ONLINE GROCERY SHOPPING AND LAST-MILE DELIVERIES

Summary Report

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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 (HGVs) 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 summarises online retailing in grocery online shopping and last-mile delivery in the UK, and the transport intensity, GHG emissions and other impacts associated with it.

Grocery shopping is a major part of the retail sector and an activity that everyone participates in on a regular basis. Total sales in UK grocery stores together with online sales by multichannel (i.e. retailers with stores and an online presence) and online-only grocers were approximately £200 billion in 2019 which represented approximately 40% of all retail sales in the country (IGD, 2019; Office for National Statistics, 2020).

On average, people made 97 physical, one-way food shopping trips per year in England in 2017 (approximately two one-way trips per week), travelling a total of 265 miles, a mean trip distance of 2.7 miles per trip, with food shopping accounting for 4% of the total distance travelled per person. In terms of transport modes used for shopping, the car predominates, accounting for 86% of the total distance travelled (Department for Transport, 2020a). These car trips resulted in an estimated 17 billion vehicle kilometres of car grocery shopping travel and 2.5 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 grocery 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 grocery products has the potential to result in substantial reductions in 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 (as the latter avoids the stem distance driven to and from the home and shop). Achieving such reductions requires that the last-mile delivery replaces the customer's car trip to the shop.

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 the final point of despatch of the goods (be that a warehouse, depot, fulfilment centre or shop) and the delivery point nominated by the consumer which could be their home, workplace, or a shop, locker bank or other location from which the consumer collects these goods.

Summary reports on the non-food parcel 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 grocery shopping in the UK

Online grocery sales have been increasing in the UK since their introduction, although market penetration rates are far lower than for non-food retail sectors such as clothing and electrical goods. Online sales accounted for approximately 5% of all product sales by multichannel grocers (i.e. those with both physical and online retailing) in the UK in January 2020 (Office for National Statistics, 2021 - see Figure 1). However, as discussed later and shown in Figure 2, online grocery penetration rates have more than doubled during the Covid-19 epidemic.

Figure 1: Online sales as a percentage of retail sales by food retailers in the UK prior to Covid-19 (Jan 2008 - Jan 2020)
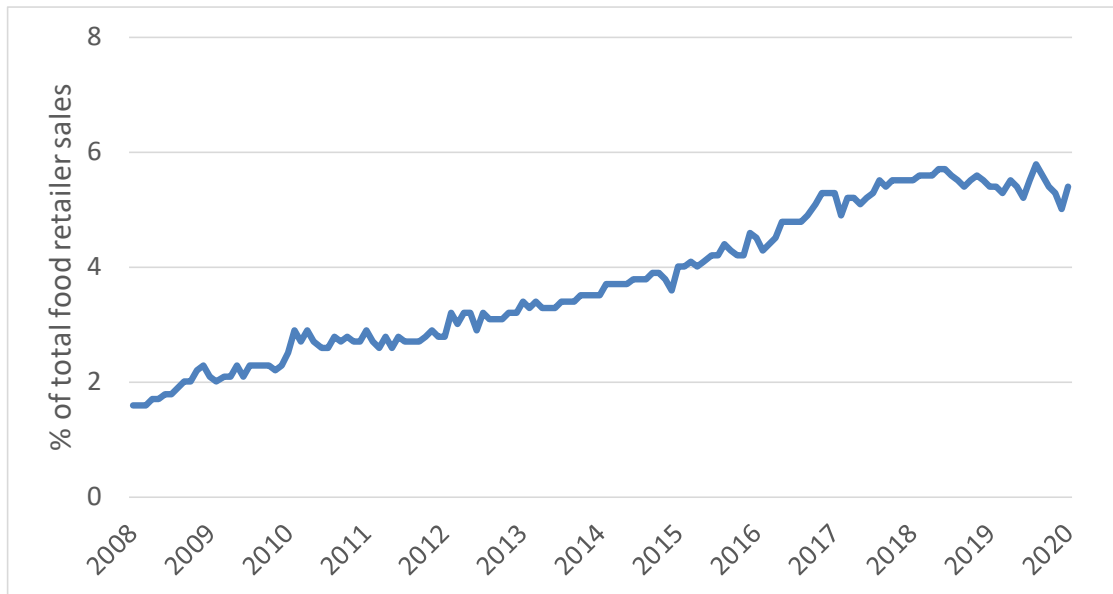
Note: Seasonally adjusted monthly data.
Source: Office for National Statistics, 2021.

Online grocery retailers in the UK

Online grocery shopping and last-mile delivery is offered on a widespread basis in the UK by many of the major retailers with the geographical coverage and services offered varying by retailer. Of these, Tesco generates by far the greatest online sales, approximately twice as much as its nearest rivals Sainsbury, Asda and Ocado (Mintel, 2019). With the exception of Amazon and Ocado, major retailers operate both physical stores and online shopping services. In addition, there are many smaller online retailers offering direct-to-consumer sales (of products such as wine), as well as recipe box and vegetable box online retailers.

Given the level of competition between retailers to generate sales and gain market share in the online grocery 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 difficult for retailers to achieve profitability on these sales (Allen et al., 2001; Tugby, 2015; Capgemini Research Institute, 2019). This situation has been exacerbated by some grocery retailers offering 'free' deliveries with minimum spend order values and the introduction of so-called 'delivery passes', membership schemes in which customers pay a fixed fee in order to receive as many deliveries as they require over a given period of time, with no additional fee per delivery.

Online shopping and last-mile delivery services

Online grocery shopping orders are either transported to customers by grocers' last-mile delivery personnel or customers collect their orders, usually by car, from the physical store or other location (known as 'click and collect' services). Most last-mile grocery deliveries to customers are made by refrigerated vans carrying out multiple deliveries on each trip on a next-day or slower basis, with customers selecting delivery day and time slots when ordering (although same-day deliveries by van are being offered by some grocery retailers). A small proportion of grocery deliveries in urban areas are made on an instant basis (usually within a couple of hours of placing the order) using bicycles and mopeds. These instant deliveries are limited in terms of the range of products available and maximum order quantity due to the limited carrying capacity of the vehicles used.

Unlike non-food products, grocery failed delivery rates (i.e. when no-one is at home to receive the delivery) are typically low as the customer knows when the delivery will be made. Product return rates for groceries are also low compared with non-food products such as clothing and electronics.

In 2019 approximately 100 million online grocery orders were placed over the course of the year in the UK, with Tesco alone responsible for approximately 30 million of them.

Comparing consumer shopping trips with last-mile deliveries

Consumer grocery 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 yoghurt, the transport energy use of the car trip per kg of yoghurt was approximately the same as the total commercial freight transport energy from farm to retail outlet (Browne et al., 2006).

Research has also shown that if online grocery shopping involves the complete substitution of consumer transport by car with a last-mile delivery van making multiple drops that the total shopping vehicle kilometres (i.e. personal travel plus last-mile trip) can be reduced by 60-80%, depending on drop-density and van load factor (Cairns, 2005). A case study of online grocery shopping in Seattle, USA showed potential vehicle kilometres reductions of 85-95% and CO_2 emissions reductions of 80-90% compared to consumers making dedicated car journeys to and from grocery supermarkets (Wygonik and Goodchild, 2012). These studies assume that the last-mile delivery replaces the customer's grocery trip to the shop. However, studies of consumer behaviour indicate that some people continue shopping in store, even when they make use of online shopping (Rotem-Mindali, 2014).

**Impacts of the Covid-19 epidemic on grocery shopping**

The outbreak of the Covid-19 epidemic resulted in panic buying in UK grocery stores, with many lines of essential items quickly becoming unavailable as some customers stockpiled food. Retailers had to impose restrictions on the quantities of these items that customers could purchase in the initial weeks of the epidemic. They also worked with their suppliers to reduce the number of product varieties available on-shelf to increase production and availability levels. Retailers also had to put in place arrangements in their shops to try to ensure that customers were not in close proximity to each other and to staff (through the installation of screens at checkouts, deployment of security personnel, and queuing systems to limit the number of customers in the shop at any one time). These resulted in queuing and delays for in-store shoppers during March to May 2020. Two of the UK's leading grocery retailers, Tesco and Sainsbury's, reported at the end of April 2020 that customers were visiting stores on a less frequent basis than normal, and were buying about twice as much as normal on each visit (Tesco, 2020a; Sainsbury, 2020).

Online grocery sales in the UK increased substantially during the Covid-19 epidemic from 5% of multichannel grocery sales in January 2020, to 11% in May 2020, 10% in September 2020 and returning to 11% in December 2020 (Office for National Statistics, 2021 – see Figure 2). This reflects customers' efforts to avoid having to shop in store. Demand for grocery deliveries has

been far outstripping supply and would retailers reported that orders would have been even greater than they were if they had been able to expand their fulfilment centres and delivery van fleets more quickly.

For example, Tesco, the largest online grocer in the UK, doubled its online ordering slots to 1.2 million per week between March and May 2020 (Tesco, 2020a) and other retailers increased theirs by approximately 50% over a similar period, taking on additional staff to help meet this demand. However, a sizeable proportion of this expansion was met by increasing in-house click and collect services, with customers collecting their ready-bagged-up orders from store car parks in their cars. Many retailers prioritised these last-mile deliveries for elderly and vulnerable customers. In August 2020, Tesco announced that it was handling 1.5 million online orders per week and would create 16,000 new permanent jobs in order picking and making deliveries, as it expects the increased demand for online grocery ordering to continue in the long-term (Tesco, 2020b).

Figure 2: Online sales as a percentage of retail sales by food retailers in the UK (Jan 2008 – Dec 2020)
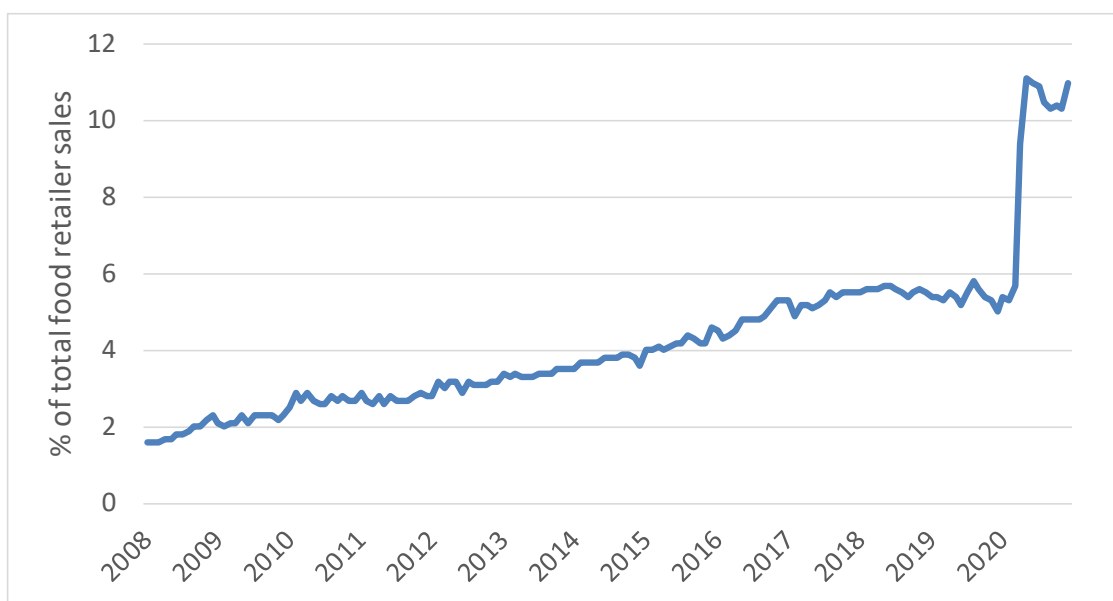
Note: Seasonally adjusted monthly data.
Source: Office for National Statistics, 2020b.

In order to expand last-mile deliveries to meet the demand since the Covid-19 epidemic began, some grocery retailers have been teaming up with meal platform providers such as Deliveroo to offer same-day deliveries of limited product ranges and quantities via their rider networks. Amazon announced in April 2020 that it was retrofitting existing UK depots to fulfil grocery orders on a same-day basis, which would be made available to approximately 40% of households before the end of 2020 (Sibson, 2020). Some major grocers such as Marks and Spencer and Aldi have entered online retailing for the first time during the Covid-19 crisis by selling food boxes with a selection of essential items.

There are also signs of disintermediation taking place with wholesalers and producers of products such as beer, cheese and chocolate commencing online shopping and delivery services for the first time. This has provided some of these companies with a source of income at a time when their sales to the hospitality trade have fallen substantially. Specialist online food and drink and meal kit sellers have increased their advertising during the Covid-19 epidemic, in view of the greater consumer interest in their delivered ingredients and instructions for home cooking.

The Covid-19 epidemic is likely to mark the start of a substantial period of change and innovation in grocery retailing channels as well as in grocery 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 grocery shopping. Therefore, this increase in online shopping has to involve deliveries to the customer rather than the use of click and collect services and car trips solely for this purpose. In addition, these deliveries need to be carried out by vans making multiple deliveries as part of a trip rather than a proliferation of trips in which a single delivery is performed. Customers can help reduce the proliferation of delivery vehicle activity by placing large orders on a less frequent basis, rather than many small, frequent orders, and by refraining from opting for same-day delivery. It also requires that customers refrain from purchasing some groceries in-store by car while ordering others online for delivery as this will negate the potential GHG emissions reduction that online shopping can provide. The future large-scale uptake of electric delivery vans will help further reduce the GHG emissions generated by grocery shopping.

Conclusions

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

- Online grocery 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 grocery shopping as a retailing channel both in relative and absolute terms, due to consumers wanting to avoid both the risk of contracting the virus that shopping in-store presents and the need to queue.

- The transport of goods by consumers using cars from shops to their homes 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 groceries carries many customers' orders in a single trip.

- However, the transport and carbon benefits of van deliveries compared to consumers' car trips for groceries are eroded by factors including consumers continuing to make some purchases in grocery stores using their cars while ordering others online, opting to collect their online orders from supermarkets by car, and the provision and desire for ever-faster deliveries.

- Therefore, the use of online grocery shopping does not necessarily result in the complete substitution of a consumer shopping trip with a last-mile delivery. For online grocery shopping to result in less total traffic and transport-related environmental impacts than conventional shopping there has to be a sizeable reduction in consumer shopping trips by car.

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

- The action that will produce the greatest reduction in last-mile grocery 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 grocery shopping and last-mile delivery. All of these actions are discussed in the next section.

Recommended actions for retailers, consumers and policy makers

Stakeholders in online shopping and last-mile delivery, including retailers, delivery operators (if different to the retailers), consumers and policymakers can take action to reduce the transport intensity, GHG emissions and other impacts of grocery 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 are also expected to result in improvements in last-mile delivery operating costs, while at the same time reducing these negative impacts.

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				
Group delivery time slots offered based on inter-drop distances between them ('green option')	✔	✔		✔
Medium-term				
Devise sustainability and decarbonisation plans for last-mile delivery	✔	✔	✔	
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	✔	✔		✔
Reconsider whether same day and instant delivery offer is appropriate	✔	✔		✔
Develop and implement packaging reduction, reuse and recycling plans		✔		
Long-term				
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	✔	✔		✔
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	✔	✔	✔	
Use IT-based routeing and scheduling for drivers	✔	✔		✔
Make use of delivery point grid coordinates for entrance door at delivery location routeing	✔	✔		✔
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	✔	✔		✔
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	✔	✔		✔
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	✔	✔		✔
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)	✔	✔		✔
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	✔	✔		
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	✔	✔		✔
Carry out strategic assessment of logistics land provision and location to prevent logistics depot sprawl	✔	✔		
Safeguard / protect existing last-mile delivery sites / land	✔	✔		
Review competition law to ensure that last-mile collaboration between delivery companies is permissible	✔	✔		✔
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	✔	✔		
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
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 clean vehicles	✔	✔	✔	
Develop multi-story, multi-level logistics fulfilment sites in urban areas (i.e. intensification of logistics sites)	✔	✔		✔

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