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Methodology to Calculate the Environmental and Financial Benefits of Recommerce

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Project background

Anthesis has estimated environmental and financial savings associated with eBay consumer to consumer (C2C) sales of used and refurbished products for a number of years. In 2021, the underlying data and assumptions were updated for product groups Electronics and Fashion, and new data were added for product groups Media, Lifestyle, and Vehicle Parts & Accessories. Geographic coverage was extended from the U.S., Canada and the U.K. to France, Italy and Germany for all product groups.

Avoided carbon emissions, avoided waste (landfill and incineration) and financial savings will be the metrics provided for this 2021 update.

This document describes the sources of external data, the calculations carried out, and the assumptions made for the update.

Key concepts

Representative product

A representative product is a single product chosen as typical of a product category. The weight, greenhouse gas (GHG) impact and material composition of the product are applied to the total sales of the category. For some categories where products had very variable materials or weights, a selection of products was combined to give a “compound” representative product.

Environmental impact categories

Carbon (or GHG) footprint and waste are important environmental metrics that are relevant to the majority of products, can be easily communicated and are increasingly becoming requested by customers. These two environmental impact categories were calculated for this assessment.

Impacts of displaced products

Through reuse of pre-owned products, the cradle-to-gate life cycle environmental burdens of a new (now displaced) product are avoided. There is an environmental benefit from the reuse of a product because the extraction of raw materials, production, processing and upstream transport of the equivalent new product are no longer required. Similarly, the displaced product will not go to a waste stream because it was not manufactured (avoided landfill and incineration).

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Use of the displaced product is not avoided because the extended life of pre-owned products generates the same use phase impact as new products would have generated — the electricity use of a secondhand radio will be broadly the same as a new radio.

New product displacement rate

New product displacement rate describes the proportion of reused product purchases that replace or displace the purchase of a new product. This parameter recognizes that some reused products are additional purchases that would not have been bought as new products — for example the purchase of a used laptop would probably displace the purchase of a new laptop, but a used garment might more often be purchased in addition to a new garment.

Additional life

Re-using a secondhand product gives the product extra life, but a reused item is assumed to have a shorter life than a new item — so more than one reused item would be needed to replace the full lifespan of a new item.

Overall displacement rate

Overall displacement rate is a combination of the new product displacement rate and the additional life. These two parameters are multiplied together to give the overall displacement rate.

Value for buyers (financial benefit)

Buying secondhand is (generally) less expensive than buying new. This reduction in price provides a value (financial benefit) to buyers. Prices for used items were evaluated against the prices for new items in all product categories in the original study. This average savings is applied to the used products sold to arrive at the financial benefit for buyers across product categories.

Mapping eBay categories to impacts

eBay provided a list of product categories by the Primary Product Groups and more detailed levels of subcategories for each Product Group. Anthesis mapped the weights and impacts of representative products to each of these product categories at an appropriate level of detail corresponding to the available weight and impact data, also considering the variability of items within the level.

Mapping was done by Anthesis using previous mappings where available and expert judgment for new product categories. If a representative product matched a lower-level category, mapping was done at that level, otherwise the next higher level was used.

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Weights, impacts and waste

Data on weights, carbon dioxide equivalents (CO₂e), or GHG impacts, and waste rates were obtained from several sources.

Electronics

CO₂e impacts for many types of electronic products were taken from Ecoinvent 3.7.1. If necessary, CO₂e impacts per kg were multiplied by the weight of the product to give CO₂e impact per product.

iPhone CO₂e impacts were averages of a wide range taken from the Apple website product sustainability reports.

Weights were taken from a variety of sources including Ecoinvent, online retailers' websites, WRAP reports and Anthesis estimates.

Fashion

Clothing CO₂e impacts were calculated in the Higg Index online tool, covering materials, manufacture, logistics and retail (cradle to gate). Ten clothing types were modeled in the Higg tool, using weights and typical fiber mixes for each type taken from Thomas et al.

An average CO₂e impact per kg for jewelry and watches was calculated using an assumed combination of metals and plastic materials, applying Ecoinvent 3.7.1 emission factors.

Fisher et al. was the source for CO₂e impacts and weights for other fashion items such as the Health & Beauty category (e.g., hair and skin-care products).

Lifestyle

The Lifestyle Product Group is extremely diverse. Representative products were identified for each category. Weights were taken from a variety of sources including Ecoinvent, online retailers' websites and Anthesis estimates. Some CO₂e impacts were available in Ecoinvent for specific products, but most were calculated from Ecoinvent based on the major material or a custom mix of materials for the representative product.

¹ CO₂e is the number of metric tons of CO₂ emissions with the same global warming potential as one metric ton of another greenhouse gas.

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Media

Most components in the Media category are categorized under books and printed paper, optical discs (e.g., DVDs, CDs, LaserDiscs) and a few categories composed of miscellaneous memorabilia items.

CO₂e impacts of printed paper items were based on Ecoinvent 3.7.1 conversion factors and adjusted according to typical weight and size of the items. Academic studies were used to estimate the impact of optical discs and items such as cassettes and vinyl records. The impact of items primarily composed of plastic were estimated using Ecoinvent 3.7.1 factors. For categories composed of miscellaneous memorabilia items, representative items were identified and used to create custom emission factors.

Weights were taken from a variety of sources including specialist websites, online retailers' websites or Anthesis estimates.

Parts & Accessories

The Parts & Accessories category was made up mainly of vehicle parts, tools, lubricants and electronics.

CO₂e impacts of vehicle parts were estimated by categorizing the main items sold and their composition. Emission factors for the materials composing the main items were taken from Ecoinvent 3.7.1 and were weighted according to their level of representation in the sample.

Items such as clothing and books used emission factors developed for the Fashion and Media sections.

Weights were taken from a variety of sources including specialist websites, online retailers' websites or Anthesis estimates.

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Assumptions

For purposes of this study, it is assumed that the sold product remains in the country where it is sold, so the local rates for displacement and disposal are applied. Canada rates of waste and displacement are assumed to be the same as U.S. rates.

Representative products

The mapping method assumes that the weights and impacts of representative products can be applied to all products that were not otherwise specified in a category. This recognizes the limits of available data and is an approach used by Anthesis in many studies where it is currently not possible to obtain information about the products in question.

Displacement rate

The fashion new product displacement rate was assumed to be 51% to 57% for different categories in the U.S. and 38% to 58% in the U.K., for commercial secondhand sales (distinguished from charity sales). These figures were taken from the Farfetch report and determined through customer surveys asking if “buying this secondhand/vintage purchase prevented the purchase of a new item” where “yes” counts as a full displacement and “don’t know” counts as a half displacement. (Farfetch, 2020)

The new product displacement rate for electronics was assumed to be 56% (WRAP, 2012) and is the same as used in the previous Anthesis study (for electronics purchased online). These figures were determined through customer surveys asking if “buying this used purchase prevented the purchase of a new item,” where “yes” counts as a full displacement and “don’t know” counts as a half displacement.

The new product displacement rate was assumed to be 16% for Books, CDs and DVDs (Anthesis study, 2018).

For mixed categories (Lifestyle, Parts & Accessories) the new product displacement rate was assumed to be 50%, broadly in line with Fashion and Electronics.

For Collectibles and Antiques the new product displacement rate was assumed to be zero.

European displacement rates are assumed to be the same as U.K. rates. Canada displacement rates are assumed to be the same as U.S. rates.

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Additional life

Clothing is assumed to have 50% extra lifetime as a secondhand product (WRAP 2017). This is a reduction from the previous Anthesis study value of 70%.

Secondhand electronics are assumed to have 70% of the lifespan of a new item. This assumption is carried over from the first Anthesis study for eBay (“Big picture numbers on the apparel sector and the circular economy”). One recent publication (André et al, 2019) was found to support this figure.

For Media, Lifestyle and Parts & Accessories the additional life was assumed to be 50%, broadly in line with fashion. This figure was selected as a conservative estimate in the absence of more specific studies.

Overall displacement rate

Overall displacement rate is new product displacement rate multiplied by additional life. European displacement rates are assumed to be the same as U.K. rates, in the absence of country-specific data. Canada displacement rates are assumed to be the same as U.S. rates.

Several categories have an overall displacement rate of 0%, including Antiques, Services and Personalized Items. Most of the Media category has a displacement rate of close to 10%, while Fashion and Electronics ranged from approximately 20% to 40%.

Avoided landfill and incineration

U.S., U.K. and EU government sources were used to find typical rates for various waste streams for textiles, electronics, various materials and general waste. Rates for landfill and incineration (energy from waste) were applied to each product category to estimate the weight of waste in each stream avoided by the displacement of new products. For some categories a proportion would also go to recycling.

The range of calculated waste rates for landfill and incineration for the categories analyzed is shown below for the six countries in this study. The balance to 100% is the calculated recycling rate, if any. Canada waste rates are assumed to be the same as U.S. rates.

Country	% Landfill Range	% Incineration Range
U.S.	25-81	6-20
U.K.	4-16	20-85
CAN	25-81	6-20
DE	1-37	5-63
FR	11-58	1-42
IT	4-34	1-66

References:

European electronic recycling rates: Eurostat 2021 (2)
 European textile recycling rates: European Parliament 2021
 U.S. waste stream statistics: EPA 2020
 European material recycling, landfill, incineration rates: Eurostat 2021 (1)
 U.K. waste stream statistics: Defra 2020 (4)

Value for buyers (financial benefit)

Buying secondhand is (generally) less expensive than buying new. This reduction in price provides a value (financial benefit) to buyers. Prices for used items were evaluated versus the prices for new items in all product categories. This average savings is applied to the used products sold to arrive at the financial benefit for buyers across all product categories.

Calculations

The following outputs were calculated for each mapped product category.

Overall Displacement Rate (for category and country)

$$\text{\% additional life} \times \text{\% new product displacement rate (for category and country)} = \text{\% overall displacement rate (for category and country)}$$

Avoided GHG emissions (kg CO2e per item)

$$\text{kg CO2e per kg} \times \text{assumed weight per item (kg)} = \text{kg CO2e per item}$$

$$\text{kg CO2e per item} \times \text{\% overall displacement rate} = \text{kg CO2e displaced per item}$$

Avoided Landfill (kg) (for category and country)

$$\text{\% to landfill (for category and country)} \times \text{\% overall displacement rate} = \text{\% displaced from landfill}$$

$$\text{\% displaced from landfill} \times \text{assumed weight per item (kg)} = \text{avoided landfill (kg)}$$

Avoided Incineration (kg) (for category and country)

$$\text{\% to incineration (for category and country)} \times \text{\% overall displacement rate} = \text{\% displaced from incineration}$$

$$\text{\% displaced from incineration} \times \text{assumed weight per item (kg)} = \text{avoided incineration (kg)}$$

Exclusions

1. eBay operations — environmental data is disclosed in eBay's annual [Impact Report](#).
2. Packaging and transport of secondhand items — believed to be comparable to packaging and transport of the displaced new item and therefore not included.

Results

eBay uses an internal platform to calculate the avoided carbon emissions, avoided waste and financial benefits of the sale of used and refurbished products on an annual basis. The internal platform employs all assumptions, burden data, and calculation methods as described in this document. Summarized results are published in eBay's annual Impact Report.

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