therefore subject to stricter regulations.

3044 **Supporting factors**

- 3045 ▪ diffuse and specific nature of E-commerce, as compared to regular international
3046 trade practice; and
- 3047 ▪ economic operators of E-commerce arrangements can be located outside the
3048 jurisdiction of competent authorities.

3049 **Mitigating factors**

- 3050 ▪ increasing attention of Member State enforcement authorities for the
3051 monitoring of E-commerce trade (also see section 3.2.5.2 Threat –
3052 Enforcement”); and
- 3053 ▪ increasing cooperation between Member State authorities on issues regarding
3054 monitoring of international trade and E-commerce.

3055 **Options for actions**

3056 **Regulators:**

- 3057 ▪ stimulate further cooperation/information exchange between Member State
3058 enforcement authorities on issues regarding market surveillance and E-
3059 commerce.

3060 **Source of information**

3061 Commission, E. (2018) *Directive 2011/65/EU of the European Parliament and of the*
3062 *Council of 8 June 2011 on the restriction of the use of certain hazardous substances in*
3063 *electrical and electronic equipment*. Available at: [https://eur-lex.europa.eu/legal-](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0065)
3064 [content/EN/TXT/?uri=CELEX:32011L0065](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32011L0065).

3065 European Commission (2017) *Final report on the E-commerce Sector Inquiry*.
3066 Available at:
3067 http://ec.europa.eu/competition/antitrust/sector_inquiry_final_report_en.pdf.

3068 Iöw – Institut für Ökologische Wirtschaftsforschung (2019), Herausforderungen des
3069 Onlinehandels für Umwelt- und Verbraucherschutz – Bedeutung und Ansätze für
3070 Regelung, Vollzug und Marktüberwachung, Available at:
3071 https://www.ioew.de/veranstaltung/herausforderungen_des_onlinehandels_fuer_umw
3072 [elt_und_verbraucherschutz/](https://www.ioew.de/veranstaltung/herausforderungen_des_onlinehandels_fuer_umw)

3073 3.2.5.2 Threat – Enforcement

3074 **Description**

3075 Compliance of imported products with environmental and products legislation is an
3076 important factor for the current policy efforts to increase recycling and market uptake
3077 of secondary raw materials on the one hand, while ensuring safe and toxic-free
3078 product life cycles on the other. However, sources indicate that the enforcement of
3079 environmental and products legislation is made more difficult due to increased entry of
3080 products to the internal market via E-commerce arrangements.

3081 **Discussion**

3082 As described in Section 3.2.5.4 below, lack of compliance with EU chemicals and
3083 product safety regulations of products placed on the internal market contributes to the
3084 perpetuation of substances of concern in the product life-cycle if such non-compliant
3085 products are recycled upon entering the waste phase. In addition, non-compliant
3086 imported products may not meet existing and future requirements regarding
3087 “recyclability” (e.g. easy disassembly).

3088 Currently, no direct reference exists regarding the potential negative effects of E-
3089 commerce on the enforcement of EU environmental and product regulations which
3090 affect the Circular Economy policies. However, in 2016, European Commission Reviews
3091 and assessments of the functioning of market surveillance activities in the period
3092 2010-2013 indicate that (European Commission, 2019e):

- 3093 ▪ non-compliance with EU product law can be an issue within the context of E-
3094 commerce arrangements; and
- 3095 ▪ various Member State Authorities consider E-commerce as a challenge for their
3096 product regulations enforcement efforts.

3097 A similar review for the period of 2014-2016 also indicates that E-commerce is
3098 receiving attention from Member State Authorities within the context of their
3099 enforcement efforts (European Commission, 2019f). From a sectoral perspective, the
3100 product group “chemicals” provides relevant indications of the potential challenges
3101 which E-commerce poses for enforcement efforts (see for example: CLEEN 2016).

3102 Sources indicate that, in the case of E-commerce arrangements, the tracing of non-
3103 compliant products can be difficult. In addition, competent authorities seem to face
3104 challenges regarding the identification of the economic operator to be held responsible
3105 for non-compliance. In addition, there is an issue of jurisdiction, as authorities cannot
3106 act against operators who are not established in the relevant Member State.

3107 While the challenges identified in e-commerce are currently not yet explicitly linked to
3108 compliance with the regulations relevant to circular economy, it can be assumed that
3109 these challenges are indirectly linked to such policies.

3110 **Classification**

3111 Effects related to the enforcement of E-commerce related compliance aspects are
3112 outside the sphere of influence of E-commerce providers. The described threat has
3113 long-term and rather systematic effects. As such, it can be defined as an indirect
3114 effect of E-commerce.

3115

3116

3117 **Current and future relevance**

3118 From the EU policy perspective, the issue of market surveillance and E-commerce is
3119 receiving explicit attention:

- 3120 ▪ in its 2015 communication on the EU single market strategy, the European
3121 Commission concluded that *"in the case of e-commerce in particular, market
3122 surveillance authorities have great difficulty tracing non-compliant products
3123 imported from non-EU countries and identifying the responsible entity within
3124 their jurisdiction"* (European Commission, 2015b);
- 3125 ▪ more recently, the 2017 Commission notice on the market surveillance of
3126 products sold online underlined that the *"development in e-commerce poses
3127 certain challenges regarding the protection of the health and safety of
3128 consumers and other end-users from dangerous non-food products and/or
3129 products that do not comply with the requirements set out in Union
3130 harmonisation legislation on products ('non-compliant products')"* (European
3131 Commission, 2017a); and
- 3132 ▪ as a most recent example, recital 19 of Regulation (EU) 2019/1020 on market
3133 surveillance and compliance of products states that *"the development of e-
3134 commerce poses certain challenges for market surveillance authorities with
3135 regard to the ensuring of compliance of products offered for sale online and the
3136 effective enforcement of Union harmonisation legislation. (...)"* (European
3137 Commission, 2019d).

3138 As such, it is likely that the issue of market surveillance and enforcement will remain
3139 relevant issues within the context of E-commerce.

3140 Although this risk generally exists for all product categories, it is particularly
3141 pronounced for small information and communication technology, because these types
3142 of products usually contains an increased level of potentially hazardous substances
3143 and is therefore subject to stricter regulations where enforcement would be of
3144 especially important.

3145 **Supporting factors**

- 3146 ▪ diffuse and specific nature of E-commerce, as compared to regular international
3147 trade practice;
- 3148 ▪ difficulties regarding tracing of products sold via E-commerce arrangements, as
3149 currently information about online traders cannot be requested (no information
3150 from internet service providers (European Commission, 2019,
3151 <https://ec.europa.eu/digital-single-market/en/new-eu-rules-e-commerce>); and
- 3152 ▪ economic operators of E-commerce arrangements can be located outside the
3153 jurisdiction of competent authorities.

3154 **Mitigating factors**

- 3155 ▪ increasing attention of Member State enforcement authorities for the control of
3156 E-commerce arrangements; and
- 3157 ▪ increasing cooperation between Member State enforcement authorities on
3158 issues regarding market surveillance and E-commerce.

3159

3160

3161 **Options for actions**

3162 **Scientific Community:**

- 3163 ▪ mapping the forms of E-commerce sales of products from third countries; and
3164 ▪ further developing of enforcement (IT-)tools and methods which
3165 enable/support the tracing of products sold via E-commerce arrangements.

3166 **Regulators:**

- 3167 ▪ stimulate further cooperation/information exchange between Member State
3168 enforcement authorities on issues regarding market surveillance and E-
3169 commerce; and
3170 ▪ commission notice on market surveillance (2017/C 250/01) should be
3171 considered in the current examination of "options and actions for a more
3172 coherent policy framework of the different strands of work of EU product policy
3173 in their contribution to the circular economy " (European Commission, 2019f).

3174 **Source of information**

3175 European Commission (2015b) *Upgrading the Single Market: more opportunities for*
3176 *people and business*. Available at: [https://eur-lex.europa.eu/legal-](https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52015DC0550&from=EN)
3177 [content/EN/TXT/HTML/?uri=CELEX:52015DC0550&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52015DC0550&from=EN) (Accessed: 6 August
3178 2019).

3179 European Commission (2017a). Commission notice on the market surveillance of
3180 products sold online. Text with EEA relevance. 2017/C 250/01. Available at:
3181 [https://eur-lex.europa.eu/legal-](https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52017XC0801(01)&from=EN)
3182 [content/EN/TXT/HTML/?uri=CELEX:52017XC0801\(01\)&from=EN](https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52017XC0801(01)&from=EN) (Last accessed:
3183 10.10.2019)

3184 European Commission (2019d). New EU rules on e-commerce. Available at:
3185 <https://ec.europa.eu/digital-single-market/en/new-eu-rules-e-commerce> (Accessed: 8
3186 October 2019).

3187 European Commission (2019e) *Regulation (EU) 2019/1020 of the European Parliament*
3188 *and of the Council of 20 June 2019 on market surveillance and compliance of products*
3189 *and amending Directive 2004/42/EC and Regulations (EC) No 765/2008 and (EU) No*
3190 *305/2011*. Available at: [https://eur-lex.europa.eu/legal-](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R1020)
3191 [content/EN/TXT/?uri=CELEX:32019R1020](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R1020) (Accessed: 6 August 2019).

3192 European Commission (2019f) *The implementation of market surveillance in Europe*.
3193 Available at: [https://ec.europa.eu/growth/single-market/goods/building-](https://ec.europa.eu/growth/single-market/goods/building-blocks/market-surveillance/organisation_en)
3194 [blocks/market-surveillance/organisation_en](https://ec.europa.eu/growth/single-market/goods/building-blocks/market-surveillance/organisation_en) (Accessed: 6 August 2019).

3195 European Commission (2019g) *Towards an EU policy framework contributing to the*
3196 *circular economy*. Available at: [https://ec.europa.eu/info/law/better-](https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-2409307_en)
3197 [regulation/initiatives/ares-2018-2409307_en](https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2018-2409307_en) (Accessed: 6 August 2019).

3198 Wirtschaftsforschung, I. für Ö. (2019) *Herausforderungen des Onlinehandels für*
3199 *Umwelt- und Verbraucherschutz - Bedeutung und Ansätze für Regelsetzung, Vollzug*
3200 *und Marktüberwachung*. Available at:
3201 https://www.ioew.de/veranstaltung/herausforderungen_des_onlinehandels_fuer_umw
3202 [elt_und_verbraucherschutz/](https://www.ioew.de/veranstaltung/herausforderungen_des_onlinehandels_fuer_umw) (Accessed: 6 August 2019).

3203

3204 3.2.5.3 Threat – EPR – Free-Rider Effect

3205 **Description**

3206 The Extended producer responsibility (EPR) is an established policy instrument within
3207 the context of waste management and resource efficiency in the EU. Various sources
3208 highlight that E-commerce is leading to a free-rider effect, which means that specific
3209 producers which are subject to EPR obligations do not comply with applicable
3210 obligations or do not take part in and financially contribute to respective organisations.
3211 This effect is potentially increased due to the international market access of E-
3212 commerce.

3213 **Discussion**

3214 The extended producer responsibility is receiving increased attention as a potential
3215 driver of the Union's envisaged transition to a Circular Economy. In the EU, EPR is
3216 understood as a set of measures taken by Member States to ensure that producers
3217 bear financial responsibility or financial and organisational responsibility for the
3218 management of the waste stage of a product's life cycle.

3219 With regard to specific product streams, EU regulations require that Member States
3220 implement the producer responsibility principle. For other product streams, Member
3221 States have chosen to lay down national EPR obligations. The focus for the description
3222 of this threat is on EPR for Waste of Electrical and Electronic Equipment (WEEE). As
3223 such, it applies to all product categories defined in the previous section, with digital
3224 goods being the only exemption.

3225 Producers which are responsible for a specific product stream can individually fulfil
3226 financial or organisational EPR obligations. Producers can also choose or be obliged to
3227 organise themselves as one or more producer responsibility organisations (PROs)
3228 which will manage the fulfilment of EPR obligations.

3229 Producers which are members of a PRO, are likely to be required to pay a fee for their
3230 membership, with which the PROs' activities are financed.

3231 For various EU regulations which form the basis for EPR systems, the definition of
3232 "producer" goes beyond the traditional concept of manufacturer and also includes
3233 natural or legal persons who place EPR-covered products on the internal market via E-
3234 commerce arrangements. As such, natural and legal persons who sell products to EU
3235 consumers are required to fulfil applicable EPR obligations in the relevant Member
3236 State.

3237 Various sources highlight that E-commerce is leading to a free-rider effect, which
3238 means that specific producers which are subject to EPR obligations do not comply with
3239 applicable obligations or do not take part in and financially contribute to a PRO (V.
3240 Monier *et al.*, 2014). As such, free riders can enjoy the benefits of existing EPR
3241 arrangements without the required contributions (Barilla, 2014; Véronique Monier *et*
3242 *al.*, 2014a; Hilton *et al.*, 2019). This could, for example, be caused by lack of
3243 awareness by the E-commerce actors or by limited oversight and enforcement by
3244 authorities and PROs.

3245 The free-rider effect poses several threats to the circular economy (Véronique Monier
3246 *et al.*, 2014b; Hilton *et al.*, 2019):

- 3247 ▪ free riders may not contribute financially to PROs, while electrical and
3248 electronic equipment produced by them is likely to enter the waste phase in the
3249 PROs' Member State. As a result, bigger waste streams will have to be
3250 managed by the PROs with less financial resources;

- 3251 ▪ consumers who purchase EPR-covered products via E-commerce arrangements
3252 might not be aware of existing take-back systems. Furthermore, E-commerce
3253 sellers may not fulfil their take-back obligations as demanded by relevant EPR
3254 systems; and
- 3255 ▪ purchase of EPR-covered products via E-commerce may contribute to an
3256 underestimation of the amount of arising waste from electrical and electronic
3257 equipment. This in turn might lead to over-estimation of recycling rates.

3258 The EPR free-rider effect is seen as particularly pronounced for small information and
3259 communication technology. Nevertheless, the other product categories are also
3260 relevant because of the packaging in which the products are delivered, since free
3261 riding can also occur here.

3262 **Classification**

3263 The EPR Free-Rider Effect can be seen as an indirect effect due to its (negative)
3264 impact on the long-term transition towards a Circular Economy.

3265 **Current and future relevance**

3266 Currently, a great number of EPR systems exists in the EU, based on EU legal
3267 requirements (e.g. WEEE Directive 2012/19/EU) or Member State law or non-
3268 legislative measures. Existing literature already mentions free riding as an issue with
3269 regard to the effectiveness of EPR. In addition, the literature highlights E-commerce as
3270 a relevant cause of free riders (Véronique Monier *et al.*, 2014b; OECD, 2016; Hilton *et*
3271 *al.*, 2019).

3272 As mentioned above, EPR is receiving renewed attention as an effective policy tool to
3273 address some of the waste management challenges and as a potential driver of the
3274 Union's envisaged transition to a Circular Economy.

3275 On EU level, the European Commission has expressed in its Circular Economy Action
3276 Plan the aim to improve Circular Economy schemes. This aim is pursued by the
3277 adoption of minimum conditions for EPR schemes in the amended Waste Framework
3278 Directive 2008/98/EC.

3279 On EU Member State level, extended producer responsibility seems to be considered
3280 for the management of additional product streams. For example, the national waste
3281 management plan of the Netherlands refers to a 2016 study on the role of extended
3282 producer responsibility for the Circular Economy in the Netherlands, in which the
3283 necessity and feasibility of extension of EPR to new product streams is assessed. The
3284 national waste management plan does not draw any conclusions on future extension
3285 of EPR and indicates that a more comprehensive analysis and consultation will have to
3286 be conducted for specific waste streams, before any decisions on the matter are
3287 taken.

3288 At the same time, products covered by EPR systems in the EU are increasingly
3289 purchased from third country markets via E-commerce arrangements. A good example
3290 is electrical and electronic equipment, such as home appliances and IT equipment.
3291 Especially small-size products, which can be sent as parcel via postal service could be
3292 placed on the internal market unnoticed. Another example is packaging, which is put
3293 on the market in combination with the shipped good.

3294 Although no data on the extent of the free-rider problem could be found, a few
3295 general deductions can be made. The combination of strengthened or expanded EPR
3296 obligations and increased purchase of EPR-covered products via E-commerce
3297 arrangements indicates that the issue of free riders has already become visible and

3298 therefore relevant. However, it should be noted that one source indicates that for
3299 many EPR systems, the issue of free riders is considered to be limited or non-existent
3300 (Véronique Monier *et al.*, 2014b). This, in return, contradicts the view of stakeholders
3301 that were consulted on this topic, as most see a high relevance in this threat. A study
3302 published by the OECD on the impact of online sales on EPR estimates regarding
3303 electrical and electronic equipment that the free-rider issue has a magnitude of 5-10%
3304 of the OECD EEE market (Hilton *et al.*, 2019). Overall, it is therefore concluded from
3305 the above points that there is relevance to this threat, although the extent cannot be
3306 accurately assessed.

3307 **Supporting factors**

- 3308 ▪ increased purchase of products covered by EPR systems via E-commerce
3309 arrangements;
- 3310 ▪ difficulties in complying with legislation due to non-harmonised EPR registration
3311 process in the different EU Member States and often not enforced regulations;
- 3312 ▪ the exemption from financing obligations (*de minimis*) for SME might hinder
3313 the general monitoring of the system and can lead to unintended effects such
3314 as loopholes in the regulations;
- 3315 ▪ difficulty of identification of E-commerce free riders by competent authorities
3316 and PROs (also see section 3.2.5.2 Threat – Enforcement”); and
- 3317 ▪ lack of awareness by the E-commerce actors of EPR obligations.

3318 **Mitigating factors**

- 3319 ▪ awareness raising by E-commerce sellers and buyers of relevant EPR
3320 obligations;
- 3321 ▪ identification of E-commerce sellers by PROs and competent authorities; and
- 3322 ▪ enforcement by competent national authorities (also see section 3.2.5.2 Threat
3323 – Enforcement”).

3324 **Options for actions**

3325 **Scientific Community:**

- 3326 ▪ mapping the magnitude and forms of E-commerce sales of EPR-covered
3327 products from third countries.

3328 **Producers/Platform providers:**

- 3329 ▪ active compliance assessment of EPR obligations applicable in relevant
3330 markets; and
- 3331 ▪ communication and coordination with PROs’ responsible for EPR-covered
3332 products.

3333 **Regulators:**

- 3334 ▪ awareness-raising for E-commerce buyers and operators regarding EPR
3335 obligations; and
- 3336 ▪ enforcement of EPR obligations by competent authorities should take E-
3337 commerce into account.

3338

3339 **Source of information**

- 3340 Barilla (2014) 'Dry Semolina Pasta Selezione Oro Chef: Environmental Product
3341 Declaration'.
- 3342 Canadian Council of Ministers of the Environment (2007) 'Analysis of the free-rider
3343 issue in extended producer responsibility programs (Final report)'.
- 3344 Ernst&Young (2016) 'Exploration of the Role of Extended Producer Responsibility for
3345 the circular economy in the Netherlands'.
- 3346 Hilton, M. *et al.* (2019) *Extended producer Responsibility (EPR) and the impact of*
3347 *online sales - environment working paper N°142*. Organisation for Economic Co-
3348 operation and Development. Available at:
3349 [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP\(20](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP(2019)1&docLanguage=En)
3350 [19\)1&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/WKP(2019)1&docLanguage=En).
- 3351 Monier, V. *et al.* (2014) *Development of Guidance on Extended Producer Responsibility*
3352 *(EPR) - Final Report*. European Commission. Available at:
3353 [https://ec.europa.eu/environment/waste/pdf/target_review/Guidance_on EPR - Final](https://ec.europa.eu/environment/waste/pdf/target_review/Guidance_on_EPR_-_Final_Report.pdf)
3354 [Report.pdf](https://ec.europa.eu/environment/waste/pdf/target_review/Guidance_on_EPR_-_Final_Report.pdf).
- 3355 NVC Netherlands Packaging Center (2019) *NL: New National Waste Management Plan*
3356 *LAP3 enacted*. Available at: [https://www.en.nvc.nl/news/item/nl-nieuwe-landelijk-](https://www.en.nvc.nl/news/item/nl-nieuwe-landelijk-afvalbeheerplan-lap3-vastgesteld/)
3357 [afvalbeheerplan-lap3-vastgesteld/](https://www.en.nvc.nl/news/item/nl-nieuwe-landelijk-afvalbeheerplan-lap3-vastgesteld/) (Accessed: 6 August 2019).
- 3358 OECD (2016) '20 years of EPR in France: Achievements, lessons learned and
3359 challenges ahead', in *Extended Producer Responsibility: Updated Guidance for Efficient*
3360 *Waste Management*. Paris: OECD Publishing.
- 3361

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3362 3.2.5.4 Threat – Lack of compliance with common market regulations

3363 **Description**

3364 Various EU regulations lay down requirements for products which are placed on the
3365 internal market. Often, access for these products to the internal market is contingent
3366 upon their compliance with these requirements. In various product regulations,
3367 requirements pertain to human health and environmental aspects of the product
3368 placed on the market. The international market access obtained through E-commerce
3369 increases the threat for a lack of compliance with common market regulations.

3370 **Discussion**

3371 A clear example of such common market regulations is Regulation (EC) No 1907/2006
3372 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals
3373 (REACH).

3374 REACH contains various provisions which pertain to the placing on the market of
3375 articles (i.e. products) containing specified substances. Firstly, REACH lays down
3376 restrictions for the placing on the market of certain dangerous substances, mixtures
3377 and articles. For example, Annex XVII to REACH determines that toys which contain a
3378 concentration of benzene in the free state, greater than 5 mg/kg (0,0005 %) of the
3379 weight of the toy or part of toy, will not be placed on the internal market.

3380 In addition, REACH requires that, under specified circumstances, producers of articles
3381 notify the European Chemicals Agency (ECHA) if a substance which is listed in Annex
3382 XIV to REACH as a substance of very high concern (SVHC) is contained in an article
3383 which is placed on the internal market.

3384 Enforcement of provisions of EU product and chemicals law such as REACH may be
3385 challenging for competent authorities, as the more diffuse distribution of products via
3386 postal services is subject to different EU customs procedures than international trade
3387 flows. Furthermore, it might be challenging for competent authorities to effectively
3388 inspect postal consignments on compliance.

3389 The issue of non-compliance with EU products and chemicals regulations poses two
3390 interrelated threats to the Circular Economy:

- 3391 ▪ the Circular Economy concept is based on the design and production of
3392 products which do not pose unacceptable risks for human health and the
3393 environment. As described above, placing on the market of products via E-
3394 commerce might make it difficult for competent authorities to enforce
3395 legislation which is aimed at mitigating such risks; and
- 3396 ▪ recycling waste streams containing specific substances may be forbidden by EU
3397 regulations. In addition, REACH and other regulations may prohibit or restrict
3398 the use of specific substances in the production of products, and thus also the
3399 use of recycled material containing these specific substances. As such, the
3400 placing on the market of products containing prohibited or restricted
3401 substances may create great challenges for recyclers, once these products
3402 enter the waste phase of their life-cycle. Products containing prohibited or
3403 restricted substances could get mixed with clean waste streams, which would
3404 render these waste streams unsuitable for recycling.

3405 **Classification**

3406 The aspect of emerging compliance risk can be seen as an indirect effect as it affects
3407 the long-term transition towards a Circular Economy.

3408 **Current and future relevance**

3409 In its 7th Environmental Action Programme (EAP), the EU has committed itself to the
3410 objective of a non-toxic environment. To this end, the EAP envisages a strategy which,
3411 among other things, aims to ensure “the minimisation of exposure to chemicals in
3412 products, including, inter alia, imported products, with a view to promoting non-toxic
3413 material cycles and reducing indoor exposure to harmful substances”. In 2017, a
3414 study for the strategy for a non-toxic environment of the 7th EAP was conducted for
3415 the European Commission, highlighting challenges regarding non-toxic material cycles.
3416 The envisaged strategy for a non-toxic environment has not been published yet.

3417 Within the context of a Circular Economy, the issue of substances of concern in
3418 products’ cycles is highlighted in the European Commission’s Circular Economy Action
3419 Plan. The action plan connects the presence of substances of concern in material
3420 cycles with the recyclability of waste streams (European Commission, 2015a)

3421 Based on the above, it can be concluded that the issue of non-compliance with EU
3422 products law and its connection with the presence of substances of concern in material
3423 cycles is currently perceived as relevant in the EU. Based on the envisaged measures
3424 concerning this issue within the context of the Circular Economy Action Plan, future
3425 relevance could also be considered likely.

3426 Although this risk generally exists for all product categories, it is particularly
3427 pronounced for small information and communication technology, because these types
3428 of products usually contains an increased level of potentially hazardous substances
3429 and is therefore subject to stricter regulations.

3430 **Supporting factors**

- 3431 ▪ diffuse and specific nature of E-commerce, as compared to regular international
3432 trade practice.

3433 **Mitigating factors**

- 3434 ▪ several national authorities have already set up specialised teams to monitor
3435 webpages and trace dangerous products that are sold online. In addition, when
3436 such products are identified, EU regulatory authorities can quickly contact the
3437 relevant online platforms to take action if needed (also see Section 3.2.5.1
3438 Threat – Difficulty to monitor) (European Commission, 2016b).

3439 **Options for actions**

3440 **Scientific Community:**

- 3441 ▪ mapping the magnitude and forms of E-commerce sales of high-risk products
3442 from third countries.

3443 **Producers/Platform providers:**

- 3444 ▪ active compliance assessment of EU product law obligations.

3445 **Regulators:**

- 3446 ▪ enforcement of EU product law obligations during customs procedures by
3447 competent authorities should take specific characteristics of E-commerce into
3448 account, e.g.:
 - 3449 ○ it could be assessed whether parcels could be placed under specific
3450 customs control mechanisms, which are designed to cover import of
3451 high-risk products via E-commerce arrangements.

3452 **Source of information**

- 3453 European Commission (2013) *Decision No 1386/2013/EU of the European Parliament*
3454 *and of the Council of 20 November 2013 on a General Union Environment Action*
3455 *Programme to 2020 'Living well, within the limits of our planet', OJ L 354. Available*
3456 *at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32013D1386>.*
- 3457 European Commission (2015a) *Closing the loop - An EU action plan for the Circular*
3458 *Economy. doi: 10.1017/CBO9781107415324.004.*
- 3459 European Commission (2016b) *Rapid Alert System for dangerous products - Working*
3460 *together to keep consumers safe - Annual Report.*
- 3461 European Commission (2017) *Study for the strategy for a non-toxic environment of*
3462 *the 7th Environment Action Programme - Final report.*
- 3463 European Commission (2018) *Communication on the implementation of the circular*
3464 *economy package: options to address the interface between chemical, product and*
3465 *waste legislation, COM(2018) 32 final.*
- 3466

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3467 3.2.6 Cluster – Logistics and transport

3468

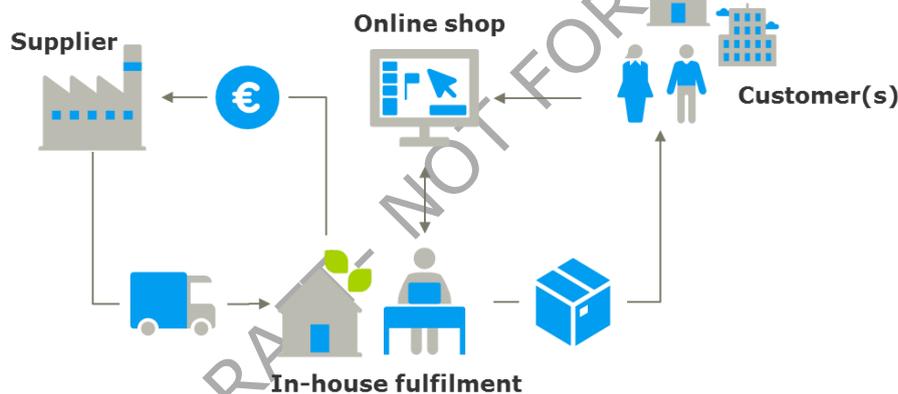
3469 3.2.6.1 Opportunity – In-House Fulfilment

3470 Description

3471 This opportunity applies to small E-commerce businesses that operate from home and
3472 do not have any additional storage place. It could be seen as opportunity as it
3473 promotes competition and reduces the impacts linked to the necessity of storage
3474 space and transport.

3475 Discussion

3476 In-house fulfilment describes here an online enterprise that usually is launched by one
3477 or a few persons and runs the entire business from home. It is the smallest and
3478 easiest form of fulfilment of the E-commerce sector (ORDORO, 2019). Figure 9
3479 illustrates a basic version of in-house fulfilment. It is characterised by two domains:
3480 the connection between retailer and customer via some type of online shop or
3481 marketplace, and the connection between retailer and producer/supplier of the
3482 product.



3483

3484 **Figure 9. Illustration of a simple in-house fulfilment enterprise (based on ORDORO, 2019)**

3485 A literature research on this topic shows that in-house fulfilment is not part of the
3486 scientific discussion around E-commerce yet. There are several websites promoting
3487 this type of business and discussing several advantages and disadvantages (ORDORO,
3488 2019; Starting-Up, 2019). Several terms can be found that describe, at least to some
3489 extent, aspects of the described business. Customer-to-customer (C2C), for example,
3490 is a common term that usually describes the selling of individual products (often
3491 second-hand products) from one to another customer. However, the regular selling of
3492 new products as a type of buy-and-sales business can be understood as a C2C
3493 business as well. The transition to a traditional business to customer (B2C) model
3494 seems seamless and difficult to differentiate exactly. For more details on C2C
3495 applications please see the point "ReCommerce" in Section 3.2.4.1.

3496 The impact of in-house businesses on the Circular Economy is difficult to evaluate due
3497 to the lack of available information. Nevertheless, it is seen as an opportunity to
3498 highlight some aspects that are deemed relevant for a sustainable development and
3499 thus for the Circular Economy:

- 3500 ▪ setting up a simple in-house business is relatively easy and characterised by
3501 low entry thresholds. Affiliating with one of the available marketplaces allows a
3502 quick and adaptable start of one own business. It is therefore well-suited to
3503 empower a part-time self-employment and to push innovation ((Starting-Up,
3504 2019); see also Section "Innovation" 3.2.1.3);
- 3505 ▪ E-commerce has seen a period of consolidation of the market with a few very
3506 large online businesses dominating the market. The possibility to start small
3507 businesses for basically every individual initiate a fragmentation process, which
3508 in turn increases the market's flexibility to adapt to changing market conditions
3509 and consumer demands;
- 3510 ▪ a strongly differentiated product line, which requires tailoring to the individual
3511 user, requires close contact between user and manufacturer for smaller
3512 production quantities, whereby the small company can gain an advantage over
3513 the large one; and
- 3514 ▪ niche online retailers meet the requirements of special demands, which is seen
3515 as a promoting factor for an emerging "green society" .

3516 Even if the impact of these aspects on the environment is difficult to assess,
3517 diversification is nevertheless seen as having a generally positive effect on the Circular
3518 Economy.

3519 Due to the poor data situation, it is difficult to assess how the relevance of in-house
3520 fulfilment differs between the product categories that are in focus of this study.

3521 **Classification**

3522 Effects arising from in-house fulfilment are allocated to evolving business models and
3523 can be seen as such as supplementary developments. The extent of the effects is
3524 hypothetical and rather long-term. They can be considered as indirect effect of E-
3525 commerce.

3526 **Current and future relevance**

3527 As already mentioned, both the data and information situation on in-house fulfilment
3528 are very scarce and do not permit any reliable statements about the current market
3529 situation. However, a few conclusions can be drawn from the marketplaces that offer
3530 microenterprises a platform for trading and which are often used by in-house
3531 businesses.

3532 One of the most prominent examples is Amazon Marketplace which enables third
3533 parties to sell new or used products in addition to the regular Amazon offers. In 2018,
3534 around 50% of all sales come from third-party sellers on this Amazon platform
3535 (Amazon, 2019e). Approximately three-quarters of those sellers were small
3536 businesses with one to five employees. In 2018, more than 1.2 million sellers joined
3537 the different Amazon marketplaces (Amazon, 2019e), which makes this a very thriving
3538 market.

3539 Besides this, there are many other significant players that provide, at least to some
3540 extent, one form of marketplace to third-party sellers. Among those are Walmart,
3541 eBay, Tokopedia, Google, Etsy – to name only a few. All of those players can have a
3542 considerable impact on the future markets development. Etsy, for example, increase
3543 their sales volume from \$314.3 million in 2010 to nearly \$4 billion in 2018 (Etsy,
3544 2018).

3545 Overall, the relevance of in-house fulfilment is therefore estimated to be high,
3546 although not as visible to the public or politics as the "classic" E-commerce. For the

3547 coming years, on the basis of the available data, a further increase in this market is
3548 estimated to be probable.

3549 **Supporting factors**

- 3550 ▪ low barriers (especially from a legal perspective) to enter the market as in-
3551 house business, thus enabling small entrepreneurs and start-ups to develop;
3552 and
- 3553 ▪ marketplaces with easy access and fair-trading conditions.

3554 **Mitigating factors**

- 3555 ▪ Complex international trade regulations make trade with non-EU countries
3556 more difficult and may have a restraining effect on the development of in-
3557 house fulfilment.

3558 **Options for actions**

3559 **Producers/Platform providers:**

- 3560 ▪ open marketplaces that allow the inclusion of third-party providers.

3561 **Regulators:**

- 3562 ▪ legal requirements that consider the characteristics of in-house businesses;
3563 and
- 3564 ▪ guidelines for in-house businesses that help to comply with regulatory
3565 requirements.

3566 **Source of information**

3567 Amazon (2019c) *Press release – Amazon.com announces first quarter sales up 17% to*
3568 *\$59.7 billion, retrieved from Statista, Percentage of paid units sold by third-party*
3569 *sellers on Amazon platform as of 1st quarter 2019. Available at:*
3570 *[https://www.statista.com/statistics/259782/third-party-seller-share-of-amazon-](https://www.statista.com/statistics/259782/third-party-seller-share-of-amazon-platform/)*
3571 *[platform/](https://www.statista.com/statistics/259782/third-party-seller-share-of-amazon-platform/).*

3572 Etsy (2018) 'Annual Report 2018, page 55, retrieved from Statista, Etsy's total annual
3573 merchandise sales volume from 2005 to 2018 (in million U.S. dollars),'.

3574 Kreilkamp, E. (1987) *Strategisches Management und Marketing: Markt- und*
3575 *Wettbewerbsanalyse, Strategische Frühaufklärung, Portfolio-Management.*

3576 MarketplacePulse (2018) *Marketplaces Year in Review 2018. Available at:*
3577 *<https://www.marketplacepulse.com/marketplaces-year-in-review-2018>.*

3578 ORDORO (2019) *ORDORO Guides – Fulfillment: In-House Fulfillment. Available at:*
3579 *<https://www.ordoro.com/guides/in-house-fulfillment>.*

3580 Platform, E. C. E. S. (2018) *Consumer Insights into the Circular Economy. Available*
3581 *at:*

3582 *https://circulareconomy.europa.eu/platform/sites/default/files/consumer_insights_circular_economy_report_v10.pdf.*

3584 Starting-Up (2019) *Gründen im E-Commerce – so klappt der Onlinehandel. Available*
3585 *at: [https://www.starting-up.de/gruenden/selbststaendig-machen/ecommerce-](https://www.starting-up.de/gruenden/selbststaendig-machen/ecommerce-onlineshop.html)*
3586 *[onlineshop.html](https://www.starting-up.de/gruenden/selbststaendig-machen/ecommerce-onlineshop.html).*

3587

3588 3.2.6.2 Opportunity – Collaboration between companies and partnering with waste
3589 management suppliers

3590 **Description**

3591 E-commerce can enable successful collaboration between online or multi-channel
3592 retailers, packaging companies and waste management providers, all of which is
3593 necessary to improve the environmental impact along the whole supply chain and
3594 product life cycle.

3595 **Discussion**

3596 E-commerce is in many cases criticized for having a negative impact on our
3597 environment. Especially accruing packaging waste and the effects on road traffic are
3598 visible to the public. Together with the growing awareness of this problem among
3599 customers, the desire for more sustainable packaging and delivery solutions is also
3600 growing (Kazarian, 2018). Collaboration between online and multi-channel retailers,
3601 packaging companies, logistics providers and also waste management companies
3602 fosters synergies to be developed and can enable a more sustainable business model.
3603 Some related aspects are mentioned in the following sections: "Optimisation of the
3604 supply chain" (Section 3.2.6.3), "Development of dedicated optimised packaging
3605 solutions" (Section 3.2.7.1) or "Excessive protective packaging" (Section 3.2.7.2).

3606 The cooperation between suppliers in E-commerce and suppliers in waste
3607 management should be emphasized here, as this aspect is seen at the end of the
3608 product life cycle and was rather neglected in the past. If the life cycle is considered in
3609 its entirety and if end-of-life aspects of packaging are already included in the design
3610 and production phase, optimisation can be achieved with regard to reusability and
3611 recyclability. These aspects are currently discussed on conferences and trade fairs
3612 such as the FackPack in Germany (trade fair for packaging, processing and
3613 technology). Companies and stakeholders along the whole value chain (including
3614 waste management) are participating to discuss new packaging solutions. With this
3615 year's key theme "Environmentally friendly packaging", it suggests that the topic is
3616 gaining more attention from the industry.

3617 The adoption of a Circular Economy program entails that a company carries out
3618 different strategies to improve the circularity of its production system and also
3619 cooperates with other companies over the supply chain for the achievement of a more
3620 effective circular pattern.

3621 **Classification**

3622 All effects related to the collaboration between companies are rather systematic and
3623 cannot be allocated to the purchase of one single product. Potential effects are
3624 emerging and are of potentially high relevance in the future, which is why they are
3625 considered indirect effects of E-commerce.

3626 **Current and future relevance**

3627 An example is the Amazon's Packaging Support and Supplier Network (APASS)
3628 program. With this certification, packaging companies provide services directly to
3629 vendors, sellers or manufacturers related to packaging design and testing in
3630 compliance with Amazon's guidelines and certification test methods (vendor is defined
3631 here as first-party seller, selling to Amazon, while a seller is defined as third-party
3632 seller, selling directly to the end-customer; (Amazon, 2019b, 2019d) a manufacturer
3633 might be a first-party seller or third-party seller, depending on who the manufacturer

3634 is selling to). In addition, packaging manufacturers also have the opportunity to
3635 partner with regulatory agencies to set standards for recyclability through public policy
3636 (Kazarian, 2018).

3637 This opportunity is of relevance for all product categories in focus of this study.

3638 **Supporting factors**

3639 ▪ cross-industry conferences, congresses, symposiums and workshops that bring
3640 together companies from different parts of the value chain, such as the ISWA
3641 World Congress (ISWA, 2019).

3642 **Mitigating factors**

3643 ▪ silo-thinking mentality that prevents companies from collaborating with other
3644 industries and that represents a barrier for working on cross-industry solutions.

3645 **Options for actions**

3646 **Producers/Platform providers:**

3647 ▪ associations that promote cross-industry cooperation for their members.

3648 **Source of information**

3649 Amazon (2019b). *Find the right Amazon Solution to grow your business*. Available at:
3650 <https://sellercentral.amazon.de/> (Accessed: 8 October 2019)

3651 Amazon (2019d). *Grow your business with Amazon*. Available at:
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3664

3665 3.2.6.3 Opportunity – Optimisation of supply chain

3666 **Description**

3667 Although enormous efforts have been made by manufacturers of all kinds to optimise
3668 their respective supply chains, further optimisation opportunities in the automation of
3669 the manufacturing process, the various delivery routes and the payment processes of
3670 end customers are attributed to E-commerce.

3671 **Discussion**

3672 E-commerce has significantly shaped the logistics and supply chain management
3673 sector since its emerging (Yu *et al.*, 2016). When customers place an order online, this
3674 triggers a process that is both extremely complex and (usually) fine-tuned (Yu *et al.*,
3675 2016). The focus of optimisation efforts is mostly on an increase of material efficiency,
3676 reduction of distribution costs and time (Yu *et al.*, 2016). A characteristic of logistics in
3677 E-commerce is its relationship to the customer which is much closer than in traditional
3678 retail (Yu *et al.*, 2016). While the order itself is rather small, the complexity of its
3679 delivery to the final destination increases in comparison to transports to retail stores
3680 (Yu *et al.*, 2016). The so called last mile delivery is considered as most important both
3681 from a customer's and from an online retailer's perspective (Yu *et al.*, 2016; Ellen
3682 MacArthur Foundation, 2019).

3683 The aspects of Internet of Things (IoT), Big Data Analytics, and Cloud Computing are
3684 not solely used by E-commerce but is specifically relevant here due to the digital
3685 environment in which the whole shopping and purchasing process takes place. The
3686 integration of these aspects into a type of digital supply chain enables companies
3687 along the chain to implement or optimise the following aspects ('E-commerce: Building
3688 an optimized digital supply chain in 5 steps', 2015; Kadłubek, 2015):

- 3689 ▪ limiting inventories;
- 3690 ▪ increase in flexibility to changing market situations;
- 3691 ▪ increase the information flow regarding products and customer behaviour;
- 3692 ▪ reduction of transaction costs;
- 3693 ▪ intensify the relationship between actors of the supply chain;
- 3694 ▪ adapt one of the many logistic strategies that fit the company's purpose most;
- 3695 ▪ advanced analytics of demand data to increase forecast accuracy;
- 3696 ▪ in-depth evaluation of market environment and customer characteristics; and
- 3697 ▪ implementation of digital supply chain aspects to address the adequate degree
3698 of centralisation and automation.

3699 It should be differentiated here between two aspects: (1) efforts taken to promise
3700 customers fast delivery options (such as same- or next day delivery) that might
3701 promote the use of inefficient transport options (e.g. aircraft instead of rail transport)
3702 and thus can lead to negative environmental impacts; and (2) optimisation efforts that
3703 have a potentially positive impact on the environment (e.g. reduction of required
3704 inventory space; shortened delivery pathways; etc.). Although both might go hand in
3705 hand to some extent, the mentioned aspects have differing objectives.

3706 **Classification**

3707 Similar to the collaboration between companies, effects arising from the optimisation
3708 of E-commerce supply chains are long-term and rather systematic. They are seen as

3709 supplementary developments due to adjusting of business models. Respective effects
3710 are considered as indirect effects of E-commerce.

3711 **Current and future relevance**

3712 The relevance of optimisation of supply chains in the E-commerce sector is already
3713 extremely high. Competition and efforts taken to shorten the delivery time immensely
3714 has put pressure on all actors involved in the market. Currently, companies face
3715 several challenges such as same- or next-day delivery, smaller parcel deliveries, last
3716 mile delivery (TLI, 2016a). The market of E-commerce logistics is increasing together
3717 with the growth of the E-commerce market itself. E-commerce Europe (2018)
3718 highlights the importance of logistics in the E-commerce sector and gives several
3719 examples of companies raising their revenue significantly due to their connection to
3720 the constantly growing e-commerce market. Since customers want fast delivery
3721 options, optimisation aspects will presumably continue to be of very high importance
3722 (Yu *et al.*, 2016; E-commerce Europe, 2018). The authors recommend that companies
3723 adapt their logistics strategy to the specific requirements of their company (Yu *et al.*,
3724 2016) and focus on tailor-made logistics.

3725 The optimisation of supply chain is of relevance for all product categories in focus of
3726 this study.

3727 **Supporting factors**

3728

- 3729 ▪ Optimised logistics chains with focus on route planning and vehicle substitution
3730 (e.g. rail instead of truck, electric transporter instead of petrol) (Postpischil and
Jacob, 2019).

3731 **Mitigating factors**

3732

- 3733 ▪ cross-border E-commerce increases complexity of logistic requirements
3734 immensely and is one of the players' key challenge (E-commerce Europe,
2018).
- 3735 ▪ significant regional differences in the logistic infrastructure (E-commerce
3736 Europe, 2018).

3737 **Options for actions**

3738 **Scientific Community:**

3739

- 3740 ▪ further development and dissemination of indices such as the Logistics
3741 Performance Index (LPI), which help countries to identify weaknesses but also
opportunities in freight transport infrastructure.

3742 **Producers/Platform providers:**

3743

- 3744 ▪ avoid multiple journeys by agreeing on delivery windows, desired neighbours,
3745 desired delivery locations (e.g. garage, parcel boxes or parcel stations)
(Postpischil and Jacob, 2019).
- 3746 ▪ cross-industry collaboration including players from all parts of the value chain
3747 (also see Section 3.2.6.2 Opportunity – Collaboration between companies and
3748 partnering with waste management suppliers”).

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- 3770

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3771 3.2.6.4 Opportunity – Substitution of individual shopping trips

3772 **Description**

3773 Traditional commerce via brick-and-mortar stores requires customers to travel to the
3774 shop physically, which causes pressure on traffic and infrastructure. E-commerce turns
3775 this way of shopping around by allowing customers to order from home or on the go
3776 and have their order delivered to their front door, without any need to visit the
3777 physical store.

3778 Although the substitution of individual shopping trips is considered here as an
3779 opportunity, it should be noted that there can be considerable differences on the
3780 environmental impact of this aspect depending on area and infrastructure (urban
3781 centre, rural area, area of high population density, etc.) and on the types of
3782 transportation used.

3783 **Discussion**

3784 Two of the main features of E-commerce - ordering products online and having them
3785 delivered to your front door - have a substantial impact on the way we shop. People
3786 no longer have to go physically to the store and no longer have to bring purchased
3787 goods home themselves. Instead, the order is conveniently received at home. The
3788 trips of the individual buyers to the shops are no longer necessary (with the exception
3789 of hybrid models) and deliveries are made to customers by parcel services, which try
3790 to optimise their routes. This has an impact on traffic and therefore on the
3791 environment. Different and sometimes oppositely results were identified in current
3792 research on the extent of the described environmental impact. However, it is certainly
3793 clear that the region (urban, rural) and the choice of transportation type play a
3794 decisive role.

3795 The assessment of the environmental impact is challenging as the methodological
3796 approaches and applied system boundaries are manifold and as uncertainties about
3797 people's behaviour is high. Smidfelt Rosqvist and Hiselius, for example, state in their
3798 2016 study about online shopping habits that it is unclear, whether a potential
3799 substitution of individual shopping trips might lead to trips for other purposes
3800 (rebound effect). The authors still identify a potential decrease of CO₂ emissions due
3801 to online shopping. Van Loon *et al.* (2015a) highlight the already mentioned
3802 importance of transportation method and basket size to evaluate the environmental
3803 impact. Going shopping in a physical store by bike significantly reduces the
3804 environmental impact, and the same goes for large basket sizes (both in online retail,
3805 if delivered in on parcel, and traditional retail). Further, a study from the German
3806 Federal Environment Agency states that E-commerce can have a positive effect on CO₂
3807 emissions especially in rural areas, where people usually use their car to go to stores.
3808 The authors also point out, however, that this is opposed by fast deliveries options
3809 (e.g. same day delivery) (Umweltbundesamt, 2018b).

3810 Overall, results from the literature research led to the conclusion that E-commerce has
3811 a potential to decrease CO₂ emissions of the transportation sector, which would be an
3812 important contribution to reach national CO₂ reduction targets. It is therefore
3813 considered worthwhile to include the substitution of individual shopping trips as
3814 opportunity in this study. Especially because the E-commerce sector with its attached
3815 logistics is increasingly focusing on alternative transportation methods. Large players,
3816 in particular, are in a position to accelerate the implementation of alternative
3817 transportation methods.

3818

3819 **Classification**

3820 The substitution of individual shopping trips has a consequential and immediate
3821 (intended) effect. It is a characteristic of the current situation in E-commerce and
3822 further persistence in future scenarios is likely. Arising effects are considered direct
3823 effects of E-commerce.

3824 **Current and future relevance**

3825 The number of shopping trips conducted per person per day is an important indicator
3826 to evaluate the relevance of individual shopping trips. As people in different countries
3827 have different shopping behaviours also the number of trips to stores varying between
3828 the EU Member States. A study from (JRC, 2013) show that between 0.1 and 1
3829 shopping trips are conducted per person per day in 2013. In this context, the car is by
3830 far the most frequently chosen means of transport (JRC, 2013). Rosqvist and Hiselius
3831 analyse the market for several EU Members States, for which they state that around
3832 20% of all trips (~10% of total passenger mileage) is done for shopping purposes. The
3833 car is used in around 30% of times (Winslott-Hiselius *et al.*, 2015).

3834 Shown numbers indicate a high relevance for the aspect of substitution of individual
3835 shopping trips as shopping puts a considerable amount of pressure on infrastructure
3836 and traffic.

3837 This opportunity is of relevance for all product categories in focus of this study.

3838 **Supporting factors**

3839

- As a direct effect of E-commerce the development of this opportunity is
3840 supported by all those factors that contribute to a satisfactory online-
3841 purchasing experience. a multi-faceted concept that takes into account regional
3842 particularities.

3843 **Mitigating factors**

3844

- delivery of damaged products diminishes positive effects;
- 3845 ▪ high return rates diminish positive effects; and
- 3846 ▪ faulty delivery (customer not present, wrong delivery address, etc.) diminishes
3847 positive effects.

3848 **Options for actions**

3849 **Producers/Platform providers:**

3850

- highlight the environmental impact of sending multiple packages compared to
3851 one package (also see Section 3.2.2.1, "Nudging").

3852 **Source of information**

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3874 [hoppers_in_Sweden](https://www.researchgate.net/publication/276429065_Travel_Behaviour_of_Online_Shoppers_in_Sweden).

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3875 3.2.6.5 Threat – Damage on delivery

3876 **Description**

3877 The delivery of products to end-consumers instead of delivery to retail shops typically
3878 increases the handling of products. This can increase the number of products that
3879 have already been delivered defective, which in return increases the impact on
3880 transport and the environment.

3881 **Discussion**

3882 Damage during transportation does occur both in logistics for E-commerce and
3883 logistics for traditional commerce. However, E-commerce supply chains have some
3884 specific features which appear to favour damage to the delivered goods. A central
3885 aspect is the (usually) higher complexity of the supply chain and the associated
3886 necessity to "handle" the product more often (Smith, 2019a). The last mile delivery is
3887 particularly noticeable as it is a major difference between traditional logistics and E-
3888 commerce related logistics and as it increases the needs for manual handling.

3889 There are many reasons why products can be damaged during transport. Logistics
3890 companies list the following points as important causes (PackagingDigest, 2014;
3891 Teter, 2016; iGPS, 2018; Smith, 2019a):

- 3892 ▪ load shifting;
- 3893 ▪ improper packaging;
- 3894 ▪ forklift damage;
- 3895 ▪ pallet damage;
- 3896 ▪ road, weather and warehousing conditions; and
- 3897 ▪ machine or human error (e.g. dropping or throwing of parcels).

3898 One of the counter measures to damage products is adequate protective packaging.
3899 As broken goods are a very unsustainable and costly aspect of every business that
3900 requires the transport to some kind of customer, companies usually use protective
3901 packaging solutions. As shown in Section 3.2.7.2, this is sometimes used to an
3902 excessive extent. The right balance between product protection and material efficiency
3903 is a challenge for every company.

3904 An aspect that is not in the focus of this section but still worth mentioning is damage
3905 on return. Some products arrive unharmed at the customer but are damaged when
3906 returned to the producer. A survey conducted by Haendlerbund in Germany indicates
3907 that for the apparel sector a total of 20% of all returned products is worn, dirty or
3908 without label (Händlerbund, 2016).

3909 **Classification**

3910 The damage of products during transportation to the customer are supplementary
3911 developments due to special conditions in the E-commerce supply chain, therefore this
3912 aspect is considered as indirect effect of E-commerce.

3913 **Current and future relevance**

3914 Although data on the number of defective products delivered to the customer varies in
3915 literature, it is of significant relevance for online retailers. Products that arrive
3916 (partially) damaged at the customer are seen as least sustainable option by the
3917 industry (Hattersley, 2019). Another important aspect is customer satisfaction. It was

3918 mentioned already several times that customers of E-commerce demand a fast
3919 delivery of their purchased goods. A damaged product is obviously contradictory to the
3920 goal to satisfy the customer's demands.

3921 It should be noted that the percentage of damaged products differs between product
3922 category. Especially clothing is usually less susceptible to damage than, for example,
3923 IT equipment or large household appliances, which require, among other things, a
3924 higher degree of shock protection (Statista Research Department, 2014a). In general,
3925 it is estimated that around 15-20% of purchases are sent back because the product
3926 arrived damaged (Statista Research Department, 2014b; Gallup Institut, 2018).

3927 **Supporting factors**

- 3928 ▪ high rates of misdeliveries increase the need for manual handling of parcels, as
3929 the parcel has to be taken out of the delivery vehicle and returned several
3930 times by the delivery service before it finally reaches the customer; and
- 3931 ▪ fast delivery options (e.g. same- or next-day delivery) increase pressure on
3932 delivery services, which in turn increases the probability that a mistake is made
3933 during manual processing (e.g. unloading or stacking of parcels).

3934 **Mitigating factors**

- 3935 ▪ collaboration with providers of E-commerce-capable packaging solutions that
3936 are designed to withstand vibrations, shock, pressure, and drops.

3937 **Options for actions**

3938 **Scientific Community:**

- 3939 ▪ development of dedicated packaging solutions that do not only fit the purpose
3940 of certain product characteristics, but that are also economically feasible as
3941 well as scalable (see Section 3.2.7.1 Opportunity – Development of dedicated
3942 optimised packaging solutions”).

3943 **Producers/Platform providers:**

- 3944 ▪ online-retailers can collaborate with providers of E-commerce-capable
3945 packaging solutions that are designed to withstand vibrations, shock, pressure,
3946 and drops.

3947 **Source of information**

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3971 3.2.6.6 Threat – Individual product delivery

3972 **Description**

3973 This threat describes the individual delivery of products that originates from a
3974 purchase of a basket of several products: instead of delivering all products together,
3975 sometimes each product is delivered individually. Moreover, it additionally considers
3976 the shipping policy of some online retailers that allows customers to purchase
3977 individual products without having economic drawbacks (free shipping even for single
3978 purchases).

3979 **Discussion**

3980 When a customer places an order in an online shop, a supply chain is triggered at the
3981 end of which there is usually the delivery of the order in one or more packages. The
3982 parcel is then unboxed by the receiver of the package, which leads to packaging waste
3983 (see “Secondary packaging” in Section 3.2.7.3 for more details). An unnecessary
3984 increase in packaging waste can occur when products that are purchased within one
3985 order are still sent in several different parcels.

3986 Some reasons that might lead to and individual delivery are the following (Amazon,
3987 2019f; Zalando, 2019b):

- 3988 ▪ different availability of the ordered products;
- 3989 ▪ products are not stored in the same warehouse and are shipped from different
3990 locations; and
- 3991 ▪ products are delivered by partners, affiliated to the online-shop/retailer and
3992 thus are not stored at the same warehouse.

3993 Products that are ordered together within one purchase process do not necessarily
3994 have to be stored in the same warehouse or fulfilment centre. If this is the case, they
3995 are typically sent to the customer from varying locations in different parcels. In case
3996 that the products would be stored in the same warehouse, but the availability is
3997 different, the aspect of fast delivery becomes of increased importance. Waiting for all
3998 components of an order is often not included as an option, as the customer usually
3999 expects the fastest possible delivery.

4000 **Classification**

4001 Individual product delivery is considered as a secondary development due to E-
4002 commerce and arising effects are considered indirect effects of E-commerce.

4003 **Current and future relevance**

4004 The current as well as the future relevance of the individual product delivery could not
4005 be assessed due to the lack of available data and information. Nevertheless, the
4006 effects on the Circular Economy are expected to be closely interconnected with those
4007 of other identified threats such as “Induced parcel transport” (Section 3.2.6.8) or
4008 opportunities, such as “Substitution of individual shopping trips” (3.2.6.4), and
4009 therefore might have a high importance if aspects are considered in a combined way.
4010 In addition, the relevance of this threat is expected to be highly dependent on the
4011 customers behaviour; an analysis of customers choices in case they are offered the
4012 option of waiting for all orders to be ready before delivery would shed a better light on
4013 this topic.

4014 Although this threat generally exists for all product categories, it is particularly
4015 pronounced for apparel and other product categories with a tendency towards smaller
4016 and multiple products per purchase.

4017 **Supporting factors**

- 4018 ▪ increasing demand for fast delivery options (same- or next-day delivery); and
- 4019 ▪ absence of financial incentives to wait for orders to be ready to be shipped
- 4020 within one parcel.

4021 **Mitigating factors**

- 4022 ▪ nudging – highlighting the environmental impacts of individual deliveries. This
- 4023 is only useful if the customer is given the opportunity to choose an option such
- 4024 as “wait for the availability of all products before shipping them in a single
- 4025 package” (see Section 3.2.2.1 “Nudging” for more details).

4026 **Options for actions**

4027 **Producers/Platform providers:**

- 4028 ▪ clear communication and transparency about the origin of the different
- 4029 products included in the basket.

4030 **Source of information**

4031 Amazon (2019f) *Über das Zusammenfassen von Bestellungen in einer Lieferung.*

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4035 [https://www.zalando.de/faq/Versand-Lieferung/65776482/Warum-kommt-meine-](https://www.zalando.de/faq/Versand-Lieferung/65776482/Warum-kommt-meine-Bestellung-in-mehreren-Paketen.htm)

4036 [Bestellung-in-mehreren-Paketen.htm.](https://www.zalando.de/faq/Versand-Lieferung/65776482/Warum-kommt-meine-Bestellung-in-mehreren-Paketen.htm)

4037 3.2.6.7 Threat – Induced freight traffic to remote locations

4038 **Description**

4039 The effects of online trade on urban and rural areas can vary considerably, making a
4040 differentiated approach in analysing them necessary. Deliveries to rural areas are
4041 characterised, among other things, by particularly long delivery routes and lower
4042 efficiency in logistics. This entails the danger of increased environmental influences,
4043 especially in connection with fast delivery options and individual deliveries.

4044 **Discussion**

4045 While urban planning usually subdivides available space into three categories (urban
4046 regions, regions with partial densification and rural regions), the rough distinction
4047 between "land" (rural) and "city" (urban) is sufficient from a logistical point of view
4048 (BBSR, 2018). The delivery concepts differ only significantly between these two
4049 categories (BBSR, 2018). This Section focuses on rural areas and uses the term
4050 "remote location" to highlight the challenges of deliveries and delivery services to
4051 areas of (very) low population density.

4052 Not all delivery concepts can be economically achieved for remote locations and large
4053 differences can be seen in the structure of passenger transport and in the availability
4054 of logistic space (BBSR, 2018). From an online retailer perspective, deliveries to
4055 remote locations are much more expensive and difficult to organize in an efficient way
4056 (Oenning, 2015). At the same time, delivery options such as same-day or next-day
4057 delivery, which are common in urban areas, are usually not economically viable in
4058 rural regions and are often not offered by the online stores. It should be noted that
4059 customers in remote locations currently emphasize less on fast delivery options, but
4060 more on the possibility to delivery to a neighbour's place (PostEurop, 2019a).

4061 It might seem more environmentally friendly to substitute individual trips by car to the
4062 supermarket with home delivery services from online retailers in rural areas, as it is
4063 shown in a recent study by the German Environmental Protection Agency
4064 (Umweltbundesamt, 2018a). At the same time, however, delivery services operate in
4065 such regions much more energy-intensively than in urban areas and the
4066 environmental impact is highly dependent on the means of transportation (BBSR,
4067 2018). Some concepts, such as the direct delivery without additional packaging,
4068 hybrid-models with delivery to stores or parcel stations, might only be available in
4069 urban areas (Verbraucherzentrale, 2017).

4070 Possible savings in CO₂ emissions that could be generated by substituting passenger
4071 transport are put into perspective especially when other risks of online trading are
4072 included in the equation. Especially the aspects of "damage on delivery" (Section
4073 3.2.6.5), "individual product delivery" (Section 3.2.6.6), and "parcel return" (Section
4074 3.2.6.11) have a relative high impact on the environmental performance of such
4075 deliveries. In addition, the differences in customer densities bring certain advantages
4076 to urban areas over rural regions in terms of bundling of activities of the logistic sector
4077 (BBSR, 2018). At the same time, although not included in the scope of this study, it
4078 should be considered that E-commerce improves the accessibility and availability of
4079 goods and thus increases the appreciation in value of the rural area (BBSR, 2018).

4080 **Classification**

4081 Induced freight traffic to remote locations is considered as a supplementary
4082 development arising from E-commerce and evolving business models. Affiliated effects
4083 are therefore considered indirect effects of E-commerce.

4084 **Current and future relevance**

4085 Although most EU citizens live in predominantly urban and intermediate land regions
4086 (around 80% in 2016), with 20% there is still a considerable number of people living
4087 in predominantly rural areas – approximately 98 million people (Umweltbundesamt,
4088 2018b). This can be considered an important market for E-commerce, which is also
4089 reflected by the number of packages delivered in rural regions. In 2016, nearly 300
4090 million packages of all sizes were delivered to customers living in rural regions in
4091 Germany alone (BBSR, 2018). This number is expected to reach around 500 million
4092 deliveries till the year 2030 (BBSR, 2018). In comparison to urban areas, E-commerce
4093 revenue in rural areas grew disproportionately by 17% in Germany in 2017
4094 (Hoffmann, 2018).

4095 Same- or next-day delivery in remote locations are currently of less relevance than in
4096 urban areas. Flexibility in receiving the parcel is of more importance to customers in
4097 such regions. At the same time, however, this type of fast delivery is estimated to
4098 become of more relevance in rural areas as well (Joerss *et al.*, 2016). The problem of
4099 cost efficiency will remain for these regions, which is why the introduction and use of
4100 (partly) autonomous deliveries will become more important in the future (BBSR,
4101 2018).

4102 Additionally, the driving technology is likely to change on a large scale. By 2015,
4103 almost all delivery vehicles had still been powered by fossil fuels (BBSR, 2018), while
4104 estimates show that in particular electric drives as drive types in road freight transport
4105 will become much more widespread (BBSR, 2018).

4106 This threat is of relevance for all product categories in focus of this study.

4107 **Supporting factors**

- 4108 ▪ less dense network of automated parcel deposit and pick-up station (BBSR,
4109 2018).

4110 **Mitigating factors**

- 4111 ▪ introduction or more widespread use of new drive technologies such as electric
4112 delivery trucks (Joerss *et al.*, 2016).

4113 **Options for actions**

4114 **Regulators:**

- 4115 ▪ integration of concepts such as "Große Emma" (concept for a regional supply
4116 infrastructure to ensure the supply of the population in rural areas of Germany)
4117 in less densely populated and structurally weak areas in the regional
4118 development programmes in order to promote cooperative forms of physical
4119 and digital networking in the retail trade (BBSR, 2018).

4120 **Source of information**

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4135 [sind-die-lieferplaene-der-onlinehaendler-/12491238.html](https://www.wiwo.de/unternehmen/handel/amazon-und-zalando-das-sind-die-lieferplaene-der-onlinehaendler-/12491238.html).
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- 4150

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4151 3.2.6.8 Threat – Induced parcel transport

4152 **Description**

4153 E-commerce implies that parcels with the purchased products are sent to the
4154 consumer, which can have a significant impact on environmental aspects related to
4155 transport and logistics. Parcel delivery in general means the movement of goods from
4156 a transportation hub to a destination. Here, we focus on the induced parcel transport
4157 represented by the last mile delivery, namely the delivery to a private consumer,
4158 typically to a personal residence (B2C) as well as other delivery options such as
4159 parcel shops or automatic parcel stations (Prümm *et al.*, 2018a).

4160 **Discussion**

4161 The growth and diversification of the E-commerce-market is increasing the number of
4162 parcel deliveries, carried out mainly by pickup trucks. The consequence is an increase
4163 in traffic, noise, energy demand and thus the increased production of greenhouse
4164 gases. These negative effects are further compounded by a currently inefficient parcel
4165 delivery system, due to a high delivery failure rate (missed or lost parcels) and the
4166 problem that often several delivery attempts are necessary. A low efficiency is also
4167 caused by the wide utilisation of the traditional "Hub and Spoke" delivery model. Each
4168 central location (Hub) is usually shared by several e-commerce players with differing
4169 pick-up times, which hampers the consolidation of parcels (deliveries) to end
4170 customers. Thus, parcel delivery routes are highly affected by delays in the central
4171 warehouse (Hong *et al.*, 2018; Prümm *et al.*, 2018b).

4172 On the other hand, parcel delivery to personal residences may replace private
4173 shopping trips. Especially in rural areas the car would primarily be used for the
4174 shopping trip, but in urban areas these trips are primarily carried out by bicycle, by
4175 foot or by public transportation, with a lower environmental impact than the delivery
4176 by a pickup truck.

4177 Besides the negative impact due to the growth of the traffic volume, an increase in
4178 parcel delivery can also increase the resource consumption for the parcel itself
4179 (cardboard) and the necessary packaging material for the items in the parcel.

4180 **Classification**

4181 Parcel delivery is classified as a direct effect of E-commerce.

4182 **Current and future relevance**

4183 The B2C parcel market is not just a large, but also a highly dynamic market. Since
4184 2013 the European parcel market is growing by 12.5% on average per year, driven
4185 largely by the growth of the E-commerce market. This resulted in an annual revenue
4186 of 19 Bn. €. Further growth is expected for the next years. All together (B2C, C2X and
4187 B2B) 8.7 Bn. items were shipped in 2016; the majority of the items were delivered in
4188 Germany, UK and France. An increase of cross-border deliveries can also be identified
4189 (Dieke, 2018).

4190 The market is strongly dependent on the consumer's needs, who asks for faster,
4191 better and cheaper parcel delivery (Hong *et al.*, 2018). In addition, the consumer
4192 demands transparency, for example through a better tracking of the parcel's location
4193 via a tracking app, or similar (Prümm *et al.*, 2018b). For the future this means an
4194 increase in the use of new technologies including drones and autonomous ground
4195 vehicles, but also bike couriers could play a more important role for the parcel delivery
4196 in urban areas (Joerss *et al.*, 2016).

4197 This threat occurs in all product categories in focus of this study.

4198 **Supporting factors**

- 4199 ▪ competition in the E-commerce market;
- 4200 ▪ persistent consumer preference for cheap delivery prices and fast deliveries;
4201 and
- 4202 ▪ factors of unpredictability (change of consumer demands, traffic etc.).

4203 **Mitigating factors**

- 4204 ▪ shifting the delivery costs to the consumer, if the first delivery attempt was not
4205 successful (e.g. consumer was not at home); and
- 4206 ▪ automation in order and delivery processes (e.g. increase automated
4207 processing).

4208 **Options for actions**

4209 **Scientific Community:**

- 4210 ▪ raise awareness of the link between packages delivered and environmental
4211 impacts (see also "Nudging" in Section 3.2.2.1).

4212 **Producers/Platform providers:**

- 4213 ▪ mitigation options of the negative effects of a traffic increase: optimising
4214 supply chain operations and the logistic system (efficiency standards, better
4215 connection of different transport networks; see also opportunity "Optimisation
4216 of supply chain" in Section 3.2.6.3);
- 4217 ▪ improving data management (e.g. better forecast);
- 4218 ▪ offering trainings for delivery personnel;
- 4219 ▪ offering the selection of personalised delivery times/dates for consumers in
4220 order to avoid failed-deliveries;
- 4221 ▪ providing the possibility for the consumer to track the delivery – developing
4222 new platforms;
- 4223 ▪ avoiding individual orders delivery (orders should only be shipped in full; see
4224 also threat 'Individual product delivery' in Section 3.2.6.6));
- 4225 ▪ avoid unnecessary packaging for the parcel content or use sustainable
4226 packaging materials (renewable resources, reusable; (renewable resources,
4227 reusable; see Section 3.2.7 for more details);
- 4228 ▪ make use of the smallest possible outer packaging (see Section 3.2.7 for more
4229 details); and
- 4230 ▪ offering flexible delivery options, such as specific service points, lockers, or as
4231 hybrid model with delivery directly to the respective shops.

4232 **Regulators:**

- 4233 ▪ amending packaging and packaging waste legislation, e.g. creating incentives
4234 for reduction of packaging material used by producers.

4235

4236 **Source of information**

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4251 3.2.6.9 Threat – Inefficient transport

4252 **Description**

4253 The E-commerce's promise of very short delivery times can favour less efficient
4254 utilisation of trucks and other means of transport whose loading capacities are not
4255 optimally utilised. Moreover, the increased use of faster means of transport can lead
4256 to additional negative environmental impacts due to a higher fuel consumption,
4257 threatening the realization of the EU's own targets for reducing CO₂ emissions in the
4258 transport sector.

4259 **Discussion**

4260 As shown in Section 3.2.6.3 companies active in E-commerce are already making
4261 great efforts to optimise their supply chains. At the same time, it was pointed out that
4262 this optimisation - at least partly - has the objective of promising customers the
4263 shortest possible delivery times. Among other consequences, immense pressure is put
4264 on logistics companies. Delivery time has become one of the most important factors
4265 for E-commerce and related transport. Optimal utilisation of delivery capacities and
4266 thus effects on the environment often play a secondary role (Choo *et al.*, 2016).

4267 The factors to be considered for calculating both costs and CO₂ emissions of
4268 transportation for the shipment of parcels are described by Pålsson (2018), as follows:
4269 incurred costs, incurred CO₂ emissions, shipping distance, empty trips, load factor,
4270 and maximum loading capacity of the vehicle. In the context of the present threat, the
4271 aspect of "load factor", which indicates how efficiently the loading capacity of a
4272 transport vehicle is being used, is considered of most relevance. Decreasing the load
4273 factor has in fact a direct effect on the amount of CO₂ emitted per parcel transported
4274 (Pålsson, 2018).

4275 A related aspect is the increase of traffic due to last-mile delivery trucks. With E-
4276 commerce expected to continuously increase its share of the overall retail market,
4277 competition between couriers, express and parcel delivery companies is very high with
4278 the expectations of a changing market due to new technologies applied (Heid *et al.*,
4279 2018). Competing with other players increases the threat of delivering parcels in a
4280 half-empty vehicle.

4281 **Classification**

4282 Inefficient transport is considered as a supplementary development arising from E-
4283 commerce; related effects are therefore regarded as indirect effects of E-commerce.

4284 **Current and future relevance**

4285 According to a survey conducted by PricewaterhouseCoopers (PWC) for their
4286 Consumer Insight Report 2018, more than half of the surveyed persons stated that
4287 they expect their order to be delivered within two days and with more than one-third
4288 even expecting next- or same-day delivery (PWC, 2018b). When being asked, whether
4289 they would pay an additional charge for delivery within a specific time, a significant
4290 majority stated that they would pay for same- or next-day delivery (PWC, 2018b).
4291 However, in other cases the willingness to pay for this additional option appears to be
4292 very limited (Joerss *et al.*, 2016), with some surveys yielding different results.
4293 Companies may be tempted to continue offering the service with an increased price
4294 for delivery, but even if this may cover the additional costs incurred by the companies,
4295 it does not necessarily have an impact on the capacity utilisation of the delivery

4296 vehicles. On the contrary, passing on the costs to the customers does not give the
4297 companies any additional incentive to better utilise available loading capacities.

4298 The relevance of inefficient transport is therefore very high and is estimated to
4299 continue as high for the near future. Additionally, this threat can be seen as relevant
4300 for all product categories in focus of this study.

4301 **Supporting factors**

4302 ▪ the customer's desire and willingness to pay for fast delivery options is one of
4303 the driving factors to inefficient transport (Heid *et al.*, 2018). As long as
4304 companies play along and see short delivery times as essential factor to
4305 compete on the international E-commerce market, this will hinder the transition
4306 to more sustainable transportation.

4307 **Mitigating factors**

4308 ▪ delivery to (automatized) parcel shops and similar for urban areas (BBSR,
4309 2018); and

4310 ▪ some surveys suggest that customers would not use fast delivery in the case of
4311 a (significant) increase in costs.

4312 **Options for actions**

4313 **Scientific Community:**

4314 ▪ comparative studies to evaluate both the technical and economic feasibility of
4315 technologies that are currently developed and tested.

4316 **Producers/Platform providers:**

4317 ▪ investing in alternative transportation modes (e.g. e-bikes for last-mile
4318 delivery, rail freight transport, light weight transport vehicle fleet).

4319 **Regulators:**

4320 ▪ incentivising the investment in alternative transportation modes and
4321 modernisation of vehicle fleet; and

4322 ▪ comprehensive development programmes to promote sustainable delivery (e.g.
4323 eco-driving) technologies and the expansion of the associated infrastructure
4324 (e.g. E-Highways).

4325 **Source of information**

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- 4344

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4345 3.2.6.10 Threat – Inferior types of transportation

4346 **Description**

4347 Online shops often offer a range of fast delivery options (e.g. same day or next day
4348 delivery) that are still in high demand from customers. This, among others, has an
4349 impact on the choice of the means of transport. In particular products that are not
4350 stored in a warehouse in the immediate vicinity of the customer need to be
4351 transported by faster means of transport (e.g. by plane instead of by railway). This
4352 can increase CO₂ emissions and result in a higher environmental burden.

4353 **Discussion**

4354 Two of the most relevant characteristics of E-commerce are relatively short delivery
4355 times and international market access. The latter might often be not obvious to the
4356 customer, as he or she typically focuses on delivery time and costs. However, both
4357 aspects favour the use of means of transport that cause a higher environmental
4358 impact. Although the traditional retail trade obviously also receives goods from
4359 abroad, these are usually not tied to such narrow time windows as in online trade. Air
4360 freight is of particular importance to online retail to make the short delivery times
4361 possible at all (BDL, 2017). The Federal Association of the German Air Transport
4362 Industry, for example, reports based on data from the Federal Statistical Office in
4363 2017 that more than 90% of all smartphones come to Germany by air. It should be
4364 noted here that freight is frequently transhipped again within Europe and redistributed
4365 to flights throughout Europe (BDL, 2017).

4366 The efficiency of the different means of transport varies significantly. Freight transport
4367 via railways, for example, generates around half of the greenhouse gas emission
4368 generated by transport via inland waterways, and around one-fifth compared to
4369 transportation via lorry – transport via plane being the least efficient alternative
4370 (Umweltbundesamt, 2018a). Regarding air freight, it is important to consider that
4371 CO₂, but also nitrogen oxides, aerosols and water vapour are emitted in high altitudes
4372 where they are contributing more to global warming than emissions generated on the
4373 ground (Umweltbundesamt, 2018a). A recent report from the German Federal
4374 Environment Agency reports that “these various effects add up to such an extent that
4375 the greenhouse effect of flying is on average two to five times higher than the sole
4376 effect of the emitted CO₂” (Umweltbundesamt, 2018a).

4377 **Classification**

4378 Similar to inefficient transport, also inferior types of transportation can be seen as
4379 supplementary developments of E-commerce and are as such considered as indirect
4380 effect of E-commerce.

4381 **Current and future relevance**

4382 The relevance of using freight transport modes that are decreasing the transportation
4383 sector’s environmental impact is very high. The EU has set several targets to reduce
4384 greenhouse emissions till 2050 by 80-95%, including transportation sector’s specific
4385 targets (Öko-Institut, 2013). At the same time, forecasts announce a continued
4386 growth in freight traffic - for Germany, freight traffic is expected to double by 2050.
4387 As a result, the transport sector is under immense pressure to achieve the specified
4388 savings in climate-damaging emissions and, at the same time, to manage the growing
4389 trade in goods (Öko-Institut, 2013).

4390 As there is currently still very strong dependence on fossil fuels, it becomes clear that
4391 a fundamental change has to be initiated (Öko-Institut, 2013). It is worth taking a
4392 more differentiated look at the sector, as there are differences between the different
4393 transportation modes (Öko-Institut, 2013):

- 4394 ▪ trucks: It is estimated that trucks can gain around 30% efficiency over the next
4395 decades by further promoting alternative propulsion technologies, such as
4396 electric driving;
- 4397 ▪ airplane: Already the least environmentally friendly option, it is currently
4398 difficult to foresee any significant increases in efficiency. In contrast to many
4399 transport options on land, there are currently few promising concepts in
4400 aviation that would suggest a comprehensive and fundamental change in
4401 propulsion technology. Investment costs and usage times of aircrafts are much
4402 higher than in other parts of the transportation sector. A renewal takes time –
4403 even with promising concepts; and
- 4404 ▪ transport on waterways: Similar to the developments on the street, there are
4405 also some promising concepts that allow to estimate an efficiency increase of
4406 around 40% till 2050 compared to 2010.

4407 This threat is in general relevant for all product categories in focus of this study.

4408 **Supporting factors**

- 4409 ▪ economic development is still seen as important factor for a nation's wealth,
4410 which in return is coupled to national and often international trade. A fast, safe,
4411 and cost-effective movement of goods is considered very important to reach
4412 this goal (Eurostat, 2018), which in turn may have an impact on the choice of
4413 means of transport. A superior mode of transport from a sustainability
4414 perspective is often not the most cost-effective and its use is therefore more
4415 infrequent. Instead, more cost-efficient means of transport and thus inferior
4416 types of transport (from a Circular Economy point of view) are used.

4417 **Mitigating factors**

- 4418 ▪ introduction of more low-emission vehicles (LEV) (Bogdanski, 2019);
- 4419 ▪ implementation of an electrical high-speed rail network between main
4420 transshipment hubs and expansion of existing networks to reduce the need for
4421 short-distance freight flights (Iea, 2019);
- 4422 ▪ new concepts such as electrification of most important motorway routes with
4423 overhead lines (Öko-Institut, 2013); and
- 4424 ▪ for last mile delivery in urban areas non-motorised vehicles (e.g. cargo bikes)
4425 or pick-up stations on strategic locations of the city (e.g. railway station,
4426 central market areas) can substitute current delivery methods (BBSR, 2018).

4427 **Options for actions**

4428 **Producers/Platform providers:**

- 4429 ▪ highlighting the environmental impact of fast delivery option (same- or next-
4430 day delivery) to the customer (see "Nudging" in Section 3.2.2.1).

4431

4432

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4457 3.2.6.11 Threat – Parcel return

4458 **Description**

4459 Sending packages back (parcel return) is one of the more obvious and well-known
4460 challenges of E-commerce. It is described here as a threat because it adds additional
4461 pressure to the transport sector. The return of parcels can have different reasons,
4462 which are important to evaluate. Thus, tailored countermeasures can potentially be
4463 developed and applied.

4464 **Discussion**

4465 In order to determine whether this aspect applies to each of the product categories
4466 within the scope, it is advisable to take a look at the underlying EU legislation.
4467 Legislation within the EU clearly states that consumers have the legal right of
4468 withdrawal for purchases made online and thus the right to send back such products
4469 for any reason. The so-called cooling off period expires 14 days after a consumer has
4470 received the purchased product (EU Directive 2011/83/EU on consumer rights). To
4471 give only a few examples for exemptions:

- 4472 ▪ sealed audio, video or computer software, which the customer has already
4473 unsealed; and
- 4474 ▪ digital online content, if the purchaser already started either downloading or
4475 streaming the product.

4476 Costs incurred by the return shipment do not have to be paid by the supplier of the
4477 product and can be passed on to the purchaser, when this was made clear before the
4478 completion of the purchase. In practice, however, the costs are often borne by the
4479 suppliers of the products. This 'free return policy' was presumably introduced with the
4480 aim of strengthening and developing E-commerce in general. One has to keep in mind
4481 that one of the major disadvantages of E-commerce compared to physical shops is
4482 that the customer only sees the products virtually and not physically in front of him.
4483 This creates a clear difference in the shopping experience, especially when it comes to
4484 apparel - changing rooms are an integral part of every physical clothing store. With
4485 the free return option, online retailers advertise that products can be tried on at home
4486 and thus promote the purchase of a selection of similar or even the same product (in
4487 different sizes). As a result, nowadays return logistics has to cope with a flood of
4488 returned parcels. Especially for 'apparel', returns often seem to be accepted as
4489 inevitable or even firmly integrated into the business model.

4490 There are basically two different reasons for returning parcels: (1) The purchased
4491 product is defective, or (2) the purchased product does not meet the buyer's
4492 expectations. The second point can be subdivided further in: a (rather) planned return
4493 (e.g. due to multiple orders of the same T-shirt in different sizes or simply testing a
4494 product) or an unexpected return (e.g. due to an incorrect description of the product
4495 or an incorrect order). Although the difference between a planned and unexpected
4496 return seems small, there can be a significant difference in its overall transport
4497 volume and thus in its impact.

4498 **Classification**

4499 The return of parcels is an inherent feature of existing E-commerce structures as well
4500 as business models and thus classified as a direct effect on the Circular Economy. It
4501 poses a threat to a Circular Economy because it puts additional pressure on the
4502 logistics and transport of goods between merchant and customer.

4503 **Current and future relevance**

4504 Surveys on online shoppers suggest that an easy return option is one of the most
4505 important shopping criteria for selecting an online shop (Bolz *et al.*, 2017; PWC,
4506 2018b). This aspect reflects the consumer's side and shows that easy returns are
4507 (typically) expected nowadays. The other side is that of online merchants who,
4508 through their shipping policy, have fomented the customers' expectations and have
4509 reinforced them through partly active advertising of easy return options. The absolute
4510 majority of retailers offers customers a free return of purchased products – a total of
4511 90% according to a study by Parcellab (2018). Besides the mere economic incentive,
4512 retailers also tend to make return as simple as possible for the customer. Around half
4513 of all retailers encloses a return label in the delivered parcel (Parcellab, 2018).

4514 With regard to the share of returned packages and products, different values can be
4515 found in literature. Logistics companies and consulting agencies have conducted
4516 numerous surveys and studies. Overall, the following trends can be derived:

- 4517 ▪ around every eighth of online purchase is sent back (Bitkom, 2017);
- 4518 ▪ there are considerable differences between the product categories in scope in
4519 regard to the return percentage:
 - 4520 ○ apparel has the highest return rates; and
 - 4521 ○ large household appliance and major furnishings have significantly lower
4522 return rates.
- 4523 ▪ young consumers (14-29 years old) send back more than older generations.

4524 This risk occurs particularly in the apparel product category, but is reduced for product
4525 categories that are large bulky products (e.g. major furnishings or major household
4526 appliances). The effort for the customer involved in sending them back is simply too
4527 high in this case.

4528 **Supporting factors**

- 4529 ▪ strongly competitive market with long-established customer behaviours related
4530 to ordering a variety of products to simply try and test them at home, before
4531 returning (at least some of them) the purchased products. Customers might be
4532 conditioned to this behaviour as it is strongly promoted by some online
4533 retailers; and
- 4534 ▪ persistent promoting of free shipping and free return.

4535 **Mitigating factors**

- 4536 ▪ change in consumer behaviour towards a more sustainable approach in
4537 ordering products online;
- 4538 ▪ no or limited free return options throughout the market; and
- 4539 ▪ cooperation among retailers to improve logistics (see opportunity "Optimisation
4540 of the supply chain" in Section 3.2.6.3).

4541 **Options for actions**

4542 **Scientific Community:**

- 4543 ▪ raise awareness of the link between packages returned and environmental
4544 impacts (see also opportunity "Nudging" in Section 3.2.2.1).

4545 **Producers/Platform providers:**

- 4546 ▪ inclusion of feedback options (both in case of a return, but also to match
4547 expectations to delivered product);
- 4548 ▪ active Quality Management to identify product (groups) with potential quality
4549 issues;
- 4550 ▪ provide information about the impact of returned products (see opportunity
4551 “Nudging” in Section 3.2.2.1; and
- 4552 ▪ provide return in-store options to decrease faulty packaging of returned
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4569 **3.2.7 Cluster – Packaging**

4570

4571 **3.2.7.1 Opportunity – Development of dedicated optimised packaging solutions**

4572 **Description**

4573 In recent years, there has been a significant development in dedicated packaging
4574 solutions that focus on a more sustainable use of materials and a flexible design of
4575 packaging that fits the product's specific transportation requirements. As these
4576 optimisation strategies for packaging potentially affect the demands for plastic and
4577 cardboard, modern solutions are seen as an opportunity for the Circular Economy.

4578 **Discussion**

4579 Dedicated packaging solutions that are discussed in this study are mainly dealing with
4580 packaging-related issues of the E-commerce sector. Those aspects are dealing with
4581 problems that arise from E-commerce itself. Therefore, many distinct opportunities
4582 associated with the optimisation of packaging are not expected to result in actual
4583 environmental benefits compared to the traditional retail channel (Pålsson, 2018).

4584 One of the requirements for the Circular Economy is to keep resources in use for as
4585 long as possible and to retrieve products and materials at the end of the materials
4586 service life (WRAP, 2019). For packaging used to ship products traded via E-commerce
4587 to the customer, this has been a challenging task.

4588 In addition to the pure optimisation of the packaging quantity, reusable packaging can
4589 also be applied. Although this might already be done to some extent by the consumer
4590 side (e.g. reusable carrying bag for groceries), it is not common on the producer's
4591 side. A major hurdle is already posed by the question of how the parcels and
4592 packaging can be returned. RePack, for example, tackles this aspect of E-commerce
4593 disposable packaging and has introduced a business model around the idea. The
4594 company's model includes both a design for packages that makes it feasible and fairly
4595 easy to return them, as well as the implementation of a take-back system for such
4596 packages (Ellen MacArthur Foundation, 2019; Zero Waste Europe, 2019).

4597 Another example is the online platform LOOP, developed by the omni-channel retailer
4598 Carrefour and U.S. waste recycling company TerraCycle. This model tackles the
4599 problem arising from single-use shipping materials by introducing reusable containers
4600 for different types of products. The company "*streamlines returns for the user by
4601 offering delivery and pickup of products and empty packaging, and removes hassle for
4602 the brandowner by taking care of reverse logistics, cleaning, sanitation, and
4603 redistribution*" (Ellen MacArthur Foundation, 2019).

4604 **Classification**

4605 This emerging opportunity is considered an indirect effect of E-commerce due its
4606 rather long-term and structural implications on packaging as a result of wide-scale
4607 market developments. As long as omni-channel structures are present, dedicated
4608 packaging solutions are still a niche segment.

4609 **Current and future relevance**

4610 From an environmental perspective, reusable packaging can reduce packaging waste
4611 throughout the supply chain. However, to determine whether the environmental
4612 impact is improved or worsened compared to one-way packaging, a systemic
4613 approach is needed which includes other environmental impacts such as transport

4614 efficiency and effects on product waste. In the current literature, such a systemic
4615 approach is seldom used. Instead, studies often assume that reusable packaging is
4616 more environmentally efficient than one-way packaging simply because it is used
4617 several times. However, in some contexts, reusable packaging is more
4618 environmentally beneficial and in others, one-way packaging is better. From an
4619 ergonomic perspective, reusable packages are often more robust with better stability,
4620 but are also heavier than one-way packaging. They are also more likely to use
4621 standardized dimensions, which can provide co-loading and other efficiency benefits,
4622 but also risk a lock-in effect, where it becomes difficult to modify the packaging to
4623 cater for new types of products, new customers and changes in order sizes (Pålsson,
4624 2018).

4625 The relevance of dedicated packaging solutions is increasing, as is the pressure to
4626 develop more sustainable solutions along the E-commerce supply chain in general.
4627 Several models were introduced in recent years and are currently being tested or
4628 already being rolled-out to some extent. The following are only two examples of many
4629 and show that these solutions still require some time to prove their effectiveness
4630 (Ellen MacArthur Foundation, 2019):

- 4631 ▪ **RePack** – provides products in reusable containers that can be returned with a
4632 deposit reward mechanism. Around 50,000 consumers use this system
4633 worldwide. Zero Waste Europe indicates that around 20,000 RePacks were used
4634 in 2017, and around 30,000 in 2018 (Ellen MacArthur Foundation, 2019); and
- 4635 ▪ **LimeLoop** – reusable packaging that can be rented by online shops to deliver
4636 purchased products. Packaging can be returned by customers via an integrated
4637 shipping label. Currently, more than 20,000 round-trip shipments to date in the
4638 US (Ellen MacArthur Foundation, 2019).

4639 Across the E-commerce sector, return models and other dedicated packaging solutions
4640 appear to still be relatively uncommon at present. At the same time, the usage of such
4641 solutions seems to have a steady and steep increase.

4642 This opportunity will be of relevance for all product categories in the future as the
4643 transition to a Circular Economy will foster the use of sustainable packaging solutions
4644 for all types of products sold via E-commerce. However, mentioned examples of
4645 currently available dedicated packaging solutions are currently still focusing primarily
4646 on food deliveries and less on the other product categories in focus of this study.

4647 **Supporting factors**

- 4648 ▪ investment in new packaging solutions and willingness to address the problem
4649 of excessive protective packaging (see Section 3.2.7.2 for more details on
4650 excessive protective packaging);
- 4651 ▪ possibility of cost savings stemming from the adoption of reusable packaging.

4652 **Mitigating factors**

- 4653 ▪ low material and disposal costs for standard packaging and integrated
4654 protective material.

4655 **Options for actions**

4656 **Producers/Platform providers:**

- 4657 ▪ cooperation with companies offering innovative packaging solutions;
- 4658 ▪ investing in concepts and infrastructure for reusable packaging systems; and

- 4659 ▪ offer the reusable packaging option in the online-store and highlighting
4660 environmental advantages to the customers.

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4671

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4672 3.2.7.2 Threat – Excessive protective packaging

4673 **Description**

4674 Products purchased via E-commerce are typically sent to consumers in packages that
4675 use different types of protective material and packaging design to ensure that the
4676 product is delivered unharmed. Adequate protection is absolute necessary to avoid
4677 damage during transportation. There are, however, various difficulties with the
4678 practical implementation of an “adequate” protection. Some products are still
4679 protected in a way that can be considered as excessive and wasteful.

4680 **Discussion**

4681 As it is discussed in the identified threat “Damage on delivery” (Section 3.2.6.5),
4682 products require adequate protection to ensure that they do not get damaged at any
4683 step of the supply chain and to ensure that they reach their destination safely.
4684 Protection might be required against atmospheric, magnetic, electrostatic, vibration,
4685 shock impact, or other factors. The type of protective packaging is determined
4686 primarily by the product to be protected, but also by the way in which the parcel is
4687 transported and handled. Companies that specialize in packaging protection advertise
4688 a wide range of applications and material types, such as foams, bubble wrap,
4689 cushioning pads – to name just a few.

4690 The threat is not seen here in the protective packaging itself, but in the partially
4691 disproportionate use of it. Companies may find it challenging to offer suitable
4692 packaging and protective packaging for all the products on offer- the offered solutions
4693 are often standardized for several product groups and sizes. The use of relatively large
4694 standard boxes for small items and the use of packaging that offers a much higher
4695 shock absorption than technically needed are only two examples of many. This can
4696 lead to a negative effect on the Circular Economy as the efficiency of material and
4697 transport is low.

4698 The challenge for companies is to provide optimal protection for each product while
4699 being efficient with protective packaging. At the same time, this solution must be
4700 integrable within the extremely synchronized and tightly timed supply chain and must
4701 be economically viable.

4702 **Classification**

4703 Excessive protective packaging is a supplementary development due to E-commerce
4704 features and is considered here as an indirect effect of E-commerce.

4705 **Current and future relevance**

4706 Currently, only very limited data is available on the overall impact of protective
4707 packaging.

4708 Product protection appears to be of very high priority for most companies in the sector
4709 and there seems to be a general understanding that “product damage is the least
4710 sustainable option” (Hattersley, 2019). To which extent, however, excessive protective
4711 packaging is discussed by industry is difficult to evaluate. Topics at the international
4712 conferences E-PACK Europe in Berlin in 2019 were dealing with several aspects of
4713 efficient and sustainable packaging and suggest that the issue is on the industries
4714 agenda. The following points show some examples that shall highlight potential
4715 solutions and approaches to reduce excessive protective packaging:

- 4716 ▪ the packaging provider DS Smith developed a test procedure, with which
4717 different factors of influence, which can affect a package during delivery, are
4718 tested. According to their own account, this procedure does not only aim at
4719 providing an adequate protection to the product, but also explicitly focuses on
4720 using only the amount of material that is absolutely necessary to achieve the
4721 desired protection level (Smith, 2019b);
- 4722 ▪ Amazon’s frustration free packaging is not only focusing on a frustration free
4723 experience for the customer, but also aims at avoiding unnecessary additional
4724 packaging, while ensuring intactness of the product (Amazon, 2019c);
- 4725 ▪ packaging distributor Kite Packaging Ltd (Kite) that initiated a project with the
4726 goal to reduce the space that is required for corrugate cardboard cartons in its
4727 warehouses, while at the same time ensuring the stability of the packages
4728 (WRAP, 2018); and
- 4729 ▪ Walmart developed a Sustainable Packaging Playbook in which the company is
4730 highlighting three main aspects of their packaging: source sustainability,
4731 support recycling, optimise design. The latter is incorporating the aspect of
4732 material reduction while protecting the product (Score, 2019).

4733 The aforementioned examples shall highlight that industry is dealing with the topic of
4734 efficiency and reduction of material regarding their products’ packaging and thus
4735 protective packaging. However, it is currently unclear to which extent such measures
4736 are already used by those companies as well as the whole industry.

4737 In terms of relevance for product categories, it can be assumed that the effect seems
4738 particularly relevant in relation to shipping of small information and communication
4739 technology (ICT), and to a certain extent, to accessories (e.g. watches), but not to the
4740 other five selected product categories, as they do not comprise small, vulnerable
4741 products.

4742 **Supporting factors**

- 4743 ▪ packaging and transport models with non-flexible “one-size fits all” for
4744 packaging; and
- 4745 ▪ uncertainty or lack of knowledge about the adequate protection required for the
4746 product to be supplied.

4747 **Mitigating factors**

- 4748 ▪ cooperation with dedicated packaging companies (see also opportunity
4749 “Development of dedicated optimised packaging solutions” in Section 3.2.7.1).

4750 **Options for actions**

4751 **Scientific Community:**

- 4752 ▪ consolidate best practices that are already in place; and
- 4753 ▪ development of flexible packaging solutions that address product groups that
4754 are currently less in focus.

4755 **Producers/Platform providers:**

- 4756 ▪ promote and support cross-company standards on protective packaging; and
- 4757 ▪ cooperation with providers of advanced protective packaging solutions.

4758 **Regulators:**

- 4759 ▪ include an aspect of packaging minimisation that is explicitly dealing with
4760 protective packaging; and
- 4761 ▪ from a regulatory perspective, Packaging and Packaging Waste Directive
4762 94/62/EC (and its amendments such as Directive (EU) 2018/852) should be
4763 mentioned, which requires EU Member States to take measures to prevent and
4764 reduce packaging waste with the goal to 'minimise the environmental impact of
4765 packaging'. The aspect of protective packaging is only addressed indirectly by
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4797 [https://www.dssmith.com/contentassets/c187988864b9404bb959135d7b92b92c/ds-](https://www.dssmith.com/contentassets/c187988864b9404bb959135d7b92b92c/ds-smith-sustainability-report-2019.pdf)
4798 [smith-sustainability-report-2019.pdf](https://www.dssmith.com/contentassets/c187988864b9404bb959135d7b92b92c/ds-smith-sustainability-report-2019.pdf).
- 4799 WRAP (2018) *Reducing corrugated cardboard weight without compromising*
4800 *performance, Waste & Resources Action Programme*. Available at:
4801 [http://www.wrap.org.uk/sites/files/wrap/15203-01 Kite Packaging report.pdf](http://www.wrap.org.uk/sites/files/wrap/15203-01_Kite_Packaging_report.pdf)
4802 (Accessed: 12 August 2019).

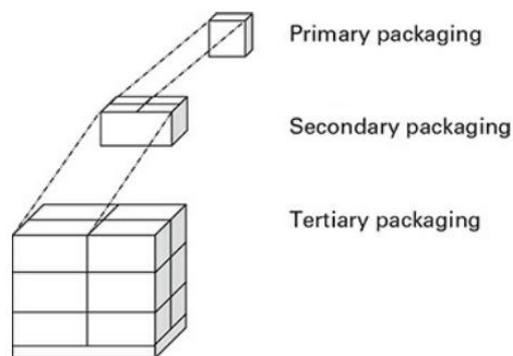
4803 3.2.7.3 Threat – Secondary packaging

4804 **Description**

4805 Primary packaging is the type of packaging closest to the product (e.g. glass bottle,
4806 paper packaging of flour) and is sometimes referred to as retail or consumer
4807 packaging. Secondary packaging is the packaging that encompasses one or several
4808 products that are wrapped in primary packaging (Pålsson, 2018). In simple terms – it
4809 is the visible parcel that the customer receives at the door when ordering products
4810 online. Secondary packaging is seen as threat to the Circular Economy as more
4811 packaging waste is accruing.

4812 **Discussion**

4813 Secondary packaging is not only used for E-commerce applications but also for
4814 transportation of goods in traditional retail. The type of packaging as well as how
4815 companies organise their supply chain can differ significantly between product
4816 groups, branches but also depending on companies involved in the logistics. In
4817 general, however, three interrelated levels of packaging are used to transport goods
4818 that are in focus of this study between point of manufacture and point of sale/end-
4819 consumer (Pålsson, 2018).



4820

4821 **Figure 10. Three interrelated levels of a packaging system by Pålsson, 2018**

4822 Each of the packaging levels has several specific functions, such as marketing
4823 purposes, protection, containment, etc. Overall, the objective is to transport the
4824 product efficiently and without any harm to its final destination. The aspect of
4825 efficiency is seen here as important aspect that can differ considerably between
4826 traditional retail and E-commerce. Material efficiency increases with optimal use of the
4827 space in a parcel. In E-commerce, products are often shipped to consumers in smaller
4828 batch size than to retail shops (e.g. 2 shirts instead of a parcel full of shirts), which
4829 results in a decrease in material efficiency and which is seen as a direct threat arising
4830 from E-commerce (Pålsson, 2018).

4831 **Classification**

4832 Secondary packaging is inherent (at least till now) to the delivery of products to the
4833 customer. Purchasing a product online has the consequential effect of secondary
4834 packaging use and thus an anticipated negative effect. It is a characteristic of current
4835 E-commerce practices and estimated to persist in future scenarios. As such it is
4836 considered a direct effect of E-commerce.

4837

4838 **Current and future relevance**

4839 Typically practice since the beginning of E-commerce and presumably still widely the
4840 most common practice is the take-and-dispose model, where customers receive a
4841 product at home and discard the parcel, in which it was delivered. However, various
4842 approaches are currently being developed to counter this wasteful approach.

4843 The possibility to purchase online and pick the product up in a store is offered by more
4844 and more companies. If the product can be unpacked on site, secondary packaging
4845 waste can be directed into regulated routes. Some companies already provide
4846 reusable primary and secondary packaging (re-use systems), which are currently only
4847 offered for a few product categories (food, hygiene articles such as soap, etc.). See
4848 section 3.2.7.1 for more examples on reusable secondary packaging solutions.

4849 Two developments can be highlighted here that are likely to have an impact on the
4850 future relevance of secondary packaging (Fisher and Lilienfeld (2017)): dimensional
4851 shipping, which incorporates the aspect of packaging size in addition to packaging
4852 weight; and Box-on-Demand, which uses customised packaging designs that fit the
4853 order's specific requirements. Both concepts directly address the problem of inefficient
4854 packaging use and have the potential to decrease this threat.

4855 Overall, the aspect of packaging waste from secondary packaging arising from E-
4856 commerce seems to get more attention from industry and customers alike. There are
4857 currently several innovations and new models that still require some time to proof
4858 their effectiveness.

4859 **Supporting factors**

- 4860 ▪ customers still prefer to receive their order at home, which makes it difficult for
4861 hybrid models to establish (Joerres *et al.*, 2016).

4862 **Mitigating factors**

- 4863 ▪ the use of social media in e-commerce has led to individual consumers being
4864 able to provide detailed information on e-commerce packaging to other users
4865 and potential customers (e.g. with so call "unboxing videos"; (Tagesspiegel,
4866 2013)). Because consumers are able to be publicly critical, companies are
4867 being urged to addressed identified packaging issues (Fisher and Lilienfeld,
4868 2017).

4869 **Options for actions**

4870 **Producers/Platform providers:**

- 4871 ▪ cooperation with providers of packaging optimisation solutions such as Box-on-
4872 Demand (Fisher and Lilienfeld, 2017).

4873 **Regulators:**

- 4874 ▪ supporting dimensional shipping that incorporates parcel size in addition to
4875 parcel weight (Fisher and Lilienfeld, 2017).

4876 **Source of information**

4877 Digest, P. (2019) *3 challenges of ecommerce packaging*. Available at:
4878 [https://www.packagingdigest.com/supply-chain/3-challenges-of-ecommerce-](https://www.packagingdigest.com/supply-chain/3-challenges-of-ecommerce-packaging-from-an-insider-2019-01-07)
4879 [packaging-from-an-insider-2019-01-07](https://www.packagingdigest.com/supply-chain/3-challenges-of-ecommerce-packaging-from-an-insider-2019-01-07) (Accessed: 12 August 2019).

- 4880 Fisher, K. and Lilienfeld, B. (2017) *Optimizing Packaging for an E-commerce World*.
4881 Available at:
4882 [http://c.ymcdn.com/sites/www.ameripen.org/resource/resmgr/PDFs/White-Paper-](http://c.ymcdn.com/sites/www.ameripen.org/resource/resmgr/PDFs/White-Paper-Optimizing-Packa.pdf)
4883 [Optimizing-Packa.pdf](http://c.ymcdn.com/sites/www.ameripen.org/resource/resmgr/PDFs/White-Paper-Optimizing-Packa.pdf).
- 4884 Joerss, M. *et al.* (2016) 'Parcel delivery: The future of last mile', *McKinsey & Company*,
4885 (September), pp. 1–32. Available at:
4886 [https://www.mckinsey.com/~media/mckinsey/industries/travel_transport_and](https://www.mckinsey.com/~media/mckinsey/industries/travel_transport_and_logistics/our_insights/how_customer_demands_are_reshaping_last_mile_delivery/parcel_delivery_the_future_of_last_mile.ashx)
4887 [logistics/our_insights/how_customer_demands_are_reshaping_last_mile](https://www.mckinsey.com/~media/mckinsey/industries/travel_transport_and_logistics/our_insights/how_customer_demands_are_reshaping_last_mile_delivery/parcel_delivery_the_future_of_last_mile.ashx)
4888 [delivery/parcel_delivery_the_future_of_last_mile.ashx](https://www.mckinsey.com/~media/mckinsey/industries/travel_transport_and_logistics/our_insights/how_customer_demands_are_reshaping_last_mile_delivery/parcel_delivery_the_future_of_last_mile.ashx).
- 4889 Pålsson, H. (2018) *Packaging Logistics - Understanding and managing the economic*
4890 *and environmental impacts of packaging in supply chains*. London: Kogan Page
4891 Limited.
- 4892 Tagesspiegel (2013). Insider packen aus. Available at:
4893 <https://www.tagesspiegel.de/gesellschaft/unboxing-insider-packen-aus/8490556.html>
4894 (Accessed: 10 October 2019)

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4895 **4 In-depth assessment of opportunities and threats** 4896 **for selected product categories**

4897 As part of the identification of the opportunities and threats for the Circular Economy
4898 arising from E-commerce, the value chain differences between the traditional sales
4899 channel and online distribution were identified, as described in Section 3.1.2.

4900 It is evident, that many value chain effects directly induced by E-commerce are
4901 broadly valid, irrespective of the product category. All identified E-commerce effects –
4902 both opportunities and threats – relate to the same system boundaries and dedicated
4903 value chain processes.

4904 In general, the assessment and potential quantification of effects on the Circular
4905 Economy arising from E-commerce necessitates a transdisciplinary methodological
4906 approach relying upon Environmental Systems Analysis, Future Studies,
4907 Environmental Economics, and Social Sciences (Börjesson Rivera *et al.*, 2014).
4908 However, this assessment primarily focuses on environmental aspects since those are
4909 at the core of pertinent Circular Economy promises (European Commission, 2015a,
4910 2018a; Webster, 2017). In line with this scope, Environmental Systems Analysis
4911 constitutes the discipline of choice in terms of literature reviewed and methods
4912 applied.

4913 As described in Section 3.1.2, the comparative analysis of the traditional retail channel
4914 and E-commerce is based on a reference model, which tries to untangle dedicated
4915 processes and attribute them to one or the other channel (see Figure 2). In doing so,
4916 opportunities and threats are by definition additional and hence they inherently mark
4917 relative changes to the assumed baseline (traditional brick-and-mortar value chain).

4918 **4.1 Circular Economy Aspects in E-Commerce Value Chains**

4919 In general, the broad and often ambiguous concept of Circular Economy exhibits
4920 different implementation scales (Moraga *et al.*, 2019). This study aims to focus on the
4921 micro scale, thus on products or services. Moreover, the sought indicators are
4922 expected to provide relevant information for decision-making in EU policy.

4923 The selection of appropriate indicators for the aim of this study needs to account for E-
4924 commerce-specific features, thus taking into account the identified dedicated value
4925 chain processes (see Section 3.1.2), as well as accommodate evident data availability
4926 constraints. The latter appears to be an issue when looking at some of the commonly
4927 proposed indicators which have been developed recently and are mainly used in
4928 academia thus far. Therefore, a more pragmatic approach is deemed necessary,
4929 balancing scientific state-of-the art with the scope of the study and data availability.
4930 Due to highly complex and diverse contexts associated with identified life cycle stages,
4931 Circular Economy aspects are defined as being largely independent from geographical,
4932 national, and temporal conditions.

4933 Amongst others, the concepts of the Product Environmental Footprint Study, PEF,
4934 (Pelletier *et al.*, 2012) and, where available, the Product Environmental Footprint
4935 Category Rules, PEFCR, (e.g. T-shirt: (Pesnel and Payet, 2019) and Environmental
4936 Product Declarations, EPD, (Barilla, 2014; ISKO division, 2018) are considered as
4937 guidelines for the quantitative assessment and the choice of representative indicators.
4938 Also, it must be remembered that the identification and selection of representative
4939 indicators is a somewhat critical step, as most statistical data or indicators often used
4940 for tracking the progress of a Circular Economy mainly refer to macro-scale contexts
4941 (e.g. per-capita-numbers) and cannot be readily applied to the micro-scale or product
4942 level (e.g. per fulfilled unit).

4943 Furthermore, the assessment of Circular Economy should be based on a set of
4944 indicators rather than on one single indicator (Moraga *et al.*, 2019) which is achieved
4945 by the selection of representative indicators per cluster, as presented and discussed
4946 below. Lastly, in some clusters, numbers of relevant effects and particularly complex
4947 interrelations between them only allowed to assess those clusters qualitatively rather
4948 than quantitatively, since robust representative indicators could not be determined.

4949 Table 10 gives an overview of the clusters and representative indicators.

4950 **Table 10. Overview of effect clusters and representative indicators (Circular Economy aspects)**

| Cluster | Representative Indicator | Unit(s) | Comment(s) |
|-------------------------------------|---|---|---|
| Accessibility of information | (not applicable) | • (n.a.) | Various effects, with complex interactions, thus assessed qualitatively |
| Consumer needs and behaviour | (not applicable) | • (n.a.) | Various effects, with complex interactions, thus assessed qualitatively |
| Digitalisation | "(Primary) Energy demand and global warming potential" | <ul style="list-style-type: none"> • kWh • CO₂-equivalents | Indicators identified. Still assessed qualitatively due to complex interactions |
| End-of-Life | "Fraction that is effectively brought into a second or prolonged life cycle and product waste per fulfilled unit" | <ul style="list-style-type: none"> • percentage (%) • absolute | Reuse, remanufacturing, recycling, landfilling - subject to product category and effect |
| Legal framework | (not applicable) | • (n.a.) | Various effects, with complex interactions, thus assessed qualitatively |
| Logistics and transport | "Transport requirements per fulfilled unit" | <ul style="list-style-type: none"> • km/unit • CO₂e/unit | Use of representative products for each product category |
| Packaging | "Amounts of plastic and cardboard packaging demand per fulfilled unit" | <ul style="list-style-type: none"> • kg plastic packaging/unit, • kg cardboard packaging/unit | Plastic is represented by LDPE foil (compare Section 4.3.8) |

4951

4952

4953 **4.2 Methodology**

4954 Based on the preceding identification and description of relevant opportunities and
4955 threats as well as proposed clusters and corresponding Circular Economy aspects or
4956 indicators, the subsequent Sections explain how the in-depth assessment was
4957 conducted.

4958 **4.2.1 Goal & Scope of In-depth Assessment**

4959 Guided and already suggested by the overall objective of this study, the following
4960 research questions are to be answered by means of the proposed assessment
4961 framework:

- 4962 ▪ To what extent do the identified opportunities and threats currently affect
4963 relevant Circular Economy aspects?
- 4964 ▪ How do E-commerce scenarios and value chains compare to the traditional
4965 retail channels (baseline)?
- 4966 ▪ At what point(s) in the life cycle of selected products are assessed CE aspects
4967 primarily taking effect?
- 4968 ▪ What long-term/future effects do certain opportunities and threats potentially
4969 exert on relevant CE aspects? (future development)

4970 Each assessment seeks to reflect these questions, depending on data availability and
4971 validity.

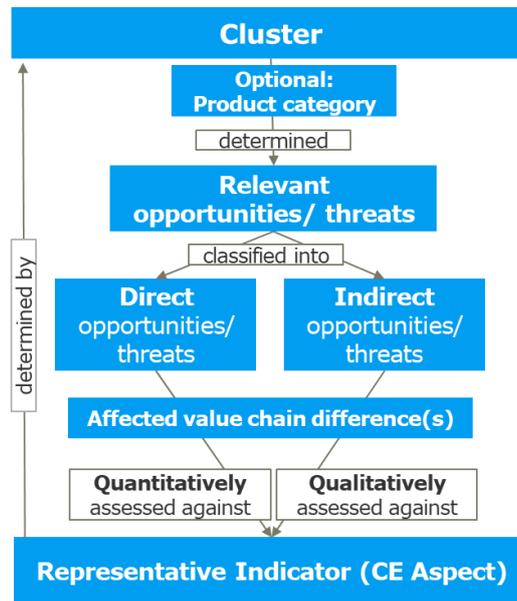
4972 **Temporal and Geographical Scope**

4973 Research and analysis were focused on Europe-wide average data. Evidently, the
4974 applicability and transferability of findings and results to certain national contexts is
4975 limited due to uncertain market conditions and obvious differences in consumer
4976 behaviour and preferences. In case EU average data was not available, data from one
4977 or more of the proposed five countries (Poland, Sweden, Spain, France and Germany;
4978 see also Section 2.1.3) was adopted as a point of reference. Moreover, if notable
4979 deviations between the results of the countries were expected or identified (depending
4980 on data availability), EU-wide data may not have provided representative information.
4981 Thus, country-specific data was also used to gauge any differences between sub-
4982 regions of Europe, or to determine, whether a certain effect could be considered more
4983 or less homogeneous across the EU.

4984 **4.2.2 Assessment Framework**

4985 Building upon the systematic classification and inherent characteristics (e.g.
4986 additional) of identified opportunities and threats (see Section 3.1.2), a quantitative
4987 assessment is provided as far as applicable. The general procedural approach is shown
4988 in Figure 11. Due to the wide project scope and data availability constraints as well as
4989 inherent limitations, only direct effects of the three clusters "Logistics and Transport",
4990 "Packaging", and "End-of-Life" are suitable for a quantitative assessment. Indirect
4991 opportunities and threats of these clusters and all effects of the remaining clusters are
4992 described in a qualitative manner, stating trends and expected future developments
4993 based on available research.

4994



4995

4996

Figure 11. Assessment framework and potential assessment sequences.

4997

4998 Due to the cascading nature of environmental effects arising from E-commerce,
4999 opportunities and threats were classified as either direct or indirect (see Table 5 in
5000 Section 3.1.2). This classification is not only a methodological choice but also a
5001 prerequisite for the in-depth assessment as it provides a rationale, whether
5002 quantitative or qualitative information is deemed appropriate. This is because direct
5003 and indirect effects entail different degrees of uncertainty (due to data availability,
5004 assumptions, etc.), requiring to individually choose, whether a quantitative or
5005 qualitative evaluation of the respective opportunity or threat is feasible. The
5006 methodological possibilities to either extrapolate quantitative data from available
5007 literature or to calculate and estimate certain effects are considered rather limited due
5008 to the numerous assumptions involved. As a general rule, scientifically sound
5009 quantifications of certain effects can only be made, if the scope and unavoidable
5010 uncertainties are clearly defined and discussed (e.g. geographical and temporal
5011 conditions, population density, behavioural aspects of consumers, etc.).

5012 Table 11 summarises available data sources and methodological possibilities referring
5013 to either direct or indirect effect pathways (opportunities or threats).

5014 **Table 11. Overview of preferred data sources and methodological possibilities for the assessment**
5015 **of E-commerce effects (Börjesson Rivera *et al.*, 2014; Dost and Maier, 2018).**

| Effect Pathway | Preferred Data Sources | Rationale | Result Type |
|----------------|---|---|--------------|
| Direct | <ul style="list-style-type: none"> Techno-scientific literature; Environmental Product Declarations (EPDs), LCA studies; LCI Databases (e.g. GaBi professional database, European Life Cycle Database (ELCD) of the Joint Research Centre); and Complementary LCA calculations / extrapolations and Inventory | Consequential effects associated with ICT/E-commerce as well as immediate enabling (substitution/optimisation) effects can reliably be assessed with bottom-up quantitative systems analysis methods (e.g. (comparative) LCA) and needed assumptions are rather limited | Quantitative |

| | Analyses. | | |
|-----------------|--|---|-------------|
| Indirect | <ul style="list-style-type: none"> ▪ Techno-scientific literature; ▪ Market reports / Grey literature (e.g. from associations); ▪ Statistics (e.g. Eurostat, Statista); and ▪ Corporate reports (e.g. annual reports and non-financial reporting). | <p>Long-term and/or structural effects associated with ICT/E-commerce cannot reliably be assessed using quantitative systems analysis (e.g. LCA); Some hypothetical effects associated with ICT/E-commerce may be assessed with quantitative systems analysis methods (e.g. LCA) but needed assumptions are considerable and/or assessments must be combined with other methods (e.g. top-down approaches).</p> | Qualitative |

5016

5017 Given the wide scope of this study and the diversity of product categories being
5018 assessed, reliable quantitative assessment results are difficult to attain and, in many
5019 of the cases, quantitative assessments are not applicable to capture certain effect
5020 clusters (e.g. consumer needs and behaviour). A quantification of complex and
5021 uncertain effects (usually indirect effects) could suggest an accuracy that cannot be
5022 achieved in this study. Hence, opportunities and threats which cannot be quantified
5023 reliably are assessed qualitatively, based on techno-scientific literature and
5024 stakeholder input.

5025 As described in Section 4.1, in order to compare the effects of the opportunities and
5026 threats between traditional brick-and-mortar retail and E-commerce for the current
5027 state as well as future developments, representative Circular Economy
5028 aspects/indicators were identified for each of the selected clusters. All quantitative and
5029 qualitative effects within the respective cluster are assessed against those
5030 representative indicators relating to a functional unit. The determination of the
5031 functional unit and of the representative indicators are explained below and in Section
5032 4.3, respectively.

5033 The in-depth assessment results will be discussed and summarised per cluster. As
5034 stated earlier, the following clusters entail a detailed quantitative assessment of the
5035 respective direct opportunities and threats:

- 5036 ▪ End-of-life;
- 5037 ▪ Logistics and transport; and
- 5038 ▪ Packaging.

5039 Based on research and evidence from previous studies relating to E-commerce and
5040 Circular Economy, these clusters are considered highly relevant for this kind of
5041 assessment. Moreover, in comparison to the other clusters, more quantitative data
5042 and points of reference for the opportunities and threats contained in these clusters
5043 were found in the literature. In contrast, the other clusters contain several
5044 opportunities and threats which have been barely addressed in the literature or by any
5045 stakeholders thus far. This circumstance renders these other clusters inappropriate for
5046 a detailed quantitative assessment under the scope of this study. Nevertheless,
5047 quantitative information and data points from literature are included in the discussions
5048 and reflected in the results to the extent possible.

5049 For the discussions and presentations of the results from the in-depth assessment,
5050 identified opportunities and threats within a given cluster are grouped according to
5051 their properties as follows (see also Section 3.1.2):

- 5052 ▪ **Relative effects associated with E-commerce as per today:** additional
5053 effects of direct opportunities and threats on respective Circular Economy
5054 aspects as well as comparison with baseline impacts as long as feasible and
5055 sufficient data available;
- 5056 ▪ **Positive influencing factors associated with E-commerce for future
5057 development:** expected effects of indirect opportunities on respective Circular
5058 Economy aspects; and
- 5059 ▪ **Negative influencing factors associated with E-commerce for future
5060 development:** expected effects of indirect threats on respective Circular
5061 Economy aspects.

5062 In order to enable a more nuanced understanding of possible influences within the
5063 assessments, influences (i.e. opportunities and threats) were – wherever possible –
5064 ascribed:

- 5065 ▪ a “plus” (+) for positive influences;
- 5066 ▪ a “minus” (-) for negative influences; or
- 5067 ▪ a “zero” (0) where influences were inconclusive.

5068 Furthermore, as a sign of their relevance within their respective cluster, a double sign
5069 (i.e. “++” or “- -”) was ascribed for highly relevant influences.

5070 The ascription of signs was done on the basis of circumstances such as occurrence of
5071 the influence in literature, its importance within the stakeholder consultations, and
5072 expert judgement. The below colour-coding was used to show both sign and relevance
5073 of the respective effect.

| | |
|-------------|---|
| ++ | Positive effect deemed to have high relevance for a given CE indicator compared to traditional (brick-and-mortar) channel |
| + | Positive , effect with low relevance |
| -- | Negative effect with high relevance |
| - | Negative effect deemed to have low relevance |
| o | Inconclusive effect thus deemed to have low relevance |
| <i>n.a.</i> | Not assessed/not applicable (e.g. due to lack of data, non-applicability) |

5082
5083
5084
5085 **Functional Unit: “One fulfilled unit”**

5077 The functional unit for the quantitative assessment needs to be applicable for the
5078 traditional brick-and-mortar commerce as well as for the E-commerce value chain, and
5079 it shall be precise but also general enough to be used for all product categories.
5080 Consequently, “one fulfilled unit” is defined as the functional unit for the assessment.
5081 One fulfilled unit is understood as one product that is shipped to or purchased and
5082 ultimately kept by the consumer. Products returned by consumers, including all
5083 related additional resource usage and emissions, are allocated to the product that is
5084 kept.

5085 In reality, a single item or product is often part of a larger and diverse shopping
5086 basket, thus associated environmental impacts would need to be allocated (e.g. based
5087 on the weight, volume or economic value of an item, number of orders during delivery

5088 time frame) to the single item under consideration (Van Loon *et al.*, 2015). The
5089 determination and justification of appropriate allocation factors is, however, associated
5090 with several methodological constraints and uncertainties (e.g. limiting factors – time,
5091 volume, weight – of a truck load can be diverse and are highly dependent on
5092 individual contexts). Therefore, the assessment is conducted under the assumption
5093 that every product is packed and shipped individually. Each product category is
5094 analysed based on at least one representative product, which then serves as a
5095 reference for values such as mass or volume, where required. Representative products
5096 are determined depending on data availability.

5097

5098 **Data Search Method**

5099 A focused literature review (= data-pull-principle) was conducted in order to support a
5100 determination of both quantitative and qualitative assessment results related to the
5101 identified opportunities and threats as well as certain product categories. Thus, all
5102 data was acquired through a secondary analysis. This method involves the utilisation
5103 of existing data (e.g. by means of extrapolation or conversion), initially collected and
5104 generated for the purposes of other studies, in order to answer above research
5105 questions and thereby support the objective of this study. In addition, a dedicated
5106 data basis for future research was compiled (see Table 12, Table 24, Table 32 and
5107 Table 41).

5108 The secondary analysis was performed by the following steps:

5109 Step 1: Determination of relevant data pools;

5110 Step 2: Capturing of potentially relevant sources;

5111 Step 3: Selection of sources and data points applicable to the respective assessment
5112 sequence (quantitative/qualitative); and

5113 Step 4: Linkage of data points/sources to relevant opportunities/threats and
5114 calculation (of quantitative) results and estimation (of qualitative) results in
5115 terms of proposed indicators.

5116

5117 **Assumptions & Limitations**

5118 In general, it must be differentiated between (i) assumptions and uncertainties
5119 inherent in adopted data points and (ii) assumptions that have been necessary to
5120 utilise existing data. Among the latter category of assumptions, the following were
5121 deemed a prerequisite of quantitative in-depth assessments:

5122 ▪ only the clusters “Logistics & Transport”, “Packaging”, “End-of-Life” were
5123 assessed quantitatively, and the remaining four clusters were selected for a
5124 qualitative assessment;

5125 ▪ focus was on environmental CE aspects and corresponding indicators;

5126 ▪ social and economic aspects were considered in a more general discussion, if
5127 relevant and available in the literature;

5128 ▪ a product-centric perspective was adopted;

5129 ▪ business models were not the focus of this assessment;

5130 ▪ representative products were identified in order to gather data and insights on
5131 certain product categories;

- 5132
5133
- comparisons between product categories were generally not possible due to different underlying assumptions, scope, etc. of data sources;
- 5134
5135
- solely single-consumer purchases were accounted for, i.e. an E-commerce purchase is placed by one individual, not by a group of individuals;
- 5136
5137
- only end-user purchases were assumed, i.e. purchases are not done with the intention to re-sell the purchased product;
- 5138
- only the first life cycle of products was considered;
- 5139
5140
- transport systems and technologies in a single country were assumed similar throughout that country;
- 5141
5142
- the project scope required pragmatic decisions regarding balance of data detail and assumptions.
- 5143 Further assumptions are mentioned in the respective in-depth assessment sections.
- 5144

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5145 **4.3 In-depth Assessment Results**

5146 **4.3.1 Quantities of fulfilled and shipped units and number of packages**

5147 Data on the absolute amount of fulfilled and shipped units as well as their division into
5148 packages is relevant for all quantitative assessments and therefore described here in a
5149 superordinate form. The approach for the determination of these values for 2017,
5150 representing the situation today, and 2030, representing the future situation, is
5151 described below, assumptions and limitations are emphasised. More detailed
5152 background data used for the calculations is provided in the Annex (see Table 55 : in
5153 Annex 2) and referred to in the text.

5154 Table 12 lists the sources used and the type of relevant information they contain for
5155 the calculations of packages shipped per product category, year and country.

5156 **Table 12: List of sources for calculation of total shipped items and number of packages sent**

| Reference | Type of reference (Data pool) | Content |
|---|----------------------------------|--|
| Allen et al. (2017) | Scientific Literature | Shares of shipped packaging size types per product category in UK (letterbox, shoebox, large box) |
| Statista (2019) | Statistics | Sales volume per country and product category (applicable for 3 product categories) |
| Postnord (2018) | Market reports / Grey literature | Shares of citizens who purchased products of the product categories online as well as return rates |
| Own assumptions⁶ | Courier service information | Maximum dimensions for standard package |
| Stakeholder Survey (2019) | Statistics | Numbers of items per package |
| DIN EN 13724, packaging material retailers | Norms and standards | Dimensions and weight-related values for packaging material |

5157

5158 In summary, data from secondary sources from 2017 were combined, so that absolute
5159 sales figures in pieces per product category and country could be derived. It is
5160 assumed that, in the case of generally published sales figures it is referred to the units
5161 sold, which includes returns (Annex 2, Table 55 :). Therefore, in the next calculation
5162 step, the proportional number of items equivalent to the return rates (Annex 2, Table
5163 56) is deducted.

5164 The result corresponds to the number of fulfilled units in the respective category
5165 (Table 13) referred to below. Sales volumes are in the following named as shipped or
5166 shipped units.

5167

⁶ Own assumptions based on data from several shipping companies (e.g. DHL)

5168 **Table 13: Number of fulfilled units per product category and country in 2017**

| Fulfilled units in pieces 2017 | Poland | Sweden (Nordics) | Spain | France | Germany | EU27 |
|-----------------------------------|-------------|------------------|-------------|-------------|-------------|---------------|
| Apparel items | 194,694,120 | 93,506,400 | 380,063,340 | 529,245,360 | 655,240,500 | 6,185,444,832 |
| Small ICT items | 16,657,344 | 7,907,400 | 25,201,260 | 42,929,280 | 48,113,568 | 442,144,857 |
| Major household appliances | 1,038,216 | 555,810 | 1,715,130 | 3,254,496 | 4,216,368 | 32,391,792 |
| Media products | 39,891,384 | 17,010,518 | 70,791,900 | 111,565,050 | 201,425,334 | n.a. |
| Non-perishable food | 30,764,160 | 14,874,048 | 72,676,800 | 94,962,000 | 95,985,120 | n.a. |
| Major furniture | 8,134,888 | 2,781,965 | 10,421,952 | 16,694,000 | 30,411,612 | n.a. |

5169

5170 In terms of the objectives of this study, a few general **limitations** are present. Firstly,
5171 no data could be found for the product category "accessories" regarding sales volume
5172 in fulfilled units or packaging size shares. Secondly, no data could be found for return
5173 rates of non-perishable food. Instead, based on expert opinion it was assumed that
5174 the rate is very low, which is why 2% were used in the calculations. Thirdly, no data
5175 could be found for absolute sold units in Europe for media products, non-perishable
5176 food and major furniture.

5177 Within the scope of the data research, information was found on the ratio of parcel
5178 sizes sent per product category (Allen *et al.*, 2017). Although the data come from the
5179 UK, and therefore not from one of the focus countries, it is assumed that the ratio of
5180 package sizes can be regarded as generally valid. This source distinguishes between
5181 three package sizes: Letterbox, Shoebox and Larger with unspecified dimensions. To
5182 be able to calculate with the parcel types, realistic sizes were determined using the
5183 DIN EN 13724 standard, courier service information and vendor information (compare
5184 Section 4.3.8.2 and Annex 2, Table 58, Table 59). Lastly, typical numbers of items per
5185 package type were taken from the stakeholder survey results. It was then assumed
5186 that letterbox packages always contain one item, while the lower value of the average
5187 range was assigned to the shoe box and the higher value of the average range to the
5188 large box (Annex 2, Table 60). Combined with the category-specific ratio of package
5189 sizes, the absolute number of shipped packages was determined, as presented in
5190 Table 14.

5191 Projections for the baseline scenario of 2030 were extrapolated (linear) based on data
5192 for the expected annual, relative revenue growth per product category from 2019 to
5193 2021 (Annex 2, Table 62 and Table 63).

5194

5195

5196
5197

Table 14: Total number of packages shipped in 2017 per package type, product category and country

| Packages quantity per product category in 2017 | | Poland | Sweden (Nordics) | Spain | France | Germany | EU27 |
|--|-----------------|------------|------------------|-------------|-------------|-------------|---------------|
| Apparel | Letterbox | 11,681,647 | 5,610,384 | 22,803,800 | 31,754,722 | 39,314,430 | 371,126,690 |
| | Shoebox | 22,065,334 | 10,597,392 | 43,073,845 | 59,981,141 | 74,260,590 | 701,017,081 |
| | Larger | 29,204,118 | 14,025,960 | 57,009,501 | 79,386,804 | 98,286,075 | 927,816,725 |
| | Total quantity | 62,951,099 | 30,233,736 | 122,887,147 | 171,122,666 | 211,861,095 | 1,999,960,496 |
| Small ICT | Letterbox | 499,720 | 237,222 | 756,038 | 1,287,878 | 1,443,407 | 13,264,346 |
| | Shoebox | 8,078,812 | 3,835,089 | 12,222,611 | 20,820,701 | 23,335,080 | 214,440,256 |
| | Total | 8,578,532 | 4,072,311 | 12,978,649 | 22,108,579 | 24,778,488 | 227,704,602 |
| Major household appliance | Larger (=total) | 692,144 | 370,540 | 1,143,420 | 2,169,664 | 2,810,912 | 21,594,528 |
| Media and entertain. products | Letterbox | 22,339,175 | 9,525,890 | 39,643,464 | 62,476,428 | 112,798,187 | n.a. |
| | Shoebox | 5,185,880 | 2,211,367 | 9,202,947 | 14,503,457 | 26,185,293 | n.a. |
| | Larger | 3,590,225 | 1,530,947 | 6,371,271 | 10,040,855 | 18,128,280 | n.a. |
| | Total | 31,115,280 | 13,268,204 | 55,217,682 | 87,020,739 | 157,111,761 | - |
| Major furniture | Larger (=total) | 8,134,888 | 2,781,965 | 10,421,952 | 16,694,000 | 30,411,612 | n.a. |

5198
5199

5200 **4.3.2 Cluster: Accessibility of information**

5201 According to the assessment framework proposed in Section 4.2.2, the following
5202 effects arising from E-commerce within the cluster "Accessibility of information" are
5203 identified:

- 5204 ▪ availability of information (opportunity);
- 5205 ▪ big data / meta data (opportunity);
- 5206 ▪ innovation (opportunity);
- 5207 ▪ market access to online aftermarkets (opportunity);
- 5208 ▪ product portfolio (opportunity);
- 5209 ▪ international market access (threat); and
- 5210 ▪ ubiquity (threat).

5211 The following two sections describe which main effects arise from E-commerce today
5212 (4.3.2.1) and which effects may be expected under future scenarios (4.3.2.2). A third
5213 and last section (4.3.2.3) summarises the main findings.

5214 Due to the wide project scope and data availability constraints as well as inherent
5215 limitations, all effects of this cluster are described in a qualitative manner only, stating
5216 trends and expected developments based on available research. Hence, representative
5217 indicators within this cluster depend on the respective opportunity or threat being
5218 qualitatively assessed. An overview of the cluster assessment is given below.

5219 **Table 15: Overview of direct and indirect effects of E-commerce within the cluster "Accessibility**
5220 **of information"**

| Accessibility of information | | |
|--|--|--------------------------------------|
| Relative effects as per today Direct opportunities and threats | Availability of information (opportunity) | |
| | Market access to online aftermarkets (opportunity) | |
| | Product portfolio (opportunity) | |
| Future developments Indirect opportunities and threats | Positive influencing factors | Innovation (opportunity) |
| | | Big data/meta data (opportunity) |
| | Negative influencing factors | International market access (threat) |
| | | Ubiquity (threat) |

5221

5222 **4.3.2.1 Observations of situation today**

5223 The following three direct opportunities have been identified as relevant for today's
5224 situation in this cluster: **Availability of information, Market access to online**
5225 **aftermarkets, and Product portfolio.**

5226 While all three effects can be considered to be contributors to a relatively higher traffic
5227 on the internet today including related increased environmental impacts, a general
5228 statement on overall resulting relative potential environmental impact (or "net
5229 impact") of E-commerce related to brick-and-mortar commerce cannot be made, since
5230 counteracting effects, for instance product/purchase-related effects, would need to be

5231 accounted for, but are difficult to map and quantify. For example, E-commerce sites
5232 often feature much more detailed information about the product than brick-and-
5233 mortar shops typically (can) offer. Also, the concept of dynamically changing user
5234 recommendations (User-Generated Content, UGC) for a particular product provided
5235 right next to the product description cannot be matched by traditional shops, even
5236 not, if an individual customer guidance by expert personnel could be assumed a
5237 standard in brick-and-mortar shops. However, a very well-informed purchase of a
5238 product can also be assumed to lead to fewer product returns and longer product
5239 keeping at users – especially in higher-value product categories – than may be the
5240 case, if the customer is less well-informed before the purchase. This circumstance
5241 would thus contribute to a reduction of environmental impact per fulfilled unit.

5242 The principally wider product portfolio that online stores can present compared to
5243 traditional stores (which have a limited shelf capacity to present portfolios) also
5244 supports a potentially higher customer satisfaction and keeping of the product, since a
5245 wider portfolio provides a higher probability of a customer finding “the right product”,
5246 i.e. another factor that reduces environmental impact per fulfilled unit. The access to
5247 internet-based aftermarkets with spare-parts and resulting potential extensions of
5248 product use stage periods is a similar factor, generally reducing environmental impact
5249 in E-commerce context.

5250

5251 4.3.2.2 Future developments

5252 Projecting future market and technology developments based on recent historic
5253 trends, it can be assumed that all three direct effects will at least maintain their
5254 relevance or even increase it, e.g. if additional types of product information would be
5255 added. Such information could for instance be transparently presented product
5256 assessments provided by independent consumer research institutes.

5257

5258 ▪ **Positive influencing factors**

5259 Indirect effects identified as contributing to an optimistic future scenario (i.e.
5260 opportunities) are **Innovation** and **Big data/meta data**.

5261 “Innovation” can be characterised as a generic, technology-driven phenomenon
5262 particularly relevant in the ICT sector – with obvious consequences on increasing E-
5263 commerce activities. Seen per physical device, innovation can be expected to increase
5264 technological efficiency of the device, e.g. of the employed battery technologies or
5265 energy requirements, which generally contributes to decreased environmental impact.
5266 “Big data” can be considered a result of technological development, allowing meta
5267 data analysis which gives E-commerce providers the opportunity to, for example,
5268 conduct enhanced shopping pattern analyses, develop more effective customer
5269 services, and predict future customer demands. In concert, this can be expected to
5270 lead to lowered environmental impact compared to traditional commerce.

5271

5272 ▪ **Negative influencing factors**

5273 Indirect effects identified as contributing to a pessimistic future scenario (i.e. threats)
5274 are **International market access** and **Ubiquity**. Both effects constitute complex
5275 contexts, where robust predictions of joint consequences are very hard to make – in
5276 general and for some of the product categories. What can be projected is that both
5277 effects can be expected to increase in the future: Global internet access is rising and
5278 so are internet-based market volume, geographical market spread, and market
5279 diversity, leading to increased numbers of individuals having access to E-markets.

5280 Likewise, ubiquity – understood as the omni-presence of internet-based offers – can
5281 only be expected to rise in the future, driven by for instance the increasing number of
5282 internet-capable electronic platforms (notebook, smartphone, tablet, etc.), the
5283 increasing number of devices within those platforms, and the increasing technical
5284 capabilities of the devices and of the networks, transmitting data traffic. For instance,
5285 mobile data traffic volume doubled from 2014 to 2016, and is expected to grow to 10
5286 times the 2014-level by 2021.

5287

5288 4.3.2.3 Summary

5289 Accessibility of information is a central theme when comparing E-commerce and
5290 traditional commerce. Several direct and indirect effects have been identified, but a
5291 summarised “net effect”, valid for certain product categories or across all of them,
5292 cannot be determined, neither for current conditions nor for the foreseeable future.
5293 Better information can be assumed to lead to less product returns and longer keeping
5294 of products at users, contributing to decreasing environmental impact. However, more
5295 devices used globally – driven by shorter innovation cycles on device-level – can be
5296 assumed to lead to increasing environmental impact potentials, globally and on EU-
5297 level.

5298

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5299 **4.3.3 Cluster: Consumer needs and behaviour**

5300 According to the assessment framework proposed in Section 4.2.2, the following
5301 effects arising from E-commerce within the Consumer needs and behaviour cluster are
5302 identified:

- 5303 ▪ sharing models and services (opportunity) ;
- 5304 ▪ nudging (opportunity);
- 5305 ▪ ease of shopping (threat);
- 5306 ▪ personalised design (threat);
- 5307 ▪ cross-selling and up-selling (threat); and
- 5308 ▪ shopping frenzy (threat).

5309 The following two sections describe which main effects arise from E-commerce today
5310 (4.3.3.1) and what effects may be expected under future scenarios (4.3.3.2). The last
5311 section (4.3.3.3) summarises the main findings and puts them into context.

5312 Due to the wide project scope and data availability constraints as well as inherent
5313 limitations, all effects of this cluster are described in a qualitative manner only, stating
5314 trends and expected developments based on available research. Hence, representative
5315 indicators within this cluster depend on the respective opportunity or threat being
5316 qualitatively assessed. An overview of the cluster assessment is given below.

5317 **Table 16: Overview of direct and indirect effects of E-commerce within the cluster "Consumer**
5318 **needs and behaviour"**

| Consumer needs and behaviour | | |
|--|---|---------------------------------------|
| Relative effects as per today Direct opportunities and threats | Sharing models and services (opportunity) | |
| Future developments Indirect opportunities and threats | Positive influencing factors | Nudging (opportunity) |
| | Negative influencing factors | Ease of shopping (threat) |
| | | Personalised design (threat) |
| | | Cross-selling and up-selling (threat) |
| | | Shopping frenzy (threat) |

5319
5320 With regards to the project scope, the following assessment investigates the positive
5321 and negative impact from Consumer needs and behaviour on the Circular Economy.
5322 This is carried out by following a lead question: Does this effect promote eco-
5323 conscious behaviour? (compare Table 17). Consequently, any development that leads
5324 to increased consumption of products and resources is considered a threat, while
5325 decisions that lead to reduced resource consumption are considered opportunities.
5326 Furthermore, it is emphasised, that the data basis for this cluster is extremely thin.
5327 Therefore, the trends highlighted below are derived from indications of partly
5328 individual sources, that are considered plausible, as well as logical conclusions from
5329 expert opinions.

5330 **Table 17: Qualitative indicator for the cluster “Consumer needs and behaviour”.**

| Cluster | Qualitative Indicator(s) | Unit(s) | Comment(s) |
|------------------------------|---|---------|---|
| Consumer needs and behaviour | Promotion of eco-conscious consumer behaviour | - | High or low significance and relevance compared to other effects within the same cluster. |

5331

5332 **4.3.3.1 Observations of situation today**

5333 **Sharing models and services** has been identified as the one direct effect arising
5334 from E-commerce. Compared to conventional systems, the sharing economy can
5335 greatly benefit from flexibility of the digital realm, which allows easy and instant
5336 communication and handling. In the sense of the Circular Economy concept, the
5337 original intention of sharing models and services can be defined as “consumers
5338 granting each other temporary access to underutilised physical assets (“idle
5339 capacity”), possibly for money” (Frenken and Schor, 2017). Sharing systems serve the
5340 consumer’s needs for temporary use of products and thus offer the opportunity to
5341 promote eco-conscious consumer behaviour.

5342 With respect to the product categories in focus for this report, one example is
5343 “Vinted”, a European apparel rental and selling platform (Vinted, 2019) and another
5344 one is “Peerby”, a household item rental platform founded in the Netherlands (Peerby,
5345 2019). However, many platforms that are established in line with above definition and
5346 enable consumer-to-consumer (C2C) lending, often struggle to cover their expenses,
5347 which in the past led to the closing down of a number of platform services (Morrissey,
5348 2015).

5349 A more capitalised form of sharing is found in business-to-consumer (B2C) services.
5350 Those expand the access of consumers to various shared products, otherwise often
5351 underutilised products without the requirement of high investment costs from a
5352 professional perspective. Some rental systems include shifts from “disposable” to
5353 “reusable” for products such as coffee cups (ReCup, 2019), designer clothes or
5354 furniture (Emma Thomasson, 2019).

5355 The largest and established systems include car and house sharing (PWC, 2015).
5356 These successful sharing systems achieved profitability from their services and
5357 mediation by monetising the collaborative consumption (Bosa and Salinas, 2019). As a
5358 result, the overall global revenue from sharing models is expected to rocket from 15
5359 billion U.S. dollars in 2014 to 335 billion U.S. dollars in 2025 (Mazareanu, 2019).

5360

5361 **4.3.3.2 Future developments**

5362 Sharing models can have positive effects for the Circular Economy, but the future
5363 success of sharing systems is highly dependent on the financial sustainability. C2C
5364 services can be expected to stabilise but are likely to remain a niche market,
5365 particularly in the product categories in focus of this project. B2C sharing services on
5366 the other hand can be expected to see further growth and increase in diversity.
5367 However, an eco-conscious consumer behaviour and positive impact for the Circular
5368 Economy is subject to sharing essential but underutilised products. Otherwise the
5369 negative impact from excess consumption would predominate. With respect to the
5370 product categories in focus, it is arguably more applicable for apparel and accessories
5371 and media products than products potentially linked to concerns regarding data
5372 protection (small ICT), physical immobility (furniture or major household appliances)

5373 or one-time use (non-perishable food). In general, the developments in the digitalised
5374 sharing economy are relatively new, therefore the research field is growing and should
5375 continue to be monitored.

5376 In the following, the effects are described that arise from E-commerce and affect
5377 consumer needs and behaviour indirectly.

5378

5379 ▪ **Positive influencing factors**

5380 In the optimistic scenario **Nudging** has been identified as an indirect effect with the
5381 potential for positive impact on the Circular Economy (Demarque *et al.*, 2015). This is
5382 a relatively new topic of interest for marketers in the E-commerce business, building
5383 on research on human behaviour. The most critical factor for its positive impact on the
5384 Circular Economy is the application.

5385 Research focuses on marketing techniques and optimisation of user interfaces to
5386 increase revenue (e.g., Mirsch, Lehrer, & Jung, 2017, Eigenbrod & Janson, 2018,
5387 Djurica & Figl, 2017), in some cases even unethical aspects (Weinmann *et al.*, 2016).
5388 Nudging strategies for improved sustainability and circularity are underrepresented
5389 (Kaiser, 2018). However great potential is confirmed for informational nudging aiming
5390 to reduce environmental impacts (e.g., Isley, Stern, Carmichael, Joseph, & Arent,
5391 2016; Demarque, Charalambides, Hilton, & Waroquier, 2015; Urban, 2017). One
5392 example for nudges practiced in business is the informational nudge with the option to
5393 activating CO₂ compensation for rides with FlixBus (2018). The European intercity
5394 coach service provider reports that ten percent of customers actively choose to
5395 compensate at additional one to three percent of the ticket costs (FlixBus, 2017). This
5396 indicates a significant potential of customers susceptible for additional options and
5397 willing to pay a premium for reduced environmental impact. Default setting of
5398 environmentally friendlier options would be an advanced step in nudging strategies
5399 and could result in an increase of participation from customers of up to approximately
5400 30% (Kaiser, 2018). On the other hand, it can be argued, that the willingness to
5401 invest in environmentally friendly options is very sensitive to price differences of the
5402 products. A survey in Europe and the USA for instance (Miremadi *et al.*, 2012)
5403 revealed that 70% of customers generally are willing to pay 5% more for a premium
5404 product, while less than 10% choose the premium option, if the price difference is at
5405 25%. Another study reported that by 2030, the share of consumers who are generally
5406 willing to pay extra for same-day delivery may increase to 25% (Joerss *et al.*, 2016).
5407 In this context, the attitude-behaviour gap between statements made by customers
5408 and their actual action is a well-known and discussed phenomenon (Kaiser, 2018).

5409 Overall, it can be expected that the implementation of environmental nudges remains
5410 highly dependent on the respective retailer policies and individual sustainability
5411 commitments. Unless incentives or growing public pressure increases the industry's
5412 economic interests in environmental efforts, the impact of environmental nudging in
5413 E-commerce is likely of minor significance but entails great potential for the Circular
5414 Economy. With respect to the product categories in focus, one example for
5415 environmental nudging are financial incentives by local governments in Germany for
5416 consumers who purchase state-of-the-art energy-efficient major household appliances
5417 (SWB, 2019). Future research may provide detailed knowledge from investigating the
5418 effectiveness of environmental nudging for the different product categories.

5419

5420

5421

5422 ■ **Negative influencing factors**

5423 Three indirect effects related to consumer needs and behaviour in E-commerce have
5424 been identified to affect the Circular Economy: Ease of shopping, Personalised design,
5425 Cross- and up-selling as well as Shopping frenzy.

5426 Due to E-commerce, consumers are enabled to shop without any restrictions to time
5427 or geography, subject to internet access. This can serve consumer needs linked to the
5428 desire for immediate action. The **Ease of shopping** may contain a threat for the
5429 Circular Economy if it leads to increasing overall purchases or impulse purchases in
5430 particular. Furthermore, two aspects relate to this effect: Physical access to unlimited
5431 purchasing options and the huge variety of product variations.

5432 On the one hand, the nearly endless product variety online has the theoretical
5433 potential to allow the customer to find the product that is best suitable to his or her
5434 needs. It is expected that this aspect is depending on the individual willingness for
5435 time-intensive research. In successful cases, e.g. if eco-conscious consumers find
5436 more sustainable products than offline, the threat can convert into an opportunity for
5437 the Circular Economy compared to brick-and-mortar.

5438 On the other hand, it is expected that the sheer opportunity of access from E-
5439 commerce is unlikely to result in uncontrolled shopping behaviour of customers, even
5440 though the occurrence of impulse purchases is possible. This expectation is based on
5441 the fact that the consumption would likely be limited by the economic situation of the
5442 individual customer. The available data indicate instead that purchase intentions in E-
5443 commerce are positively related to trust that the consumer has in the e-retailer and
5444 the satisfaction with offered services (Miremadi et al., 2012; Nisar & Prabhakar, 2017;
5445 Zhu, Mou, & Benyoucef, 2019).

5446 In conclusion, it can be assumed that the ease of shopping in E-commerce does not
5447 lead to significantly higher overall consumption but may shift more purchases to E-
5448 commerce. It could be argued that the constant access of E-commerce serves
5449 consumer desire of immediate product access (compare Section 4.3.7). However, any
5450 impulse purchase implies negative impacts for the Circular Economy. The ease of
5451 shopping is further linked to the accessibility of information, which generally supports
5452 eco-conscious consumer behaviour (compare Section 4.3.1).

5453 Optimised customer experiences through interface design is another important aspect
5454 e-retailers focus on (Mirsch et al., 2017). The effect of **Personalised design** is linked
5455 to the effect of nudging (compare Section 4.3.3). It is considered very relevant for
5456 customer satisfaction in E-commerce and chances as well as challenges arising from
5457 E-commerce are being discussed and the importance for the future strongly
5458 emphasised (E-commerce Europe, 2018). If the consumer is connected with the
5459 retailer on various media channels like web-based, e-mail and apps, and potentially
5460 around the clock, this approach is referred to as ubiquitous commerce (Kumar et al.,
5461 2015). The use of artificial intelligence plays a major role here (EcommerceEurope,
5462 2018). Personalised product recommendations, omni-channel experiences, or push
5463 notifications by brands on availability of desired products based on wish-lists or similar
5464 are reported to result in likely conversions from 90% of the (U.S.) customers
5465 (Scalefast, 2019). It can be argued that in cases where a product would not have been
5466 purchased anyways, excess consumption is encouraged and synonymic to negative
5467 impacts from consumer behaviour for the Circular Economy. Moreover, there is a
5468 narrow line between the advantages of utilising from personalised design and
5469 increasing amounts of customers expressing concerns about privacy protection
5470 (Kumar et al., 2015).

5471 Comparing E-commerce and brick-and-mortar, conventional, single channel retail
5472 could not provide this high level of personalisation because of the lack of detailed

5473 customer data. By 2030, it is assumed likely that a large share of retailers operates
5474 omni-channel and capitalises on personalisation features. Consumer expectations may
5475 increase by then, too, leading to SMEs investing in personalised design.

5476 In conclusion, personalised design tends to promote additional purchases and can
5477 therefore negatively affect the Circular Economy by creating artificial consumer needs
5478 and unsustainable consumption behaviour.

5479 Similar to the previously described effects, **Cross-selling and up-selling** is closely
5480 linked to the effect of nudging. Cross-selling and up-selling strategies are based on
5481 nudges to increase sales. This is done by offering product combinations, additional
5482 purchases or premium products for reasons of higher revenue and better transport
5483 efficiency (compare Section 4.3.7). This effect does not aim towards the promotion of
5484 more environmentally friendly products. On the contrary, the practice negatively
5485 affects the Circular Economy, as more products are sold than were originally needed
5486 and/or requested by the customer.

5487 However, in brick-and-mortar stores, too, products are placed strategically next to
5488 related products and banners can be used to advertise bargains and achieve up-
5489 selling. It is therefore assumed that the impact of cross-selling and up-selling is
5490 roughly the same in both E-commerce and brick-and-mortar. On the other hand, the
5491 utilisation of collected customer behaviour data (e.g. through cookies) in E-commerce
5492 could become increasingly efficient in combination with optimised personalised
5493 advertisements (see above, personalised design) and generate additional desires with
5494 customers. This could then stimulate additional purchases and therefore increased
5495 negative impact for the Circular Economy.

5496 The last effect considered is **Shopping frenzy**, which refers to the behaviour of
5497 customers to purchase numerous consumer goods in a very short time. Real life
5498 examples are event days, where a large share of retailers (online as well as offline)
5499 offer various shopping deals, bargains or sales with potentially high discounts. Very
5500 popular examples are Black Friday and Cyber Monday in the U.S. or Single's Day in
5501 China. Additionally, outlet stores, or outlet cities advertise with large discounts
5502 throughout the year.

5503 Historical data on U.S. holiday season (the time between end of November and early
5504 January that includes Black Friday and Christmas shopping) prove significant sales
5505 volumes. Shares of annual sales were converted during this period that ranged from
5506 18% in conventional food and beverages stores to more than 30% for hobby, game
5507 and toys stores. In E-commerce, 22% of annual sales were generated (Manage
5508 Artworks, 2018).

5509 The event of Black Friday and Cyber Monday was introduced in Europe relatively
5510 recently and has since been adopted by a growing number of retailers. The German
5511 Trade Association reported 1.7 billion Euros revenue from the events in 2017. With
5512 participation rates of 13-16%, the acceptance is much lower in Germany
5513 (Handelsverband Deutschland, 2017).

5514 On the other hand, sales from Black Friday were expected to increase by 15% in 2018
5515 (Handelsverband Deutschland (HDE), 2018). Online presence for Black Friday
5516 shopping can be found, too, with countdowns and information about participating
5517 retailers (Black Friday GmbH, 2019).

5518 Amongst other specific thematic offers and sales in Europe are Easter Sales,
5519 Valentine's Day, Mother's or Father's Day as well as summer or winter sales and
5520 special shopping Sundays in Germany.

5521 With respect to the shopping frenzy, guaranteed return rights by strict EU law further
5522 strengthen the consumer position by reducing the risk of misbuys or unappreciated

5523 gifts and thus increasing potential of returns (European Commission, 2019b). In fact,
5524 analytics estimated 30% higher return rates resulting from impulse purchases from
5525 events like Amazon Prime Day (Morris, 2019). In the UK for instance, the returns
5526 generated additional handling costs of 130 million British pounds (Davidson, 2015).

5527 In comparison, around half of the customers preferred multi-channel, while one
5528 quarter of consumers shopped only either online or offline (Sterling, 2018). E-
5529 commerce tends to be preferred by customers for shopping frenzies due to
5530 convenience aspects. At the same time, another trend is the extension of sales days or
5531 pre-event sales aspects (BlackFriday.com, 2019b).

5532 It can be suspected, that the circumstance of strong consumer rights compared with
5533 shopping frenzy days contributes to the intensification of E-commerce and increases
5534 the number of returns in absolute terms linear to the sector's growth rates.
5535 Consequently, in this combination, shopping frenzy has a high relevance and negative
5536 impact for the Circular Economy. On the one hand, additional, not necessarily
5537 required, products are purchased (for the benefit of the bargain) and on the other
5538 hand the increased return rates greatly affect the environmental impact per fulfilled
5539 unit.

5540

5541 4.3.3.3 Summary

5542 In summary, sharing models and services, identified as the only direct effect for
5543 consumer needs and behaviour arising from E-commerce, are considered to support
5544 eco-conscious consumer behaviour and positive impact for the Circular Economy,
5545 subject to sharing essential but underutilised products. For other sharing systems of
5546 non-essential products, the negative impact from excess consumption would
5547 predominate. With respects to the product categories in focus, there are only few
5548 sharing systems applicable and those that exist are expected to remain a niche market
5549 in the future.

5550 Regarding an optimistic scenario for this cluster, environmental nudging is concluded
5551 to contain great potential for the Circular Economy through the promotion of eco-
5552 conscious consumer behaviour. However, the implementation of environmental
5553 nudges is expected to be of minor significance, unless incentives or growing public
5554 pressure increase economic interests in environmental efforts.

5555 Regarding the pessimistic scenario it is concluded, that the ease of shopping can be
5556 seen as a neutral effect, possibly resulting in customers buying online rather than
5557 offline. The tendency for negative impacts from impulse purchases could increase
5558 through the spontaneity of access compared to brick-and-mortar sales. Furthermore,
5559 personalised design was found to promote additional, initially unintended purchases
5560 and consequently unsustainable consumer behaviour, whereas cross-selling and up-
5561 selling was concluded to be similar in E-commerce as for brick-and-mortar. In
5562 combination and optimised, the effects can become very significant. Lastly, shopping
5563 frenzy is the most significant and highly relevant effect with negative impacts on the
5564 Circular Economy. This is due to its promotion of purchasing additional, not necessarily
5565 required, products, and the high return rates that come with it.

5566

5567

5568 **Table 18: Summary of the expected effects of identified opportunities and threats within the**
5569 **cluster "Consumer needs and behaviour"**

| Consumer needs and behaviour | | Determined relevance of effect | |
|--|---|---|--|
| Relative effects as per today Direct opportunities and threats | Sharing models and services | + Positive effects but niche market | |
| Future developments Indirect opportunities and threats | Positive influencing factors Nudging | + Positive effect but minor significance for environmental nudging subject to economic interests | |
| | Negative influencing factors | Ease of shopping | o |
| | | Personalised design | -- -- In combination with cross-selling and up-selling it may be very effective in generating additional desires. |
| | | Cross-selling and up-selling | o |
| | Shopping frenzy | -- | |

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5573 **4.3.4 Cluster: Digitalisation**

5574 According to the assessment framework proposed in Section 4.2.2, the following
5575 effects arising from E-commerce within the "Digitalisation" cluster are identified:

- 5576 ▪ operational energy demand for the network infrastructure (threat);
- 5577 ▪ digital goods (opportunity);
- 5578 ▪ reduction of retail space (opportunity); and
- 5579 ▪ substitution of printed marketing material (opportunity).

5580 The following two sections describe which main effects arise from E-commerce today
5581 (4.3.4.1) and what effects may be expected under future scenarios (4.3.4.2). The last
5582 section (4.3.4.3) summarises the main findings and puts them into context.

5583 Due to the wide project scope, data availability constraints as well as inherent
5584 limitations, all effects of this cluster are described in a qualitative manner, stating
5585 trends and expected developments based on available research.

5586 **Table 19: Overview of the direct and indirect effects of the "Digitalisation" cluster**

| Digitalisation | | |
|--|--|--|
| Relative effects as per today Direct opportunities and threats | Operational energy demand for the network infrastructure | |
| | Digital goods | |
| Future developments Indirect opportunities and threats | Positive influencing factors | Reduction of retail space |
| | | Substitution of printed marketing material |
| | Negative influencing factors | (none) |

5587

5588 The focus of scientific ICT-related assessments is on energy demands and often
5589 strongly correlated global warming potentials (carbon footprints). These two indicators
5590 are also highly relevant for a Circular Economy as energy-efficient and regenerative
5591 systems are considered essential building blocks of a low-carbon society.

5592 Table 20 provides an overview of the representative indicators for the cluster
5593 "Digitalisation".

5594 **Table 20: Representative Indicators for the cluster "Digitalisation"**

| Cluster | Representative Indicator(s) | Unit(s) | Comment(s) |
|-----------------------|--|-----------------------------------|------------|
| Digitalisation | “(Primary) Energy demand and global warming potential” | kWh, CO ₂ -equivalents | - |

5595

5596 **4.3.4.1 Observations of situation today**

5597 The direct effects identified as relevant for today’s situation are **Operational energy**
5598 **demand from the network infrastructure** and **Digital goods**.

5599 An indisputable pre-requisite and characteristic for E-commerce is a network
5600 infrastructure that enables data flow between parties, e.g. between store and
5601 customer or store and supplier. Some of that infrastructure exists irrespective of the
5602 E-commerce context, e.g. certain hardware including some baseline energy demand
5603 used for traditional electronic warehouse keeping and supplier dialogue. It is relevant
5604 to identify the additional **operational energy demand for the network**
5605 **infrastructure** from E-commerce.

5606 Main drivers of such additional energy demand are activities of the customer and of
5607 the store. Via their additional energy demand, these activities have a direct effect on
5608 the environmental impact of the overall type of commerce. Additionally, they occur
5609 across product categories (i.e. not only for selected product categories) but not in all
5610 life cycle stages.

5611 Evidently, it is difficult to attribute electricity consumption to one single E-commerce
5612 application (e.g. browsing and purchasing a product) as there are always many
5613 features running in parallel on a specific ICT hardware, for instance a smartphone.
5614 Furthermore, E-commerce applications are multifunctional, and unambiguous system
5615 boundaries are not present between E-commerce and traditional value chains, e.g.
5616 due to mixed ordering and delivery methods in omni-channels and showrooms.
5617 However, some general remarks can be made. Aslan et al. (2018) show in their study
5618 that an average electricity consumption can be linked to data transmission through the
5619 Internet (kWh/GB transmitted). Comprehensive recent estimates for data traffic on
5620 the world-wide web state around 0.06 kWh electricity consumption per Gigabyte (GB)
5621 traffic in 2015 (ibid.). However, when communicating via global network components,
5622 the electricity intensity of the IP core network and a fixed network access equipment
5623 that is needed for the abovementioned, is only one part in a complex system of data
5624 transmission infrastructures comprised of distinct network access points, data centres,
5625 etc. Depending on the type of the end-user device, either a mobile or fixed network
5626 access point (e.g. LTE and DSL or Wi-fi) is needed. This adds to the energy demands
5627 associated with data transmission. The storage and provision of data further
5628 necessitates the operation of data rooms or centres. Apart from the complex structure
5629 of data transmission networks, actual electricity demands are highly dependent on the
5630 geographical context (e.g. population or subscriber density, geographical distribution)
5631 (Aigner, 2018). Even if that information was known, the actual amount of data that is
5632 required to provide a certain function (e.g. display of goods online and the potential
5633 consumer buying process) is challenging to quantify. This is due not least to hidden
5634 data traffic from user analytics, updates, automatic or default downloads.

5635 In conclusion, an EU average or representative electricity demand for the overall
5636 digital purchasing process per fulfilled unit cannot be reliably quantified under the
5637 scope of this study.

5638 A study from the year 2009 compared the total primary energy associated with Retail
5639 and E-commerce systems by life-cycle stage (Weber *et al.*, 2009b). Albeit its outdated
5640 data base and reference year, the data is deemed applicable to put this threat into
5641 perspective. Here, the additional energy demands arising from E-commerce are
5642 estimated to be 0.28-0.56 kWh (per fulfilled unit) of primary energy use from the
5643 consumer placing the order. Another 0.07 kWh (per fulfilled unit) is related to the
5644 operation of a data centre. The total energy use for the network infrastructure
5645 corresponds to about 6% of the total primary energy demand (per fulfilled unit)
5646 associated with the suggested E-commerce value chain. When comparing the total
5647 energy demand for the network infrastructure to the slightly more energy-intense
5648 traditional retail scenario, it corresponds to only 5% of the total (ibid.).

5649 Today, energy intensities per data volume transmitted are significantly lower,
5650 therefore potentially reducing this share and overall impact. At the same time though,

5651 it can be assumed that data volumes per fulfilled unit have increased due to numerous
5652 effects (e.g. hidden data traffic for analytics, high-definition displays, animated online
5653 content, etc.) (Aslan *et al.*, 2018). Hence, it can be stated that the additional primary
5654 energy demand arising from E-commerce lies probably below 5% of the total primary
5655 energy demand associated with all other life cycle stages in the respective value
5656 chains (e.g. packaging, warehousing, transport, retail store, etc.) and is therefore of
5657 moderate relevance.

5658 This is in line with the findings from a more recent study from 2015 on carbon
5659 emissions from online retailing of fast-moving consumer goods (FMCGs). Under the
5660 assumption that placing an online order takes between 15 and 30 min and accounting
5661 for the electricity consumption of PC's, laptops, smart phones, or tablets as well as the
5662 life cycle impacts of the respective computers, infrastructures and routers, ICT
5663 operations in total are found to have a minor impact (Van Loon *et al.*, 2015).

5664 Arguably, neither primary energy demand, nor electricity demand are the most
5665 suitable Circular Economy indicators. Instead, the share of renewable energy sources
5666 in the respective channels should be factored in as to give an indication about CO₂
5667 emissions or other energy-related environmental impacts. Network infrastructure, run
5668 on renewable energies, offers a great potential to largely offset any additional impacts
5669 due to E-commerce.

5670 In contrast to the universal operational energy or electricity demands associated with
5671 E-commerce, the opportunity of **Digital goods** is currently only applicable to one of
5672 the selected product categories ("media and entertainment products/services").

5673 In the special case of digital goods, the processes associated with one fulfilled unit are
5674 less definite. The equivalent to the physical shipping stage would be data transmission
5675 associated with a certain type of digital content. This process is, in many instances,
5676 already part of the use stage (e.g. streaming of a video). Therefore, the proposed
5677 functional unit would account for digital contents transmitted to the end-user devices
5678 (e.g. smartphones, tablets) but not for the electricity demands and life cycle
5679 implications of those devices.

5680 In general, the opportunity of providing digital goods through E-commerce structures
5681 represents a very important cornerstone of a Circular Economy. Evidently,
5682 virtualisation of goods affects all life cycle stages from raw material extraction until
5683 disposal. However, many of the typical implications of digital goods are referred to life
5684 cycle stages that are outside the scope of this study, and thus are not attributable to
5685 E-commerce but a larger digitalisation trend. With the provision of digital goods not
5686 only the value chain within an E-commerce scenario is streamlined and dematerialised
5687 but the whole traditional value chain may become obsolete. Whether digital goods in
5688 fact substitute their physical counterparts and corresponding value chains depends on
5689 the specific product and cultural aspects associated with it. This circumstance is often
5690 highly speculative, and at least controversial in literature (Börjesson Rivera *et al.*,
5691 2014). Especially e-books provide a good example to emphasise that physical goods
5692 are not simply replaced by their digital version. Printed books are not only still the
5693 more popular format, but the share of printed books and e-books is estimated to be
5694 constant for the near future (Atasoy and Morewedge, 2018). Most importantly,
5695 however, is the circumstance that many of the potential positive effects on a Circular
5696 Economy cannot be attributed to E-commerce alone. Looking at the E-commerce value
5697 chain, the only notably affected life cycle stage is the E-fulfilment process of
5698 purchasing a digital good which is assumed to be congruent with the digital shipping
5699 (data transfer) of certain goods (e.g. purchasing an e-book or streaming a video is
5700 immediately linked to the download of the content). In contrast, comparable physical
5701 goods pass through secondary packaging, distribution from manufacturer, retailer

5702 operations, collection, possible return, unboxing, and disposal in an E-commerce value
5703 chain in case physical products are purchased online.

5704 Under consideration of in-scope life cycle stages, the positive enabling effect of E-
5705 commerce is particularly high for products where impacts due to data transmission of
5706 contents are rather low. This is the case for digital goods comprised of little data
5707 volumes. Here, induced electricity demands remain low (Aslan *et al.*, 2018).
5708 Therefore, products that fall into the segment of e-publishing could be taken as a
5709 point of reference. Within this segment, e-books make up the biggest share of the
5710 market volume in terms of revenue in Europe (Statista, 2019e). An indication of the
5711 importance of books or e-books related to E-commerce lies in the observation that
5712 books are the most frequently assessed product in quantitative assessments in the
5713 available literature on E-commerce effects (Pålsson *et al.*, 2017). Compared to other
5714 e-publishing products (e.g. e-magazines or e-papers), e-books are associated with a
5715 small amount of data (2-3 MB) being transferred through E-commerce platforms to
5716 the user (Moberg *et al.*, 2011; Aigner, 2018). Assuming a correlation between
5717 electricity demands of internet infrastructures (e.g. data centres, transmission and
5718 access networks) and data volumes (Malmodin *et al.*, 2014), the impact of purchasing
5719 an e-book is considered negligible. Essential processes with notable implications for a
5720 Circular Economy (e.g. upstream effects of devices needed to read e-books, electricity
5721 demands for operation of devices) are not solely attributable to E-commerce and
5722 generally not within the area of influence of providers. In some cases it is, however,
5723 observed that E-commerce platform providers expand their area of influence by e.g.
5724 offering dedicated devices to consumers (e.g. Amazon Kindle e-reader devices). On
5725 the other hand, processes needed to provide consumers with physical books in the
5726 traditional value chain scenario may be substantial and versatile.

5727 Due to the very complex and potential systemic implications of digital goods offered
5728 through E-commerce, disentangling of certain impacts and attributing them to generic
5729 value chains is considered impossible under the scope of this study. Also it must be
5730 remembered that the environmental impacts induced by digital goods are
5731 predominantly determined by the use stage, hence allocated to upstream impacts of
5732 devices and electricity for operating end-user devices (Moberg *et al.*, 2011).

5733

5734 4.3.4.2 Future developments (all qualitative)

5735 When delimiting the operational energy demands for the network infrastructure to the
5736 E-fulfilment purchasing process as the most distinct process (compared to the
5737 traditional value chain), it must be remembered that this potentially offsets an
5738 individual consumer trip. Hence, any additional impacts may be weighed against
5739 impacts associated with consumer trip scenarios. However, online purchases often not
5740 necessarily replace but complement a consumer trip (Van Loon *et al.*, 2015).
5741 Therefore, it is worthwhile to look at trends and forecasts associated with respective
5742 ICT use. Energy demand and the associated global warming potentials are the main
5743 focus of current ICT-related assessments. Several indications point to a shift from
5744 overall electricity consumption dominated by (increasingly more energy-efficient) end-
5745 user devices towards an increasing relative significance of networks and data centres
5746 (Prakash *et al.*, 2014; Andrae and Edler, 2015; Cook, 2017; Pärssinen *et al.*, 2018).
5747 Assuming that this trend also holds true for E-commerce applications, it can
5748 reasonably be expected that efficiency gains related to the use of networks and data
5749 centres are overcompensated by increasing data volumes per fulfilled unit.
5750 Consequently, E-commerce providers should embrace strategies towards data
5751 sufficiency and a transition to renewable energy supplies. Moreover, virtualisation and
5752 cloud computing can increase the utilisation of existing hardware and are therefore
5753 expected to further mitigate this threat in the future (Umweltbundesamt, 2018b).

5754 Energy demands associated with the network infrastructures are inextricably linked to
5755 the provision and subsequent use of digital goods. This opportunity, however, entails
5756 immediate as well as long-term systemic implications for the Circular Economy. In any
5757 case, these predominantly positive effects deserve attention in the future as the
5758 European market of e-publishing is expected to grow on average by 7% per year in
5759 terms of turnover over the years 2017 until 2023 (Statista, 2019). The corresponding
5760 average growth rates for video-on-demand and digital music are both around 5%
5761 (Statista, 2019).

5762

5763 ▪ **Positive influencing factors**

5764 The full potential relating to the **reduction of retail space** may unfold if E-commerce
5765 actually replaces existing brick-and-mortar distribution systems. There are indications
5766 that E-commerce value chains could become more environmentally friendly if energy
5767 and resource demands of physical retail stores are offset and taken into account when
5768 estimating the overall performance of E-commerce (Umweltbundesamt, 2018b).
5769 However, these beneficial effects differ from product category to product category. For
5770 instance, physical display space may be less important for media and entertainment
5771 products like books, while for apparel the display space may facilitate trying on clothes
5772 and thus could reduce product returns.

5773 As a general rule it can be stated that the carbon footprint of running an E-commerce
5774 website is significantly lower than its physical counterpart comprising allocated
5775 impacts from Heating Value and Air Conditioning systems and the life cycle of
5776 buildings (CANDRIAM, 2017). This assumption is supported by the circumstance that
5777 energy consumption in stores is usually higher than in warehouses (Fichter, 2001;
5778 Pålsson *et al.*, 2017). In addition, there is a tendency towards fewer, larger and more
5779 energy-efficient warehouses in E-commerce value chains (Pålsson *et al.*, 2017). In the
5780 case of products with low space requirements like books, it was found that the life
5781 cycle energy consumption related to buildings is 5-6% lower in E-commerce value
5782 chains compared to traditional distribution systems (Pålsson *et al.*, 2017). Regarding
5783 the entire life cycles of analysed media products, however, buildings have only a
5784 minor effect on the total energy consumption differences. These were instead found to
5785 predominantly be influenced by packaging, transport, and the amount of unsold
5786 products or product returns (Pålsson *et al.*, 2017). Similarly, for a representative
5787 product from the small information and communication technology product category
5788 (one fulfilled unit of a flash drive) the total primary energy demand associated with
5789 the physical retail store had a minor impact, too (Weber *et al.*, 2009b). Overall, this
5790 factor is considered to be of medium relevance to the Circular Economy.

5791 Comparable to the opportunity of digital goods, traditional processes associated with
5792 paper-based content production may become obsolete due to **substitution of**
5793 **printed marketing material** with digital equivalents. This specific opportunity is
5794 neither well-described in the literature, nor linked to the specific E-commerce
5795 applications, nor compared with traditional marketing means. In comparison with
5796 other effects within this cluster, this opportunity is expected to be of minor importance
5797 per fulfilled unit of any product category. Nevertheless, from a top-down perspective
5798 online advertising is an essential factor regarding the energy demand: On a global
5799 scale it was found that online advertising makes up 25 to 75% of the total data traffic
5800 associated with web, e-mail and data applications, which arguably includes E-
5801 commerce (Pärssinen *et al.*, 2018). Although digitalisation of text-based content is in
5802 most cases beneficial for the environment (Aigner, 2018), the possibilities introduced
5803 by digital marketing (e.g. more quantity, animated content, personalised content and
5804 analytics) have at least a large potential to overcompensate these environmental
5805 gains and must therefore carefully be looked at in the future.

5806 **▪ Negative influencing factors**

5807 *Not applicable, as no indirect threats have been identified within this cluster.*

5808

5809 **4.3.4.3 Summary**

5810 In summary, the effects within this cluster are mainly expressed in energy demands
5811 and/or associated carbon footprints. ICT assessments in the literature focus on these
5812 parameters. On the one hand, energy demands and associated environmental impacts
5813 arising from operations and advertisement in E-commerce due to operations and
5814 advertisement deserve attention. On the other hand, a positive net effect on the
5815 Circular Economy can only be expected when traditional value chain processes (e.g.
5816 physical retail space) are substituted. This holds also true for the specific opportunity
5817 related to digital goods. Under current conditions with multi-channel value chains, the
5818 net effect of mentioned opportunities and threats remains unclear (Dost and Maier,
5819 2018). In the future, several trends (e.g. increasing data traffic, changes in physical
5820 retail stores, further growth of digital goods sector, energy efficiency and renewable
5821 energy sources for network and data centre operations) will affect E-commerce and
5822 traditional value chains jointly.

5823 Table 21 summarises the expected effects of identified opportunities and threats
5824 within the cluster "Digitalisation".

5825 **Table 21: Summary of the expected effects of identified opportunities and threats within the**
5826 **cluster "Digitalisation".**

| Digitalisation | | (Primary) Energy demand (per fulfilled unit) | Global Warming Potential (per fulfilled unit) |
|--|--|--|---|
| Relative effects as per today Direct opportunities and threats | Operational energy demand for the network infrastructure | - | n.a. |
| | Digital goods | o | o |
| Future developments Indirect opportunities and threats | Positive influencing factors | Reduction of retail space | + |
| | | Substitution of printed marketing material | o |
| | Negative influencing factors | - | |

5827

5828

5829 **4.3.5 Cluster: End-of-Life**

5830 According to the assessment framework proposed in Section 4.2.2, the following
5831 effects arising from E-commerce within the End-of-Life cluster are identified:

- 5832 ▪ second-hand E-commerce / online auctioning (opportunity);
- 5833 ▪ extended product selling cycle (opportunity);
- 5834 ▪ product take-back (opportunity);
- 5835 ▪ end-of-Life challenges (threat);
- 5836 ▪ waste from returns (threat); and
- 5837 ▪ food waste (threat).

5838 The following two sections describe which main effects arise from E-commerce today
5839 (Sections 4.3.5.1 and 4.3.5.2) and what effects may be expected under future
5840 scenarios (4.3.5.3). The last section (4.3.5.4) summarises the main findings and puts
5841 them into context.

5842 **Table 22: Overview of the direct and indirect effects of the "End-of-Life" cluster**

| End-of-Life | | |
|--|--|--|
| Relative effects as per today Direct opportunities and threats | Second-hand E-commerce / online auctioning (opportunity) | |
| Future developments Indirect opportunities and threats | Positive influencing factors | Extended product selling cycle (opportunity) |
| | | Product take-back (opportunity) |
| | Negative influencing factors | End-of-Life challenges (threat) |
| | | Waste from returns (threat) |
| | | Food waste (threat) |

5843

5844 The above direct and indirect effects mainly refer to the reuse, remanufacturing,
5845 refurbishing, or recycling of a product at the end of its first life cycle. With regard to
5846 the EPDs of different specific products, exemplary from the product category apparel
5847 (ISKO division, 2018), End-of-Life indicators used are "components for reuse",
5848 "material for recycling" or "energy recovery" and accounted in kg. Another EPD in the
5849 Non-perishable food product category refers to percentages of "recycling", "energy
5850 recovery" and "landfill" (Barilla, 2014).

5851 From a wider Circular Economy perspective, the relative importance of upstream,
5852 production-based impacts generally makes a strong case for reuse. In addition, there
5853 is a ubiquitous trend that energy requirements of many powered products are
5854 decreasing in the use phase and thus shifting the majority of life cycle impacts to the
5855 production phase (Cooper and Gutowski, 2017). This is particularly relevant for
5856 products from the selected categories of small information and communication
5857 technology and major household appliances. Consequently, it is argued that potential
5858 environmental gains from reuse are particularly high for products whose average life
5859 cycle impacts are largely determined by the production stage. This is likely to hold
5860 true for many product categories. Although reuse scenarios in general are understood

5861 to positively contribute to a Circular Economy, environmental benefits are not always
5862 guaranteed (Cooper and Gutowski, 2017). For instance, this may be the case if the
5863 use phase of energetically inferior products is prolonged although newer and more
5864 energy-efficient products would be available (e.g. refrigerators).

5865 Despite aforementioned limitations and uncertainties, it is assumed that reuse rates
5866 are a valid indicator for measuring the positive and negative contributions to a Circular
5867 Economy arising from E-commerce. Moreover, reuse is commonly prioritised over
5868 other End-of-Life options (recycling, recovery, disposal) and should therefore receive
5869 the most attention (European Commission, 2016c; Ellen Macarthur Foundation, 2017).
5870 In contrast to other potential indicators (e.g. recycling rates, repair rates, etc.), reuse
5871 rates can potentially be captured at the point where product ownership is transferred
5872 between customers, often facilitated by E-commerce platforms for other resale
5873 activities. In addition, most EoL pathways cannot be attributed to either one of the
5874 distinct retail channels, thus making a comparative in-depth assessment impossible.
5875 However, a differentiation between reuse, remanufacturing and recycling will be
5876 included to the extent possible, depending on data availability and the specific effect
5877 under consideration.

5878 Due to evident time lags between purchase and potential reuse or alternative EoL
5879 scenarios as well as unclear origins of products, respective rates cannot always be
5880 expressed per fulfilled unit.

5881 Table 23 provides an overview of the representative indicators for the cluster "End-of-
5882 Life".

5883 **Table 23: Representative Indicators for the cluster "End-of-Life"**

| Cluster | Representative Indicator(s) | Unit(s) | Comment(s) |
|-------------|---|-------------|--|
| End-of-Life | "Fraction that is effectively brought into a second or prolonged life cycle and product waste per fulfilled unit" | %, absolute | Reuse, remanufacturing, recycling, landfilling -subject to product category and effect |

5884

5885 **4.3.5.1 Observations of situation today**

5886 The direct effect identified as relevant for today's situation is **Second-hand E-**
5887 **commerce / online auctioning.**

5888 In recent years, there have been noticeable effects on reuse possibilities due to the
5889 increasing proliferation and acceptance of online platforms (Umweltbundesamt, 2017).
5890 According to a survey in Germany, E-commerce platforms are the dominant channel
5891 for purchasing used products (Statista, 2017). Next to established customer-to-
5892 customer (C2C) platforms (e.g. eBay, Shpock), professional intermediaries (e.g.
5893 AmazonWarehouse, reBuy) are entering this segment.

5894 Evidently, marketplaces and channels for resale of used products are versatile and
5895 fragmented. Consequently, data sources and quantitative information relating to
5896 product-specific reuse rates and/or E-commerce specific circumstances are rare and
5897 highly uncertain. Apart from identified data points (see Table 24), most sources do
5898 only reveal qualitative data or survey results with limited validity for a European policy
5899 context.

5900 Taking the position that respective online platforms which facilitate the reuse of
5901 products are attributable to E-commerce, reuse becomes an inherent feature of E-

5902 commerce. Thus, this opportunity is understood as a direct effect arising from E-
5903 commerce. Therefore, a quantitative assessment sequence was deemed appropriate in
5904 line with Step 3 of the assessment framework.

5905 The selection of sources and data points needed for this quantitative assessment
5906 sequence is presented in Table 24.

5907 **Table 24: Overview of sources and data points applicable to the assessment of second-hand E-**
5908 **commerce (opportunity)**

| Reference | Type of reference (Data pool) | Content |
|---------------------------------------|----------------------------------|--|
| Statista (2019e) | Statistics | Industry revenues of online and offline retail sales of second-hand goods in different countries |
| Statista (2019b) | Statistics | Total revenues and future projections in E-commerce in different countries |
| Statista (2019a) | Statistics | Total revenue in traditional retail per country in Europe |
| Statistisches Bundesamt (n.d.) | Statistics | Industry revenues of offline retail sales of second-hand goods in Germany |
| eBay (2016) | Survey | Preferred channel for sale of second-hand goods |

5909

5910 With regards to the weak database, this opportunity may be approached by looking at
5911 the overall industry revenues from online and offline retail sales of second-hand
5912 goods, as presented in Table 25. European aggregates or averages were not found in
5913 identified data sources. Thus, this assessment focuses on the identified relevant
5914 countries.

5915 **Table 25: Industry revenues of online and offline retail sales of second-hand goods in selected**
5916 **countries for the year 2017 in Million EUR** (Statista, 2019g).

| Poland | Sweden | Spain | France | Germany |
|---------------|--------|--------|----------|----------|
| 301.22 | 164.7 | 354.33 | 1,894.33 | 2,881.48 |

5917

5918 4.3.5.2 Findings from quantitative assessment for situation today

5919 No revenue shares of online and offline retail are disclosed or readily available. The
5920 literature or respective statistics does not provide any indications or shares concerning
5921 the respective products or product categories that constitute the overall revenue.
5922 Therefore, further assumptions and approximations were made.

5923 According to the survey by eBay (2016), 89% of the respondents refer to online
5924 channels as their first choice to purchase second-hand goods. In the case of 82% of
5925 the respondents, online platforms are the preferred channel to sell their products
5926 (eBay, 2016). Available data supports these tendencies for the German market of
5927 second-hand goods: Taking 2016 as a reference year, the industry revenue of second-
5928 hand goods in offline channels amounted to 617 Million Euro (Sueddeutsche Zeitung,
5929 2018). Comparing this value to the respective turnover from both channels together
5930 (Statista, 2019d), sales through offline channels correspond to about 22%. For

5931 subsequent calculations and estimates it was therefore assumed that 80% of revenues
5932 were generated by E-commerce (and online platforms in general) and 20% by
5933 traditional retail. Applying this ratio, the following revenues can be attributed to the
5934 respective retail channels (see Table 26). In addition, total revenues in respective
5935 retail channels are given as reference and the relevance of the second-hand market is
5936 calculated as the percentage of total sales in both channels.

5937 **Table 26: Allocated industry revenues of retail sale of second-hand goods through E-commerce**
5938 **and traditional channels in relation to respective total revenues for the year 2017 in Million EUR**
5939 **(own calculations based on Statista (2019b, 2019a)).**

| | Poland | Sweden | Spain | France | Germany |
|--|-----------|----------|-----------|-----------|-----------|
| E-commerce (online) retail: | | | | | |
| Industry revenue of retail sale of second-hand goods through E-commerce | 240.98 | 131.76 | 283.46 | 1,515.46 | 2,305.18 |
| Total revenue in E-commerce (B2C) | 6,889 | 8,729 | 13,986 | 38,109 | 59,111 |
| Percentage of second-hand sales compared to total sales in E-commerce | 3% | 2% | 2% | 4% | 4% |
| Traditional (offline) retail: | | | | | |
| Industry revenue of retail sale of second-hand goods through traditional retail | 60.24 | 32.94 | 70.87 | 378.87 | 576.30 |
| Total revenue in traditional retail (B2C) | 119,376.8 | 78,046.2 | 227,640.7 | 469,185.7 | 560,228.6 |
| Percentage of second-hand sales compared total sales in traditional retail | 0.05% | 0.04% | 0.03% | 0.08% | 0.10% |

5940

5941 Both absolute revenues from second-hand goods as well as noticeable fractions with
5942 respect to total sales in E-commerce range from 2 to 4% in the different countries.
5943 This demonstrates a positive contribution from E-commerce for the Circular Economy.
5944 Arguably, these fractions are expected to be significantly higher if revenues from
5945 second-hand goods were to be compared to the total revenues associated with
5946 products that can potentially be reused. Yet, there was no possibility to gather data
5947 without accounting for foodstuff, personal care products, household products, etc.

5948 Furthermore, the assumed ratio between both channels indicates that the absolute
5949 revenue from second-hand retail is significantly lower in the traditional retail channel.
5950 However, the presented percentages for traditional retail must not be compared to the
5951 percentages in E-commerce. In fact, they only serve as a point of reference for the
5952 traditional retail channel. This is because of the noteworthy deviations in products sold
5953 via the respective channels. For instance, the total turnover in the traditional retail is
5954 dominated by foodstuff, while this category is currently negligible in E-commerce.
5955 Therefore, a majority of products generating the revenue in the traditional retail
5956 channel are not applicable for a potential reuse scenario. This has a weakening effect
5957 on the percentages of second-hand sales in comparison with the total values.

5958 The assessment results and industry revenues cannot be derived per product category
5959 due to a lack of data. However, surveys in Germany, Spain, and France commonly
5960 indicate that the product categories "media and entertainment products and services",
5961 "apparel", and "small information and communication technology" are dominating this
5962 segment in both E-commerce and traditional channels (Statista, 2019i, 2019k, 2019j).
5963 Taking eBay as an example for online second-hand trade with high market share, it
5964 was found that commonly sold products vary significantly between E-commerce and
5965 traditional channels (e.g. reuse centres) (Umweltbundesamt, 2017). While E-
5966 commerce platforms seem to be the primary choice to sell and purchase used
5967 electronic devices in Germany, traditional channels are still more relevant for apparel
5968 and furnishings (Umweltbundesamt, 2017).

5969 Although the relative shares of second-hand sales cannot be compared between the
5970 distinct channels, it is evident that second-hand sales are an outstanding feature of
5971 dedicated E-commerce platforms. Thus, it is argued that the positive effects from this
5972 opportunity are of high relevance for the Circular Economy.

5973

5974 **4.3.5.3 Future developments (all qualitative)**

5975 Due to the incommensurability of traditional and E-commerce channels regarding
5976 second-hand retail revenues and percentages, a future scenario is only proposed for
5977 expected developments in E-commerce. This approach is deemed appropriate to
5978 gauge the importance of second-hand retail in E-commerce.

5979 For the calculation of respective revenues average annual growth rates between 2017
5980 and 2023 (Statista, 2019d, 2019g) have been applied and revenues from Table 26
5981 were extrapolated to the year 2030. The revenue share of second-hand retail
5982 generated by E-commerce was assumed to remain at 80%.

5983 **Table 27: Average annual growth rates and extrapolated revenues in E-commerce for the year**
5984 **2030 in million EUR (own calculations based on Statista (2019b, 2019e)).**

| | Poland | Sweden | Spain | France | Germany |
|--|--------|--------|--------|---------|---------|
| Annual growth rates: | | | | | |
| Annual growth rate (2017-2023) of revenue of retail sale of second-hand goods | 3% | -1% | 5% | -1% | 1% |
| Annual growth rate (2017-2023) of total revenue in E-commerce (B2C) | 12% | 7% | 11% | 8% | 6% |
| Estimated industry revenues in 2030: | | | | | |
| Industry revenue of retail sale of second-hand goods through E-commerce | 344.83 | 123.26 | 564.15 | 1306.90 | 2534.00 |
| Total revenue in E-commerce (B2C) | 30,186 | 20,874 | 56,363 | 100,295 | 130,921 |
| Percentage of second-hand sales compared to total sales in E-commerce | 1.1% | 0.6% | 1.0% | 1.3% | 1.9% |

5985

5986 Considering the market developments in E-commerce it becomes evident that the
5987 whole sector is strongly growing in terms of revenue. In contrast, the revenues from
5988 second-hand sales show lower growth rates and are even expected to decrease in
5989 Sweden and France. Consequently, the percentages of second-hand sales compared to
5990 the overall market volume in E-commerce are expected to be lower in 2030 than what
5991 they were in 2017. This trend may be an indication that beneficial effects on a Circular
5992 Economy (by facilitating reuse) are potentially overcompensated by increased
5993 consumption in the future. Yet it must be remembered that revenue figures do not
5994 allow for conclusions concerning the actual numbers of fulfilled units. This is due to the
5995 fact that new and second-hand goods differ significantly in economic values per unit.
5996 Furthermore, it should be highlighted that growth rates of second-hand resale differ
5997 between product categories. For instance, the global market for refurbished and used
5998 mobile phones is expected to grow by 8.9% per year between 2017 and 2025 (Digital
5999 Day News, 2019). During the period of 2017 to 2023, the global second-hand apparel
6000 market is expected to grow on average by 17% per year (ThredUp Resale Report,
6001 2019). Moreover, several market actors are promoting and experimenting with digital
6002 business models in the second-hand apparel market. German fashion store Zalando
6003 for instance broadened its portfolio recently with its purchase program "Zalando
6004 Wardrobe" (Zalando, 2019a), while thredUP in the U.S. focuses on second hand-only
6005 (thredUP, 2019). In both cases, issues of reliability and transparency concerning peer-
6006 to-peer transactions do not apply anymore. Instead, consumers close a contract with a
6007 business entity whereby customer rights and a guarantee of at least one year apply as
6008 per the law (European Commission, 2019b). Such business models may provide
6009 significant opportunities for the Circular Economy.

6010

6011 **▪ Positive influencing factors**

6012 In comparison to traditional brick-and-mortar distribution channels, E-commerce
6013 channels are expected to avoid environmental impacts and negative effects on a
6014 Circular Economy associated with unsold products due to **extended product selling**
6015 **cycles** (Pålsson *et al.*, 2017). For products whose life cycle impacts are mainly
6016 determined by the production stage, every product that is not brought into a service-
6017 providing use stage has far reaching and significant negative impacts on a Circular
6018 Economy. In the case of some (here unspecified) product categories, the number of
6019 unsold products can be up to 35% of all products in traditional brick-and-mortar
6020 stores (Mangiaracina *et al.*, 2015). Consequently, any environmental impacts
6021 accumulated due to production and distribution to retail stores would need to be
6022 allocated to eventually fulfilled items. An investigation of Borggren, Moberg and
6023 Finnveden (2011) found that 14% of the books in traditional bookstores were not sold,
6024 whereas only 0.5% could not be sold via online bookstores. This circumstance would
6025 result in a 13.5% higher upstream impact for books distributed via traditional supply
6026 chains, ultimately leading to a higher share of product waste per fulfilled unit.
6027 Depending on the magnitude of environmental impacts associated with production
6028 stages for certain products, the number of unsold products can be a decisive factor for
6029 the overall environmental performance (e.g. energy efficiency) of different sales
6030 channels (Pålsson *et al.*, 2017). For instance, the environmental impacts from books
6031 produced and not sold were found to exceed impacts associated with transport for
6032 product returns (Borggren *et al.*, 2011). Given significantly lower shares of unsold
6033 products reported for E-commerce distribution channels, this opportunity is of high
6034 relevance for a Circular Economy which seeks to increase and optimise the utilisation
6035 of single products.

6036 From a strategic Circular Economy perspective, there are **product take-back**
6037 programs for products facilitated by retailers or manufacturers. This is most relevant

6038 for (technical) products which can be repaired, remanufactured or recycled at the end
6039 of their useful life. Currently, this seems especially applicable to valuable products
6040 from the categories "small information and communication technology" and "major
6041 household appliances". In the future this opportunity could certainly be relevant for all
6042 products apart from food products. Whether this approach is environmentally
6043 beneficial must be analysed for each individual case (Umweltbundesamt, 2018b). If
6044 deemed applicable and in favour of the environmental performance, it would require
6045 manufacturers and retailers to fully embrace eco-design approaches and circular
6046 business models. In parallel to largely digitalised and automated distribution and E-
6047 fulfilment processes, reverse logistic processes could be implemented into the existing
6048 E-commerce systems which already facilitate smooth reverse logistics
6049 (Umweltbundesamt, 2018b). In this respect, E-commerce may exhibit substantial
6050 advantages over decentralised and less automated processes in traditional supply
6051 chains. Moreover, E-commerce platform providers usually gather more data about
6052 their customers which could be used to stimulate effective take-back programs. Apart
6053 from take-back programs where manufacturers collect products directly from the
6054 consumers, retailers can play an important role in collecting products from their
6055 customers and give or sell them back to the manufacturers (Kumar and Putnam,
6056 2008). In this case, E-commerce value chains are expected to facilitate product take-
6057 back schemes of a larger scale than traditional channels. Next to likely bigger
6058 geographical reach and efficient logistics processes in place, this circumstance is based
6059 on the assumption that E-commerce consumers are already familiar with returning
6060 goods (The Supply Chain Consulting Group, 2019). In summary, there are reasonable
6061 indications of a positive effect on a Circular Economy arising from this opportunity.
6062 Yet, these indications remain rather speculative and unspecific. Thus, this effect is
6063 considered to be of medium relevance.

6064

6065 **▪ Negative influencing factors**

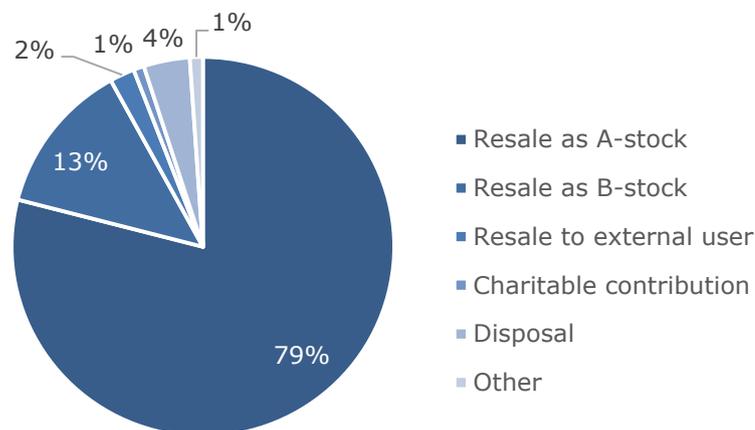
6066 Apart from the manifold opportunities concerning resale through E-commerce
6067 channels, **End-of-Life challenges** may arise. This is due to the circumstance that
6068 disposal opportunities are less prevalent in pure E-commerce markets the lower the
6069 revenue generation is. Yet, those cost-incurring end-of-life treatments (e.g. waste
6070 collection and recycling) still constitute the dominating fate of many products. This is
6071 particularly relevant for products with low economic value which are often found in the
6072 product categories of "apparel", "accessories", and "major furnishings". Also, many
6073 products from the categories "small information and communication technology" as
6074 well as "major household appliances" lose economic value very quickly or exhibit
6075 generally short lifespans.

6076 Due to well-established collection and disposal systems for most of the product
6077 categories considered, the greatest attention should be paid to hazardous wastes,
6078 which are mainly found in electrical appliances. Currently, there are indications that
6079 many E-commerce platforms do not sufficiently adhere to information and take-back
6080 obligations stipulated in the European Waste Electrical and Electronic Equipment
6081 Directive (WEEE Directive) (DVZ, 2018). It was furthermore found that certain E-
6082 commerce operators hamper the return of waste electrical equipment through
6083 strategies like hiding information, high demands on packaging for returns and
6084 complicated customer service (DVZ, 2018). On the contrary, stationary retailers are
6085 fulfilling their obligations by offering and financing well-functioning reverse logistic
6086 systems (DVZ, 2018). Despite these indications and potential differences between E-
6087 commerce and traditional channels concerning the treatment of waste products, a
6088 conclusive assessment cannot be provided. While potential negative effects on a

6089 Circular Economy may occur, they are not attributable to either one of the distinctive
6090 value chains nor can they be expressed per fulfilled unit.

6091 Environmental impacts and negative effects on a Circular Economy depend on the
6092 product-specific return rates (see Section 4.3.1). Additionally, there is concern related
6093 to product returns in E-commerce. Substantial damages to the products due to
6094 handling during E-fulfilment or shipping can ultimately lead to **waste from returns**
6095 caused by E-commerce. Even more alarming are indications that E-commerce actors
6096 are suspected to systematically destroy functioning products upon return from
6097 customers. This suspicion is based on the circumstance that costs for processes
6098 associated with returns (e.g. checking, storing, repacking) may exceed the profit
6099 margin achievable from the product's resale in some cases. Such practices and their
6100 potential negative effects on a Circular Economy cannot reliably be quantified nor
6101 conclusively evaluated (Postpischil and Jacob, 2019). An exemplary ratio of destroyed
6102 products after return of 0.5% of all received items is disclosed by the German retailer
6103 Zalando (WirtschaftsWoche, 2018). Zalando, however, claims to only destroy products
6104 in exceptional cases, e.g. due to contamination. Given the platform's product portfolio
6105 this ratio applies to the product categories "accessories" and "apparel". From the
6106 perspective of overall reprocessing options for returned products in the German E-
6107 commerce market, disposal makes up for approximately 4% (see Figure 12).
6108 Extrapolating this number for the German market in 2019, 7 million items (approx.
6109 2.3 million textile articles and 750,000 electronic goods) are expected to be disposed
6110 of upon return from customers (Gsell, 2019). Another interesting observation is that
6111 the disposal rate depends on the company size. Large companies seem to achieve
6112 significantly lower disposal rates (2.7%) for returned goods than medium (6.5%) and
6113 small companies (14.7%) (Asdecker, 2019). Other reprocessing options and
6114 percentages are shown in Figure 12.

6115



6116

6117 **Figure 12. Reprocessing options for returned products in Germany** (Asdecker, 2019).

6118

6119 The treatment and potential destruction of returned products is not an exclusive
6120 problem in E-commerce value chains. Therefore, a comparison with traditional
6121 channels is challenging. Due to more fragmented and decentralised structures in the
6122 traditional brick-and-mortar distribution channels, data on wasted products from
6123 returns are not available. However, the theoretical risk for disposal of products is
6124 significantly higher in E-commerce due to the higher return rates (Postpischil and

6125 Jacob, 2019). This potential is further amplified when factoring in steady growth of
6126 market volumes in E-commerce. Consequently, this threat is assumed to be more
6127 relevant for E-commerce value chains with a potential for negative impacts on the
6128 fraction of untimely product waste per fulfilled unit. Thus, this threat is of medium
6129 relevance to a Circular Economy.

6130 Based on the selection of relevant product categories, **food waste** may only be
6131 relevant for non-perishable food in this assessment. On the one hand, food waste
6132 could be generated due to damage during delivery or resulting from grocery products
6133 returns by customers. However, such data is unavailable, and it remains unclear to
6134 what extent E-commerce of groceries contributes to or mitigates food wastage.

6135 On the other hand, experimental research indicates that food waste is more likely if
6136 products (e.g. non-perishable crackers) were bought online rather than offline (Ilyuk,
6137 2018a). This assumption is based on experiments which have shown that online
6138 purchases are associated with lower perceptions of purchase effort and thereby reduce
6139 experiences of psychological ownership. This could increase consumers' intentions of
6140 eventually discarding those groceries (Ilyuk, 2018b). Arguably, this threat is highly
6141 speculative and clearly outside the area of influence of E-commerce platform
6142 providers. Therefore, the potential negative effects to a Circular Economy are of
6143 medium relevance.

6144

6145 4.3.5.4 Summary

6146 There is clear evidence that E-commerce facilitates the reuse of certain goods and
6147 therefore potentially positively affects a Circular Economy. From a broader
6148 sustainability perspective the trading of used goods is considered mostly positive
6149 (Clausen *et al.*, 2010). For instance, the Schibsted Media Group as a provider of ten
6150 online marketplace platforms like Leboncoin (France), Vibbo (Spain), Blocket
6151 (Sweden), estimated the overall savings from secondhand products at 21.5 million
6152 tons CO₂ equivalents (Schibsted, 2019). Nevertheless, it remains unclear whether
6153 there has only been a shift from traditional channels to E-commerce channels in
6154 second-hand trade.

6155 Moreover, a positive net effect on environmental impacts depends on an actual and
6156 beneficial substitution of new products through reuse (Cooper and Gutowski, 2017). It
6157 can even be argued that the net effect may be negative due to overconsumption
6158 through purchasing unnecessary items. Reasons are low prices and abundant
6159 possibilities (Parguela *et al.*, 2016). Additionally, rebound effects are potentially
6160 caused by savings from second-hand purchases (Parguela *et al.*, 2016). In conclusion,
6161 future trends indicate that positive effects from reuse may be overcompensated by a
6162 disproportional increase in consumption.

6163 Whether E-commerce induces additional or more severe challenges at the end-of-life
6164 stage of products cannot reliably be documented. Current research usually does not
6165 separate product waste stemming from unsold products or returns from unsatisfied
6166 customers (Pålsson *et al.*, 2017). Nevertheless, there are indications that E-commerce
6167 value chains could potentially generate more product waste due to higher return rates
6168 than traditional channels. Yet, potential negative effects from highlighted end-of-life
6169 issues or wasted products from returns in E-commerce channels have to be weighed
6170 against impacts associated with unsold products. Those are considered a
6171 predominantly bigger concern in traditional supply chains. It is argued that a
6172 hypothetical switch to a digital market could reduce manufacturing waste and reduce
6173 overproduction in the future, ultimately leading to fewer unsold products (Pålsson *et al.*,
6174 2017). Lastly, it is assumed that E-commerce channels and structures facilitate

6175 more effective and efficient tack-back schemes for products, hence allowing for an
6176 individual producer responsibility.

6177 Table 28 summarises the expected effects of identified opportunities and threats
6178 within the cluster "End-of-life".

6179 **Table 28: Summary of the expected effects of identified opportunities and threats within the**
6180 **cluster "End-of-life".**

| End-of-Life | | Fraction that is effectively brought into a second or prolonged life cycle (per fulfilled unit) | Product waste (per fulfilled unit) |
|--|--|---|------------------------------------|
| Relative effects as per today Direct opportunities and threats | Second-hand E-commerce / online auctioning | ++ | n.a. |
| | Future developments Indirect opportunities and threats | Positive influencing factors | Extended product selling cycle |
| Product take-back | | | + |
| Negative influencing factors | | End-of-Life challenges | o |
| | | Waste from returns | n.a. |
| | | Food waste | n.a. |

6181

6182

6183

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6184 **4.3.6 Cluster: Legal framework**

6185 According to the assessment framework proposed in section 4.2.2, the following
6186 effects arising from E-commerce within the cluster "Legal framework" are identified -
6187 all four effects are threats for the Circular Economy:

- 6188 ▪ difficulty to monitor (threat);
- 6189 ▪ enforcement (threat);
- 6190 ▪ EPR – Free-Rider Effect (threat); and
- 6191 ▪ lack of compliance with common market regulations (threat).

6192 The following two sections describe which main effects arise from E-commerce today
6193 (4.3.6.1) and which effects may be expected under future scenarios (4.3.6.2). A third
6194 and last section (4.3.6.3) summarises the main findings.

6195 Due to the wide project scope and data availability constraints as well as inherent
6196 limitations, all effects of this cluster are described in a qualitative manner only, stating
6197 trends and expected developments based on available research. Hence, representative
6198 indicators within this cluster depend on the respective threat being qualitatively
6199 assessed. An overview of the cluster assessment is given below.

6200 **Table 29: Overview of direct and indirect effects of E-commerce within the cluster Legal**
6201 **Framework**

| Legal Framework | | |
|--|---|-------------------------|
| Relative effects as per today Direct opportunities and threats | Lack of compliance with common market regulations | |
| Future developments Indirect opportunities and threats | Positive influencing factors | (none) |
| | Negative influencing factors | Difficulty to monitor |
| | | Enforcement |
| | | EPR - Free-Rider Effect |

6202

6203 **4.3.6.1 Observations of situation today**

6204 The only direct effect in this cluster – and thus only effect relevant for today's
6205 situation – is "Lack of compliance with common market regulations". One example for
6206 this is REACH regulation, to which products placed on the internal market may not
6207 comply due to their contents of regulated chemicals but for which at the same time
6208 the situation may be diffuse concerning responsibility for the placement on the EU
6209 market. This is especially valid in E-commerce, where a particularly large number of
6210 economic operators may be involved, which may be located both inside and outside
6211 the EU.

6212

6213

6214

6215 4.3.6.2 Future developments (all qualitative)

6216 Projecting future market and technology developments based on recent historic
6217 trends, it can be assumed that the identified direct effect will stay relevant or even
6218 become more relevant. For instance, an expectable increasing number of economic
6219 operators selling products within or exporting products to the EU internal market, can
6220 be assumed to lead to a corresponding increase in non-compliance cases. With REACH
6221 regulation as one example, an increasing relevance can be assumed for all seven
6222 selected product categories. Within the potentially increasing number of non-
6223 compliance cases, the share of detected and enforced cases may increase, stay at the
6224 current share or decrease. The effect cannot be allocated to one main player or
6225 economic operator which could be said to have main responsibility for it or main
6226 influence to mitigate it.

6227

6228 ▪ **Positive influencing factors**

6229 *No optimistic scenario is applicable, as no indirect opportunities have been identified*
6230 *within this cluster.*

6231

6232 ▪ **Positive influencing factors**

6233 Indirect effects identified as contributing to a pessimistic future scenario are "Difficulty
6234 to monitor" non-/compliance, "Enforcement" of non-/compliance, and "EPR – Free-
6235 rider effect". The three effects can be seen as mutually amplifying: Difficulties in
6236 monitoring non-/compliance entail generic difficulties in enforcing compliance
6237 requirements (what is not known, cannot be assessed in terms of its compliance, and
6238 thus nor be enforced) and enforcement in non-EU countries can be difficult, creating a
6239 situation which entails higher potentials for free-riding (deliberate or undeliberate),
6240 and a resulting increased number of cases, in turn, makes monitoring more difficult.

6241

6242 4.3.6.3 Summary

6243 The legal framework around an economic system is core for such a system's
6244 functioning as it regulates the way economic operators (or: "players") interact within
6245 the system. This requires, however, that involved players and their modes of
6246 interaction are known. Both is not necessarily fully transparent in traditional economy
6247 due to, for instance, complex global supply chains. And E-commerce as practiced
6248 today seems not to improve such transparency – although it in principle could do so –
6249 due to several constraints, e.g. that an economic operator on the internet can exist for
6250 only a very short time with a web shop and that products for potential testing cannot
6251 be bought by an anonymous person (e.g. a governmental agent not presenting their
6252 name), which is possible in traditional commerce.

6253 No direct or indirect opportunities have been identified during the research, and no
6254 data on effects-damping factors has been identified either. Such data could have been
6255 a clearly rising critical end-user awareness towards origins of a product, or substantial
6256 spreading of Blockchain-like technologies that would allow full traceability of products
6257 and money flows.

6258 Overall it is therefore considered more likely, that E-commerce would lead to more
6259 challenges for the legal framework than the current traditional commerce does,
6260 resulting in rising environmental impact potentials.

6261

6263

6264 **4.3.7 Cluster: Logistics and transport**

6265 According to the assessment framework proposed in Section 4.2.20 the following
6266 effects arising from E-commerce within the "Logistics and transport" cluster are
6267 identified:

- 6268 ▪ substitution of individual shopping trips (opportunity);
- 6269 ▪ induced parcel transport (threat);
- 6270 ▪ parcel return (threat);
- 6271 ▪ in-House Fulfilment (opportunity);
- 6272 ▪ optimisation of supply chain (opportunity);
- 6273 ▪ collaboration between companies and partnering with waste management
6274 suppliers (opportunity);
- 6275 ▪ induced freight traffic to remote locations (threat);
- 6276 ▪ damage on delivery (threat);
- 6277 ▪ inefficient transport (threat);
- 6278 ▪ individual product delivery (threat); and
- 6279 ▪ inferior types of transportation (threat).

6280 The following three sections describe which direct and indirect effects arise from E-
6281 commerce today (see Section 4.3.7.1), summarize findings, and display what effects
6282 may be expected under future scenarios (see Section 4.3.7.2). The last section
6283 (Section 4.3.7.3) summarises the main findings and puts them into context.

6284 **Table 30: Overview of the direct and indirect effects of the logistics and transport cluster**

| Logistics and transport | | |
|--|---|--|
| Relative effects as per today Direct opportunities and threats | Substitution of individual shopping trips | |
| | Induced parcel transport | |
| | Parcel return | |
| Future developments Indirect opportunities and threats | Positive influencing factors | In-House Fulfilment |
| | | Optimisation of supply chain |
| | | Collaboration between companies and partnering with waste management suppliers |
| | Negative influencing factors | Induced freight traffic to remote locations |
| | | Damage on delivery |
| | | Inefficient transport |
| | | Individual product delivery |
| | | Inferior types of transportation |

6285

6286 All three direct effects mainly refer to resource efficiency from a Circular Economy
6287 perspective. “Logistics and transport” is an often-mentioned topic in the public
6288 discourse about environmental impact of E-commerce. The additional driven distance
6289 by the delivery vans as well as the return rate of some products indicate an additional
6290 environmental burden. This discourse will be even stronger in the next decade as an
6291 increasing number of packages in shorter time will be shipped (BIEK, 2018; Statista,
6292 2018b; BMVdI, 2019). To assess the current status, the following indicators were
6293 identified which allow to compare the impact on the last mile, the substitution of
6294 shopping trips as well as parcel return (Table 31).

6295 **Table 31: Indicator for the logistics and transport cluster**

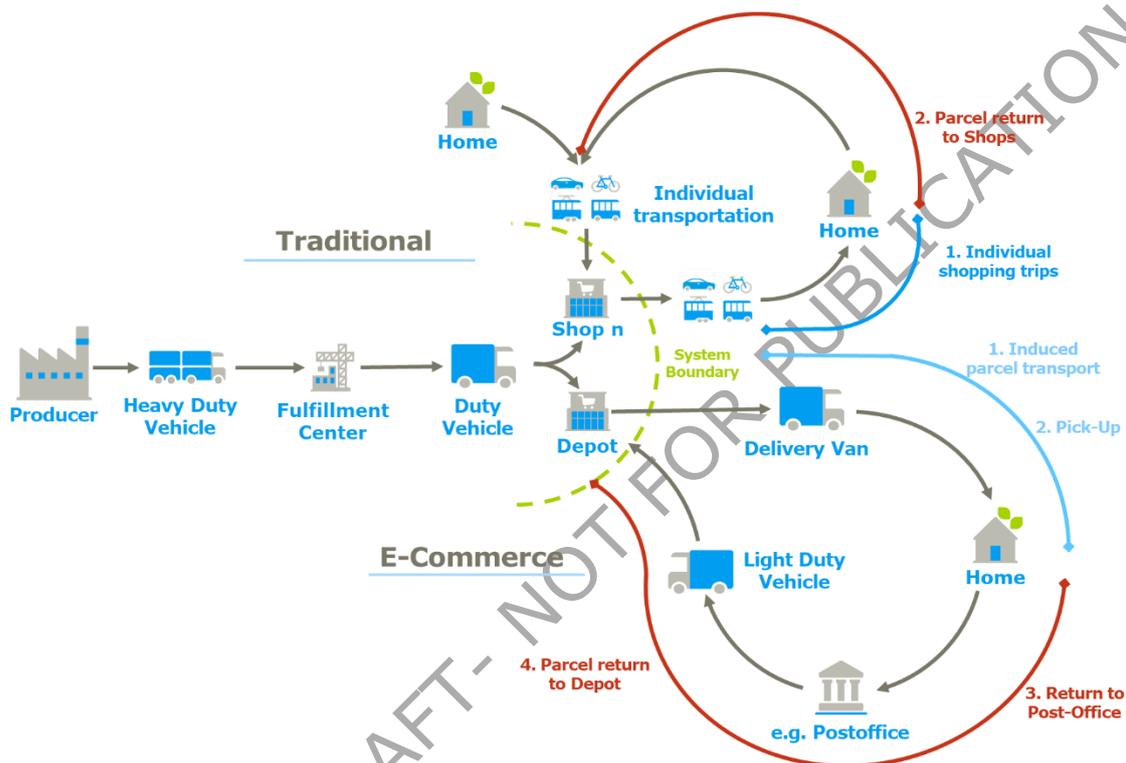
| Cluster | Representative Indicator | Unit(s) | Comment(s) |
|--------------------------------|---|--|--|
| Logistics and Transport | “Transport requirements per fulfilled unit” | km/fulfilled unit & CO _{2e} /fulfilled unit | Use of representative products for each product category |

6296
6297 The first indicator (unit: km per fulfilled unit) represents the distance covered due to
6298 the induced parcel transport or shopping trip. The second indicator reflects the
6299 “Environmental impact” by using the impact category global warming (unit: CO_{2e} per
6300 fulfilled unit, i.e. Carbon Dioxide equivalents). One fulfilled unit is defined as one
6301 product that is shipped to or purchased and ultimately kept by the customer. Products
6302 returned by customers, including all related additional resource usage and emissions,
6303 are allocated to the product that is kept.

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6304 4.3.7.1 Observations of situation today

6305 To evaluate the direct effect in the transport and logistics sector, the following scope
6306 was chosen (see Figure 13). This figure shows that in the traditional retail sector the
6307 transport from the home to the different shops (n) by various means of transportation
6308 is considered as well as the way back home. For the E-commerce calculation, the
6309 "Last-mile" delivery from the last depot to the customer is taken into consideration.
6310 Both traditional and E-commerce are also differentiated into urban and rural scenarios
6311 to reflect the diverse transport distances and customer behaviours in the selected
6312 countries.



6313

6314 **Figure 13: Schematic representation of the scope of the assessment of the two retail sectors. The**
6315 **numbers indicate the different steps which are calculated individually for urban and rural areas**

6316

6317 Along the assessment of the two different scenarios some assumptions were made
6318 and due to some data constraints, some limitation needs to be considered as well.
6319 Most of the data used is available in Germany, England and Sweden (see Table 32).
6320 The applicability of these data points to the other selected countries might be limited,
6321 though. In general, limited data was available, and it needs country- or even product-
6322 specific studies to get specific insight to the supply chain. Also, only delivery to home
6323 and to a Pick-Up Station were considered although several other options exist. There
6324 are different means of transportation with individual emission factors in the respective
6325 countries, but average factors were chosen in this study. Additionally, choosing one
6326 fulfilled unit as the functional unit has its limitations as it makes no distinction
6327 between the types of consumer item, the weight or volume of the product (Van Loon
6328 *et al.*, 2015).

6329 **Table 32: Overview of sources and data points applicable to the assessment of logistics and**
6330 **transport cluster**

| Reference | Type of reference (Data pool) | Content |
|---|----------------------------------|--|
| Biek (2017) | Report | Sustainability Report of urban courier express parcel service in three German cities, Methodological approach |
| Statista (2019) | Statistics | Sales volume per country and product category (applicable for 3 product categories) |
| Postnord (2018) | Market reports / Grey literature | <ul style="list-style-type: none"> ▪ Shares of citizens who purchased products of the product categories online ▪ Return rates |
| Biek (2019) | Report | Current situation and development of the transport market |
| Statista (2018) | Report | Shares of engine types (Battery Electric Vehicle (BEV), Intern Combustion Engine (ICE)) of the Light-Duty vehicles (LDVs) |
| Smidfelt, Rosqvist and Hiselius (2016) | Scientific Paper | Share of means of transportation for the Pick-Up of packages |
| BBSR (2019) | Report | Customer behaviour in urban and rural areas for several product categories |
| Knörr et al., (2016) | Report | Transport-related emission factors |

6331

6332 **4.3.7.2 Findings from quantitative assessment for situation today**

6333 **Induced parcel transport** on the last mile through E-commerce is an often-
6334 discussed effect, which is only applicable to physical goods. This effect can be clearly
6335 seen, as the European parcel market has grown since 2012 between 8 and 14 % until
6336 2018, driven largely by the growth of the E-commerce market (Statista, 2019I) and is
6337 mainly due to the B2C market (Mohr, 2017).

6338 The delivery opportunities of purchased goods are getting more diverse due to the
6339 growth of the E-commerce market: instead of picking them up at a physical store, the
6340 goods can be delivered directly to the consumer, to the neighbour, to a parcel shop, to
6341 the working address or to an automatic parcel station. It is therefore of high
6342 importance to understand the general environmental impact. Looking in general at the
6343 delivery of the goods ordered online, today they are mainly delivered by light-duty
6344 vehicles (LDVs) with a transport capacity between 2.8 t and 7.5 t (BIEK, 2017).
6345 Germany is by far the largest E-commerce market in Europe and within the selected
6346 five countries (Statista, 2018b). However, the markets in the five selected countries
6347 show different peculiarities. For example, the number of people buying online varies
6348 significantly and the behaviour between urban and rural areas as well. This leads to
6349 different shares of potential customers and thus to different average transport
6350 distances. In Poland, only 33 % of the population is buying online, whereas Sweden
6351 has the highest rate of 67 % (see Annex, Table 63). In order to determine the
6352 transport performance and the related CO_{2e} emissions, the most important parameters

6353 are the fulfilled units in the countries, as well as the share between urban and rural
6354 areas. Those figures are presented in Table 33 and give an indication where the
6355 highest transport demand can be expected. The indicator delivered packages per
6356 capita shows that the lowest package per capita ratio can be expected in rural areas of
6357 Poland whereas urban region delivery in Germany has the highest with 7.9.

6358 **Table 33: Fulfilled units and delivered packages in urban and rural areas for the selected**
6359 **countries and product categories**

| Country | Fulfilled Units | | | Delivered packages | | | Delivered packages | | |
|------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-------------------------|-------------------------|-------------------------|
| | Total [mio. pieces] | Urban [mio. pieces] | Rural [mio. pieces] | Total [mio. pieces] | Urban [mio. pieces] | Rural [mio. pieces] | Total [pieces / capita] | Urban [pieces / capita] | Rural [pieces / capita] |
| Poland | 292 | 191 | 101 | 139 | 91 | 48 | 3.7 | 3.9 | 3.2 |
| Sweden (Nordics) | 137 | 121 | 15 | 72 | 64 | 8 | 7.1 | 7.3 | 5.8 |
| Spain | 561 | 467 | 94 | 273 | 227 | 46 | 5.9 | 6.1 | 5.0 |
| France | 797 | 661 | 136 | 406 | 337 | 69 | 6.3 | 6.5 | 5.3 |
| Germany | 1,031 | 816 | 215 | 623 | 493 | 130 | 7.5 | 7.9 | 6.5 |

6360

6361 For the actual calculation of the transport distances, more parameters must be
6362 considered in order to get a reasonably conclusive statement. Therefore, the number
6363 of packages delivered per tour in the three identified LDVs, the first delivery ratio, the
6364 effective distance, the actual distance and the distance to the Pick-Up Station must be
6365 also included. The effective average distance describes the distance from the first to
6366 the last delivery stop while the actual average distance also covers the distance
6367 from/to the depot. Distance to Pick-Up shows the average distance (Round-trip) to a
6368 Pick-up station. Table 34 shows the average figures, and more detailed numbers can
6369 be found in the Annex (Table 64).

6370 **Table 34: Parameters to calculate the impact of Induced parcel transport** (BIEK, 2017)

| Area | Number of packages per Delivery Van (Average) | First Delivery Ratio (Average) | Effective average distance per tour [km] | Actual average distance per tour [km] | Distance to Pick-Up [km] |
|-------|---|--------------------------------|--|---------------------------------------|--------------------------|
| Urban | 157 | 94 | 19 | 53 | 5.0 |
| Rural | | | 39 | 94 | 20.0 |

6371

6372 **Parcel returns** are one of the more obvious and well-known challenges of E-
6373 commerce and are considered here as a direct effect as they add additional pressure
6374 to the transport sector. The return of parcels can have different reasons, especially for
6375 'apparel', returns often seem to be accepted as inevitable or even firmly integrated
6376 into the business model. There are basically two different reasons for returning
6377 parcels: (1) The purchased product is defective, or (2) the purchased product does not

6378 meet the buyer's expectations. It is important to determine the return rate per
6379 product category as it effects the transport demand and thus both indicators (km/unit
6380 and CO_{2e}/unit). The return rate for apparel varies between 13 % and 28 % in the
6381 selected countries for the online purchased goods (Mohr, 2017). In the brick-and-
6382 mortar context, a return rate of 8 percent can be expected (Inwesp, 2019). The
6383 impact of this direct effect is included in the "induced parcel transport" effect as well
6384 as in the "substitution of individual shopping trips" effect, as shown in Figure 13.

6385 **Results for the direct effects (Induced parcel transport and returns) of today**

6386 Based on the limited data, following results (Figure 14) could be derived. It can be
6387 clearly seen that Germany has the highest transport demand per fulfilled unit in the
6388 urban as well as rural area (0.9 km and 3.3 km, respectively). Looking more into the
6389 different steps along the process, the first step of the induced parcel transport and the
6390 pick-up distance only vary slightly. However, the return of the parcel indicates a
6391 considerable difference. The main factor is the return rate, which varies substantially
6392 between the countries, in addition to the varying consumer behaviour. Overall, the
6393 transport demand per fulfilled unit differs on average roughly by a factor three
6394 between urban and rural areas. These results can only be an indication, as more
6395 country-specific data may lead to other conclusions.



6396

6397 **Figure 14: Results for the induced parcel transport and Carbon Dioxide Intensity per fulfilled unit**
6398 **(fu)**

6399 In terms of carbon intensity per fulfilled unit a similar pattern across the countries can
6400 be observed. However, the induced parcel transport plays a more crucial role for the
6401 overall results. It is responsible for up to 80 % of carbon intensity in the urban areas
6402 and up to 70 % in the rural areas. The carbon intensity of the means of transportation
6403 is crucial for this calculation and the differences between the urban and rural
6404 transportation patterns can be clearly seen (data can be found in Annex 2, Table 65
6405 and Table 66). Comparing the urban and rural scenario, the pick-up of parcels is more
6406 carbon dioxide intense in rural areas due to the higher share of transportation by car.
6407 In Germany for example the whole induced parcel transport including return might
6408 emit between 120 g CO_{2e} and 260 g CO_{2e}, whereas it in Poland with the lowest return

6409 rates has the smallest impact. Overall, the carbon intensity between urban and rural
6410 areas varies in general by a factor 2.5.

6411 **Substitution of individual shopping trips** means that due to E-commerce a
6412 physical journey to a shop is called off. To understand the importance, first the actual
6413 impact of the shopping trips must be determined. However, no study was found which
6414 indicates comprehensively the impact of individual shopping trips. To identify the
6415 annual shopping trips per selected country, the number of fulfilled units based on
6416 annual sales subtracted the returns have been identified (see Table 35) for the urban
6417 and rural areas. The return rate in general is smaller in traditional commerce
6418 compared to E-commerce (Inwesp, 2019). The number of trips was determined by
6419 using three different basket sizes per product category (e.g. 1, 3 or 5 apparel items
6420 bought per trip) and how likely those sizes are. By this, the total numbers of trips and
6421 per-capita trips have been identified. A recent study shows that 0.6 shopping trips per
6422 person and day can be expected for shopping. This would result in about 220 trips per
6423 year, which seems quite high (Smidfelt Rosqvist and Hiselius, 2016). In this study the
6424 selected products represent 30 % of the total market volume of the products which
6425 indicates a slightly higher number (e.g. 46.7 trips in Sweden compared to 60 trips
6426 based on the economic value). It can be seen, that due to the limited distances in
6427 urban areas more trips are made in comparison to rural areas where more combined
6428 trips (30 %) can be expected in order to lower the time effort.

6429 **Table 35: Fulfilled units, number of trips and per-capita trips for the selected product categories**
6430 **per year**

| Country | Fulfilled Units | | | Number of trips | | | Trips per capita | | |
|------------------|---------------------|---------------------|---------------------|-----------------|--------------|--------------|------------------------|------------------------|------------------------|
| | Total [mio. pieces] | Urban [mio. pieces] | Rural [mio. pieces] | Total [mio.] | Urban [mio.] | Rural [mio.] | Total [trips / capita] | Urban [trips / capita] | Rural [trips / capita] |
| Poland | 2,115 | 1,281 | 834 | 826 | 607 | 218 | 21.7 | 26.4 | 14.6 |
| Sweden (Nordics) | 1,069 | 920 | 148 | 472 | 434 | 39 | 46.7 | 49.8 | 27.4 |
| Spain | 4,604 | 3,684 | 920 | 1,979 | 1,739 | 239 | 42.7 | 46.9 | 25.9 |
| France | 6,263 | 5,009 | 1,254 | 2,698 | 2,369 | 328 | 41.6 | 45.7 | 25.3 |
| Germany | 7,539 | 5,708 | 1,830 | 3,197 | 2,714 | 483 | 38.6 | 43.3 | 24.0 |

6431

6432 Several assumptions were needed in order to determine the distance and the carbon
6433 dioxide intensity per fulfilled unit (see Table 36 and Table 37) due to limited data. The
6434 average travel distance is based on data from Smidfelt, Rosqvist and Hiselius (2016a)
6435 and adjusted according to the different basket sizes which also reflects additional
6436 stops during one trip for several items. The study shows an average distance in urban
6437 areas of 4.6 km while no accurate data for rural areas is available. Therefore a best
6438 estimate based on data from BIEK (2017) was chosen and aligned to the distances of
6439 parcel transport in rural areas.

6440

Table 36: Average distance per basket size

| | | Smallest basket | Medium basket | Large basket |
|-------|-----------|-----------------|---------------|--------------|
| Urban | km / trip | 5 | 6 | 7 |
| Rural | | 20 | 25 | 30 |

6441

6442 Another important factor contributing to the impact of shopping trips is the selection
6443 of the means of transportation. In urban areas, a lot of shopping trips are done by
6444 foot, bike or public transport while the car is less important (see Table 37).

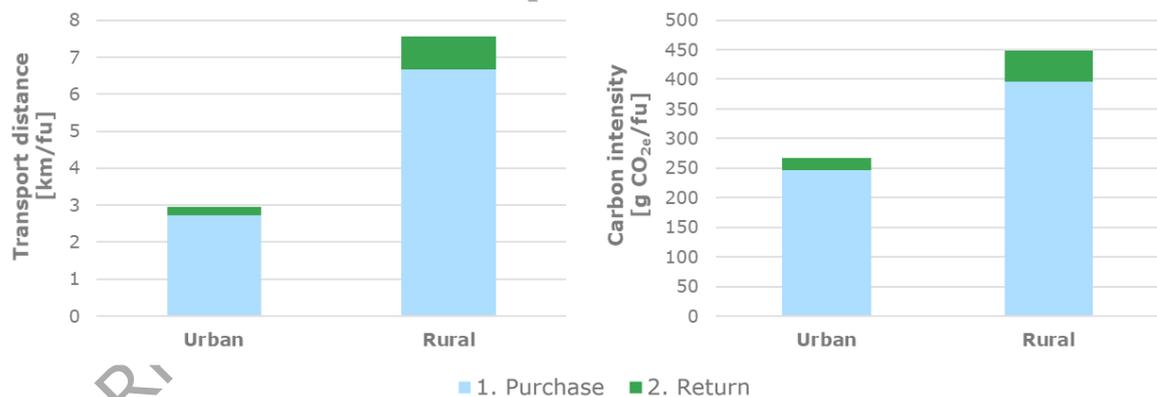
6445

Table 37: Share of means of transportation in urban and rural areas for shopping trips

| | Pedestrian | Bike | Bus | Metro | Car |
|-------|------------|------|------|-------|------|
| Urban | 0.25 | 0.20 | 0.15 | 0.10 | 0.30 |
| Rural | 0.05 | 0.25 | 0.05 | - | 0.65 |

6446

6447 By combining these data, following results were derived (see Figure 15), which
6448 indicate a higher transport distance, and hence a higher carbon intensity, per fulfilled
6449 unit in rural areas compared to urban areas. In urban areas, an average transport
6450 distance per fulfilled unit of about 2.8 km can be expected compared to 6.8 km in
6451 rural areas. A significant characteristic of the individual shopping trips is the low return
6452 rate, which leads to a minor impact.



6453

Figure 15: Transport distance and carbon intensity per fulfilled unit for individual shopping trips

6455 It can be concluded, although the data availability is quite limited, that the individual
6456 shopping trips tend to have a higher impact on average than the delivery in E-
6457 commerce. The most significant parameters are the combination of the trips (larger
6458 basket size with more products) and the selection of the means of transportation
6459 (Cheris *et al.*, 2017). Some studies indicate that the travel habits already are changing
6460 due to E-commerce with less shopping trips and less car travel, especially in urban
6461 areas (National Travel Survey, 2010; Smidfelt Rosqvist and Hiselius, 2016).

6462 Comparing both scenarios – parcel transport and individual shopping trip – there is a
6463 tendency towards less environmental impact for E-commerce on the “last mile”. In

6464 urban areas, the factor might be even bigger compared to rural areas from relative
6465 perspective (e.g. some 3 times higher related Carbon Dioxide emissions). However, it
6466 must be mentioned, that the parameter selection of the means of transportation has a
6467 great impact. Therefore, for people who only move around by bicycle to shop in the
6468 cities, it's more environmentally friendly, but for such an evaluation, a separate study
6469 would be needed.

6470

6471 4.3.7.3 Future developments (all qualitative)

6472 Based on the analysis above, the following parameters play a crucial role for the
6473 scenario 2030 in order to determine the transport distance and carbon intensity per
6474 fulfilled unit:

- 6475 1. number of fulfilled units incl. return rate;
- 6476 2. degree of Urbanisation;
- 6477 3. technology progress of delivery and individual shopping trips; and
- 6478 4. number of items per package or shopping trip.

6479 Assuming that expected annual revenue growth rates between 2019 and 2021 can be
6480 applied for the linear increase of fulfilled units and that those further continue until
6481 2030, an increase of 5 % for the packages per year can be expected. Parts of it are
6482 likely to result from a strong increase of foreign packages outside the European Union
6483 that is observed (from 60 million in 2016 to 164 million in 2018) (Statista, 2018d).
6484 Additionally the trend of urbanisation might play a role as well, as it reduces the
6485 average transport distance, thus leading to less impact in rural areas (Rösch, 2015).
6486 Regarding the means of transport, mainly light duty vehicles (<3,5 t) are used today
6487 e.g. for delivery packages in Germany, whereas 97 % are fossil fuel and only 3 % are
6488 battery-electric vehicles (BEV) (Statista, 2018d). More electric vehicles (BEV) and
6489 Hydrogen Fuel Cell vehicles (HFCV) can be expected in the upcoming years for the
6490 delivery services (Buthe *et al.*, 2018). This might lead to less direct emissions even
6491 though over the life cycle no final statement for 2030 is possible. The number of
6492 individual shopping trips will most likely decrease according to National Travel Survey
6493 (2010) and thus a positive impact per fulfilled unit can be expected. However, on an
6494 absolute scale more items will be sold which might counteract the effect of reduction
6495 of individual shopping trips, especially if the number of items per trip will remain low.

6496

6497 ▪ **Positive influencing factors**

6498 To improve the parcel transport, the following two opportunities have been identified.
6499 The effect of **in-house fulfilment** refers to small enterprises as well as C2C systems,
6500 whereby production, storage and packaging take place at the retailer's home rather
6501 than requiring extra space outside. This is relevant, because in the whole supply chain
6502 of E-commerce more and more SMEs are active (PostEurop, 2019b). Therefore, due to
6503 in-house fulfilment, transport distances might be reduced by cutting one or several
6504 process steps (e.g. to the fulfilment centre or to an additional depot). This effect is
6505 confirmed by Amazon (2019), who reported that three-quarters of the marketplace
6506 sellers can already be assigned to the C2C-group. Based on the revenue growth in the
6507 C2C business between 2010 and 2018 and its assumed continuation until 2030
6508 moving into into the digital space (Etsy, 2018), the future developments in this
6509 segment can be expected to grow linear with no disruptive change. There is also a
6510 tendency of increasing delivery services provided for the specific needs of SMEs,
6511 including package pick-up services, that can further increase transport efficiency and
6512 reduce the CO_{2e}- emissions per fulfilled unit (PostEurop, 2019b).

6513 However, no definite picture can be drawn to assess the impact on Circular Economy
6514 aspects, due to limited data basis. Overall, positive effects from in-house warehousing
6515 may be outweighed by the high risk for inefficient delivery logistics if the seller drops
6516 the parcel at the post office with a half-utilised vehicle.

6517 An additional lever for less environmental impact is the **optimisation of supply**
6518 **chain**, which goes hand in hand with financial savings and environmental impact
6519 reduction. Until 2030 it is likely, that optimisation efforts in the supply chain focus on
6520 same-day delivery, smaller parcel deliveries and last mile delivery in general (TLI,
6521 2016b). While these aspects are likely to lead to inefficient transport and therefore
6522 include strong, negative impacts on the Circular Economy, retailers and delivery
6523 service operators continuously try to optimise their supply chains out of economic
6524 interest. Aspects of implementing dedicated packaging solutions, described in Section
6525 4.3.8.3, also play a role here, since improved packaging and optimised parcel
6526 dimensions help to reduce the CO_{2e} emissions per fulfilled unit in transport (compare
6527 Kite Packaging, 2007).

6528 In conclusion, the optimisation of the supply chain is and will continue to be highly
6529 relevant (ECommerce Europe, 2018). However, it is expected that any measure could
6530 only soften the negative effects that come with the increase of faster delivery options,
6531 assuming that slower and thus more utilised delivery options will remain to be more
6532 transport efficient and environmentally-friendlier.

6533 **Collaboration between companies and partnering with waste management**
6534 **suppliers** can be understood as an optimisation of supply chain as well as dedicated
6535 packaging solutions. This has been already described in detail above in this section, in
6536 the packaging as well as End-of-Life section. Therefore, this opportunity is an
6537 overarching topic which cannot be assessed individually.

6538

6539 **▪ Negative influencing factors**

6540 Several threats have been identified for the transport and logistics as well for the
6541 upcoming years. One of them is the **Induced freight traffic to remote locations**.
6542 In rural areas, population density is significantly lower than in urban areas, and
6543 distances are greater, resulting in negative impacts in transport, due to higher
6544 transport costs and carbon footprints overall and therefore per fulfilled unit. However,
6545 in rural regions in Europe, too, it is important to secure the basic supply which
6546 includes postal and delivery services. It can be assumed that the governments across
6547 Europe will maintain their responsibility to provide basic services in the future, through
6548 for instance national operators (PostEurop, 2019b). Consequently, it can be assumed,
6549 that same-day deliveries will not play a role in rural regions (see also the effect of
6550 inefficient transport described below).

6551 On average, 87 % of households in the EU had an internet connection in 2018. In
6552 purely technical terms, there is further growth potential for E-commerce here
6553 (Statista, 2019h). It is likely that the largest share of households without internet
6554 access can be seen in rural areas, and that a higher volume of freight transport can be
6555 expected here in the future as a result (PostEurop, 2019; Moriset, 2018).

6556 However, research did not provide any indication for extreme increase in freight traffic
6557 in remote locations. On the contrary, studies have indicated that a customer's social
6558 environment and income situation have a greater impact on purchasing behaviour
6559 than its geographical location (Moriset, 2018).

6560 On the other hand, technological changes, such as the use of drones are expected to
6561 increase in importance for rural regions in particular (Joerss *et al.*, 2016). In
6562 mountainous, rural China, e.g. operator JD.com has already implemented a drone

6563 delivery system with capacities of 15 kg per drone, planning for capacities of one ton
6564 (Moriset, 2018).

6565 In conclusion, the impact of induced freight traffic to remote locations is assumed to
6566 be less significant but negative due to higher CO_{2e} emissions per fulfilled unit.
6567 However, the freight traffic from E-commerce is not expected to drastically increase by
6568 2030, if basic supplies remain locally available.

6569 A second identified threat is the **Damage on delivery**. The delivery of products to
6570 customers instead of retail shops typically increases handling steps of the products.
6571 This may increase the number of defective products. Damaged products delivered to
6572 the customer require exchange and result in at least doubled transport and package
6573 kilometres. Some literature describes 15-20% damaged products (Gallup Institut,
6574 2018; Statista Research Department, 2014), which appears too extreme. More
6575 differentiated data is provided by the Research Group "Retourenmanagement"
6576 (Forschungsgruppe Retourenmanagement, 2019). They found that the share of returns,
6577 neither appropriate for direct resale (e.g. originally packed) nor B-ware (minor faults
6578 or scratches), amounts to a maximum of 8% across all product categories. The data
6579 does not provide further distinction between defects from production, which are
6580 expected equal in share for both traditional retail and E-commerce, or from E-
6581 commerce-specific handling in distribution phase. Considering average return rates
6582 across product categories of 7%, this means that 0.6 % of all shipments in Europe or
6583 19.7 million of expected 3.5 billion packages in 2020 in Germany are defective and
6584 disposed (Bundesverband Paket&Express Logistik BIEK, 2018). In conclusion, the
6585 impact of damages from deliveries has minor significance for the logistics and
6586 transport cluster. In particular, product protection has been a thematic focus in
6587 previous years and is expected to remain priority, due to the impact of low customer
6588 satisfaction on the businesses (OSM, 2016, Billerudkorsnäs, no date). This is expected
6589 to further decrease damages caused specifically by the E-commerce value chain.

6590 The third threat is the so-called **inefficient transport**, which describes same-day or
6591 express deliveries as an additional selling point for growing expectations from
6592 customers (Allen *et al.*, 2017) and as a means of competition with advantages against
6593 traditional retail. The amount of online retailers offering same-day delivery could
6594 increase to 65 % in the next couple of years (Saleh, no date). Other surveys found,
6595 that in 2016 around 25% of customers from China, USA and Germany were willing to
6596 pay extra for express deliveries and it is further expected that these numbers are
6597 likely to increase (PWC, 2018b), subject to price developments for faster delivery
6598 (Joerss *et al.*, 2016).

6599 In the case of efficiently loaded delivery vehicles, many challenges have been
6600 experienced in the literature. Regarding assessments of general load factors of
6601 vehicles, values likely contain uncertainties and biases due to the complexity of the
6602 system (Santén and Rogerson, 2018). Consequently, attempts on determining the
6603 impact of same-day deliveries on vehicle load factors would be highly speculative and
6604 inappropriate for this study. However, the German Environmental Agency states, that
6605 CO_{2e} emissions of same-day deliveries are high compared to standard delivery
6606 (Umweltbundesamt, 2018b).

6607 It is reported, however, that logistic processes currently do not enable same-day
6608 deliveries on large, nationwide scales (Hausmann *et al.*, 2014). It can be expected,
6609 that the systemic limitations will remain until 2030. Accordingly, the impact from
6610 same-day deliveries can be estimated as follows: The proportion of the urban
6611 population in Europe is expected to rise to just below 80 % by 2030, with for instance
6612 Sweden reaching even 90 % (UN DESA, 2018). Based on 520 million inhabitants
6613 projected for the EU (Eurostats, 2019), this would mean that around 416 million
6614 people will live in urban regions of Europe in 2030. Of those 416 million citizens, 25 %

6615 or 104 million may prefer to choose same-day delivery over standard delivery.
6616 Considering that there are multiple orders per person and year (four orders per person
6617 and year on average in Europe in 2017 in apparel product category alone), there is
6618 large environmental impact to be expected from same-day delivery. Under the
6619 assumption that there is a greater risk of empty runs and inefficiency with this
6620 delivery option, inefficient transport is expected to be highly significant and assumed
6621 as the most relevant indirect effect.

6622 The fourth threat is **individual product delivery** although the data basis appears to
6623 be very weak. Zhang *et al.* (2019) described the threat but no actual numbers of last-
6624 mile split shipments are given. Cheris *et al.* (2017) report that rising expectations
6625 from consumers towards fast delivery are likely to lead to an increase of split orders
6626 and higher carbon footprints of the purchased items. Additionally, developments like
6627 Amazon prime membership promote guaranteed free, single shipments of small and
6628 low-value items. On the other hand it is stated that, if E-commerce purchases are sent
6629 together rather than split, a doubling of items per package can reduce the carbon
6630 emission by 30% and costs by 50% (Cheris *et al.*, 2017).

6631 Overall, this is expected to be an effect with limited impact for the logistics and
6632 transport cluster. The significance of the effect of individual product delivery depends
6633 on the scale of this logistic practice but the development is likely restricted by
6634 economic feasibility.

6635 The last considered threat are the **inferior types of travel** in E-commerce. Like the
6636 inefficient transport, it stems from the aim to achieve a high customer satisfaction,
6637 short-term availability and fast dispatch. As part of a study, shipping options were
6638 already named as the third-most important purchase criterion in 2017 (KPMG, 2017b,
6639 Cherrett and Allen, 2019). Faster delivery processes ultimately also shift long distance
6640 freight shipping towards air travel (Cheris *et al.*, 2017). Referring to expectations and
6641 assumptions stated for the effect of inefficient transport, inferior types of travel are
6642 expected to further increase in importance as customer expectations rise towards
6643 same-day deliveries. Due to the larger environmental impact from air travel compared
6644 to ship, the use of inferior types of transport on long distances causes a significant and
6645 immediate deterioration in the environmental impact (Jofred and Öster, 2011).

6646

6647 4.3.7.4 Summary

6648 In summary, there is clear evidence, that logistics and transport is a manifold cluster
6649 with impacts depending on the selected country and/or product but also on, the
6650 various assumptions which are necessary for the assessment and the data limitations
6651 that exist. Therefore, it is recommended to carry out country- and product-specific
6652 related studies to gain a clearer picture.

6653 In general, it can be expected that parcel deliveries to personal residences
6654 increasingly replace private shopping trips, while increasing the degree of the
6655 utilisation of the means of transport, leading to less energy demand per fulfilled unit.
6656 The use of more alternative means of transportation (Battery electric, Plug-In and Fuel
6657 Cell) in the delivery sector will most likely lower the direct emissions. It can be seen
6658 that the means of transportation is typically better utilised in urban areas than in rural
6659 areas. In urban areas, individual shopping trips are currently primarily carried out by
6660 bicycle, by foot or by public transportation (see Table 37), and this share will rise,
6661 meaning individual shopping trips with even less environmental impact. The increase
6662 of failures in delivery attempts might play a greater role due to the total increase of
6663 packages. Additionally, in urban areas the opportunity to deliver within 24 hours could
6664 also increase the probability of more delivery attempts.

6665 To conclude, a reliable quantification of outlined impacts on Circular Economy aspects
6666 is considered unfeasible under the scope of this assessment, and concrete scenarios
6667 must be defined. Only indications can be given. Looking at induced parcel transport
6668 and individual shopping trips, there is a tendency towards less environmental impact
6669 for E-commerce on the "last mile". In urban areas, the effect might be even bigger
6670 compared to rural areas from a relative perspective. The total amount however will
6671 increase with the total number of fulfilled units both in urban and rural areas.

6672 **Table 38: Summary of the expected effects of identified opportunities and threats within the**
6673 **cluster "Logistics and transport".**

| Logistics and transport | | km / fulfilled unit | g CO _{2e} / fulfilled unit | | |
|--|---|--|-------------------------------------|-------------|---|
| Relative effects as per today Direct opportunities and threats | Substitution of individual shopping trips | | + | + | |
| | Induced parcel transport | | o | + | |
| | Parcel return | | - | - | |
| Future developments Indirect opportunities and threats | Positive influencing factors | In-House Fulfilment | o | o | |
| | | Optimisation of supply chain | + | o | |
| | | Collaboration between companies and partnering with waste management suppliers | <i>n.a.</i> | <i>n.a.</i> | |
| | Negative influencing factors | Induced freight traffic to remote locations | | - | - |
| | | Damage on delivery | | o | o |
| | | Inefficient transport | | - | o |
| | | Individual product delivery | | - | o |
| Inferior types of transportation | | o | - | | |

6674

6675

WORKING

6676 **4.3.8 Cluster: Packaging**

6677 According to the assessment framework proposed in Section 4.2.2, the following
6678 effects arising from E-commerce within the “Packaging” cluster are identified:

- 6679 ▪ secondary Packaging (Threat);
- 6680 ▪ development of dedicated optimised packaging solutions (Opportunity); and
- 6681 ▪ excessive protective packaging (Threat).

6682 The following two sections describe which main effects arise from E-commerce today
6683 (Section 4.3.8.1 and 4.3.8.2) and what effects may be expected under future
6684 scenarios (Section 4.3.8.3). The last section 4.3.8.4 summarises the main findings and
6685 puts them into context.

6686 **Table 39: Overview of direct and indirect effects of E-commerce within the cluster “Packaging”**

| Packaging | | |
|--|------------------------------|--|
| Relative effects as per today Direct opportunities and threats | Secondary Packaging | |
| Future developments Indirect opportunities and threats | Positive influencing factors | Development of dedicated optimised packaging solutions |
| | Negative influencing factors | Excessive protective packaging |

6687

6688 All three effects (direct and indirect) refer to material efficiency regarding the
6689 packaging and its waste. The material weight in kg is as such the most significant unit
6690 in which to express the effects of this cluster, but it is sought differentiated into
6691 material types, in particular cardboard and plastics, as they vary between the product
6692 categories. While cardboard is used for appr. 75 % of E-commerce shipments, the
6693 market share of flexible plastic packaging materials is growing fast (All4Pack, 2018).
6694 In combination with the increased relevance of plastic pollution in the political context
6695 (European Commission, 2018e), plastic packaging is included in the quantitative
6696 assessment.

6697 A weak basis of available data, as well as the scope of the study require adaptations
6698 within the assessment of this cluster. In favour of achieving reasonable comparability
6699 of the packaging material demands, it was therefore decided that only the actual
6700 dispatch box material is assessed. Inner protective material is excluded here but
6701 qualitatively discussed in the pessimistic scenario.

6702 In this context, Low-Density Polyethylene foil (in the following referred to as LDPE foil
6703 or just LDPE) is the main material for secondary packaging at this value chain stage
6704 (PlasticsEurope, 2018; New InnoNet, 2016), representing the plastic packaging. The
6705 importance of LDPE in E-Commerce is, moreover, implicitly emphasised by the
6706 circumstance that reusable packaging solutions (e.g. RePack) aim to reduce both
6707 disposable LDPE and cardboard (RePack, 2018). It is also the second-most demanded
6708 plastic material in Europe with a share of 17.5% , while Polypropylene (PP) ranks first.
6709 However, PP is insignificant for the secondary packaging that is assessed below
6710 (PlasticsEurope, 2018). Furthermore, the packaging sector is ranked as the largest
6711 consumer LDPE foil and responsible for 40% of the overall plastics demand in Europe

6712 (ibid.). Consequently, the quantitative assessment is conducted in consideration of
6713 values for LDPE foil and cardboard.

6714 Table 40 provides an overview of the representative indicators for the cluster
6715 "Packaging".

6716 **Table 40: Representative Indicators for the cluster "Packaging"**

| Cluster | Representative Indicator | Unit(s) | Comment(s) |
|-----------|--|---|-------------------------------------|
| Packaging | "Amounts of plastic and cardboard packaging demand per fulfilled unit" | <ul style="list-style-type: none"> kg plastic packaging/unit, kg cardboard packaging/unit | Plastic is represented by LDPE foil |

6717

6718 **4.3.8.1 Observations of situation today**

6719 The only direct effect identified as relevant for today's situation is "Secondary
6720 packaging" in the stage of distribution to consumer.

6721 Unless a separate packaging solution is specifically developed for the E-commerce
6722 channel (see opportunity "Development of dedicated optimised packaging solutions"
6723 above), a direct threat arising from E-commerce is the additional packaging demand
6724 for final shipping to the customer (Pålsson, 2018). This type of secondary packaging
6725 at this value chain stage does not exist in the traditional retail value chain. Therefore,
6726 a quantitative assessment sequence was deemed appropriate in line with Step 3 of the
6727 assessment framework.

6728 The selection of sources and data points applicable to the assessment sequence is
6729 presented in Table 41.

6730 **Table 41: Overview of sources and data points applicable to the assessment of secondary**
6731 **packaging (threat)**

| Reference | Type of reference (Data pool) | Content |
|---|--------------------------------|---|
| DHL (2019) | Business service | Maximum dimensions for standard package |
| Stakeholder Survey (2019) | Statistics | Numbers of items per package |
| DIN EN 13724 (2013), packaging material retailers | Norms | Dimensions and weight-related values for packaging material |
| Hestin et al. (2017); Reiner (2019) | Market report/grey literature | Plastic demand, packaging material share and waste |
| Packaging today (2018) | Grey literature | Cardboard packaging demand Germany, likely overestimated |
| Kinsella et al. (2018) | Market report/ Grey literature | Cardboard packaging demand Europe |

6732

6733 In summary, all quantities of shipped packages are differentiated per country, product
6734 category, the ratio of the packaging material and package dimension (Section 4.3.1).
6735 They are multiplied with the respective packaging weight, which was determined by
6736 standardised densities of LDPE foil and corrugated cardboard, respectively (Annex 2,
6737 Table 58 and Table 59). In a next step, the total weight is brought in context with the
6738 absolute number of fulfilled units of the product category packed in cardboard or LDPE
6739 foil in order to determine a unit-specific weight.

6740

6741 Accordingly, a number of **assumptions** had to be made for the quantitative
6742 assessment in addition to those mentioned in Section 4.3.1. Firstly, in comparison
6743 with traditional retail, all secondary packaging from distribution to consumer is
6744 additional in E-commerce. The baseline of a brick-and-mortar scenario would be zero
6745 packaging material in this case. Secondly, packaging material dimensions are the
6746 same for LDPE and cardboard, respectively, within the respective category (letterbox,
6747 shoebox, large box) but the weights are determined by the different packaging
6748 material weights. Additionally, the ratio of plastic and cardboard packaging for product
6749 categories is estimated from expert opinions due to an information gap in available
6750 literature within this research field Reasons for the choice of LDPE and exclusion of
6751 inner protective material are explained earlier in this Section.

6752

6753 4.3.8.2 Findings from quantitative assessment for situation today

6754 The ratio of packaging size and resulting material demands is presented in Table 42.
6755 There are large variations between the product categories. While 75 % of media and
6756 entertainment products are shipped in shoebox-sized packages or smaller, apparel is
6757 often packed in large boxes. Smaller packaging sizes and major furniture as well as
6758 household appliances are mutually exclusive. Similarly, large packaging does not apply
6759 for small ICT devices, but small letterbox-sized-packaging is hardly ever used either
6760 (Allen *et al.*, 2017).

6761 **Table 42: Share in quantity of packaging size and packaging material per product category in**
6762 **[%]**

| Product | Letterbox | | Shoobox | | Larger | | Total quantity |
|---|-----------|-----------|---------|-----------|---------|-----------|----------------|
| | Plastic | Cardboard | Plastic | Cardboard | Plastic | Cardboard | |
| Media and entertainment products | 28% | 28% | 0% | 26% | 0% | 18% | 100% |
| Apparel | 6% | 0% | 34% | 0% | 6% | 54% | 100% |
| Major household appliances | 0% | 0% | 0% | 0% | 80% | 20% | 100% |
| Small information technology | 0% | 3% | 0% | 97% | 0% | 0% | 100% |
| Major furniture | 0% | 0% | 0% | 0% | 60% | 40% | 100% |

6763

6764

6765 In Table 43, the average weights per fulfilled unit of cardboard and LDPE foil
6766 packaging are displayed, differentiated by product category and country. European
6767 values are calculated as average from all focus countries. Considering that the weight
6768 per package ranges from 10 to 35 grams for LDPE foil material and 71 to 1,176 grams
6769 for cardboard (see Annex 2, Table 59), there are a number of interesting results. It
6770 can be seen that the weight per fulfilled unit apparel with cardboard packaging is on
6771 average 368 g, while Poland is lowest with 339 g and Germany highest by far with 406
6772 g. This reflects the impact of the apparel return rates in Germany on the values for the
6773 fulfilled unit. Similarly, the cardboard packaging weight of major furniture is
6774 significantly increased due to the high return rates common in the online retailing of
6775 major furniture. The values for LDPE foil in apparel on the other hand, are lower than
6776 the average packaging weight for the smallest parcel type. This can be explained by
6777 the fact that if shoebox-sized LDPE foil parcels contain three items, the packaging
6778 share per item is reduced from around 15 g to 4 g.

6779 **Table 43: Secondary packaging material demand for cardboard and LDPE foil per fulfilled unit,**
6780 **product category and country as per 2017**

| E-commerce: Secondary packaging per fulfilled unit per product category in [kg] | | Poland | Sweden (Nordics) | Spain | France | Germany | EU27 |
|---|----------------|--------|---------------------|-------|--------|---------|-------|
| Apparel | Plastic (LDPE) | 0.007 | 0.008 | 0.007 | 0.008 | 0.008 | 0.008 |
| | Cardboard | 0.339 | 0.377 | 0.355 | 0.362 | 0.406 | 0.368 |
| Small information technology | Plastic (LDPE) | 0.011 | 0.011 | 0.012 | 0.011 | 0.011 | 0.011 |
| | Cardboard | 0.148 | 0.148 | 0.160 | 0.152 | 0.152 | 0.152 |
| Major household appliances | Plastic (LDPE) | 0.025 | 0.025 | 0.026 | 0.025 | 0.025 | 0.025 |
| | Cardboard | 0.820 | 0.821 | 0.886 | 0.845 | 0.841 | 0.843 |
| Media and entertainment products | Plastic (LDPE) | 0.010 | 0.011 | 0.011 | 0.011 | 0.011 | n.a. |
| | Cardboard | 0.227 | 0.230 | 0.229 | 0.231 | 0.233 | 0.230 |
| Major furniture | Plastic (LDPE) | 0.036 | 0.036 | 0.035 | 0.036 | 0.036 | n.a. |
| | Cardboard | 1.198 | 1.195 | 1.185 | 1.198 | 1.217 | 1.199 |

6781

6782 Table 44 provides an overview of the total quantity in tonnes from secondary
6783 packaging of the "last mile" for all fulfilled units including returns in 2017. Compared
6784 to the values per fulfilled unit, the absolute impact and market demand for packaging
6785 is visible. Apparel occupies by far the front position regarding total material demand
6786 for secondary packaging for the distribution to the customer in E-commerce and for
6787 both packaging material types. Almost 1.5 billion tons of additional cardboard
6788 packaging and around 26 thousand tons of LDPE foil are consumed by E-commerce
6789 compared to brick-and-mortar businesses. The second-highest impact originates from
6790 major furniture, followed by media and entertainment products. In the low range,

6791 results indicate minor significance of LDPE foil from secondary packaging in small
6792 information and communication technology, as cumulative values remain below 20
6793 tons in Europe. This reflects the fact that small electronic articles are more sensitive to
6794 transport damage from shocks than is the case for apparel and that cardboard meets
6795 these requirements better.

6796 **Table 44: Total secondary packaging material demand for cardboard and LDPE foil per product**
6797 **category and country in 2017**

| E-commerce current state 2017: Secondary packaging per product category in [t] | | Poland | Sweden (Nordics) | Spain | France | Germany | Europe |
|--|----------------|--------|---------------------|--------|---------|---------|-----------|
| Apparel | Plastic (LDPE) | 631 | 336 | 1,287 | 1,829 | 2,536 | 21,632 |
| | Cardboard | 35,692 | 19,032 | 72,785 | 103,477 | 143,484 | 1,223,830 |
| Small information technology | Plastic (LDPE) | <2 | <2 | <2 | <2 | <2 | <20 |
| | Cardboard | 2,458 | 1,168 | 4,016 | 6,525 | 7,281 | 66,968 |
| Major household appliances | Plastic (LDPE) | 20 | 11 | 36 | 66 | 85 | 652 |
| | Cardboard | 170 | 91 | 304 | 550 | 709 | 5,454 |
| Media and entertainment products | Plastic (LDPE) | 117 | 50 | 210 | 333 | 607 | n.a. |
| | Cardboard | 6,533 | 2,811 | 11,676 | 18,551 | 33,804 | n.a. |
| Major furniture | Plastic (LDPE) | 175 | 60 | 222 | 359 | 664 | n.a. |
| | Cardboard | 3,897 | 1,330 | 4,942 | 7,997 | 14,809 | n.a. |

6798
6799 Reviewing literature, the comparison of packaging demand with total plastic packaging
6800 demand could be conducted for only 5 out of the 7 product categories.

6801 Table 45 provides an overview of the impacts of the product categories on the total
6802 packaging demand regarding LDPE foil. Secondary packaging from distribution to
6803 consumer indicates the highest relevance in apparel, which leads back to the size of
6804 the market and the extreme return rates. Runner's up are media and entertainment
6805 products and major furniture with just below 0.2‰.

6806 **Table 45: European plastic packaging material demands and share of secondary plastic**
6807 **packaging from distribution to consumer per product category in 2017**

| Country | Market share [%] | Plastic packaging demand for packaging purposes per country [t] | Share of secondary packaging LDPE foil from distribution to consumer per product category in [‰] | | | | |
|----------------|------------------|---|--|-----------|----------------------------|----------------------------------|-----------------|
| | | | Share Apparel | Small ICT | Major household appliances | Media and entertainment products | Major furniture |
| EU27 | 100.00% | 19,551,000 | 1.1‰ | <0.1‰ | <0.1‰ | n.a. | n.a. |
| Germany | 24.60% | 4,809,546 | 0.53‰ | <0.1‰ | <0.1‰ | 0.13‰ | 0.14‰ |

| Country | Market share [%] | Plastic packaging demand for packaging purposes per country [t] | Share of secondary packaging LDPE foil from distribution to consumer per product category in [‰] | | | | |
|---------------|------------------|---|--|-----------|----------------------------|----------------------------------|-----------------|
| | | | Share Apparel | Small ICT | Major household appliances | Media and entertainment products | Major furniture |
| France | 9.60% | 1,876,896 | 0.97‰ | <0.1‰ | <0.1‰ | 0.18‰ | 0.19‰ |
| Spain | 7.70% | 1,505,427 | 0.85‰ | <0.1‰ | <0.1‰ | 0.14‰ | 0.15‰ |

6808

6809 With regards to cardboard, the data basis is even weaker than for plastics. Data was
6810 searched for using combinations of "cardboard", "packaging", "demand"
6811 "consumption" with Europe or focus countries but only two data points were relevant
6812 and included in Table 46. Furthermore, the websites of the following cardboard and
6813 packaging related associations were included in the search for data, but no actual
6814 values could be identified:

- 6815 ▪ European Federation of Corrugated Board Manufacturers;
- 6816 ▪ Packaging Europe Ltd.;
- 6817 ▪ European Association of Carton and Cartonboard manufacturers (Pro Carton);
- 6818 and
- 6819 ▪ The Confederation of European Paper Industries (CEPI).

6820 The two identified datapoints indicate the significance of packaging in apparel with a
6821 2.4% share of the total paper packaging demand in Europe. The second datapoint
6822 from non-scientific literature reports a market share of Germany of 40%. In this case,
6823 the share of apparel decreases to 0.7%. However, a market share of 40% is expected
6824 to be too high. Consequently, these data points are to be handled with restraint.

6825 **Table 46: European paper packaging material demand and share of secondary cardboard**
6826 **packaging from distribution to consumer per product category in 2017**

| Country | Tonnages of paper packaging [t] | Share of secondary packaging cardboard from distribution to consumer per product category in [%] | | | | |
|----------------|---------------------------------|--|------------------------------|----------------------------|----------------------------------|-----------------|
| | | Share Apparel | Small information technology | Major household appliances | media and entertainment products | Major furniture |
| EU27 | 50,600,000 | 2.4% | <0.05% | <0.01% | n.a. | n.a. |
| Germany | 20,500,000 | 0.7% | <0.05% | <0.01% | 0.16% | 0.07% |

6827

6828 Overall, it can be expected that the outer packaging material as the secondary
6829 packaging for distribution to the consumer in E-commerce already accumulates to a
6830 relevant threat for the Circular Economy. This significance increases when considering
6831 the results extrapolated to all product categories and with the inclusion of protective
6832 inner packaging filler material like polystyrene (PS). With regards to (Hestin *et al.*,
6833 2017) and (Reiner, 2019), plastic packaging waste accounted for 60 % of the total
6834 plastic waste. The majority (70%) of this plastic packaging waste is partially or

6835 entirely lost for circularity as about a quarter (23% points) of it is landfilled and about
6836 half (47% points) is incinerated.. This shows the importance of demand reduction and
6837 the successful implementation of circularity aspects for increased recycling of plastic
6838 packaging.

6839

6840 4.3.8.3 Future developments

6841 Table 47 provides the baseline scenario data for 2030, if expected annual revenue
6842 growth rates between 2019 and 2021 can be applied for the linear increase of fulfilled
6843 units and further continue until 2030. Under these conditions, packaging materials
6844 without any other technological or regulatory innovations, can be expected to roughly
6845 double in total for cardboard and LDPE foil.

6846 **Table 47: Total secondary packaging material demand for cardboard and LDPE foil per product**
6847 **category and country in BAU scenario 2030**

| E-commerce BAU Scenario 2030: Secondary Packaging per product category in [t] | | Poland | Sweden (Nordics) | Spain | France | Germany | EU27 |
|--|----------------|--------|---------------------|---------|---------|---------|-----------|
| Apparel | Plastic (LDPE) | 1,058 | 508 | 2,066 | 2,877 | 3,562 | 33,628 |
| | Cardboard | 59,882 | 28,760 | 116,896 | 162,781 | 201,533 | 1,902,464 |
| Small information technology | Plastic (LDPE) | <5 | <5 | <5 | <5 | <5 | <50 |
| | Cardboard | 6,951 | 3,300 | 10,517 | 17,915 | 20,078 | 184,509 |
| Major household appliances | Plastic (LDPE) | 42 | 22 | 69 | 132 | 170 | 1,309 |
| | Cardboard | 351 | 188 | 580 | 1,100 | 1,425 | 10,950 |
| media and entertainment products | Plastic (LDPE) | 533 | 227 | 946 | 1,490 | 2,690 | n.a. |
| | Cardboard | 29,686 | 12,659 | 52,680 | 83,022 | 149,892 | n.a. |
| Major furniture | Plastic (LDPE) | 450 | 154 | 577 | 924 | 1,684 | n.a. |
| | Cardboard | 10,047 | 3,436 | 12,871 | 20,617 | 37,559 | n.a. |

6848

6849 **Positive influencing factors**

6850 Evidently, optimisation strategies for packaging potentially affect the demands for
6851 plastic and cardboard. Yet, most packaging solutions have been implemented in order
6852 to optimise the demand of materials in response to packaging-related issues of the E-
6853 commerce value chain. Therefore, many distinct opportunities associated with the
6854 optimisation of packaging are not expected to result in actual environmental CE
6855 benefits compared to the traditional retail channel (Pålsson, 2018). Rather, they
6856 constitute relative changes and optimisations to alternative E-commerce channels.

6857 For instance, reusable packaging systems (e.g. RePack) are a response to the waste
6858 issues associated with secondary packaging (last-mile shipping) but do not necessarily
6859 result in actual benefits compared to the traditional value chain. In fact, such
6860 measures only mitigate amounts of plastic and cardboard packaging demand per
6861 fulfilled unit in different E-commerce scenarios. Material-related aspects of so-called
6862 "frustration-free packaging" solutions (e.g. appropriate dimensions of shipping box,
6863 replacement of additional shipping box, recyclable material use) are likewise mainly
6864 addressing E-commerce-specific challenges, at best counteracting additional impacts
6865 from E-commerce scenarios. After 20 uses of a specific reusable packaging solution,
6866 demands for disposable plastic (LDPE) and cardboard are assumed to be almost
6867 entirely offset (relative savings of 92% of LDPE and 96% of cardboard) (RePack,
6868 2018; Zero Waste Europe, 2019). However, it needs to be remembered that the
6869 reusable packing material will also turn into waste after about 20 uses (RePack,
6870 2018). Further research is required for comparison of benefits from reusable
6871 packaging on the one hand and the efforts and resources required for the collection,
6872 transport and provision of reusable packaging.

6873 In contrast to mere elimination or mitigation opportunities, the convergence of
6874 primary and secondary packaging or "e-channel-enabled packaging" may offer actual
6875 improvements in terms of amounts of plastics and cardboard per fulfilled unit
6876 compared to traditional packaging suitable for brick-and-mortar or omni-channel
6877 retail. The life cycle stages affected by those changes are secondary packaging and e-
6878 fulfilment (after sales). In this respect, it is noteworthy that those life cycle stages are
6879 typically influenced by different actors, thus collaboration along the value chain is
6880 paramount in order to capitalise on this opportunity.

6881 The emerging opportunity lying in value chain collaboration is considered an indirect
6882 effect of E-commerce due its rather long-term and structural implications on
6883 packaging because of wide-scale market developments. Hence, a qualitative
6884 assessment sequence was deemed appropriate in line with Step 3 of the assessment
6885 framework. In this context, it can be argued that E-commerce will alter the current
6886 role of primary and secondary packaging with respect to attracting consumer interest
6887 in retail stores (Feber, 2019). Assuming a continuing shift from traditional brick-and-
6888 mortar channels towards digital single-markets for certain product categories – i.e.
6889 respective products are potentially only distributed via E-commerce – packaging would
6890 no longer need to fulfil any marketing, "on-the-shelf" display and/or product
6891 information purposes. A potential shift to utilitarian and minimalistic protective
6892 packaging could result in packaging dimensions that are notably smaller than current
6893 packaging which is often designed for omni-channel distribution (Pålsson, 2018).
6894 Consequently, product manufacturers may be developing dedicated packaging
6895 solutions for online distribution. For example, a detergent producer in the USA has
6896 innovated packaging to reduce its overall weight during transport as part of the launch
6897 of a novel laundry detergent specifically designed for E-commerce (Feber, 2019).
6898 Thus, dedicated packaging solutions for E-commerce channels have the potential to
6899 reduce amounts of plastics and cardboard per fulfilled unit. However, minimising the
6900 demand of packaging materials in response to altered requirements from a marketing
6901 perspective needs to be weighed against remaining protection requirements. As
6902 protection demands are generally higher in E-commerce value chains, the positive net
6903 effect of dedicated packaging solutions could be diminished or even (over-)
6904 compensated.

6905 In a worst-case scenario, material-efficient packaging solutions could even result in
6906 increased damages to the products, and thereby negatively affect a Circular Economy.

6907 Looking at the selected product categories, it is assumed that accessories, non-
6908 perishable food products, media and entertainment products as well as small

6909 information and communication technologies offer opportunities related to dedicated
6910 packaging for E-commerce. This is because those products are generally smaller than
6911 products from the other categories. However, certain products within those categories
6912 (e.g. watches, smartphones, crisps, books) are more vulnerable and thus need
6913 protection which may inhibit any optimisation possibilities. For apparel products, no
6914 noteworthy opportunities are expected in this regard as those items are usually sold in
6915 plastic bags in E-commerce or even without packaging in traditional stores (Pålsson,
6916 2018), resulting in low optimisation potential. Hence, relative possibilities for
6917 improvement are very limited in the digital market.

6918

6919 **▪ Negative influencing factors**

6920 The direct effect of over-sized as well as over-protective packaging (and combinations
6921 of the two) represent a threat for the CE. Examples are the use of relatively large
6922 standard boxes for small items and the use of packaging (incl. inner packaging) that
6923 offers a much higher shock absorption than technically needed. The former type can
6924 generally be characterised as having a negative effect on Circular Economy, due to low
6925 material efficiency (more material used than needed for the fulfilled unit; both
6926 cardboard and plastic material) and low transport efficiency (transportation of air
6927 instead of goods). The latter type, though, represents an optimisation challenge
6928 between, on the one hand, ensuring that the packaged product reaches its destination
6929 in perfect condition and, on the other hand, material efficiency related to the
6930 expectable shock impacts during transportation.

6931 Excessive protective packaging is found as not well-described in the analysed data
6932 pools. Neither earlier studies, e.g. Kite Packaging (2007) nor recent studies, e.g.
6933 OECD (2019), – although dedicated and broad – touch upon this effect. In the entire
6934 pool of reviewed sources, neither qualitative nor quantitative data points could be
6935 retrieved for this threat. Thus, the present qualitative assessment was done.

6936 In terms of relevance for product categories, it can be assumed that the effect seems
6937 particularly relevant in relation to shipping of small information and communication
6938 technology (ICT), and to a certain extent, to accessories (e.g. watches), but not to the
6939 other five selected product categories, as they don't comprise small, shock-vulnerable
6940 products.

6941 While both product categories deemed relevant show relatively low growth rates (see
6942 Section 2.1.1), particularly small ICT equipment has high market relevance today and
6943 in the foreseeable future, and the same goes for its consumer relevance, purchase
6944 frequency, and return rates. Thus, excessive protective packaging is a threat to be
6945 solved particularly related to small ICT equipment.

6946

6947 **4.3.8.4 Summary**

6948 The total current secondary packaging material demand from E-commerce was
6949 identified taking into account two packaging materials (cardboard and LDPE foil) and
6950 three packaging sizes per product category and country. The highest EU-wide demand
6951 in cardboard packaging in kg per fulfilled unit across the 7 selected product categories
6952 is found for major furniture (1.2 kg/unit with cardboard packaging) and major
6953 household appliances (0.84 kg/unit) with apparel ranking third (0.37 kg/unit). The
6954 LDPE foil packaging demand is highest in major furniture (0.036 kg/unit) and major
6955 furniture (0.025 kg/unit). However, by normalisation of the values over market share
6956 of total plastic packaging demand, apparel is significantly highest (1.1 ‰), followed
6957 by media products and major furniture in the range of just below 0.2 ‰. In cardboard

6958 packaging, subject to the reliability of the data point, secondary packaging for apparel
6959 may be responsible for up to 2.9% of the cardboard packaging demand.

6960 The majority of suggested mitigation-oriented packaging solutions (e.g. reusable
6961 packaging) optimise the demand of materials within the E-commerce value chain but
6962 is not expected to result in actual environmental CE benefits compared to the
6963 traditional retail channel.

6964 Dedicated packaging solutions for E-commerce channels have the potential to reduce
6965 amounts of plastics and cardboard per fulfilled unit. However, the positive net effect of
6966 dedicated packaging solutions could be diminished or (over-)compensated due to
6967 inherently higher protection demands in E-commerce value chains.

6968 **Table 48: Summary of the expected effects of identified opportunities and threats within the**
6969 **cluster Packaging**

| Packaging | | Packaging demand (per fulfilled unit) |
|--|--|--|
| Relative effects as per today Direct opportunities and threats | Secondary Packaging | +2.9% Secondary Packaging is additional compared to Brick-and-mortar as per scope of the assessment |
| Future developments Indirect opportunities and threats | Positive influencing factors Development of dedicated optimised packaging solutions | 0 |
| | Negative influencing factors Excessive protective packaging | -2.9% |

6970

6971

6972

6973 **5 Conclusions**

6974 **5.1 Correlations between identified opportunities and threats**

6975 As part of the systemic identification, classification and description process as outlined
6976 in Section 3.1.2 as well as the conducted in-depth assessment, all opportunities and
6977 threats have been clustered and attributed to distinct characteristics or properties (see
6978 attribution matrix in Annex 2, Section 9.2). Therefore, the following properties were
6979 used to examine potential interrelations between the identified opportunities and
6980 threats:

- 6981 ▪ E-commerce feature;
- 6982 ▪ life-cycle stage;
- 6983 ▪ effect order; and
- 6984 ▪ cluster.

6985 Eventually each of the opportunities and threats is clearly described by one E-
6986 commerce feature that primarily facilitates a certain effect and by one life-cycle stage
6987 from where the effect is expected to originate. And, as already elaborated on, every
6988 single opportunity or threats is unambiguously attributed to a cluster and an effect
6989 pathway (direct or indirect).

6990 With these specific properties at hand, valid assumptions can be made whether a
6991 certain opportunity or threat is closely or less closely linked to another. For instance, it
6992 can be argued that opportunities and threats that originate from the same E-
6993 commerce features are potentially stronger linked than others. Moreover, a closer link
6994 can be assumed when opportunities and threats affect the same life-cycle stages of a
6995 given product. Naturally, stronger interrelations are assumed when two opportunities
6996 or threats are both classified as direct or indirect, thus coming into effect either today
6997 or in the future. An attribution to the same cluster certainly constitutes a close link as
6998 specific opportunities and threats are suspected to affect the same Circular Economy
6999 indicators.

7000 To establish an objective assessment of correlations within a highly complex and
7001 uncertain web of effects, it is assumed that the more properties a pair of opportunities
7002 or threats has in common, the closer the link. Adopting this approach, the following
7003 nuances resulted from this assessment:

- 7004 ▪ 0: very low probability of a strong link;
- 7005 ▪ 1: low probability of a strong link;
- 7006 ▪ 2-3: moderate probability of a strong link;
- 7007 ▪ 4: high probability of a close link; and
- 7008 ▪ 5: very high probability of a close link.

7009 In Figure 16, the probability of a strong link is shown for all identified opportunities
7010 and threats.

7011

7014 Based on above assessment, a ranking of all opportunities and threats is facilitated by
7015 adding up the number of overlaps a given opportunity or threat has in common with
7016 others (see Table 49). Hence, those opportunities or threats sharing many properties
7017 with others should be given priority in analysing their actual implications on other
7018 effects. Based on this ranking the opportunities and threats have been further
7019 allocated to three groups identifying a high, medium or low number of correlations
7020 with other opportunities/threats. The results are reported in
7021 Table 50.

7022 **Table 49. Ranking of opportunities and threats based on the sum of overlapping properties with**
7023 **other effects**

| Rank | Opportunity/Threat | Sum |
|------|--|-----|
| 1 | Innovation | 66 |
| 2 | Induced freight traffic to remote locations | 56 |
| 3 | Damage on delivery | 55 |
| 4 | Individual product delivery | 55 |
| 5 | Inefficient transport | 55 |
| 6 | Inferior types of transportation | 55 |
| 7 | In-House Fulfilment | 53 |
| 8 | Shopping frenzy | 52 |
| 9 | Enforcement | 50 |
| 10 | International market access | 49 |
| 11 | Difficulty to monitor | 47 |
| 12 | EPR free-rider effect | 47 |
| 13 | Optimisation of supply chain | 47 |
| 14 | Ubiquity | 45 |
| 15 | Ease of shopping | 45 |
| 16 | Substitution of printed marketing material | 43 |
| 17 | Waste from returns | 43 |
| 18 | Nudging | 42 |
| 19 | Cross-selling and up-selling | 42 |
| 20 | Extended product selling cycle | 42 |
| 21 | End-of-Life challenges | 42 |
| 22 | Product take-back | 41 |
| 23 | Substitution of individual shopping trips | 41 |
| 24 | Induced parcel transport | 41 |
| 25 | Food waste | 40 |
| 26 | Excessive protective packaging | 40 |
| 27 | Development of dedicated optimized packaging solutions | 39 |
| 28 | Personalised design | 38 |
| 29 | Market access to online aftermarket | 37 |
| 30 | Sharing models and services | 36 |
| 31 | ReCommerce: Second-hand E-commerce /online auctioning | 36 |
| 32 | Collaboration between companies and partnering with waste management suppliers | 36 |
| 33 | Reduction of retail space | 34 |

| Rank | Opportunity/Threat | Sum |
|------|--|-----|
| 34 | Lack of compliance with common market regulation | 33 |
| 35 | Parcel return | 33 |
| 36 | Availability of information | 29 |
| 37 | Big data/ meta data | 29 |
| 38 | Product portfolio | 29 |
| 39 | Digital goods | 28 |
| 40 | Secondary Packaging | 26 |
| 41 | Operation of network infrastructure | 21 |

7024

7025 **5.2 Relevance of opportunities and threats**

7026 Based on the findings from the in-depth assessment (see Section 4) all opportunities
7027 and threats were grouped according to their estimated relevance for a Circular
7028 Economy in Europe. Therefore, opportunities and threats arising from E-commerce are
7029 either of

- 7030 ▪ high,
- 7031 ▪ medium, or
- 7032 ▪ low

7033 relevance for a Circular Economy in comparison to the traditional (brick-and-mortar)
7034 channel.

7035 The differentiation between the three groups is subject to the assumptions and
7036 limitations of the in-depth assessment, as indicated in Section 4. Therefore, this
7037 ranking describes the relevance of certain opportunities and threats in terms of their
7038 expected influence on identified environmental Circular Economy aspects (e.g.
7039 packaging demand, product waste, global warming potential, etc.). Moreover, the
7040 respective relevance and influence on a Circular Economy of a given opportunity or
7041 threat is not understood as an absolute influence. In fact, it describes a relative
7042 difference to the traditional value chain. Hence, compared to the traditional value
7043 chain, a certain opportunity/threat is of high/medium/low relevance for a Circular
7044 Economy.

7045 It must be remembered that the actual impacts of certain opportunities and threats
7046 may depend on the product category. Yet, as described, many of the affected value
7047 chain stages and thus identified effects are largely independent from the most critical
7048 life-cycle stages of a product value chain (see also Figure 2 in Section 3.1.2).

7049 The presented ranking does not make value judgements between the assessed
7050 Circular Economy aspects (indicators) or clusters. This means, none of the Circular
7051 Economy aspects or indicators is assumed to be of higher relevance than another, i.e.
7052 they are considered equally important.

7053 In summary, the proposed ranking primarily takes into account:

- 7054 ▪ the described effect pathway, with direct effects being generally more relevant
7055 as per definition;
- 7056 ▪ the degree of evidence from the assessment and the reviewed literature; and
- 7057 ▪ the measurability of a given opportunity or threat in terms of a Circular
7058 Economy aspect or indicator.

7059

7060

7061 Table 50 summarises and groups all 41 opportunities and threats in descending order
7062 based on the in-depth assessment results. The grouping of relevance according to the
7063 stakeholder inputs is also presented as point of reference.

7064

7065 **Table 50: Grouping of opportunities and threats according to their relevance based on the in-**
7066 **depth assessment, the stakeholder input and the number of correlations with other**
7067 **opportunities/threats**

| | Name of the opportunity/threat | Clusters | Relevance (from in-depth assessment results) | | Number of correlations with other O/Ts |
|-------------|--|------------------------------|--|--------------------------|--|
| | | | In-depth assessment results | Stakeholder consultation | |
| Opportunity | Availability of information | Accessibility of information | high* | low | high |
| | Market access to online aftermarket | Accessibility of information | high* | medium | medium |
| | Product portfolio | Accessibility of information | high* | contrasting | low |
| | Sharing models and services | Consumer needs and behaviour | high | medium | medium |
| | Second-hand E-commerce /online auctioning | End of life | high | medium | medium |
| | Substitution of individual shopping trips | Logistics and transport | high | low | medium |
| Threat | Inefficient transport | Logistics and transport | high | medium | high |
| | Induced parcel transport | Logistics and transport | high | high | medium |
| | Parcel return | Logistics and transport | high | high | low |
| | Lack of compliance with common market regulation | Legal framework | high* | high | low |
| | Shopping frenzy | Consumer needs and behaviour | high | low | high |
| | Secondary Packaging | Packaging | high | low | low |
| Opportunity | Extended product selling cycle | End of life | high | low | medium |
| | Nudging | Consumer needs and behaviour | medium | contrasting | medium |
| | Digital goods | Digitalisation | medium | medium | low |
| | Product take-back | End of life | medium | high | medium |
| | Optimization of supply chain | Logistics and transport | medium | medium | medium |
| Threat | Inferior types of transportation | Logistics and transport | medium | medium | high |
| | International market access | Accessibility of information | medium* | low | medium |
| | Ubiquity | Accessibility of information | medium* | low | medium |
| | Personalised design | Consumer needs and behaviour | medium | low | medium |
| | Operational energy demand for the network infrastructure | Digitalisation | medium | medium | low |
| | Waste from returns | End of life | medium | high | medium |

| | Name of the opportunity/threat | Clusters | Relevance (from in-depth assessment results) | | Number of correlations with other O/Ts |
|-------------|--|------------------------------|--|--------------------------|--|
| | | | In-depth assessment results | Stakeholder consultation | |
| | Difficulty to monitor | Legal framework | medium* | high | medium |
| | Enforcement | Legal framework | medium* | high | medium |
| | EPR free-rider effect | Legal framework | medium* | high | medium |
| | Excessive protective packaging | Packaging | medium* | high | medium |
| Opportunity | Innovation | Accessibility of information | low* | medium | high |
| | Big data/ meta data | Accessibility of information | low* | contrasting | low |
| | Reduction of retail space | Digitalisation | low | low | low |
| | Substitution of printed marketing material | Digitalisation | low* | medium | medium |
| | Development of dedicated packaging solutions | Packaging | low | low | medium |
| | Collaboration between companies and partnering with waste management suppliers | No cluster | - | low | medium |
| | In-House Fulfillment | Logistics and transport | low* | low | high |
| Threat | Induced freight traffic to remote locations | Logistics and transport | low | low | high |
| | Damage on delivery | Logistics and transport | low | medium | high |
| | Individual product delivery | Logistics and transport | low* | medium | high |
| | Ease of shopping | Consumer needs and behaviour | low* | low | medium |
| | Cross-selling and up-selling | Consumer needs and behaviour | low* | low | medium |
| | EoL challenges | End of life | low* | medium | medium |
| | Food waste | End of life | low* | low | medium |

7068 * little evidence / limited data basis

7069

7070 From a Circular Economy perspective, secondary packaging and direct effects within
7071 the cluster "logistics and transport" deserve special attention. Moreover, certain
7072 effects relating to "consumer needs and behaviour" as well as facilitated second-hand
7073 E-commerce within the cluster "end-of-life" are of high relevance.

7074 The effects from the clusters "accessibility of information" and "legal framework" could
7075 not be translated into specific Circular Economy aspects or indicators. Nevertheless,
7076 direct effects from these clusters are potentially of high relevance despite the fact that
7077 there is little evidence or only a limited data basis. One of the main reasons for this
7078 conclusion is that the reviewed literature does not clearly differentiate between E-
7079 commerce and traditional channels when it comes to legal issues or the accessibility of
7080 information.

7081 The opportunities and threats relating to the cluster “Digitalisation” are of medium to
7082 low relevance. This is not least due to the cascading effects from digitalisation which
7083 cannot exclusively be allocated to E-commerce.

7084 The potential opportunity of “collaboration between companies and partnering with
7085 waste management suppliers” , as already mentioned in Section 4.3.7.3, could not be
7086 ranked as it could not clearly be assigned to a single cluster or expressed in terms of a
7087 certain Circular Economy aspect. This opportunity was inherently assessed as part of
7088 the opportunities “product-take back” and “development of dedicated packaging
7089 solutions”.

7090

7091 **5.3 General conclusions**

7092 The relevance of the identified opportunities and threats cannot be univocally defined
7093 due to the extremely broad scope of the topic and the different aspects that come into
7094 play while analysing the impacts on the Circular Economy of a potential positive or
7095 negative future development. Nevertheless, the outcomes of the assessment of
7096 relevance performed under different perspectives (in depth-assessment, stakeholder
7097 consultation and correlations) and reported in

7098 Table 50 can be compared with the aim of highlighting those opportunities or threats
7099 that can be considered relevant under a combination of the perspectives considered.

7100 The opportunities and threats where a more in-depth analysis of the potential effects
7101 on the Circular Economy is deemed particularly relevant, based on what reported
7102 above, are the following:

- 7103 ▪ **Induced parcel transport** (threat), **Parcel return** (threat), **Lack of**
7104 **compliance with common market regulation** (threat): these threats turned
7105 out to have a high relevance based both on the in-depth assessment performed
7106 in this study and the stakeholders’ feedback. A further and more extensive
7107 analysis, also considering the current limited availability of data, is considered
7108 therefore relevant;
- 7109 ▪ **Inefficient transport** (threat), **shopping frenzy** (threat) and **availability of**
7110 **information** (opportunity): these threats/opportunity show a high relevance
7111 for the Circular Economy based on the in-depth assessment and a high number
7112 of overlapping properties with other opportunities and threats. Therefore,
7113 further studies and potential actions aimed at supporting or mitigating their
7114 effects could indirectly affect also a significant number of other opportunities
7115 and threats.

7116

7117

7118 **6 Glossary of terms and abbreviations**

7119 **6.1 Terms**

7120 **Circular Economy**

7121 "In a circular economy the value of products and materials is maintained for as long as
7122 possible; waste and resource use are minimised, and resources are kept within the
7123 economy when a product has reached the end of its life, to be used again and again to
7124 create further value. This model can create secure jobs in Europe, promote
7125 innovations that give a competitive advantage and provide a level of protection for
7126 humans and the environment that Europe is proud of. It can also provide consumers
7127 with more durable and innovative products that provide monetary savings and an
7128 increased quality of life."⁷

7129 **E-commerce**

7130 "E-commerce can be defined generally as the sale or purchase of goods or services,
7131 whether between businesses, households, individuals or private organisations, through
7132 electronic transactions conducted via the internet or other computer-mediated (online
7133 communication) networks."⁸

7134 "Any form of business transaction in which the parties interact electronically rather
7135 than by physical exchanges or direct physical contact" (Abukhader and Jonson, 2004).

7136 **IT, Internet, E-commerce**

7137 "It is important to clearly differentiate between terms that are sometime used as
7138 synonyms in literature. E-commerce is one activity that is provided by the internet,
7139 which in turn is one functionality that can be provided by IT" (Abukhader and Jonson,
7140 2004).

7141 "The technology itself (information and communication technologies, Internet) does
7142 not determine sustainability, but rather its design, use, and regulation" (Stefansdotter
7143 *et al.*, 2016).

7144 **Last mile delivery**

7145 Last mile delivery is defined as the movement of goods from a transportation hub to
7146 the final delivery destination. The final delivery destination is typically a personal
7147 residence. The focus of last mile logistics is to deliver items to the end user as fast as
7148 possible.

7149 **Light goods vehicles (LGV) and heavy goods vehicles (HGV)**

7150 "Light goods vehicles (LGVs) – up to and including 3.5 tonnes gross weight – [...]
7151 heavy goods vehicles (HGV) – over 3.5 tonnes gross weight [...]" (Allen *et al.*, 2017).

7152 "Unlike HGVs (which are almost entirely used for goods movement), LGVs are used for
7153 a wider range of purposes, including the provision of services, the transportation of

⁷ http://europa.eu/rapid/press-release_MEMO-15-6204_en.htm

⁸ <https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:E-commerce>

7154 goods and commuting (as many LGVs are taken home by workers overnight). Fig. 1
7155 illustrates the LGV sector in terms of the distinction between fleet LGVs (i.e. those
7156 operated by companies with sizeable fleets) and those operated by self-employed
7157 individuals and small businesses. It is also important to note that the van owner and
7158 van user can differ, and that vehicles may be sold to a company considered by the
7159 vehicle manufacturer to be a fleet buyer (for example the rental and leasing
7160 companies) although these vehicles may subsequently be rented or leased to another
7161 company, small business or individual" (Allen *et al.*, 2017).

7162

7163 **Network slicing**

7164 "Network Slicing to Enable Scalability and Flexibility in 5G Mobile Networks discussion,
7165 we have generally defined "slice" as an isolated set of programmable resources to
7166 implement network functions and application services through software programs for
7167 accommodating individual network functions and application services within each slice
7168 without interfering with the other functions and services on the coexisting slices.
7169 Network slicing is considered one of the most important concepts to realize "extreme
7170 flexibility" in 5G mobile networks. The current mobile networks are optimized to serve
7171 only mobile phones. However, 5G mobile networks need to serve a variety of devices
7172 with very different, heterogeneous quality of service (QoS) requirements without
7173 interference among one another" (Nakao *et al.*, 2017).

7174 **Nudging**

7175 "Nudging can be defined as a way to design a situation of choice and the way options
7176 are presented (also called choice architecture), in order to change people's behaviour
7177 in a predictable way without any elimination of opportunities or change of incentives"
7178 (Stefansdotter *et al.*, 2016).

7179 "[...] nudging is about changing people's behaviour while presuming that they already
7180 have the attitudes necessary to demonstrate this behaviour" (Stefansdotter *et al.*,
7181 2016) .

7182 **Primary packaging**

7183 The primary package concerns the structural nature of the package; it is usually the
7184 smallest unit of distribution or use and is the package in direct contact with the
7185 contents (Regattieri, 2015).

7186 Primary Packaging contains the finished or final products, sometimes called retail or
7187 consumer packaging. This packaging is used to contain, preserve, protect and inform
7188 the end user. The primary pack can be made of a number of components, e.g. for a
7189 multi-pack of beers this would include the bottles, their labels and the card sleeve or
7190 shrink film. Primary packaging should include all packaging up to the point of sale, but
7191 does not include carrier bags (single use and bags for life) and delivery boxes (WRAP,
7192 no date).

7193 **Raw Material Consumption**

7194 "The RMC measures the global material use associated with domestic production and
7195 consumption activities, equalling DEU (domestic extraction used) plus imports in RME
7196 (raw material equivalents) minus export in RME" (Vercauteren *et al.*, 2017).

7197 "In a successful CE the RMC decreases. As more materials circulate, there is a
7198 decreasing need for primary raw materials reflected via a decreasing RMC"
7199 (Vercajsteren *et al.*, 2017).

7200 **Secondary packaging**

7201 The secondary package relates to the issues of visual communication and it is used to
7202 group primary packages together (Regattieri, 2015).

7203 Packaging additional to the primary packaging and that is used for protection and
7204 collation of individual units during storage, transport and distribution. They can be
7205 used in some sectors to display primary packs on shelf. Sometimes called grouped or
7206 display packaging. This category also includes packaging purposely made to display
7207 multiple product units for sale, in order to speed restocking from storeroom to shelf.
7208 Also known as retail-ready packaging (RRP), shelf-ready packaging (SRP) or counter-
7209 top display units (CDUs) (WRAP, no date).

7210 **Tertiary packaging**

7211 The tertiary package is used for warehouse storage and transport shipping (Regattieri,
7212 2015).

7213 Outer packaging, including pallets, slip sheets, stretch wrap, strapping any labels,
7214 used for the shipment and distribution of goods. This packaging is also referred to as
7215 transport or transit packaging and is rarely seen by the final consumer. The final
7216 destination will often deal with this via its own internal reuse or recycle routes.
7217 (WRAP, no date)

7218 **Circular Economy Indicators**

7219 Indicators are commonly understood as either a variable (parameter) or a function of
7220 variables but may also be the result of composite information relying on quantitative
7221 and qualitative information (Moraga *et al.*, 2019). Moreover, an inherent feature of
7222 any indicator is that they usually refer to a comparison value or reference (Waas *et*
7223 *al.*, 2014). To this end, the specific traditional value chain characteristics or scenarios
7224 are considered as the baseline.

7225 A comprehensive literature review on micro-scale indicators referring to single
7226 products conducted by Moraga *et al.* (2019) identified the following CE indicators and
7227 corresponding measurement scopes:

- 7228 • Technological cycles without aspects of Life Cycle Thinking:
 - 7229 ○ eDiM (ease of Disassembly metric)
- 7230 • Technological cycles with aspects of Life Cycle Thinking:
 - 7231 ○ TRP (Total Restored Products)
 - 7232 ○ Longevity
 - 7233 ○ MCI (Material Circularity Indicator)
- 7234 • Cause-and-effect modelling with/without Life Cycle Thinking:
 - 7235 ○ EVR (Eco-cost value ratio)
 - 7236 ○ PLCM (Product-level Circularity Metric)
 - 7237 ○ SCI (Sustainable Circular Index)

7238 **6.2 Abbreviations**

7239

| ABBREVIATION | TERM |
|---------------------|--|
| 0-9 | |
| 2G, 3G, 4G | Second-, third-, and fourth-generation cellular technology standards |
| A | |
| APASS | Amazon Support and Supplier Network |
| B | |
| B2B | Business-to-Business |
| B2C | Business-to-Customer |
| BEV | Battery Electrified Vehicle |
| C2C | Customer-to-Customer |
| C2X | Customer-to-Everyone |
| C | |
| CE | Circular Economy |
| CED | Cumulative Energy Demand |
| CEPI | Confederation of European Paper Industries |
| CO ₂ -eq | CO ₂ equivalents |
| CP | Consumer preferences |
| CPA | Classification of Products by Activity |
| E | |
| EAP | Environmental Action Programme |
| EC | European Commission |
| ECHA | European Chemicals |
| EEA | European Environment Agency |
| EEE | Electrical and electronic equipment |
| ELCD | European Reference Life Cycle Database |
| EoL | End-of-Life |
| EPD | Environmental Product Declaration |
| EPR | Extended Producer Responsibility |
| ERRT | European Retail Round Table |
| EWOM | Electronic word-of-mouth |
| F | |
| FCEL | Fuel Cell Electrified Vehicle |
| FMCG | Fast Moving Consumer Goods |

| ABBREVIATION | TERM |
|--------------|--|
| FU | Functional Unit |
| G | |
| GB | Gigabyte |
| GR | Growth rate |
| H | |
| HDV | Heavy Duty Vehicles |
| HGV | Heavy Goods Vehicle |
| I | |
| ICE | Internal Combustion Engine |
| ICT | Information and Communications Technology |
| IoT | Internet of Things |
| IREU | InternetRetailing Europe |
| ISA | International Organisation for Standardisation |
| K | |
| kWh | Kilowatt-hour |
| L | |
| LCA | Life-cycle assessment |
| LDPE | Low-density Polyethylene foil |
| LDV | Light Duty Vehicles |
| LPI | Logistics Performance Index |
| M | |
| MB | Megabyte |
| M-Commerce | Mobile Commerce |
| MR | Market relevance |
| O | |
| OECD | The Organisation for Economic Co-operation and Development |
| P | |
| P2P | Peer-to-Peer |
| PEF | Production Environmental Footprint |
| PEFCR | Product Environmental Footprint Category Rules |
| PHEV | Plug-in Hybrid Vehicle |
| PRO | Producer Responsibility Organisation |
| PS | Polystyrene |
| Prodcom | Production Communautaire |
| R | |

| ABBREVIATION | TERM |
|---------------------|--|
| REACH | Registration, Evaluation, Authorisation and Restriction of Chemicals |
| REAP | Retailers' Environmental Action Programme |
| S | |
| SMCG | Slow Moving Consumer Goods |
| SVHC | Substance of very high concern |
| T | |
| tkm | tonne-kilometre |
| U | |
| U-Commerce | Ubiquitous Commerce |
| UGC | User-generated content |
| W | |
| WEEE | Waste of Electrical and Electronic Equipment |

7240

7241

WORKING DRAFT - NOT FOR PUBLICATION

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- 8061
- 8062

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8064

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8069 Amazon

8070 Ambilamp

8071 eBay

8072 Ecolight

8073 Ecotic

8074 European eCommerce & Omni-Channel Trade Association (EMOTA)

8075 Eucobat

8076 EuroCommerce

8077 European Recycling Platform/Landbell Group

8078 Extended Producer Responsibility Alliance (EXPRA)

8079 Independent Retail Europe

8080 WEEE Forum

8081 Zero Waste Europe (ZWE)

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⁹ The inclusion in the list does not imply that the organisation endorses the contents of the present report.

8086 **9 Annexes**

8087 **9.1 Annex 1: Tables - Selection of relevant products for assessment of opportunities and threats**

8088 **Table 51: Results of the application of the screening criteria to the initial set of product categories. The product categories coloured in green**
8089 **represent the final 7 product categories selected for the study.**

| Product categories | Product category type | | Market Relevance | | | | Level of circularity | | | | Consumer behaviour | | | |
|----------------------|-----------------------------|-------|-----------------------------|------|---|--------|----------------------|-------|-------------------------|-------|--------------------|-------|-----------------------------|--------|
| | Product category diversity | | Current purchases (2019) | | Online growth rate purchases (2021 vs 2019) | | Return rates | | Packaging | | Purchase frequency | | Consumer preferences | |
| | Diversity (A to J) | | Relevance (high/medium/low) | | | | Diversity (A, B, C) | | Diversity (A, B, C, D) | | Diversity (A, B) | | Relevance (high/medium/low) | |
| | Product type | Score | Total [mio €] | Rank | Online growth rate | Score | Return rate | Score | Nr. of items per parcel | Score | SMCG/ FMCG | Score | % for online purchases | Score |
| Accessories | Accessories and eyewear | A | 53,209 | 13 | 1.15 | low | n/a | n/a | n/a | n/a | SMCG | A | 22% | medium |
| Apparel | Apparel and footwear | B | 393,946 | 1 | 1.14 | low | 19.3% | B | 3-4 | B | FMCG | B | 19% | medium |
| Beverages | Food, beverages and tobacco | D | 275,024 | 2 | 1.10 | low | < 10% | A | > 6 | D | FMCG | B | 3.05% | low |
| Chilled foods | Food, beverages and tobacco | D | 65,189 | 12 | 1.26 | medium | < 10% | A | > 6 | D | FMCG | B | 3% | low |

| Product categories | Product category type | | Market Relevance | | | | Level of circularity | | | | Consumer behaviour | | | |
|------------------------------------|-----------------------------|-------|-----------------------------|------|---|--------|----------------------|-------|-------------------------|-------|--------------------|-------|-----------------------------|--------|
| | Product category diversity | | Current purchases (2019) | | Online growth rate purchases (2021 vs 2019) | | Return rates | | Packaging | | Purchase frequency | | Consumer preferences | |
| | Diversity (A to J) | | Relevance (high/medium/low) | | | | Diversity (A, B, C) | | Diversity (A, B, C, D) | | Diversity (A, B) | | Relevance (high/medium/low) | |
| | Product type | Score | Total [mio €] | Rank | Online growth rate | Score | Return rate | Score | Nr. of items per parcel | Score | SMCG/FMCG | Score | % for online purchases | Score |
| Cosmetics and personal care | Personal care and home care | I | 80,928 | 11 | 1.17 | low | < 10% | A | 1-2 | A | FMCG | B | 14% | medium |
| Deep-frozen foods | Food, beverages and tobacco | D | 88,583 | 10 | 1.30 | medium | < 10% | A | > 6 | D | FMCG | B | 3% | low |
| Eyewear | Accessories and eyewear | A | 50,816 | 14 | 1.14 | low | < 10% | A | 1-2 | A | FMCG | B | 10% | medium |
| Footwear | Apparel and footwear | B | 100,196 | 8 | 1.17 | low | 19,3% | A | 3-4 | B | FMCG | B | 23% | medium |
| Fresh bakery products | Food, beverages and tobacco | D | 116,653 | 7 | 1.29 | medium | < 10% | A | > 6 | D | FMCG | B | 3% | low |
| Fresh fruits and vegetables | Food, beverages and tobacco | D | 0 | 26 | 0.00 | low | < 10% | A | > 6 | D | FMCG | B | 3% | low |
| Home and laundry care | Personal care and home care | I | 31,314 | 19 | 1.01 | low | < 10% | A | 1-2 | A | FMCG | B | 3% | low |

| Product categories | Product category type | | Market Relevance | | | | Level of circularity | | | | Consumer behaviour | | | |
|---|--|-------|-----------------------------|------|---|--------|----------------------|-------|-------------------------|-------|--------------------|-------|-----------------------------|--------|
| | Product category diversity | | Current purchases (2019) | | Online growth rate purchases (2021 vs 2019) | | Return rates | | Packaging | | Purchase frequency | | Consumer preferences | |
| | Diversity (A to J) | | Relevance (high/medium/low) | | | | Diversity (A, B, C) | | Diversity (A, B, C, D) | | Diversity (A, B) | | Relevance (high/medium/low) | |
| | Product type | Score | Total [mio €] | Rank | Online growth rate | Score | Return rate | Score | Nr. of items per parcel | Score | SMCG/FMCG | Score | % for online purchases | Score |
| Luxury goods | Luxury goods | H | 99,134 | 9 | 0.00 | low | n/a | n/a | n/a | n/a | SMCG | A | 10% | medium |
| Major furnishings | Furnishings | E | 252,140 | 3 | 1.25 | medium | 1.9% | A | > 6 | D | SMCG | A | 9% | low |
| Major household appliances | Household appliances | F | 32,532 | 18 | 1.18 | low | 6.5% | A | 1-2 | A | SMCG | A | 37% | high |
| Major information and communication technology | Information and communication technology | G | 34,281 | 17 | 1.11 | low | 6.5% | A | 1-2 | A | SMCG | A | 36% | high |
| Media and entertainment products/services | Cultural and recreational goods | C | 18,870 | 22 | 1.55 | high | 1.3% | A | 1-2 | A | FMCG | B | 60% | high |
| Musical instruments | Cultural and recreational goods | C | 3,798 | 25 | 1.09 | low | n/a | n/a | n/a | n/a | SMCG | A | 25% | high |

| Product categories | Product category type | | Market Relevance | | | | Level of circularity | | | | Consumer behaviour | | | |
|---|--|-------|-----------------------------|------|---|--------|----------------------|-------|-------------------------|-------|--------------------|-------|-----------------------------|--------|
| | Product category diversity | | Current purchases (2019) | | Online growth rate purchases (2021 vs 2019) | | Return rates | | Packaging | | Purchase frequency | | Consumer preferences | |
| | Diversity (A to J) | | Relevance (high/medium/low) | | | | Diversity (A, B, C) | | Diversity (A, B, C, D) | | Diversity (A, B) | | Relevance (high/medium/low) | |
| | Product type | Score | Total [mio €] | Rank | Online growth rate | Score | Return rate | Score | Nr. of items per parcel | Score | SMCG/FMCG | Score | % for online purchases | Score |
| Non-perishable foods | Food, beverages and tobacco | D | 247.157 | 4 | 1.30 | medium | < 10% | A | > 6 | D | FMCG | B | 3% | low |
| Nonprescription pharmaceuticals and healthcare | Personal care and home care | I | 20.096 | 21 | 1.13 | low | < 10% | A | 1-2 | A | FMCG | B | 13% | medium |
| Pet foods and supplies | Pet foods and supplies | J | 20.280 | 20 | 1.34 | medium | n/a | n/a | n/a | n/a | FMCG | B | 3% | low |
| Small furnishings | Furnishings | E | 50.034 | 15 | 1.26 | medium | 1.9% | A | > 6 | D | SMCG | A | 9% | low |
| Small household appliances | Household appliances | F | 15.626 | 24 | 1.19 | low | 6.5% | A | 1-2 | A | SMCG | A | 37% | high |
| Small information and communication technology | Information and communication technology | G | 120.570 | 6 | 1.16 | low | 6.5% | A | 1-2 | A | SMCG | A | 36% | high |

| Product categories | Product category type | | Market Relevance | | | | Level of circularity | | | | Consumer behaviour | | | |
|-------------------------------------|---------------------------------|-------|-----------------------------|------|---|-------|----------------------|-------|-------------------------|-------|--------------------|-------|-----------------------------|-------|
| | Product category diversity | | Current purchases (2019) | | Online growth rate purchases (2021 vs 2019) | | Return rates | | Packaging | | Purchase frequency | | Consumer preferences | |
| | Diversity (A to J) | | Relevance (high/medium/low) | | | | Diversity (A, B, C) | | Diversity (A, B, C, D) | | Diversity (A, B) | | Relevance (high/medium/low) | |
| | Product type | Score | Total [mio €] | Rank | Online growth rate | Score | Return rate | Score | Nr. of items per parcel | Score | SMCG/ FMCG | Score | % for online purchases | Score |
| Sports and leisure equipment | Cultural and recreational goods | C | 16.109 | 23 | 1.09 | low | 1.7% | A | 1-2 | A | SMCG | A | 25% | high |
| Tobacco products | Food, beverages and tobacco | D | 148.902 | 5 | 1.02 | low | n/a | n/a | n/a | n/a | FMCG | B | 0.10% | low |
| Toys and games | Cultural and recreational goods | C | 35.677 | 16 | 1.09 | low | 2.2% | A | 1-2 | A | SMCG | A | 25% | high |

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8092 **Table 52: Initial range for the selection of the final 7 product categories, classification information and statistical/market data matching**

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|--------------------|---|--|---|--|---|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| 1 | Accessories | Tanned and dressed leather; luggage, handbags, saddlery and harness; dressed and dyed fur Jewellery, bijouterie and related articles | Watches & Jewellery Watches Jewellery Luggage & Bags Suitcases & Briefcases Handbags Wallets & Little Cases Bags & Containers | - | Accessories Bags/leather goods Fine jewellery/watches | - |
| 2 | Apparel | Wearing apparel, except fur apparel articles of fur Knitted and crocheted apparel | Women's & Girls' Apparel: Coats & Jackets, Blazers Suits & Ensembles, Dresses & Skirts, Trousers, Blouses, Jerseys, Sweatshirts & Pullovers. Men's & Boys' Apparel: Coats & Jackets, Blazers, Suits, Trousers, Shirts, Jerseys, Sweatshirts & Pullovers. Sports & Swimwear: Track & Jogging Suits (unisex), Swimwear (women & girls), Swimwear (men & boys). Underwear: Night & Underwear (women & girls), Night & Underwear (men & boys). T-Shirts & Singlets Hosiery Tights & Stockings Socks Clothing Accessories & Other Clothes Leather Clothes | Clothing and footwear | Apparel-women Apparel-men Apparel-children | Clothing |

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|----------------------|--|---|---|--|---|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| | | | Baby Clothes Gloves Neckwear Hats & Caps Other Clothing Accessories & Clothes | | | |
| 3 | Beverages | Beverages | Liqueurs & Other Spirits Wine Still Wine Sparkling Wine Fortified Wine Cider, Perry & Rice Wine Non-Alcoholic Drinks Bottled Water Soft Drinks Juices Orange Juice Apple Juice Grapefruit Juice Pineapple Juice Grape Juice Other Juice, Juice Mixtures & Smoothies Hot Drinks Coffee Roast Coffee Instant Coffee Tea Cocoa | Food | Wine Liquor Beer | Food/ Nearfood |
| 4 | Chilled foods | Dairy products Preserved meat and meat products | Confectionery Chocolate Confectionery Sugar Confectionery | Food | Food/groceries | Food/ Nearfood |

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|------------------------------------|--|--|---|--|---|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| | | | Cookies & Crackers | | | |
| 5 | Cosmetics and personal care | Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations Articles of paper and paperboard | Cosmetics Skin Care Personal Hygiene Hair Care Fragrances Oral Care Tissue & Hygiene Paper Toilet Paper Paper Tissues Household Paper Feminine Hygiene Baby Diapers Incontinence | Cosmetics, skincare and haircare | Cosmetics/skin care Perfume/cologne | Health & Beauty |
| 6 | Deep-frozen foods | Dairy products | Canned, Dried & Frozen Vegetables Canned, Dried & Frozen Fruit Ice Cream Convenience Food Ready Meals | Food | Food/groceries | Food/ Nearfood |
| 7 | Eyewear | Medical and dental instruments and supplies | Spectacle Lenses Sunglasses Eyewear Frames Plastic Eyewear Frames Non-Plastic Eyewear Frames Contact Lenses | | Eyewear | |
| 8 | Footwear | Footwear | Leather Footwear Athletic Footwear | Clothing and footwear | Shoes-women Shoes-men | Shoes and Lifestyle |

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|------------------------------------|--|---|---|--|---|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| | | | Sandals, Textile & Other Footwear | | Shoes-children | |
| 9 | Fresh bakery products | Bakery and farinaceous products | Bread | Food | Food/groceries | Food/ Nearfood |
| 10 | Fresh fruits and vegetables | Products of agriculture, forestry and fishing | - | Food | Food/groceries | Food/ Nearfood |
| 11 | Home and laundry care | Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations | Laundry Care Household Cleaners Dishwashing Detergents Polishes, Room Scents & Insecticides | - | - | - |
| 12 | Luxury goods | Jewellery, bijouterie and related articles | Luxury Leather Goods Luxury Watches & Jewellery Luxury Watches Luxury Jewellery Luxury Fashion Luxury Apparel Luxury Footwear Luxury Eyewear Prestige Cosmetics & Fragrances Prestige Cosmetics Prestige Skin Care Prestige Fragrances | | Fine jewellery/watches | |
| 13 | Major furnishings | Furniture | Living-room & Dining-room Furniture Seats & Sofas Wooden Furniture for Living & Dining-room | Home furnishings | Furniture/ home decor | Home and Garden |

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|---|---|--|---|--|--|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| | | | Bedroom Furniture Beds Mattresses Closets, Nightstands & Dressers Kitchen Furniture Plastic & Other Furniture Office Furniture Floor Covering | | | |
| 14 | Major household appliances | Domestic appliances | Refrigerators Freezers Dishwashing Machines Washing Machines Cookers & Ovens | Home electronics | Household goods and appliances | Household Electronics |
| 15 | Major information and communication technology | Computers and peripheral equipment Communication equipment Consumer electronics | Televisions Desktop PCs PC Monitors and Projectors Printers and Copiers | Home electronics | Electronics/ computers/ peripherals | Information Technology Consumer Electronics |
| 16 | Media and entertainment products/services | Printing services and services related to printing Reproduction services of recorded media | | Books/ audiobooks Films CDs | Books/ Music | Media and Entertainment |

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|----------------------------|--|--|---|--|---|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| 17 | Musical instruments | Musical instruments | Acoustic Pianos & Stringed Keyboard Instruments String Instruments Wind Instruments Percussion Instruments Electronic & Electromechanical Musical Instruments Parts & Accessories of Musical Instruments | - | - | - |
| 18 | Non-perishable food | Preserved meat and meat products Processed and preserved fish, crustaceans and molluscs Processed and preserved fruit and vegetables Vegetable and animal oils and fats Grain mill products, starches and starch products Other food products | Processed Fish & Seafood Canned, Dried & Smoked Fish Fish Fingers & Portions Processed Vegetables, Fruit & Potatoes Preserved Pastry Goods & Cakes Pasta & Rice Pasta & Noodles Sauces & Condiments Tomato Ketchup Sauces & Condiments (without ketchup) Breakfast Products Breakfast Cereals Jams, Jellies, Purées & Marmalade Chocolate Spreads Peanut Butter Snack Food Tortilla Chips, Flips & Pretzels Potato Chips Nuts & Seeds Baby Food | Food | Food/ groceries | Food/ Nearfood |

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|--|--|--|---|--|---|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| 19 | Non-prescription pharmaceuticals and healthcare | Basic pharmaceutical products Pharmaceutical preparations | Analgesics Cold & Cough Remedies Digestives & Intestinal Remedies Skin Treatment Vitamins & Minerals | - | Pharmacy/ healthcare | - |
| 20 | Pet foods and supplies | Prepared animal feeds | Pet Food | - | Pet food and supplies | - |
| 21 | Small furnishings | Furniture | Lamps & Lighting | Home furnishings | Furniture/ home decor | Home and Garden |
| 22 | Small household appliances | Domestic appliances Manufactured goods n.e.c. | Vacuum Cleaner Small Kitchen Appliances Hair Clippers Irons Toasters Grills & Roasters Hair Dryers | Home electronics | Household goods and appliances | Household Electronics |
| 23 | Small information and communication technology | Consumer electronics Electronic components and boards Communication equipment Measuring, testing and navigating equipment; watches and clocks Optical instruments and photographic equipment | Smartphones Video Game Consoles Landline Phones Laptops Tablet PCs Keyboards Headphones Speakers Cameras | Home electronics | Electronics/ computers/ peripherals Telecommunications/ phones | Information Technology Telecom Consumer Electronics |

| N. | Product categories | Classification information | Statistical/Market Data Matching | | | |
|----|-------------------------------------|--|---|---|--|---|
| | | Eurostat 3-digit categories (CPA/PRODCOM) C – MANUFACTURED PRODUCTS | Statista Market Outlook 2021 | Postnord: E-commerce in Europe 2018 (Top E-commerce products in Europe) | KPMG: 2017 Global Online Consumer Report (Top categories for online consumption) | Ecommerce Europe (Popular product groups) |
| 24 | Sports and leisure equipment | Sports goods | Winter Sports Equipment Summer Sports Equipment Other Sports Equipment Fishing Articles & Equipment | Sports and leisure products | Sporting goods/ equipment | Sports & Recreation |
| 25 | Tobacco products | Tobacco products | Cigarettes Smoking Tobacco Cigars | - | - | - |
| 26 | Toys and games | Games and toys | Dolls & Stuffed Toys Construction Sets & Models Card Games Puzzles Toys for Toddlers & Kids Plastic & Other Toys | Toys Children's items | Toys/ games/ video games | Toys |

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8095 **Table 53: Selection criteria for I, II and III screening rounds**

| Current market relevance (MR) | Growth rate (GR) | Consumer preferences (CP) | Result |
|---|------------------|---------------------------|----------|
| I screening (Current market relevance - first 10 product categories) | | | |
| high | low | medium | SELECTED |
| high | low | high | SELECTED |
| high | medium | low | POSSIBLE |
| high | low | low | EXCLUDED |
| medium | low | medium | POSSIBLE |
| medium | medium | low | POSSIBLE |
| II screening (HIGH consumer preference) | | | |
| high | low | high | SELECTED |
| low | high | high | SELECTED |
| low | low | high | POSSIBLE |
| III screening (MEDIUM consumer preference) | | | |
| high | low | medium | SELECTED |
| medium | low | medium | POSSIBLE |
| low | low | medium | EXCLUDED |

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8098 **9.2 Annex 2: Tables – Correlations between identified opportunities and threats**

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8100 **Table 54: Attribution matrix: correlations between identified opportunities and threats**

| T/O | Ranking according report | Name | E-commerce feature | | | | | | | | Life cycle stage where O/T originates from | | | | | | | Effect order | | Clusters | | | | | | | | |
|-----|--------------------------|---|---|-----------------------------|----------------------------------|-----------------------------|--------------------------|---------------------------------|--|------------------------------|--|-------------------|--------------------------------|---|--------------------------------|---|--|---|----------------------------|---------------------|--------|----------|------------------------------|------------------------------|----------------|-----|-----------------|-------------------------|
| | | | (Non-physical) online shops and platforms | Automatization of processes | Automatization of data analytics | Availability of information | Availability of products | Digital and mobile connectivity | Digital purchasing and transaction process | Easier/broader market access | Shipping of products | Primary packaging | Distribution from manufacturer | E-fulfillment center operations (warehouse) | E-fulfillment purchasing (ICT) | E-fulfillment - after sales (secondary packaging) | Shipping (transport to parcel network/last mile) | Return (transport and E-fulfillment operations) | Unboxing (packaging waste) | EoL (reuse, repair) | Direct | Indirect | Accessibility of information | Consumer needs and behaviour | Digitalization | EoL | Legal framework | Logistics and transport |
| O | 1 | Availability of information | | | | ● | | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| O | 2 | Big data/ meta data | | | ● | | | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| O | 3 | Innovation | | | | | | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| O | 4 | Market access to online aftermarket | | | | | | | | | | | ● | | | | | | ● | | ● | | | | | | | |
| O | 5 | Product portfolio | | | | | ● | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| T | 6 | International market access | | | | | | | | | ● | | | | | | | | | ● | | ● | | | | | | |
| T | 7 | Ubiquity | | | | | ● | | | | | ● | | | | | | | | ● | | ● | | | | | | |
| O | 8 | Nudging | | | | ● | | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| O | 9 | Sharing models and services | | | | | | | | | | | ● | | | | | | ● | | ● | | | | | | | |
| T | 10 | Cross-selling and up-selling | | | ● | | | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| T | 11 | Ease of shopping | | | | | ● | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| T | 12 | Personalised design | | | | | ● | | | | | ● | | | | | | | | ● | | ● | | | | | | |
| T | 13 | Shopping frenzy | | | | | | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| O | 14 | Digital goods | | | | | | ● | | | | | | ● | | | | | | ● | | ● | | | | | | |
| O | 15 | Reduction of retail space | ● | | | | | | | | | | ● | | | | | | | ● | | ● | | | | | | |
| O | 16 | Substitution of printed marketing material | | | | | | ● | | | | | ● | | | | | | | ● | | ● | | | | | | |
| T | 17 | Operation of network infrastructure | ● | | | | | | | | | ● | | | | | | | | ● | | ● | | | | | | |
| O | 18 | Extended product selling cycle | ● | | | | | | | | | | | | | | | | | ● | | ● | | | | | | |
| O | 19 | Product take-back | | | | | | | | | | | | | | | | | ● | | ● | | | | | | | |
| O | 20 | ReCommerce: Second-hand E-commerce /online auctioning | | | | | | | | | | | | | | | | | ● | | ● | | | | | | | |
| O/T | 21 | Food waste | | | | | | | | | | | | | | | | | ● | | ● | | | | | | | |
| T | 22 | End-of-Life challenges | ● | | | | | | | | | | | | | | | | | ● | | ● | | | | | | |
| T | 23 | Waste from returns | | | | | | | | | | | | | | ● | | | | ● | | ● | | | | | | |

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8105 **9.3 Annex 2: Tables – In depth assessment of opportunities and threats for selected product categories**

8106 **Table 55 : Shipped units 2017**

| Country | Apparel items [items] | small ICT items [items] | Major household appliances [items] | Media products [total] | n-p food [items] | major furniture [items] |
|-------------------------|-----------------------|-------------------------|------------------------------------|------------------------|------------------|-------------------------|
| Poland | 224,820,000 | 17,424,000 | 1,086,000 | 40,112,000 | 31,392,000 | 8,284,000 |
| Sweden (Nordics) | 119,880,000 | 8,280,000 | 582,000 | 17,260,800 | 15,177,600 | 2,827,200 |
| Spain | 458,460,000 | 28,476,000 | 1,938,000 | 71,688,000 | 74,160,000 | 10,506,000 |
| France | 651,780,000 | 46,260,000 | 3,507,000 | 113,900,000 | 96,900,000 | 17,000,000 |
| Germany | 903,780,000 | 51,624,000 | 4,524,000 | 207,548,000 | 97,944,000 | 31,482,000 |
| EU 28 | 7,708,680,000 | 474,811,917 | 34,785,000 | n.a. | n.a. | n.a. |

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8108 **Table 56: Product category-specific return rates per country (Source: Postnord 2018 and Eurostat)**

| Country | share of citizens who returned apparel [%] | Return rates small ICT [%] | Return rates major household appliances [%] | Media return rate average [%] | assumed return rate non-perishable food, based on expert opinion | Share of citizens who returned home furniture [%] |
|---------------------------------|--|----------------------------|---|-------------------------------|--|---|
| Poland | 13% | 4% | 4% | 1% | 2% | 2% |
| Sweden (Nordics) | 22% | 5% | 5% | 1% | 2% | 2% |
| Spain | 17% | 12% | 12% | 1% | 2% | 1% |
| France | 19% | 7% | 7% | 2% | 2% | 2% |
| Germany | 28% | 7% | 7% | 3% | 2% | 3% |
| EU 28 (average of above) | 20% | 7% | 7% | 2% | 2% | 2% |

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8111 **Table 57: Package weight material LDPE foil**

| Parcel type | Dimensions LxWxH in [mm] | | | Area in [m ²] | Thickness 60µm in [m] | Foil volume in [m ³] | Density LDPE foil 0.93 g/cm ³ in [g/m ³] | Packaging weight per item in [g] |
|--------------------|--------------------------|-----|-----|---------------------------|--------------------------|-------------------------------------|--|--|
| Standard Letterbox | 229 | 324 | 35 | 0.187 | 0.00006 | 0.0000112 | 930000 | 10.4 |
| Standard Shoebox | 313 | 215 | 120 | 0.261 | 0.00006 | 0.0000157 | | 14.6 |
| Standard Large Box | 600 | 300 | 150 | 0.630 | 0.00006 | 0.0000378 | | 35.2 |

8112 **Table 58: Package material weight cardboard**

| Parcel type | Dimensions LxWxH in [mm] | | | Area in [m ²] | Average area density in [g/m ²] | Packaging weight per item in [g] |
|--------------------|--------------------------|-----|-----|---------------------------|--|-------------------------------------|
| Standard Letterbox | 229 | 324 | 35 | 0.187 | 377 | 71 |
| Standard Shoebox | 313 | 215 | 120 | 0.261 | 1098 | 287 |
| Standard Large Box | 600 | 300 | 150 | 0.630 | 1867 | 1176 |

8113 **Table 59: Units per package and packaging size**

| Units per package and packaging size | Apparel | | | Small information technology | | | Major household appliances | | | Media and entertainment products | | | Major furniture | | |
|--|---------------|-------------|--------------|---------------------------------|-------------|--------------|-------------------------------|-------------|--------------|--|-------------|--------------|-----------------|-------------|--------------|
| | Lette rbox | Shoe box | Large box | Lette rbox | Shoe box | Large box | Lette rbox | Shoe box | Large box | Lette rbox | Shoe box | Large box | Lette rbox | Shoe box | Large box |
| Shipped units per package applied in calculations | 1 | 3 | 4 | 1 | 2 | - | - | - | 1.5 | 1 | 2 | 2 | - | - | 1 |

8114 **Table 60: Online retail growth rate**

| Online retail growth rate | Apparel | small ICT | Major household appliances | Media products | n-p food (pasta & rice) | major furniture |
|---|---------|-----------|----------------------------|----------------|-------------------------|-----------------|
| Average annual growth rate 2019-2021 | 7.2% | 15.07% | 8.9% | 27.45% | 15.1% | 12.5% |

8115 **Table 61 Shipped units scenario 2030 (linear)**

| Shipped units scenario 2030 (linear) [items] | | | | | | $y=m*x+b$ |
|--|----------------|---------------|----------------------------|----------------|-------------|-----------------|
| Country | Apparel | small ICT | Major household appliances | Media products | n-p food | major furniture |
| Poland | 377,187,470 | 49,284,590 | 2,238,385 | 182,259,442 | 91,022,856 | 21,357,809 |
| Sweden (Nordics) | 181,153,095 | 23,395,865 | 1,198,322 | 77,719,229 | 44,008,298 | 7,303,933 |
| Spain | 736,309,498 | 74,563,734 | 3,697,806 | 323,440,575 | 215,031,059 | 27,362,400 |
| France | 1,025,324,845 | 127,016,166 | 7,016,666 | 509,728,711 | 280,966,958 | 43,829,401 |
| Germany | 1,269,419,470 | 142,355,077 | 9,090,454 | 920,290,682 | 283,994,094 | 79,844,419 |
| EU 28 | 11,983,270,414 | 1,308,187,438 | 69,836,429 | n.a. | n.a. | n.a. |

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8118 **Table 62: Fulfilled units BAU scenario 2030**

| Fulfilled units BAU scenario 2030 (linear) [items] | | | | | | $y=m*x+b$ |
|--|---------------|---------------|----------------------------|----------------|-------------|-----------------|
| Country | Apparel | small ICT | Major household appliances | Media products | n-p food | major furniture |
| Poland | 326,644,349 | 47,116,068 | 2,139,896 | 181,257,015 | 89,202,399 | 20,973,369 |
| Sweden (Nordics) | 141,299,414 | 22,343,051 | 1,144,397 | 76,592,300 | 43,128,132 | 7,187,070 |
| Spain | 610,400,574 | 65,988,905 | 3,272,558 | 319,397,568 | 210,730,437 | 27,143,501 |
| France | 832,563,774 | 117,871,002 | 6,511,466 | 499,279,273 | 275,347,619 | 43,040,472 |
| Germany | 920,329,115 | 132,674,932 | 8,472,303 | 893,142,107 | 278,314,212 | 77,129,709 |
| EU 28 | 9,615,376,180 | 1,218,184,142 | 65,031,683 | n.a. | n.a. | n.a. |

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8120 **Table 63: Urban and Rural Consumers per country**

| | Urban [%] | Rural [%] | Density [capita/km2] | Capita [mio] | Urban [mio] | Rural [mio] | Return Rate |
|-------------------------|-----------|-----------|----------------------|--------------|-------------|-------------|-------------|
| Poland | 60,6 | 39,5 | 121,4 | 38,0 | 23,0 | 15,0 | 0,13 |
| Sweden (Nordics) | 86,1 | 13,9 | 22,5 | 10,1 | 8,7 | 1,4 | 0,22 |
| Spain | 80,0 | 20,0 | 92,1 | 46,3 | 37,1 | 9,3 | 0,17 |
| France | 80,0 | 20,0 | 122,1 | 64,8 | 51,8 | 13,0 | 0,19 |
| Germany | 75,7 | 24,3 | 231,2 | 82,8 | 62,7 | 20,1 | 0,28 |
| EU 28 | 75,3 | 24,8 | 117,7 | 443,0 | 333,4 | 109,6 | 0,20 |

8121 **Table 64: Background data for delivery in urban areas** (BIEK, 2017)

| | Number of tours per day | | | Number of packages | | | First delivery ratio | | |
|----------------|-------------------------|-------|-------|--------------------|-------|-------|----------------------|------|------|
| | a | b | c | a | b | c | a | b | c |
| Hamburg | 664,0 | 234,0 | 314,0 | 169,0 | 147,0 | 193,0 | 94,3 | 91,9 | 95,8 |
| Berlin | 1.298,0 | 897,0 | 256,0 | 163,0 | 148,0 | 133,0 | 92,9 | 97,0 | 93,0 |
| Munich | 430,0 | 238,0 | 378,0 | 158,0 | 183,0 | 121,0 | 93,9 | 97,1 | 94,4 |
| Average | 797,3 | 456,3 | 316,0 | 163,3 | 159,3 | 149,0 | 93,7 | 95,3 | 94,4 |

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8123 **Table 65: Transport distance per fulfilled unit**

| Country | Urban [km/FU] | | | Country | Rural [km/FU] | | |
|----------------|---------------|-----------|------------|----------------|---------------|-----------|------------|
| | 1. Purchase | 2. Return | Total | | 1. Purchase | 2. Return | Total |
| Poland | 2,7 | 0,2 | 2,9 | Poland | 6,7 | 0,9 | 7,5 |
| Sweden | 2,7 | 0,2 | 2,9 | Sweden | 6,6 | 0,9 | 7,5 |
| Spain | 2,7 | 0,2 | 2,9 | Spain | 6,7 | 0,8 | 7,5 |
| France | 2,7 | 0,2 | 2,9 | France | 6,7 | 0,9 | 7,5 |
| Germany | 2,7 | 0,2 | 3,0 | Germany | 6,7 | 1,0 | 7,7 |

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8126 **Table 66: Carbon intensity per fulfilled unit**

| Urban [km/FU] | | | Rural [km/FU] | | | |
|----------------|-------------|-------------------|----------------|-------------|-----------|--------------|
| Country | 1. Purchase | Total | Country | 1. Purchase | 2. Return | Total |
| Poland | 247,6 | 268,1 | Poland | 396,0 | 51,9 | 447,8 |
| Sweden | 245,7 | 267,4 | Sweden | 393,4 | 54,7 | 448,0 |
| Spain | 247,5 | 266,8 | Spain | 395,0 | 48,5 | 443,5 |
| France | 247,3 | 267,4 | France | 396,0 | 50,7 | 446,7 |
| Germany | 246,3 | 23,2 269,4 | Germany | 397,0 | 58,5 | 455,5 |

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