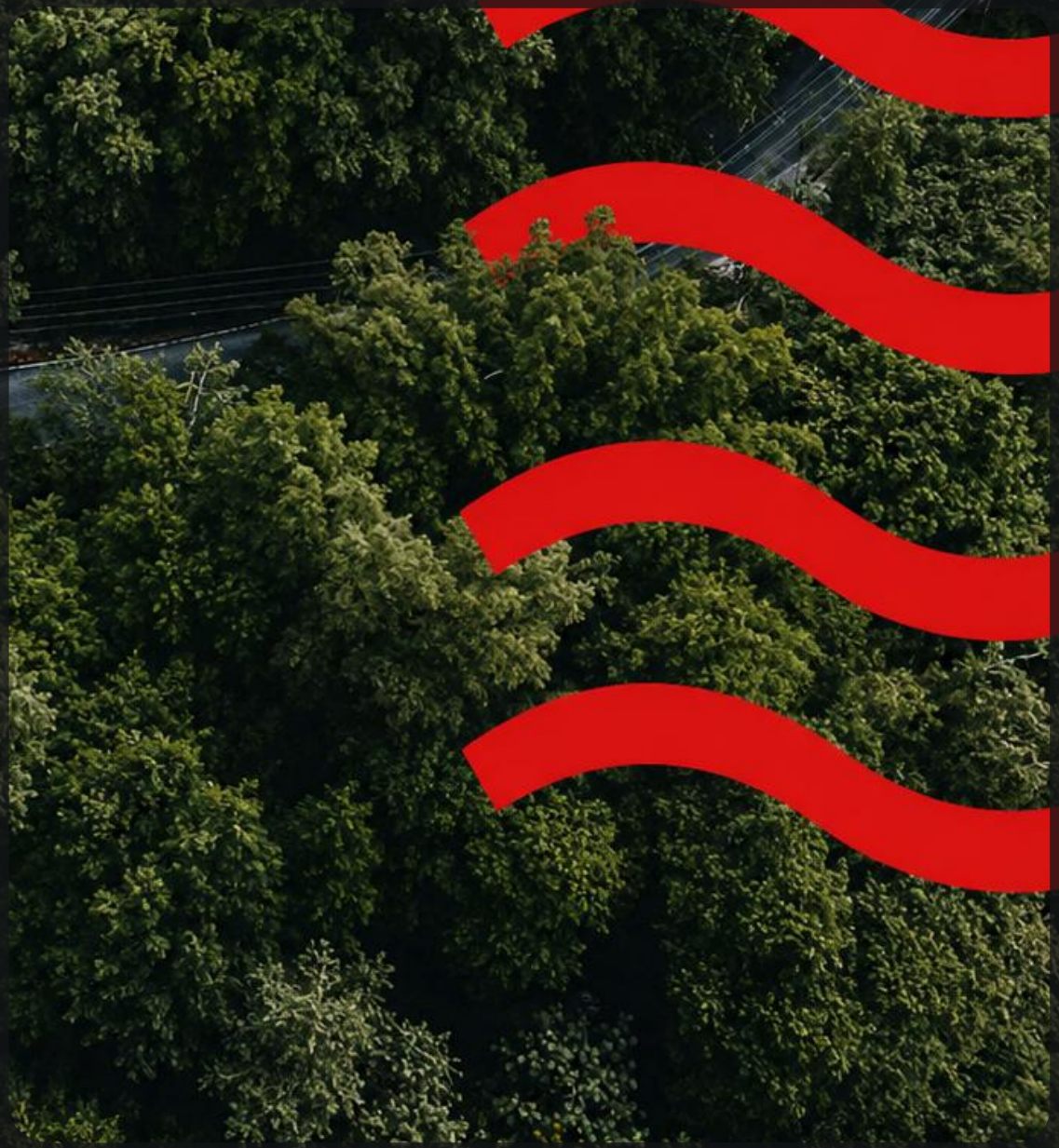
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Royal Mail

Mail Product Carbon Footprint Assessment

Technical Report



CARBON QUOTA®

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1. Executive summary

This study quantifies the cradle-to-grave greenhouse gas emissions of fourteen representative mail formats supplied in the UK. Base-case results represent a reference production quantity of 50,000 items.

Study at a glance

14	50,000	22.64–73.29
formats assessed	items in the base-case run	carbon footprint range (g CO_2e/item)

Lowest carbon footprint: A5 2pp leaflet — **22.64 g CO_2e/item**

Highest carbon footprint: A5 130 gsm booklet without an outer ('naked booklet') — **73.29 g CO_2e/item**

Formats include leaflets and flyers, one-piece mailers, postcards, letter and insert packs, and A5 booklets.

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Key findings

- **Delivery is material**

  Delivery accounts for 20.9%-61.9% of the total footprint and is the largest reported life-cycle stage for nine formats.

- **Product specification matters**

  Raw-material and production impacts become more influential as product mass and manufacturing complexity increase.

- **Results are sensitive to production choices**

  Paper-production energy, sheet geometry, outer configuration and envelope specification can materially affect individual product results.

- **Findings are product-specific**

  The results should be interpreted within the assessed specifications, quantities and supply-chain scenarios.

Scope and standards

The study assesses climate change only. It applies the life-cycle assessment principles of ISO 14040 and ISO 14044 and considers relevant guidance from the GHG Protocol Product Life Cycle Accounting and Reporting Standard. Conformity with these standards is not claimed. Review arrangements are described in Section 3.8.

2. About CarbonQuota and the assessment

About CarbonQuota

CarbonQuota is a carbon-accounting specialist providing greenhouse-gas measurement and reduction support for print, packaging and associated supply chains. Marketreach commissioned CarbonQuota to develop the product carbon footprint models, conduct the technical assessment and prepare this report.

Purpose and status of the report

This report is the technical evidence base for the study. It documents the methodology, assumptions, data sources, results, uncertainty and interpretation needed to understand and evaluate the principal conclusions. The detailed inventory, emission factors and calculations are retained in the supporting model and may be made available for independent technical review, subject to applicable data-licensing and confidentiality restrictions.

A separate How-to Guide draws on the key findings from this report to help mail users produce more sustainable mail campaigns. The guide remains separate from this technical assessment.

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Roles and inputs

CarbonQuota's role

- Developed the modelling approach
- Compiled the life-cycle inventory
- Calculated the product footprints
- Prepared the technical interpretation

Marketreach and Royal Mail inputs

- Representative product information
- JICMAIL audience data
- Royal Mail distribution information

Technical responsibility

Marketreach and Royal Mail supplied information used as model inputs but did not determine the calculated results or CarbonQuota's technical interpretation.

3. Goal and scope definition

3.1 Goal of the study

Intended application

This study provides representative cradle-to-grave product carbon footprints (PCFs) for selected mail formats. The results are intended to support carbon-footprint reporting, internal comparison of the assessed formats, identification of carbon hotspots and evaluation of reduction opportunities. Supplementary JICMAIL-based metrics, described in Section 5.4, provide additional context by relating the calculated footprints to commercial impacts and mail-ad impressions.

Reasons for carrying out the PCF study

The study was commissioned by Royal Mail Marketreach to provide an evidence-based understanding of the greenhouse gas (GHG) emissions associated with mail products used across the industry, support internal decision-making, and enable the communication of carbon footprint information to relevant stakeholders.

Intended audience

The key audiences are Marketreach and Royal Mail marketing, sustainability and technical teams, as well as the wider mail industry. The report may be used as a technical evidence base by advertisers and agencies commissioning mail, print and mailing suppliers, and other key industry stakeholders.

Comparative assertions

The results are not intended to support comparative assertions disclosed to the public, as defined in ISO 14044. The supplementary commercial-impact analysis is not a direct comparison between mail and digital communication channels.



3.2 Functional unit and reference flow

Function

To provide a printed mail communication to a recipient or household in the UK.

Functional unit

The provision of one finished mail item, manufactured and distributed in the UK and assessed from raw material production through to the end-of-life treatment. Results are reported separately for each assessed format in g CO_2e per item.

Reference flow

One mail item meeting the relevant product specification in **Table 1,** equivalent to the functional unit.

Base-case quantity

Production was modelled using an agreed reference print run of 50,000 items. Alternative quantities were modelled for selected scenarios where relevant.

Additional reporting metrics

Mail Carbon Intensity (MCI) and JICMAIL-based metrics express the calculated PCFs using additional reporting denominators but do not change the functional unit or reference flow.

3.3 Products assessed

The fourteen representative products assessed are summarised in **Table 1.**

3.4 System boundary

A cradle-to-grave system boundary has been adopted. For reporting, modelled inputs are grouped into four life-cycle stages, as illustrated in **Figure 1** on the following page:

- **Raw materials** – production of paper, paperboard, envelopes and other product components, including their upstream transport to the production site.
- **Production** – printing and the applicable finishing or conversion processes for each format, including printing consumables and the transport and treatment of production waste.
- **Delivery** – downstream transport of finished items through the distribution network, including the allocated Royal Mail final-mile delivery impact for addressed mail, Business Mail products and door drops.
- **End of life** – collection, transport and treatment of the mail item after use through representative UK waste-management routes.

Use phase

- The assessed products are passive during use and were assigned no use-phase emissions.

Excluded processes

The following processes were excluded because their contribution to the overall PCF was considered negligible:

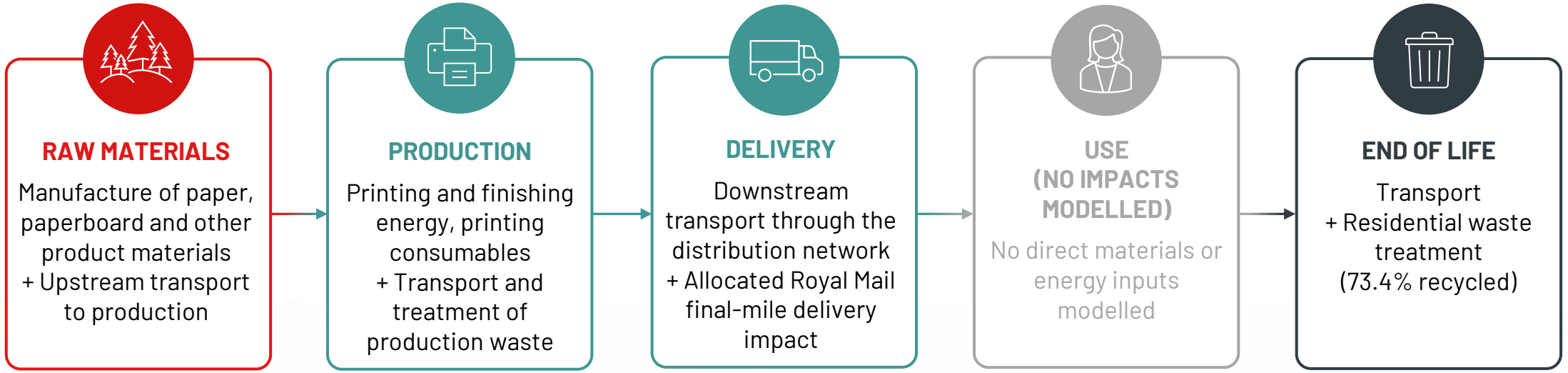
- Data processing, mailing list management and electronic data transfers.
- Minor consumables, such as glue tabs or glue dots, where these contribute less than 1% of the overall product carbon footprint.
- Transport packaging and distribution materials considered negligible or subject to extensive reuse.

Table 1. Products assessed

Category	Representative specification
Leaflets / Flyers – unaddressed (door drop)	A5 2pp, 4/4, 150 gsm on coated stock
	A5 4pp, 4/4, 150 gsm on coated stock
	A5 6pp, 4/4, 150 gsm on coated stock
One-Piece Mailers – addressed	A5 8pp, 4/4, 150 gsm, roll-fold one-piece mailer on coated stock
Postcards	C6 2pp, 4/4, 330 gsm, addressed on 1-sided coated board
	A5 2pp, 4/4, 330 gsm, addressed on 1-sided coated board
	C6 2pp, 4/4, 330 gsm, door drop on 1-sided coated board
	A5 2pp, 4/4, 330 gsm, door drop on 1-sided coated board
	A5 3-ply Mailmark Economy postcard, 170 gsm silk, addressed
Letter and Insert / Brochure Packs	White C5 window envelope on uncoated stock with a 2pp A4 4/4 addressed letter on uncoated stock folded to A5, plus an A5 2pp on coated stock, 4/4, 150 gsm coated insert
	White DL window envelope on uncoated stock with a 2pp A4 4/4 addressed letter on uncoated stock folded to 99 × 210 mm
Magazines / Catalogues – addressed	A5 saddle-stitched 16pp self-cover, 4/4, 60 gsm on lightweight coated stock, sealed (naked)
	A5 saddle-stitched 16pp self-cover, 4/4, 100 gsm on coated stock, sealed (naked)
	A5 saddle-stitched 16pp self-cover, 4/4, 130 gsm on coated stock, sealed (naked)

Figure 1. Process flowchart

Overview of the life-cycle stages within the defined system boundary.



3.5 Allocation procedures

This study follows the allocation hierarchy defined in ISO 14040 and ISO 14044. Allocation was avoided wherever possible by directly assigning inputs and outputs to the assessed mail products.

Where allocation was required for printing and finishing processes, a mass-based approach was applied. These processes were modelled using emission factors expressed as kg CO_2e/kg of material processed, thereby assigning impacts according to the mass of substrate processed rather than estimated machine operating times or energy consumption.

For end-of-life modelling, the cut-off (recycled content) approach was adopted. The study includes the impacts associated with recycled material used as an input but does not assign any burdens or credits associated with the generation of secondary material following recycling at the product's end of life. End-of-life transport and treatment are included within the system boundary, and no credits are applied for material or energy recovery.

3.6 Cut-off criteria

Cut-off decisions considered mass, energy use and potential environmental significance. Inputs estimated to contribute less than 1% of total mass, energy use or GHG impact were considered for exclusion, provided that cumulative exclusions did not exceed 5%. Potentially significant inputs, including inks, adhesives and other production consumables, were included regardless of mass, using representative proxy data where necessary. Where emissions were excluded, it was because screening indicated that they contributed no more than approximately 0.25% of the total product footprint.

3.7 Data quality requirements

Data quality requirements considered technological, geographical and temporal representativeness, precision, completeness, consistency and source reliability.

Preference was given to the most recent available data and, where practicable, to data published or updated within the preceding ten years. Data were selected to represent the relevant technologies and geographical conditions, with UK-specific data used where available and appropriate European data used for upstream processes.

Data quality was assessed qualitatively against these criteria; no formal numerical scoring system was applied. Consistency and completeness were also reviewed across the assessed formats.

3.8 Review arrangements

CarbonQuota completed internal technical and quality-assurance checks of the model and report. The study was also subject to a focused independent technical review by Dr Matthew Fishwick of Fishwick Environmental Ltd. This was not a formal critical review, verification or assessment of conformity with a specific standard. Conformity with ISO 14040, ISO 14044 or the GHG Protocol Product Standard is not claimed.



4. Life cycle inventory and modelling

4.1 Representative product specifications and modelling approach

Representative specifications for the selected mail formats were agreed between Marketreach and CarbonQuota's print subject-matter experts and informed by consultation with experienced UK commercial printers. The specifications covered product dimensions, paper grammage, page count, print and finishing requirements, and whether the item was addressed or distributed as a door drop. They represent typical industry configurations rather than measured bills of materials for individual products or production jobs.

The assessment was completed using CarbonQuota's established PCF modelling approach, implemented in a project-specific Microsoft Excel Model. The model combines product specifications, material requirements, production processes, transport, waste and end-of-life assumptions with the applicable emission factors to calculate cradle-to-grave GHG emissions for each assessed format and sensitivity scenario.

Base-case production represents a typical UK commercial printing operation using grid electricity and a conventional range of digital and lithographic equipment suitable for commercial mail production. Lithographic printing was modelled separately in the high-volume sensitivity scenarios. The assessment does not represent every available press configuration. Specialist equipment optimised for particular formats may achieve more efficient sheet utilisation or production performance and could therefore produce different results.

As the assessment represents modelled production scenarios rather than measured production jobs, **Table 2** summarises the main assumptions used to define the base cases and sensitivity scenarios.

Table 2. Key scenario assumptions

Element	Assumption
Product specifications	Representative specifications were used rather than supplier-specific bills of materials or measured production jobs. Product-specific substrate, print and addressing assumptions were based on the agreed specifications for each assessed format.
Paper procurement	Paper and standard envelopes were assumed to be sourced through a paper merchant, except where an order exceeding approximately 10 tonnes would permit direct mill sourcing.
Base coated paper	Relevant base-case products used Swedish coated paper manufactured near Stockholm, representing a realistic, comparatively low-carbon paper source for UK imports.
Alternative virgin paper	The German-paper sensitivity used CarbonQuota's representative German paper-production model.
Recycled paper	The recycled-paper sensitivity represented a commercially available Italian recycled grade. For the postcard comparison, 350 gsm was modelled because an equivalent 330 gsm recycled grade is unlikely to be an available stock weight.
Standard envelopes	The C5 and DL base-case mailers used pre-manufactured 90 gsm white uncoated window envelopes manufactured at scale and subsequently overprinted.
Full-bleed envelopes	Full-bleed envelopes were modelled using 130 gsm coated stock, four-colour printing and dedicated envelope conversion at the assessed production quantity.
Booklet outers	Paper outers were modelled as 100 gsm uncoated paper printed with mailing information. Polywrap was modelled as unprinted 25-micron low-density polyethylene film.
Print coverage	Leaflets, one-piece mailers and booklets were modelled with four-colour printing on both sides at 75% coverage. Postcards were modelled with four-colour printing on one side and single-colour printing on the other, at 75% and 25% coverage respectively. Letters were modelled at 50% coverage.
Print method	Base cases used digital printing. Lithographic printing was modelled at matched high production quantities for the reported print-technology sensitivity analysis.
Printer electricity	Base-case production used standard UK grid electricity.
Production waste	Production waste was assumed to be pre-sorted, with 90% sent for recycling and the remaining 10% sent to landfill. Waste transport was modelled as 80 km by HGV.
Transport to Downstream Access	Finished products were assumed to travel approximately 150 km to the Downstream Access (DSA) provider. The reported base-case and high-volume scenarios were modelled using HGV transport.
Product end of life	Mail items were assumed to enter UK residential waste management. Paper and card were modelled as 73.4% recycled, with the remaining 26.6% sent to landfill. Waste transport was modelled as 80 km by heavy goods vehicle.

4.2 Data sources and emission factors

Background life-cycle inventory data were obtained from ecoinvent v3.10, International Energy Agency electricity (2024), UK Government GHG Conversion Factors for Company Reporting (2024), and CarbonQuota's internal models, as appropriate. Royal Mail supplied the delivery methodology and operational factors used for downstream distribution.

Primary data were limited to the Royal Mail operational data underlying the allocated final-mile delivery factor and the representative product specifications agreed with Marketreach. The product specifications were project-specific inputs rather than measurements from individual production jobs. Material production, printing, electricity, other transport, production-waste and end-of-life inputs were based on secondary data and representative CarbonQuota models.

The detailed inventory and calculations are retained in the supporting calculation workbook, which is available from CarbonQuota. Key inputs and assumptions are summarised in this report.

4.3 Raw material and production modelling

Material quantities were calculated from the dimensions, grammage, page count and component specifications of each format, including modelled production waste. Raw-material impacts include substrate manufacture and upstream transport. Production includes printing and finishing energy, consumables and the transport and treatment of production waste. Printing and finishing processes were assigned according to the mass processed and the applicable modelled production configuration.

4.4 Distribution modelling

Distribution was modelled using Royal Mail operational methodology supplied for the study. Final-mile emissions were modelled using a fixed factor of 13.86 g CO_2e per delivered item, supplied by Royal Mail and applied to both addressed mail and door drops. This item-based allocation reflects the shared, multi-drop nature of final-mile delivery, whose activity does not vary directly with the weight of an individual mail item. Other downstream transport components vary mainly with item mass and the applicable distribution assumptions.

4.5 End-of-life modelling

Product end of life was modelled using a simplified UK residential waste scenario. Paper and card were assumed to be 73.4% recycled, using the UK 2023 paper-and-cardboard packaging recycling rate as a representative national proxy, with the remaining 26.6% modelled as landfilled. Incineration was not modelled. The non-recycled fraction was assigned to landfill as a conservative modelling assumption to avoid understating potential climate impacts from waste disposal. This approach was applied consistently across all assessed scenarios. Waste transport was modelled as 80 km by HGV. No credits were assigned for recycled material or energy recovered from waste treatment. Actual treatment may differ according to local collection, sorting and disposal conditions.



5. Impact assessment and additional metrics

5.1 Impact assessment method

Climate change impacts were assessed using the 100-year Global Warming Potential (GWP100) characterisation method. GHG emissions are reported as g CO_2e per mail item, using characterisation factors based on the IPCC Sixth Assessment Report (AR6).

The reported climate-change results are relative expressions of potential climate-change impacts and do not predict actual environmental damage, impacts on category endpoints, the exceedance of environmental thresholds, safety margins or risks.

5.2 Mail carbon intensity

MCI was calculated as PCF per item divided by item mass and is reported in g CO_2e/g. It allows carbon intensity to be considered separately from the absolute footprint of the finished item.

5.3 Sensitivity scenarios

Sensitivity scenarios were developed to examine how selected material, design and production variables influence the calculated carbon footprints. The objective was to identify the parameters with the greatest influence on the footprints and support evidence-based recommendations for reducing GHG emissions.

The scenarios assessed:

- Paper source, including paper mill energy mix and recycled content;
- Digital and lithographic printing at high production volumes;
- Booklet outer configuration; and
- Envelope specification, including full-bleed scenario.

The results of the sensitivity analysis are presented in Section 6.3.

5.4 JICMAIL-based metrics

JICMAIL is the UK's independent audience measurement currency for mail (JICMAIL, 2026a). As a supplementary analysis, base-case PCFs were combined with aggregated JICMAIL Discovery Portal data for all sectors and adults, covering Q2 2025 to Q1 2026 inclusive. The analysis applies the JICMAIL category mapping documented in the model. A commercial impact is a recorded commercial action; it does not necessarily represent a completed sale or unique customer.

Carbon per commercial impact was calculated as PCF per item divided by commercial impacts per item. Carbon per impression was calculated as PCF per item divided by JICMAIL mail-ad impressions per item, where impressions reflect item reach multiplied by frequency of interaction.

These indicators do not change the product footprint or the LCA functional unit. They express the same emissions against modelled audience outcomes and should be interpreted as indicative category averages rather than campaign predictions.



6. Results

6.1 Product carbon footprints and MCI by format

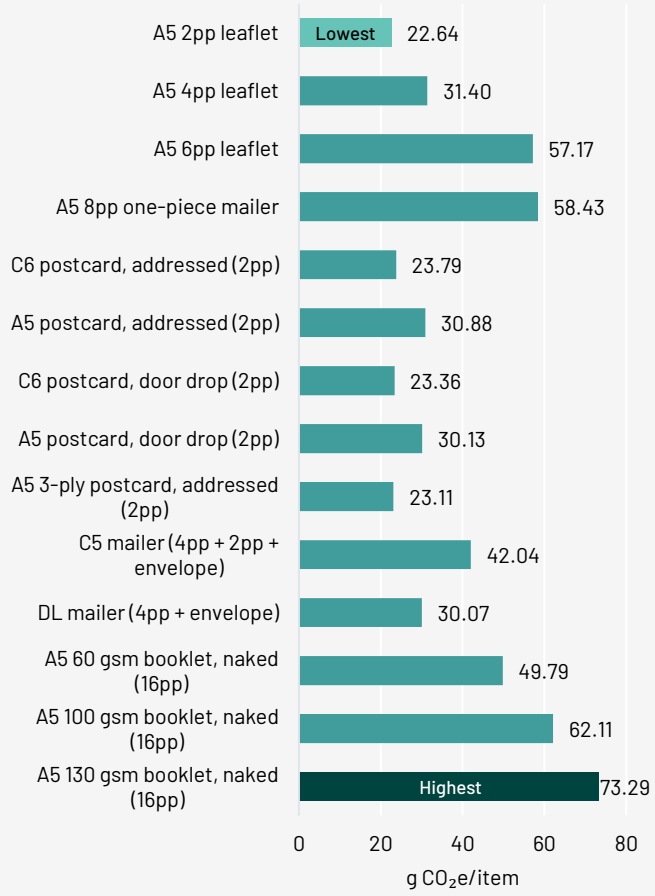
Table 3 summarises item mass, cradle-to-grave PCF and MCI for the fourteen formats at the 50,000-item reference quantity. **Figure 2** compares the corresponding PCFs.

Table 3. Base-case PCF and MCI results

Product format	Item mass (g)	PCF (gCO_2e/item)	MCI (gCO_2e/g)
A5 2pp leaflet	4.66	22.64	4.86
A5 4pp leaflet	9.32	31.40	3.37
A5 6pp leaflet	13.99	57.17	4.09
A5 8pp one-piece mailer	18.65	58.43	3.13
C6 postcard, addressed (2pp)	6.09	23.79	3.90
A5 postcard, addressed (2pp)	10.26	30.88	3.01
C6 postcard, door drop (2pp)	6.09	23.36	3.83
A5 postcard, door drop (2pp)	10.26	30.13	2.94
A5 3-ply postcard, addressed (2pp)	5.28	23.11	4.37
C5 mailer (4pp + 2pp + envelope)	17.89	42.04	2.35
DL mailer (4pp + envelope)	9.41	30.07	3.19
A5 60 gsm booklet, naked (16pp)	14.92	49.79	3.34
A5 100 gsm booklet, naked (16pp)	24.86	62.11	2.50
A5 130 gsm booklet, naked (16pp)	32.32	73.29	2.27

Note: *PCF is the total cradle-to-grave greenhouse-gas emissions per finished mail item. MCI is PCF divided by item mass. The fixed per-item delivery impact can increase MCI for lighter items, so MCI should be interpreted alongside the total impact of the item through its PCF.*

Figure 2. Base-case PCF by assessed format



Overall results

PCFs ranged from 22.64 to 73.29 g CO_2e/item. The A5 2pp leaflet had the lowest footprint and the A5 130 gsm naked booklet the highest. MCI ranged from 2.27 to 4.86 g CO_2e/g, showing that absolute footprint and carbon intensity are related but distinct measures.

Postcards and mailers

Postcard results ranged from 23.11 to 30.88 g CO_2e/item, while the DL and C5 mailers resulted in 30.07 and 42.04 g CO_2e/item. The relatively fixed delivery burden is more prominent for lighter items; materials and production account for more of the footprint as mass and complexity increase.

Effect of booklet grammage

The A5 16pp booklet PCF increased with grammage, from 49.79 g CO_2e/item at 60 gsm to 62.11 at 100 gsm and 73.29 at 130 gsm, reflecting the additional substrate and related processing requirements.

Interpretation of results

The products perform different communication functions and contain different quantities of material. The results should therefore be interpreted as product-specific footprints rather than evidence that one mail format is universally environmentally preferable to another.

6.2 Life cycle stage contributions and carbon hotspots

Figure 3 presents contributions from raw materials, production, delivery and product end of life.

Delivery

Delivery contributed 20.9%–61.9% and was the largest reported stage for nine of the fourteen formats. Its absolute contribution was comparatively stable at 14.02–15.31 g CO_2e/item because the 13.86 g CO_2e/item final-mile factor was applied per delivered item.

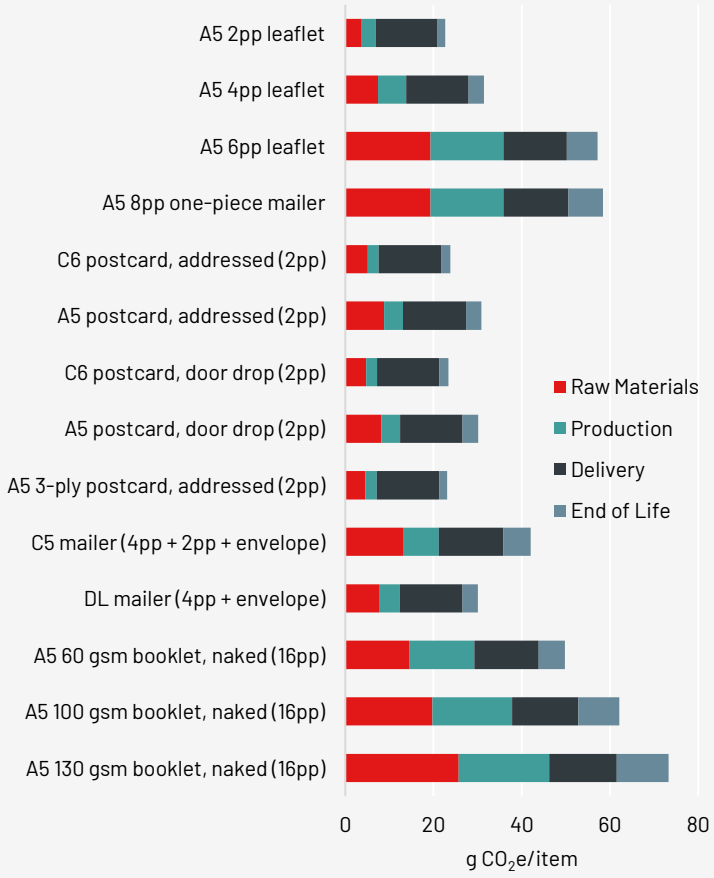
Raw materials and production

Raw materials contributed 16.4%–35.1% and production 10.8%–31.9%. These shares generally increased with item mass and manufacturing complexity; production was the largest stage for the 60 gsm booklet, while raw materials were largest for the 6pp and 8pp formats and the 100 gsm and 130 gsm booklets.

End of life and overall pattern

Product end of life contributed 7.2%–15.2%. The results therefore identify delivery as a major hotspot for lighter formats, while material and production choices remain increasingly important for heavier or more complex products.

Figure 3. Life-cycle-stage contributions by assessed format



6.3 Sensitivity results

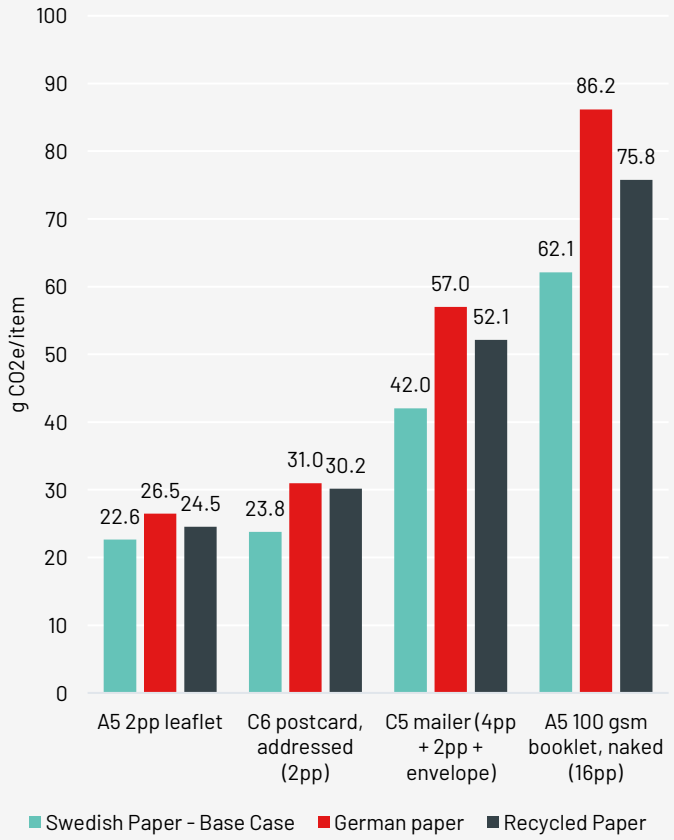
Sensitivity analyses assessed the influence of paper source, recycled content, print technology, outer configuration and selected product specifications. Results apply to the modelled scenarios and should not be generalised to all mail products or supply chains.

Paper production and fibre source

Figure 4 on the next page compares the Swedish base-paper scenarios, produced using a relatively renewables-rich energy mix, with the modelled German virgin-paper and Italian recycled-paper scenarios. The scenarios represent selected alternative European paper production configurations.

6. Results *cont'd*

Figure 4. Effect of paper production and fibre source on selected PCFs



German virgin-paper scenario

Replacing the Swedish base paper with the modelled German paper increased footprints by 17.0%–38.7% across the four representative formats. This sensitivity mainly reflects the different electricity mix applied to paper production; other possible differences between the countries, such as transport distances, mill fuels and site-specific manufacturing efficiency were not independently assessed.

Italian recycled-paper scenario

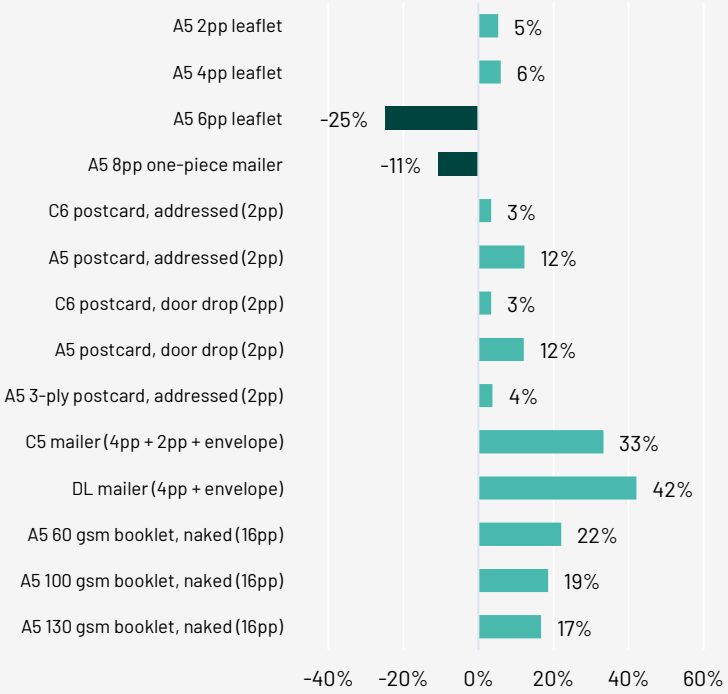
The recycled-paper scenarios were 8.4%–26.9% higher than the Swedish base cases but 2.5%–12.1% lower than the German virgin-paper scenarios. The recycled scenarios represent a specific commercially available Italian grade and its associated production profile, rather than the effect of recycled fibre alone.

The results therefore show that recycled content alone does not determine climate-change performance. The energy and manufacturing profile of the specific paper grade can also materially affect the result.

Print technology at high production volumes

Figure 5 presents the percentage change in PCF from digital to lithographic printing. Positive values indicate that litho has a higher footprint, and negative values indicate that litho has a lower footprint.

Figure 5. Change in PCF from digital to litho printing



Note: *Digital and litho results are compared at the same production quantity for each product. Comparisons use either 1,000,000 or 2,500,000 items, depending on the modelled format. The comparison applies the same finished-product specification and output quantity while accounting for the material use, production waste, energy and consumables associated with each modelled print configuration.*

6. Results *cont'd*

Digital printing had a lower footprint than litho for 12 of the 14 formats at matched high-volume quantities. For these formats, litho was 3.4%–42.1% higher. The result reversed for the A5 6pp leaflet and A5 8pp one-piece mailer, for which litho was 24.9% and 10.8% lower, respectively. At these high quantities, lithographic setup impacts were distributed across many items, while more favourable sheet geometry reduced the material required per finished product sufficiently to produce a lower overall result for these two formats.

Booklet outer configuration

Figure 6 compares naked booklets with the corresponding paper-outer and polywrap scenarios at each assessed grammage.

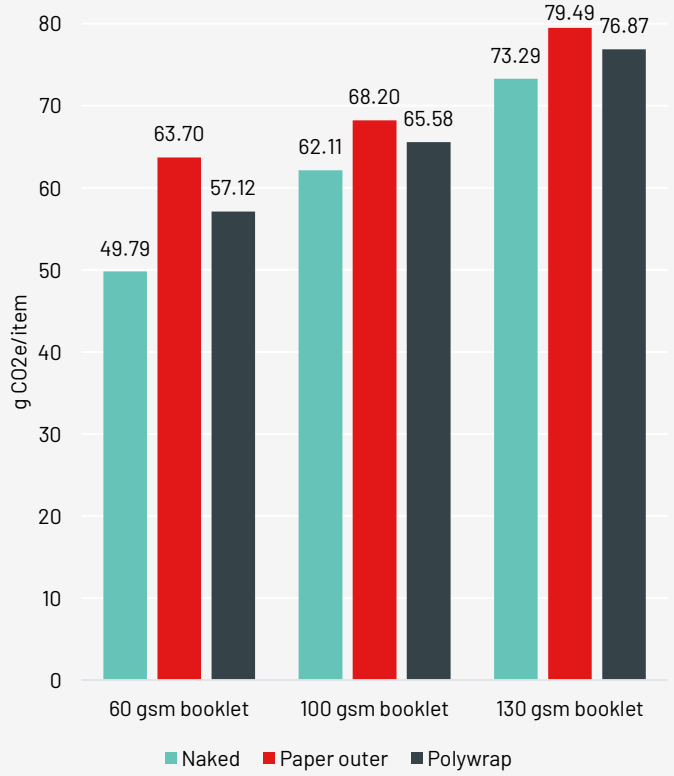
Adding an outer increased the footprint across all three grammages. Paper outer increased results by 8.5%–27.9%, while polywrap increased results by 4.9%–14.7%.

The proportional effect was greatest for the 60 gsm booklet because the outer represented a larger contribution relative to the lighter naked product. These findings cover climate change only and do not represent a complete environmental comparison between paper and plastic.

Envelope specification

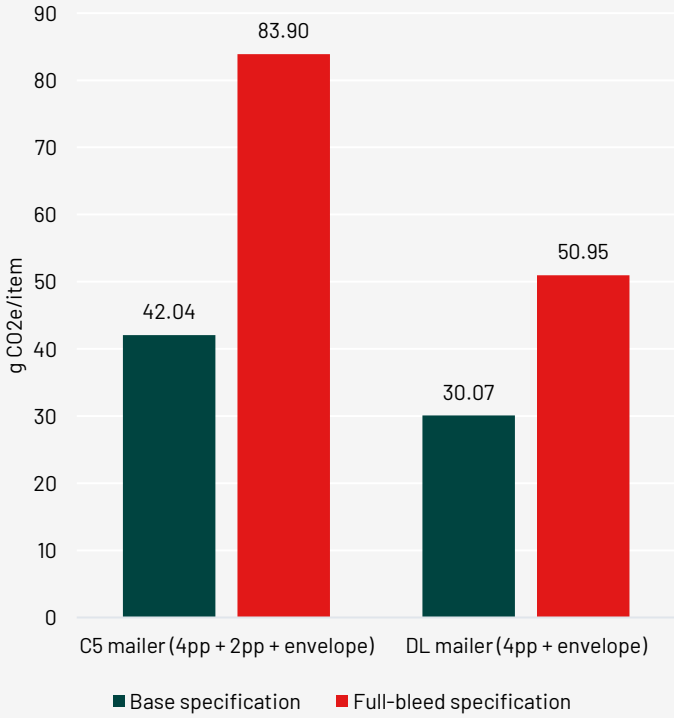
Figure 7 compares the base C5 and DL mailers with the corresponding full-bleed envelope scenarios.

Figure 6. PCF of naked, paper-outer, and polywrapped A5 16pp booklets by paper grammage



Note: *Results represent A5 16pp booklets produced at the reference quantity of 50,000 items.*

Figure 7. Effect of full-bleed envelope specifications on mailer PCF



Note: *The full-bleed scenarios model a 130 gsm coated sheet with four-colour printing and dedicated envelope conversion, rather than the 90 gsm pre-manufactured window envelope on uncoated stock used in the base case. The scenarios also reflect the different production scales over which envelope-conversion impacts are allocated.*

The full-bleed specification increased the C5 mailer footprint from 42.04 to 83.90 g CO_2e/item, an increase of 99.6%. For the DL mailer, the footprint increased from 30.07 to 50.95 g CO_2e/item, an increase of 69.4%.

These differences reflect the combined effects of envelope substrate, grammage, printing, conversion requirements and production scale. They should not be attributed to print coverage alone.

Overall, paper source and product specification had a substantial influence on the results. The effects of print technology varied by format, demonstrating the importance of assessing reduction opportunities at product level rather than applying universal assumptions across all mail.

The implications of these findings are discussed in Section 7.

6.4 Supplementary JICMAIL metrics

Table 4 presents indicative carbon per commercial impact (PCF per item divided by commercial impacts per item) and carbon per impression alongside the base-case PCFs.

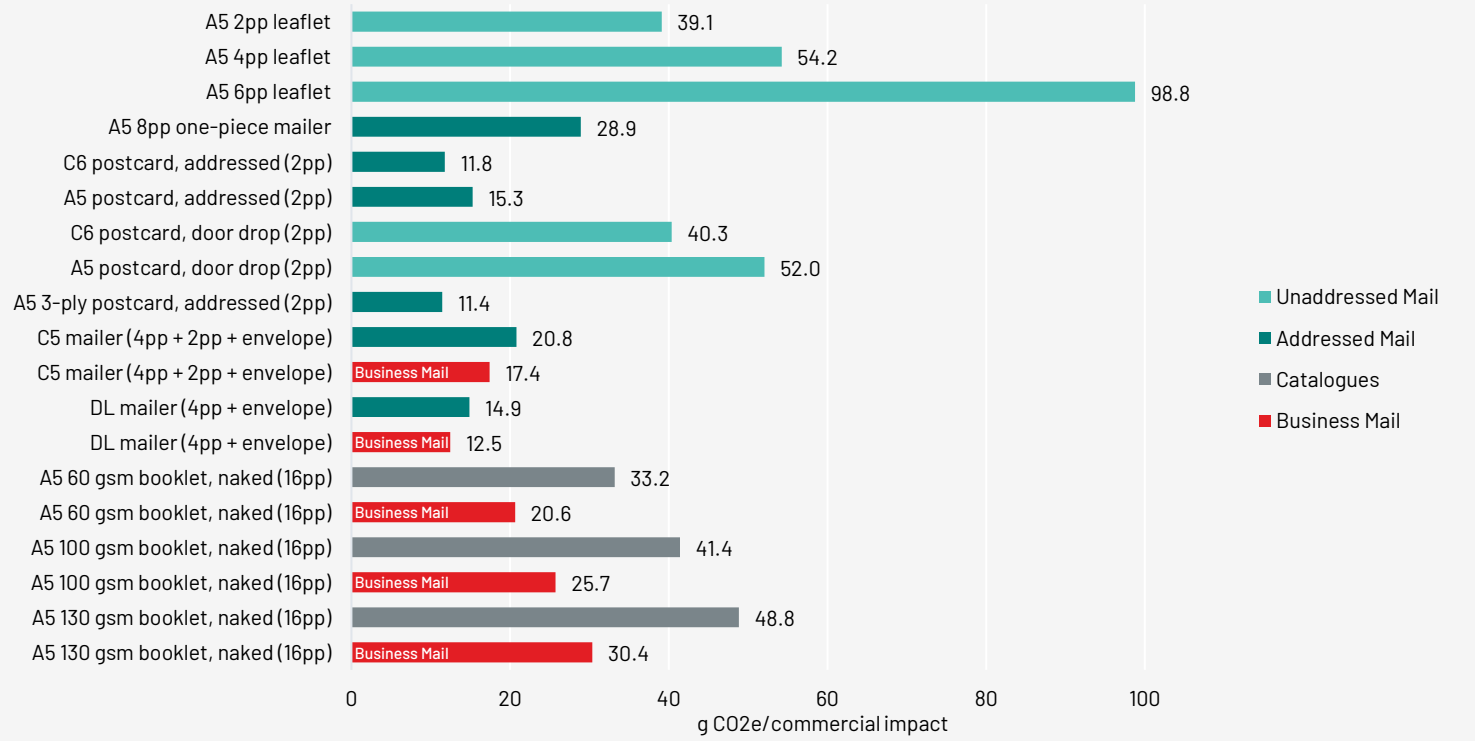
Across the primary JICMAIL categories, carbon per commercial impact ranged from 11.44 to 98.76 g CO_2e, while carbon per impression ranged from 4.49 to 17.42 g CO_2e. The A5 3-ply addressed postcard had the lowest result for both indicators; the A5 6pp unaddressed leaflet had the highest. Unaddressed mail has lower impact per item but delivers effective reach at scale.

Table 4. Supplementary JICMAIL metrics for the assessed mail formats

Product format	PCF (g CO_2e/ item)	JICMAIL category	Commercial impact/ item	Carbon/ commercial impact (g CO_2e)	Business Mail result (g CO_2e/ commercial impact)	Carbon/ impression (g CO_2e)
A5 2pp leaflet	22.64	Unaddressed Mail	0.58	39.11	–	6.90
A5 4pp leaflet	31.40	Unaddressed Mail	0.58	54.24	–	9.57
A5 6pp leaflet	57.17	Unaddressed Mail	0.58	98.76	–	17.42
A5 8pp one-piece mailer	58.43	Addressed Mail	2.02	28.92	–	11.35
C6 postcard, addressed (2pp)	23.79	Addressed Mail	2.02	11.78	–	4.62
A5 postcard, addressed (2pp)	30.88	Addressed Mail	2.02	15.28	–	6.00
C6 postcard, door drop (2pp)	23.36	Unaddressed Mail	0.58	40.35	–	7.12
A5 postcard, door drop (2pp)	30.13	Unaddressed Mail	0.58	52.05	–	9.18
A5 3-ply postcard, addressed (2pp)	23.11	Addressed Mail	2.02	11.44	–	4.49
C5 mailer (4pp + 2pp + envelope)	42.04	Addressed Mail	2.02	20.81	17.42	8.17
DL mailer (4pp + envelope)	30.07	Addressed Mail	2.02	14.88	12.46	5.84
A5 60 gsm booklet, naked (16pp)	49.79	Catalogues	1.50	33.19	20.63	10.05
A5 100 gsm booklet, naked (16pp)	62.11	Catalogues	1.50	41.40	25.73	12.53
A5 130 gsm booklet, naked (16pp)	73.29	Catalogues	1.50	48.84	30.36	14.79

6. Results *cont'd*

Figure 8. Indicative carbon per commercial impact by assessed mail format



Note: *PCF is the total cradle-to-grave greenhouse-gas emissions per mail item. A commercial impact is a recorded commercial action associated with mail, such as visiting the sender's website, making a purchase or payment, or using a voucher; it does not necessarily represent a completed sale or unique customer. Carbon per commercial impact is calculated by dividing PCF per item by the average commercial impacts per item for the JICMAIL category shown. Primary results use the applicable category; the red bars show an alternative Business Mail calculation for selected formats. Results use aggregated category averages and are not campaign-specific predictions.*

Category effects

Door drop formats had higher carbon per commercial impact than addressed equivalents despite slightly lower PCFs because the JICMAIL data attribute fewer commercial impacts to each unaddressed item. For the two mailers and three booklets, the red bars show how the result changes when the Business Mail category average is used instead of the primary category assigned in the study. Business Mail has a higher average number of commercial impacts per item, so dividing the same product PCF by this larger number produces a lower carbon-per-commercial-impact result. The underlying product PCF does not change.

Interpretation and comparability

These indicators relate the fixed product PCF to aggregated JICMAIL commercial outcomes. They show how the carbon-per-outcome result varies with the category average used, but they do not change the underlying product footprint and should not be interpreted as campaign-specific predictions. Comparisons with digital-media metrics are only valid where the outcome definition, functional unit and system boundary are equivalent.

7. Life cycle interpretation

7.1 Key findings

PCF and MCI measure different outcomes

Absolute PCF generally increased with product mass, page count and complexity, but MCI did not follow the same ranking. The two metrics answer different questions: PCF describes emissions per delivered item, whereas MCI expresses those emissions per gram of product.

Delivery dominates lighter formats

Delivery was the largest reported stage for nine formats because a fixed Royal Mail final-mile impact of 13.86 g CO_2e, representing the final delivery stage to the recipient, was allocated per item. Its proportional importance was greatest for lighter products. Raw-material and production impacts became more prominent as mass and manufacturing requirements increased, so product specification remains a key controllable lever.

Product and production choices materially affect results

Paper-production energy materially affected results: the modelled Swedish paper scenario produced the lowest footprints, while the Italian recycled-paper scenarios fell between Swedish and German virgin-paper scenarios. Digital printing generally produced a lower carbon footprint at matched high volumes, but sheet geometry reversed the result for two formats. Neither fibre source nor print technology should therefore be treated as a universal indicator of a lower carbon footprint.

Product specification is a key reduction lever

Higher booklet grammage, added outers and more complex envelope specifications increased PCFs. JICMAIL-based results also varied markedly because audience outcomes differed by mail category; they provide useful internal context but do not alter the underlying LCA results.

7.2 Data quality, robustness and uncertainty

Representative UK and European data

The representative mail formats and production scenarios were selected to reflect common mail applications in the UK market. UK-specific data were used for downstream transport and end-of-life modelling. Representative European datasets were used for upstream material production, with country-specific multipliers applied to reflect the energy profile of the modelled paper-production country.

Consistent modelling across all formats

The model was reviewed for completeness and consistency. Relevant life-cycle stages and material inputs within the defined system boundary were included, and the same functional unit, system boundary, allocation approach and impact-assessment method were applied across all assessed formats.

Uncertainty assessed through sensitivity analysis

Uncertainty was assessed qualitatively through review of the modelling assumptions and sensitivity analysis rather than through statistical uncertainty modelling. The sensitivity analysis showed that paper-mill energy, print technology and sheet geometry, booklet configuration, and envelope specification could materially influence individual product results.

Suitable for the intended application

Overall, the selected data and modelling approach were considered suitable for the study's intended application as a representative assessment of UK mail formats. The conclusions remain subject to the assumptions and limitations described in this report.

7.3 Conclusions and evidence-based carbon reduction opportunities

Based on the assessment, carbon-reduction efforts should focus on:

- **Selecting paper using mill-specific carbon and energy information** rather than relying on recycled content alone;
- **Reducing grammage, page count and product mass** where function and quality permit;
- **Avoiding unnecessary outers** and selecting lighter, simpler envelope specifications where appropriate;
- **Comparing digital and lithographic production** for the intended format, sheet geometry and quantity;
- **Improving sheet utilisation and reducing production waste**;
- **Using audience and campaign-performance evidence** to avoid unnecessary production, while recognising that targeting benefits were not quantified within the product PCFs; and
- **Supporting Royal Mail's continued network decarbonisation,** including its aim for a 100% zero-emission final mile by 2035, which is expected to reduce the delivery emissions allocated to mail items.



Apply findings at product level

The findings should be applied at product level and within the study's defined specifications and system boundary. They should not be used to support universal claims that one paper type, print technology or mail format is always lower carbon.

8. Study limitations

Climate change only

This study assesses climate change only and is not a complete environmental or circularity assessment. End-of-life treatment is included in the climate-change results. Recyclability and material circulation may be discussed as supporting context, but circularity was not assessed using a separate indicator or framework.

Representative rather than supplier-specific

The formats and production scenarios are representative rather than supplier-specific. Actual footprints may vary with paper mill, printer, production volume, sheet utilisation, energy supply, transport, manufacturing efficiency and waste rates.

Reference quantities and scenario comparisons

Base-case results use a reference quantity of 50,000 items. The digital and lithographic comparison uses commercially relevant high-volume quantities. These scenarios were compared at equivalent quantities within each format but should not be compared directly with the base-case results.

Results are product-specific

The products perform different communication functions and contain different amounts of material. Primary results reported per item do not account for campaign reach, response or commercial effectiveness and should not be used to determine that one format is universally preferable.

Supplementary JICMAIL metrics

The supplementary results use aggregated JICMAIL averages and are not campaign-specific. Performance may vary by audience, sector, content, creative execution and campaign objective. A commercial impact does not necessarily represent a sale or unique customer.

Use, end-of-life and delivery assumptions

Printed mail was assigned no use-phase emissions. End-of-life results use modelled UK routes and may differ from actual treatment. The Royal Mail final-mile delivery factor is an operational average allocated to individual items and does not represent route-specific emissions.

Model uncertainty

The results contain uncertainty arising from modelling assumptions and secondary life cycle inventory data. No formal quantitative uncertainty analysis was undertaken; conclusions and external communications should therefore remain within the defined scope, specifications and intended application.



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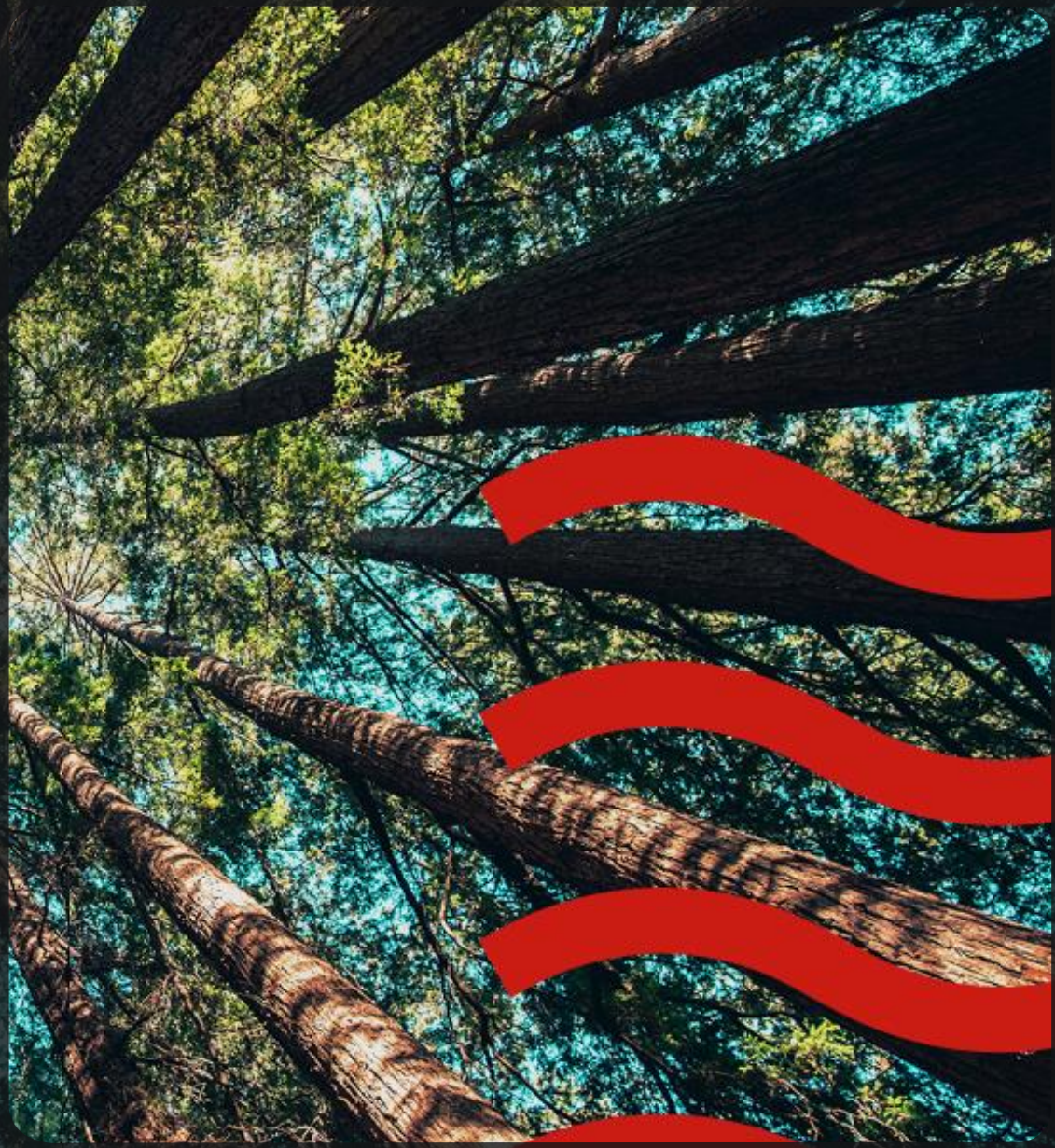


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