

## **Exnovation challenges in the retail sector in Brussels**

An analysis of the sector dynamics and of the sustainability impacts of e-commerce

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## Summary

This document analyses exnovation<sup>1</sup> challenges in the retail trade sector in the Brussels Region from a sustainability assessment perspective. The entry point for this case is the concern that the current e-commerce surge weakens traditional retail forms while generating mixed sustainability impacts. In this context, we aim to understand whether certain forms of (online) retail are to be destabilized or exnovated to reach sustainability objectives. Our two main research questions are the following: i) What are the current trends in the retail trade sector, in terms of emerging or declining models and practices? In particular, what is the extent of the rise of e-commerce and is it coupled with a decline in more traditional forms of retail? ii) What are the sustainability impacts of e-commerce? Is the e-commerce surge a negative trend in terms of sustainability? Findings: i) Online retail grows at an impressive rate, and represent now around 12 % of retail sales, with only one in four consumers not using e-commerce yet. On the supply side, the adoption of e-commerce by Belgian companies is one of the highest in the EU (about one quarter). However online Belgian purchases benefit more abroad-based pure-players, than existing Belgian retailers. Also, pricing practices of e-commerce giants such as Amazon are likely to contribute to the growing fragility of the whole retail sector that is observed in Belgium, by putting a downward pressure on margins. More specifically, the surge in e-commerce results in the decline of shops of digitalized goods (e.g. books) and of mid-size city centers. Also, it would reinforce the long-term decline of independent retail, that the rise of chains initially drove. For their part, chains seem to resist better than independent shops to the growth of e-commerce by developing successful online channels. Whereas the e-commerce surge seems to be a negative trend for the (Belgian) retail trade sector, we then investigate ii) whether it is also in terms of sustainability. The net environmental impacts of e-commerce depends on the performance of online retail when compared to physical retail (*impacts per unit*), and on its impacts on overall demand (*impacts on production and consumption quantities*). Studies generally consider the former only, despite the fact that e-commerce is very likely to generate additional consumption: it generates efficiency gains (price, time), but also makes easier the buying and selling of products because of the increased choice of options (access to a broader variety of products, from any location, at any time, etc.). In Belgium, additional consumption would regard at least one third of online purchases. Regarding impacts per unit, studies focus especially on the last mile impacts, while neglecting other phases (e.g. upstream transport, building of infrastructure). Early studies conclude in favour of e-commerce: with e-commerce and home deliveries, the last mile travel is shared, rather than realized with individual cars. However those studies use questionable assumptions. Some recent studies nuance the early results by using parameters that are more realistic and adapted to the European or Belgian context and also by considering the diversity of practices among online retailers and shoppers. This leads us to other sustainability issues raised by e-commerce: employment conditions for the last mile delivery with the use of on-call work, and in warehouses with the high use of temporary jobs, the disproportionate market power of platforms that exacerbates fair competition and trading relationships issues with suppliers and competitors, or tax optimization practices of Amazon. Conclusion: Those social sustainability issues together with uncertain environmental benefits could justify a move from the current market-led process that weakens remaining independent retailers and that destabilise the overall retail sector. What is more, with growing evidence on the sustainability issues raised by specific forms of e-commerce, exnovation appears as a promising horizon for policy intervention. Most problematic (online) retail trade forms

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<sup>1</sup> Exnovation refers to the active unmaking (destabilization, deliberate decline, phasing-out) of industries, technologies, business models or practices that are carbon-intensive or that raise other systemic sustainability issues (environmental, socioeconomic, related to urban-planning, etc.).

include: i) pure players, ii) remote, carbon-intensive and quick e-commerce iii) (online) retail giants, and iv) (online) retail of new or non-sufficiency-oriented goods.

## Highlights

- There is a surge in e-commerce ongoing. The three quarter of Belgian consumers are taking part. This type of purchase benefits pure players, often based abroad.
- The e-commerce surge results in the decline of specific forms of traditional retail, especially shops of digitized goods, shops in the centre of middle-size cities and independent retailers. Chains resist better by becoming omnichannel, but overall, the rise of e-commerce giants would destabilize the whole retail sector by putting a downward pressure on margins, and subsequently on suppliers and workers.
- From a social sustainability perspective, e-commerce would create jobs in logistics and transport, but poor quality jobs (even if better paid), and it would destroy jobs in retail, the balance being uncertain. Also, certain practices of big actors towards suppliers and public authorities are problematic.
- Regarding environmental impacts, existing research does not provide the full picture, including on the likely overconsumption effects of e-commerce. Regarding the performance of online versus offline purchase, while early studies conclude in favour of e-commerce, recent studies provide less optimistic and more nuanced results, and highlight the most problematic forms.
- We propose exnovation scenarios of certain forms of e-commerce: pure players, (online) retail giants, remote, carbon-intensive and quick e-commerce and (online) retail of new or non-sufficiency-oriented goods.

## Exnovation challenges in the retail sector in Brussels

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Dr. Solène Sureau (SONYA – ex-Geste – IGEAT/ULB)

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## 1. Introduction

### 1.1 The case: the surge in online retail from an exnovation perspective

Since a few years, online retail which corresponds to the activity of buying/selling products or services online, is experiencing phenomenal growth, **with 2-digit growth rates**. The COVID crisis has exacerbated this trend and online retail reaches now 12% of market share in Belgium and up to more than 30% in the UK (Marketline, 2021c, 2021e). In this introductory section, we define precisely what is e-commerce, we expose the general problems that this phenomenon raises and the link we consider with the exnovation<sup>2</sup> concept.

#### 1.1.1 What is online retail, how does it differentiate from traditional retail?

We can distinguish different forms of online retail, namely three: e-commerce platforms, pure-play online retailers, multichannel retailers (cf. Table 1) (Marketline, 2021e). Those forms differentiate from traditional physical retailers on several aspects (cf. 1.1.1).

**Table 1: The various forms of e-commerce and their characteristics**

Forms of e-commerce / Types of innovation	Delivery mode of products	Infrastructure for the transaction	Business model, market/chain governance
Traditional/physical retail/brick and mortar	Self pick-up	Store	Retail trader
Multi-/omni-channel/brick and click retailers (e.g. Van Den Borre)	Home delivery/collection point/self pick-up	Webshop	Retail trader
Pure-play online retailers (e.g. Coolblue)	Home delivery/collection point	Webshop	Retail trader
E-commerce platforms (ex: Zalando, Ebay)	Home delivery/collection point	Platform	Marketplace (Platform economy)

#### *A new transaction infrastructure (from store to online) and product delivery mode (from self-pickup to deliveries)*

Historical retailers (so-called **brick-and-mortar retailers**) increasingly use the online channel in addition to the offline channel: they are in this case qualified as **omnichannel** retailers (also called multi-channel or ‘bricks and clicks’). The main differences between the two channels are the **infrastructure dedicated to the transaction** (webshop versus stores) and the **delivery mode of products** (to consumer homes or collection points versus self-pickup) (cf. 3<sup>rd</sup> line of Table 1).

However, it is mostly new actors, such as Amazon, Alibaba, Zalando and Bol.com, which are the main actors and beneficiaries of the surge in online retail, with high growth rates and markets shares. Those are called **online pure-players**, in the sense that the online channel is the only channel used<sup>3</sup>. They use warehouses for the storage of products, from which the fulfillment is organized.

<sup>2</sup> Exnovation refers to the active unmaking (destabilization, deliberate decline, phasing-out) of industries, technologies, business models or practices that are carbon-intensive or that raise other systemic sustainability issues (environmental, socioeconomic, related to urban-planning, etc.).

<sup>3</sup> Although some of those actors start developing physical channels, e.g. Amazon (Neerman, 2019)

### *New 'retail' business models (from web shops to platforms)*

In addition to the online infrastructure for the transaction and the delivery, some e-commerce actors, and namely e-commerce platforms (also called online marketplaces) bring a new form of business model which is even qualified of new market governance (cf. 1<sup>st</sup> line of Table 1). E-commerce platforms are part of the broader **platform economy** (which includes Airbnb, Uber or Blablacar). As such, e-commerce platforms are 'digital matchmakers': they "bring together many actors enabling a much wider scale and scope of goods and services that can be profitably sold online but might have been impossible to sell offline or through an individual website" (OECD, 2019, p. 3).

Those platform "have **transformed buyer-seller relationships**" (OECD, 2019, p. 1): where a classical retail trader buys and sells products through a shop or a webshop (that they produced themselves or that they bought to other actors), a platform **provides the digital infrastructure** to manufacturers, wholesalers or other retailers to sell their goods to consumers. Platforms act as service providers, but which can be considered as intermediaries (Moati, 2021). Platforms are not always neutral, in the sense that the entry or participation of sellers is not always free. On a platform such as Amazon, it is up to the platform manager to decide who can sell on the platform<sup>4</sup>. In addition, a rating system allows participants (sellers and buyers) to rate each other.

As explained by (Moati, 2021, p. 17) in his book on the subject, "the main specificity of the marketplace economy (and of most platforms) is to be directed at a two-sided market (or even more), each side generating positive externalities for the other (the famous **cross-network effects**), which result in the cumulative mechanisms whereby success feeds success". This is because "for consumers, the platform will be all the more attractive, useful and efficient as the number of sellers increases, [and vice versa]. So, when one side of the platform develops, it creates a benefit – a positive externality – for the other side. As a result, it tends to expand and, in doing so, it increases the benefits that players of the other side derived from their presence, this encouraging the arrival of new entrants".

Contrary to other physical platforms such as malls or hypermarkets, the growth of online marketplaces is unlimited, or only limited by the number of consumers and sellers in the world (since online marketplaces, as other online actors, act on the international scene). Thus, a main feature of platforms lies in the fact that "their business model leads spontaneously and quickly to the **emergence of dominant positions**" (ibid, p. 11), **as we have seen with platforms such as Blablacar, Booking.com or, Amazon**. For some analysts, the movement of "platformisation" of consumption markets would be "one of the main structural features of contemporary capitalism" (ibid, p. 9).

Amazon and e.g. Bol.com have the particularity of combining both forms of market governance: marketplace/platform through which products from other suppliers are sold, and classical retail trade/webshop, through which it buys and sells products, incl. from its own brands (Leterme, 2019). Other main pure players provide marketplaces only (e.g., Alibaba, eBay, Zalando).

#### **1.1.2 Problem statement: the link between the e-commerce surge and exnovation**

##### *Initial problem statement*

The surge in online retail is both applauded and feared. On one side, e-commerce would bring new **opportunities, including jobs and growth**, as claimed by e.g. international institutions (OECD, 2019; UNCTAD, 2021a). E-commerce is also said to be more environmentally performant than physical retail, because it would be more efficient and it would replace individual travel with

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<sup>4</sup> This is not the case on platforms such as Airbnb or Blablacar, where the participation to the platform is free and open to anyone who comply to the rules.



mutualized travels for the last mile. On the other side, the rise of e-commerce raises **concerns** at various levels. It would imply **detrimental environmental impacts**, because of the new infrastructures needed for e-commerce (information technologies, warehouses) or because of over packaging. There are also concerns that e-commerce leads to overconsumption or to consumerist behaviors, while Western consumers should already decrease their consumption quantities not to exceed planetary boundaries (d’Allens, 2019). Also of concerns are the **employment and working conditions** provided by main pure players or platforms, to their workers and other supply chain actors, and their behaviour towards public authorities (Chaibi et al., 2020; RTBF, 2021b). And finally, the activity of e-commerce actors, who are mainly based outside Belgium, is **threatening their main competitors, i.e. traditional and local retailers** (RTBF, 2021a), who are providers of **both jobs and access to goods and services** to final consumers of the territory. At the same time, some observers claim that e-commerce and physical retail are mutually reinforcing, particularly within multichannel retailers.

The **Brussels urban area**<sup>5</sup> is particularly concerned by the issue. It has the largest concentration of commercial offer in Belgium by far with “nearly 28 000 points of sale or provision of services of a commercial nature and 2,4 billion m2 of net sales area for goods” (Wayens, Debroux, et al., 2020, p. 4). Also, it offers 104 000 full-time equivalents in the wider Brussels urban region, i.e. 20 % of national employment in retail trade (Ibid, p. 10). In the Brussels Capital region more specifically, retail trade offers 61 000 full time equivalent, contributing to 9 % of employment in the region. This includes self-employment, restaurants (29,5% of this employment in terms of full time equivalent) and car sales (5%) (but not banks and insurance or non-stationary retail) (ibid, p. 10). The sector is important for the region, as it provides low-skilled jobs to Brussels residents, more than other sectors (Ibid).

On the basis of existing research, this report examines the development of e-commerce and its impact on retail trade and on sustainability more generally: **what does research says on the above-mentioned claims regarding e-commerce?**

#### *Further specification of the case “under exnovation lenses”*

We can consider the surge in e-commerce as the surge of an innovation disrupting the retail trade regime. However, unlike in the two other GOSETE cases, **the innovation seems to raise more sustainability issues than the regime at first sight**. Those sustainability issues involved by e-commerce, in comparison with traditional retail, will be extensively reviewed in the report.

Also, it appeared rather early that **there are other important dynamics spurring on the retail sector, that also raise sustainability issues (e.g., the rise of chains, of malls)**. With this work on case 3, we want to highlight those various dynamics and related impacts on the sector and on sustainability.

Contrary to the two other GOSETE cases, there is as yet no clear and integrated strategy governing the development of the sector at the regional (or at other) level(s), as there is for mobility (Good Move) or circular economy (PREC) (Wayens, Debroux, et al., 2020). In the mobility sector, sustainable and unsustainable options are discussed, the place occupied by cars, and more particularly Internal combustion engines (ICEs), is questioned (case 1, cf. D3.1). Regarding the way production chains are organized, it is now clear that the extract-produce-throw away business model is questioned, and that circular business models are to be put forward (case 2, D3.2). However, regarding retail trade, it seems that mainly market forces give directions, and **there is even less clear positioning about what should be maintained and what should be dismantled or exnovated**.

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<sup>5</sup> Including its suburbs.

Exnovation that corresponds to the active unmaking (destabilization, deliberate decline, phasing-out) of industries, technologies, business models or practices that raise systemic sustainability issues is the conceptual lens through which we regard the retail trade sector. Our final objective is **to identify what elements of the retail system should be exnovated based on existing research on retail trade developments and on the sustainability impacts of e-commerce** and to build on this basis exnovation scenarios, that could guide policy making.

Whereas the first case focuses on a specific sector or socio-technical system (mobility) and the second case focuses on a specific business model (circular economy), the present case focuses on a **specific chain node** (retail trade), that can affect most sectors (as case 2, circular economy).

### 1.1.3 Further definitions: our scope

**We define retail trade** in this report as the last node in the supply of goods and services to final consumers. Whereas trade is the activity of selling goods or services, retail trade resells them in quantities suitable for the final consumer, and wholesale trade supplies them to retail resellers or institutions. In the business world, this is referred to as “business to consumer” (B2C) and “business to business” (B2B) respectively (Wayens, Debroux, et al., 2020, p. 2). It has to be noted however that part of the turnover of retail trade from the sale of goods come from professional purchases (B2B) (it would represent 47 % of the turnover in 2012) (Wayens, Debroux, et al., 2020). It has also to be noted that B2B e-commerce represents the majority of e-commerce: for the top ten countries, it represents 82% of total sales in 2019 (UNCTAD, 2021b). However, our focus is B2C e-commerce and retail trade. The term e-commerce when used in this report means B2C e-commerce.

In the main report that we use to describe e-commerce trends (Marketline, 2021e, p. 9), the **online retail market** excludes services and includes “all sales within Clothing & Footwear, Electricals, Food & Grocery, Health & Beauty, Home and Other (Books, News & Stationery, Jewelry & Watches, Luggage & Leather Goods, Music, Video & Entertainment Software, Sports & Leisure Equipment and others) segments, provided they take place over the internet, where the payment does not occur in-store on a later occasion. Other sources that we use (e.g. Eurostat) might include services in online retail trade. It is specified in that case.

## 1.2 Objectives and research questions

We seek in this deliverable to address two main sets of research questions. As we have seen in the section above, there are concerns that the surge in e-commerce destabilizes traditional retail trade. We would like to understand whether such a destabilization is taking place or is likely to take place in the near future. We propose to look first at key trends and consumption behaviours in the retail trade sector, in order to address the following questions:

- What are the dynamics affecting the sector in Brussels?
- Is there a surge in e-commerce? Who is concerned and to which extent? Can we talk about a decline of traditional retail? How are the dynamics of e-commerce and traditional retail related? Is e-commerce having a destabilising effect on traditional retail?

Secondly, we would like to understand whether such a trend (surge in e-commerce) is desirable from a sustainability point of view. We propose to review the sustainability impacts of e-commerce (which is the assumed initial destabilization factor) on the basis of existing literature, in order to address the following second set of questions:

- What are the sustainability impacts of e-commerce in comparison with traditional retail?
- Which elements/forms/practices within e-commerce are considered as problematic in terms of sustainability?
- What should be exnovated and maintained? What could be exnovation futures?

### 1.3 Material and method

We address those research on the basis of desk research and literature review. We present our analysis of the dynamics of the retail trade sector in section 2. This analysis builds on various data and sources, including:

- 2.1. Statistics on e-commerce development in Belgium and in broader geographical areas, including the reports on e-commerce in Belgium from (Marketline, 2021d, 2021e) (provider of commercial Intelligence or information on markets), a report from (UNCTAD, 2021a), statistics from (Eurostat, 2022a), surveys on e-commerce use commissioned by Comeos (Amsterdam University of Applied Science & Center for Market Insights, 2021), and statistics and analysis from a report commissioned by the French government on the impacts of e-commerce development that combines a review of existing literature, statistics and interviews conducted towards many different actors (Bon-Maury et al., 2021).
- 2.2 Analysis on trends affecting retail trade more generally are mainly based on the work of Wayens and colleagues from IGEAT/ULB (Grimmeau & Wayens, 2016; Wayens, Debroux, et al., 2020; Wayens et al., 2020)
- 2.3 Analysis on the influence of e-commerce on retail trade is based on above-mentioned sources, as well as a literature review of studies investigating the impacts of e-commerce on physical retail or high-streets in European countries, that come from the field of geography.

We present our analysis on the sustainability impacts of e-commerce in section 3. This analysis builds on a literature review of studies assessing the environmental performance of e-commerce versus physical trade and of studies assessing the rebound effects of e-commerce or of ICT. Those are mainly sustainability assessment/Life cycle assessment and transport and logistics studies. We also reviewed some studies and resources relating to the social and socioeconomic impacts of e-commerce (Bon-Maury et al., 2021; ILO, 2021; MacGillis, 2021; Moati, 2021).

## 2. Analysis of key trends and consumption behaviors in the retail trade

In this section, we investigate the main trends affecting the retail trade sector (2.2), including the surge in e-commerce (2.1) and how it affects traditional retail in Brussels (2.3).

### 2.1 Trends in e-commerce in Belgium and Brussels

#### 2.1.1 General market trends

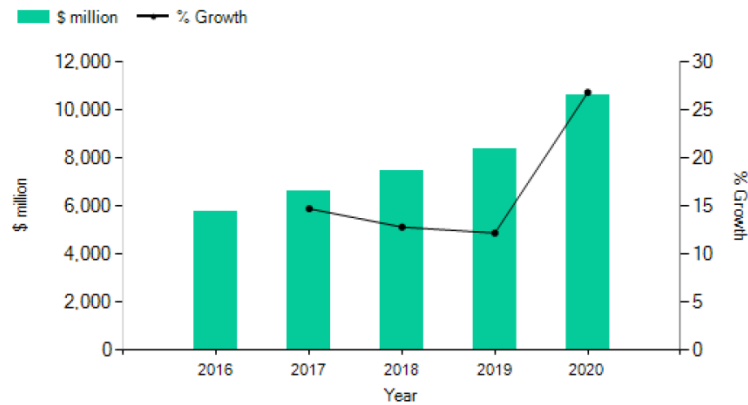
##### *Evolution in absolute value*

According to (Marketline, 2021e), “the Belgian online retail sector has grown impressively in the **historic period**, with strong growth forecast to continue in the coming years”. The annual growth of the sector value was around 14,5 % between 2014 and 2018 (Marketline, 2020).

The **Covid pandemic** had a considerable effect on the development of the online market, with a growth rate of 26.9% in 2020, to reach a value of €9,304.5 million<sup>6</sup> (cf. Figure 1), but only reinforces an already existing trend. The most important growth during that year was for the food and grocery retail products (33.6%), while the value of apparel retail and electrical and electronics retail grew by 20.3% and 28.2% respectively (Marketline, 2021e, p. 9).

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<sup>6</sup> It has also to be noted that “the growth in the value of the sector in 2020 was also driven to some extent by increases in food prices” (Marketline, 2021e, p. 10).



**Figure 1: Belgium online retail sector value: \$ million, 2016–20 (Marketline, 2021e, p. 12)**

The market value is expected to **grow further** by 65.2% between 2020 and 2025, to reach €15,372.5 million, but the annual growth rate is expected to be lower than in the recent years, and to amount 10.6% during the 2020-2025 period (Marketline, 2021e, p. 10).

#### *Evolution of the market share*

Those growth rates in absolute value are reflected in the market share evolution: while online retail sales contributed to 7.2 % of total retail sales in 2016, the rate rose to 9.8% in 2019, and to 12% in 2020 (Marketline, 2021e).

In comparison with other European countries, the Belgian market is less well developed than in the United Kingdom (UK) (from 23.1% in 2019 to 32.9% in 2020), and to a lesser extent less developed than in France (13.5% to 17.1%), in Germany (13.7% to 16.1%) (Marketline, 2021a, 2021b, 2021c)<sup>7</sup>, and in the Netherlands (Statista, 2021).

At a global level, the UK is one of the most developed market, behind China and South Korea but well ahead of the United States (UNCTAD, 2021b, p. 2) (cf. Table 2).

**Table 2: Online retail sales, selected economies, 2018-2020 (UNCTAD, 2021b, p. 2)**

Economy	Online retail sales (\$ billions)			Retail sales (\$ billions)			Online share (% of retail sales)		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Australia	13.5	14.4	22.9	239	229	242	5.6	6.3	9.4
Canada	13.9	16.5	28.1	467	462	452	3.0	3.6	6.2
China	1,060.4	1,233.6	1,414.3	5,755	5,957	5,681	18.4	20.7	24.9
Korea (Rep.)	76.8	84.3	104.4	423	406	403	18.2	20.8	25.9
Singapore	1.6	1.9	3.2	34	32	27	4.7	5.9	11.7
United Kingdom	84.0	89.0	130.6	565	564	560	14.9	15.8	23.3
United States	519.6	598.0	791.7	5,269	5,452	5,638	9.9	11.0	14.0
<b>Economies above</b>	<b>1,770</b>	<b>2,038</b>	<b>2,495</b>	<b>12,752</b>	<b>13,102</b>	<b>13,003</b>	<b>14</b>	<b>16</b>	<b>19</b>

Source: UNCTAD, based on national statistics offices.

#### **2.1.2 Its adoption by Belgian actors: e-commerce penetration rates**

According to (Marketline, 2021e, p. 10), the e-commerce phenomena is affecting both supply and demand: in recent years, “the volume and frequency of online purchases [...] increased in line with a greater number of online offerings”. In this subsection we look in more details at how and to which extent actors adopt this innovation, including which sellers and which buyers are taking part, and which of them are not.

<sup>7</sup> According to sources, figures vary. (Statista, 2021) indicates a higher market share for Germany than for France.

### On the side of buyers

#### A surge in online shopping...

According to 2021 Eurostat figures, online shoppers (making at least one online purchase) represent **75 % of Belgian individuals aged between 16 and 74**. This rate increased by 8 points in 5 years, and by 20 points in 20 years. This is well above the EU average (66 %) or the rate for Italy (44%), but similar to Germany or France, and well below the Netherlands (89%) (Eurostat, 2022a).

While it affected only slightly the share of online shoppers, the **COVID pandemic** had strong impacts on both the frequency and amounts of online purchases, which are “set to be long-lasting in terms of shaping habits in the long-term” (Marketline, 2021e, p. 11):

- 43 % of shoppers spent more or a lot more in online purchases in 2020 than in 2019;
- In 2020, 56 % of shoppers made online purchases at least once a month (48% in 2019), and 18% once a week (12% in 2015) (InSites Consulting, 2020).

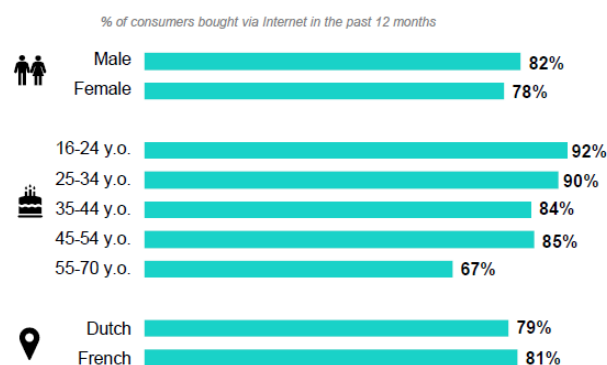
Additionally, according to a recent study based on a survey among a very large sample of Belgian consumers and retailers, “the young, better educated urban households with children” drove the increased online demand that accompanied the pandemic (Beckers et al., 2021, p. 7)

#### Affecting populations differently

E-commerce penetration is **rather unequal according to age and social classes** (Beckers et al., 2018). The rate of penetration of online purchases is particularly high among young shoppers (92%), and particularly low among older shoppers (67%) (InSites Consulting, 2020) (cf. Figure 2). Figures at the EU level indicate around 20 point difference between low- and highly educated people and between workers on one side and unemployed and retired people on the other side (Eurostat, 2022a).

Reasons for the lack of consumer participation in e-commerce include the following (OECD, 2019): preference for brick-and-mortar stores; trust and payment security (especially for the elderly); lack of skills (especially for the elderly and people with low levels of education); access to payment mechanisms (especially for low-income households).

In addition, around 6% of Belgian aged between 16 and 74 do not use internet (Eurostat, 2022a).



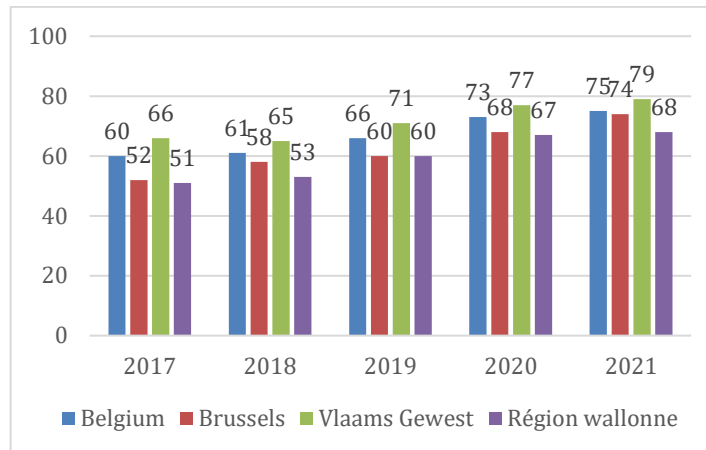
**Figure 2: E-commerce Penetration among different profiles - % of consumers bought via internet in the past 12 months (InSites Consulting, 2020, p. 6)**

#### Affecting Brussels inhabitants differently?

A few years ago (2017), the share of online shopper was **much lower in Brussels** (52%) than in Flanders (66%), and positioned below the Belgian average (60%). This difference was explained by the “socio-demographic structure of the population in the region [Beckers et al. 2018], and probably also [by] the density of the commercial offer in Brussels” (Wayens, Debroux, et al., 2020, p. 13). At the same time, (Beckers et al., 2018, p. 39) found that, contrary to other countries, “the urbanisation level of an area does not have a significant impact on the shopping probability”, given

the “historical lack of urban planning in the country, resulting in relatively high shopping accessibility throughout Belgium”.

However, Brussels inhabitants gradually closed the gap (74%) to position in 2021 close to the Flemish (79%) and to reach almost the Belgian average (75%). In comparison, the Walloon region still lags behind in terms of e-commerce use (68%) (cf. Figure 3). Yet, it could be that, in value, Brussels inhabitants shop online less than in the rest of the country: in fact, “in 2017, a survey of private consumers in Brussels, [...], estimated the market share in value of e-commerce at 2,2 %, mainly for small relatively common purchases [Vazquez Parras et al., 2019]”, while the Belgian average amounted 7.2 % in 2016 (Marketline, 2021e).



**Figure 3: Individuals (16-74 years old) who ordered goods or services over the internet for private use (Eurostat, 2022b)**

#### *On the side of the sellers/retailers*

On the seller or retailer side, recent newspaper headings suggest that foreign actors take the lion share of online spendings of Belgian consumers (Het Nieuwsblad, 2021; RTBF, 2021a). How is it? Who are the main players and to which extent do Belgian sellers participate in online retail?

#### *SMEs are less likely to participate in e-commerce but participation is high in Belgium*

According to (OECD, 2019, p. 11), “**large firms are more than twice as likely as SMEs** to participate in e-commerce in a majority of countries”. Main reasons for this gap are the lack in skills to engage in e-commerce, and the high costs associated with implementing the infrastructure and the logistics. According to a French survey (INSEE), only 15 % of companies with 10-49 workers sell online, while this rate reaches 50 % for companies with more than 250 workers (Bon-Maury et al., 2021).

Whereas small companies are more likely to remain outside of this trade, in Belgium, the **rate of adoption of e-commerce by companies is high**. More than 7 out of ten companies have a website containing a description of goods and services, including price lists (Statbel, 2020). The portion of enterprises selling online is one of the highest in Europe (24%) (Marketline, 2021e, p. 26), and this share is growing more than in other European countries (+ 5 points in 2020) (Trends Tendances, 2022).

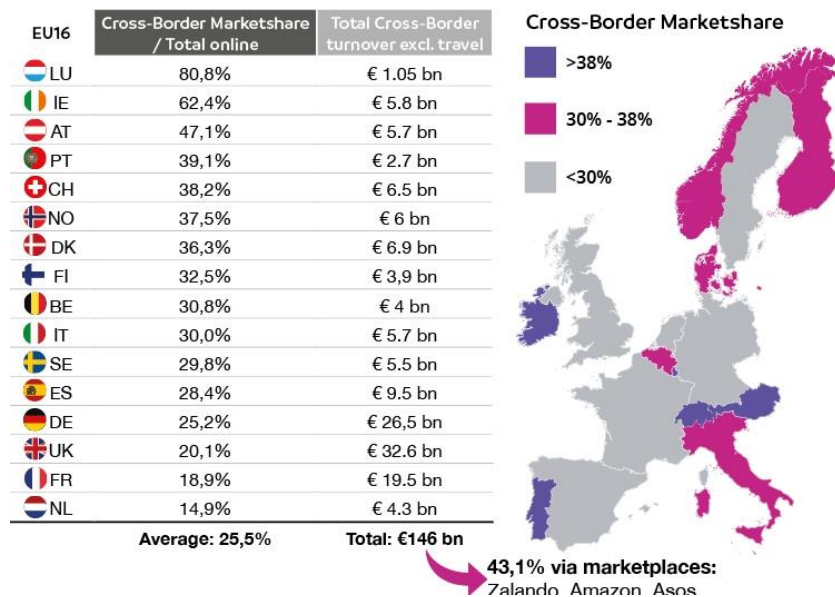
According to the consultancy specialized in e-commerce Retis, since 2010, there has been a **strong growth** in the number of Belgian online sellers and even more since the **COVID crisis**: 20,000 new webshop were created in 2020, against 3,000 to 5,000 in previous years (Amsterdam University of Applied Science & Center for Market Insights, 2021; Oलगnier, 2021). However, online sellers are mainly located in Flanders, especially around Antwerp (Oलगnier, 2021). According to a survey among Belgian retailers (targeting particularly local/independant, small businesses), “50% of those not operating an online channel before the pandemic opened a webshop at the beginning

of the lockdown”, so that 70 % of those had an operating online channel after the pandemic. However, their survey shows “a lack of professionalism concerning the management of the new online channels”, with quick fixes implemented during the lockdown rather than long-lasting solutions (Beckers et al., 2021, p. 7).

*Foreign pure layers dominate the market*

While Belgian companies perform well in terms of e-commerce adoption when comparing with other European countries, foreign-owned pure players dominate the market. **Pure players contribute to 54.9%** of Belgian retail sales (against 45 for multichannel retailers). While multi-channel retailers have recorded a stronger growth in comparison with pure players during 2016–2020 (17.3% versus 15.9% per year) (Marketline, 2021e), pure players are considered as the big winner of the COVID crisis, which benefited from the additional purchases, while not being obliged to close down their main activity, contrary to brick and mortar shops (Beckers et al., 2021). Among those sales from pure players, French figures indicate that **marketplaces** would take 20% of the online retail market.

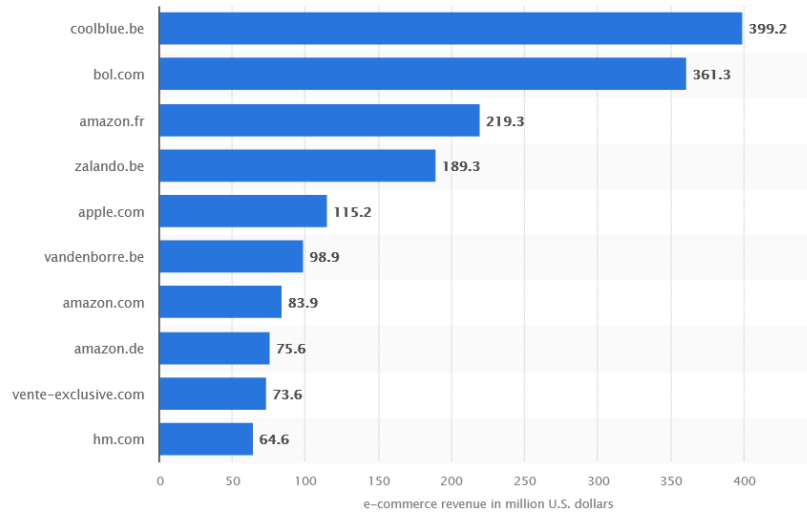
Additionally, **30.8% of online purchases are directed towards operators based abroad** in 2020, according to Cross-Border Commerce Europe<sup>8</sup>. This is above the European average (25.5%), but also rather typical for a small country and close to the rates prevailing for Spain and Italy (cf. Figure 4). However, it is well above the rate for the Netherlands (14.9%) which has the lowest rate in Western Europe and where “efficient online retailers operate for more than two decades” (Bol.com, Coolblue, Wehkamp et AH) (Van Rompaey, 2021).



**Figure 4: Cross-border e-commerce market share in selected EU countries (CBCommerce.eu, 2021)**

Nine out of the Belgian top 10 players are foreign-owned, and the four main sellers include the US conglomerate Amazon, German firm Zalando and Dutch Coolblue and Bol.com (Marketline, 2021e, p. 26) (cf. Figure 5).

<sup>8</sup> According to COMEOS, the rate would be higher, and more than half of retail turnover in Belgium would be spent on platforms based outside Belgium (Wayens, Debroux, et al., 2020, p. 13)

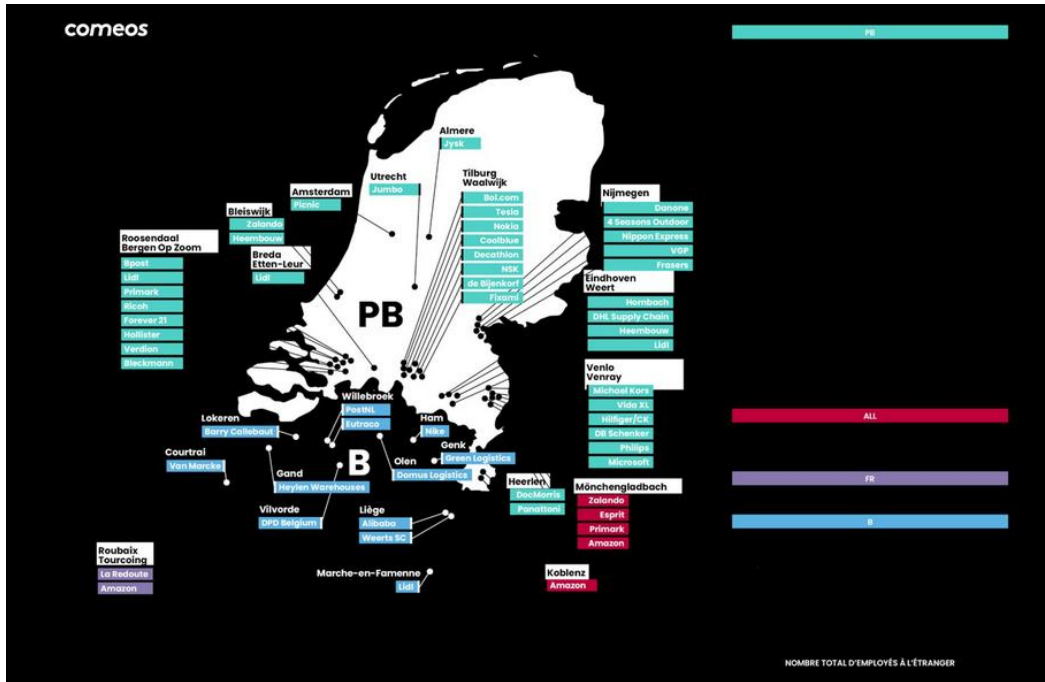


**Figure 5: Most popular online stores in Belgium, e-commerce net sales (Statista, 2022)**

A specific issue of concern for Belgium is that not all of those foreign-owned retailers have distribution warehouses/centers in Belgium, and **one out of two orders is prepared abroad** (RTBF, 2021a). According to the Belgian trade association of retail trade actors (Comeos), this situation cause a considerable loss of jobs<sup>9</sup>, and result from the higher attractiveness of the Netherlands for logistics activities: labour costs are lower, with the high use of students, and regulations on night work are more flexible (RTBF, 2021a; Ruysen, 2021). According to a map of the distribution warehouses located in Belgium and close to its borders designed by Comeos, there is a very high number of them in the Netherlands, namely 3 times more than in Belgium, and warehouses of main e-commerce actors (Amazon, Zalando) are located very close to the border in France and Germany (cf. Figure 6) (Ruysen, 2021). This situation would result from consumers buying through foreign-based operators, but also from Belgian merchants that “move their e-commerce platform abroad for regulatory and cost reasons. [...] According to Comeos, the share of Belgian companies in the turnover of national e-commerce went from 67% in 2012 to 53% in 2015” (Grimmeau & Wayens, 2016, pp. 86–87).

<sup>9</sup> Comeos stated in 2016 that 10,000 jobs would be lost, and actualized this figure to 20,000 jobs in 2021 (Grimmeau & Wayens, 2016; Ruysen, 2021). The federation of Belgian enterprises (FEB) assesses this loss to one billion € and 6000 jobs annually between 2012 and 2019 (BX1, 2022, p. 1)





**Figure 6: Mapping of e-commerce distribution centers in Belgium and neighbouring countries (Source: COMEOS) (Ruyssen, 2021)**

The Walloon region targets to reverse this trend with the ‘Pôle de compétitivité’ Logistics in Wallonia that promotes transport, logistics and mobility. A main achievement in this regard in the e-commerce domain is the current implementation of a major distribution center of the Chinese e-commerce giant **Alibaba at Liège Airport** (Leterme, 2021).

*Which sectors are taking part the most?*

French figures indicate that e-commerce has the highest market for tourism and cultural products with more than 45% in 2018-19 (when digitalized new products are taken into account for the latter). Market shares amount around 15-25% for household electronic equipment, toys and clothing. Finally, furniture and fast-moving consumer goods (including food) amount around 7% market shares (Bon-Maury et al., 2021) (cf. Table 3).

**Table 3: E-commerce market shares by sector/product (Bon-Maury et al., 2021, p. 19 Annex II)**

Marché	2015	2016	2017	2018	2019
Tourisme	43,0 %	44,0 %	N.C.	44,0 %	46,0 %
Produits culturels physiques neufs et dématérialisés	39,0 %	43,0 %	45,0 %	48,0 %	19% <sup>17</sup> .
Maison, high tech	21,0 %	22,0 %	23,0 %	19,0 %	25,9 %
Maison électroménager	17,0 %	17,0 %	18,0 %	26,0 %	20,4 %
Habillement	15,0 %	16,0 %	13,0 %	20,0 %	14,7 %
Jeux et jouets	N.C.	N.C.	N.C.	27,1 %	26,0 %
Meubles	12,0 %	N.C.	13,0 %	14,0 %	7,3 %
Produits grande consommation	N.C.	N.C.	6,6 %	7,1 %	7,6 %
dont drive PGC	4,0 %	4,9 %	5,0 %	5,7 %	6,0 %

Source : Fédération du e-commerce et de la vente à distance (FEVAD), Panel e-commerce Kantar. mission.

NB: <sup>17</sup> Change in method in 2019. Only physical new products are provided.

When looking at good retail only with more recent and Belgium specific data specifically, sectors in which e-commerce contributes the most are **consumer electronics, apparel and footwear**. In fact, the nature of products makes it easier to be sold through e-commerce and “consumers are more likely to buy products from these categories online, as the price, variety, and quality of products in these categories are even more important for consumers, while the in-store experience is deemed less important” (Marketline, 2021e, p. 10).

The adoption of the online channel by **food retailers** is late in comparison to other sectors. For those goods, in-store visits are important for consumers. Also, distributing such products online pose specific logistic challenges, and the main competitor Amazon did not enter the market (Marketline, 2021e; Moati, 2021). However, there is a **strong growth potential in this sector**, “as consumers and retailers become more accustomed with online purchases and sales of food and groceries” (Marketline, 2021e, p. 10). The Covid crisis has already removed some barriers on the consumer side, with the ‘drive-through’ development (Moati, 2021), what can be seen in the sector growth rate: the food and grocery retail segment is the one which witnessed the highest growth rate (19.9% per year during 2016–20), followed by the footwear segment (19.1%), electrical and electronics retail (18%) and home and garden products (16.3%) (Marketline, 2021f).

Another development in the food retail is **the rise of quick commerce in big cities** (also called q-commerce) or 15-minute grocery delivery, with start-ups such as the Germans Gorillas or Flink. The business model is based on the delivery of goods in record time and at any time of the day (from 7 to midnight), and on several warehouses in the same city called dark stores which are “empty buildings converted into ghost warehouses in the middle of the city where 1,500 to 2,000 everyday consumer products are stored”, i.e. a limited product range (Prévost, 2022). While already active in other countries since 2020, some of those startups entered the Belgian market lately: active companies include Gorillas (three warehouses in Brussels), the Belgian Ding Dong (one warehouse in Ixelles), Frichti and eSupply (Daphné Van Ossel, 2021). Another development within the quick commerce is the rise of **one-day shipping or next-day delivery** with the Amazon prime subscription and delivery offers of other main e-commerce giants (Bon-Maury et al., 2021). **In Brussels** more specifically, “the majority of online spending is on relatively common, relatively small (facilitating transport) and non-perishable (facilitating inventory management) products [Vazquez Parras et al., 2019b]” (Wayens, Debroux, et al., 2020, p. 24).

It is feared that this surge in e-commerce, that has been reinforced by the COVID crisis, could affect retail trade importantly. This is yet not the only trend affecting the sector. We set in the next section the broader retail scene and its dynamics in the last 70 years.

## 2.2 Trends affecting retail trade in Brussels

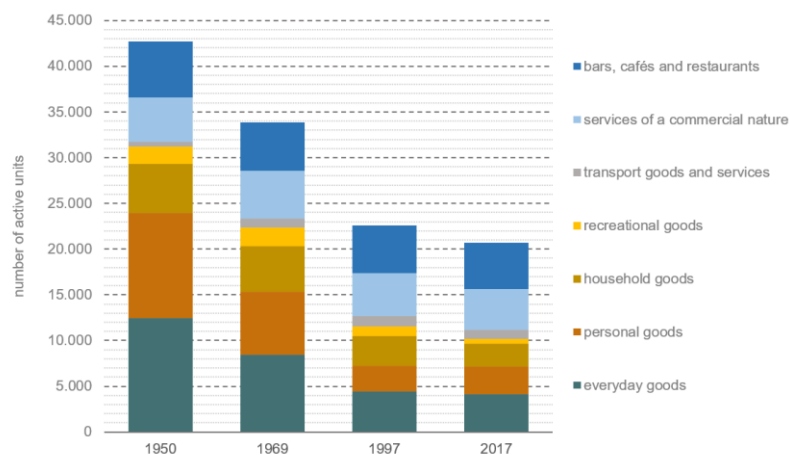
In this section, we rely mainly on the research of Benjamin Wayens and colleagues (IGEAT, ULB), who made extensive research on retail trade in Brussels, and in Belgium more generally.

### 2.2.1 A sector being transformed: fewer selling points, and more surface area

A main trend affecting the retail trade sector in the last decades is the **decline in the number of shops** in Belgium, which is not a recent phenomenon. In Brussels, between 1950 and 2017, their number decreased by more than 50%, from 42712 to 20 696 number of active points of sale (Figure 7). Since two decades, this decline however slows down. Focusing on the last ten years, the decline is less important in the Brussels region than in the two other Belgian regions (Wayens, Godart, et al., 2020).

Also, whereas between 1950 and 1997, shops specialized in personal and everyday goods decreased in favour of restaurants and services, the structure got stabilized in the last 20 years (Vazquez Parras et al., 2017).

However, on the other side, the “turnover of retail trade was growing until 2007-2009 (constant purchase power) and employment increased meaningfully until 2000” (Grimmeau & Wayens, 2016, p. 107). Also, the **net area occupied for retail trade** increased. At a Belgian level, the area dedicated to retail trade was multiplied threefold between 1961 and 2015, even if this trend is slowing down in the last decade. In the Brussels area, in the last ten years, the net sales area still increases, especially in the suburbs (+2.3% per year) (Wayens, Debroux, et al., 2020, p. 15) (cf. Table 4).



**Figure 7: Extent and structure of the commercial offer in the Brussels-Capital Region (1950-1969-1997-2017) (Wayens, Debroux, et al., 2020, p. 4)**

**Table 4: Changes in the number, occupancy and characteristics of commercial units in the Brussels urban region between 2009 and 2019 (Wayens, Debroux, et al., 2020, p. 15)**

	commercial units (number)						net sales area (in sq.m.)			
	sale of goods		cafés & restaurants		other services		total	sale of goods		
	number	AAGR	number	AAGR	number	AAGR		2009-19	moyenne	AAGR
	2019	2009-19	2019	2009-19	2019	2009-19	2019	2019	2009-19	
Brussels-Capital Region	8932	-0,9%	5284	0,3%	5240	-1,0%	1316749	0,4%	147	1,4%
remainder of urban area	2365	-1,5%	1332	-0,5%	2237	0,0%	801915	0,9%	339	2,5%
suburbs	1033	-1,0%	547	-1,1%	941	-0,5%	250241	2,3%	242	3,3%

### 2.2.2 New formats of shops and of commercial space outside of cities

This simultaneous decrease in number and increase in surface area is the sign of the increase in shop size, which itself results from the **rise of super- and hypermarkets**. The former appeared at the end of the 50's (the first one in Belgium opened in 1957 in the BCR, and there was 1000 of them in 1980) and the latter just a few years later (the first one opened in 1961 also in the BCR and there was around 100 of them in 1990) (Grimmeau & Wayens, 2016, p. 34).

Total net sales area increased as a result of the emergence of new commercial spaces. At the end of the 60's, **shopping malls** appeared in Belgium, in cities and in suburbs. In the 70's, so-called **commercial or retail parks**<sup>10</sup> and **baanwinkels** appeared, i.e. collections of big box units with car parking, outside or surrounding towns, that may include specialized shops and supermarkets or hypermarkets (Wayens, Debroux, et al., 2020, p. 6). Between 2008 and 2017 the area dedicated to baanwinkels and retail parks increased by +260% and 150% respectively. Retail parks represented 37,4 % of the Flemish commercial area in 2008 (Grimmeau & Wayens, 2016, p. 39).

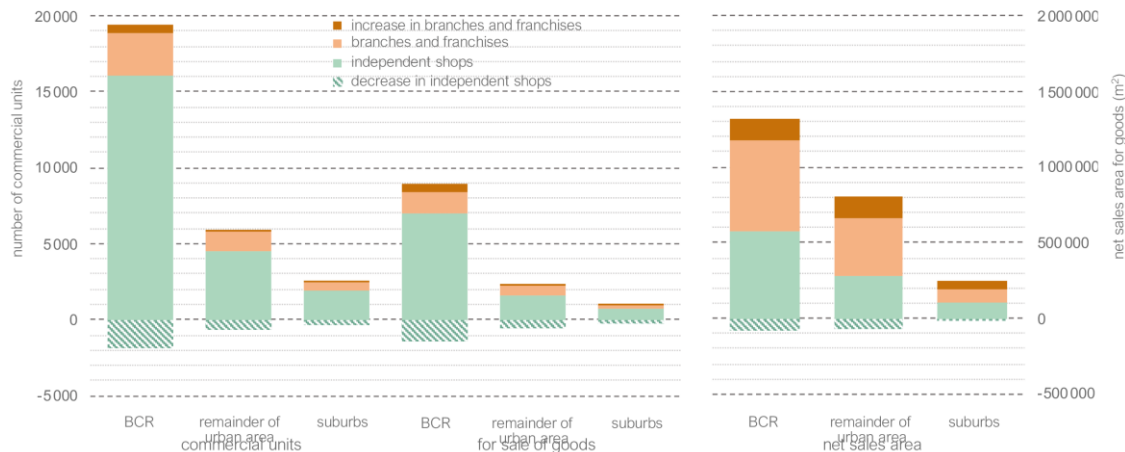
With the rise of those commercial spaces, retail activities are being **decentralized out of the inner city** (Beckers et al., 2021). This can be reflected in the increasing sales area and shop size, which are especially strong in the peripheries of cities: in the Brussels urban region, the growth rate of net sales area during the 2009-19 period is +0.4% per year in the BCR, and +2.3% in its suburbs (cf. Table 4).

This migration of retail trade follows the migration of the population from city centers to peripheries that happened in the 60's. On the other side, "as outlying commerce has developed, downtown businesses have lost suburban customers" (Grimmeau & Wayens, 2016, p. 108). Within Brussels, retail offer decreased especially in the Pentagon and the inner ring, and remained on main commercial streets (Wayens, Debroux, et al., 2020).

<sup>10</sup> Called "parc commerciaux" in French, "retail parken" in Flanders.

### 2.2.3 The rise of organized and integrated retail and the decline of independent retail

A major and long-term trend that is shaping other trends is the **rise of organized and integrated retail trade**<sup>11</sup> (or so-called chains, i.e. branches and franchises), and the increased economic concentration in the sector (Ibid). This rise has been **at the expense of independent retail trade**<sup>12</sup>, which declines sharply since more than 60 years. Those are still in majority in number, in terms of the number of employees (according to Locatus, 82 % of points of sale in Brussels, 87 % of commercial services). However, it is no longer in majority in terms of sales area (43 % for the sale of goods) (Wayens, Debroux, et al., 2020, p. 20) (cf. Figure 8).



**Figure 8: Evolution in the number of units (link) and net sales areas (right) according to operating mode in the Brussels urban region [2009-19] (Wayens, Debroux, et al., 2020, p. 16)**

(Wayens, Debroux, et al., 2020) analyse this trend of increased surface area per shop and of increasing role of organized and integrated retail as a reply to the stagnating consumption since 20 years and to the decrease in the consumption per capita: merchants “are trying to compensate for the drop in performance per square metre by increasing the number of square metres or by optimising their logistics operations” (Wayens, Debroux, et al., 2020, p. 26).

### 2.2.4 The recent market saturation, retail oversupply and vacancy issue

According to (Wayens, Debroux, et al., 2020, p. 17), there are clear signs of the current fragility and volatility of the retail sector:

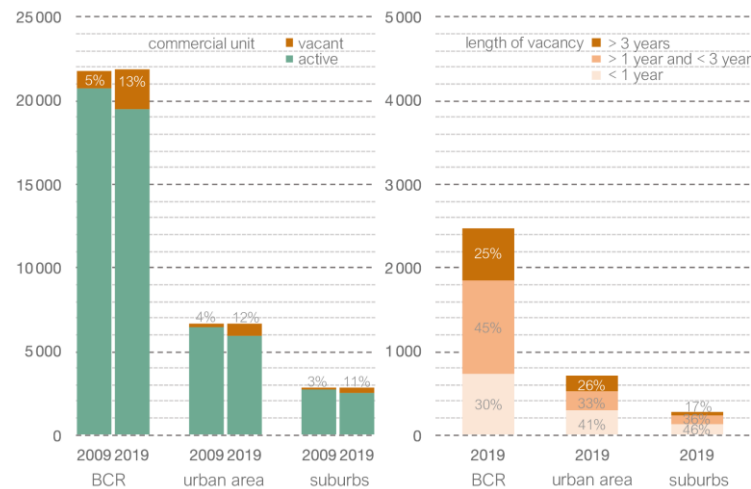
- There is first **an accelerated decline in the performance or productivity** of physical retail: “Turnover in retail trade in Belgium has stagnated since the beginning of the 2000s and is now only sustained by population growth, while turnover per capita has been falling sharply for the past 20 years. At the same time, the growth in surface area continues, although it has slowed down sharply over the past two decades. As the growth in net sales areas is faster than the growth in consumption via retail trade, turnover per square metre has been falling faster in recent years. As a result, the performance per square metre is now lower than in the past” (Wayens, Debroux, et al., 2020, p. 17). They point to several risks linked to this decrease in productivity, if the rents do not adapt to it, including a

<sup>11</sup> “Organised or integrated retail (“chains”), brings together points of sale operating as networks with various statuses [...]. The points of sale in a network grouped under the same brand name may be managed as a branch (the manager is an employee) or as a franchise (managed by a self-employed person in the context of a separate business, linked contractually to the franchiser)” (Wayens, Debroux, et al., 2020, p. 8).

<sup>12</sup> Independant or “unorganised retail [...] consists of points of sale operating alone, without being a branch and without a franchise agreement” (Wayens, Debroux, et al., 2020, p. 8).

decrease in the quantity and quality of jobs, a further increase in the size of shops or a decentralization to the outskirts.

- The second observation is the **current low profit margins and the increase in the bankruptcies**. For the sales of goods, profit margins were estimated at 1.5 % of the turnover in 2013, while it was between 9 and 16% in 1950 according to sectors.
- The third one is **the extreme and increasing versatility of the sector**, within commercial cells but also between the commercial and non-commercial spaces, and at the level of both points of sales and companies, with decreasing life time of businesses. Also, the share of **empty commercial units** now exceeds what is considered as normal and associated with rotation (5-10%): it increased from 5% in 2009 in the BCR, to 13% in 2019, of which 70% remains empty for more than one year (Wayens, Debroux, et al., 2020, p. 16) (cf. Figure 9). This phenomenon affects especially the small units located at the margin of commercial spaces.



**Figure 9: Evolution of commercial vacancy [2009-19] and length of vacancy of commercial units in 2019 in the Brussels urban region (Wayens, Godart, et al., 2020, p. 16)**

This **increase in the vacancy rate** is also observed in the rest of Belgium (La Libre Eco & Belga, 2022), in the UK (Grimsey, 2012), and in France where an increase from 7,2% to 13% [2012-2019] is observed in city centers of municipalities with 25,000 to 200,000 inhabitants (Bon-Maury et al., 2021, p. 18).

Also, recently, **a loss of interest for hypermarkets is observed** among consumers and big retailers develop mini supermarkets instead of hypermarkets (Delescluse, 2021; Le Vif, 2018). It is also the case for **shopping malls**: in Belgium, visits to malls declined by 15 % between 2007 and 2014 (Grimmeau & Wayens, 2016, p. 110), the phenomena occurs also in neighbouring countries (e.g. France) and in the US, where one talks about “dead malls”.

(Grimmeau & Wayens, 2016) argue that since 2000, the **market gets saturated**. They explain this situation by the change in regulation of sales area from 2005, that resulted in “a national space is saturated with shops” and in **a surge in authorized sales area**: “From 2005 to 2013, 5.2 million m<sup>2</sup> were authorized, i.e. 28% of the total area in 2015” (Ibid, p. 110). At the same time, the growth in net sales area decreases clearly (from + 368 000 m<sup>2</sup> per year between 2007-2011 to + 27 000 m<sup>2</sup> between 2011-2015), which means that a lot of sales area disappear.

In that context, (Grimmeau & Wayens, 2016) argue for a **slowing down in the increase in shopping area in Belgium**, as a main policy recommendation. They propose a differentiated approach favoring incumbent retail areas, at the expense of new areas: on one side, “to block the granting of new permits for large businesses” (at least on a limited period), and on the other side “to

authorize the extension of small shops in commercial centers”. Similarly, following the analysis made at the Brussels level, authors recommend the following:

*“[...] considering retail trade as an economic activity, there is a clearer need for action in order to **restore economic vitality** to the sector and increase the competitiveness, or rather the hospitality, of the urban area for retail trade, and also to assume the reorganisation of the sector and the **renunciations which this entails**: consolidating existing areas, abandoning and reassigning the least profitable areas, drastically limiting the increase in the offer in order to slow down the decrease in performance, integrating new operating logics (digitalization, logistics revolution, increases in productivity and associated training needs).”* (Wayens, Debroux, et al., 2020, p. 32).

In official plans, the view is yet different: “the main stated retail objective of the [2018 Sustainable Development Regional Programme] is to “strengthen the retail offer” (Ibid).

The difficulties faced by the retail sector could also be linked to the e-commerce surge. In the next section, we examine how this surge affects physical retail, and the retail sector more generally.

### 2.3 How does the surge in e-commerce impacts traditional retailers?

This increase in online purchases could be at the expense of offline purchases and **existing physical retailers**. A strong decline of existing shops and retailers would be problematic for several reasons. A first concern is that a decline of shops in the retail landscape could reduce the **access to goods and services for some parts of the population**. It could also contribute to a reduction of social interactions and to the further development of a sedentary lifestyle.

A strong decline of shops could also **change territories** and the appearance of historic commercial spaces like city centers and high streets, but also of more recent commercial spaces like commercial parks and malls. In the US, the ‘dead malls’ expression has been coined to refer to those shopping malls with a high vacancy rate, a low consumer traffic level, or that are deteriorating in some manner (“Dead Mall,” 2022).

Finally, there are big concerns for the **economic activity of existing retailers and the jobs they provide**. The fact that e-commerce is less labour intensive than physical retail (26 % weaker for pure players than for the rest of retail trade (Bon-Maury et al., 2021)) reinforces this concern, since the jobs created in the e-commerce would not compensate the potential loss in physical retail. Finally, there are additional concerns for Belgian jobs since 30.8% of online purchases escape from Belgian-based retailers (cf. 2.1.2).

In order to understand whether e-commerce is a threat to physical retail, there is a need to look at studies considering both online and physical retail dynamics and the relationship between them. After looking at i) available figures of the evolution of purchases through both channels, we look at ii) analysis investigating the influence of e-commerce over the number of selling points. Finally, we report on the iii) analysis of the French report (Bon-Maury et al., 2021) that explains how e-commerce impacts the functioning of the whole sector.

#### 2.3.1 How do offline purchases evolve along the surge in online retail and what does it mean for the retail sector?

##### *Co-evolution of online and offline purchases*

On the basis of the available figures of the online retail sector and its market share between 2016 and 2020 (cf. Table 5) (Marketline, 2021e) and given inflation rates<sup>13</sup> during that period (around 1,55%/year) (Statbel, n.d.), we can conclude that:

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<sup>13</sup> « Indice des prix à la consommation harmonisé », including energy and petroleum products prices.

- There is a surge in online purchases (+16.5%/year) (cf. also 2.1.1)
- Overall purchases increased slightly (+2.55%/year)
- Offline purchases increased by +1.2%/year, i.e. they stabilized or even slightly decreased in constant value.

**Table 5: Evolution of retail sales to the Belgian market, on the basis of (Marketline, 2021e)**

	Value in €1000		Growth rate	
	2016	2020	2016-20	Annual
Online retail sector value/Online retail sales to the Belgian market/ (Marketline, 2021e)	5.048.100	9.304.500	84%	16,52%
Market share of online purchases (Marketline, 2021e)	7,20%	12,00%	+4,8 points	
Offline retail sales to the Belgian market (calculated)	65.064.400	68.233.000	5%	1,20%
Overall retail sales to the Belgian market (online and offline) (calculated)	70.112.500	77.537.500	11%	2,55%

While the above available figures from Belgium are on a limited period (2016-2020), **French figures** corroborate the two latter trends regarding overall and offline purchases: online purchases surge (+14% annually) and offline purchases experience a quasi-stability in constant prices in the last ten years (Bon-Maury et al., 2021, p. 13 Annex II); “the market shares won by e-commerce translate, at constant consumer purchasing power, into a drop in sales of physical retail” (Bon-Maury et al., 2021, p. 10 Annex VI).

Also, the total turnover of the Belgian retail sector in constant prices stagnates since 10 years, while it was growing since the 60’s (Wayens, Godart, et al., 2020). This stagnation of the Belgian retail turnover has to be considered in the context of an important share of online purchases passing through foreign-based operators (30%) (cf. 2.1.2).

Thus, the surge in online retail appears to make overall retail sales grow slightly, while making offline purchases stagnate or even decrease slightly: the **increase in online purchases seems to add to existing demand, and to go hand in hand with a stagnating or slight downward trend for offline purchases.**

#### *What does it imply for Belgian retailers?*

Is this slight decrease/stability in offline purchases for the benefit of online purchases necessarily a bad news for incumbents? Not for all of them in any case. We have seen in 2.1.2 that almost half of online purchases are made through multichannel retailers. Not all of those multichannel retailers are necessarily historical retailers based in Belgium, but at least one part of them are (cf. Van Den Borre which is the top ten seller for the Belgian market). Thus, in the case of multichannel retailers, this shift in demand leads partly to a **shift in channel (online/offline) within the same retailer.**

This trend is however likely to be negative for those retailers **that did not develop successfully an online channel** in parallel to the offline channel (75% of Belgian companies did not develop an online channel yet, cf. 2.1.2): this shift in demand from offline to online partly leads to an increase in demand for young pure player actors and a decrease in demand for incumbents.

Also, given the share of online purchases that go through foreign-based operators (30%, cf. 2.1.2), an increase in online purchases at the expense of offline purchases is not a good news for Belgian retail and related jobs in general: a loss of economic activity (and jobs) within historical Belgian retailers will not be necessarily offset by gains of activity in other companies (pure players) or sectors (logistics) operating in Belgium. This is less the case for countries such as France or the Netherlands where distribution centers are in place. Thus, there are **specific concerns for Belgian retailers in general** (and related employment), given this competition from foreign-based operators.

Also, those figures correspond to overall trends, and within the retail sector, some actors win from e-commerce development, and some actors lose. In order to understand more precisely who are those winners and losers, we look next at the impacts of e-commerce on the number of shops.

### 2.3.2 The influence on the number of (physical) selling points

Studies linking both dynamics (e-commerce and physical retail developments) are rare, at a Belgium level, or for neighboring countries. We report on the results of the analysis of Wayens and colleagues of the co-evolution of e-commerce and number of selling points differentiating sectors and legal forms at the Belgian level and over the last ten years, complemented with findings from France and the UK.

We have seen in the preceding section (2.3.1) that the surge in e-commerce goes along with a stagnation or slight decrease in overall offline purchases. However, this evolution would **hide disparities according to sectors, actors/models and areas**.

#### *A decline of shops in sectors where e-commerce is active*

In Belgium, it is observed that the “**sectors of activity** that are most subject to competition from e-commerce decline in the physical landscape” (Wayens, Godart, et al., 2020, p. 20). We can observe this phenomenon on Figure 10: in sectors where market shares of the online segment and where growth rates are high, the decrease in the number of the selling points is higher; in sectors in which goods can be digitalized, both shops from independent retailers and chains decline.

This is also the conclusion of studies in the UK, which identify retail of media-content amongst the most vulnerable (Delage et al., 2020; Singleton et al., 2016), and of an analysis of the evolution of job in the French retail sector between 2010-18: given the lower job intensity of online retail in comparison to physical retail, “the destruction of jobs in retail businesses operating on markets with strong competition from online commerce is superior to direct job creation” (Bon-Maury et al., 2021, p. 10 Annex VI). More specifically, “jobs in the retail trade are created in the food retail, which faces little competition from online retail. But sectors where e-commerce is well established (household equipment, small electronics, games and toys, clothing and footwear) experienced job cuts” (Bon-Maury et al., 2021, p. 22).

#### *A (further) decline of independent shops*

In addition, impacts are different according to the **legal forms of shops**. (Wayens, Godart, et al., 2020) conclude that:

- Chains “resists probably a little better to the growth of e-commerce” (Ibid, p. 20).
- E-commerce reinforces the long term trend of declining independent retail trade.

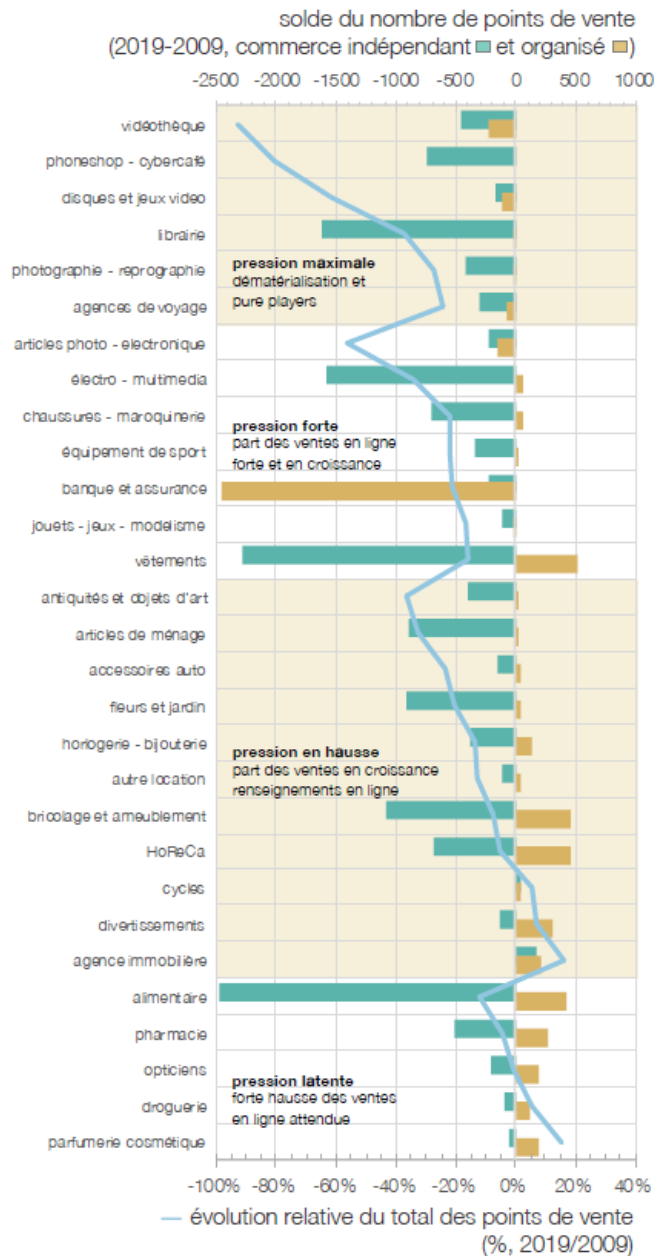
Table 6 which is based on Figure 10 (Wayens, Godart, et al., 2020) summarizes those findings with a classification of sectors according the progression of e-commerce and to the evolution of numbers of selling points.

- The surge in e-commerce result in a decline of both chains and independent retail in the particular case of **goods and services that can be digitalized** (1<sup>st</sup> column of Table 6).
  - In the case of CDs and DVDs, **both chains’ and independent shops decline**.
  - In the case of books however, the decline affects independent retailers only.

In **other sectors** (2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> columns of



- Table 6), **only independent retailers decline, and chains progress** (except from banking and insurance), but not to the same extent yet.
  - For some sectors such as textile (2<sup>nd</sup> column), e-commerce already contributes to a significant market share, and the number of independent selling points decreased already strongly.
  - For some others, e-commerce starts progressing (3<sup>rd</sup>), or will progress in the near future (4<sup>th</sup>). In those sectors, the decline of independent retailers is mainly attributable to the **growth of chains** (e.g. furniture, food).



**Figure 10: Evolution of the number of selling points and progression of e-commerce by sector in Belgium (Wayens, Godart, et al., 2020, p. 20)**

**Table 6: Evolution of the number of selling points and progression of e-commerce by sector in Belgium, adapted from (Wayens, Godart, et al., 2020, p. 20)**

Sectors	Digitalized goods (e.g. books, travel agencies)	Textile, household electrical goods, multimedia, toys	Furniture, DIY shops, garden, horeca	Food, hardware shops, beauty shops
Pressure level	Maximal pressure	Strong pressure	Increasing pressure	Latent pressure
E-commerce	Pure players particularly active	Quick progress of online market share, for the benefit of pure players	Strongest growth rate, but online market share still limited	Strongest growth forecasted
Traditional retail	Strong absolute and relative decline of both independants and chains	Strong relative decline	Strong relative decline	Weak relative decline or progress
Chains		Tend to resist better, by becoming multichannels	Continuous development, by becoming multichannels	Transformation of the sector in favour of chains
Independants		Stronger decline	Decline, because of competition from chains and from online players	

#### *A decline of shops in secondary and medium sized centres*

Looking at the dynamics in the UK, (Singleton et al., 2016, p. 5) calculate the so-called ‘e-resilience’ for retail centres across England, i.e. “the extent to which retail centres have **spatially differentiated vulnerability** to the impacts of online consumption”. They find that “the most attractive retail centres, in particular the inner areas of the larger urban areas such as Greater London, Birmingham or Manchester demonstrated the highest levels of e-resilience, followed by the small local centres. Conversely, the least e-resilient centres were predominantly located in the suburban and rural areas of South East England, and to a lesser degree around other major conurbations of the country. Typically, these were the secondary and medium sized centres.

#### **2.3.3 The influence on the functioning of the retail market and on retail profitability**

Beyond those specific trends, e-commerce influences retail trade more generally: according to a report commissioned by the French government, the deterioration of productivity and margins of retail trade since a decade (observed also in Belgium, cf. 2.2.4) is to be linked with the surge in e-commerce (Bon-Maury et al., 2021). The extent of those impacts depends largely on the retail forms and how they differentiate from each other (i.e. brick and mortar, multichannel retail, pure play online retailers and e-commerce platforms).

#### *Organizational and economic characteristics of each model*

The three e-commerce forms share the (online) infrastructure for the transaction, and the delivery mode of products, that goes generally to the final consumers, and e-commerce platforms differentiate from online retailers on the business model used or the market/chain governance (cf. 1.1.1). The three e-commerce forms can reach different markets, have access to different consumer data and require different assets and capital, also in comparison to physical retail (cf. Table 7).

**Table 7: Characteristics of e-commerce forms – based on (Marketline, 2021e, p. 27)**

	<b>Brick and mortar</b>	<b>Multichannel/Brick and click retailers (e.g. Van Den Borre)</b>	<b>Pure-play online retailers (e.g. Coolblue)</b>	<b>E-commerce platforms (ex: Zalando, Ebay)</b>
Fixed assets costs (stores, labour)	High	High	Low	Low
Need of capital to buy inventory	High	High	High	Low
Market	Limited to nearby consumers	Caters for all type of consumer audiences	Can serve a greater area than physical shops	Vast scale and scope of products because of economies of scale achieved from network effects
Access and use of consumer data	Low access	Access to valuable customer data	Access to valuable customer data	Access and use of big data analytics and artificial intelligence to match buyers and sellers

#### *Multichannel retailers*

Multichannel retail resembles brick and mortar retail since the logistics is likely to be still **organized around physical shops**, and a large part of the workforce still works in shops. However, multichannel retail **caters for all type of consumer audience** (offline and online) – this implying additional costs (relating to the web infrastructure), but this also providing **access to valuable consumer data** that may help retailers to attract consumers. As other e-commerce models, those retailers can **serve a greater area than physical shops** since they have access to consumers located further away from warehouses; their **access to markets** is thus increased, including to foreign markets.

#### *Pure players online retailers*

When the logistics is not organized around shops, and in the case of pure player's online retailers, major differences arise: most of the retail work is done in **warehouses**, this implying a different work organization, but also a different way of interacting with clients. Those retailers face **low fixed asset costs** in comparison to brick and mortar and brick and click retailers.

#### *E-commerce platforms*

Finally, e-commerce platforms are the most different forms of 'retail': the business model is radically different since goods are not traded by the platform, the platform provides the infrastructure for the transaction and may take care of the storage and the delivery. For those platforms, fixed assets are low as in the case of pure play retailers, but there is also no need of capital to buy the inventory and the platform **does not hold the transaction risk** (risk of buying the good and not selling it, or not at the right price). Instead, the supplier of the good holds the risk alone.

In addition, platforms tend to gain dominant positions on the market, through cross-network effects generated by the platform economy (cf. 1.1.1), this **increasing horizontal concentration**. Additionally, very big platforms such as Amazon and Alibaba are **vertically integrated**, with a broad business portfolio, from e-commerce to cloud computing.

#### *Hybrid online retailers*

Some actors combine both forms of market governance: marketplace/platform through which products from other suppliers are sold, and classical retail trade and webshop, through which it buys and sells products, including from its own brands (Leterme, 2019). This is the case of Amazon

or Bol.com. Those online retailers have an increased access to consumer data (those from the marketplace/platform) that they can use directly to market their own products (on the webshop). This **specific access to consumer data** gives them a high competitive advantage over their competitors.

Amazon more particularly is also known for the **specific trading practices** with their suppliers that they are able to implement given their size and their dominant position on the market. This includes the complex and unclear contractual terms that are unilaterally determined by the platforms and unfair trading practices such as sudden delisting and the trading of counterfeit products. Amazon also practices price dumping that is made possible given that losses from e-commerce can be offset by gains from other activities (e.g. cloud) (MacGillis, 2021; Moati, 2021).

### *Specific implications for traditional/physical retailers/competitors*

*The competitive advantages of e-commerce actors make it difficult for other to compete*

This all give them also a competitive advantage, that **makes it difficult for traditional retailers to compete**. Pure play online retailers and e-commerce platforms benefit from **advantages in terms of costs, needed capital and risks** (in the case of platforms), and they have also **access to a broader range of consumers** than brick and mortar retail, and an increased access to consumer data.

Because of **their size, high market power and the (unfair) trading practices used**, it is even more difficult for traditional retail actors, especially independent ones, to cope with their presence on the market and to remain profitable. Also the degree of market power concentration may discourage new entrants (ILO, 2021).

The French report argues that marketplaces have a strong influence on the retail market, that exceed their market share. In fact, marketplaces such as Amazon are used by consumers not only for their actual purchases, but also to get information and to compare prices (Bon-Maury et al., 2021). The report highlights two elements that are particularly affecting the retail sector, including the practices of those actors in terms of **delivery pricing** and in terms of **prices**.

*Price levels: e-commerce is driving down prices of fast-moving consumer goods*

Because of “the increased availability of information and therefore a strengthening of competition”, e-commerce would drive prices down (Bon-Maury et al., 2021, p. 2). Other factors would contribute to this effect, including (Bon-Maury et al., 2021, p. 27 Annex II):

- “consumer access to cheaper products without modification of the margin for the distributor, in the case of sales on own website;
- the facilitation of price modification, therefore a reduction in the downward price rigidity;
- lower transaction costs”

There are **few studies on the subject**, but two recent studies find evidence for the **lower price rigidity** assumption, especially for goods for which the market share of online retail is high, and for goods also sold by the main online e-retailer Amazon: retailers modify their prices more frequently. Also, pricing practices of online retailers would **influence those of physical shops**: “physical stores tend to present uniform prices vis-à-vis Amazon, and [...] prices of these products tend to be lower than prices of other products” (Ibid).

The report concludes: existing studies “are consistent with the statements collected during interviews according to which **e-commerce contributes to driving down the prices of fast-moving consumer goods** while allowing higher margins for niche products or brands [...]” (Ibid).

*Delivery pricing: free delivery is generalized, at the expense of online retail profitability*

According to the report, marketplaces such as Amazon have imposed **free delivery or delivery offered to consumers as a dominant practice**, with their *Prime* subscription or free delivery from

purchases above €25 (in France). This means that “in e-commerce, **the seller bears the cost** of preparing the order and of the delivery most of the time, which deteriorate the margins and explains the low profitability of online sales” (Bon-Maury et al., 2021, p. 20).

For Amazon, the free delivery model is made possible given on one side, the “**more efficient and automated logistics [of Amazon]** when compared to traditional retail trade, allowing greater productivity gains”, and on the other side, **its other profitable activities** (Amazon cloud services), through which it can compensate potential losses on its commercial activity (Bon-Maury et al., 2021, p. 28 Annex II).

**For other retailers, it is difficult to compete while remaining profitable:** “E-commerce competition results in a downward harmonization of prices, for the benefit of the consumer [...], at least in the short term, but **at the expense of traditional retail chains**, that see their profitability decline” as well (Ibid, p. 28-29).

According to a survey conducted with very small, small and medium French enterprises, only 40 % of their webshops are profitable, and the motivation for those companies to develop an online channel is to increase the visits (62% of respondents) and the turnover (61 %) of their physical shop. In fact, figures at national level indicate **the low rate of return or profitability rate of pure players (1%)**, in comparison to that of physical retail (4%): “the viability of the economic model is based above all on its ability to win new market shares to increase sales volume” (Ibid, p. 30).

However, gaining new market shares is difficult in this context of increased competition and platform economy in which the winner takes all (Moati, 2021). **The remaining possibility for retailers to create value is to reduce costs**, e.g. by increasing pressure on suppliers to reduce prices, outsourcing logistics, limiting wages and employment through increased automation in warehouses and shops, closing of shops or transformation into warehouses) (Bon-Maury et al., 2021, p. 34), this possibility being likely **at the expense of other suppliers and workers**.

## Conclusion to the second part

Various dynamics have affected the retail sector in the last 60 years, including the rise of organized and associated retail and slow decline of independent retailers, the development of supermarkets, malls and retail parks (2.2), and more recently the surge in online retail (2.1). This latter development is a major trend, that affects both consumers and suppliers. Online purchases are **becoming part of consumption habits for the broad majority** of the Belgian population, including in Brussels, though to a lesser extent for the elderly, low-educated and low-income households. While the penetration of e-commerce among Belgian companies is high in comparison to other EU countries, online purchases are directed for a large part **towards foreign-owned pure players**, that not always have local distribution centers, this potentially putting at risk employment in the Belgian physical retail sector, it is feared (cf. upcoming 3.2.4).

The rise of e-commerce does not seem however to result in a general and sharp decline in offline demand (2.3.1), **it tends to affect sectors, retailers, and areas differently** (2.3.2.):

- For **sectors** in which the competition from e-commerce is the most developed, the decline of physical retail is very strong, and stronger than in other sectors, affecting both independent and organized retail. Typical examples are DVD rentals and bookshops.
- The competition from e-commerce seems to be more detrimental to **independent retail**, with organized and integrated retail resisting better.
- Shops located in the inner center of large urban areas like the Brussels region are likely to decline less than shops located in **mid-sized centers**.

Thus, not all retailers are affected the same way by this development, and multichannel, organized and associated retailers, are said to resist better. However, e-commerce impacts the **whole sector by affecting its profitability**. Competing with those online actors with a higher competitive

advantage and with questionable trading practices is difficult, and this drives retailers to decrease their margins (2.3.3). This statement is in accordance with the diagnosis of the Belgian retail sector that highlights its fragility in the last 20 years (2.2.4), including an increasing **vacancy rate** among shops, that is also visible in neighboring countries.

For the period of analysis, at issue is the **market saturation**, that results from the surge in authorized sales area. In that context, Belgian experts argued **to limit commercial development**, in order to address economic issues and to improve the profitability of existing businesses (Grimmeau & Wayens, 2016; Wayens, Debroux, et al., 2020). The e-commerce surge is likely to contribute to this retail oversupply, while escaping the usual regulations that limit commercial development.

When comparing with case 2, in which we show that the emergence of the circular economy does not destabilize the linear economy, **the surge in online retail seems to result in the decline of certain physical shops, and to weaken and destabilize the overall traditional retail sector**. While this development is not a good news for the latter, we may ask **whether it is the case from a sustainability point of view**. In fact, e-commerce is criticized on several aspects, and some voices speak up against the poor quality jobs it provides (cf. statement by Paul Magnette (Berns, 2022)), or the environmental impacts generated (e.g. cf. the opposition to the implementation of Alibaba at Liège Airport (Leterme, 2021)).

In the next section, we aim to provide a comprehensive overview of the state of knowledge about the sustainability impacts of e-commerce to address the following questions: is e-commerce raising critical sustainability issues? Is it justified from a sustainability perspective to leave market forces act? Or should we restrain e-commerce or certain e-commerce forms for sustainability reasons? If so, which specific forms of e-commerce should be restrained?

### 3. What are the sustainability impacts of the surge in e-commerce?

#### 3.1 Introduction

E-commerce may generate a series of environmental impacts (cf. Figure 11): energy and material use, greenhouse gas and pollutant emissions, land-use. It may also create social, economic and territorial impacts: employment, quality of jobs, accessibility of products and services, social relationships, access to markets for suppliers. While most parts of this review focus on environmental impacts, a specific subsection is dedicated to social sustainability impacts (3.2.4).

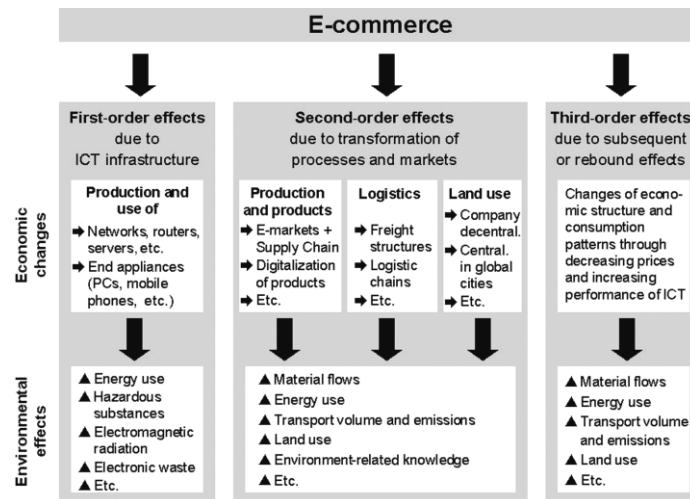


Figure 11: Environmental effects of e-commerce (Fichter, 2002, p. 28)

The assessment of sustainability impacts of online retail is a complex exercise: it implies the consideration of various factors and mechanisms that lead to various effects and impacts. Several attempts have been made to list, name and classify those effects, that lead to several taxonomies of effects, of e-commerce (Börjesson Rivera et al., 2014; Buldeo Rai, 2021; Fichter, 2002; Van Loon et al., 2014) or of ICT in general (Pohl et al., 2019). On the basis of those taxonomies and the classification of effects used in the previous report (D3.2) and proposed by (Zink & Geyer, 2017), we divide the identified effects into two main kinds: i) changes in life cycle impacts and ii) changes in consumed, retailed and produced quantities (cf. Table 18 in Annex).

#### Changes in impacts per unit

Looking at **changes in life cycle impacts or unit impacts** means looking at whether e-commerce has lower or higher unit impacts than what it is supposed to replace, i.e. traditional or physical retail (adapted from (Zink & Geyer, 2017)). According to literature review on e-commerce impacts, it entails two major impacts, i) those resulting from the production and use of the ICT infrastructure, and ii) those resulting from the application of ICT on markets and processes, i.e. logistics and transport impacts (referred to as respectively first- and second-order effects in (Fichter, 2002), cf. Figure 11).

Most studies assessing impacts of e-commerce compare impacts of online purchase with impacts of the same item offline, with Life cycle assessment (LCA) or other methods (Feichtinger & Gronalt, 2021). Such assessment with comparison assumes a substitution between online and offline retail (so-called substitution effects (Börjesson Rivera et al., 2014; Pohl et al., 2019)). The relevance of this substitution assumption can however be raised: online retail might add to existing shopping rather than replacing it, which would likely result in an increase in environmental impacts (unless the changes in life cycle impacts compensate this increase in quantities) (cf. 3.3).

The first question to be addressed is whether it is environmentally beneficial to push for a substitution of traditional retail by online retail, i.e. is online retail more environmentally performant than offline retail? We address this question in a first section by looking at the changes in life cycle impacts induced by online retail, as identified in the literature (cf. 3.2).

**Changes in produced and consumed quantities**

Secondly, we look for evidence regarding the assumed substitution effect. Researchers started investigating the different kinds of alternative effects to substitution in order to understand how e-commerce influences consumption, under third-order effects (Fichter, 2002; Van Loon et al., 2014), second-/higher-order effects or rebound, induction and transformational effects (Börjesson Rivera et al., 2014; Pohl et al., 2019) or impacts related to consumer behaviour (Buldeo Rai, 2021) (cf. Table 18 in annex). In accordance with our classification of effects, we embrace those kinds of effects under ‘**changes in quantities**’ resulting from the introduction and diffusion of e-commerce, in opposition to ‘changes in unit/life cycle impacts’.

We seek to address the following questions: How do physical and online retail interact? Does online retail replace existing retail activities or does it increase overall consumption? This is the second set of questions that we seek to address in a second section by looking at the changes in quantities induced by e-commerce (cf. 3.3).

When looking at impacts of e-commerce, one has to consider both types of changes, because an increase in overall demand could offset the potential reduction in life cycle impacts. However, changes in quantities linked to e-commerce are rarely considered (Feichtinger & Gronalt, 2021), and both research streams are fragmented. One exception is the recent MOBI/VUB review article “*The net environmental impact of online shopping, beyond the substitution bias*” that seeks to bridge both streams (Buldeo Rai, 2021).

Figure 12 illustrates how both types of changes influence net environmental impacts of e-commerce. This figure is an adaptation of the work of (Zink & Geyer, 2017) on Circular economy rebound (cf. D3.2).

		<b>Changes in life-cycle/unit impacts: Are online purchases less impacting than offline purchases?</b>	
		Ee<Ep	Ee>Ep
<b>Changes in quantities: Does e-commerce induce additional consumption?</b>	$\Delta\text{Cons}>0$	Q1: Uncertainty/rebound	Q2: Higher net impact
	$\Delta\text{Cons}<0$	Q4: Lower net impact	Q3: Uncertainty/potential shortfall

**Figure 12: Framework of potential environmental outcomes of e-commerce activities. Adapted from (Zink & Geyer, 2017, p. 597).**

Explanation of Figure 12 (adapted from (Zink & Geyer, 2017, p. 597): Ee and Ep correspond to the environmental impact of distributing one unit through e-commerce and through physical retail, respectively, and  $\Delta\text{Cons}$  corresponds to the variation in total production and consumption. One fundamental distinction is whether e-commerce has lower or higher unit impacts than the distribution channel it is competing with. The other distinction is whether e-commerce increases overall production and consumption, that is,  $\Delta\text{Cons}>0$ , or not.

Activities in Q2 will always increase net environmental impact, whereas activities in Q4 will always decrease net environmental impact. Activities in Q3 may not decrease consumption enough in order to reduce overall environmental impact and thus suffer from the aforementioned shortfall. Activities in Q1 also have the potential to reduce overall environmental impact, but experience a rebound, that is,  $\Delta\text{Cons}>0$ . In the best case, this increase in total production and consumption only reduces the net environmental benefits, but does not reverse its sign. In the worst case, net environmental impact increases, resulting in backfire.



## 3.2 Changes in impacts per unit

### 3.2.1 Introductory learnings over reviewed studies

#### *About parameters and assumptions of reviewed studies*

*What is compared: online retail differentiating on product delivery and transaction infrastructure*

As a first remark, studies differentiate e-commerce from traditional/physical retail on the following criteria only: **product delivery mode and transaction infrastructure**. None reviewed study considers the changes in the **business model or in the chain governance**, which is yet another important feature of existing e-commerce models (cf. 1.1.1). This can be explained by the fact that sustainability assessment studies of e-commerce consider environmental impacts only. The e-commerce platform model is likely to result in differentiated socioeconomic impacts (for suppliers, for final consumers).

#### *Production stage excluded*

The **production stage is generally excluded** from assessments of impacts of e-commerce, contrary to most LCAs of products. This exclusion is in line with the conclusions of the French report that reports “no differences in terms of GHG balance linked to primary production” of products, whatever local or imported (Bon-Maury et al., 2021, p. 13).

#### *A questionable point of distribution divergence*

Analysis thus focus on specific nodes, generally “between the point at which the online and conventional channels separate (i.e. **the point of distribution divergence**) and the home”. The point of divergence can be different according to sectors: “In the case of multi-channel retailers, retail channels tend to diverge at a national distribution centre, for clothing the divergence point can be at the factory or port (for imported goods), books, on the other hand, usually separate at a book distributor’s warehouse and groceries mostly diverge at the supermarket, with online deliveries distributed from the back of store” (J. Edwards et al., 2011, p. 58).

The point of distribution divergence with the traditional channel can be yet different according to online channels, as well as the freight mode. First, **consumers purchasing online are more inclined to buy to foreign retailers** than traditional shoppers do, since “through e-commerce, private consumers can order goods from private and commercial agents all over the world” (Börjesson Rivera et al., 2014, p. 108). Secondly, **certain e-commerce actors favour the use of air freight**, with “major e-commerce companies, such as Wish or AliExpress, [basing] their business model on the importation of products by express air freight, mainly from Asia” (Ibid). In the review of (Pålsson et al., 2017), we noticed that only one study out of 11 consider different freight transport modes for the two channels, with online retail using air freight in combination with road transport and traditional retail using road transport.

#### *The specific focuses of reviewed studies on transport, overlooking infrastructure impacts*

It has to be noted that within the research on e-commerce, **logistics and transport** related research prevails, given the importance of impacts induced by transport (cf. 3.2.3). This predominance is visible in the results of this review (there is a strong predominance of studies looking at the impacts of e-commerce on transport, and more particularly the last mile (cf. 3.2.3)). Very few studies look at the **impacts of ICT infrastructure** (cf. 3.2.2), meaning that the changes in the infrastructure needed for the transaction (store versus web shop/platforms) are overlooked.

Also, reviewed studies **compare channels as if they were developed at the same level, while the infrastructure dedicated to online channels is currently being developed** (e.g. warehouses, distribution centers, servers) and the one dedicated to physical channels is mostly already built, since decades or more. To develop online retail at a large scale, there is a need to build warehouses for example, and this will cause GHG emissions, material use but also land

artificialization. Even if ‘buildings’ are included in some of the reviewed reviews, the building of infrastructures is generally outside the boundaries of studies, and only emissions relating to daily energy consumption are included (excluding thus embodied or grey energy) (as in (Pålsson et al., 2017; Van Loon et al., 2014)). On the other side, if physical retail is abandoned, there is a need to deal with the aftercare: what do we do with abandoned shops? This situation is already happening in the US, where dead malls multiply and the issue of what to do with them is pending (Thomas, 2020).

### Main conclusions

#### *Distribution and retail: a small contribution to emissions along the life cycle of products*

Overall, the retail or distribution node of products contributes little to their life cycle impacts, in comparison to the production or manufacturing phase: most LCAs that calculated the carbon footprints of particular non-food products across their respective supply chains found that “raw materials, packaging (where relevant) and manufacturing accounted for the vast majority of emissions. **Distribution and retail, on average, emitted a relatively small proportion of emissions (between 6 and 14 %)** (J. Edwards et al., 2011, p. 58). The contribution would be even lower for food products (Bon-Maury et al., 2021). It seems thus even more important to look at the changes in quantities induced by e-commerce as well (cf. 3.3).

#### *Environmental assessment: online purchases would perform better than physical retail*

When comparing life cycle environmental impacts of e-commerce with life cycle impacts of physical retail, the **balance is generally in favour of e-commerce**. This what four review articles conclude from studies comparing both channels (Buldeo Rai, 2021; Feichtinger & Gronalt, 2021; Pålsson et al., 2017; Van Loon et al., 2014) (cf. Table 8).

**Table 8: Main conclusions of reviews of comparisons of online and offline retail**

Author, data, scope	Characteristics	Overall conclusion
(Van Loon et al., 2014) – <b>Carbon impacts of ICT infrastructure, supply chain processes, changes in consumption</b>	Physical good only (no consideration of online purchases not resulting in a freight movement)	<i>In favour of e-commerce</i> for the 3 cited studies But these studies have had a narrow scope and been underpinned by several limiting assumptions, incl. the purchase of a single item on a dedicated personal trip, the successful first-time delivery and retention of the online order
(Pålsson et al., 2017) – <b>Energy consumption, excluding ICT infrastructure</b>	All 16 cases concern search products <sup>14</sup> with a low level of product returns, quite volume and weight-efficient products and products being purchased as single items (e.g. books, IT products). Focus on the US	<i>In favour of e-commerce in the majority of the cases</i> But unsold product and product returns not considered.
(Feichtinger & Gronalt, 2021) – <b>Environmental impacts of transport</b>	15 studies comparing online and in-store shopping, including in Western Europe (10) USA (4), China (1)	<i>In favour of e-commerce</i> for most reviewed studies comparing online and offline retail <sup>15</sup>
(Buldeo Rai, 2021) - <b>Environmental impacts of transport</b>	43 articles, between 2005 and 2021. Focus on last mile and packaging issues	<i>In favour of e-commerce</i> (studies comparing in-store purchases with purchases online)

<sup>14</sup> “Search goods (e.g. books, CDs) are characterised by attributes that can be evaluated before purchase, while experience goods (clothing) are evaluated when consumed or tested” (Pålsson et al., 2017, p. 766).

<sup>15</sup> The remaining 2 do not make such conclusion, since various online channels (pure players, click and collect) are compared to the offline channel and there is no convergence between the compared channels.

However, those studies do not all cover the same life cycle stages, rest on a number of questionable parameters and assumptions. In addition, some recent studies nuance those results, especially when the diversity of the retail environment and of consumer practices is taken into account (cf. 3.2.3). Finally, this does not mean that the surge in e-commerce brings net environmental benefits, since impacts on overall production and consumption quantities are not taken into account in those calculations: a full substitution between online and offline retail is assumed in those studies, while it is still to be demonstrated (cf. 3.3).

### 3.2.2 ICT/digital infrastructure impacts

Those effects resulting from the production and use of ICT infrastructure necessary for e-commerce are called first-order effects by (Fichter, 2002) and (Van Loon et al., 2014). Those effects result from (Fichter, 2002):

- Operations at consumer's house, i.e. part of the energy used in the manufacture and disposal of a computer
- Construction, use and ultimate disposal of computer servers for data warehousing, hosting, back-up and system management functions.
- Search engines

According to a 2014 review, the impacts of ICT infrastructure production and use were not often considered in environmental assessments of e-commerce (Van Loon et al., 2014), and mostly for dematerialized products, such as DVD and CDs. The authors conclude in a further research article that those impacts would barely contribute to the impacts of e-commerce, "as expected from previous research" (Van Loon et al., 2015, p. 482): in an assessment of several online retail channels for fast-moving consumer goods in the UK, "the electricity consumption of PC's, laptops, smart phones, or tablets [...] as well as the life cycle impacts of the computers, infrastructures, routers etc., [allocated with a burden factor]" **contribute from 0.2% to 1.1 % of climate change potential** (Ibid).

On the other hand, **at a macro level**, e-commerce contributes to the growing impacts of ICT production and use, but the extent to which is uncertain. In Wallonia, more than 10 % of electricity was consumed for digital services in 2018 and this consumption could triple by 2030 (Climact, 2021). Similar estimations are made for France, with 9% forecast annual increases (Ferreboeuf, 2019). This consumption contributes to climate change (2.5 % of the French carbon footprint, to 6.7% in 2040); but also to the demand for raw materials, that impacts in turn abiotic resources and ionizing radiations (Etienne Lees Perasso (Bureau Veritas) et al., 2022).

(Van Loon et al., 2014, p. 286) state however that "it is not known how much of the energy consumption in the production and use of the ICT infrastructure is attributable to e-commerce as opposed to other ICT activities, and the extent to which e-commerce is creating additional waste of electrical and electronic equipment (WEEE)".

### 3.2.3 Supply chain impacts

Those effects include impacts of ICT application at different stages in the supply chain, including i) production, ii) packaging, iii) storage and order picking; iv) transport (cf. Table 9).

#### *What do reviews conclude?*

##### *All life cycle phases*

Except for packaging, for most life cycle phases, e-commerce is less impacting than physical retail, according to the examined reviews (Buldeo Rai, 2021; Pålsson et al., 2017; Van Loon et al., 2014). However, those reviews highlight that several parameters and assumptions are unrealistic or problematic, mostly on the e-commerce side (cf. below).

**Table 9: Supply chain impacts of e-commerce in comparison with physical retail**

<b>Life cycle phases</b> (contribution to difference)	Characteristics of both channels
	<i>Assessment results</i>
	Related parameters and assumptions
<b>Packaging</b> (major effect)	Additional packaging needed for e-commerce home delivery. But online retail can reduce secondary packaging and less need of sophisticated packaging (for merchandising purpose) (Van Loon et al., 2014)
	<i>In favor of physical retail</i> (Mangiaracina et al., 2015; Pålsson et al., 2017)
	E-commerce consumes 5 times more. But only material use considered and <u>not indirect effects</u> (packaging affects logistics efficiency and product waste) (Pålsson et al., 2017).
<b>Buildings</b> (minor effect)	Warehouses use generally less energy per square meter than retail stores. The most centralized the warehouses, the least energy is used, but trade-off with transport impacts But automatization in parcel hubs and in distribution centers is energy-intensive (Van Loon et al., 2014) and increased complexity of the order-and-delivery process (Pålsson et al., 2017)
	<i>In favour of e-commerce</i> : 5-6% lower (Pålsson et al., 2017)
	Energy consumption/item depends on: product nature, types of handling equipment used, nature of the racking, space utilization and degree of mechanization (Van Loon et al., 2014)
<b>Transport, incl.:</b>	<i>In favour of e-commerce</i> (Buldeo Rai, 2021; Feichtinger & Gronalt, 2021; Pålsson et al., 2017) <i>No general consensus</i> (Mangiaracina et al., 2015)
<b>Upstream transport (up to the store or parcel distribution center)</b> (minor effect)	No major difference concerning the origin of products in e-commerce and physical retail. But e-commerce would favor international trade and the purchase of products that originate from more remote areas than physical retail (Bon-Maury et al., 2021)
	<i>In favour of physical retail</i> : (modest) median increase of 10% for e-commerce, except when it uses air freight, and conventional channels other transport modes (Pålsson et al., 2017)
	But big difference in terms of sustainability between shopping online at local or remote retailers “although the difference between the two is rarely raised” (Mangiaracina et al., 2016). And Europeans attracted by US and Chinese retailers, that use air freight (Cullinane 2009) (Buldeo Rai, 2021) ( <u>Location and type of e-retailer (and freight mode)</u> )
<b>Last mile</b> (major effect)	Transport distances lower in home delivery rounds (shared-used vehicle travel) as compared to individual store visits But stem distances (i.e. travel required before the delivery round) potentially higher in e-commerce, because of the international coverage of online retailing, as compared to the national or even regional presence of offline retailing based on stores (Buldeo Rai, 2021)
	<i>In favour of e-commerce</i> (Pålsson et al., 2017; Van Loon et al., 2014)
	But depends on <u>area/drop density</u> (Pålsson et al., 2017), on consumer preferences and retailer practices (Van Loon et al., 2014) and based on the following (questionable) assumptions (Buldeo Rai, 2021; Pålsson et al., 2017; Van Loon et al., 2014): - <u>Transport mode and vehicle type</u> : passenger transport with cars <sup>16</sup> in almost all cases (Pålsson et al., 2017) (because of the dominance of US case studies) and transport for online retail by trucks (less common in Europe than in the US) and vans (realistic) (Buldeo Rai, 2021) - <u>Purchase reception</u> : no consideration of failed deliveries (ranging between 7 and 20% in France and of product returns (ranging between 10 and 30% (and also not of unsold products in physical retail) (Bon-Maury et al., 2021, p. 17) - <u>Vehicle utilization</u> : no consideration of the possibility of trip chaining <sup>17</sup> for physical retail - <u>Purchase baskets size</u> : single item purchase, while there are differences in basket size between the two channels (in physical retail, simultaneous product purchases is the norm)

<sup>16</sup> To be related to the geographical area

<sup>17</sup> I.e. the fact that “passenger transport would be conducted regardless of sales channel as a part of another trip or purchase of other products » (Pålsson et al., 2017, p. 774).

### Packaging

Regarding packaging, **e-commerce brings higher environmental impacts** than physical retail, and it contributes considerably to the impact difference between both channels. In addition, those impacts would be underestimated since indirect effects are generally not considered (packaging affecting logistics and waste); i.e. only material use is considered (Pålsson et al., 2017).

### Buildings

The ‘buildings’ category gathers impacts related to the storage in warehouses or in stores. It has a minor effect on the energy consumption difference between the two channels and **e-commerce is the most efficient channel** in this regard (Pålsson et al., 2017).

### Transport

Transport is the most assessed life cycle stage. It includes both last mile/passenger transport (from store/parcel distribution center to home) and upstream/freight transport stages (from the point of distribution divergence to the store/parcel distribution center). Globally, transport impacts are more favourable in e-commerce, but this is not the case for **upstream transport**.

#### Upstream transport

E-commerce and physical retail would supply the same kinds of products, of similar origin (Bon-Maury et al., 2021), and the difference between the two channels for upstream transport is not major. (Pålsson et al., 2017) find a **modest median increase of 10% for e-commerce**.

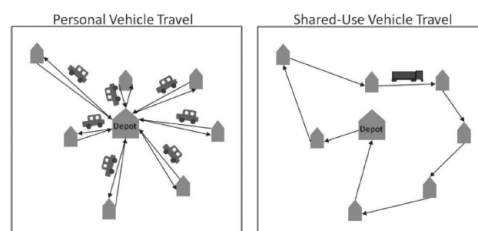
However, “in cases where **air freight** is used over traditional road transport, the impact of goods transport on the total energy consumption of e-commerce skyrockets, show Pålsson et al. (2017)” (Buldeo Rai, 2021, p. 8). It is not a detail, given the attraction of European consumers for goods from Chinese and US retailers “are not rarely shipped by airfreight”, as noted by (Buldeo Rai, 2021, p. 8). Some e-commerce actors such as AliExpress have even based “their economic model on the import of Asian products by express air freight” (Bon-Maury et al., 2021, p. 23).

(Mangiaracina et al., 2015) note that reviewed studies do not yet differentiate between purchases through **(online) foreign or local retailers**, while it would make “the world of a difference in terms of sustainability” according to (Buldeo Rai, 2021, p. 8), who reports the call for research “to shift its focus from the last mile to further up the transportation flow”.

#### Last mile

Those higher environmental impacts linked to upstream transport for e-commerce would be outweighed by the benefits gained on the **last mile** (Pålsson et al., 2017, p. 774). Within all life cycle phases, the last mile “accounts for a large proportion of the total CO<sub>2</sub> emitted from a retail supply chain” (online or offline) (J. Edwards et al., 2011, p. 60).

Even if warehouses are generally located further to homes than stores, the transport distance for the last mile is lower for e-commerce. In fact, the **vehicle travel is shared**, while when shopping physically, consumers are disadvantaged “because of the individual nature of their shopping trips” (Buldeo Rai, 2021, p. 4) (cf. Figure 13). Following that reasoning, the highest the drop density, the lower the associated environmental impacts.



**Figure 13: Illustration of personal vehicle travel compared to shared-use vehicle travel by Wygonik and Goodchild (2012) cited by (Buldeo Rai, 2021, p. 5)**

### *Problematic assumptions and parameters*

The review articles highlight a number of parameters and assumptions that would be problematic and might give an (biased) advantage to e-commerce. Studies assume that goods **are purchased individually** with e-commerce and physical retail, while this is not necessarily the case, especially for the latter. According to (Buldeo Rai, 2021, p. 7), purchases are increasingly fragmented (as opposed to consolidated), and this is not disconnected from the development of e-commerce, which has “become a preferred channel for specific and specialised purchase”.

Also, studies do not consider **trip chaining**, i.e. the fact that passenger transport for physical shopping would be conducted regardless of sales channel as part of another trip or purchase of other products. In addition, most studies do not consider **failed deliveries**, which are yet particularly important in e-commerce and **products returns**, which are higher for online purchases than for physical shopping and would represent between 10 and 30% of sales in France (Bon-Maury et al., 2021). In relation to products returns, studies do not consider the practice of product destruction by major e-commerce actors such as Amazon (Domenech, 2021) which could be more important than that of traditional retail trade actors.

Rather than using one channel or the other, a growing share a consumers would behave **omnichannel** (Buldeo Rai, 2021). This means that for a single purchase consumers combine several channels (combining online browsing with travel for purchasing (webrooming), collection (click and collect) or delivery) or do several trips (including online purchase following an in-store visit or home delivery of in-store purchases).

Finally, the parameters used regarding **transport modes and vehicle types** would fit to a US context, but not to a European context. Studies assume that transport for online retail is made by truck (less common in Europe than in the US) and that passenger transport in physical retail is made by car (thus excluding soft transport mode, though important in a European urban context).

### *Recent studies refine results*

More recent and/or European-based studies seek to consider the above-mentioned critics, to use more realistic parameters, or more adapted to our geographical context and to differentiate between the various e-commerce forms (cf. Table 11).

Three studies look at online retail in the UK, which is the most developed EU market. (**Edwards et al., 2010**) compared the carbon impacts of the last mile of various non-food products (apparel, footwear, books, electronics) order on- and offline, considering the basket size. (**Van Loon et al., 2015**) compare seven channels that distinguish between brick and mortar, brick and clicks and pure players, and between different fulfillment methods, including in-house/local van delivery and outsourced parcel delivery network. Those various scenarios rest on a number of parameters, as specified in Table 10<sup>18</sup>. Partly based on the input data of the former study and focusing of the same product type, (**Shahmohammadi et al., 2020, p. 3499**) “developed a stochastic model to quantify the variability in the greenhouse gas (GHG) footprints” and to identify the main contributors to variability, but for three of the channels only, thereby reducing the complexity: brick and mortar, pure players (with outsourced home parcel delivery) and brick and clicks (with in-house van delivery).<sup>19</sup>

<sup>18</sup> Personal communication from Patricia Van Loon

<sup>19</sup> They justify the choice of two online models only as follows: “We selected two archetypes of ecommerce [...] while other types of online shopping channels, such as pure play with its own van delivery (rather than through parcel delivery companies) and click and collect (where consumers order online and travel to a shop or collection point to retrieve their goods), are currently also employed. However, these new forms resemble the archetypes studied here with the supply chain of click and collect being similar to that of

**Table 10: Shopping basket size and consumer trips for retail channels (Van Loon et al., 2015)**

Model	PP1	PP2	PP3	B&C1	B&C2	D2C1	B&M
Explanation	Centralised pure player with van delivery	Centralised pure player through parcel delivery network	Drop-shipping from supplier through parcel delivery network	Van delivery from local shops	Click & collect in local stores	Bypass retailer and use parcel delivery network	Conventional retailing in local supermarkets
Number of items in order	55	2	1.4	45	45	6	30
Percentage trips to the local store <sup>a</sup>	75%	90%	90%	75%	100%	90%	100%
Percentage returns	0.1%	5%	5%	0.2%	0.2%	0.1%	0.01%
Percentage failed deliveries	1%	40%	40%	1%	0%	40%	0%

<sup>a</sup> The parameter 'percentage trips to the local store' is not included in the base scenario where complete trip substitution is assumed.

NB: The basket size, the share of failed deliveries and of returns rely on the fulfillment methods: deliveries with parcel network deal with very small baskets and have high return (except for D2C1) and failed deliveries (PP2, PP3), while van deliveries deal with large baskets and have low returns and failed deliveries (PP1, B&C1). On the other side, self-delivered baskets are large and encounter very low returns (B&M, B&C2). In addition, at the time of the study, the pure players (e.g. Amazon, eBay) used all parcel networks (PP2), while online retailer (e.g. Tesco) their own in-house delivery system for home deliveries (B&C1).

The last two studies originate from the VUB (Vrije Universiteit Brussel), focus on e-commerce in Belgium and assess impacts expressed as external costs for different last mile configurations. **(Mommens et al., 2021)** compare home deliveries and collection points. They evaluate “last mile deliveries of non-food retail products sold on an e-commerce platform [whose e-distribution center is located near Brussels] and delivered to collection points of three different retail brands in Belgium” (two food supermarket and one non-food brand), in three types of area: rural (Wallonia), urbanized (Flanders) and urban (BCR).

(Buldeo Rai, 2019) conducted two case studies. In the first one she calculates the CO2 footprint of six previously identified shopping profiles on the basis of data from a footwear omnichannel retailer based in Belgium. She considered the omnichannel behaviors of shoppers, including travels and online searches that are sometimes conducted by shoppers in addition to the purchase (online or offline). In the second one, she assesses CO2 emissions, “external transport costs for PM, SO2 and NOX emissions, as well as costs originating from accidents, noise and congestion” of a crowd logistics platform, as opposed to a specialized logistics service provider (LSP) (Ibid, p. 190).

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traditional retailing while pure players with van delivery is likely to be similar to bricks and clicks” (Shahmohammadi et al., 2020, p. 3506).

**Table 11: Additional studies addressing some of the challenges identified by existing reviews**

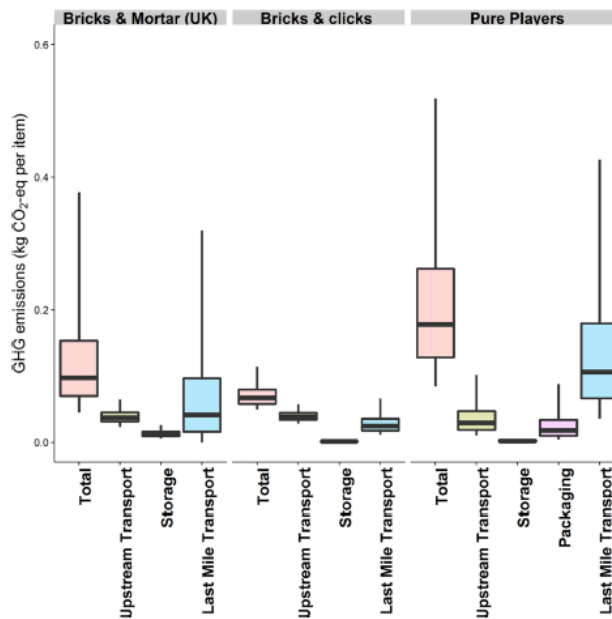
Study	Models/channels/Scenarios	Considered impacts	Products, location	Challenges addressed
(J. B. Edwards et al., 2010)	-Home delivery -Conventional shopping	Carbon impacts of the last mile	Non-food, UK	Basket size
(Van Loon et al., 2015)	-1 Brick and mortar (B&M) -2 Brick & click: B&C1 with local van delivery, B&C2 with collection by consumers -3 pure players: PP1 with local van delivery, PP2 with parcel companies and PP3 where products shipped from suppliers to consumers via parcel network -1 direct to consumer: D2C1, bypassing the retailer and using parcel network	Carbon emissions related to upstream transport, product storage, and packaging, last mile	Fast moving consumer goods (FMCGs), e.g. personal care, homecare, and food and refreshment products, UK	Basket size, failed deliveries, product returns
(Shahmohamadi et al., 2020)	-Brick and mortar -Bricks and clicks: online retail and delivery from a store-based supplier -Pure player: online retail and home parcel delivery from a non-store-based supplier	Stochastic model to quantify the variability in GHG footprints of product distribution		Variability in consumer practice, choices, transport modes
(Mommens et al., 2021)	Products sold on an e-commerce platform and delivered to homes or to collection points of 3 retail brands -Direct <u>home delivery</u> : outsourced and organised by a well-established LSP with 5 DCs and 230 final delivery hubs -Hub <u>home delivery</u> : e-DC organizes homes deliveries in-house, via 10 dedicated intermediate DCs, located near the country main cities -Direct <u>collection point</u> delivery: organised from e-DC to collection points + consumers' collection trips -Supply <u>collection points</u> : goods are redirected from e-DC to traditional DCs of the 3 retail brands, who are responsible for store supply (the e- volume is delivered to these DCs and added to the regular store replenishment transport) + consumers' collection trips	Transport-related external costs, incl. congestion, accidents, air polluting and climate change emissions, infrastructural damages and noise nuisance	Non-food, Belgium, including the BCR	Difference between home deliveries and collection points and between area type
(Buldeo Rai, 2019)	*1 <sup>st</sup> case study: -Single channel shoppers: "online shopper" and "traditional shopper" -Online purchases picked up in-store: "click-and-collect shopper" -In-store purchases delivered to consumers: "ship-from-store shopper" -Online purchase + offline researching and/or testing: "showroomer" -Offline purchases in-store + online research: "research shopper"	External costs for CO2 emissions from the retailer's distribution centre to consumers' homes, and back in case of returns.	Footwear, Belgium	Consumers' omnichannel shopping and travel behaviour
	*2 <sup>nd</sup> case study: -Delivery with specialized LSP - Crowdsourced delivery	+ external transport costs for PM, SO2 and NOX emissions, and originating from accidents, noise and congestion.	Not specified, BCR	Diversity in fulfilment methods (crowdsourcing)



(1) Results on fast moving consumer goods in the UK

*Brick and clicks and brick and mortar (to a smaller extent) outperform pure players*

The first conclusion of (Shahmohammadi et al., 2020) on the basis of their study on **FMCGs** makes a big **distinction between impacts of brick and clicks and pure players**: “shopping via bricks and clicks (click and fulfillment via in-house store delivery) most likely decreases the GHG footprints when substituting traditional shopping” but this is not the case of goods purchased through pure players with outsourced parcel delivery which “often have higher GHG footprints compared to those purchased via traditional retail” (Ibid, p. 3499) (cf. Figure 14).



**Figure 14: GHG footprint of different retail channels by phase in kg CO<sub>2</sub>eq/item. (Boxplots show the 5th, 25th, 50th, 75th, and 95th percentiles.) (Shahmohammadi et al., 2020, p. 3504)**

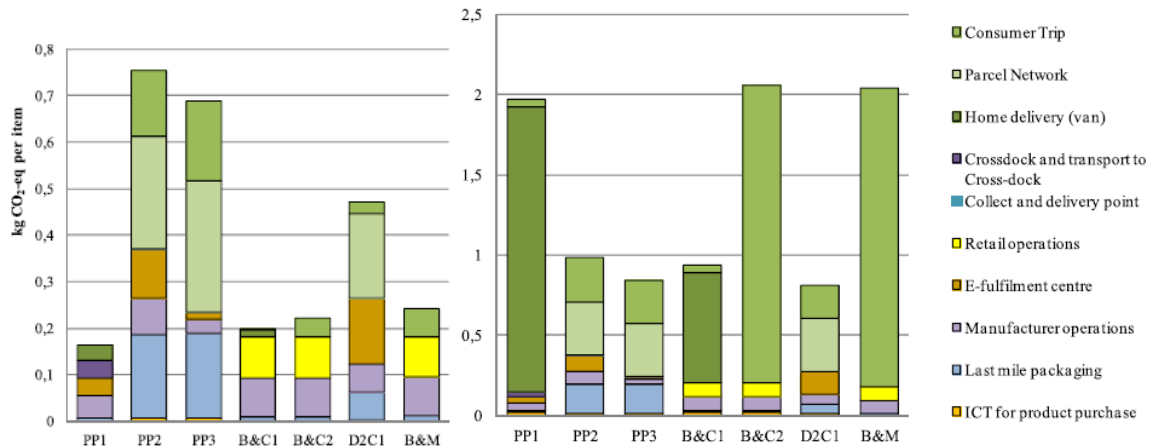
*In-house van delivery outperforms outsourced parcel delivery*

The seven scenarios of (Van Loon et al., 2015) are more precise and highlight the **role of fulfilment methods** behind this result: when the average number of items purchased is taken into account, “the carbon footprint of [in-house] van home deliveries and consumer pick-up methods [...] is ~200 g CO<sub>2</sub>-eq per item. [...] [Outsourced parcel delivery] methods all lead to substantially larger carbon footprints (~500-800 g CO<sub>2</sub>-eq per item)” (Ibid, p. 482) (cf. Figure 15, left).

*Because of their different basket sizes*

The results of (Shahmohammadi et al., 2020) and (Van Loon et al., 2015) differ from other existing studies which almost all show the superiority of online retail. This is because those two studies consider the actual basket size of purchases. According to estimates of (Shahmohammadi et al., 2020), the **number of items** is one of the main contributors to the variance for all of the three assessed retail channels (with the last mile distance and the transport mode). (Edwards et al., 2010) had found ten years before that (for non-food products) “on average, when a customer buys fewer than 24 items per shopping trip [...] it is likely that the home delivery will emit less CO<sub>2</sub> per item purchased” (ibid, p. 117). Otherwise, the pick-up by consumer is preferred.

(Van Loon et al., 2015) developed an alternative scenario where only one product is purchased to show the **importance of the basket size**: when a single purchase is assumed, carbon footprints of various scenarios surge (and reach between 800 g and 2 kg CO<sub>2</sub>-eq per item), especially those using in-house van delivery (PP1, B&C1) and collection by consumers (B&C2, B&M) (cf. Figure 15, right). When comparing with the basic scenario, it can be concluded that the usual assumption (single purchase) **particularly disadvantages those latter delivery modes**, for FMCGs at least.



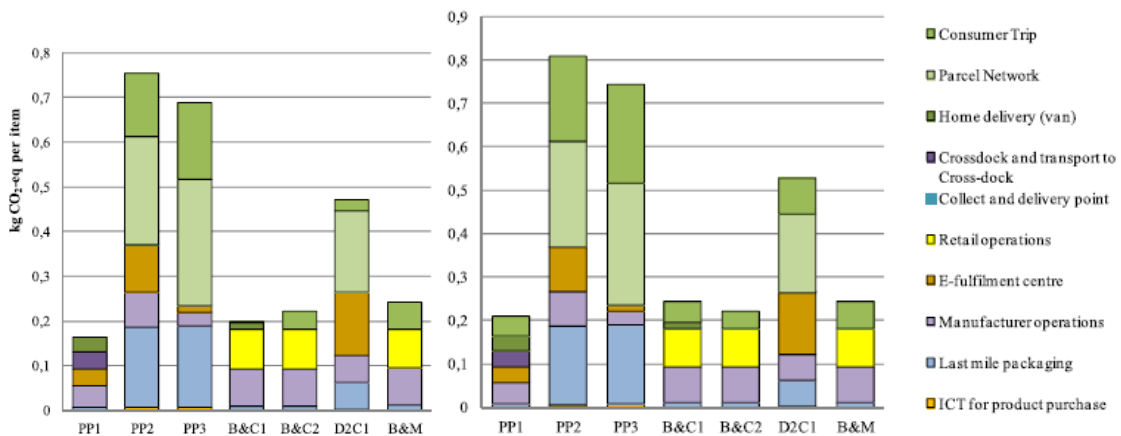
**Figure 15: Base case scenario- CO2-eq emissions for different fulfilment methods, assuming complete trip substitution (left) and Scenario three-climate change potential of different e-retail methods for the acquisition of one FMCG product (right) (Van Loon et al., 2015)**

*The last mile distance disadvantages pure players in front of brick and click and brick and mortar*

(Shahmohammadi et al., 2020) also found that the **last mile distance** is one of the main contributors to the variance for all of the three assessed retail channels. The last mile includes both stem and drop distances, i.e. respectively “the distance between the depot of the parcel company and the delivery zone” and “the distance travelled after a delivery zone has been reached” (ibid, p. 3501). Warehouses being often located further than stores, this is “partly because of these **stem distances** [...] [that] the **environmental footprint of brick-and-mortar shopping** [...] is actually lower than shopping at a pure online retailer” (Buldeo Rai, 2021, p. 4).

*Considering purchase reception parameters changes the ranking*

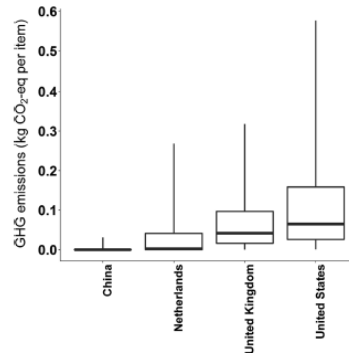
(Van Loon et al., 2015) quantify the impacts of considering the **complementary shopping trips, returns and failed deliveries** in assessments, with an alternative scenario, where “consumer trips arise due to returning unwanted goods, picking up failed deliveries or collecting deliveries at a CDP”. Accordingly, **carbon emissions of all channels based on home delivery increase**, especially those using parcel delivery networks (between +7,3% and +28,7%), thereby **reducing their advantage in front of self-pick-up methods**: “In this scenario, brick & click with home delivery (B&C1) has now a higher environmental impact than the click and collect option (B&C2) and is on par with conventional retailing (B&M)” (Ibid, p. 482) (cf. Figure 16, right).



**Figure 16: Base case scenario- for various fulfilment methods, assuming complete trip substitution (left) and Scenario two- based on industry average shopping basket sizes, complementary shopping trips, returns and failed deliveries (right) (Van Loon et al., 2015)**

*Transport mode used in consumer trips matters*

In addition, last mile emissions in the brick and mortar channel is estimated to be even lower in countries where car is less used to pick up goods. (Shahmohammadi et al., 2020, p. 3507) concludes that “online shopping of FMCGs could increase emissions in the regions where people often walk or cycle to the shops (e.g., China and the Netherlands) [...]” (cf. Figure 17).

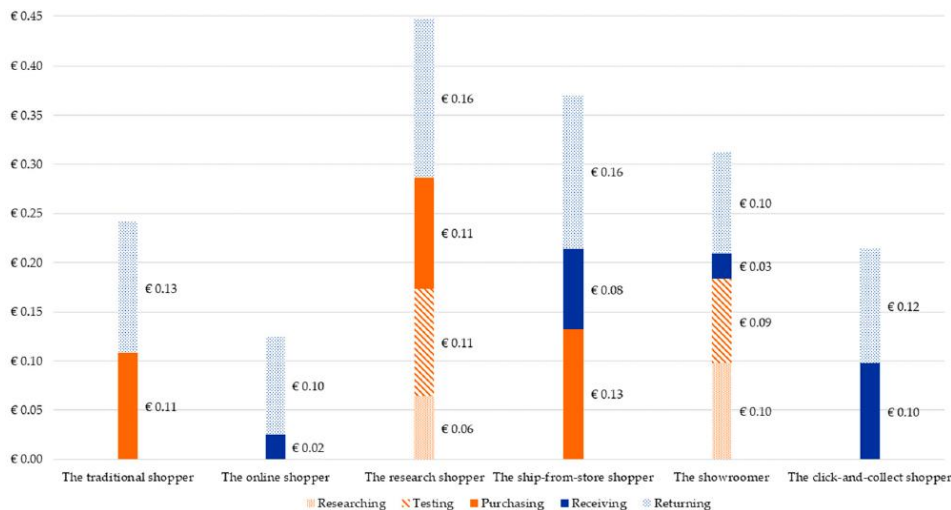


**Figure 17: Differences in Last-Mile GHG Footprints between Countries (Brick and Mortar) (Shahmohammadi et al., 2020, p. 3505)**

*(2) Results for non-food products in Belgium*

*In most of the cases, online shopping generates higher impacts than traditional shopping, because of consumer omnichannel behaviors*

(Buldeo Rai, Mommens, et al., 2019, p. 13) show that when omnichannel behaviors of consumers are considered, the impacts of online shopping can be substantially higher than expected, and “nuance common claims that online shopping outperforms offline shopping in terms of environmental impact” (cf. Figure 18):



**Figure 18: Total external transport cost for CO2 emissions per omnichannel shopping behaviour profile (Buldeo Rai, Mommens, et al., 2019, p. 13)**

- “The online shopper” that shops online and receives its purchase at home or at a collection point generates the lowest impact”, followed by the “click and collect” and “traditional shoppers”.
- “However, when online shoppers travel to stores prior to their e-purchase and become “showroomers” [or when in-store purchases are delivered to consumers], the external CO2 costs double compared to “traditional shoppers” [...] and are more than eight times higher compared to “online shoppers”” (excl. returns) (Ibid, p. 1).

- Finally, the “research shopper” that purchases in-store and does some online research generates the highest impact.

According to the conducted survey, the “research shopper” and other online shoppers with high impacts represent 34% of shoppers, while the “online shopper” and “click and collect” represent respectively 12% and 5% of shoppers (the traditional shopper representing 48% of shoppers).

*Collection points generate less impacts than home deliveries in Brussels*

(Mommens et al., 2021, p. 8) find that “home deliveries are preferred in rural and urbanised areas [...]. In urban areas, collection point deliveries are more sustainable” (cf. Figure 19, with scenarios 3 and 4 corresponding to collection points). According to (Buldeo Rai, Verlinde, et al., 2019, p. 311), “pick-up points and lockers increase consolidation and avoid delivery failure resulting from receiver absence [...]”.

In Belgium, around 70% of online purchases are delivered at home (InSites Consulting, 2020), but deliveries to pick-up points (parcel points are attended by service personnel and based in existing outlets) and lockers (automatic boxes that are accessible 24/7) are developing: In 2018, there were 42 automatic lockers and 646 manned pick-up points in Brussels (BIPT, 2018) (Buldeo Rai, Verlinde, et al., 2019).



**Figure 19: External cost per item for the different areas types and configurations (in €/item) (Mommens et al., 2021, p. 7)**

*Outsourced deliveries with LSPs outperform in-house home deliveries*

(Mommens et al., 2021) find also that **home deliveries through a well-established logistic service provider (LSP) for non-food products generate less impacts** than in-house home deliveries on the basis of a Belgian case study on non-food products (cf. configuration 1 and 2 of Figure 19 that represent the results for the urban area, but this conclusion applies to rural and urbanized areas). In Belgium, non-food products are mostly delivered through outsourced LSP (see Box 1).

**Box 1: In-house, outsourced or crowdsourced last mile delivery? (Buldeo Rai, 2019)**

On the basis of “a review of the literature on omnichannel retail logistics and outsourcing strategies in retail, as well as semistructured interviews with nineteen decision-makers from retailers that are leading the omnichannel development in Belgium”, (Buldeo Rai, 2019, p. 183) sought to understand whether retailers used in-house, outsourced or crowdsourced<sup>20</sup> delivery for the last mile, and the related environmental impacts. She finds that in Belgium, the last mile delivery is made **in-house for food products**, while for **electronics and fashion, it is outsourced to specialized logistics service providers**. However, the last mile delivery could be increasingly crowdsourced with the development of “shipping from store”: “omnichannel

<sup>20</sup> “By means of a web or mobile platform, “crowd logistics” enables non-professionals to carry out professional logistics activities, including parcel delivery. In this way, trips that are made for other purposes (e.g. home-work commute) can be optimised by also carrying parcels for other people (Buldeo Rai, Verlinde, Merckx, et al., 2017) to non-professional individuals” ((Buldeo Rai, 2019, p. 53)

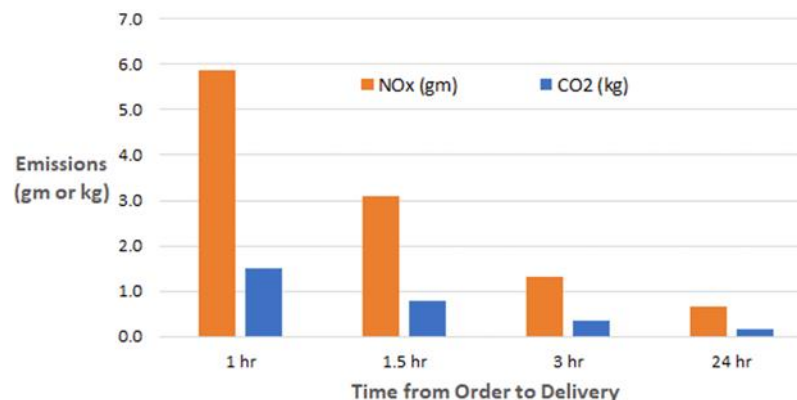
non-food retail increasingly evolves around stores, which are managed in-house. Stores' inventories can be used when consumers choose to pick-up their orders in-store. More importantly, shipping from stores allows to deliver faster. Although delivery on the day of purchase is uncommon, retailers expect this to change in the short term, to same-day delivery or even delivery within one or two hours after purchase. Fulfilling orders in-store and shipping from there is a strategy that anticipates on this development. These ship-from-store developments drive retailers' interest for crowdsourcing. Although the crowd's actual involvement in the last mile is limited to date, the concept is gaining traction thanks to its flexible on-demand capabilities" (Ibid, p. 184).

#### *Outsourced to specialized logistic service provider outperforms crowdsourced*

(Buldeo Rai, 2019) finds that crowdsourcing the last mile is unfavourable from an environmental sustainability perspective. External costs amount €2,75 per delivery, as opposed to logistics service providers which amount €0,32 per delivery. She explains this difference with the "number of kilometres that is driven per parcel. For logistics service providers, this number is very small as they consolidate and deliver parcels on a route that is organised as efficiently as possible. Contrary, the crowd handles parcels in a more individual and ad hoc way, resulting in higher vehicle kilometres per parcel" (Ibid, p. 191). Currently, crowdsourcing is barely used, but this could change with the development of fast deliveries (cf. Box 1).

#### *(3) The issue of fast deliveries*

More generally, fast deliveries such as same-, next-day delivery or one-day shipping "reduces the opportunity to consolidate orders and organise efficient delivery routes (Allen, Piecyk and Piotrowska, 2017), leading to an increase in vehicles and vehicle kilometres (Verlinde, Macharis and Witlox, 2012)" (Buldeo Rai, 2019, p. 108). As concluded by (Jaller & Pahwa, 2020) on the basis of a US study where fast deliveries are broadly used, "consolidation benefits [of e-commerce] are wiped out by rush deliveries": "expedited delivery times were among the most important determinants in worsening emissions and increasing the number of vehicle miles traveled. As delivery times get shorter (e.g., 2-days to 1-day to 1-hour), the environmental and societal costs dramatically increase" (cf. Figure 20).



**Figure 20: Emissions per package according to delivery time (Jaller et al., n.d.)**

### **3.2.4 Social sustainability impacts**

Beyond environmental impacts, e-commerce also differs from physical retail because it generates differentiated impacts for other chain actors, workers, or society more generally (generally referred to as social impacts (Benoît & Mazijn, 2009)). From the various reports and documents reviewed (Bon-Maury et al., 2021; MacGillis, 2021; Marketline, 2021e; Moati, 2021), we identified those impacts and issues and classified them in Table 14, with the support of social life cycle assessment (S-LCA) frameworks (Benoît Norris, C. et al., 2020; Sureau, 2020).

**Table 12: Social sustainability impacts linked to e-commerce**

Other value chain actors (VCA): Chain governance and relations between VCA	Model
<b>Access to markets</b>	
(+) <b>Increased market access</b> for <u>retailers</u> because of the diversity of available channels and the <b>low entry costs to sell online</b> (Marketline, 2021e). (-) Less for SMEs however, for which <b>the costs to sell online</b> with their own infrastructure are too high (Bon-Maury et al., 2021; OECD, 2019)	All
(+) <b>Increased access to foreign markets</b> for <u>retailers</u> , without a physical presence in the country (Marketline, 2021e) (-) <b>But increased competition from foreign retailers</b> , not playing with the same rules (Marketline, 2021e)	All
(+) <b>Increased market access</b> for <u>suppliers</u> with platforms (Leterme, 2019) (-) <b>But reliance on platforms</b> with increasing control over the retail market	Platforms
<b>Market power of organizations</b>	
(-) <b>Increased horizontal economic concentration</b> with the platform economy and “network effects”, and actors playing at a global level (Marketline, 2021e; Moati, 2021). Implications for <u>competitors/other retailers</u> (because of the strong influence of those actors on the retail market) and for <u>suppliers</u> of those big buyers (because of the unbalanced power relationship and potential implications for transaction modalities). The <b>dominance of platforms on markets</b> may be such that suppliers/retailers can be obliged to go through them to reach markets, including public procurements (MacGillis, 2021).	Platforms
<b>Transaction modalities, supplier relationships, (fair) competition</b>	
(-) Complex, unclear and <b>unilaterally determined by the platforms contractual terms</b> between platforms and business users, incl. commission fees that can vary and be decided arbitrarily (ILO, 2021)	Platforms
(-) <b>Sudden delisting practices of account</b> of <u>suppliers</u> by platforms (Brown, 2018) (Buyse, 2019), selling of <b>counterfeit products</b> and lack of clear regulatory frameworks about the responsibility of platforms in cases of intellectual property rights infringements (ILO, 2021)	Platforms
(-) <b>Aggressive pricing/dumping strategies</b> (including delivery pricing) from big platforms with a broad business portfolio (vertical concentration) through which losses from e-commerce can be offset by gains from other activities (e.g. cloud) (MacGillis, 2021; Moati, 2021). Implications for <u>competitors/other retailers</u> , who are pushed to align their prices, and for <u>suppliers</u> , who in fine suffer from a downward pressure on their prices.	Platforms
(-) Lower costs beard by online retailers who have a <b>competitive advantage</b> over physical retailers, this <b>putting the profitability of the latter at risk</b>	PP, platforms
<b>Final consumers</b>	
(+) <b>Increased transparency over prices</b> resulting in an increase of power of consumers (Marketline, 2021e)	All
(+) <b>Increased accessibility</b> to a variety of products and services (-) But <b>risk of decreased accessibility</b> to goods and services <b>for non-users</b> (elderly, low-income, low-education individuals and households) if e-commerce generalizes and destabilizes physical retail	PP, platforms
<b>Workers</b>	Model
<b>Jobs – quantity</b>	
(-) The <b>job destruction in retail businesses</b> operating on markets with strong competition from e-commerce is superior to direct job creation. This is because of the <b>lower labour-intensity</b> of online retail compared to physical retail (-26 % less wage-workers) (Bon-Maury et al., 2021) (+) Stimulation of <b>job creation in transport and logistics</b> , because of the lengthening of chains to final consumers (Bon-Maury et al., 2021)	PP, platforms

(-) <b>Unequal distribution of jobs geographically</b> /increased regional disparities/higher concentration of retail jobs/retail activities in areas where warehouses are located. Example of US cities chosen to settle an Amazon warehouse: <u>winnertakes-all</u> approach for areas where warehouses are located, while other cities see the jobs in retail disappearing (MacGillis, 2021)	PP, platforms
Jobs – quality	
<i>Employment conditions</i> (Bon-Maury et al., 2021)	
(-) High use of <b>non-standard forms of employment</b> in online retail compared to the rest of trade, including: - <b>Temporary work</b> , especially in <u>warehouses</u> , and in <u>transport and logistics</u> , while retail trade uses less temporary work than the rest of retail - <b>On-call work disguised employment through digital labour platforms</b> for <u>last mile delivery drivers</u> . (+) But <b>better income</b> in <u>online retail</u> and in <u>transport and logistics</u> when compared to retail trade (+) Higher use of <b>fixed contracts</b> in <u>transport and logistics</u>	PP, platforms
<i>Working conditions</i>	
(-) <b>Hard working conditions</b> in <u>warehouses</u> , including those resulting from automation (incl. repetitive tasks, lack of autonomy), heavy loads, night/shift work (Hill, 2020; MacGillis, 2021)	PP, platforms
(-) <b>More intense working rhythm</b> imposed to <u>delivery drivers</u> and <u>order pickers</u> by quick commerce/q-commerce/15-minute grocery delivery (in so-called dark stores) and one-day delivery (e.g. Amazon subscription programme Prime) (Prévost, 2022)	Quick-commerce
Broader societal impacts and issues	
(-) Massive practices of <b>tax optimization or evasion</b> of the main pure players actor (Amazon), with implications for public revenues and expenses (Attac France et al., 2019)	Amazon
(-) Weakening of <b>social ties/relations/cohesion</b> when purchased are made online and home delivered (MacGillis, 2021) (-) Especially in <b>cities, as a main retail area</b> and in the case of quick-commerce (Prévost, 2022). Impact on vitality in cities. (-) <b>Health impacts</b> of “business de la flemme”, of increased sedentary lifestyle (Heidsieck, 2021).	All with home deliveries

*Issues/impacts in relation to value chain actors and final consumers*

*Increased access to goods and markets*

In addition to the impacts of e-commerce on other retailers (cf. 2.3.3), e-commerce affects value chain actors and final consumers. It **improves the access** to goods and services for final consumers and to markets for retailers, including to foreign markets. It may also improve market access for suppliers/ manufacturers who develop their own online channel. However, actors who are not able to participate in e-commerce are **excluded** from this innovation and its benefits, including SMEs, for which it is not profitable to sell online, because of the relative high costs to set up such a channel and the potential number of clients that could be reached in a market increasingly dominated by a small number of actors (e.g. Amazon, Bol.com) (cf. 2.1.2).

To sell online, SMEs that do not set up their own online channel can market their products through **platforms**. This can be especially relevant for specific goods that are not traded through classical retailers easily (e.g. artisanal goods, or niche products). In a sense, such a business model shortens product chains, and could rebalance power relations in product chains.

*At the expense of balanced and fair trading relationships*

However, those suppliers become **dependent on those platforms**, that they do not control (Sureau et al., 2019), that dominate the market, and that are not above reproach.

As reported by (ILO, 2021, pp. 126–127), “traditional businesses, particularly SMEs, encounter a number of challenges in conducting their activities through digital platforms [...]”, incl. because of **“the contractual terms between platforms and business users, many of which are SME, [which] are unilaterally determined by the platforms and are generally complex and unclear[...]”**. For instance, the criteria for blocking a user’s account are not clearly defined, which can have severe implications for the continuation of their business operations [...] the commission fees charged by platforms to business users can vary considerably, and platforms can increase rates arbitrarily without any negotiation [...]”.

Amazon in particular is singled-out for unfair trading practices such as the **delisting of suppliers**, **counterfeiting**, but also **price dumping** (including delivery prices). It is a special case since it is **not a pure marketplace** and it acts also as an online retailer: on the webshop/platform, goods from other suppliers are sold together with goods from its own brand. Thus, while this platform model may benefit certain suppliers, it benefits even more the actor driving the platform, which controls the chain, has access to consumer data and has a disproportionate market power.

*High economic concentration and market power for platforms*

According to the ILO report, “the scale of the data that platforms are able to gather and analyse in making decisions about products to be sold, or their price, or about attracting users or customers, has allowed them **to consolidate their position in the market**. The pricing decisions based on such data can therefore have a large impact on third-party sellers on the platform as well as traditional retail stores, due to information asymmetry” (ILO, 2021, p. 42).

Platforms are not the only ones with disproportionate market power. Economic concentration is also a major issue in the overall retail sector (Sureau, 2020). However, because of cross-network effects (cf. 1.1.1)), this consolidation phenomenon is particularly important with platforms and the reliance on platforms such as Amazon is even more problematic for suppliers.

*Issues/impacts in relation to workers**Job destruction on one side (retail in middle size cities), and creation on the other side (logistics/transport in dynamic areas)*

In terms of job creation and destruction, the few studies identified by the French report (that concern France, but also the US and other European countries, excluding Belgium) conclude that “e-commerce does not create jobs and most conclude to strong job destructions” (Bon-Maury et al., 2021, p. 24 Annex VI) (cf. Table 13). This is because the **labour intensity of e-commerce is lower** than the one of physical retail. However, in most studies, the possible creation of jobs in transport and logistics is not considered, and neither are the potential impacts that could be generated through price reductions. The French report’s own assessment concludes that e-commerce has **destroyed between 5800 and 15600 jobs in retail**, but has also **created between 9200 and 27900 jobs in transport and logistics** in France over the 2010-2018 period.

Beyond this uncertain result in terms of overall job quantities, e-commerce is likely **to strengthen territorial disparities**, with job destruction taking place middle-size cities (small non-food shops), and job creation in warehouses taking place in dense and economically dynamic areas (Bon-Maury et al., 2021; MacGillis, 2021).



**Table 13: Employment impacts of e-commerce (Bon-Maury et al., 2021, p. 25 Annex VI)**

Source	Champ temporel	Champ spatial	Méthode	Résultat
Biagi et Falk (2016)	2002-2010	Dix pays européens	Modèle	Pas d'impact
Mahjoubi (2019)	2018	France	Comparaison des intensités en ETP du chiffre d'affaire	2,2 emplois détruits pour 1 emploi créé
Duthoit (2020)	2008-2019	Etats-Unis	Comparaison des niveaux d'emploi du commerce en ligne et du commerce de détail	4,5 emplois détruits pour 1 emploi créé
Mouradian et Kuhanathan (2020)	2009-2018	Sept pays européens	Modèle	En France : 7 emplois détruits pour 1 emploi créé (commerce de détail) 2 emplois détruits pour 1 emploi créé (commerce de détail et de gros)
Mission	2010-2018	France	Comparaison de l'évolution de l'emploi du commerce en ligne, du commerce de détail et du transport et de la logistique	Évolution négative du commerce de détail (- 5 800 à - 15 600 ETP) Évolution positive du transport et la logistique (+ 9 200 à + 27 900 ETP)

Source : Mission

#### *The high use of temporary employment in online retail and in transport and logistics*

While employment conditions in retail are already not good when compared to other sectors (high rate of part-time work, high rate of temporary employment, including temporary work, high rate of workers working on Saturdays and in evenings) (CCE, 2017), e-commerce would raise new issues.

In terms of job quality, studies are scarce, but the French report highlights the higher rates of non-standard forms of employment in e-commerce when compared to the retail sector in general (Bon-Maury et al., 2021 Annex VI). Particularly, it compares the rate of temporary employment<sup>21</sup> in the retail sector (1.5%) with the rate in **one surveyed pure-player in France** (16%, i.e. 7 times more). Within activities of this pure player, most temporary jobs are located in the warehouses, where 44 % of jobs are temporary employment jobs. In the **transport and logistics sector**, the rate of temporary employment is higher than in retail, and it is growing, from 3.8 % in 2011 to 6.5% in 2018.

It has to be noted however that when looking at **employee and trainee jobs only (thus excluding temporary employment and other non-standard forms of employment)**, there is a higher rate of **fixed contracts** in transport and logistics (around 70% against 60% in retail), and there is no difference between online retail and retail in general. Also, **full time** jobs are more used in the transport of goods (96%) and in the storage/warehousing of goods (82%) than in retail (76%).

#### *The use of digital labour platforms and on-call work for the last mile delivery*

While e-commerce creates jobs in the sector of transport and logistics by extending the chain towards homes of final consumers, a large share of those jobs for the last mile uses non-standard forms of employment, including on-call work with free-lance workers and whose hiring is facilitated through **digital labour platforms**. On-call work raises specific challenges to workers including “regularity of work and income, working conditions, social protection, skills utilization, freedom of association and the right to collective bargaining” (ILO, 2021, p. 19). It is used by a large scope of companies, from SMEs in the catering and retail sector to big web shops and platforms. According to FGTB, the use of false self-employed workers is highly developed in parcel delivery companies that operate in Belgium for e-commerce companies, such as PostNL, DPD, GLS (FGTB-UBT, 2021).

A study in Belgium assessed the fairness of working conditions of five labour platforms, including three platforms in the food delivery sector (Takeaway, the only platform analysed that offers

<sup>21</sup> i.e. ‘travail intérimaire’

employment contracts, Ring Twice and Deliveroo), under the Fairwork research project (Centre for Sociological Research at KU Leuven and University of Oxford) (Pulignan et al., 2022). They rated the working conditions of platforms against five principles of fair work – fair pay, fair conditions, fair contracts, fair management and fair representation. As a conclusion, “they find that **five of the largest platform companies in Belgium fail to offer fair working conditions** [...] Workers on these platforms reported dire conditions, including pay below minimum wage, unclear contracts, and lack of access to collective representation mechanisms” (Lyons, 2022).

#### *Jobs are better paid in online retail*

On the other side, jobs in online retail and in transport and logistics would be **better paid** than jobs in retail, likely because of the use of service providers, i.e. temporary work agencies. In France, the net average wage is 25 % higher in online retail than in retail in general, and 6.5 % higher in transport and logistics. Within pure player leaders, wages are even 79% higher than in the rest of retail.

**Table 14: Net average wages by sector in Euro**

	All jobs	Difference with retail
In-store retail	20.935	-0,66%
Online retail	26.374	25,14%
<i>Pure player leaders</i>	37.756	79,15%
<i>Other pure players</i>	28.871	36,99%
<b>Retail</b>	21.075	0,00%
Transport	21.182	0,51%
Logistics	26.919	27,73%
<b>Transport and logistics</b>	22.437	6,46%

#### *Lack of comparative studies on working conditions*

We did not find any reports/studies comparing the working conditions prevailing for e-commerce and physical retail/overall retail. However, several press articles report on the hard working conditions in online retail. Amazon in particular is pointed out regularly for the hard working conditions in its warehouses. A recent study finds that **the rate of injuries in Amazon’s warehouses in the US is 80 % higher** than in warehouses of competitors (BBC, 2021).

#### *To favour e-commerce, labour legislation is made more flexible in Belgium*

In Belgium, the use of night work has been facilitated in the e-commerce sector (cf. Box 2) and could be further facilitated in order to accommodate e-commerce warehouses, in the context where Belgian online purchases benefit mainly foreign-owned pure players through their warehouses located in neighbouring countries, especially the Netherlands (cf. 2.1.2).

#### **Box 2: The flexibilisation of night work for e-commerce in Belgium (CCE, 2017)**

[...], les autorités ont pris en 2016 des mesures visant à autoriser le travail de nuit (entre 20 heures et 6 heures) dans le secteur de l'e-commerce via une CCT d'entreprise. La loi-programme du 25 décembre 2017 facilite la conclusion d'une CCT sur le travail de nuit.

Celle-ci permet aux entreprises actives dans le commerce électronique de marchandises et de services d'introduire le travail de nuit (entre 24 h et 5 h) en concluant une CCT avec au moins une organisation syndicale représentative. Avant cette loi-programme, une CCT d'entreprise signée par toutes les organisations syndicales représentées dans la délégation syndicale était requise.

En outre, la loi-programme introduit une deuxième mesure axée sur le commerce électronique de marchandises, à savoir que l'entreprise reçoit la possibilité d'introduire le travail de nuit (entre 20 h et 6 h) durant la période 2018-2019 via une procédure simplifiée, et de maintenir celui-ci à partir de 2020 selon une procédure simplifiée.

Liberals and the retail trade association COMEOS push currently for the further **flexibilization of work regulations, including the possibility to use night work in e-commerce warehouses**, this resulting in a draft legislation in this direction, agreed in February 2022 (Allo, 2022; RTBF, 2021a). It is in this context that the president of the French speaking socialists Paul Magnette has made his statement over the **“phase-out of e-commerce”**, arguing that Belgium should not compromise its labour law to attract e-commerce warehouses, but also mentioning other issues generated by e-commerce, including environmental impacts and impacts on physical retail (Noulet, 2022). While media reported in the first instance on the negative reactions over Magnette’s statement, socialist, Christian and liberal worker trade unions stood up against this draft legislation (L’avenir, 2022; Moustique, 2022; Steffens, 2022). With the argument to facilitate the implementation of e-commerce warehouses and to create jobs in Belgium, there is a risk that night work would be further used beyond the specific sectors (e.g. health) for which exceptions are in place.

In the framework of this debate, the CSC trade union argues that working conditions in e-commerce in the Netherlands are so low that local workers do not want those jobs, for the benefit of posted Eastern European workers, hired mainly through temporary employment (most of the 380 000 workers in the logistic sector would be migrant workers) (Tendances/Trends, 2022).

#### *Broader societal issues/impacts*

The development of e-commerce raises also broader societal issues. The development of home deliveries implies a reduction in social contacts, and the development of a more sedentary lifestyle, with subsequent health impacts. Amazon is criticized for its tax optimization practices, as other GAFAM, with implications on public revenues and expenses (Attac France et al., 2019).

### **3.3 Changes in demand quantities or higher-order effects of e-commerce**

Those comparative assessments reviewed in 3.2 **assume that online purchases completely replace traditional purchases**. In that case, the net environmental impact of introducing e-commerce relies exclusively on the compared efficiency between both channels. Such assumption implies that the overall demand for the purchases of the goods and services that are bought online remains steady (Frick & Matthies, 2020), which would not be a bad news for climate, resources and the environment. In contrast, at the economic level, this may result in negative impacts, since a certain exnovation would occur: in fact, “as a result of the substitution, traditional shops may have to shut down” (Börjesson Rivera et al., 2014, p. 108).

However, as with other technologies potentially increasing efficiency, rebound effects are likely, because of the possible **freed income and time**. This would mean an increased consumption of goods and services, bought through online channels or not. In addition, it can be that the interaction between both channels is different than what is expected: rather than replacing offline purchases, online purchases may exist because **new needs and purchase means are created**, this making overall consumption increase. Such increases would be rather a bad news for climate, resources and the environment, especially given the fact that consumption levels of Northern countries already exceed planetary boundaries (Frick & Matthies, 2020).

The question we seek to answer here is the following: how does the overall demand react to the introduction of e-commerce? In this section, we detail those various effects playing a role in changes in demand and consumption quantities due to e-commerce, and we present the state of the art, i.e. studies seeking to estimate those effects, which is yet scarce (Börjesson Rivera et al., 2014). We build on review articles focusing on environmental effects of ICT, e-commerce being one of the ICT products and services under review (Börjesson Rivera et al., 2014; Coroama & Mattern, 2019; Pohl et al., 2019), and on the few articles reviewing and assessing the net environmental impacts of e-commerce, and that go beyond the substitution assumption (Buldeo Rai, 2021; Fichter, 2002; Frick & Matthies, 2020).

### 3.3.1 Those effects among other ICT effects

Currently, there is no consensual taxonomy of ICT and e-commerce effects, despite the various attempts, and authors use various terms to refer to the same kind of effect, as already highlighted in 3.1 (cf. Table 15). In this section, **we focus** on so called higher-order indirect effects (Horner et al., 2016), second-order effects (Börjesson Rivera et al., 2014) or higher order effects due to changes in use patterns (Pohl et al., 2019), that “occur when the introduction of ICT causes a change in consumption or production elsewhere in the economy” (Horner et al., 2016, p. 1).

**Those effects differentiate** from direct (Horner et al., 2016) or first-order effects (Pohl et al., 2019) (that results from the ICT infrastructure itself), but also from optimization/efficiency and substitution effects (when “ICT enables us to make existing products and services more efficient as well as create ‘e-substitutes’ for physical products” (Horner et al., 2016, p. 1)), both covered in the previous section (3.2)<sup>22</sup>.

For (Pohl et al., 2019), “**higher order effects** [...] refer to the application of ICT and the resulting behavioral and structural effects (Røpke, 2012). While optimization and substitution effects have to do with technological change, other effects under that heading are “changes in use patterns”, which are referred to in the literature as rebound or induction effects (p. 700). For (Börjesson Rivera et al., 2014, p. 106), **second-order effects** “go beyond the direct consequence of an activity” and are effects of effects or indirect effects and encompass “ripple effects”, different types of “rebound effects” and “structural and transformational changes”.

**Table 15: Various taxonomies of ICT effects**

Definitions (Horner et al., 2016)	(Horner et al., 2016)	(Börjesson Rivera et al., 2014)	(Pohl et al., 2019)
<b>Changes in life cycle impacts</b>			
ICT itself consumes energy	Direct effects	First-order effects (direct)	First-order effects
ICT enables us to make existing products and services more efficient as well as create ‘e-substitutes’ for physical products	Indirect effects (efficiency and substitution)	First-order effects (substitution)	Intended higher order effects (substitution and optimization)
<b>Changes in quantities</b>			
Occur when the introduction of ICT causes a change in consumption or production elsewhere in the economy	Higher-order indirect effects	Second-order effects	Higher order effects due to changes in use patterns

### 3.3.2 The various identified effects

The various reviews identify several effects aligning with variations in consumption and production quantities and provide various taxonomies of effects. (Börjesson Rivera et al., 2014, p. 108) identify a dozen of second-order effects of ICT and provide examples for e-commerce, but note that those “effects may actually overlap”. (Pohl et al., 2019) describe three user-related higher-order effects of ICT (direct-, indirect rebound- and induction effects), and (Horner et al., 2016) identify four higher-order indirect effects (direct and indirect rebound, economy-wide rebound/structural change and systemic transformations).

<sup>22</sup> It has to be noted however that (Pohl et al., 2019) embraces substitution and optimization effects under higher-order effects, but categorize them as ‘intended effects’, and that (Börjesson Rivera et al., 2014) embrace those effects as first-order effects.

We distinguish **five main types of effects**, i) the classical rebound effects, as conceptualized in Energy economics (direct and indirect), ii) time rebound, iii) induction effects, iv) economy-wide/macroeconomic effects and v) transformational effects (cf. Table 16).

**Table 16: Summary of effects affecting consumption and production quantities**

Higher-order effects	Definition	Drivers
Direct and indirect re-spending rebound	Increased resource efficiency (in comparison with offline retail) and decreased price are followed by an increase in the demand (of the same good or of other goods), which consequently outweighs the efficiencies (adapted from (Pouri, 2021))	Price and income
Time rebound	Changes in other activities due to changes in time use resulting from purchasing goods and service online.	Time
Induction effects	Changes in user behavior that are not directly attributable to efficiency gains, but to an increased choice of options, and an easier access to goods and services (adapted from (Börjesson Rivera et al., 2014; Pohl et al., 2019; Pouri, 2021))	Accessibility
Economy-wide/macroeconomic rebound	Changes in output and factor prices which lead to further changes in market composition and economic growth (Font Vivanco et al., 2016)	Prices
Transformational effects	E-commerce implications on consumers' preferences, alter social institutions, and rearrange the organization of production (Greening et al., 2000), that do not relate to price mechanisms (Börjesson Rivera et al., 2014)	Other than price mechanisms

#### *Classical rebound and time rebound effects*

E-commerce might be more efficient than physical retail and thus might reduce environmental impacts in general if online purchases substitute to offline purchases (cf. 3.2). At the same time, this increased efficiency could affect costs and prices linked to retail and to the products traded. It is also likely that e-commerce induces savings in terms of time for consumers. Because of the freed time and income, e-commerce could result in a change in conducted activities, and in additional consumption from online consumers, that could affect environmental impacts. Those effects resemble direct and indirect re-spending rebound effects and the so-called time rebound.

#### *Direct and indirect re-spending/microeconomic effects*

**Rebound effects** have been initially analyzed in the framework of policies meant to improve energy efficiency, e.g. of buildings. In that context, rebound is an effect encompassing “both the behavioral and systems responses to cost reductions of energy services as a result of energy efficiency measures” (Hertwich, 2005, p. 85). RE include both direct and indirect effects: in the former case, cost reductions resulting from energy savings are spent in increased consumption of the same product or service, and in the latter case in increased consumption of other products and services<sup>23</sup>. As a result of the effect, “the environmental benefits of eco-efficiency measures are lower than anticipated (rebound) or even negative (backfire)” (Hertwich, 2005).

Rebound effects can also be analyzed for **technologies** that improve efficiency and thus environmental performance. E-commerce was not developed initially to reduce the environmental impacts linked to the distribution of goods. However, e-commerce might be more efficient than physical retail (cf. 3.2), and thus might reduce energy consumption and environmental impacts in general. At the same time, this increased efficiency could affect costs

<sup>23</sup> E.g. households reduce less than expected their emissions resulting the retrofitting their house: they use the generated savings for other carbon-intensive activities, like more heating (direct), or travels (indirect).

and prices linked to retail and to the product traded, which could in turn result in additional consumption.

(Horner et al., 2016, p. 4) define direct **rebound effects of ICT** as “energy service own-price-elasticity effects: as prices fall (due to improvements in efficiency or productivity), substitution and income effects increase consumption [of the same product]”, and indirect rebound effects as a “result from cross-price elasticity of demand for other products and services due to increased real consumer income”.

(Börjesson Rivera et al., 2014, p. 108) distinguish **two kinds of efficiency improvement relating to e-commerce**: “a) in the trading service itself, or b) for a particular service[/good] being sold using e-commerce rather than through traditional commerce”. The first results in lower transaction costs, and the second in lower market prices of the services/goods sold on the market. Because e-commerce facilitates matching between producers and consumers, it makes the transaction costs go down. This will then influence the market prices of goods/services. For example, “when consumers have more information about the prices at different retail outlets, it is easier for them to buy services[/goods] at the lowest price and thus increase their real incomes” (Börjesson Rivera et al., 2014, p. 109). This additional income might be used to consume more of the particular good/service (direct effect) or for other goods and services (indirect effects).

#### *Time rebound*

In addition to cost and income factors, e-commerce could **alter other consumption factors, including time** (Börjesson Rivera et al., 2014). The time rebound has been also identified in the extended taxonomy of Environmental rebound effects of (Font Vivanco et al., 2016) (cf. D3.2), together with socio-psychological costs and other factors such as space or volume, skills and information. The underlying assumption is that e-commerce helps save time, and this could lead to changes in activities conducted by consumers, to additional consumption, and thus to changes in environmental impacts.

This effect is also highlighted by the review of (Buldeo Rai, 2021) under the heading effect on ‘overall activity demand’, that focuses however solely on the impacts on transport demand (rather than on impacts on overall demand, including e.g. goods). She highlights in that context that “true reductions in transport and negative environmental effects associated with it only occur if consumers stay at home or perform trips using other modes than private motorised ones” (Buldeo Rai, 2021, p. 7). The same review reports the results of a “Norwegian research by Bjørgen et al. (2019) suggest[ing] that the use of home delivery services for food and groceries is associated with more environmentally friendly travel modes” (Ibid, p. 7).

#### *Induction effects*

(Pohl et al., 2019) and (Börjesson Rivera et al., 2014) mention induction effects as separate effects. We interpret induction effects as purchases through e-commerce that would not have been made at all without the existence of e-commerce (even through offline channels). Digressing from the substitution assumption, those purchases thus do not replace purchases that would have taken place physically, but add to it or complement it (Buldeo Rai, 2021).

(Pohl et al., 2019, p. 700) reports that induction effects “are not directly attributable to efficiency gains” (e.g. in terms of price or time), and that the term “describes all the changes in user behavior that can be attributed to an **increased choice of options**”. (Börjesson Rivera et al., 2014, p. 108) relate induction effects with the fact that e-commerce **creates more opportunity and makes it easier** to buy and sell products, including from remote retailers, and thus from remote locations. Citing Hilty (2008), (Coroama & Mattern, 2019, p. 4) refer to induction effects as “the ease of accessing or using a service [that] creates new demand”. On the other side, for (Horner et al., 2016, p. 6), induction effects “align loosely with” or “are special cases of” direct rebound effects.

The induction effect is also highlighted by (Buldeo Rai, 2021, p. 7), under the heading effect on ‘overall purchase demand’, focusing again solely on transport demand: “By creating new needs of products that were not available, known or even existent before [...], the worldwide web increases transport demand”.

According to (Frick & Matthies, 2020, pp. 212–2013), this effect from e-commerce contains two opposing effects, e-commerce could lead to an increase in consumption levels and overconsumption but also to an increase in consumption of sufficiency-oriented goods and services. On one hand, it could lead to **overconsumption** because of it improves access (“always open” shops, with “endless shopping opportunities”) and it facilitates shopping (“the ease of point and clicking” in a “frictionless market”). The use of mobile internet and of comparison portals (such as marketplaces) further improves this access and ease. In this way, shopping efficiency increases “as one can buy more products or services investing less time, effort and money” (ibid, p. 213), and one can talk about perceived behavioural efficiency gains which include “not only financial costs but also effort and time, theoretically founded on behavioral costs” (Ibid, p. 213). On the other hand it could lead to **an increase in environment-friendly goods and services** since access to those is improved as well, especially for second-hand products.

### *Economy-wide/macroeconomic effects*

Both (Horner et al., 2016) and (Börjesson Rivera et al., 2014) identify **economy-wide effects** as potential high-order effects of ICT. According to (Börjesson Rivera et al., 2014, p. 109), those effects are the result of direct and indirect microeconomic rebound and corresponds to “growth and changed resource consumption [effects] due to price and quantity readjustments throughout the economy”. (Horner et al., 2016, pp. 4–5) define those effects as when “the ICT introduction causes macroeconomic adjustments across economic sectors”, including the changes in “growth in other sectors of the economy, inducing structural changes that have energy use implications of their own”.

What they consider as economy-wide effects seems actually to correspond to what is called **macroeconomic rebound** by (Font Vivanco et al., 2021). For the latter, economy-wide effects are the combination of micro-economic or partial equilibrium and macro-economic or general equilibrium rebound, with:

- “the first type relat[ing] to situations where increases in effective income/profits from consumers/producers are re-invested leaving prices constant [and corresponding to above-described direct and indirect rebound effects],
- [and] the second type account[ing] for changes in output and factor prices which lead to further changes in market composition and economic growth”. For the latter, they cite the example of “the widespread fuel efficiency improvements in transport driving down oil prices and triggering further demand for energy services worldwide” (Ibid, p.2).

(Horner et al., 2016, p. 5) cite examples of **effects of e-commerce on the growth of other sectors**:

- “the logistics industry (Hesse 2002), including growth in urban freight vehicle sales and changing patterns in distribution center floor space (Harrington 2015),
- increased trucking and adoption of new pricing strategies by freight carriers (Shorr Packaging Corp 2015), and
- use of more specialized packaging and a broader range of box sizes (Mohan et al 2014)”.

### *Transformational effects*

(Börjesson Rivera et al., 2014) and (Horner et al., 2016) cite transformational effects as effects of e-commerce and ICT in general, using both the definition of (Greening et al., 2000, p. 391), i.e. “changes in technology [that] also have the potential to **change consumers’ preferences, alter social institutions, and rearrange the organization of production**”. Those effects differentiate

from the economy-wide/macroeconomic effects on the basis that those are **not directly linked to price mechanisms** (Börjesson Rivera et al., 2014, p. 112).

(Buldeo Rai, 2021, p. 7) also refers to similar effects that she embraces under the ‘consumption geography’ category or the “wider geographical implications of e-commerce on environmental sustainability”, to be considered when assessing the net environmental impacts of e-commerce.

Several examples of transformational effects of e-commerce are cited:

- Changes in the structural organisation of production, including “how e-commerce or the internet in general has influenced the **number or type of producers operating in an industry**” (Börjesson Rivera et al., 2014, p. 112).
- Change in **local store network**, and a decline being “unavoidable and already set in motion in many cities, in particular the small to mid-sized ones”, and with further implications for the e-commerce adoption by further consumers (Buldeo Rai, 2021, p. 7)
- “the fundamental constraints on **where people live and work** continue to loosen: e-commerce and home delivery make proximity to traditional retail outlets less important” (Horner et al., 2016, pp. 5–6)
- Similarly, e-commerce is likely to impact **mobility lifestyles** in the long run. It could make car ownership obsolete or it could cause “store closures in remote areas and as such forces consumers to rely on their cars even more” (Buldeo Rai, 2021, p. 8)

### 3.3.3 State of the art: consideration of those effects by existing studies

#### *A lack of research on the subject*

Overall, there is a **lack of consideration of higher order effects** of ICT, including of e-commerce, with most efforts being put on the assessment of direct or first-order effects (Börjesson Rivera et al., 2014; Horner et al., 2016; Pohl et al., 2019).

(Horner et al., 2016) who reviewed the literature on the indirect energy effect of ICT conclude that studies “rarely address the higher-order effects beyond efficiency and substitution”. If some studies address those rebound effects, those contributions are not empirical, but rather theoretical or based on speculative models (ibid, p. 14). (Pohl et al., 2019) examine whether and how LCA case studies on environmental effects of ICT take into account related higher order effects, in commerce, telework and monitoring and control. They found that “technology-based higher order effects, such as optimization and substitution, are usually included in the assessment by choosing comparative study designs, while user-related higher order effects, such as rebound effects and induction effects, are less often considered”. More particularly, none of the reviewed studies on e-commerce included those effects (Pohl et al., 2019).

(Horner et al., 2016, p. 15) explain this non-consideration of rebound effects by the related uncertainty and the “**inability to disentangle root causes of interrelated economic effects**. The dynamics of these effects are hugely dependent upon human behavior, which is laden with uncertainty and confounds efforts to achieve the full technical potential of ICT interventions”. More particularly for LCA, this shortcoming can be explained by the fact that “changes in user behavior are typically ignored” in general LCA practice (Pohl et al., 2019, p. 708).

#### *Results of the few existing studies*

According to (Horner et al., 2016, p. 14), “a set of case studies conducted in the EU find ICT-related rebound effects from e-commerce and telework ranging from 14% to 73% (Jørgensen et al 2006)”.

Also, we found one main study investigating the induction effect or the relationship between online shopping and overall consumption levels.



*Relationship between online shopping and overall consumption levels: it depends on sectors*

While there exists some studies showing the positive relationship between behavioural efficiency gains of online shopping and online consumption, there was until recently no research looking at the impact of those gains on the **overall consumption level of individuals**. This is yet the way to verify whether online shopping replaces offline shopping or whether it induces additional consumption (Frick & Matthies, 2020).

And this is what (Frick & Matthies, 2020) intend to do on the basis of a **survey in Germany looking at clothes, digital devices and leisure travel**. They investigated for the three items the consumption increase resulting from effects than “can be subsumed both under [extended] rebound- or induction effects” (Ibid, p. 213), by first measuring the level of perceived behavioural efficiency gains of online-shopping. Then, they analysed the relationship between the latter and the level of consumption of new and sufficiency-oriented products (e.g. “travelling by train instead of plane or purchasing ‘second-hand’ instead of new goods”), to verify two assumptions: that online shopping i) leads to overconsumption of new products and ii) to more sufficiency-oriented goods and services being bought (Ibid, p. 212). They found that “possible rebound-, induction or beneficiary effects of online shopping depend on the context of both the consumption domain and the individual’s motivational background” (Ibid, p. 214):

- “all in all, perceived behavioral costs of online shopping were lower than those of in-store shopping [...], with the exception of alternative transport modes booking” (ibid, p. 220): “thus **online shopping does make consumption more efficient and easy** (with the exception of booking buses and trains online)” (Ibid, p. 221). This is a confirmation of previous research that shown higher shopping convenience for online purchase (in comparison with in-site shopping), (Beauchamp and Ponder, 2010 cited by (Frick & Matthies, 2020));
- Perceived behavioral efficiency gains of online shopping and the amount of new products bought online correlate positively.
- an **induction/rebound effect was found for new digital devices only**, while a **substitution effect was found for new clothing**, meaning direct consumption-increasing effects for the former, but not for the latter. For leisure air travel, only when individuals had purchase intentions, did a consumption-increasing effect occur (interaction effect).
- On sufficiency-oriented products, “no definite conclusions were drawn” (ibid, p. 221).

On the substitution effects, results of a survey by the Belgian trade association Comeos indicates that 35% of online purchases are new or mainly new purchases, 42% come as replacements of previous offline purchases and 32% are difficult to categorize (“There are as often new/extra purchases as replacement of previous offline purchases”) (cf. Figure 21) (De Vuyst & Mikulenaite, 2017).

	2011	2012	2013	2014	2015	2016	2017
Not at all, these are new / extra purchases	20%	15%	16%	12%	14%	15%	13%
Not really, these are mainly new / extra purchases	22%	21%	21%	23%	23%	22%	22%
These are as often new / extra purchases as replacement of previous offline purchases	27%	29%	32%	33%	33%	30%	32%
Rather, these are mainly replacements of previous offline purchases	23%	26%	25%	25%	24%	25%	25%
Totally, these are replacements of previous offline purchases	8%	9%	6%	7%	7%	8%	7%

**Figure 21: Substitution offline purchases (question asked: to what extent do these purchases via the internet replace offline purchases?) (De Vuyst & Mikulenaite, 2017, p. 19)**

### Conclusion to the third part

As a conclusion, **the current state of research does not allow to provide a straightforward answer regarding the net environmental impacts of e-commerce.** However, our review provides useful indications on both the impacts per unit (in comparison with traditional retail) and the impacts on produced and consumed quantities.

Regarding the impacts on quantities, a number of studies have identified various mechanisms through which e-commerce may induce additional consumption, including the known **rebound effects** (i.e. change in consumption that are attributable to efficiency gains) and the less known **induction effects** (i.e. change in consumption that are attributed improved access to goods and services), that are not always distinguishable. **There is a need for more research** to verify the results of the unique empirical study that we found (Frick & Matthies, 2020). This study finds that the presence of induction and rebound effects depends on products considered, with online purchases of digital devices inducing additional consumption and online purchases of clothes replacing physical purchases. However, the survey conducted by COMEOS indicates a rather high level of induction effect, with at least one third of online purchases being additional. Those elements point out that **e-commerce does induce additional consumption** and that this effect varies according to products. It is yet not clear to which extent this effect occurs.

Regarding impacts of e-commerce per unit, early studies are unanimous regarding the environmental superiority of e-commerce, mainly because, for the last mile, the vehicle travel is shared (contrary to the personal vehicle travel of physical retail). However, those studies do not consider a number of key parameters (product returns, failed deliveries, trip chaining, browsing trips) and rest on a number of unrealistic assumptions (e.g. basket sizes). Thus, we conclude that **the superiority of e-commerce over physical retail in terms of environmental impacts is very unlikely.** More recent studies show that it depends on e-commerce forms, and only under specific conditions online purchases outperform physical purchases. Some developments could improve performance (e.g. use of cargo bikes or electric vehicles for the last mile), but others are likely to deteriorate it, including fast deliveries.

When looking at the global picture (cf. Figure 22), this means that:

- in the best case (Q1, online purchases outperform physical purchases and e-commerce induces additional consumption), e-commerce activities have the potential to reduce environmental impact, but experience rebound, making the result uncertain; and
- in the worst case (Q2, physical purchases outperform online purchases and e-commerce induces additional consumption), e-commerce activities increase net environmental impacts (in the case where online purchases do not outperform physical purchases).

		Changes in unit impacts: Are online purchases less impacting than offline purchases?	
		Ee<Ep	Ee>Ep
Changes in quantities: Does e-commerce induce additional consumption?	$\Delta\text{Cons}>0$	Q1: Uncertainty/rebound	Q2: Higher net impact
	$\Delta\text{Cons}<0$	Q4: Lower net impact	Q3: Uncertainty/potential shortfall

**Figure 22: Synthesis of results - potential environmental outcomes of e-commerce activities. Adapted from (Zink & Geyer, 2017, p. 597)**

In addition, our literature review reveals that certain forms of e-commerce are more problematic than others, and than physical retail.

- Pure online shopping of footwear in Belgium and click-and-collect generate less impacts than traditional shopping, but **more often, online shopping** involves more than one travel, **and is thus likely to be more impacting than traditional shopping** (Buldeo Rai, Mommens, et al., 2019)

- When considering differentiated basket sizes, failed deliveries and product returns, brick and mortar has higher impacts than brick and click, but **outperforms pure players** (fast moving consumer goods in the UK), because warehouses are located further than stores (Shahmohammadi et al., 2020)
- **Collection points** are better for non-food products in urban areas like Brussels, while home deliveries are to be preferred in urbanized and rural areas like Flanders and Wallonia (Mommens et al., 2021) In Belgium, around 70% of online purchases are delivered at home (InSites Consulting, 2020).
- **Home deliveries** through outsourced specialised logistic service providers would generate less external costs than in-house deliveries for non-food products (Belgium) (Mommens et al., 2021) but for fast moving consumer goods (UK), in-house deliveries are to be preferred (Van Loon et al., 2015).
- **Crowdsourced** deliveries generate much higher impacts than deliveries outsourced through a specialized logistics service provider. This last result meets the findings on the social sustainability of the last mile.

Key messages from the review on social impacts include:

- For workers: **e-commerce destroys jobs in the retail sector** (since it requires less labour, and since online purchases partly replace offline purchases), but **creates jobs in transport and logistics**, by extending the value chain until consumers' homes. Employment conditions in **warehouses and for last-mile delivery** are less good than in retail, but jobs in warehouses and in transport and logistics are generally better paid than jobs in retail. In Belgium, in order to favour the establishment of e-commerce warehouses, **labour legislation on night work is made more flexible**.
- For suppliers: while e-commerce might increase market access, platforms such as Amazon, with their dominant position on markets create **unbalanced power relations** and make transaction modalities possibly unfair for suppliers.
- For society in general, home delivery is likely to results in a **weakening of social ties**, and platforms such as Amazon practice **tax optimization**, reducing public revenues.

Research on the impacts of e-commerce must continue, in order to confirm the recent findings, but also because of the identified research gaps. There is a large focus on the last mile, but impacts of **infrastructures (ICT and warehouses)** and of **upstream transport** should be further examined, especially given the development of e-commerce with air freight and deliveries within short delays for the latter. Also, studies focusing on Belgian purchases could differentiate between purchases through **local and foreign online retailers**, given their importance within the online market (Buldeo Rai, 2021).

Finally, reviewed attributional assessments compare two channels as if they were developed at the same stage, and do not assess the impacts of a change from **offline purchases to online purchases**, what consequential assessment would do. Online purchases through pure players involve new warehouses (as well as other ICT infrastructure needed by e-commerce), while most infrastructures for physical retail are already built, and land is already artificialized. This last element would worsen the environmental assessment of pure players, when comparing with already established brick and click.

## 4. Conclusion

### 4.1 On current dynamics and impacts

#### 4.1.1 Retail sector dynamics: the need to limit commercial development to maintain existing retail

While we can clearly talk about a surge in online retail (2.1), we cannot talk about a general decline of physical retail, but rather of a decline of physical shops in certain sectors (e.g. digitalized goods), certain areas (mid-sized town center, as seen in the UK) and for a certain type of retailers (independent retailers) (2.3.2). This can be seen in the increasing vacancy rates in cities, including in neighboring countries, Belgium and Brussels (from 5 to 13% in 10 years for the latter). This trend could have major consequences since independent retail still represents the majority of the retail sector in terms of numbers of shops and of employment. In addition, and maybe more importantly, the surge in online retail deteriorates the profitability of the whole retail sector (2.3.3), and this could increase the pressure on workers and suppliers.

This diagnosis regarding the deterioration of the profitability agrees with the one made at the Belgian level for the retail sector pointing the difficulties of the sector, the market saturation, and the need to limit commercial development to address those economic difficulties (2.2). This same diagnosis at Belgian level also points to the other developments that affected the sector (beyond the surge in e-commerce), including the longstanding rise of chains, that goes along with the decline of independent retailers, and the development of retail parks and malls in the 60-70's.

This re-actualisation of the diagnosis of the decline of independent retail trade is essential to understand the recent interest of regional policy for restraining commercial developments (cf. D2.3). However, the policy recommendation of restraining commercial development meets with the difficulty relating to the implementation means (*how to limit*), in the context where one part of the demand (online demand, especially through foreign operators) escapes traditional means (regulations on commercial establishments). Also, it meets with the difficulty of agreeing and deciding what kind of retail we want to restrain, and what kind of existing retail we do want to keep (*what to limit and what to keep*). Our second main section on the sustainability impacts of e-commerce provides some elements to address this question.

#### 4.1.2 Sustainability issues relating to e-commerce

Based on our review, we can state that either e-commerce increases net environmental impacts (worst case) or have the potential to reduce environmental impact (impacts per unit), but because of the presence of rebound and induction effects (impacts on quantities), the net impact is uncertain (best case). This result is different from usual results found because the effects of e-commerce on overall demand are generally not considered. Methodologically, this means that impacts of online purchases per unit are 'just' compared with impacts of offline purchases per unit. Yet, the net environmental impacts of e-commerce depend on its compared impacts *per unit* (so-called performances) and on its effects *on production and consumption quantities*, while e-commerce is deemed to favor consumerism.

In addition, environmental assessments generally neglect certain life cycle phase that are judged as low impacting phases (i.e. ICT infrastructure building and use). Also, they do not take into consideration the fact that infrastructures for physical retail trade are already built, and have already artificialized land, while infrastructures meant for pure play e-commerce (warehouses) are still to be built, especially in Belgium, where the supply is not well developed yet. If pure players would replace physical retail for a large part of purchases, this would mean that new infrastructures would have to be built, and that some of the existing infrastructures, not used anymore, would have to be taken care of.

Thus, the argument that e-commerce would perform better than physical retail from an environmental perspective is very fragile. E-commerce also raises a number of social and socioeconomic issues, especially for workers in warehouses and in the transport sector (especially for the last mile), and for suppliers trading through platforms.

Finally, more recent studies adapted to the European, Belgian and Brussels context highlight the worst forms of e-commerce in terms of sustainability.

## 4.2 On possible and desirable futures

### 4.2.1 Current governance: support to digitalization for traditional retail

E-commerce threatens the retail sector generally, and more specifically retail in digitalized goods, shops in mid-sized cities and independent retail. According to some commentators, the key to survive and to compete with e-commerce giants would be to become omni-channel. Thus, several policy interventions focus on supporting independent retail to develop an online channel, as done in Brussels with the platform “Mymarket.brussels”, that was implemented by the region for Brussels retailers (BX1, 2020, p. 1), or the subsidies provided by the Walloon region to SMEs to develop their own channel (Defoy, 2022). In the same vein, an analysis of the short- and longer-term impacts of COVID-19 on Belgian retail, (Beckers et al., 2021, p. 10) concludes:

*“If the local shop neglects its online channel when physical retail resumes, the large (international) online players will attract these shoppers and local shops will lose a share of their turnover. This might prove the final blow in an already difficult retail landscape. Policymakers and sector federations recognize this issue, and budgets are set aside to support local retailers in professionalizing their online stores for example through trainings by UNIZO”.*

The support to independent retailers to develop online channels is considered as the appropriate mean, the ‘happy medium’ to address retail issues: as a reaction to the statement made by P. Magnette on the e-commerce exit, B. Trachte tweeted: *“Entre Amazon et la bougie, il existe aussi des initiatives qui concilient e-commerce et PME/indépendants. Comme le projet <http://mymarket.brussels> que nous avons soutenu [...] »*. While this initiative can be useful for independent retailers, is it enough to support retailers to compete with e-commerce giants that destabilize furthermore the whole retail trade sector?

On the basis of our report, it seems that those measures that we can qualify as measures *supporting the adoption of innovations*, are likely to have little effects given the competitive advantage and the dominance of big pure players and platforms.

Also, while physical retail is disadvantaged on many aspects in front of e-commerce because of the respective basic characteristics (e.g., costs, needed assets, market access, access to consumer data, cf. 2.3.3), it is also disadvantaged by existing regulations. As argued by the French report, “the major e-commerce actors are generally favoured by the tax legislation in force” (Bon-Maury et al., 2021, p. 1 Annex III). This includes GAFAM, which largely escape state taxation, the high use of VAT fraud by platforms, and local land taxation that favours pure play online retailers. Also problematic are consumer protection rules that favour big e-commerce actors, and competition policy that is inadequate to deal with giants of the platform economy. Such analysis should be carried out for Belgium to check whether similar issues are faced in Belgium. If so, policies should be envisaged to restore a level playing field between both forms of retail and to stop favouring certain e-commerce actors and practices.

In addition, given the social sustainability issues raised by e-commerce, the uncertain benefits in terms of environmental impacts (especially when rebound and induction effects are taken into account) and the services provided by the traditional retail sector (access to basic goods and services to all, jobs distributed on the territory and where people live), exnovation policies could be envisaged to disadvantage and limit e-commerce frontally.

#### 4.2.2 Our exnovation scenarios: restraining certain unsustainable forms of online retail

Contrary to the two other GOSETE cases, exnovation (i.e. active unmaking) would target a new technology that is becoming (quickly) part of the regime, rather than fully implemented and existing elements of the regime (the automobility, the linear economy). Exnovation policies may indeed target unsustainable modes of production and consumption, whatever part of the regime or only emerging. In the words of Bonnet et al. (2021, p. 129), policy may focus on “shutting down what already exists” and on “shutting down zombie infrastructures before they appear”.

Rather than the mere exit of e-commerce, we argue for **the exit of unsustainable forms and practices of online retail**, given that some practices are shared with other forms of retail. We propose exnovation scenarios that restrain the surge in specific forms of e-commerce that destabilizes traditional forms of retail trade and that generate negative sustainability impacts. We have identified four main negative trends in retail that are exacerbated by the rise of e-commerce.

Those scenarios represent different answers to the question of what should or could be phased-out, actively unmade for sustainable futures. Those scenarios are built based on the trends and the sustainability issues identified, as well as on the [results](#) of a [participatory workshop](#) held in Brussels in September 2021. They aim to stimulate the debate on exnovation policies and intervention. Table 17 below details those various scenarios: what should be restrained and the rationale behind, the alternatives, and some examples of possible exnovation measures.

The basic scenario or Business as usual constitutes in the decline of the weak elements of the retail sector (particularly independent retailers), as implied by the surge in e-commerce.

The first exnovation scenario consists in the active unmaking **of pure player e-commerce and of the development of new commercial and logistic areas, in order to favour those that use existing infrastructure**. Behind this scenario, there is the issue that new infrastructure is continuously being built, while there are already infrastructures for retail trade. Multi-channel or brick-and-click forms of e-commerce that use existing infrastructure and do not develop new ones are more sustainable than e-commerce pure players in terms of land use, but also regarding the last mile, since shops are located closer to consumers' homes than warehouses, and are already there in a sufficient number overall. In addition, this scenario reduces the number of jobs in warehouses, where employment conditions are not as good as in shops. Possible measures could be moratoires on the building of new retail infrastructures (shops, warehouses), or on infrastructure on non-already artificialized land as proposed in France and implemented in Germany (Bon-Maury et al., 2021, p. 14).

The second exnovation scenario aims at destabilizing purchases from **remote and quick e-commerce, in order to favour slow and local retail**. Behind this scenario, there is the issue that we buy goods from far away, that have to arrive quickly, and that travel with very carbon-intensive mode while some low-carbon alternatives exist (shipping freight versus air freight, rail or fluvial freight versus road freight, electric versus diesel small trucks). With Amazon Prime type subscriptions and free deliveries, the delivery price is completely disconnected from the ecological costs of deliveries but also from the cost price. This scenario that goes against current trends is essential to tackle transport-related GHG emissions that are the only ones not reducing. Possible measures include the prohibition of dumping on delivery pricing, that should correspond to actual costs, and include external environmental costs ideally so that purchases of goods stored nearby and good shipped through low-carbon freight could be favoured, at the expense of goods stored further away and shipped by air freight. This includes Prime Amazon abonnement, which makes delivery price disconnected from the actual cost. Home deliveries in urban areas could also be limited, for example to large orders that cannot be easily picked-up with soft or public transport modes, and favour collection points in the BCR, while 70% of goods are currently home delivered.

The third exnovation scenario targets a destabilization of **e-commerce giants, in order to favour more balanced power relationships in retail**. Behind this scenario lies the issue and trends of increasing economic concentration, with a few players dominating the market and imposing the terms of trade on the rest of the chain. The platform economy, marketplaces, increases concentration through network effects and therefore exacerbates this issue. The aim here is to destabilise those e-commerce giants, which have a disproportionate market power compared to other actors. Another objective is to counter a trend that has been going on for several decades, that is the decline of independent shops due to the rise of chains. An appropriate competition policy could contribute to the realisation of this scenario.

The last exnovation scenario targets the destabilization of **online retail of new and unsustainable goods, in order to favour sufficiency-oriented goods and services retail**. E-commerce increases very likely the overall consumption of goods and services. On the other hand, e-commerce also makes it easier to match the supply and demand of very specific goods, especially sustainable goods (ecological, fair trade, long-lasting) and second-hand goods. The idea here is to deliberately curb the retail of non-sustainable goods, in order to favour the retail of sustainable goods. This is even more important to address this dimension given that the production phase accounts for most of emissions of a product along its life cycle, while distribution contributes only to 6 to 14%. A reduced VAT for those types of products could contribute to the realization of this scenario.

**Table 17: Set of exnovation scenarios for a sustainable retail**

Exnovation of	To favour	Rationale	Targeted dimension	Possible exnovation measures
Isolated independent physical retailers	No clear intentionality	Market-led		n.a.
Pure player e-commerce and development of new commercial and logistic areas	Retailers that use existing infrastructures	Environmental impacts of pure players (carbon impacts of the last mile, land use) (3.2), of employment and working conditions in warehouses, of the lack of accessibility for all and weakening of social contacts (3.2.4)	<b>Storage infrastructure and logistics</b>	Moratoires on the building of new retail infrastructures
Remote and quick e-commerce	Local and slow commerce	Higher environmental (and social) impacts of imported goods, of goods shipped by air freight, of goods shipped the next day/with crowdsourced delivery, of goods that are home delivered in urban areas, of goods shipped with motor vehicles in cities (cf. 3.2.3)	<b>Product delivery and transport logistics</b>	Regulations on delivery pricing, on types of allowed
E-commerce giants and retailers or with a disproportionate market power, incl. platforms	Independent retailers or retailers with a reasonable market power	Unbalance in the value chain generated by those actors, and the potential effects on suppliers (3.2.4, 2.3.3)	<b>Value chain actors and chain governance</b>	Appropriate competition policy
Online retail that is not based on the supply of sufficiency-oriented goods and services	Retailers supplying sufficiency-oriented goods and services	To avoid the risk that online retail induces additional consumption and so that it serves the objective of reducing resource consumption (3.3)	<b>Type of sold products and services</b>	Reduced VAT on sufficiency-oriented goods

## References

- Allo, M. (2022, February 15). Accord sur la réforme du marché du travail: Équilibre vie privée-vie professionnelle, semaine de 4 jours, flexibilité, e-commerce, économie de plateforme.... *RTBF*. <https://www.rtbef.be/article/accord-sur-la-reforme-du-marche-du-travail-equilibre-vie-privee-vie-professionnelle-semaine-de-4-jours-flexibilite-e-commerce-economie-de-plateforme-10935193>
- Amsterdam University of Applied Science & Center for Market Insights. (2021). *2021 European E-commerce report* (p. 111). E-Commerce Europe and Eurocommerce. <https://www.fevad.com/wp-content/uploads/2021/10/2021-European-E-commerce-Report-LIGHT-VERSION.pdf>
- Attac France, Les Amis de la Terre, & Union syndicale Solidaires. (2019). *Impunité fiscale, sociale et environnementale: Immersion dans le modèle Amazon*. <https://france.attac.org/nos-publications/notes-et-rapports/article/nouveau-rapport-impunite-fiscale-sociale-et-environnementale-immersion-dans-le>
- BBC. (2021, June 2). Amazon warehouse injuries “80% higher” than competitors, report claims. *BBC News*. <https://www.bbc.com/news/technology-57332390>
- Beckers, J., Cárdenas, I., & Verhetsel, A. (2018). Identifying the geography of online shopping adoption in Belgium. *Journal of Retailing and Consumer Services*, *45*, 33–41. <https://doi.org/10.1016/j.jretconser.2018.08.006>
- Beckers, J., Weekx, S., Beutels, P., & Verhetsel, A. (2021). COVID-19 and retail: The catalyst for e-commerce in Belgium? *Journal of Retailing and Consumer Services*, *62*. Scopus. <https://doi.org/10.1016/j.jretconser.2021.102645>
- Benoît, C., & Mazijn, B. (2009). *Guidelines for social life cycle assessment of products*. UNEP/SETAC.
- Benoît Norris, C., Traverso, M., Neugebauer, S., Ekener, E., Schaubroeck, T., Russo Garrido, S., Berger, M., Valdivia, S., Lehmann, A., Finkbeiner, M., & Arcese, G. (2020). *Guidelines for Social Life Cycle Assessment of Products and Organisations 2020*. United Nations Environment Programme (UNEP). <https://www.social-lca.org/the-revision-of-the-slca-guidelines/>
- Berns, D. (2022, February 7). Paul Magnette: «Après la sortie du nucléaire, sortir de l’e-commerce». *Le Soir*. <https://www.lesoir.be/422704/article/2022-02-07/paul-magnette-apres-la-sortie-du-nucleaire-sortir-de-le-commerce>
- Bon-Maury, G., Fosse, J., Deketelaere-Hanna, M., Lambert, P., Vinçon, P., Constanso, V., Verzat, V., & Guérin, V. (2021). *Pour un développement durable du commerce en ligne* (N° 013543-01; p. 318). France Stratégie. <https://www.strategie.gouv.fr/publications/un-developpement-durable-commerce-ligne>
- Bonnet, E., Landivar, D., & Monnin, A. (2021). *Héritage et fermeture: Une écologie du démantèlement*. Editions Divergences.
- Börjesson Rivera, M., Håkansson, C., Svenfelt, T., & Finnveden, G. (2014). Including second order effects in environmental assessments of ICT. *Environmental Modelling and Software*, *56*, 105–115. Scopus. <https://doi.org/10.1016/j.envsoft.2014.02.005>
- Brown, D.-C. (Director). (2018). *L’irrésistible ascension d’Amazon*.
- Buldeo Rai, H. (2019). *Environmental sustainability of the last mile in omnichannel retail* [Vrije Universiteit Brussel (VUB)]. [https://cris.vub.be/en/publications/environmental-sustainability-of-the-last-mile-in-omnichannel-retail\(1e13f586-6499-4451-81a8-907b08b6a2f9\).html](https://cris.vub.be/en/publications/environmental-sustainability-of-the-last-mile-in-omnichannel-retail(1e13f586-6499-4451-81a8-907b08b6a2f9).html)
- Buldeo Rai, H. (2021). The net environmental impact of online shopping, beyond the substitution bias. *Journal of Transport Geography*, *93*, 103058. <https://doi.org/10.1016/j.jtrangeo.2021.103058>



- Buldeo Rai, H., Mommens, K., Verlinde, S., & Macharis, C. (2019). How Does Consumers' Omnichannel Shopping Behaviour Translate into Travel and Transport Impacts? Case-Study of a Footwear Retailer in Belgium. *Sustainability*, 11(9), 2534. <https://doi.org/10.3390/su11092534>
- Buldeo Rai, H., Verlinde, S., & Macharis, C. (2019). City logistics in an omnichannel environment. The case of Brussels. *Case Studies on Transport Policy*, 7(2), 310–317. <https://doi.org/10.1016/j.cstp.2019.02.002>
- Buyse, N. (2019, March 13). Vendre sur Amazon: Les PME tiraillées entre déconvenues et opportunités. *Les Echos Executives*. <https://business.lesechos.fr/entrepreneurs/actu/0600788064493-vendre-sur-amazon-les-pme-tiraillées-entre-deconvenues-et-opportunités-327768.php#Xtor=AD-6000>
- BX1. (2020, December 1). “Acheter local, acheter bruxellois”: Une plateforme d’e-commerce veut sensibiliser aux achats locaux. *BX1*. <https://bx1.be/categories/news/acheter-local-acheter-bruxellois-une-plateforme-de-commerce-veut-sensibiliser-aux-achats-locaux/>
- BX1. (2022, May 30). La FEB pointe le retard du commerce en ligne belge face aux autres pays. *BX1*. <https://bx1.be/categories/news/la-feb-pointe-le-retard-du-commerce-en-ligne-belge-face-aux-autres-pays/>
- CBCommerce.eu. (2021). *TOP 16 Cross-Border EU Countries 2021*. Cross-Border Commerce Europe. <https://www.cbcommerce.eu/product/top-16-cross-border-eu-countries/>
- CCE. (2017). *L'emploi dans le secteur de la distribution* (No. 2017–1633; p. 84). Conseil central de l'économie (CCE/CRB). <https://www.ccecrb.fgov.be/p/fr/390/l-emploi-dans-le-secteur-de-la-distribution>
- Chaibi, L., Omar, I., Tlaib, R., & Corbyn, J. (2020, August 12). Il faut faire payer Amazon. *La Libre*. <https://www.lalibre.be/debats/opinions/2020/12/07/il-faut-faire-payer-amazon-UJ5JOKMNYJGR7GAUORD53TW5O4/>
- Climact. (2021, January 22). *What is the impact of the ICT on Wallonia's electricity consumption and climate targets?* Climact. <https://climact.com/nl/quel-est-l'impact-du-secteur-numerique-sur-la-consommation-delectricite-et-les-objectifs-climatiques-de-la-wallonie/>
- Coroama, V. C., & Mattern, F. (2019). Digital rebound – Why digitalization will not redeem us our environmental sins. *CEUR Workshop Proceedings*, 2382. Scopus. [http://ceur-ws.org/Vol-2382/ICT4S2019\\_paper\\_31.pdf](http://ceur-ws.org/Vol-2382/ICT4S2019_paper_31.pdf)
- d'Allens, G. (2019, April 12). Le commerce par Internet est un désastre écologique. *Reporterre*. <https://reporterre.net/Le-commerce-par-Internet-est-un-desastre-ecologique>
- Daphné Van Ossel. (2021, November 21). Vos courses livrées en 10 minutes: Toujours plus vite, le “quick commerce” nouvel eldorado de la livraison à domicile. *RTBF*. <https://www.rtbf.be/article/vos-courses-livrees-en-10-minutes-toujours-plus-vite-le-quick-commerce-nouvel-eldorado-de-la-livraison-a-domicile-10880552>
- De Vuyst, P., & Mikulenaite, U. (2017). *E-Commerce Studie 2017* (p. 76). COMEOS. <https://comeos.be/research/94930/E-Commerce-Studie-2017>
- Dead mall. (2022). In *Wikipedia*. [https://en.wikipedia.org/w/index.php?title=Dead\\_mall&oldid=1073011205](https://en.wikipedia.org/w/index.php?title=Dead_mall&oldid=1073011205)
- Defoy, C. (2022, January 27). 22% d’e-commerce: La Wallonie veut beaucoup plus. *RTBF*. <https://www.rtbf.be/article/22-de-commerce-la-wallonie-veut-beaucoup-plus-10923331>
- Delage, M., Baudet-Michel, S., Fol, S., Buhnik, S., Commenges, H., & Vallée, J. (2020). Retail decline in France's small and medium-sized cities over four decades. Evidences from a multi-level analysis. *Cities*, 104, 102790. <https://doi.org/10.1016/j.cities.2020.102790>

- Delescluse, R. (Director). (2021). Hypermarchés, la chute de l'empire. In *Thema*. ARTE. <https://www.arte.tv/fr/videos/095178-000-A/hypermarches-la-chute-de-l-empire/>
- Domenech, C. (2021, August 5). *Destruction des produits invendus: Amazon annonce un changement de politique*. Capital.fr. <https://www.capital.fr/entreprises-marches/destruction-des-produits-invendus-amazon-annonce-un-changement-de-politique-1411444>
- Edwards, J. B., McKinnon, A. C., & Cullinane, S. L. (2010). Comparative analysis of the carbon footprints of conventional and online retailing: A “last mile” perspective. *International Journal of Physical Distribution & Logistics Management*, 40(1/2), 103–123. <http://dx.doi.org/10.1108/09600031011018055>
- Edwards, J., McKinnon, A., & Cullinane, S. (2011). Comparative carbon auditing of conventional and online retail supply chains: A review of methodological issues. *Supply Chain Management: An International Journal*, 16(1), 57–63. <https://doi.org/10.1108/13598541111103502>
- Etienne Lees Perasso (Bureau Veritas), Caroline Vateau (APL-datacenter), Firmin Domon (Bureau Veritas), Yasmine Aiouch (Deloitte), Augustin Chanoine (Deloitte), Léo Corbet (Deloitte), Pierrick Drapeau (Deloitte), Louis Ollion (Deloitte), Valentine Vigneron (Deloitte), Damien Prunel (Bureau Veritas), Georges Ouffoué (APL-datacenter), Romain Mahasenga (APL-datacenter), & Julie Orgelet (DDemain), Frédéric Bordage (GreenIT.fr) et Prune Esquerre (IDATE). (2022). *Evaluation environnementale des équipements et infrastructures numériques en France—Synthèse* (p. 30 pages). ADEME et ARCEP. [https://bibliothèque.ademe.fr/consommer-autrement/5226-evaluation-de-l-impact-environnemental-du-numerique-en-france-et-analyse-prospective.html#/44-type\\_de\\_produit-format\\_electronique](https://bibliothèque.ademe.fr/consommer-autrement/5226-evaluation-de-l-impact-environnemental-du-numerique-en-france-et-analyse-prospective.html#/44-type_de_produit-format_electronique)
- Eurostat. (2022a, January). *E-commerce statistics for individuals*. [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce\\_statistics\\_for\\_individuals](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics_for_individuals)
- Eurostat. (2022b, April 2). *Individuals who ordered goods or services over the internet for private use* [Database]. [https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc\\_r\\_blt12\\_i&lang=en](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_r_blt12_i&lang=en)
- Feichtinger, S., & Gronalt, M. (2021). The Environmental Impact of Transport Activities for Online and In-Store Shopping: A Systematic Literature Review to Identify Relevant Factors for Quantitative Assessments. *Sustainability*, 13(5), 2981. <https://doi.org/10.3390/su13052981>
- Ferreboeuf, H. (2019). *Lean ICT-Towards digital sobriety* (p. 90). The Shift Project. [https://theshiftproject.org/wp-content/uploads/2019/03/Lean-ICT-Report\\_The-Shift-Project\\_2019.pdf](https://theshiftproject.org/wp-content/uploads/2019/03/Lean-ICT-Report_The-Shift-Project_2019.pdf)
- FGTB-UBT. (2021). *La misère derrière un clic de souris—Dans les coulisses de l'e-commerce* (p. 25). Union Belge du Transport. [https://www.btb-abvv.be/images/WegvervoerEnLogistiek/eigenrijders/Zwartboek\\_Pakjesdiensten\\_2021\\_FR.pdf](https://www.btb-abvv.be/images/WegvervoerEnLogistiek/eigenrijders/Zwartboek_Pakjesdiensten_2021_FR.pdf)
- Fichter, K. (2002). E-commerce: Sorting out the environmental consequences. *Journal of Industrial Ecology*, 6(2), 25–41. Scopus. <https://doi.org/10.1162/108819802763471762>
- Font Vivanco, D., McDowall, W., Freire-González, J., Kemp, R., & van der Voet, E. (2016). The foundations of the environmental rebound effect and its contribution towards a general framework. *Ecological Economics*, 125, 60–69. <https://doi.org/10.1016/j.ecolecon.2016.02.006>
- Font Vivanco, D., Nechifor, V., Freire-González, J., & Calzadilla, A. (2021). Economy-wide rebound makes UK's electric car subsidy fall short of expectations. *Applied Energy*, 297, 117138. <https://doi.org/10.1016/j.apenergy.2021.117138>
- Frick, V., & Matthies, E. (2020). Everything is just a click away. Online shopping efficiency and consumption levels in three consumption domains. *Sustainable Production and Consumption*, 23, 212–223. <https://doi.org/10.1016/j.spc.2020.05.002>

- Greening, L. A., Greene, D. L., & Difiglio, C. (2000). Energy efficiency and consumption—The rebound effect—A survey. *Energy Policy*, 28(6), 389–401. [https://doi.org/10.1016/S0301-4215\(00\)00021-5](https://doi.org/10.1016/S0301-4215(00)00021-5)
- Grimmeau, J.-P., & Wayens, B. (2016). Les causes de la disparition des petits commerces (1945-2015). *Courrier hebdomadaire du CRISP*, n° 2301-2302(16), 5–114.
- Grimsey, B. (2012). *Sold out*. Filament Publishing.
- Heidsieck, L. (2021, September 17). Livraisons en 10 minutes, films à la demande... Les dangers du business de la flemme. *Le Figaro*. <https://www.lefigaro.fr/conjoncture/livraisons-en-10-minutes-films-a-la-demande-les-dangers-du-business-de-la-flemme-20210917>
- Hertwich, E. G. (2005). Consumption and the Rebound Effect: An Industrial Ecology Perspective. *Journal of Industrial Ecology*, 9(1–2), 85–98. <https://doi.org/10.1162/1088198054084635>
- Het Nieuwsblad. (2021, September 12). Belgen kopen meer online, maar buitenlandse webwinkels plukken de vruchten. *Het Nieuwsblad*. [https://www.nieuwsblad.be/cnt/dmf20211209\\_95357333](https://www.nieuwsblad.be/cnt/dmf20211209_95357333)
- Hill, D. W. (2020). The injuries of platform logistics. *Media, Culture and Society*, 42(4), 521–536. Scopus. <https://doi.org/10.1177/0163443719861840>
- Horner, N. C., Shehabi, A., & Azevedo, I. L. (2016). Known unknowns: Indirect energy effects of information and communication technology. *Environmental Research Letters*, 11(10), 103001. <https://doi.org/10.1088/1748-9326/11/10/103001>
- ILO. (2021). *The role of digital labour platforms in transforming the world of work* [Report]. International Labour Office. [http://www.ilo.org/global/research/global-reports/weso/2021/WCMS\\_771749/lang--en/index.htm](http://www.ilo.org/global/research/global-reports/weso/2021/WCMS_771749/lang--en/index.htm)
- InSites Consulting. (2020). *E-commerce survey 2020—Belgium* (p. 73). COMEOS. <https://www.comeos.be/research/280152/E-Commerce-Studie-2019>
- Jaller, M., & Pahwa, A. (2020). Evaluating the environmental impacts of online shopping: A behavioral and transportation approach. *Transportation Research Part D: Transport and Environment*, 80, 102223. <https://doi.org/10.1016/j.trd.2020.102223>
- Jaller, M., Pahwa, A., & Karten, S. (n.d.). Keeping e-Commerce Environmentally Friendly—What Consumers Can Do. *ITS/UCDavis*. Retrieved July 28, 2022, from <https://its.ucdavis.edu/blog-post/keeping-e-commerce-environmentally-friendly-what-consumers-can-do/>
- La Libre Eco & Belga. (2022, March 2). Le taux de vacuité commerciale baisse en Belgique, une première depuis 14 ans. *La Libre.be*. <https://www.lalibre.be/economie/immo/2022/02/03/le-taux-de-vacuite-commerciale-baisse-en-belgique-une-premiere-depuis-14-ans-3FCYI3CK7VEWFDLBS4OVWRDH4I/>
- L’avenir. (2022, February 15). Réforme du marché du travail: “consternation” des syndicats sur le travail de nuit. *lavenir.net*. <https://www.lavenir.net/actu/belgique/2022/02/15/reforme-du-marche-du-travail-consternation-des-syndicats-sur-le-travail-de-nuit-536CJUDKRZADPAVCHT7JW7ZPBY/>
- Le Vif. (2018, January 23). L’hypermarché: “chronique d’une mort annoncée.” *Le Vif*. <https://www.levif.be/actualite/belgique/l-hypermarche-chronique-d-une-mort-annoncee/article-normal-788377.html>
- Leterme, C. (2019, December 19). « Alibaba, c’est tout l’inverse d’Amazon »... Vraiment? - Gresea. *GRESEA*. <https://gresea.be/Alibaba-c-est-tout-l-inverse-d-Amazon-Vraiment#nb16>
- Leterme, C. (2021, October 30). COP26: Entre la logistique et le climat, la Wallonie doit choisir! *Le Soir*. <https://www.lesoir.be/403518/article/2021-10-30/cop26-entre-la-logistique-et-le-climat-la-wallonie-doit-choisir>

- Lyons, H. (2022, April 30). 5 of Belgium's largest platform companies do not offer fair working conditions, study shows. *The Brussels Times*. <https://www.brusselstimes.com/213879/5-of-belgiums-largest-platform-companies-do-not-offer-fair-working-conditions-study-shows>
- MacGillis, A. (2021). *Le système Amazon. Une histoire de notre futur*. Coédition Seuil/Éditions du sous-sol. <https://www.decitre.fr/livres/le-systeme-amazon-9782021480528.html>
- Mangiaracina, R., Marchet, G., Perotti, S., & Tumino, A. (2015). A review of the environmental implications of B2C e-commerce: A logistics perspective. *International Journal of Physical Distribution & Logistics Management*, 45(6), 565–591. <https://doi.org/10.1108/IJPDLM-06-2014-0133>
- Marketline. (2021a). MarketLine Industry Profile: Online Retail in France. *Online Retail Industry Profile: France*, 1–58.
- Marketline. (2021b). MarketLine Industry Profile: Online Retail in Germany. *Online Retail Industry Profile: Germany*, 1–52.
- Marketline. (2021c). MarketLine Industry Profile: Online Retail in United Kingdom. *Online Retail Industry Profile: United Kingdom*, 1–58.
- Marketline. (2021d). MarketLine Industry Profile: Online Retail in Belgium - February 2021. *Online Retail Industry Profile: Belgium, 0160–2344*, 57.
- Marketline. (2021e). MarketLine Industry Profile: Online Retail in Belgium - October 2021. *Online Retail Industry Profile: Belgium*, 1–60.
- Moati, P. (2021). *La plateforme de la consommation* (Gallimard). <https://www.eyrolles.com/Litterature/Livre/la-plateforme-de-la-consommation-9782072966385/>
- Mommens, K., Buldeo Rai, H., van Lier, T., & Macharis, C. (2021). Delivery to homes or collection points? A sustainability analysis for urban, urbanised and rural areas in Belgium. *Journal of Transport Geography*, 94, 103095. <https://doi.org/10.1016/j.jtrangeo.2021.103095>
- Moustique. (2022, February 8). E-commerce: Les propos de P. Magnette critiqués de toute part. *moustique.be*. <https://www.moustique.be/actu/belgique/2022/02/08/e-commerce-paul-magnette-critiques-polemiques-226858>
- Neerman, P. (2019, August 22). Amazon continue d'ouvrir des magasins physiques. *RetailDetail*. <https://www.retaildetail.be/fr/news/g%C3%A9ral/amazon-continue-d%E2%80%99ouvrir-des-magasins-physiques>
- Noulet, J.-F. (2022, August 2). Paul Magnette et une Belgique sans e-commerce: De quoi parle-t-il exactement ? *RTBF*. <https://www.rtbf.be/article/paul-magnette-et-une-belgique-sans-e-commerce-de-quoi-parle-t-il-exactement-10930479>
- OECD. (2019). *Unpacking E-commerce: Business Models, Trends and Policies* (OECD Going Digital, p. 8) [Policy Note]. Organisation for Economic Co-operation and Development. <https://www.oecd.org/publications/unpacking-e-commerce-23561431-en.htm>
- Olagnier, F. (2021, October 26). Seuls 24 % des e-commerçants belges se trouvent en Wallonie, et l'écart se creuse. *La Libre.be*. <https://www.lalibre.be/economie/digital/2021/10/26/seuls-24-des-e-commerçants-belges-se-trouvent-en-wallonie-et-lecart-se-creuse-HXK6NCUGRJBMEKHKSHYGI3JH4/>
- Pålsson, H., Pettersson, F., & Hiselius, L. W. (2017). Energy consumption in e-commerce versus conventional trade channels—Insights into packaging, the last mile, unsold products and product returns. *Journal of Cleaner Production*, 164, 765–778. <https://doi.org/10.1016/j.jclepro.2017.06.242>

- Pohl, J., Hilty, L. M., & Finkbeiner, M. (2019). How LCA contributes to the environmental assessment of higher order effects of ICT application: A review of different approaches. *Journal of Cleaner Production*, 219, 698–712. <https://doi.org/10.1016/j.jclepro.2019.02.018>
- Pouri, M. J. (2021). Eight impacts of the digital sharing economy on resource consumption. *Resources, Conservation and Recycling*, 168, 105434. <https://doi.org/10.1016/j.resconrec.2021.105434>
- Prévost, T. (2022, January 16). Livraisons en 15 minutes: L’empire du moindre effort. *Arrêt Sur Images*. <https://www.arretsurimages.net/chroniques/clic-gauche/livraisons-en-15-minutes-lempire-du-moindre-effort>
- Pulignan, V., Marà, C., Franke, M., Domecka, M., Bertolini, A., & Graham, M. (2022). *Fairwork Belgium Ratings 2021: Towards Decent Work in the Platform Economy*. Fairwork. [https://fair.work/wp-content/uploads/sites/131/2022/04/Fairwork\\_Report\\_Belgium-2022-EN-1.pdf](https://fair.work/wp-content/uploads/sites/131/2022/04/Fairwork_Report_Belgium-2022-EN-1.pdf)
- RTBF. (2021a, July 9). Achats sur internet: “Si on ne fait rien, on va perdre 26.000 emplois en 2025”, prévient Comeos. *RTBF*. <https://www.rtf.be/article/achats-sur-internet-si-on-ne-fait-rien-on-va-perdre-26000-emplois-en-2025-previent-comes-10837270>
- RTBF. (2021b, August 4). Etats-Unis: Quand des milliers de PME jouent à David contre Goliath face au géant Amazon. *RTBF*. <https://www.rtf.be/article/etats-unis-quand-des-milliers-de-pme-jouent-a-david-contre-goliath-face-au-geant-amazon-10735801>
- Ruysen, A. (2021, October 15). La Belgique a-t-elle vraiment perdu 20.000 emplois dans le secteur de l’e-commerce ? *RTBF*. <https://www.rtf.be/article/la-belgique-a-t-elle-vraiment-perdu-20000-emplois-dans-le-secteur-de-le-commerce-10860630>
- Shahmohammadi, S., Steinmann, Z. J. N., Tambjerg, L., van Loon, P., King, J. M. H., & Huijbregts, M. A. J. (2020). Comparative Greenhouse Gas Footprinting of Online versus Traditional Shopping for Fast-Moving Consumer Goods: A Stochastic Approach. *Environmental Science & Technology*, 54(6), 3499–3509. <https://doi.org/10.1021/acs.est.9b06252>
- Singleton, A. D., Dolega, L., Riddlesden, D., & Longley, P. A. (2016). Measuring the spatial vulnerability of retail centres to online consumption through a framework of e-resilience. *Geoforum*, 69, 5–18. <https://doi.org/10.1016/j.geoforum.2015.11.013>
- Statbel. (n.d.). *Indice des prix à la consommation harmonisé en base 2015 selon la nomenclature COICOP, par année, trimestre et mois*. Statbel. Retrieved March 3, 2022, from <https://bestat.statbel.fgov.be/bestat/crosstable.xhtml?view=19b2d3d0-0df7-48ca-bf6e-fc20dfae7900>
- Statbel. (2020, December 17). *L’ICT dans les entreprises en 2020*. <https://statbel.fgov.be/fr/nouvelles/lict-dans-les-entreprises-en-2020>
- Statista. (2021). *Online share of retail trade in EU countries 2019*. Statista. <https://www.statista.com/statistics/281241/online-share-of-retail-trade-in-european-countries/>
- Statista. (2022). *Belgium top online store sales 2018*. Statista. <https://www.statista.com/forecasts/871157/top-online-stores-belgium-ecommercedb>
- Steffens, E. (2022, August 2). Nombreuses réactions négatives à la proposition de Magnette de faire de la Belgique un pays sans e-commerce. *VRT NWS*. <https://www.vrt.be/vrtnws/fr/2022/02/08/nombreuses-reactions-negatives-a-la-proposition-de-magnette-de-f/>
- Sureau, S. (2020). *On what to assess when bridging sustainability pillars in S-LCA: Exploring the role of chain governance and value distribution in product social sustainability* [PhD Thesis,

- Université libre de Bruxelles, Faculté des Sciences – Géosciences, Environnement et Société]. [https://cibleplus.ulb.ac.be/permalink/32ULDB\\_U\\_INST/1hd430l/alma991009812329704066](https://cibleplus.ulb.ac.be/permalink/32ULDB_U_INST/1hd430l/alma991009812329704066)
- Sureau, S., Lohest, F., Van Mol, J., Bauler, T., & Achten, W. M. J. (2019). How Do Chain Governance and Fair Trade Matter? A S-LCA Methodological Proposal Applied to Food Products from Belgian Alternative Chains (Part 2). *Resources*, 8(3), 145. <https://doi.org/10.3390/resources8030145>
- Tendances/Trends. (2022, April 26). La CSC tire à boulets rouges contre le travail de nuit dans l'e-commerce. *Site-Trends-FR*. <https://trends.levif.be/economie/entreprises/la-csc-tire-a-boulets-rouges-contre-le-travail-de-nuit-dans-l-e-commerce/article-news-1552685.html>
- Thomas, L. (2020, August 27). 25% of U.S. malls are expected to shut within 5 years. Giving them a new life won't be easy. *CNBC*. <https://www.cnbc.com/2020/08/27/25percent-of-us-malls-are-set-to-shut-within-5-years-what-comes-next.html>
- Trends Tendances. (2022, January 21). La Belgique enregistre la plus forte croissance d'entreprises d'e-commerce en Europe. *Site-Trends-FR*. <https://trends.levif.be/economie/entreprises/la-belgique-enregistre-la-plus-forte-croissance-d-entreprises-d-e-commerce-en-europe/article-normal-1516061.html>
- UNCTAD. (2021a). *COVID-19 and e-commerce: A global review* (p. 151). United Nation Conference on Trade and Development. <https://unctad.org/webflyer/covid-19-and-e-commerce-global-review>
- UNCTAD. (2021b). *Estimates of global e-commerce 2019 and preliminary assessment of Covid-19 impact on online retail 2020* (No. 18; UNCTAD Technical Notes on ICT for Development, p. 12). United Nation Conference on Trade and Development. [https://unctad.org/system/files/official-document/tn\\_unctad\\_ict4d18\\_en.pdf](https://unctad.org/system/files/official-document/tn_unctad_ict4d18_en.pdf)
- Van Loon, P., Deketele, L., Dewaele, J., McKinnon, A., & Rutherford, C. (2015). A comparative analysis of carbon emissions from online retailing of fast moving consumer goods. *Journal of Cleaner Production*, 106, 478–486. <https://doi.org/10.1016/j.jclepro.2014.06.060>
- Van Loon, P., McKinnon, A. C., Deketele, L., & Dewaele, J. (2014). The growth of online retailing: A review of its carbon impacts. *Carbon Management*, 5(3), 285–292. Scopus. <https://doi.org/10.1080/17583004.2014.982395>
- Van Rompaey, S. (2021, June 22). Les Belges effectuent un tiers de leurs achats en ligne à l'étranger. *RetailDetail*. <https://www.retaildetail.be/fr/news/g%C3%A9n%C3%A9ral/les-belges-effectuent-un-tiers-de-leurs-achats-en-ligne-%C3%A0-%C3%A9tranger>
- Vazquez Parras, J., Boswell, R., & Wayens, B. (2017). *Le commerce bruxellois en chiffre—Evolution de la structure commerciale régionale*. Région de Bruxelles Capitale. Observatoire du commerce. <http://perspective.brussels/fr/etudes-observations/economie-urbaine/observatoire-du-commerce>
- Wayens, B., Debroux, T., Godart, P., Mahieu, C., Strale, M., & d'Ieteren, E. (2020). Retail trade in Brussels: Reconciling the city with a changing sector (J. Corrigan, Trans.). *Brussels Studies. La Revue Scientifique Pour Les Recherches Sur Bruxelles / Het Wetenschappelijk Tijdschrift Voor Onderzoek over Brussel / The Journal of Research on Brussels*. <https://doi.org/10.4000/brussels.4344>
- Wayens, B., Godart, P., Strale, M., Istaz, D., & May, X. (2020, September 12). Une décennie d'évolution du commerce "brick and mortar" en Belgique. Exploration des inventaires de terrain Locatus [Academic blog]. *Geomarketing*. <https://geomarketing.hypotheses.org/1430>
- Zink, T., & Geyer, R. (2017). Circular Economy Rebound. *Journal of Industrial Ecology*, 21(3), 593–602. <https://doi.org/10.1111/jiec.12545>

## Abbreviations

B&C Brick and click

B&M Brick and mortar

CP Collection point

DCs Distribution centres

ICT Information and communication technologies

LCA Life cycle assessment

PP Pure player

SME Small and medium enterprises

## Annex

**Table 18: The various effects of e-commerce/ICT**

(Fichter, 2002), used by (Van Loon et al., 2014)	(Börjesson Rivera et al., 2014)	(Pohl et al., 2019)	(Buldeo Rai, 2021)
<b>i) Changes in life cycle impacts</b>			
1) due to ICT infrastructure/ICT impacts			
<b>1<sup>st</sup> order effects:</b> production and use of ICT infrastructure (PCs, mobile phones, servers, routers, etc.) that lead to energy consumption and electronic waste.”	<b>1<sup>st</sup> order effects</b> are those that ICT hardware causes during the product lifecycle; It includes I) direct effects, e.g. impacts of the ICT infrastructure that is needed to maintain the commerce	<b>Direct effects:</b> life cycle use of ICT	
2) due to ICT application/supply chain impacts			
<b>2<sup>nd</sup> order effects: market and processes changes, including logistics:</b> E-commerce impacts resource productivity, transportation, and land use through effects on production, storage, order picking, packaging, transport to the home.	<b>And ii) Substitution effects:</b> Dematerialisation through substitution to digital products and through online instead of printed marketing. Substitution of traditional individual shopping trips.	<b>Higher order effects:</b> intended functions /benefits and unintended effects of an ICT-based service or ICT application. It includes I) substitution and optimization effects	<b>Individual purchases:</b> comparison of the environmental impact of an in-store purchase with that of purchasing the same item online <b>Consumption geography:</b> effects context in which any type of transport occurs determines its environmental impact.
<b>ii) Changes in quantities</b>			
<b>3<sup>rd</sup> order effects: Rebound effects and behavioral changes:</b> “E-commerce causes structural change of the economy and affects lifestyles and consumption patterns, which, in turn, indirectly affect the environment.	<b>2<sup>nd</sup> and 3<sup>rd</sup> order effects:</b> 2nd order are those that ICT causes to other processes (e.g. traffic or industrial production) and 3rd-order are changes in economic structures and lifestyles that indirectly affect the expression of first and second order effects.	ii) Rebound, induction and transformational effects	<b>Consumer behavior:</b> different ways in which e-commerce drives consumption and transport