CARBON IMPLICATIONS OF RETURNING UNWANTED GOODS ORDERED ONLINE

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INTRODUCTION

With increasing concerns about climate change, consumers are being urged by government, businesses and environmental groups to alter their behaviour to reduce their personal carbon footprints. The need for such lifestyle change may be seen as pressing by these various organisations, but how *best* to achieve the necessary carbon reductions at an individual level is less clear. Online shopping is one area where broad consensus exists among the general public; ordering goods online is thought to be beneficial for the environment (IMRG, 2009; Royal Mail, 2008). Recent research supports this supposition. There are environmental savings to be made from shopping online where the goods are delivered to the home (Edwards, McKinnon & Cullinane, 2009a; Weber et al., 2008).

To maximise these benefits, orders have to be delivered successfully first-time (i.e. no failed deliveries) and the goods retained by the customer (Edwards et al., 2009). This product retention is a challenge for the e-commerce sector as product return rates are high for goods bought online, and generally much higher than those experienced in conventional retailing. The problem seems to be that online customers are not able to ‘touch and feel’ goods prior to purchase (Ofek, Sarvary & Katona, 2007). Additionally, the round-the-clock availability of online shopping may encourage consumers to buy goods that they do not necessarily want. Kang & Johnson, (2009) found that one characteristic of frequent product returners is their tendency to impulse buy. As a result, online customers often face the expense and inconvenience of returning unwanted items, with retailers forced to manage the process and subsume the handling costs associated with any return (Yalabik, Petruzzi & Chhajed, 2005).

The returns policy for unwanted goods, however, is a highly competitive area for online retailers (Charlton, 2008). Future sales and customer loyalty may hinge on how customer friendly a retailer’s returns policy is for the consumer (Stock, Speh & Shear, 2006). Nevertheless, the issue of online returns is an under-researched area of study among academics (Bonifield, Cole & Schultz, 2010). This oversight on the part of researchers is somewhat surprising as customer satisfaction is one of the key metrics of success in online retailing[1]. Virtually all online retailers gave customer service as the reason for the existence of reverse logistics management (Dissanyake & Singh, 2006), yet, it seems that customers are often dissatisfied with the returns process. In a recent survey conducted by PriceRunner, 40% of online shoppers indicated that they were unhappy with the returns processes for unwanted goods purchased online (Charlton, 2007) and IMRG (Interactive Media Research Group) found that only 40% of those consumers they surveyed gave returns between 80 - 100% satisfaction ratings (IMRG, 2009). Dissatisfaction arises in part because returns policies vary widely among online retailers. Some retailers offer lenient, unconditional money back guarantees, others offer only store credit notes, while a few allow no refund whatsoever (Mukhopadhyay & Setoputro, 2004, Bonifield, Cole & Schultz, 2010).

The research presented here is the first to examine in detail the carbon implications of consumers returning unwanted non-food goods ordered online, and as such, makes several contributions to theory and practice. It informs online consumers (and retailers) of the environmental impact of their chosen returns method, and makes recommendations for the most carbon-efficient returns option. The remainder of the paper is structured as follows: First, return rates for unwanted items are compared across product categories and between conventional and online retail channels. Then customer returns methods and aspects of the upstream reverse supply chain are examined. Practical issues to be address in carbon auditing the reverse process are highlighted and a justification given for focussing on the initial 'last mile' stage. In the methodology section the data gathering process and assumptions are outlined, before the findings from the CO_2 analysis are presented.

PRODUCT RETURNS RATES

Online shoppers return items for a variety of different reasons. The most popular explanations include:

- damage to goods (in transit);
- delivery of the wrong product, owing to errors in order picking; and
- the consumer no longer wanting the particular item ordered (Charlton, 2007).

Some product categories, such as clothing, have up to 35-40% of online orders returned as unwanted (Beveridge, 2007) (Table 1), though more typically between 25-30% of all non-food goods bought online are returned (de Koster, 2002)[2], compared with just 6-10% of goods purchased by traditional shopping methods (Nairn, 2003; Fernie & McKinnon, 2009)[3]. In 2008, UK online shopping sales were forecast to amount to £63 billion (IMRG, 2008), so returns at 30% would represent £19 billion of goods[4].

[1] 90% of online shoppers consider good customer service to be critical when choosing an internet retailer (The Business Link, 2009).
[2] Catalogue retailing can also result in a similar level of returns (DfT, 2004)
[3] High street returns by sales volume are slightly less, at between 1-5% (Bernon & Cullen, 2004)
[4] The UK national statistics stated that online (wholesale, retail, catering and travel) sales in 2008 were £104bn (ONS, 2009). This higher online sales volume includes catering and travel sales that generate very few returns.

Table 1 *- Percentage returns by product category*

Product type	**Conventional retailing**		**Online retailing**	
	Rogers & Tibben-Lembke (1998)	**Cransfield University *et al*. (2004)**	**Beveridge (2007)**	**The Business Link (2008)**
Consumer electronics, software	4-5%	4-5%	5-10%	20%
Book distribution	10-20%*	10-12%*	3%	15%
Computers, printers etc.	4-8%	10%	-	
Clothing	-	-	35-40%	27%

Source: after Rogers & Tibben-Lembke (1998), Cranfield University et al. (2004), Beveridge (2007) and The Business Link (2008)

Potentially online retailers have to contend with significant levels of returns and often have to present several different consumer returns-route options. From a customer's point of view, the ease of returning items is sometimes dependent on the type of goods being returned. Generally, clothing retailers attempt to make the process easy for customers to return unwanted goods, while electronic and electrical goods suppliers are criticised for having less helpful returns policies (Snow Valley, 2009).

The environmental implications of these online returns are strongly influenced by both parcel carriers' returns policies and consumers' preferred post-purchase habits, with the situation complicated further when customers have a choice of returns channels. At a broad level, Cranfield University, Sheffield Hallam University and CILT (2004) estimate that between 0.4 and 0.8% of road freight transport CO_2 emissions could be the result of product returns.

RETURNS METHODS FOR THE CONSUMER

Unwanted non-food products are normally returned by post, courier pick-up or, in the case of multi-channel retailers via one of their shops. Snow Valley (2009) found that 55% of retailers stipulated their chosen returns method, though only a third provided the customer with pre-paid returns labels. In the case where online shoppers are able to choose their preferred returns channel, cost as well as convenience of the returns carriage will influence the selection of returns method by a consumer.

Courier collection

Parcel carriers sometimes offer to take back items when they are delivering in the customer's area, and as a result, very little additional mileage is generated when the returned items are collected as part of a standard outbound delivery round. In these integrated returns cases, an allowance is made for collections within the planned outbound delivery schedule (the number of drops are modified accordingly), and any additional energy use is subsumed within the overall delivery round. Other benefits of this approach include the customer being spared a trip to the post office or shop and, from the retailer's point-of-view, goods are returned in a resale-able state (Snow Valley, 2009). As vans are not sent on separate, dedicated pick-up runs, courier-collection avoids additional 'collection-only' mileage (Beveridge, 2009).

Postal services

Alternatively, customers can send items back through the standard postal service by taking them to their local post office. Where there is a choice between parcel carrier or postal services, approximately half of returns are via carrier collection and half by post (Beveridge, 2007).

Multi-channel retailers

For retailers with a high street presence (and who allow such practice) customers may choose to return items to a physical store. Almost three-quarters of UK consumers in a recent industry survey preferred to return their goods in-store when shopping from multi-channel retailers[5] (IMRG, 2009), though the availability of this method of return depends on the number of high street stores operating such a returns policy. For instance, a high percentage of the clothing bought online from supermarket chains is returned to the shops. Some popular high street retailers find that half their returns are to shops. On the other hand, other multi-channel retailers have very little returned to stores owing to their relatively sparse high street presence (Beveridge, 2007). While this returns route offers convenience to the consumer, returning unwanted goods to store can have serious environmental consequences as a result of the personal travel to the shops.

In a recent survey, Snow Valley (2009) revealed that a third of retailers used courier pick-up as a collection method (though only 10% insisted on courier collection as the process for returning unwanted items), 60% of retailers with a store network allowed returns to store and 80% allowed goods to be returned by post, with 43% of retailers insisting on this returns method (Table 2). The use of the postal service remains the most popular returns option (Snow Valley, 2009).

Table 2 *- Returns method options offered by the retailer to the consumer*

Returns Method Option	Percentage
Post only	43%
Post or store	21%
Post, store or courier	12%
Courier only	10%
Courier or store	7%
Post or courier	4%
Store only	2%
Not clear	1%

Source: Snow Valley (2009)

Collection / delivery points (CDPs)

As a consequence of the large proportion of failed home deliveries[6], different delivery solutions have emerged, allowing carriers to drop consignments without the need to obtain the final customer's signature (McLeod & Cherrett, 2009; McKinnon & Tallam, 2003). Initially viewed as a solution to the problem of failed deliveries, CDP are well-positioned to receive products that consumers wish to return. The retailer / parcel carrier simply requires

[5] In contrast, 62% of Canadian consumers would rather return products by post than travel to a physical store (The Business Link, 2009), presumably owing to the greater length of shopping trips in Canada and a more dispersed population.
[6] At least one in eight home deliveries fail, owing to no-one at home to receive the delivery (IMRG, 2008).

notification of a return in advance, and the location of a suitable CDP identified for carrier collection.

An advantage of CDPs, assuming that they have been carefully positioned near residential areas (e.g. post offices) or in locations already frequented by consumers (e.g. supermarkets and railway stations), is that they can generate little additional travel by the consumer (Weltevreden, 2008; Cairns et al., 2004).

There are two broad categories of CDPs:

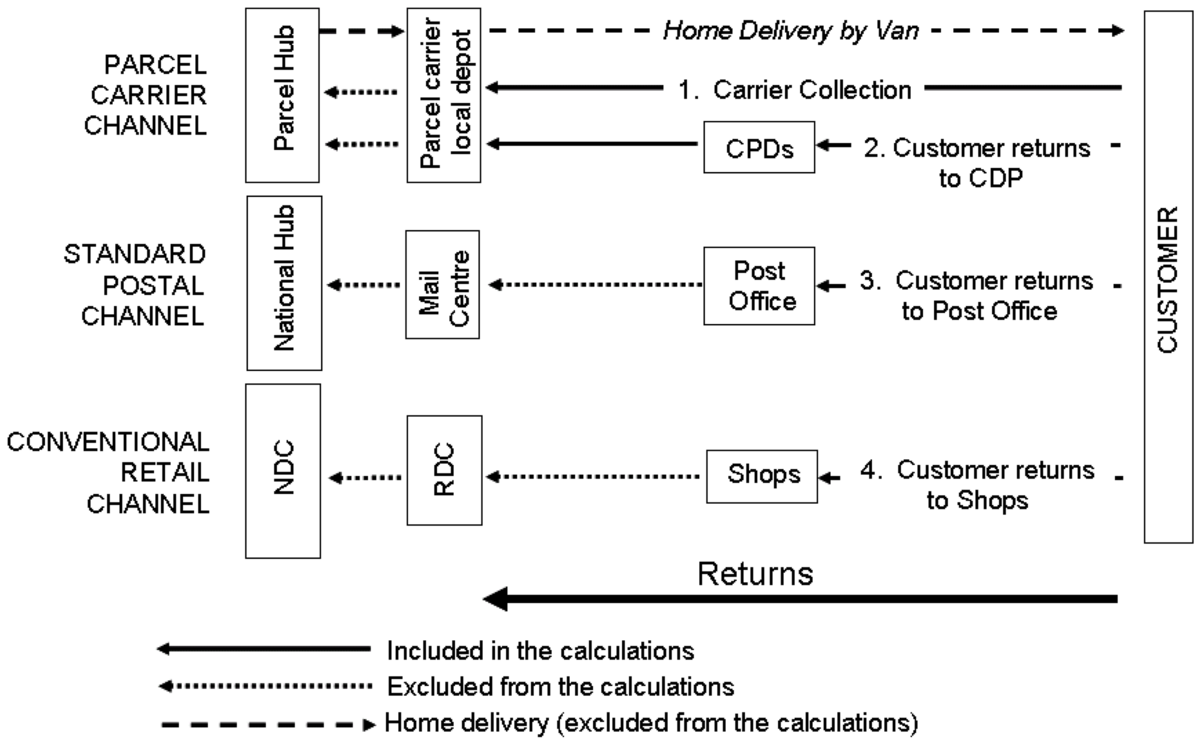
1. *A local attended CDP*
This can be in a shop, a petrol station or a post office. This delivery method is now used by Royal Mail and Parcel Force in the UK using specific post offices as CDPs. Other examples use grocery stores, newsagents and petrol stations. Kiala has 5000 CDPs across Europe with outlets in the UK, Belgium, Germany, Austria, Spain, The Netherlands, Luxembourg and France. Using a network of convenience stores, Pickpoint has a network of CDPs across Germany and a similar system is in operation in Japan (Chopra, & Meindl, 2003). An attended CDP requires someone to be available to receive the products returned by a customer, to provide a returns receipt and to pass on the unwanted goods to a delivery driver. The service is, therefore, restricted to certain 'manned' hours of opening which may increase costs as at least one member of staff must be present to operate the facility.

2. *Unattended CDPs*
These usually comprise of a bank of mechanised storage boxes which the customer accesses via a personal code. As there is no requirement for an intermediary person to receive the goods, the boxes potentially allow 24-hour access. Unattended CDPs are well established for business-to-business (B2B) deliveries and collections, though their potential for the business-to-consumer (B2C) home delivery market has yet to be realised. To date, few companies offer this unattended delivery service for returns, though interest is growing. In the UK, ByBox , which mainly operates in the B2B market, has recently diversified into B2C (Rowlands, 2009), and Collect+, launched jointly by Home Delivery Network Ltd. and PayPoint in the summer 2009, offers consumers a high street collection and despatch service via 1,200 PayPoint outlets (e-Fulfilment & e-logistics, 2009). Plans were in place to increase this network to 4,000 outlets within a few months of launch (paypoint.com, 2009).

The research model takes account of these different returns options.

METHODOLOGY

This paper examines the return of unwanted non-food products and in so doing, investigates the carbon implications of *customer* returns only i.e. the first stage in the reverse supply chain when a consumer either makes a personal trip to return an item or the parcel carrier collects the item from the consumer's home (Figure 1). In the case of a consumer returning unwanted items to a CDP, the minor deviation in the outbound delivery round to collect returns is also included in the calculations. The actual goods being returned were not categorised by product type, as generally all returned products receive similar handling during their return journey back up the supply chain. The study remit also excluded the carbon auditing of upstream supply-chain activities. Importantly, emissions associated with consumer travel behaviour in the so-called 'last mile' can exceed all other emissions associated with the distribution and retailing of goods (Edwards, McKinnon & Cullinane, 2009b; Weber et al., 2008). By concentrating on the initial stages of the returns process emissions from person travel can be highlighted.



1. Carrier collection
2. Customer returns to CDP
3. Customer returns to post office
4. Customer returns to shops

Figure 1 *- Scope of the study: a CO_2 analysis of four returns methods*

Using an Excel spreadsheet carbon audit model, outlined by Edwards, McKinnon & Cullinane (2009a), carbon dioxide (CO_2) emissions for a variety of representative returns scenarios are calculated. In particular, the research considers the possible variations to carbon emissions from customers returning goods:

- to their nearest post office or alternative CDP;
- directly to a store for multi-channel retailers with a high-street presence; and
- for courier collection, as part of an outbound home delivery round.

Rather than relying on only one information source for freight-related emissions factors, emissions data for diesel- and petrol-fuelled vans from four statistical sources were used, and averaged:

1. Department for the Environment, Food and Rural Affairs (Defra, 2008): emission factors for vans;
2. National Atmospheric Emissions Inventory (NAEI, 2008): emission factors for vans, taking data for Euro II vehicles and speeds of 40-kph (default speed);
3. Road Haulage Association (RHA, 2008): emissions factors calculated from Defra values, and based on average fuel consumption of 27 miles per Imperial gallon; and
4. Freight Transport Association (FTA, 2008): emissions factors calculated from Defra values, based on average fuel consumption of 25 miles per Imperial gallon for a van.

The model was calibrated using data from leading parcel carriers in the UK, with the analysis presented here based on a typical van[7] home delivery round of 120 drops and 50-miles distance. The approach of averaging emissions factors (at 181g CO_2 per average drop) ensured consistency to the calculations[8].

Consumer travel data were taken from two sources. First, distances to the post office and alternative CDPs (e.g. railway stations and supermarkets) were taken from Song et al., (2009) who surveyed 379 households across West Sussex, UK to establish the impacts of varying densities of CDPs on householder collection mileage. Second, distances for personal shopping trips to the high street were obtained from the National Travel Survey, undertaken by the Department for Transport (DfT). This survey collects data on personal travel in the UK and on travel behaviour over time, and distinguishes between food and non-food shopping trips. It also differentiates between different types of motorised transport. According to the survey, an average one-way journey for non-food shopping is 6.4-miles for car travel (car driver) and 4.4-miles for bus travel in the UK (DfT, 2009). These trip lengths were used to represent average non-food shopping trips.

Table 3 *- Research assumptions: Return type and trip characteristics of return trip*

Type of return trip	**Number of returns (& initial delivery drops) by the courier**	**Typical delivery round distances or distances from customer's home in miles (km)**
Average carrier collection (diesel van <3.5-t)	120	50 (80)
City-centre carrier collection (diesel van <3.5-t)	110	25 (40)
Rural carrier collection (diesel van <3.5-t)	70	80 (128)
Courier collection (private car)	40	25 (40)

Table 3 lists the type of return trip assumptions applied to this study[9]. Courier collection-round characteristics were based on information supplied by leading parcel carriers in the UK. Types of alternative CDP and typical distances from a consumer's home (Table 4) were taken from Song et al., (2009).

Table 4 *- Research assumptions: Point of return and average distance from consumers*

CDP point for customer returns	**Typical delivery round distances or distances from customer's home in miles (km)**
Post office	0.75 (1.2)
Large superstore	4.03 (6.5)
Other supermarket	1 (1.6)
Railway station	2 (3.2)

[7] A van denotes a light goods vehicle up to 3.5-tonnes maximum permissible gross vehicle weight of van-type construction on a car chassis that operates on diesel fuel.
[8] The CO_2 emissions per average drop varied by statistical source and were as follows: 178g Defra; 160g NAEI; 185g RHA and 199g FTA.
[9] Each drop or return consists of an average of 1.4 items.

In the case of returns to a post office, alternative CDP or a physical store, it was assumed that the items were returned either by car or bus, and that the customer travelled an average distance to access these facilities. For courier collections, emissions from a delivery van (both diesel and electric) and from private car, in the case of private couriers, were calculated for a typical round trip. City centre and rural areas were also distinguished. Efforts were made to ensure that the modelling closely reflected current industry practice in collecting returned goods. All the return options were given a carbon rating.

ANALYSIS

The actual gCO_2 per online return is very sensitive to the proportion of products returned and the method by which these unwanted items are sent back by the customer to the retailer.

Four returns scenarios were considered:

1. Where the unwanted item is collected on a subsequent delivery round;
2. Where the unwanted item is returned via a CDP;
3. Where the consumer returns the item using the standard postal service;
4. Where the consumer returns the item to a high-street store.

1. Where the unwanted item is collected on a subsequent delivery round:

a) By van

The most efficient returns method (using a motorised vehicle[10]) is when a parcel carrier modifies their outbound delivery schedule to collect returns as part of the standard outbound delivery round (Table 5), as companies in their scheduling take into consideration the number of items delivered and collected per stopping point. In some cases, the parcel carrier waits until the return to be collected is situated in the same street or even stopping point where other goods need to be delivered.

Table 5 *- CO_2 emissions from courier collection of unwanted online returns*

Transport mode	Locality of collection	Distance (miles)	Collection (& drops) per round	gCO_2 emissions per collection
Van	Non-geographically specific	50	120	181g
	City-centre	25	110	98g
	Rural	80	70	495g
Private car (courier)	City-centre	25	40	417g
Private car & delivery van	City-centre	25	40	340g

Edwards, McKinnon & Cullinane (2009a) calculated that carbon emissions for a standard 50-mile delivery round by diesel van, consisting of 120 drops, produced 21,665gCO_2 (based on average outbound delivery round emissions calculated from the four emissions factors outlined in the Methodology). They argued that each successful first-time drop would be allocated 181gCO_2, i.e. its 'share' of the 21,665g total[11]. Therefore, when picked-up as part of an average outbound delivery round, an

[10] Either walking or cycling to the shops, post office or local CDP would be a more efficient method of return, though an analysis of these two modes is beyond the remit of this research.
[11] This assumes that all drops are successfully delivered first-time with no delivery failures.

integrated return would be the equivalent of one outbound drop, and therefore, allocated 181gCO_2. In the case of a more compact city-centre collection, the return would be allocated 98gCO_2 (10,832gCO_2 for the 25-mile round divided by 110 drops/collections). For rural collections, each would be assigned 495gCO_2 to take into account the greater distance covered and the fewer collection / delivery opportunities per round (34,663gCO_2 divided by 70 drops/collections).

There is a case for allocating the collection twice the CO_2 of an outbound drop, as the unwanted item has the combined emissions of an outbound *and* return trip (in effect the combined CO_2 of two outbound deliveries), though to do so would mean that each returns options e.g. by post, courier or CDP collection would equally have a base of 181gCO_2, as any online order must be first delivered, before it can be returned. The original delivery is common to all returns scenarios, therefore, only emissions produced by the actual process of returning unwanted goods are included in this comparison (highlighted in Figure 1).

b) Private courier

The use of third party couriers has grown in popularity in recent years. Several online retailers now contract self-employed, part-time staff to deliver orders to customers. Generally, these casual employees use their own private vehicles to undertake deliveries, and as a result, carry fewer deliveries (at about 40 drops / collections per round) than van-based parcel carriers. Their delivery / collections area is predominantly urban based and therefore it is assumed that a typical courier round is a similar distance to a city-centre van (25-miles). As a result of these lower drop densities and the use of relatively inefficient private vehicles, CO_2 emissions per standard courier collection are 417g (or six-times the emissions of a city centre van-based delivery). This assumes that couriers use their cars to collect deliveries in person from their local depot. When a delivery van undertakes part of the route first to the courier's home the CO_2 is reduced to 340g per drop. The relative inefficiency of car-based couriers for home delivery has not been highlighted previously. Nevertheless, courier-style deliveries are popular among both clients and carriers, as they achieve relatively high first-time delivery rates. Couriers often have a regular customer base and therefore, become familiar with their customers' availability to receive deliveries. Additionally, couriers often combine deliveries with other activities, e.g. supermarket shopping or performing the 'school run' (Beveridge, 2009), thereby partly off-setting the relatively high emissions per courier drop.

2. Where the unwanted item is returned via a CDP:

The emissions associated with the return of an unwanted item to a CDP for carrier collection comprise two elements. First, the emissions produced by the consumer in dropping the unwanted item at the CDP and second, the additional emissions for the outbound parcel carrier making a detour to the CDP to collect that return. Table 6 shows the increased CO_2 per average collection for a parcel carrier (compared with a standard home delivery round) and the emissions from a consumer making a dedicated trip to drop the returned items at the CDP. The increased average emissions per courier collection reflects the additional detour distance when a parcel carrier deviates from the outbound round to collect returned items from the nominated CDP. It has been assumed that the additional mileage undertaken by the parcel carrier is equal to the average distance from a consumer's home to the facility. In many cases, a skilled van driver may be able to reduce this additional end-of-round 'detour' distance.

In the case of a carrier diverting to a local post office, the relatively short additional mileage (0.75-miles) adds just 4gCO_2 to each collection (compared with a standard drop of 181gCO_2, whereas extending an average delivery round by 4.03-miles (6.5km) to collect returned items at a large superstore would result in each collection being allocated an extra 23gCO_2. The parcel carrier may drop failed deliveries at the CDP at the same time as returns are collected, thereby minimising the emissions impact from the combined drop / collection detour.

Table 6 *- Emissions (gCO2) per return via CDPs*

Location of CDP	Average Detour Distance	CO_2 emissions per collection			Total CO_2 emissions per CDP collection	
		By diverted parcel carrier van	By private car	By bus	Parcel carrier van & private car	Parcel carrier van & bus
Large superstore	4.03 (6.5 km)	204g	2,340g	1,159g	2,544g	1,363g
Other Supermarkets	1 (1.6 km)	186g	581g	288g	767g	474g
Railway Station	2 (3.2 km)	185g	1,161g	575g	1,346g	760g
Post Office	0.75 (1.2 km)	192g	436g	216g	628g	408g

3. Where the consumer returns the item using the standard postal service

As 28 million people visit a post office branch every week (Department of Transport, 2007), it is not surprising that the postal service is the most popular method for returning unwanted items. Song et al. (2009) calculated that, on average, customers would only have a 1.5-mile round trip to visit their nearest post office[12]. A short, dedicated car trip over this distance emits 436gCO_2 and a bus trip 216gCO_2 (assuming average bus patronage[13]). The emissions from the bus trip at 216gCO_2 are similar to those produced by an average home-delivery diesel–van collection (181gCO_2). In carbon terms, therefore, bus travel should be encouraged for a short returns trips , especially at peak times when emissions per passenger trip / post office return would be less than 216gCO_2, owing to the greater number of people using the service. Many customers will be combining a return with other activities, rather than making a dedicated trip to the post office to send goods back, reducing emissions per return still further.

4. Where the consumer returns the item to a high-street store:

In the case of an online shopper making a separate car trip to return an unwanted item to a high street store, the CO_2 for the returns trip would be 4,455gCO_2 (181gCO_2

[12] 96% of people live within a mile of a post office (Department for Transport, 2007).
[13] Average bus patronage is 9.2 passengers (Defra, 2008).

for the original home delivery plus 4,274gCO_2 for the returns car-based trip), calculated on the basis of the average 12.8-miles car-based round trip for non-food shopping purposes. By bus to the high street, total emissions for the 8.8-miles round trip to return items would be 1,446gCO_2 (181gCO_2 plus 1,265gCO_2). Both returns trips made by private car emit much more CO_2 than other returns methods.

DISCUSSIONS

The emissions shown in Table 6, for the personal travel component of a returns trip, are based on a consumer making a dedicated journey, solely for the purposes of returning an unwanted item to a location. Such an assumption may be considered rather hypothetical, as in reality, shoppers will want to maximise convenience and minimise any expense associated with the returns process, and would usually wish to return goods as part of a trip primarily tended for shopping. Therefore, it can be assumed that shoppers will combine the returns trip with other activities. Figure 2 shows emissions produced by personal travel when the returns trip is assigned 50% of the overall emissions for that trip (it is assumed that the consumer will undertake another activity, be that shopping or an alternative pursuit, in addition to the return of an order).

Mainly because of convenience, many shoppers opt to return goods ordered online to a shop (IMRG, 2009), yet clearly this is the worst option in terms of carbon emissions (Figure 2). If a consumer wishes to return goods bought online to the high street, ideally the returns trip should take place as part of an overall 'trip chain' where the journey also includes several other activities (Edwards, McKinnon & Cullinane, 2010). The marginal CO_2 impact would then be greatly reduced. Similarly, returning items to a large superstore, such as Tesco Extra, produces relatively high emissions, though again consumers could combine the online return with their routine shopping trip. To illustrate potential emissions savings, assuming 6 goods are purchased at the same time that the unwanted item is returned, the 'return' would be allocated just 637g CO_2 of the trip's total CO_2 (at 4,456g), with the newly-purchased items allocated the major share at 3,819g CO_2. This allocation could be refined further by calculating the weight of both the total goods purchased and the returned item and allocating CO_2 emissions based on their respective mass[14].

The proximity of a local post office to consumers' homes in the UK means that the post office appears to be a good alternative for returning unwanted items, though overall, returns by van-based parcel carrier produce the least emissions. What is less clear from Figure 2, however, is that the van-based collection returns the unwanted item directly to the parcel carrier's local depot, while emissions for the postal van trip to the mail sortation centre are excluded from the calculations (Figure 1). In the measurement of carbon emissions, therefore, these two returns options are not directly comparable.

[14] This approach would require extensive primary data collection. Retailer companies may collect such information incidentally, though only on an individual store basis. They are also often reluctant to release these confidential consumer behaviour data. The collective total weight of goods purchased and returned during a entire shopping trip can only be determined by face-to-face interview surveys.

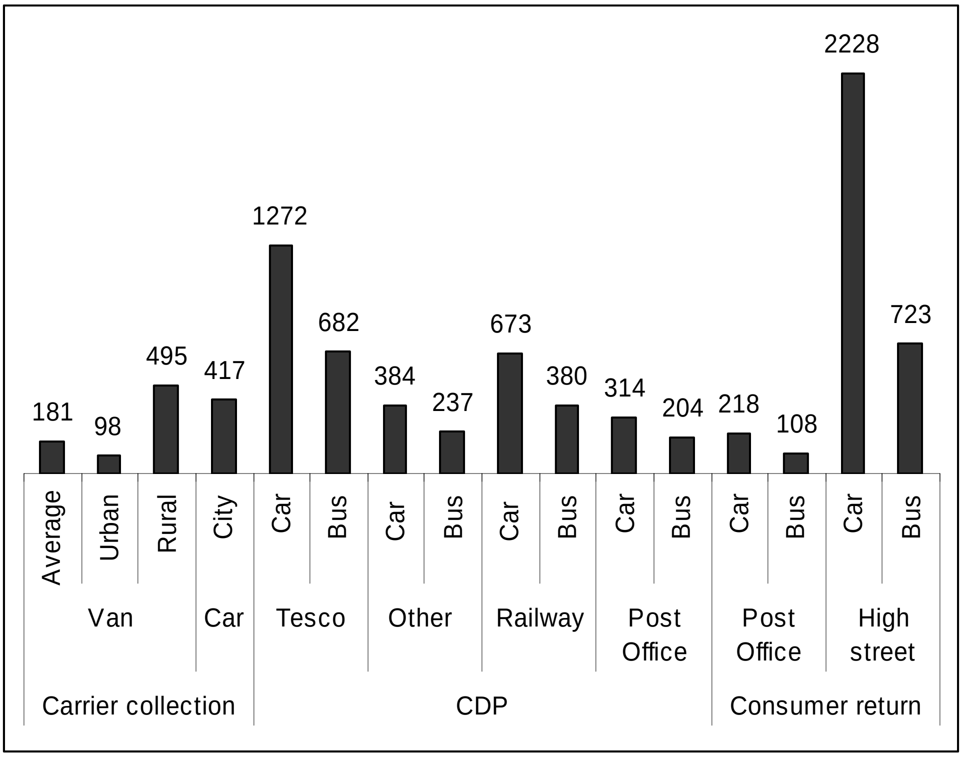


Figure 2 - *Emissions (gCO_2) per returns method*

The use of a post office as a location for a CDP is more favourable. Staff are already on-site and customers are already familiar with its locality. The parcel carrier would also only need to deviate slightly from their outbound delivery round to collect any returns. Limitations, however, may arise from a lack of storage space on the premises (many post offices occupy a relatively small area with limited free space), and employees, already having a variety of duties to perform, may not be able to devote time to the CDP operation. Supermarkets as unattended CDP locations offer convenience for the shopper with their extended opening hours, though space again may be an issue. Security will be more of an issue for CDPs located at railway stations.

It is hoped that by locating CDPs at points where people either shop or use facilities on a regular basis (e.g. railway stations) will minimise emissions from personal travel.

SUMMARY

Overall, the research suggests that personal travel by a shopper returning unwanted items to stores or a courier using private transport to collect returns from a customer's home, generates the greatest emissions when the return is the main purpose of the trip. The fewest emissions result from unwanted items being collected by a parcel carrier as part of an outbound delivery round. In these cases very little additional CO_2 is produced and the unwanted items are sent back to the local depot as part of a backhaul that had to occur anyway.

In an effort to reduce carbon emissions, collection by van-based parcel carrier or the use of local post offices or CDPs for returns by consumers need to be promoted. A customer making a dedicated trip by private transport to the shops to return items needs to be discouraged. In all cases, combining the return of goods with other activities and / or deliveries reduces allocated emissions still further.

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