ONLINE NON-FOOD PARCEL SHOPPING AND LAST-MILE DELIVERIES

Summary Report

Technical Report CUED/C-SRF/TR17

January 2021

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January 2021

ISSN Number: 2054-4081

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Introduction

Policy commitments to reduce greenhouse gases (GHG) in the UK and many other countries require the road freight industry to achieve major change in relation to this aspect of vehicle activity. In the UK, the road freight industry has pledged support to the government's voluntary commitment to reduce GHG emissions from heavy goods vehicles by 15% by 2025 (from 2015 levels) and will also play its part in the government's commitment to bring all GHG emissions to net zero by 2050. As an ever-increasing proportion of retailing shifts online in the UK, the last-mile deliveries associated with this trend are a growing source of GHG emissions in the road freight industry. This briefing report provides a review of non-food online retailing and last-mile delivery in the UK and the transport intensity, GHG emissions and other impacts associated with it.

Non-food shopping is a major part of the retail sector and an activity that everyone participates in on a regular basis. The UK non-food retail market (both in-store and online) generated sales of approximately £220 billion in 2019 and represented approximately 60% of all retail sales in the country (Office for National Statistics, 2020).

On average, people made 92 physical, one-way, non-food shopping trips per year in England in 2017 (approximately two trips per week), travelling a total of 474 miles, a mean trip distance of 5.2 miles per trip, with non-food shopping accounting for 7% of the total distance travelled per person. In terms of transport modes used for shopping, the car predominates, accounting for 86% of total distance travelled (Department for Transport, 2020a). These non-food car trips resulted in an estimated 30 billion vehicle kilometres of car grocery shopping travel and 4.5 million tonnes of greenhouse gas (GHG) emissions in Britain in 2018 (calculated using data from Department for Transport, 2020b). Due to the relatively low weight of goods carried on these journeys compared to that transported by trucks and vans, consumer non-food shopping trips by car are also responsible for a considerable proportion of total retail logistics energy use and related GHG emissions per unit of weight transported.

Online shopping for non-food products has the potential to result in substantial reductions in consumer shopping vehicle kilometres and GHG emissions if it involves the complete substitution of consumer transport by car with a last-mile van delivery making multiple drops. Achieving such reductions requires that the last-mile delivery replaces the customer's trip to the shop, and that people do not continue visiting shops by car to search for, browse, buy, collect or return goods when making use of online non-food shopping.

The term 'last-mile delivery' in this report refers to the final commercial transport stage in the retail supply chain of goods purchased online by consumers. This last-leg of commercial transport takes place between their final point of despatch of the goods (be that a warehouse, depot, fulfilment centre of shop) and the delivery point nominated by the consumer be that their home, workplace, or a shop, locker bank or other location from which the consumer collects these goods.

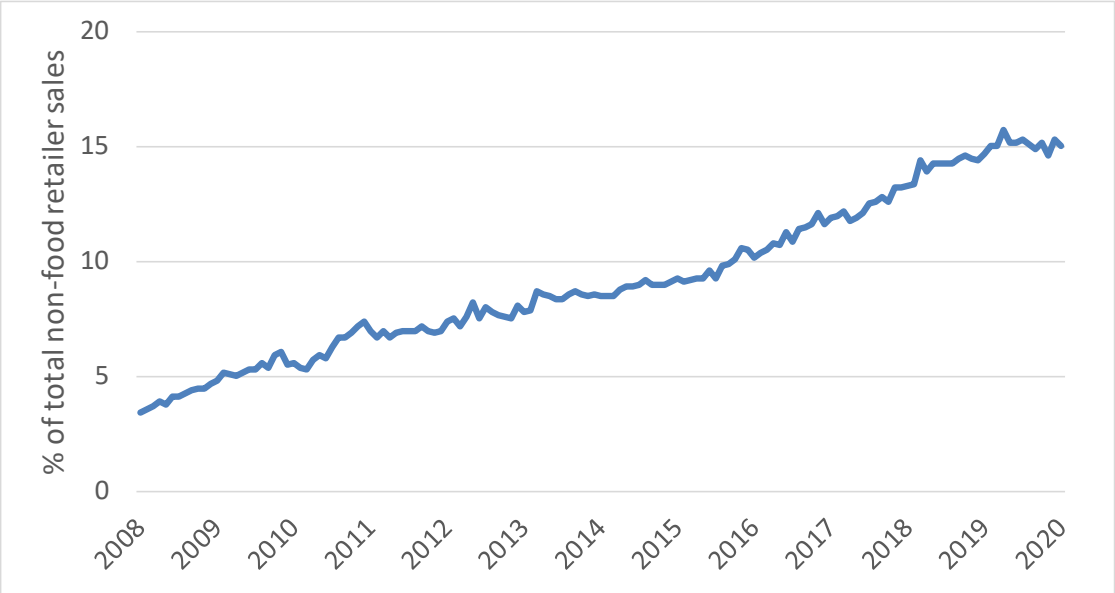
This report has been produced as part of the Centre for Sustainable Road Freight (SRF – EPSRC grant number EP/R035148/1). Further details about the SRF project are available at: http://www.csrf.ac.uk/

Summary reports on the grocery and ready-to-eat meal online shopping and last-mile delivery sectors, as well as a longer report containing references to all the documents consulted in compiling these summary reports, are available on the SRF website.

Online non-food shopping in the UK

Online non-food sales in the UK have been increasing since their introduction, with substantial market penetration rates in sectors including clothing and footwear, electrical products, toys and games and sports equipment. Online retail sales of non-food products accounted for 15% of sales by non-food retailers with both stores and an online presence in the UK in January 2020 (Office for National Statistics, 2021). Figure 1 shows the growth in the penetration of online non-food retailing in the UK prior to the onset of the Covid-19 epidemic. However, as discussed later and shown in Figure 2, online non-food sales penetration rates have grown very strongly during the Covid-19 epidemic.

Figure 1: Online sales as a percentage of retail sales by non-food retailers in the UK prior to Covid-19 (Jan 2008 - Jan 2020)



Note: Seasonally adjusted monthly data.
Source: Office for National Statistics, 2021.

Deliveries of non-food online shopping in the UK

The majority of non-food online purchases are small in size and relatively light in weight. These are delivered as parcels and packages mostly by vans and some by cars making multi-stop trips. The remainder comprises large, heavy items such as furniture and white goods that are delivered and installed by two-person delivery crews in larger goods vehicles. There are eleven third-party parcel carriers that offer national next-day delivery services for business-to-consumer (B2C) and business-to-business parcels movements in the UK (namely APC, DHL, DPD, DX, FedEx, Hermes, Parcelnet, Royal Mail which includes Parcelforce, Tuffnells, UPS and Yodel). In addition, Amazon Logistics carries out in-house last-mile logistics services via agents and also uses other carriers. There are also many smaller next-day parcel carriers that either work in specific sectors or localities, as well as same-day parcel couriers such as CitySprint and Addison Lee. These leading parcel carriers are estimated to have handled 2.6-3.6 billion parcels and packages in 2018 (Mintel, 2019; Ofcom, 2019). These parcel volumes include both business-to-consumer (B2C) parcels and business-to-business (B2B) parcels with B2C parcels comprising approximately three-quarters of all parcels.

Given the level of competition between retailers to generate sales and gain market share in the online non-food market, the relatively low delivery charges (or even free deliveries offered) and the substantial costs involved in picking and delivering goods to customers, it is often difficult for retailers to achieve profitability on these sales (Retail Logistics Task Force et al., 2001; Tugby, 2015; Capgemini Research Institute, 2019). At the same time retailers have been enhancing the delivery service levels they offer to the consumer (in terms of factors such as the speed of delivery, real-time notifications of delivery days and times, delivery day guarantees, and product returns policies), which are more expensive to operate.

This has also caused financial difficulties for parcel carriers providing these enhanced home delivery services to retailers, because they are often so without related increases in the unit prices paid (Allen et. al., 2016). Data analysed by Ofcom indicates that the revenues these carriers receive per parcel handled have been falling over the period 2013-2018 (Ofcom, 2014-19).

Last-mile parcel delivery services

Online non-food shopping orders in parcels and packages are either transported to customers by parcel carriers' last-mile delivery personnel or customers collect their orders, usually by car, from a physical store or other location such as a locker bank or 'collection point' in a convenience store or garage. Most last-mile parcel deliveries to customers are made by vans carrying out multiple deliveries on each trip on a next-day or slower basis (but same-day deliveries by van are being offered by some retailers). A small proportion of these parcel deliveries in dense urban areas are made using cargo cycles.

Delivery vehicles are despatched from parcel depots, fulfilment centres and logistics hubs. These facilities together with collection points and locker banks require logistics land. Rising land values in urban areas over recent decades have made the acquisition of such logistics land increasingly difficult for parcel carriers and has instead resulted in parcel depots moving further away from urban centres, with a consequent increase in the distance between such facilities and the delivery locations they serve. This so-called 'logistics sprawl' can thereby result in an increase in transport activity by delivery vehicles (Dablanc et al., 2014). Increasing shop vacancy rates in the UK may provide a potential opportunity for some of these logistics land requirements.

There are several features of non-food parcel deliveries that result in the need for additional transport operations. First, product return rates for some products such as clothing and footwear, electrical items and homewares are relatively high, estimated to be 8% of all non-food sales by value and 22% (either in part or in entirety) of all physical orders, with this rising to 20% of all clothing sales by value and up to 40% of clothing orders being returned (Global Data, 2018; IMRG, 2020a). Return rates can be exacerbated by retailers providing 'free' deliveries and returns, thereby encouraging customers to order more items than they require and return those they decide they do not want, effectively using their home as a showroom. Second, the vast majority of non-food parcels are too large to fit through the letterbox; they therefore usually require someone to be present to receive them at the home. However, for many parcel deliveries, the customer is not notified of the day and time of delivery, resulting in failed deliveries (i.e. when no-one is at home to receive the delivery and there is no neighbour or safe place to leave them). Failed delivery rates have been estimated to range from approximately 3%-30% of parcel carrier deliveries, depending on the carriers' policies for dealing with the situation of no one being home to receive the item. Industry data suggest that approximately 85% of consumers state that their home is their usual selected delivery destination for their online parcel orders, with the workplace, store-based collection points, the Post Office and locker banks accounting for the rest (IMRG, 2020b). Non-food parcel deliveries are also subject to considerable peaks in demand (especially in the run-up to Christmas. These demand levels can place carriers' resources and infrastructures under substantial pressure (including the quantity of workers needed, as well as vehicle fleet and depot requirements).

Comparing the impacts of consumer shopping trips and last-mile deliveries

Consumer non-food shopping trips by car can be responsible for a considerable proportion of total retail logistics energy use and related emissions. A study found that in the case of jeans sold in a UK retail store, the consumer transport trip to the shop by car used one third of the energy used in the total international commercial freight transport stages from cotton field to shop per kg of jeans transported (Browne et al., 2005; Browne et al., 2006).

Research has shown that purchasing a book online and having it delivered to home rather than making a personal trip by car or bus to the shops could substantially reduce transport CO_2 emissions. If only one book was purchased and assuming average UK values for distance travelled, fuel efficiency and vehicle loading, shopping by car or bus would result in 24 and 7 times more CO_2 than a last-mile delivery by van, respectively) (Edwards et al., 2009; Edwards et al., 2010; McKinnon, 2018).

A case study in Sweden of the purchase of electronic goods (such as a desktop computer or small stereo) showed that, on average, customers buying online (and collecting from a local postal collection point) account for only 14% of the transport CO_2 emissions of those buying at a store (Carling et al., 2015). A comparison of store-based and online clothes retailing in Germany estimated that store-based retailing results in ten times more CO_2 emissions per item purchased than online shopping, and six times more CO_2 emissions per transaction (Wiese et al., 2012).

Such studies assume that the last-mile delivery replaces the customer's trip to the shop, that last-mile deliveries succeed on their first attempt and that the customer does not return the products purchased. However, this is not always the case. Studies of consumer behaviour indicate that, in the case of non-food products, some people continue making trips to stores to browse for potential products, to inspect and obtain advice about products, to collect and to return products even when purchasing the item online (Hoogendoorn‑Lanser et al., 2019; Zhai et al., 2017). In addition, consumers may choose to buy some products online and others in-store, thereby not reducing their total shopping trips only the quantity of products they purchase per trip (Rotem-Mindali, 2014).

Survey work shows that, on average, people's annual shopping mileage reduced by 18% in England between 2002 and 2018, some of which is likely to be due to the increase in online shopping (Department for Transport, 2019a). However, due to a lack of data about last-mile delivery vehicle activity, it is currently not possible to ascertain whether this has led to an overall decline in road traffic.

Other factors affecting the GHG emissions of online non-food shopping and parcel deliveries

Some non-food online shopping is purchased by consumers directly from overseas retailers. These cases of international online retailing commonly take place on retail platforms such as eBay and Amazon Marketplace. The items sold are then transported long-distance as individual parcels in non-unitised loads and make use of aviation or maritime transport. International parcels represent approximately 20% of total parcels handled in the UK and inbound international parcel flows to the UK have been growing substantially in recent years (Ofcom, 2019).

Research has indicated that there are major differences in operational performance between parcel delivery drivers of varying levels of experience based on their tacit knowledge. The variation in effectiveness of the drivers relates to better route planning and exploitation of accumulated knowledge to reduce the time taken, distance driven and thereby GHG emissions of last-mile deliveries (Bates et al., 2018). Computing technology could be developed and used to improve the routeing decisions of novice drivers.

Online shopping for non-food items is associated with the use of substantial packaging, especially cardboard and plastic polybag packaging. Primary packaging for non-food products sold online is typically greater than for those sold in store, as it is necessary to prevent damage to them as they are handled and transported to the customer. In addition, the returns of non-food products purchased online but returned by consumers require repackaging, which can involve the use of additional packaging materials.

A lifecycle assessment compared the purchase of a USB memory stick in-store by car with online purchase and delivery, taking into account of upstream freight transportation from the manufacturer, energy use in the warehouse and physical store, electricity use to place the order using a home computer and at the data centre, and packaging for both retail options. The results indicated that the online retailing and last-mile delivery resulted in approximately 25% less CO_2 emissions than for in-store shopping and consumer transport, with consumer car transport being the main contributor to overall CO_2 emissions (Weber et al., 2011).

Impacts of the Covid-19 epidemic on non-food shopping

The outbreak of the Covid-19 epidemic resulted in the closure of all non-food shops in the UK (with the exception of newsagents, chemists, petrol stations, banks, pet shops, bicycle shops and hardware shops (UK Government, 2020)). In addition, some non-food online retailers closed their businesses in the first few weeks of the epidemic following the introduction of the lockdown on 23 March 2020; some of these closures were self-imposed as retailers safeguarded their workers and installed safe working practices,

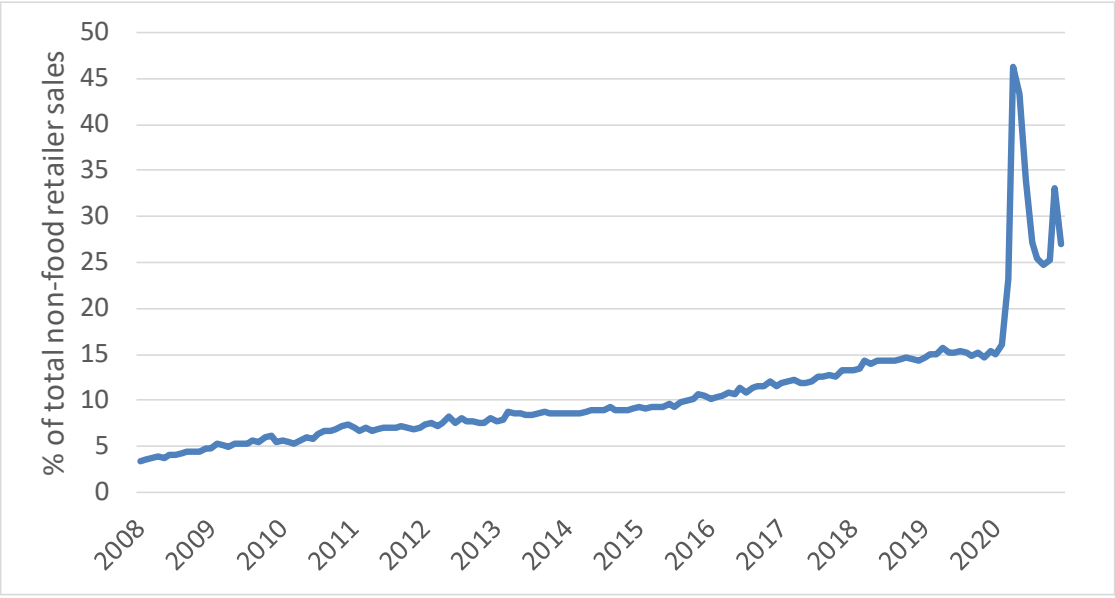
while others were enforced by Environmental Health Officers due to physical distancing concerns. Online clothing and footwear retailers that took the voluntary decision to initially close their operations included Next, River Island, Net-a-Porter, Tk Maxx and Schuh. These companies put in place measures in their warehouses and fulfilment centres to ensure that staff were working at safe distances from each other by reorganising picking systems and in some cases reducing product range in order to recommence their operations. The time they temporarily ceased trading ranged from approximately two to six weeks.

Delivery lead times increased for many non-food orders due to the greater time taken to pick and pack orders, and due to increased order volumes. Availability of some products was also affected due to production and distribution difficulties upstream of the fulfilment centre. International online orders faced particular challenges given the delays at border crossings and the roads leading to them, especially in the initial weeks following the UK lockdown (and production shutdowns in China and other countries that preceded this).

As would be expected, online non-food retailing in the UK increased substantially as a proportion of all non-food retail sales during the period when non-essential, non-food shops were closed. These shops were not permitted to reopen until 15 June 2020 in England, 22 June in Wales, and between 29 June and 15 July in Scotland (where different dates were imposed for those in highs streets and inside shopping centres). Following their reopening, shops were required to put in place measures to ensure distancing between people and other safety measures. Even once non-food stores reopened, the number of customers using shops remained well below pre Covid-19 epidemic levels. Footfall on high streets in July 2020 was reported to be 47% lower than in July 2019 (British Retail Consortium, 2020). Many store-based non-food retailers, including John Lewis, Marks and Spencer, Boots and Debenhams have announced job losses since the onset of the epidemic, with several retailers also announcing store closure programmes. Further closures of non-food physical shops took place in many areas from October 2020.

Amazon, the largest online-only retailer in the UK, recruited an additional 3,000 permanent staff (a 10% increase in its permanent staffing levels) as well as many temporary staff to help cope with the increased demand during the Covid-19 epidemic. In September 2020 it announced its plan to recruit an additional 7,000 permanent staff by the end of the year. However, absolute online sales of clothing (for online-only retailers as well as those with both stores and online channels) fell between March and May 2020 compared to a year earlier, with the lack of social interactions resulting in a reduced demand for garments.

Figure 2: Online sales as a percentage of retail sales by non-food retailers in the UK (Jan 2008 - Dec 2020)



Note: Seasonally adjusted monthly data.
Source: Office for National Statistics, 2021.

ONS data shows that online sales by non-food store-based and online-only retailers increased from 15% of total retail sales in January 2020 to 46% in April 2020, falling back to 25% in August 2020 after non-food physical shops were allowed to reopen, before increasing again towards the end of 2020 due to further closures of non-food physical shops (Office for National Statistics, 2021 – see Figure 2).

The substantial increase in online sales of non-food during the Covid-19 epidemic is likely to lead to a longer-term increase in non-food online shopping penetration rates. For these changes in consumer online purchasing habits to result in a decrease in road travel and GHG emissions it is necessary for them to be associated with a reduction in car-based shopping. Therefore, this increase in online shopping has to involve deliveries to the customer or collection by the customer of parcels from collection points and locker banks on-foot or by bicycle or as part of an existing car trip such as a daily commute rather than by a car-based trip solely for this purpose. The total transport and GHG emissions of delivery vehicles can be reduced if they deliver large quantities of parcels to a single location such as a collection point or locker bank rather than individual homes, with customers collecting their goods in environmentally-friendly ways.

It also requires that customers refrain from continuing to visit shops, especially by car, to browse, inspect, and return goods that they purchase online, as this will negate the potential road traffic and GHG emissions reductions that online shopping can provide. Customers can help reduce the proliferation of delivery vehicle activity.by consolidating their online orders with a given retailer into larger quantities on a less frequent basis, rather than making many small, frequent orders, and by not opting for same-day delivery. Transport activity and GHG emissions resulting from non-food shopping could be further reduced by customers and retailers making efforts to reduce product return rates and by retailers providing customers with notifications of when deliveries will be made to reduce failed delivery rates. The availability and affordability of logistics land for fulfilment centres, collection points and locker banks are also required to prevent delivery vehicles being despatched from distant locations to make deliveries. The expected future large-scale uptake of electric delivery vans will help further reduce the GHG emissions resulting from non-food shopping.

The Covid-19 epidemic may also lead to other important changes in non-food online shopping and deliveries that could have a bearing on the sustainability of these operations. It is creating even greater competition between carriers for B2C parcels, as both B2B parcel and letter volumes have diminished due to office closures and staff working from home. The growth in total parcel volumes may also lead to carriers facing major investments in sortation hubs and automated equipment to expand their parcel handling capacity. If the demand for B2C parcel shipping and last-mile delivery continues to exceed supply and requires large-scale infrastructure investment by carriers, this could result in parcel delivery charges increasing. If this were to happen, it is possible that retailers may have to reconsider the ‘free’ delivery and return propositions they make to consumers. More explicit charging for these delivery and return services would potentially result in more environmentally sustainable operations.

Growth in total quantity and frequency of non-food online orders will lead to more deliveries to the same addresses and a general increase in parcel drop density. This, together with potential increases in carrier costs due to investment needs and the possible imposition of further restrictions and requirements on urban road freight transport operations, may further encourage carriers to consider collaborating with each other to prevent them replicating the work of each other, and thereby reduce their operating costs. This would reduce the last-mile van activity per delivery but several hurdles would need to be overcome before this happens, most importantly traditional resistance to it from the carriers themselves, together with commercial and legal considerations.

Consumers affected by delivery delays on international online orders during the Covid-19 epidemic may opt to purchase less from international retailers and more from national retailers in future to avoid these problems, while these delays may also encourage online retailers to source products from less distant producers. The epidemic also reduced the provision of airfreight capacity and led to greater use of long-distance shipping by sea. Producers and online retailers may not return to shipping by air to the same extent as they did previously, given the price differentials between these modes. They may decide that a slower, but reliable service by sea is acceptable for these orders.

Conclusions

The review of online non-food shopping and last-mile delivery carried out and the analysis of the findings of the material reviewed leads to the following conclusions:

- Online non-food shopping has grown rapidly since its inception and is forecast to continue to do so. Covid-19 has significantly increased the uptake and penetration of online non-food shopping as a retailing channel both in relative and absolute terms, due to the closure of physical shops as well as removing the risk of contracting the virus that shopping in-store presents.

- The transport of goods by consumers using cars from shops to their home is typically the most carbon-intensive stage of the retail supply chain (on a per item basis) despite the short distance involved.

- Van delivery to customers can be less transport- and carbon-intensive than consumers' shopping trips by car as the vanload of parcels carries many customers' orders in a single trip.

- However, the transport and carbon benefits of van deliveries compared to consumers' car trips for non-food products are eroded by factors including failed delivery rates, customers returning goods, and the provision of, and desire for, ever-faster deliveries.

- In addition, some consumers continue to make car trips to shops to browse and view items prior to placing non-food online orders. Therefore, the use of online shopping does not necessarily result in the complete substitution of a consumer shopping trip with a last-mile delivery.

- For online non-food shopping to result in less total transport-related environmental impacts than conventional shopping there has to be a sizeable reduction in consumer shopping trips by car.

- Online non-food shopping also results in consumers placing order for goods that are shopped internationally, which has consequences for GHG emissions.

- In addition to transport-related environmental impacts on online shopping, there are other environmental impacts related to online non-food shopping that need to be taken into account in order to understand its overall impact. These include packaging waste, computing energy use, goods storage locations and their energy consumption, the safety and wellbeing of delivery workers, casualisation of labour in last-mile delivery operations, and social inclusion/exclusion issues related to consumers' access to online shopping.

- The action that will produce the greatest reduction in last-mile non-food delivery GHG emissions is the uptake and use of zero-emission delivery vehicles. However, it will take time for the use of these clean vehicles to become widespread, and even when they are, their use will still result in transport impacts.

- There are other logistics actions that the stakeholders (retailers, carriers, consumers and policy makers) can take to reduce the negative transport and environmental impacts of online non-food shopping and last-mile delivery. All of these actions are discussed in the next section.

Recommended actions for retailers, parcel carriers, consumers and policy makers

Stakeholders in online shopping and last-mile delivery, including retailers, parcel carriers, consumers and policy makers can take action to reduce to reduce the transport intensity, GHG emissions and other impacts of non-food online shopping and last-mile deliveries. These are summarised in Tables 1-5. These recommended actions have been categorised in terms of the aspects of last-mile delivery operations on which they will positively impact:

- Transport intensity (last-mile delivery vehicle kilometres travelled).
- GHG emissions (due to online shopping and last-mile delivery activity).
- Wellbeing and safety of last-mile delivery workers (including their working conditions and health).

Some of these recommended actions will also results in improvements in last-mile delivery operating costs while at the same time reducing these negative impacts. This has also been indicated in Tables 1-5.

These recommended actions have been sub-divided into those that could potentially be implemented in the short term (with 18 months), medium term (18-36 months) and long term (more than 36 months). A tick mark denotes a positive link between the recommended action and potential improvements in the sustainability of delivery operations (in terms of transport intensity, GHG emissions and/or worker wellbeing and safety). Those recommended actions that are also expected to have a positive impact on operating costs have also been shown with a tick mark. The impacts of these actions have been assessed by the authors using their expert judgement, drawing on the results of research reviewed in carrying out this work.

A review of the innovations that specific retailers, carriers and policy makers have put in place in efforts to make online shopping and last-mile delivery more sustainable in transport and environmental terms, as well as findings from research, can be found in the full report available on the SRF website.

Table 1: Possible actions for online retailers

Initiatives and measures	Potential impacts			
	Transport intensity of last-mile deliveries	GHG emissions	Wellbeing and safety of last-mile workers	Last-mile delivery operating costs
Short-term				
Reconsider the provision of free returns	✓	✓		✓
Sanction customers who regularly return large volumes	✓	✓		✓
Offer 'green' checkout option to consolidate items into single consignment (delaying delivery)	✓	✓		✓
Request alternative delivery address details (in case needed)	✓	✓		✓
Medium-term				
Devise sustainability and decarbonisation plans for last-mile delivery	✓	✓	✓	
Make online tools and product information available to help customers select the correct item	✓	✓		✓
Incentivise consumers to ensure returned items are in good condition				✓
Implement delivery charges that reflect operating and external costs (including removal of 'free' deliveries)	✓	✓		✓
Obtain grid coordinates of entrance point at delivery location from customers	✓	✓		✓
Refrain from offering or at least make clear to customers items that involve direct deliveries from overseas	✓	✓		✓
Reconsider whether same day and instant delivery offer is appropriate	✓	✓		✓
Develop and implement packaging reduction, reuse and recycling plans		✓		
Offer and promote agnostic locker banks and collection points (especially in locations easily reached by non-car modes)	✓	✓		✓
Long-term				
Use vacant shop space for last-mile logistics services: collection, returns, showrooms/fitting rooms etc.	✓	✓		✓
Join sustainable last-mile delivery certification schemes (if/when they exist in UK)	✓	✓	✓	

Table 2: Possible actions for last-mile delivery operators (retailers and carriers)

Initiatives and measures	Potential impacts			
	Transport intensity of last-mile deliveries	GHG emissions	Wellbeing and safety of last-mile workers	Last-mile delivery operating costs
Short-term				
Refrain from instant and same-day delivery services where possible	✓	✓		✓
Provide consumers with real-time delivery information and expected time of arrival	✓	✓		✓
Provide training to inexperienced multi-drop parcel drivers (for vehicle loading, vehicle driving/walking strategies, suitable kerbside stopping locations)	✓	✓		✓
Medium-term				
Devise sustainability and decarbonisation plans for last-mile delivery	✓	✓	✓	
Use zero emissions vans and other vehicles where possible (electric vehicles etc.)		✓	✓	
Use walking porters and electric cargo bikes in dense urban areas to decouple delivery personnel and vehicles	✓	✓		
Use micro logistics hubs to facilitate use of clean vehicles and walking porters	✓	✓	✓	
Use IT-based routeing and scheduling for drivers	✓	✓		✓
Make use of delivery point grid coordinates for entrance door at delivery location routeing	✓	✓		✓
Work with retailers and delivery operators to develop agnostic locker banks and collection points (especially in locations easily reached by non-car modes)	✓	✓		✓
Provide more training to last-mile delivery workers (including driving style)	✓	✓		✓
Pay self-employed/contractors by time period, rather than payment per delivery, and ensure at least the minimum wage	✓	✓		
Long-term				
Continue investigation of pavement drones and aerial droids for last-mile deliveries	✓	✓		✓
Collaborate with other carriers to share loads in dense urban areas	✓	✓		✓
Improve working conditions for pickers/packers and drivers (provision of insurance, sick pay, holiday entitlement, protective clothing, vehicle)	✓	✓	✓	
Join/provide operational data to sustainable last-mile delivery certification schemes (if/when they exist in UK)	✓	✓	✓	

Table 3: Possible actions for consumers

Initiatives and measures	Potential impacts			
	Transport intensity of last-mile deliveries	GHG emissions	Wellbeing and safety of last-mile workers	Last-mile delivery operating costs
Short-term				
Make use of 'green' delivery options provided on online retailer's checkouts where available (including time slots where delivery vehicles will be in your vicinity, and slower delivery options to improve consolidation of deliveries in your area)	✓	✓		✓
Do not select same-day / instant delivery options where possible	✓	✓		✓
Agree for items in order to be consolidated into single delivery on online retailer's checkouts	✓	✓		✓
Do not order individual items from retailers if possible (wait until several items are required or use fewer retailers)	✓	✓		✓
Place combined orders with others in the household	✓	✓		✓
Refrain from ordering multiple similar items and then returning those unwanted (particularly clothing)	✓	✓		✓
Ensure you are available to receive goods if having them delivered to your home via a service that provides expected time of arrival (and notify them in advance if for some reason you cannot be at home)	✓	✓		✓
Provide alternative delivery location details (such as friends and neighbours in case you are not home) if permitted at the time of ordering	✓	✓		✓
Pick up goods from shops and lockers as part of existing trips (e.g. commute to work) avoiding use of car where possible	✓	✓		✓
Refrain from making trips to shops by car to view and study items and gain staff knowledge before placing orders online	✓	✓		
Return goods as part of trips already being made for other purposes (avoiding use of car where possible)	✓	✓		
Reconsider ordering items where it is apparent they are delivered directly from overseas	✓	✓		✓
Reconsider need for and impacts of 'fast fashion' and food before placing orders to prevent waste arising	✓	✓		
Long-term				
Use online retailers signed up to sustainable last-mile delivery certification schemes (if/when they exist in UK)	✓	✓	✓	

Table 4: Possible actions for policy makers

Initiatives and measures	Potential impacts			
	Transport intensity of last-mile deliveries	GHG emissions	Wellbeing and safety of last-mile workers	Last-mile delivery operating costs
Short-term				
Encourage and promote greater use of non-car modes for personal shopping trips	✓	✓		
Provide information/education on impacts of product disposability and waste (fast fashion and food waste)	✓	✓		
Medium-term				
Disseminate last-mile information and advice to stakeholders including consumers	✓	✓		✓
Work with retailers and delivery operators to develop agnostic locker banks and collection points (especially in locations easily reached by non-car modes)	✓	✓		✓
Carry out strategic assessment of logistics land provision and location to prevent logistics depot sprawl	✓	✓		
Safeguard / protect existing last-mile delivery sites / land	✓	✓		
Consider requirement of inclusion of micro logistics hubs to serve local area in major building development	✓	✓		
Provide micro logistics hub sites / land in dense urban areas to facilitate use of cargo cycles and walking porters and rapid EV recharging (i.e. former car parks etc.)	✓	✓		
Implement training requirements for last-mile delivery workers	✓	✓	✓	
Review competition law to ensure that last-mile collaboration between delivery companies is permissible	✓	✓		✓
Clarify law on employment status (i.e. greater definition, or remove the 'worker' or 'self-employed' employment categories)			✓	
Increase requirements for uptake of renewable electricity (for vehicles and computing)		✓		
Increase requirements for energy saving technology for computers and smartphones		✓		
Long-term				
Consider implementing delivery tax/charges to prevent ‘free’ delivery / incentivise green delivery options	✓	✓		
Use planning system to mandate internal logistics systems at large commercial buildings	✓			✓
Plan/provide energy infrastructure for zero emission vehicles (including last-mile delivery vehicles)		✓	✓	
Require relocation of server farms to locations with cooler ambient temperatures		✓		

Table 5: Possible actions for land owners, property developers and building managers

Initiatives and measures	Potential impacts			
	Transport intensity of last-mile deliveries	GHG emissions	Wellbeing and safety of last-mile workers	Last-mile delivery operating costs
Short-term				
Ensure reception points and internal logistics systems so drivers can make deliveries to loading bay or front door rather than having to deliver to desk inside large buildings with single user such as hospitals and central/local government offices	✓			✓
Medium-term				
Design-in secure unattended delivery facilities (lockers) attached to houses in new builds	✓	✓		✓
Design-in secure unattended delivery facilities (lockers and concierge facilities) for residential apartment new builds to prevent failed deliveries	✓	✓		✓
Design micro logistics hubs and rapid recharging points in major new commercial and residential developments to facilitate use of walking porters, cargo cycles and electric vehicles	✓	✓	✓	
Provide former high street retail sites for multi-user locker banks/collection points/showrooms/wardrobes	✓	✓		✓
Develop multi-story, multi-level logistics fulfilment sites in urban areas (i.e. intensification of logistics sites)	✓	✓		✓

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