Marketreach, Royal Mail

COMMERCIAL LETTER PRODUCTS LIFE CYCLE ASSESSMENT

Technical Report

SEPTEMBER 2022

CONFIDENTIAL

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EXECUTIVE SUMMARY

Marketreach, the marketing authority on commercial mail within the Royal Mail group, commissioned WSP to conduct a product carbon Life Cycle Assessment (LCA) of 10 commercial letter product types. A cradle to grave product life cycle was completed, in line with ISO 14067 and included the following product life cycle stages:

- Raw materials
- Creative time
- Printing process
- Ink
- Delivery
- End of life

A summary of the results is shown below. For the purposes of the summary, where multiple products have been assessed an average value has been taken.

Product	Total (gCO_2e per product)
Postcard	**43.61**
Occasion Card	**51.68**
DL outer and letter	**55.55**
C5 letter: Average	**63.99**
Leaflet: Average	**72.06**
A4 Letter	**86.34**
C5 catalogue: Average	**162.59**
A4 Letter (transactional pack)	**184.36**
Magazine: Average	**327.65**
A4 or C5 large catalogue	**445.29**

The results showed that the size and weight of the product has a direct correlation with the associated carbon emissions. The delivery and printing stages were found to be significant for the 'smaller' products (e.g. postcard, occasion card) whereas raw materials and ink are more significant for the 'larger' products (e.g. magazine, catalogue).

The assessment is considered robust and detailed. The analysis outcomes provided key recommendations on the opportunities to improve data granularity and therefore results on the nuances of different products. In addition, the results show carbon hotspots exist in material and ink use as well as delivery, so these phases offer the maximum opportunity for carbon reduction.

These results will be used to inform Royal Mail, Marketreach and their supply chain's emissions reductions activities and be used to communicate the impact of commercial letters to Royal Mail's customers.

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GLOSSARY OF TERMS AND ABBREVIATIONS

DEFINITIONS

This Technical Report uses the following key terminology:

Carbon: generic term used traditionally in carbon footprinting terminology to describe the combination of Kyoto Protocol greenhouse gas emissions reported as carbon dioxide equivalent (CO_2e).

Carbon dioxide: both a naturally occurring gas and one of the most abundant greenhouse gases in the atmosphere, and a by-product of industrial processes, combustion of fossil fuels and land use changes.

Carbon footprint (also GHG emissions' footprint): the total set of greenhouse gas emissions caused by an organisation (event or product) over a defined timeframe. Results of a carbon footprint are typically reported as carbon dioxide equivalent (CO_2e), referred to as 'carbon'.

Carbon hotspot: Carbon hotspots represent the highest carbon emitting source(s) of the carbons and show where quick wins in carbon reductions are possible.

Climate change: a pattern of change affecting global or regional climate, measured by criteria such as average temperature and rainfall, and/or changes in the frequency and intensity of extreme weather conditions and events. This variation is caused by both natural processes (e.g. volcanic activity) and human activity. Global warming is one aspect of climate change.

Embodied carbon: includes the energy (and therefore carbon emissions) required to extract the raw materials, process them, assemble them into usable products (i.e. paper).

Greenhouse gas emissions: defined by the IPCC[1] as 'those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit [infrared] radiation'.

Kyoto Protocol: an international agreement that extended the 1992 United Nations Framework Convention on Climate Change (UNFCCC) to require industrialised country signatories to meet GHG emission reduction targets relative to their 1990 levels. Effective from 2005.

Product life cycle: is the process of managing the entire life cycle of a product from its inception through the engineering, design and manufacture, as well as the service and disposal.

Scope 1: all direct greenhouse gas emissions such as petrol and diesel used in plant, equipment and machinery, for industrial processes, transport and combustion for electricity generation (e.g. generators).

Scope 2: indirect greenhouse gas emissions from consumption of purchased electricity, heat or steam.

Scope 3: other indirect greenhouse gas emissions neither owned nor or directly controlled by the reporting company and that occur in its value chain.

[1] https://www.ipcc.ch/sr15/chapter/glossary/

ABBREVIATIONS

This document uses the following abbreviations and acronyms.

CO_2e	Carbon dioxide equivalent
DL	Dimension lengthways
EoL	End of Life
g	gram
GHG	Greenhouse Gas
GWP	Global Warming Potential
ISO	International Organization for Standardization
kg	kilogram
kWh	Kilowatt hour
LCA	Life Cycle Assessment
MS (Excel)	Microsoft
UK	United Kingdom

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INTRODUCTION

1 INTRODUCTION

WSP were commissioned by Marketreach, the marketing authority on commercial mail within the Royal Mail group, to provide data insights into the carbon impact of commercial letters in the UK. This information will be used to communicate the impact of commercial letters to customers and other stakeholders, to help drive carbon emission reductions. This is in line with Royal Mail's ambition to be net zero by 2040[2].

A commercial letter is a mailing from a company or organisation to a consumer or business, marketing a product/service or a bill, invoice, notification or statement. The majority of these letters are estimated to be graphically designed, printed in bulk and in colour and distributed through Royal Mail's distribution network, or via a third-party mail provider where Royal Mail provides the final mile delivery.

A Life Cycle Assessment was deemed the most robust approach for Marketreach to be able to determine the carbon impact of commercial mail.

1.1 LIFE CYCLE ASSESSMENT

A Life Cycle Assessment (LCA) is a holistic technique for assessing the environmental impacts associated with a product, system or asset over its life cycle. This assessment has been conducted for a product, in this case commercial letters. The life cycle stages of a product can broadly be considered as the raw material extraction, material manufacture, product manufacture, use and end-of-life treatment. This is also known as a 'cradle to grave' LCA.

The environmental impacts that can be considered in an LCA are outlined in the information box below:

Information box: **LCA Environmental Impacts**

- Global Warming Potential (GWP)
- Ozone Depletion Potential
- Acidification Potential for Soil and Water
- Eutrophication Potential
- Photochemical Ozone Creation
- Abiotic Depletion Potential – Elements
- Abiotic Depletion Potential – Fossil Fuels
- Net use of fresh water
- Hazardous waste disposed
- Non-hazardous waste disposed

[2] https://www.royalmail.com/sustainability/environment/net-zero

Information box: **LCA Environmental Impacts**

- Radioactive waste disposed (high-level nuclear waste)

To standardise the LCA processes and methodologies there are a series of principles, requirements and guidelines for the quantification and reporting of product carbon footprints. This study adheres to the International Standard ISO 14067: *Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification*.

In relation to ISO 14067 this technical report and LCA was prepared in line with the four phases:

- **Goal and Scope:** defines the project goals and scope to include functional unit, boundaries and life cycle stages assessed. See section 2.
- **Life cycle Inventory Analysis:** considered the sources of data, how data was collected, methodology for assessment and assumptions and limitations. This is the stage where the calculations are completed. See section 3.
- **Impact Assessment:** an assessment of the result of the calculations to understand the product carbon footprint. See section 4.
- **Interpretation:** an evaluation of the results to consider the carbon hotspots and how data and assumptions/limitations may affect the results. See section 5

The phases are designed to be iterative and allow for refinement and increased robustness of the assessment. Figure 1-1 outlines the relationship between the four phases of ISO 14067.

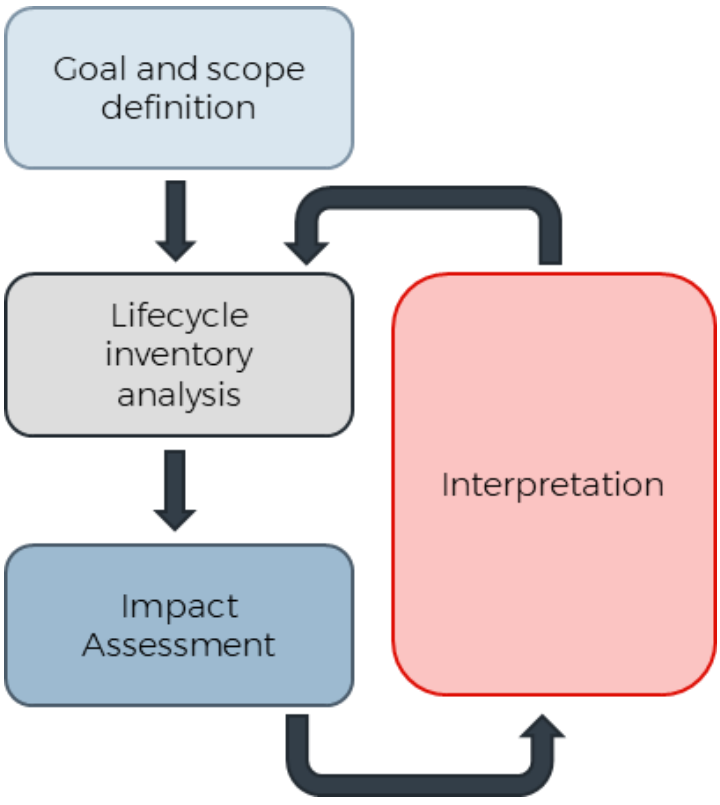


Figure 1-1 – ISO 14067 LCA phases

1.2 GREENHOUSE GASES REPORTING

The scientific consensus reports that the major increase in the atmospheric concentration of Greenhouse Gases (GHGs) from anthropogenic sources, predominantly the combustion of fossil fuels, is contributing to climate change.

Information box: **Greenhouse Gases**

There are many types of greenhouse gases. Six GHGs are controlled by the Kyoto Protocol (into force 2005). The three key GHGs are:

- Carbon dioxide (CO_2)
- Nitrous oxide (N_20)
- Methane (CH_4).

The three synthetic (i.e. industrial) GHGs, most often used in refrigeration and cooling activities are:

- Perfluorocarbons (PFC)
- Hydrofluorocarbons (HFC)
- Sulphur hexafluoride (SF_6).

To consider a product's contribution to climate change through the release of GHG emissions, a **product carbon footprint** is undertaken. A product carbon footprint is an LCA that specifically focuses only on the Global Warming Potential (GWP) LCA environmental impact. This is also known as 'carbon dioxide equivalents' and is the internationally recognised measure of GHG emissions and abbreviated to CO_2e. The term 'carbon emissions' is often used to refer to CO_2e emissions. The ISO 14067 standard was therefore followed due to the focus on product carbon emissions.

Information box: **Global Warming Potential**

Each of GHG has a different capacity to heat the atmosphere, which is referred to as their Global Warming Potential (GWP). GWP was developed by the IPCC to allow comparisons of the global warming impacts of different GHGs. It is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time (the time period usually used for GWP's is 100 years), relative to the emissions of 1 tonne of carbon dioxide (CO_2). Therefore, CO_2 is assigned a GWP of 1.0. The Other GWPs are:

- CH_4 GWP = 21–36 (depending on reference source)
- N_2O GWP = 271-298
- PFC GWP = 6,000-9,000
- HFC GWP = 1,000-10,000
- SF_6 GWP = 23,900.

2

GOAL AND SCOPE

2 GOAL AND SCOPE

This section outlines the objective and boundary of the LCA, established at the start of the project, to ensure transparency on the context of the LCA results.

2.1 GOAL OF THE STUDY

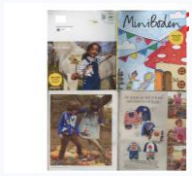
The objective of the study is to understand the carbon emissions across the life cycle for several commercial letter formats (mailing delivered by Royal Mail in the UK). The results of the study will be used to externally communicate the impact of commercial letters to Royal Mail's customers and key stakeholders and to help drive emission reduction activities within Royal Mail, Marketreach and their supply chain.

COMMERCIAL LETTER PRODUCTS

The commercial letter formats assessed in this study are outlined in Table 2-1 below.

Table 2-1 – Commercial letter formats assessed in LCA

Commercial Letter Format	**Example**	**Description** – provided by Royal Mail	**Average weight per product (g)**
Postcard		2-side colour	6
Occasion card		Standard sized card with envelope, full colour	9
DL outer and letter		DL outer with 2-side black and white + colour + 4 side letter black and white + colour	10
C5 letter		2-side black and white + colour plus envelope + 4 side letter black and white + colour	15
Leaflet		2-side colour & 4 side colour & envelope versions with 2 slide colour	21

Commercial Letter Format	Example	**Description** – provided by Royal Mail	Average weight per product (g)
A4 letter		4 side letter black and white + colour + envelope	25
C5 catalogue		12, 16, 24 or 32 page colour no envelope	26
A4 Letter (transactional pack)		4 side letter black and white + colour + 12 side booklet black and white + colour + envelope	74
Magazine		28-page or 64 page with plastic sleeve	134
A4 or C5 large catalogue		64-page colour with paper envelope wrapping	195

2.2 SCOPE OF THE STUDY

With reference to section 1.1, this LCA is a product life cycle carbon impact assessment, only focussing on the GWP (hereafter referred to as 'carbon') impacts of the products life cycle stages.

PRODUCT LIFE CYCLE

Following a discussion with Royal Mail and key supply chain stakeholders to understand the processes involved in the life cycle of the commercial letter formats (outlined in Table 2-1), the scope of the LCA and the life cycle stages shown in Figure 2-1 have been assessed in this LCA.

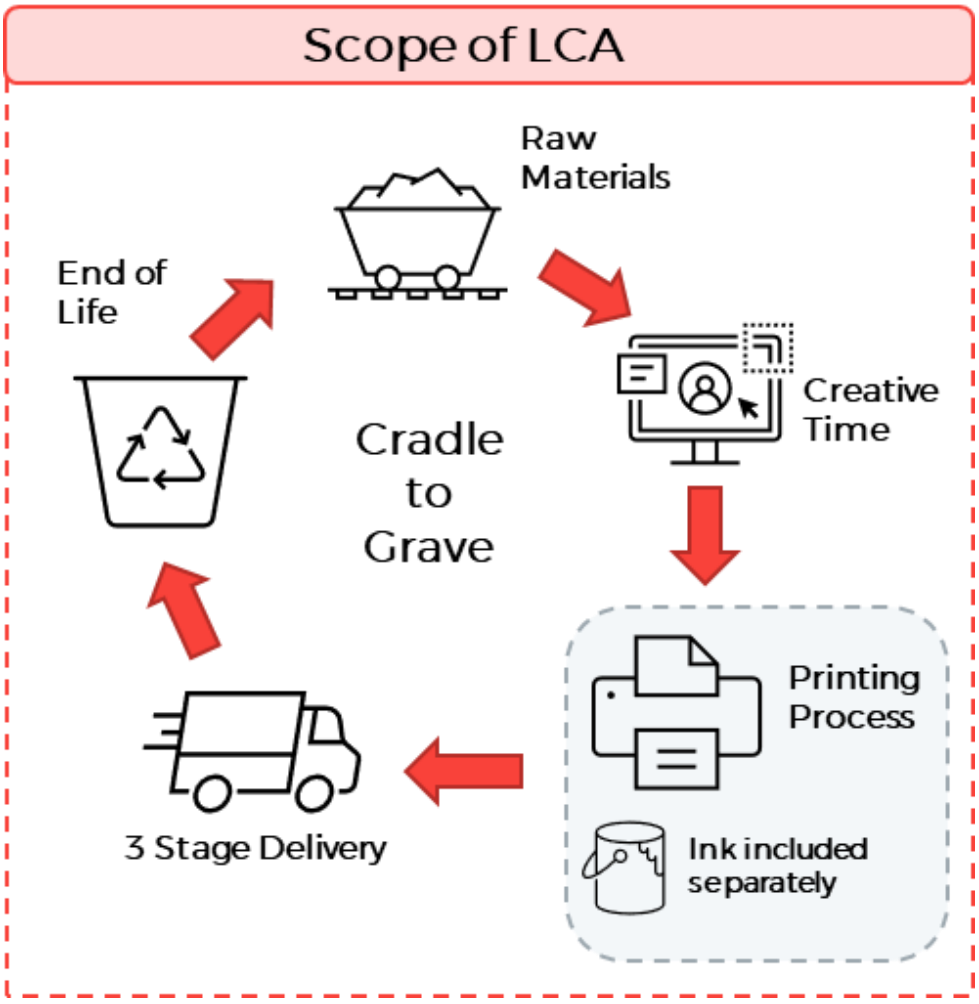


Figure 2-1 – Scope of the LCA

Table 2-2 below outlines the elements included in the assessment for each life cycle stage.

Table 2-2 – Life cycle stages assessed in the LCA

Life cycle Stage		Elements included
	**Materials** *(Embodied carbon defined as: raw material extraction, transport, manufacturing)*	Paper, envelope/wrap
	**Creative Time**	Time used for design and copywriting on a computer
	**Printing Process**	Use of printing machines
	**Ink**	Embodied impact of ink used during the printing process
	**Delivery**	A three-stage delivery which includes: ▪ Delivery to Royal Mail distribution centres ▪ Processing and automation at Royal Mail site ▪ Delivery to the final user
	**End of Life (EoL)**	Disposal (both landfill and recycled) of paper and envelopes (excludes poly wrap)

2.3 FUNCTIONAL UNIT

A functional unit relates to the function of a product and serves as the reference basis for all calculations in the LCA. The functional unit of this assessment is 'grams of CO_2e per product'.

2.4 SYSTEM BOUNDARY

This LCA is a 'cradle to grave' assessment. This was considered the most robust approach for the goal of the study and the scope of the study reflects the life cycle stages that have the potential to make a significant contribution to the carbon impact of the products. They also represent elements in which Royal Mail can have either direct control over or influence over decisions to reduce emissions.

OUT OF SCOPE

The following elements were omitted from the scope of the study for the reasons given below:

- Transport to end of life processing – considered to be minimal and reliable data on the destination of waste for disposal is not known.
- Use of stamps – this is considered out of the boundary of the assessment which focused on products.
- Postal sorting of mail for distribution – This is not a relevant activity for commercial mailing as the focus was on bulk mail products only.
- Printing on envelopes – The data provided included envelopes with windows.

3

INVENTORY ANALYSIS

3 INVENTORY ANALYSIS

This section outlines how the LCA was completed from the inputs to the calculation methodology and any assumptions/ limitations made.

3.1 DATA COLLECTION

SUPPLY CHAIN ENGAGEMENT

Throughout the course of this study, WSP, Marketreach and Royal Mail consulted a variety of supply chain organisations to provide details on their processes to be able to scope the study and include primary data in the LCA.
These organisations include:

- **Strategic Mailing Partnership**[3] - a professional body that represents and protects the interests of printers and mailing houses in the UK.
- **Paragon Customer Communications**[4] - communications specialists
- **Encore Envelopes**[5] – largest independently owned UK manufacturer of printed envelopes
- **Linney**[6] - a creative marketing agency with specialisms in print management, fulfilment and design
- **Pepper Communications**[7] - providing end-to-end print solutions for direct mail

DATA SOURCES

There are two distinct datasets required to complete a LCA: activity data (e.g. quantity of materials or kWh) and environmental impact factor data, also known as emissions factors (e.g. carbon emissions factors per unit quantity for different materials or per kWh).

The data sources varied across the different life cycle stages. Primary activity data was taken directly from the Royal Mail and partners where possible. A summary of how activity data was derived for each life cycle stage is provided in Table 3-1.

[3] https://thestrategicmailingpartnership.co.uk/
[4] https://www.paragon-cc.com/
[5] https://theencoregroup.co.uk/encore-envelopes/
[6] https://www.linney.com/
[7] https://www.pepper.co.uk/

Table 3-1 – Data sources for life cycle stages

Life cycle Stage		Data Type	Source
	**Materials** *(Embodied carbon defined as: raw material extraction, transport, manufacturing)*	Primary (material sizes/ quantities/specifications) For example, types of paper e.g. 'white woodfree coated or uncoated'	Royal Mail, Strategic Mail Partnership, Paragon Customer Communications and Encore Envelopes
	**Creative Time**	Primary (computer time used for design and copywriting)	Paragon Customer Communications and Linney
	**Printing Process**	Primary (gCO_2e per pack figure for all activities on the site of the printing supplier)	Paragon Customer Communications
	**Ink**	Secondary ($kgCO_2e$ per kg ink figure; estimated kg of ink per product)	Sourced from scientific literature from the British Printing Industries Federation Limited. Data from Paragon Customer Communications and Pepper Communications.
	**Delivery**	Primary (gCO_2e per item figure)	Royal Mail
	**End of Life (EoL)**	Envelope: Primary (gCO_2e per item figure) Paper: Secondary (assumptions on national recycling/landfill rates)	Encore Envelopes UK Government (Department for Environment and Rural Affairs)

EMISSION FACTORS

A summary of how the emissions factor data sourced for each life cycle stage is provided in Table 3-2; further details are provided in Appendix A.

Table 3-2 – Emission factor sources for each life cycle stage

Life cycle Stage		Emissions Factor source
	**Materials** *(Embodied carbon defined as: raw material extraction, transport, manufacturing)*	**Paper and polywrap:** Ecoinvent 3.6[8] (SimaPro 9.1.1.1) **Envelopes:** Encore Envelopes
	**Creative Time**	Ecoinvent 3.6[2] (SimaPro 9.1.1.1)
	**Printing Process**	Paragon Customer Communications
	**Ink**	Sourced from scientific literature from the British Printing Industries Federation Limited.
	**Delivery**	Royal Mail *(using UK Government: Department for Business, Energy and Industrial Strategy – Conversion Factors for company reporting 2021 and Royal Mail FY 2021/22 data)*
	**End of Life (EoL)**	**Paper:** UK Government: Department for Business, Energy and Industrial Strategy – Conversion Factors for company reporting 2021. **Envelopes**: Encore Envelopes

DATA QUALITY

Most of the raw input data included material quantities and life cycle stage emissions (gCO_2e per product) for various life cycle stages, was primary data provided by Royal Mail and industry partners. Any assumptions made were checked with Royal Mail for robustness and applicability to reflect real world considerations.

Although there is scope for greater granularity of data within the industry, it is considered that the underlying data is of high quality because the data is mostly primary data. This means that the results can be considered representative and robust.

[8] Ecoinvent 3.6 released in September 2019, see Appendix B for further information

3.2 METHODOLOGY

CARBON CALCULATION APPROACH

A hybrid approach to calculate the carbon emissions for the commercial letter products was carried out by using outputs from SimaPro LCA software and an MS Excel model created by WSP.

Information box: **SimaPro**
SimaPro software is a science-based LCA tool that can be used to quantify and analyse the sustainability performance data of products and services. The largest database in SimaPro is EcoInvent, which is the world's leading LCA database. This has some 15,000 datasets. SimaPro contains the world's most complete implementation of EcoInvent.

SimaPro was used because it offers the databases required to calculate the carbon emissions for a few stages of the life cycle and is considered more robust for LCAs than other available carbon factor databases. It allows for detailed analysis of what goes into the products and includes emissions right from raw material extraction, through to manufacturing, and the transport in between. Not all the data was incorporated into, and assessed using SimaPro as both the Royal Mail and industry partners had carbon intensity data for some of the life cycle stages. For consistency with other assessments that Royal Mail and its suppliers carry out, these figures were used. The carbon emissions results from the SimaPro software were extracted and incorporated in the WSP MS Excel model as hardcoded values to combine with the Royal Mail and supplier carbon values. These results can be seen in Appendix B. Table 3-3 below outlines the methodologies used for each life cycle stage.

Table 3-3 – Methodology for calculation of carbon emissions for each life cycle stage

Life cycle Stage		Methodology for calculation of carbon emissions
	**Materials** *(Embodied carbon defined as: raw material extraction, transport, manufacturing)*	SimaPro using Ecoinvent emissions factors. Encore Envelopes provided carbon data across the envelope life cycle.
	**Creative Time**	SimaPro using Ecoinvent emissions factors.
	**Printing Process**	WSP MS Excel model using Paragon Customer Communications supplied emissions factor
	**Ink**	WSP MS Excel model using emissions factor sourced from scientific literature from the British Printing Industries Federation Limited.

Life cycle Stage		Methodology for calculation of carbon emissions
	Delivery	WSP MS Excel model using emissions factor sourced from Royal Mail
	End of Life (EoL)	WSP MS Excel model using UK Government (BEIS 2021) emissions factors. Encore Envelopes provided carbon data across the envelope life cycle.

The following calculation (Figure 3-1) is a basis for calculating carbon emissions at each life cycle stage:

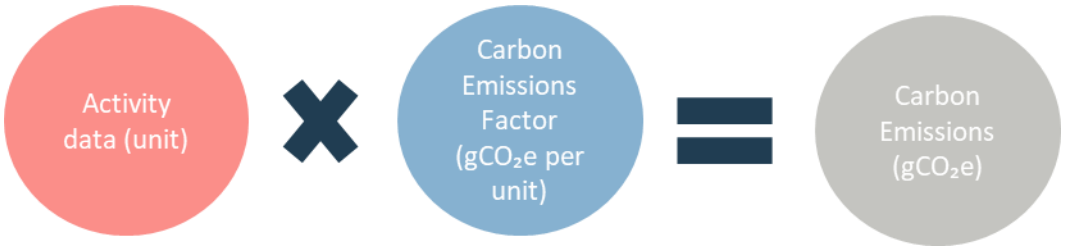


Figure 3-1 – Example calculation

PRODUCT CALCULATIONS

All the commercial letter products outlined in Table 2-1 were individually assessed as part of the LCA. To be able to provide a summary per product type, as per the functional unit (Section 2.3), the results of the individual products for each life cycle stage were averaged.

3.3 ASSUMPTIONS/ LIMITATIONS

The following assumptions have been made for this LCA.

Raw materials

- Virgin paper material has been modelled for the purposes of this assessment. Various discussions with Paragon Customer Communications were held on the material types to model.
- Feedback from Paragon on recycled contents: '*Generally recycled stock does not run well on high-speed printing equipment. Each time paper is recycled the fibre becomes shorter and weaker which results in increased web / paper breaks, increased paper dust resulting in decreased running speeds, increased maintenance & increased machine breaks. Paper can only be recycled a finite number of times (6 or 7) so virgin fibre is always required.'*
- Bleaching of paper is included in the SimaPro modelling, which is in line with comments from Paragon Customer Communications. FSC mix could not be specified in the assessment.
- The emissions factor used relates to 80% of paper from integrated mill and 20% from non-integrated mill.
- Location of the source of paper material assumed to be Europe, which can be specified in SimaPro.
- Emissions relating to envelopes were provided by Encore Envelopes, shown in Appendix A.

Creative Time

- Design and copywriting time information provided by Linney was assumed on a base print run of 500 or 1000 items as per the Figure 3-2 below.

Product Types	Product details	Base level printing volume (no. of items)
Postcard	2-side colour	1000
Occasion Card	Standard sized card with envelope, full colour	1000
Leaflet	2-side colour & envelope versions with 2 side colour	1000
	4 side colour & envelope versions with 2 side colour	500
A4 or C5 large catalogue	64-page colour with paper envelope wrapping	500
Magazine	28-page or 64 page with plastic sleeve	500
C5 Letter	2-side black and white + colour plus envelope	1000
	4 side letter black and white + colour	500
A4 Letter (transactional pack)	2-side black and white plus envelope + colour	1000
	4 side letter black and white + colour	1000
	12pp A4 booklet	500
A4 Letter	2-side black and white plus envelope + colour	1000
DL Outer	DL outer with 2-side black and white + colour + 4 side letter black and white + colour	1000
C5 catalogue	12, 16, 24 or 32 page colour no envelope	500

Figure 3-2 – Design and copywriting information provided by Linney

Printing Process

- A figure of 9.11 gCO_2e per pack was provided by Paragon Customer Communications. This figure was used for the printing process emissions for all formats.
- According to Paragon, this figure provides an average that encompasses all Scope 1 and 2 and relevant Scope 3 activities (waste, staff travel, water and wastewater and transmission and distribution) on production and facilities sites. It assumes that within that pack a variety of processes will have happened, which include data processing, laser printing / personalisation, litho printing, finishing, enclosing, goods receipt & warehousing, preparation for collection.
- The printing processes exclude the volumes of ink used and is only the operational emissions associated with the printers.
- It is acknowledged that this footprint will vary depending on the type of printing, for example long run marketing print used very large presses that use larger amounts of energy than digital printing.
- This figure reflects Paragon specific calculations but small fluctuations may exist between different printers
- Carbon footprint data at machine level was unavailable so the emissions per pack provided the best available estimate

Ink

- A variety of ink types were provided by British Printing Industries Federation Limited which had a range of emissions factors ($kgCO_2e$ per kg of ink) from 3.3 $kgCO_2e$ to 6.1 $kgCO_2e$. An average emission factor of 5.3 $kgCO_2e$ per kg of ink was used for the purposes of this study. This was to try to account for the range of ink types as the type of ink used for the products was unknown. Further information is provided in Appendix A.
- These emissions factors were sourced from scientific literature.
- To model the quantity of ink on the paper, an assumption of 12 grams of ink per m^2 was used at a 25% coverage for smaller items (letters, leaflets, cards etc.) and 50% coverage for larger items (catalogue, magazines).
- These assumptions were made following discussions with Royal Mail and partners on the representativeness of this approach, which was considered appropriate by WSP for this assessment

Delivery

- Results in this assessment have been modelled on letter delivery emissions (gCO_2e per item), based on Royal Mail carbon footprint for the year 2021/2022.
- Emissions data per format type is not currently recorded, therefore the delivery emissions figure is the same for formats. This is the best estimate currently available based on Royal Mail specific data
- This approach doesn't account for the product specific transport emissions, e.g. the emissions for transporting a lighter weighing item should be less per tonne.km than delivering a heaver weighing item.

- The formats within the LCA range in weight from 6g to 193g, both of which are in the lightest product ranges Royal Mail service. On a typical delivery route a handful of 6g formats and a handful of 193g formats is a small differential weight wise, and compared to the full tare of a van, relatively insignificant. On this basis, fluctuations on the delivery carbon footprint dependant on format weight are likely to be negligible, so are not calculated to this level of granularity at this time. For this reason, we have applied the average emissions per letter to each of the format options. This figure is assured and published annually in customer reports ensuring a consistent and materially truthful footprint. Had the format weight range been in excess of 1kg, variable carbon footprints would have been more representative.
- A sensitivity test has been undertaken to assess the impact of a first vs. second-class delivery based on indicative data provided by Royal Mail, see section 5.2 for further information.

End of Life

- End of life emissions factors for envelopes (gCO_2e per product) were provided by Encore Envelopes, as shown in Appendix A.
- For the paper elements, end of life emissions were calculated using the assumption; 70.6% of the volume of packaging paper is recycled, with the remainder (29.4%) assumed to be sent to landfill as worst-case scenario.
- The recycling assumption was sourced from the UK Government on waste statistics for packaging in 2021[9].
- The product weight (g) was then apportioned by these waste stream percentages and multiplied by the UK government emissions factors to provide the emissions result.

[9] UK_Statistics_on_Waste_dataset_May_2022_accessible.xlsx (live.com)

4

IMPACT ASSESSMENT

4 IMPACT ASSESSMENT

This section summarises the results of the LCA.

4.1 RESULTS SUMMARY

A summary of the carbon emission results of the LCA per life cycle stage are provided in Table 4-1 below. The results are reported in gCO_2e per product. For the purposes of the summary, where multiple products have been assessed an average value has been taken. Further breakdown of carbon emissions for these products is in section 4.2.

Table 4-1 – Results summary

Product	Materials	Design	Printing	Ink	Delivery	End of Life	Total
Results are in gCO_2e per product							
Postcard	5.98	0.75	9.11	1.00	24.77	2.00	**43.61**
Occasion Card	13.03	0.94	9.11	0.50	24.77	3.33	**51.68**
DL outer and letter	15.24	0.68	9.11	2.01	24.77	3.75	**55.55**
C5 letter: Average	22.31	0.83	9.11	2.00	24.77	4.98	**63.99**
Leaflet: Average	28.44	1.85	9.11	2.26	24.77	5.64	**72.06**
A4 Letter	35.58	0.60	9.11	8.03	24.77	8.25	**86.34**
C5 catalogue: Average	29.00	9.20	9.11	82.28	24.77	8.22	**162.59**
A4 Letter (transactional pack)	82.35	4.11	9.11	40.14	24.77	23.88	**184.36**
Magazine: Average	133.60	26.37	9.11	92.32	24.77	41.48	**327.65**
A4 or C5 large catalogue	190.79	29.82	9.11	128.44	24.77	62.36	**445.29**

The table providing further granularity of the results is in Appendix B. For the smaller products (weighing <30g), the printing and delivery has a significant impact on the total carbon emissions. For the larger products (weighing >60g) the quantity of paper and ink used in the product has a much higher impact than the printing or delivery. Figure 4-1 below outlines this in further detail.

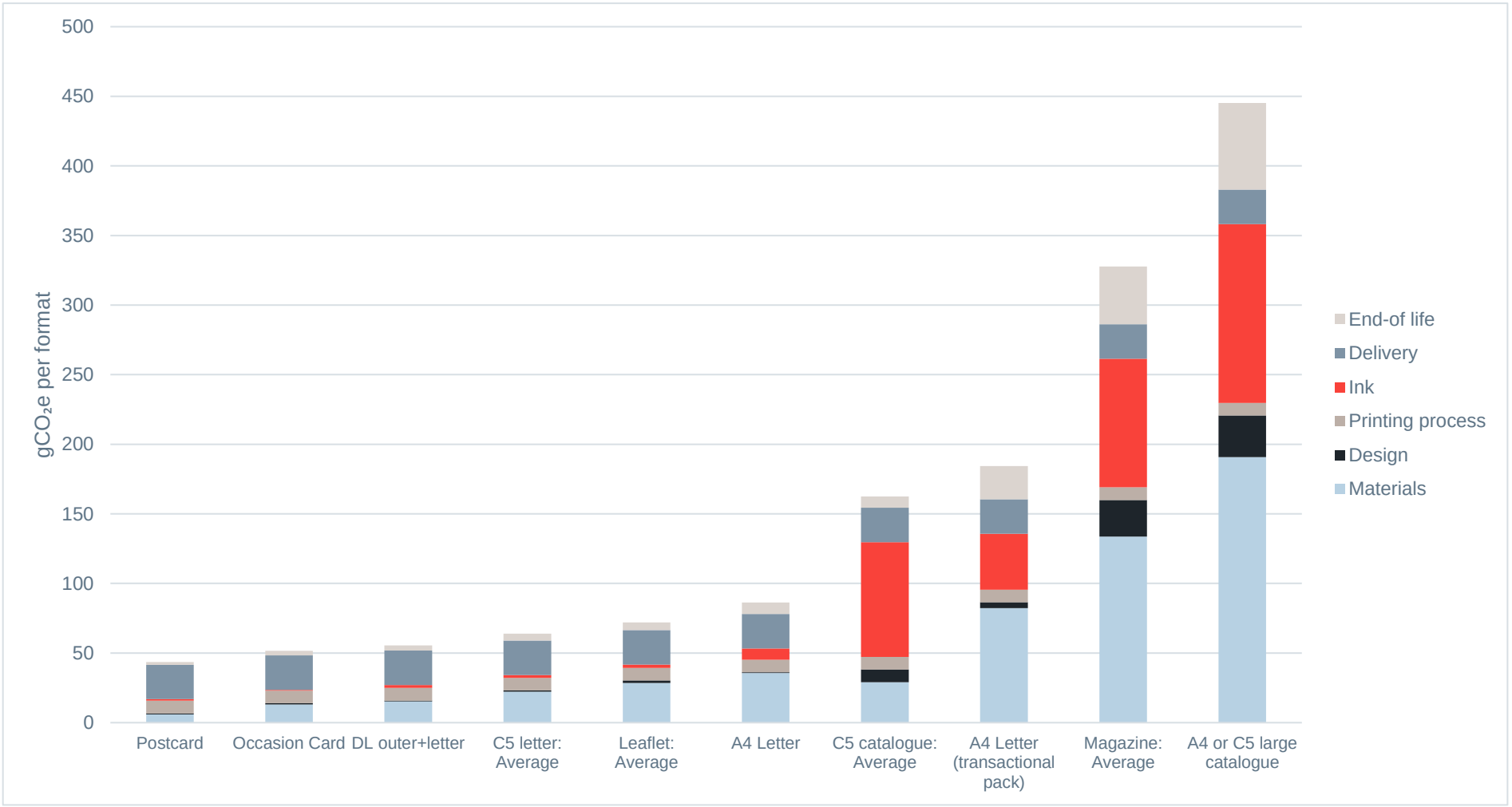


Figure 4-1 – Results summary per format and life cycle stage

The results should be framed in context of the assumptions and limitations listed in Section 3.3. This is with particular reference to the printing and delivery figures which we were unable to get further granularity per format at this stage. Therefore, a representative figure (calculated using primary data from relevant data providers) has been provided for all formats to be able to model the full life cycle of each format. This is considered the best estimate of emissions.

These results show that as the products increase in weight, emissions from the raw materials, design, ink and end of life increase in significance in relation to its impact on the whole life cycle emissions of the product. As a result, the emissions from delivery become less significant to the emissions total.

As emissions from printing and delivery are the same for all product types, the absolute numbers do not change, but do change in significance of contribution to the overall format emissions result i.e. account for a lesser/greater percentage proportion of the total format emissions.

The results show that the three hotspot areas are materials, delivery and ink. These are discussed further in Section 5.1.

The carbon emissions from ink for C5 catalogue average returns a higher result compared to the ink emissions for A4 transactional pack, despite the smaller page size. This is because the C5 catalogue is an average of four catalogue types ranging from 12pp to 32pp, with the ink emissions ranging from 48 gCO_2e per product to 128 gCO_2e per product. See the C5 catalogue breakdown in section 4.2 for further information.

4.2 LETTER FORMAT BREAKDOWN

This section shows the breakdown of the formats labelled as ‘Average’ shown in Table 4-1 and Figure 4-1. The graphs show the emissions results for each individual format with the red line showing the average of all formats, which is reported in section 4.1

C5 LETTER

Two variations of the C5 letter were assessed, a A4 2pp and a A5 4pp, with the average of the two presented in section 4.1. The A4 2pp is 7% lower in life cycle carbon emissions than the A5 4pp.

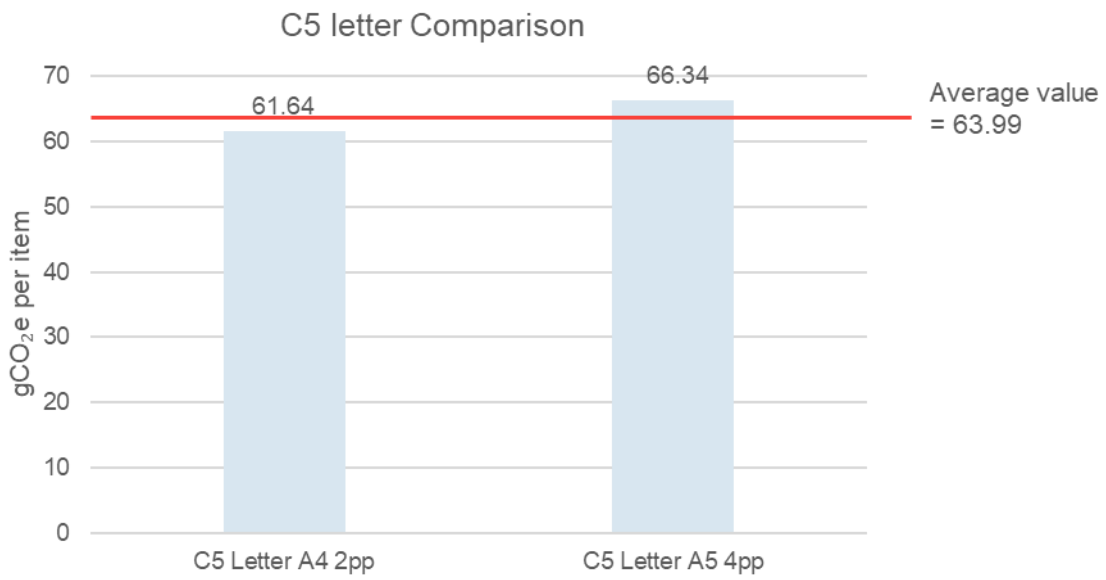


Figure 4-2 – C5 letter emissions comparison

The main difference between the C5 letter A4 2pp and C5 letter A5 4pp is an increase in material use therefore associate embodied emissions from materials, creative time and EoL

MAGAZINE

Two variations of the magazine were assessed, a 64pp and a 28pp magazine, with the average of the two presented in section 4.1. The 28pp magazine is 50% lower in life cycle carbon emissions than the 64pp magazine.

Due to the increased number of pages of the 64pp magazine, this results in an increase in emissions from all life cycle stages (with the exception of printing and delivery as the same data has been applied for all formats as detailed in section 3.2)), relative to the 28pp magazine, hence the large increase in emissions.

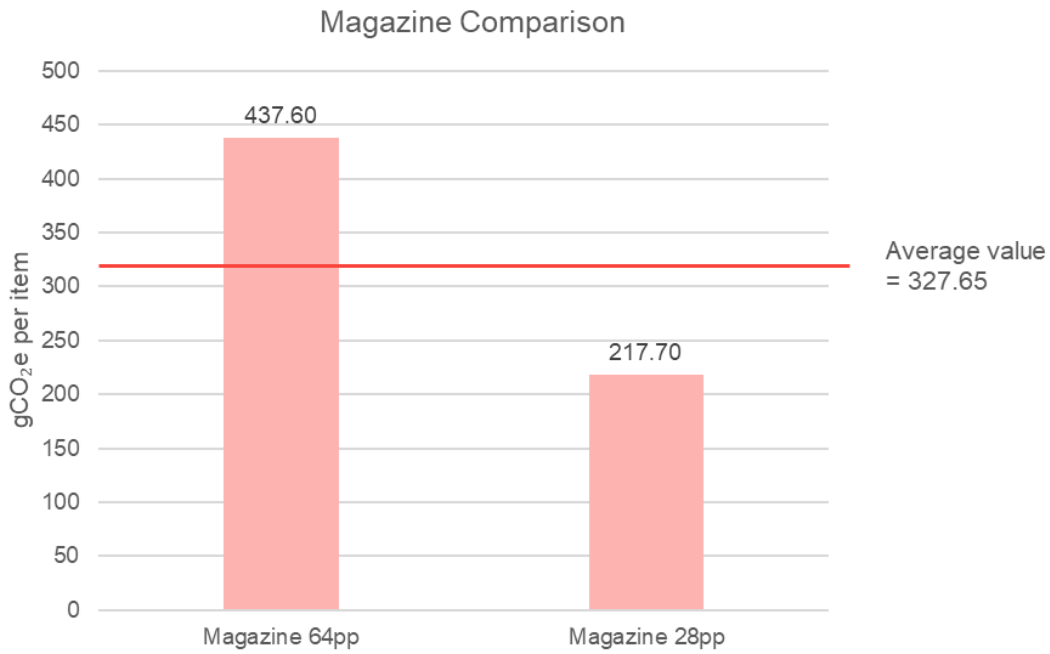


Figure 4-3 – Magazine emissions comparison

LEAFLET

Four types of leaflet were assessed, an A4 2pp and A4 4pp and an A5 2pp and A5 4pp, with the average of the four presented in section 4.1. The 2pp leaflets are lower in life cycle carbon emissions for both the A4 and A5 leaflets compared to 4pp. However, the A5 size leaflets are lower in life cycle carbon emissions for both 2pp and 4pp compared to the A4 2pp.

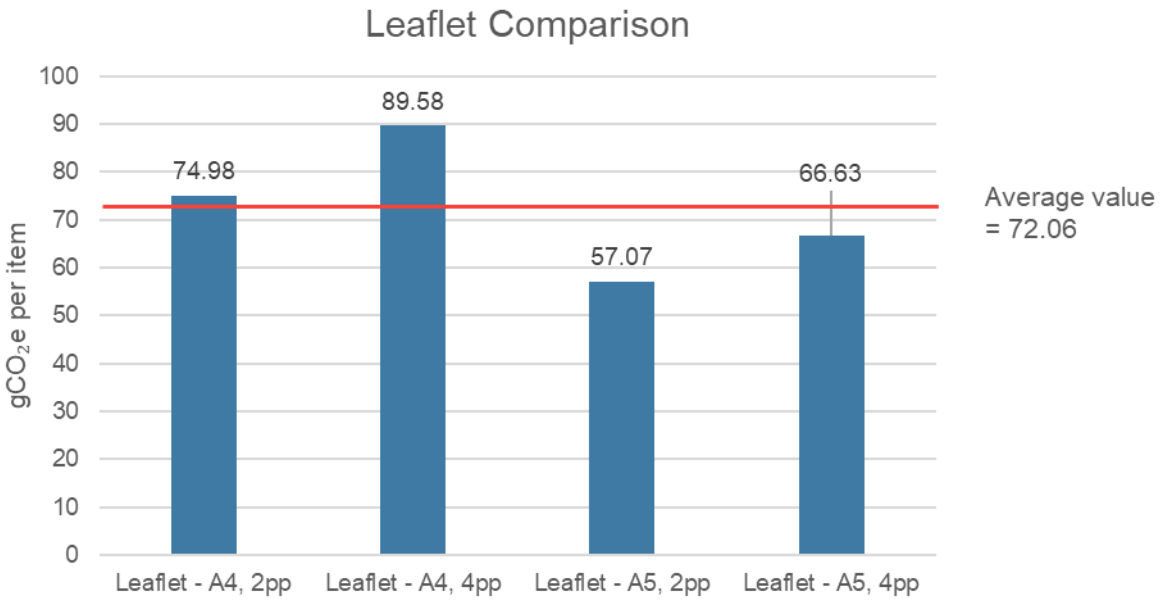


Figure 4-4 – Leaflet emissions comparison

The A5 formats require less material compared to A4 formats which reduces embodied emissions from the paper and envelope as well as less ink being required so a reduction in carbon emissions from ink. It also equates to less waste, therefore carbon emissions at EoL.

C5 CATALOGUE

Four types of C5 catalogue were assessed, a 12pp, 16pp, 24pp and a 32pp catalogue, with the average of the four presented in section 4.1.

The C5 catalogue 12pp is the lowest in life cycle carbon emissions compared to the other C5 catalogues (103% lower than a C5 catalogue 32pp).

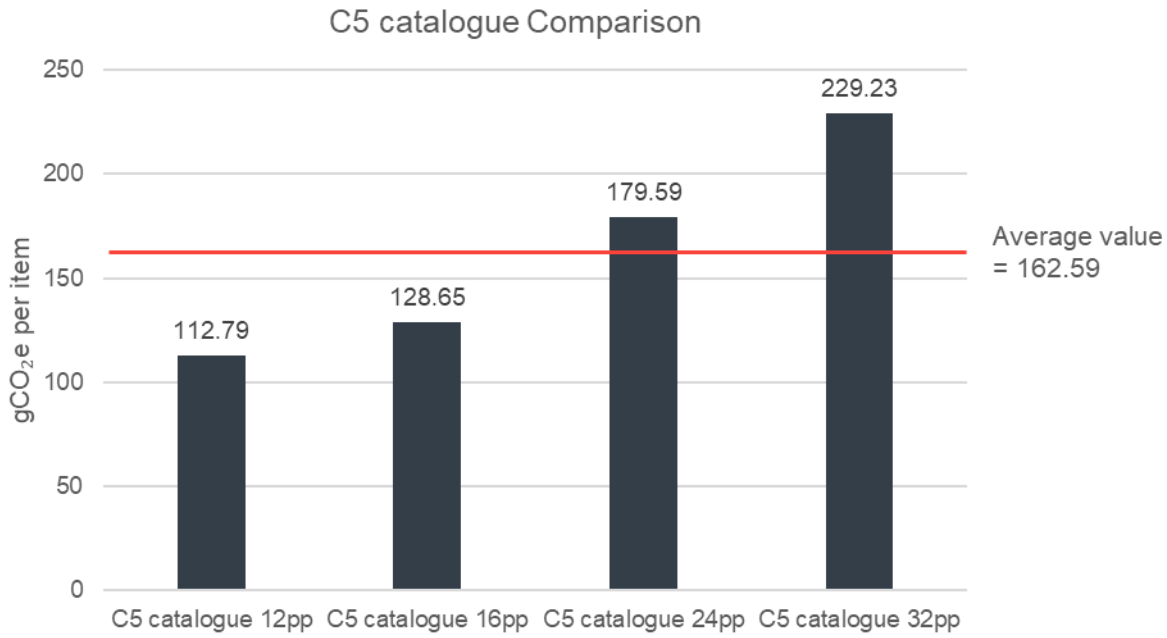


Figure 4-5 – C5 catalogue emissions comparison

Similar to the magazine format, the increase in the number of pages equates to an increase in resources required and therefore carbon emissions.

5

INTERPRETATION

5 INTERPRETATION

5.1 CARBON EMISSION HOTSPOTS

This section outlines and explains some of the key carbon emission hotspots identified through the LCA analysis.

Materials

The materials included in this assessment are paper for the letters/magazine/catalogues and the envelope materials (including paper and polywrap).

For products with an average weight of less than or equal to 25g (with the exclusion of the postcard), the emissions from the envelope material accounted for >50% of the total raw material emissions.

For the products with an average weight of greater than 25g, the emissions from the paper was more significant (>50%) of the total raw material emissions. In particular, the envelope emissions for the A4 or C5 large catalogue and an average magazine were 13% and 11% of the total raw material emissions respectively.

This means that depending on the product the most impactful carbon emission reductions will vary between either the envelope or the paper. Considerations on reducing carbon emissions from raw materials include using less of the material or substituting it for a lower carbon emission alternative.

Delivery

The carbon emissions (gCO_2e per item) were provided by Royal Mail and split into three phases; delivery to Royal Mail distribution centres, processing and automation at Royal Mail sites and the final mile delivery.

These emissions were calculated using the relevant Scope 1, 2 and 3 emissions totals for each delivery phase for Royal Mail during the period 2021 to 2022 and were apportioned by the Royal Mail letter revenue percentage and the volume of Royal Mail letters delivered.

Of the three phases, the delivery to the Royal Mail distribution centres is the carbon hotspot, accounting for 53% of total delivery emissions. As delivery emissions decarbonise as the UK and Royal Mail progresses towards Net Zero, emissions from delivery are also likely to reduce. Royal Mail have plans to reduce the emissions relating to letters and parcels via their Net Zero 2040 strategy ‘Steps to Zero’. This focuses on the electrification of final miles, optimisation of local and national distribution, moving from planes to trains and delivering efficient building energy.

This would have more of a significant impact on the carbon emissions of the smaller products (weighing <30g).

Ink

To calculate the emissions from ink usage, first the quantity of ink used per product had to be calculated. See section 5.2 for further insight into the various options for calculating the quantity of ink.

For the assessment, the assumption of 12 grams of ink per m² of paper was used at a 25% coverage for smaller items (letters, leaflets, cards etc.) and 50% coverage for larger items (catalogue, magazines). This assumption was explored in partnership with Royal Mail and was based on information provided by supply chain organisations. WSP deem this assumption to be the most representative and defensible approach pending any further granularity in data becoming available. The area (m²) of the paper was calculated using the product dimensions (height, width) and number of pages and sides.

As the types of ink used per product was not known, an average emissions factor from five types of ink was multiplied by the quantity of ink calculated to provide the carbon emissions associated with ink use. As mentioned in section 3.3, these ink emissions factors ranged from 3.3 $kgCO_2e$ to 6.1 $kgCO_2e$ per kg of ink.

As the products increase in size (dimensions), including number of pages and sides, the quantity of ink increases and therefore the associated emissions. For example, with an A4 letter (transactional pack), average magazine and A4 or C5 large catalogue, after materials, ink is the second largest lifecycle stage contributor to total carbon emissions.

This demonstrates that both quantity and type of ink impact on carbon emissions and are key considerations for reducing carbon emissions. Any improvements in more specifically understanding the ink quantities and types of ink per product would provide further information on how to reduce carbon emissions from this source.

5.2 SENSITIVITY ANALYSIS

This section reviews the sensitivity analyses completed on the data provided and carbon emissions results to show how differences can impact on the carbon emissions results. This feeds into the 'interpretation' phase of the ISO 14067 standard. These analyses were used to feed back into the life cycle inventory analysis and impact assessment phases.

POSTAGE - FIRST CLASS VS. SECOND CLASS DELIVERY

As outlined in section 3.3, the results of this LCA were modelled on letter delivery emissions (gCO_2e per item), based on Royal Mail carbon footprint for the year 2021/2022

A sensitivity test was undertaken to consider the impact of how a first vs. second-class delivery would have on the overall carbon emission results. This data was also sourced from Royal Mail and is based on indicative figures. This section is to be used for illustrative purposes only.

The results shown in Figure 5-1 demonstrate that assuming that 90% of Royal Mail domestic flights are utilised by first class mail as opposed to second class mail, the indicative difference in emissions between first and second class delivery emissions is 9%. There is evidence to suggest that picking a second-class mail product would help Royal Mail use lower-carbon alternative to air and the emission saving comes from the transport to the Royal Mail distribution centres.

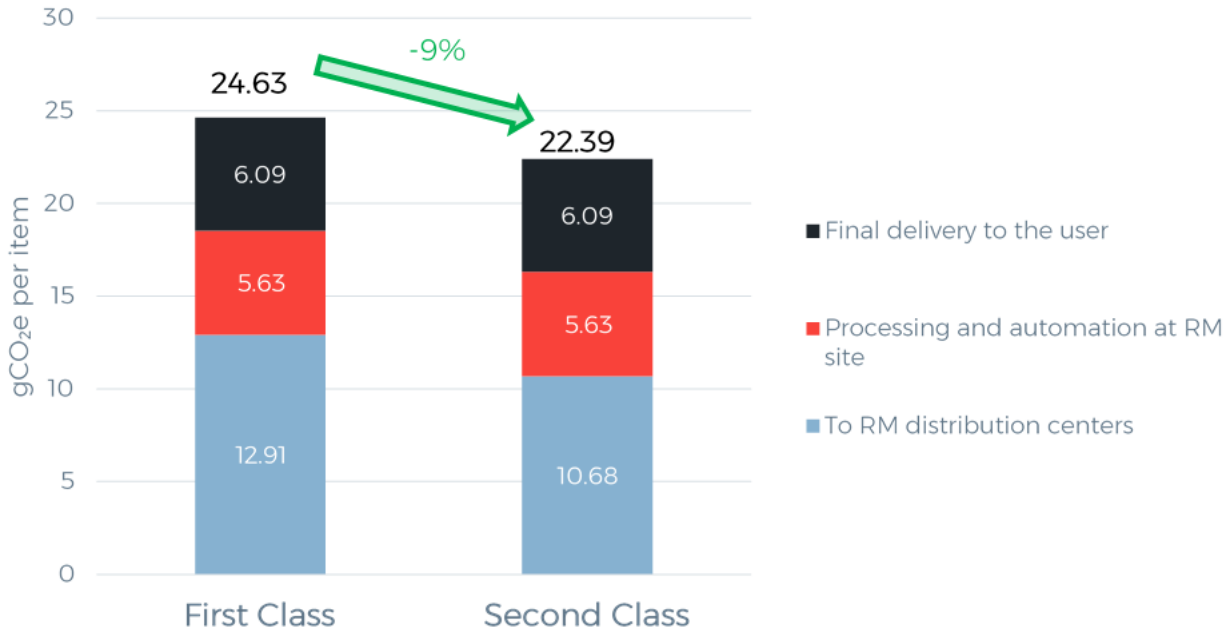


Figure 5-1 – Comparison of first class delivery vs. second class delivery emissions

The main emissions saving from switching from first-class to second-class is not using air freight during the delivery to Royal Mail distribution centres. This can result in up to a 5% decrease in total LCA emissions for smaller products (<30g) and up to 1% for larger products (>60g). This is because

delivery emissions vary in significance in their contribution to total product emissions between smaller products and larger products.

INK CARBON EMISSIONS

As mentioned in section 5.1, different methodologies for calculating the quantity of ink for each product was explored in partnership with Royal Mail as part of this LCA, based on information provided by supply chain organisations. The aim was to refine the approach and select the most robust and defensible assumption on the quantity of ink required per format as data on specific ink quantities per format was not readily available.

These methodologies are outlined in Table 5-1 below.

Table 5-1 – Ink quantity calculation scenarios

Methodology Description	Used in the LCA?	Justification
Scenario 1: 12 grams of ink per m² using a **60% coverage** for all product types.	✗	The 60% coverage of all product types was considered too high, especially considering some of the smaller products where ink coverage was not considered to be much. This prompted further discussion on tailoring the percentage coverage to be more product specific
Scenario 2: 12 grams of ink per m² using a **25% coverage for smaller items** (letters, leaflets, cards etc.) and **50% coverage for larger items** (catalogue, magazines).	✓	Following indications from Royal Mail, the 25% coverage for smaller products seemed more realistic as well as the reduction from 60% coverage to 50% coverage for the remaining products.
Scenario 3: Grams of ink per format provided.	✗	It was unclear how this data was calculated, and the results did not seem consistent with the formats (e.g. larger items having less ink quantities). This method was not considered robust or transparent enough to use in the assessment at this stage.

The table below Table 5-2 shows how the carbon emissions from ink use only varied between the different calculation scenarios.

Table 5-2 – Comparison of ink carbon emissions per product using different ink scenarios

Product Type	Scenario 1	Scenario 2	Scenario 3
Postcard	2.40	1.00	0.33
Occasion Card	1.20	0.50	1.34
DL outer and letter	4.82	2.01	1.41
C5 letter: Average	4.81	2.00	1.58
Leaflet: Average	5.41	2.26	0.88
A4 Letter	19.27	8.03	0.60
C5 catalogue: Average	98.74	82.28	2.92
A4 Letter (transactional pack)	38.53	32.11	1.21
Magazine: Average	110.78	92.32	11.80
A4 or C5 large catalogue	154.13	128.44	16.63

The table below (Table 5-3) outlines how the ink calculation scenario selected would impact the total the carbon emissions per product results.

Table 5-3 – Comparison of total carbon emissions per format with different ink scenarios

Product	Ink Scenario 2*	Ink Scenario 1		Ink Scenario 3	
	Total gCO_2e per product	Total gCO_2e per product	% difference to Scenario 2	Total gCO_2e per product	% difference to Scenario 2
Postcard	**43.47**	44.87	+3%	42.80	-2%
Occasion Card	**51.53**	52.23	+1%	52.37	+2%
DL outer and letter	**55.40**	58.21	+5%	54.81	-1%
C5 letter: Average	**63.85**	66.66	+4%	63.43	-1%
Leaflet: Average	**71.92**	75.08	+4%	70.55	-2%
A4 Letter	**86.2**	97.44	+13%	78.77	-9%
C5 catalogue: Average	**162.45**	178.90	+10%	83.08	-49%

Product	Ink Scenario 2*	Ink Scenario 1		Ink Scenario 3	
	Total gCO_2e per product	Total gCO_2e per product	% difference to Scenario 2	Total gCO_2e per product	% difference to Scenario 2
A4 Letter (transactional pack)	**176.19**	182.61	+4%	145.29	-18%
Magazine: Average	**327.51**	345.97	+6%	246.99	-25%
A4 or C5 large catalogue	**445.15**	470.83	+6%	333.34	-25%

*the results of the LCA as presented in Section 4.1

Based on available information from supply chain organisations and understanding of processes, it was considered that Scenario 3 was under-representing carbon emissions from ink whereas Scenario 1 was overestimating carbon emissions. It was therefore agreed that Scenario 2 would be used as the most defensible approach, with the caveat that if further data or insights became available, it could be used to update the results.

RECYCLED PAPER

The impact of using recycled paper as the raw material was considered by reviewing the Ecoinvent emissions factors available and used in the Sima Pro software.

For paper production, woodfree, uncoated at a non-integrated mill (relating to the pulp production subset of the raw materials embodied carbon emissions factor) the results showed that using 100% recycled paper would result in a 1% reduction in carbon emissions and using 50% recycled would result in an 8% reduction in carbon emissions relative to the equivalent virgin material emissions factor. To note, this reduction in emissions relates to a subset of emissions sources that combine with other elements (including the inclusion of integrated mill processes to create the total materials emissions factor.

Most of the emissions from recycled paper production were related to the de-inking process. For example, for 100% recycled paper, deinked pulp equated to 63% of the total emissions.

Other factors would have to be considered throughout the life cycle, including printing considerations if recycled paper was used[10], so for the purposes of this LCA the results were modelled using virgin material and can also be considered as a worst-case scenario.

[10] Based on discussions with Paragon Customer Communications

However other environmental considerations can be considered here, to include the reduction in deforestation and associated soil erosion as well as a difference in water consumption and chemical use.

5.3 RECOMMENDATIONS BASED ON FINDINGS

Recommendations from the outcome of the study have been listed below:

Improving the assessment

- Improved granularity in product specific data collection will enable a better understanding of the carbon emission nuances of each format. This primarily relates to the carbon emissions results for printing and delivery. In this assessment, print and delivery figures do not vary by format. This is considered as the best estimate available at the time. In reality, these emission sources are likely to show variation by format.
- Increased granularity of ink data, making it more specific to formats would help to improve accuracy.
- In addition, different ink types could be considered, the study incorporates the average carbon emissions of different ink type to account for a range of ink types as the ink types for the formats are unknown or difficult to extract. Improving the granularity of the information with regards to specific ink types used per format would further fine-tune the assessment to increase accuracy.
- Where possible, using weights instead of mileage to assess transport would provide product specific information.

Reducing emissions

- Reducing emissions in delivery and transport will have a significant impact on the emissions and is an area Royal Mail can influence, especially with Royal Mail's net zero 2040 strategy.
- Paper does have a significant impact on product emissions. Options such as recycled content and using formats with fewer raw materials should be considered, including other sustainability factors such as biodiversity should also be considered alongside carbon.
- Ink has a significant impact on the results, work to reduce emissions here would significantly improve the products.

6

CONCLUSION

6 CONCLUSION

A product carbon LCA was undertaken for 10 commercial letter formats (including product variations) following the ISO 14067 product carbon footprinting standard.

The LCA was undertaken using a hybrid approach using SimaPro LCA software and a WSP MS Excel model incorporating Royal Mail specific carbon data.

The results showed that a **postcard equated to the least emissions per product** and an **A4 or C5 large catalogue had the largest carbon emissions impact.**

In summary, the **size and weight of the product has a direct correlation with the associated carbon emissions**. In particular:

- For the **smaller products (weighing <30g), the printing and delivery has a significant impact on the total carbon emissions**.
- For the **larger products (weighing >60g) materials and ink used in the product has a much higher impact than the printing or delivery**.

Key recommendations include:

- Consider ways to improve data quality by improving granularity of the data
- Focus on reducing emissions from carbon hotspots identified: materials, delivery and ink.

Appendix A

EMISSIONS FACTORS

APPENDIX A

EMISSIONS FACTORS

A table of the emissions factors used for each life cycle stage is provided below.

Life cycle Stage		Emissions Name	Emissions Factor	Unit
	**Materials**	Paper: Ecoinvent v3.6 (SimaPro)	-	-
		Envelopes: size 162 x 229 C5 *(used for: C5 letter)*	14.83	gCO_2e per unit
		Envelopes: size 114 x 162 C6 *(used for: occasion card)*	7.05	gCO_2e per unit
		Envelopes: size 110 x 220 DL *(used for: DL outer and letter)*	9.24	gCO_2e per unit
		Envelopes: size 229 x 324 C4 *(used for: A4 leaflet, A4 or C5 large catalogue, A4 letter transactional pack, A4 letter)*	24.79	gCO_2e per unit
		Envelopes: size Colour C5 *(used for: A5 leaflet, C5 catalogues)*	11.89	gCO_2e per unit
	**Creative Time**	Ecoinvent v3.6 (SimaPro)	-	-
	**Printing Process**	Paragon Printing Process	9.11	gCO_2e per pack
	**Ink**	Sheetfed Ink	6.13	$kgCO_2e$ per kg
		Heatset ink	5.06	$kgCO_2e$ per kg
		Flexo ink	6.13	$kgCO_2e$ per kg
		Screen ink	6.13	$kgCO_2e$ per kg
		Digital ink	3.37	$kgCO_2e$ per kg

Life cycle Stage		Emissions Name	Emissions Factor	Unit
	**Delivery**	Royal Mail: Average delivery	24.77	gCO_2e per item
	End of Life	Envelopes: size 162 x 229 C5 *(used for: C5 letter)*	2.48	gCO_2e per unit
		Envelopes: size 114 x 162 C6 *(used for: occasion card)*	1.33	gCO_2e per unit
		Envelopes: size 110 x 220 DL *(used for: DL outer and letter)*	1.74	gCO_2e per unit
		Envelopes: size 229 x 324 C4 *(used for: A4 leaflet, A4 or C5 large catalogue, A4 letter transactional pack, A4 letter)*	4.65	gCO_2e per unit
		Envelopes: size Colour C5 *(used for: A5 leaflet, C5 catalogues)*	2.26	gCO_2e per unit
		Paper: Recycling	21.29	$kgCO_2e$ per tonne
		Paper: Landfill	1041.80	$kgCO_2e$ per tonne

Appendix B

FULL RESULTS

APPENDIX TITLE

APPENDIX B

A table of the full results breakdown per product per life cycle stage is provided below.

Commercial Letter Product	Materials		Design		Printing process	Ink	Delivery			End of Life			Total, gCO_2e per product
	Paper	Envelope/ Wrap	Creative time	Copywriting	Printing	Paper	To RM distribution centres	Processing and automation at RM site	Final delivery to the user	Paper - landfill	Paper - Recycled	Envelopes	
Postcard	5.98	0.00	0.38	0.38	9.11	1.00	13.05	5.63	6.09	1.90	0.09	0.00	**43.61**
Occasion Card	5.98	7.05	0.38	0.57	9.11	0.50	13.05	5.63	6.09	1.90	0.09	1.33	**51.68**
DL outer and letter	6.00	9.24	0.30	0.38	9.11	2.01	13.05	5.63	6.09	1.91	0.09	1.74	**55.55**
C5 letter - Average	7.48	14.83	0.38	0.45	9.11	2.00	13.05	5.63	6.09	2.38	0.12	2.48	**63.99**
C5 Letter A4 2pp	6.00	14.83	0.15	0.30	9.11	2.01	13.05	5.63	6.09	1.91	0.09	2.48	**61.64**
C5 Letter A5 4pp	8.96	14.83	0.60	0.60	9.11	2.00	13.05	5.63	6.09	2.86	0.14	2.48	**66.34**
Leaflet - average	10.11	18.34	0.72	1.13	9.11	2.26	13.05	5.63	6.09	3.22	0.16	2.26	**72.06**
Leaflet – A4 2pp	8.99	24.79	0.30	0.75	9.11	2.01	13.05	5.63	6.09	2.87	0.14	2.26	**75.98**
Leaflet – A4 4pp	18.00	24.79	1.13	1.51	9.11	4.01	13.05	5.63	6.09	5.73	0.28	2.26	**91.59**
Leaflet - A5 2pp	4.48	11.89	0.30	0.75	9.11	1.00	13.05	5.63	6.09	1.43	0.07	2.26	**56.06**

Commercial Letter Product	Materials		Design		Printing process	Ink	Delivery			End of Life			Total, gCO_2e per product
	Paper	Envelope/ Wrap	Creative time	Copywriting	Printing	Paper	To RM distribution centres	Processing and automation at RM site	Final delivery to the user	Paper - landfill	Paper - Recycled	Envelopes	
Leaflet – A5 4pp	8.96	11.89	1.13	1.51	9.11	2.00	13.05	5.63	6.09	2.86	0.14	2.26	**64.62**
A4 Letter	10.79	24.79	0.30	0.30	9.11	8.03	13.05	5.63	6.09	3.44	0.17	4.65	**86.34**
C5 catalogue - Average	17.12	11.89	4.30	4.90	9.11	82.28	13.05	5.63	6.09	5.66	0.28	2.28	**162.59**
C5 catalogue 12 pp	8.06	11.89	2.72	3.02	9.11	48.16	13.05	5.63	6.09	2.67	0.13	2.26	**112.79**
C5 catalogue 16 pp	12.10	11.89	3.62	4.52	9.11	56.19	13.05	5.63	6.09	4.00	0.20	2.26	**128.65**
C5 catalogue 24 pp	20.10	11.89	3.62	4.52	9.11	96.33	13.05	5.63	6.09	6.66	0.33	2.26	**179.59**
C5 catalogue 32 pp	28.20	11.89	7.24	7.54	9.11	128.44	13.05	5.63	6.09	9.33	0.46	2.26	**229.23**
A4 Letter (transactional pack)	57.56	24.79	2.11	2.00	9.11	40.14	13.05	5.63	6.09	18.34	0.90	4.65	**184.36**
Magazine - Average	119.40	14.20	13.56	12.81	9.11	92.32	13.05	5.63	6.09	39.54	1.94	n/a	**327.65**
Magazine 64pp	166.00	14.20	19.28	18.08	9.11	128.44	13.05	5.63	6.09	55.02	2.70	n/a	**437.60**
Magazine 28pp	72.80	14.20	7.84	7.54	9.11	56.19	13.05	5.63	6.09	24.07	1.18	n/a	**217.70**
A4 or C5 large catalogue	166.00	24.79	14.76	15.06	9.11	128.44	13.05	5.63	6.09	55.02	2.70	4.65	**445.29**

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