BIC Green Supply Chain Designed for Recycling Project

Part 1 – Life Cycle Assessment

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The UK Book Industry's Supply Chain Organisation

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This report details the findings of the BIC Task and Finish Working Group (T&FWG) regarding the BIC Project Design for Recycling, Part 1 Life Cycle Assessment. This project comes from the BIC Green Supply Chain Committee Work Plan 3. Design for Recycling Project, i Life Cycle Assessment, and forms the first project to look at the recycling of books in the supply chain. Part 2 will look at putting recyclable design at the heart of designing a book from the publisher up to and including the manufacturing of the book. Part 3 will then look at ways to improve recycling in the parts of the supply chain not already covered in the previous projects.

For this report we are using DEFRA (Department for Environment, Food and Rural Affairs) definition of recycling as any operation by which waste is reprocessed into products, materials or substances, for either its original or other purposes.

1. Purpose

The purpose of this project was to assess the recycling and waste programs that are used in the book industry and report on the materials being disposed of vs recycled, the carbon footprint impact of books etc. The project's T&FWG will help identify the points in the book industry supply chain lifecycle where recycling/waste occurs and list the materials involved at these stages. These materials will then need to be assessed for their recyclability, how much is being recycled, their carbon footprint, sustainability, and general green credentials. It is intended that the outcome of this assessment leads to a 'Designed for Recycling and Waste Prevention in Manufacturing' combined project. To look at all aspects of waste prevention was deemed by BIC too large a project to be completed in one go. However, it was agreed that manufacturing links directly with how a book is designed and printed. A separate BIC project will look at waste prevention in the whole supply chain.

Methodology

The T&FWG team divided the task of investigating the supply chain into areas that they had contacts, experience knowledge. They then enlisted the help of those people and companies to ascertain what recycling was currently being done by them, and to obtain numerical data around how much material was being recycled compared to going to landfill or being burnt/destroyed. The publishers in the T&FWG concentrated on their own publishing houses practices and paper mills and merchants. The printers in the T&FWG looked at their own processes, what happened to the recycling that was collected from their plants, and how it was recycled. Some of the T&FWG team also looked at doorstep recycling of books. By "doorstep recycling" we mean individual members of the public's recycling options and practices.

Approaches were made to BIC members working in the following areas: libraries and library procurement, warehousing, shipping, and bookselling. Although these contacts did not have time to work on the project itself, they kindly agreed to provide information and data around their recycling practices.

The work involved; talking to organisations across the book industry supply chain (from publishers through to booksellers), online research, and liaising with experts on book recyclability. A lot of time was spent investigating exactly what happens to books when they are being recycled as it transpired throughout the course of the investigation that there are many lines of investigation to follow until you have a full picture.

There is also the question of 'What is a book?' A book can take many forms, and we probably think of a book as something we buy in a bricks and mortar or online bookshop, or take out of the library (public, academic, institutional, or other). For this project we are defining a book as a physical item, that has printed content (however minimal) for reading for pleasure or learning, which includes journals. The end-of-life investigations have also shown that products such as notebooks, diaries, directories and other such printed matter or paper bound between a cover also end up in the same recycling and pulping processes.

2. Results and findings

2.1 Publishers

Encouragingly, our investigations revealed that from a publisher's perspective, the end-of-life recyclability of a book is often determined during its conception and initial design. This mainly involves consideration of the materials being used in the production of a book, such as the paper, type of cover material be that paper based, cloth or leather. Then there are the extras such as foil, glitter and different types of laminations used on the cover, all of these have an effect upon the recyclability of a book and its sustainability.

Another consideration is the quantity of books they are going to print, which then ties in with sales, returns and ultimately the number of books that will be recycled without ever being sold or leaving the warehouse. Our investigations from the publishers in the T&FWG team revealed that this is directly linked with their sustainability goals and requirements to reach net zero by 2050.

3.1.1 Carbon Footprint

If we look at the carbon footprint of a book there are variations between academic and trade publishers and this relates to the printing location, number printed, what shipping was involved and the use of POD (Print on Demand) as the delivery strategy for a title. Although it has not been possible to determine extensive data due to commercial sensitivity.

The CO2e (carbon dioxide equivalent) associated with a single book will vary significantly depending on several factors – what materials are being included in the CO2e calculations, where the book is being printed, how far a product must travel to a warehouse or its end customer, and the method of transportation for all these journeys. Carbon dioxide equivalent is the new measure of CO2 as it considers all the other harmful greenhouse gases such as methane. It is important to understand the carbon footprint of products so you can work to mitigating them as part of an organisations journey to net zero. When analysing this, and comparing data sets, it is important to also look at what protocols are being used, are the parameters and scope. There is also a difference in opinion between publishers on the T&FWG as to if we should be talking about the CO2e associated around a single book, or the CO2e associated with an organisation.

Measurements of greenhouse gas emissions can differ in multiple ways which should be considered when comparing emissions between organisations and products.

Scope of measurement

Firstly, regarding the materials and processes included within the scope of the measurement. CO2e or carbon footprint is typically measured following the Greenhouse Gas Protocol, an international accounting framework for organisations, products and projects defining three scopes of emissions divided based on the degree of control over the emissions source. Scope 1 typically covers all activities within an organisation's direct control, released at source from the reporting company's premises such as any onsite combustion of fossil fuels or biomass. Scope 2 includes the emissions associated with a company's purchases of electricity and scope 3 covers all sources across the upstream and downstream supply chain, as well as business travel and commuting. These scopes of emissions may then be used to estimate the emissions at product level through allocating each scope to the lifecycle. The selection of categories and materials to be included within a carbon footprint is qualitative, based on very subjective judgements on what aspects are relevant, the anticipated effect on emissions or differing organisational structures and positions. For example, whether the emissions associated with heating the printing site would be considered as relevant to include within the footprint of a product or to the organisation only.

Carbon intensities

This is mirrored at higher level, with variations between how emissions are attributed to different processes and materials outside of the organisation's direct control in scopes 2 and 3. Emissions for these scopes are measured using carbon intensities; quantifying the emissions released per a unit of activity such as tonne of paper produced or KWh generated.

An assessment by Intergraf suggests one of the largest emissions associated with the production of a book is likely to be in the production of paper. However, there are multiple standards used to estimate the emissions associated with the manufacturing process. The most common frameworks only cover emissions released at the pulp and paper mill itself, missing a key segment of emissions associated with the sourcing of other raw materials within a paper supplier's scope 3. And whilst paper is one area in which supplier or product specific carbon intensities are available, other production materials associated within a book such as inks and printing plates may be excluded due to the current lack of specific measures.

Within scope 2, there are two methods under the Greenhouse Gas Protocol to measure the emissions associated with the electricity used to manufacture products.

- The location-based method reflects the physical flow of electricity to the reporting company, most commonly using the carbon emissions associated with the mix of generation sources within the region and measured consistently for organisations within the same area.
- The market-based method is often less comparable, using a range of contractual instruments to reflect the emissions released by the energy source chosen by an organisation. The eligibility of different types of contractual instruments is currently under review by the Greenhouse Gas Protocol as the allocation of certain renewable energy tariffs likely conflates relevant differences in emissions.

The choice of accounting method for scope 2 can cause significant differences in emissions. For example, a company may use a renewable energy tariff to claim zero emissions under the market-based method compared to the grid average emissions under the location-based method.

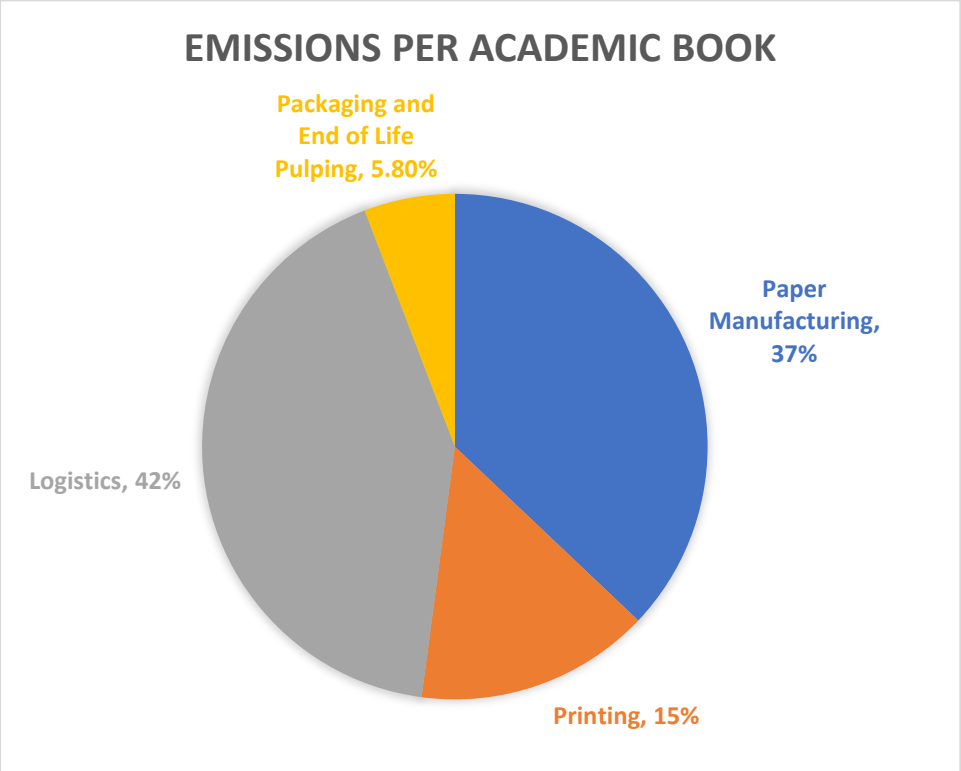
Variations in both the scope of measurement and the carbon intensities selected by different reporting companies limits the like-for-like comparability between products and organisations. Any measurement of carbon footprint needs to be accompanied by a detailed breakdown of the calculation methods to contribute towards industry-specific standards for organisational and product level carbon footprints.

3.1.1.1 Book Industry Emissions Data – examples

The following emissions data have been calculated using DEFRA conversation factors, and are here to give an indication of the emissions associated with the book industry. As noted above there are various ways of calculating these figures, depending on what is or isn't included in the calculations.

For an **Academic Publisher**, the average emissions per book is around **1.6kg CO2e**. If you break this down by key stages in the lifecycle of the book, it approximates to the table below. You can see that the largest contributor to a products carbon footprint is the logistics 42%, followed by the paper used in its manufacture 37%. When it comes to book pulping and emissions 5.8%, it works out at around **12g CO2e** per book for an academic title. This was calculated using the DEFRA emission factors for Closed Loop mixed paper disposal, only extends as far as the transportation to the pulping/recycling facility. The actual emissions for pulping will differ depending on whether the material is pulped with the intention of making cardboard boxes and packaging, or whether it is made into recycled print-grade paper, and these would be allocated to the next user in the chain i.e., not to the Academic Publisher.

EMISSIONS PER ACADEMIC BOOK		
Activity	CO2e	%
Paper Manufacturing	592g	37%
Printing	240g	15%
Logistics	672G	42%
Packaging and End of Life Pulping	92.8g	5.8%



3.1.1.2 Packaging

The data provided below for packaging is based upon an academic title taking average figures from across the publisher's product range. It has not been easy to gather information in this area. According to one trade publisher that we consulted, for one pallet they use around 168g of pallet wrap.

We know that pallet wrap is an environmental concern for packaging and transportation generally in the industry. There are now biodegradable wraps available, but some shippers are not using them as they degrade down to microplastics, which are known to be even worse for the world's ecosystem. One shipper did say that they are using a thicker, stronger pallet wrap so that they use less of it. This is not ideal, but one way of looking at it, until a permanent solution has been found.

Average Packaging Per Single Book Order	
Cardboard	90g
Paper	30g (Most don't use as they use cardboard sleeves)
Plastic	50g (Most don't use plastic as they use cardboard sleeves)

Average Packaging Per Carton / Box of books	
Cardboard	400g
Paper	90g (Paper filler)
Plastic	30g

Despite our best efforts, we were unfortunately unable to gather any data around CO2e emissions from a trade publisher or from other areas of the supply chain.

3.1.2 Publisher's recycling data

From the publisher's perspective some of data around how many books and journals are being recycled through pulping or the tonnage of paper is sensitive, and we are unable to gain a full picture of what is happening in the industry. However, the information provided below gives an indication of what is going on with one publisher in the UK.

Pulping Tonnage (MT)						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**
Books	443	520	388	90.7	217	460
Journals	80	67	82	180	64	41
TOTAL	**523**	**587**	**470**	**271**	**281**	**501**

It is hard to divine a trend from this data. Although the reduction in pulping Journals over the last 3 years could be attributed to the move to Open Access Journals, and therefore fewer journals being printed and pulped at a later date.

The following data combines a number of publishers together as they use a shared warehouse resource. The numbers above are also included in this table below.

Pulping Tonnage (MT)						
	2016	**2017**	**2018**	**2019**	**2020**	**2021**
TOTAL in metric tonnes	**1507**	**1850**	**2117**	**1781**	**1991**	**3153**

The only trend one can draw from this data is that pulping has been increasing across the years, but with a dip that corresponds to the pandemic. The huge leap up in 2021, is probably due to a catching up on stock reductions and hence recycling through pulping while nothing happened during the various UK lockdowns. This is sensitive data and we are unable to say how many books these pulping tonnages refer to.

We have been told from one publisher, that of all the books returned to the warehouse only 13% are 'green box', which means that they are good enough for several reasons to be resold. This leaves 87% that are sent for recycling as they are not fit for resale. For another publisher it was 10% being resold and 90% sent for recycling. In both cases this is a huge proportion of books being pulped and recycled.

Our investigations show that academic books generally have much lower print runs (average typically in the hundreds of copies) and lend themselves more to Inkjet printing, and POD distribution models. This also leads to more standardisation of papers and trim sizes to fit the various models being used by the publisher. The majority of the work is printed mono (printing black ink only on paper), which can be printed close to market using a global network of printers to deliver the product. These

products tend to have much higher retail prices to trade books. The recycling of such books can be simpler as there are fewer contaminates, such as ink, foil, spot UV and other cover lamination options.

This is compared with trade books that have much longer lithographic[1] print runs (average typically in the thousands of copies) with more embellishment to the book covers. Due to the selling price point and the need to make a margin, these tend to be produced in global locations that can offer a lower UMC (Unit Manufacturing Cost), requiring greater shipping distances to reach their markets.

We know that returns are an issue in the industry especially as, on average, they can run (anecdotally) at approximately 10-30%. So, depending upon the print run this can be a high volume of books that are being returned to the publisher either to be returned to stock or as detailed above more likely recycled.

The sale or return model that is used in publishing does not help with the volume of returns, and arguably exacerbates the issue. Additionally, there are the current issues in the supply chain around paper availability. At the start of the pandemic with all the global lockdowns paper mills saw the demand for paper for books halve overnight. As they didn't know when demand would return if ever, a number of mills either closed or converted their operation to producing packaging. These mills have not reopened or reverted to making paper. Packaging is more profitable than paper, and this, coupled with the increase in online shopping has only helped to keep the low availability of paper in the market.

All these factors are making printing decisions much more complicated. Printers are struggling to maintain paper supplies, and extending printing times to compensate for this. Publishers are then reacting to this by using different and opposing solutions to the crisis. Firstly, by printing more copies for the first print run to make sure they have the paper they want, that they do not run out of stock and therefore avoid a reprint. Secondly, they are printing shorter first print runs, and then printing more reprints. Publishers are also having to make different paper choices to those they might normally make to maintain production schedules and more importantly publication dates. The question is how many of these books are going to end up being pulped? The whole book industry really needs to examine how it is operating and be prepared to make radical changes to be more sustainable, which is where Parts 2 and 3 of this project come in to help design books with recycling at the forefront to begin with.

3.1.3 The recycling and pulping process of books

To better understand the book recycling and pulping process, we consulted with a US paper recycling merchant. The following is their response: with regards to

3.1.3.1 What is the end-to-end process for pulping from receiving books for pulping through to the creation of new product from the pulp?

1. Books are collected by the recycling company from a publisher's warehouse and transported by lorry to a commercial recycling centre,
2. The recycling centre processes a variety of recyclables - from clean, white roll paper to corrugated to plastics and metals,

[1] A printing process using the fact that oil and water do not mix, content is etched / burned onto a plate (usually aluminium). Plate is treated so that the image areas are receptive to oil (i.e., ink) and repel water, non-image areas are receptive to water and repel oil therefore the two areas remain separate. Ink is then transferred onto a substrate either onto a blanket for offset printing or directly to the paper.

3. Upon receipt, the recycler sorts the products into different classifications based on the expected resale grade and re-usability of the processed recyclables,
4. The whole book including the cover, head and tail bands, and any ribbons if used, is fed into an industrial shredder, where the books are shredded into small pieces of paper that are then baled into 1200 to 1500 lbs. bales. These bales are then shipped to a paper mill to make paper products. It should be noted that CD/DVDs would be removed before shredding,
5. There are two possible grades of waste that can be produced from shredded books. This is determined by the thickness of the book (percentage of covers vs. pages) and the type of paper the books are printed on (freesheet or groundwood),
    a. High grade books (those that are printed on freesheet pages and are thicker than 1 inch) can be shredded and sold as a substitute to Sorted Office Waste[2] which is then de-inked and manufactured back into tissue products or deinked pulp to be used in printing and writing paper manufacturing,
    b. Bulk grade books (those that are printed on groundwood pages or are thin freesheet books less than 1 inch) can be shredded and sold as a mixed paper substitute to the board mills to make paper products such as plasterboard liner or solid cardboard,
6. The Bulk Grade output is sold to various firms who use the Bulk Grade as an input to their products, typically corrugated makers,
7. The process for treating the Bulk Grade waste occurs at other firms in the supply chain, downstream and away from the shredder/recycler,
8. The amount of energy and chemical processing applied by these downstream firms varies tremendously by the type of goods being produced, as in 5 a and b above.

3.1.3.2 How much of a book is able to be pulped? Does this include the cover? 100%. The process of cutting covers and separating the covers from the pages is very labour intensive and is not economical at this time. Recyclers have moved to shredding the books as is and the mills have found a way to use the shredded books as part of their supply of raw materials, otherwise known as furnish.

3.1.3.3 How do you deal with glues and other types of binding? Water soluble glues are the most easily recyclable; however, all glues used in conventional book bindings are able to be screened out in the pulping process by the consuming mills. Mills have come a long way over the years in figuring out how to screen out adhesives during the papermaking process.

3.1.3.4 Are chemicals used in the pulping process and are there any environmental concerns with their use? Chemicals are not used in the shredding process, however, when the shredded books are converted into downstream products there typically are chemicals used to de-ink and process the material. Those chemicals are specific to the type of end product being made. Chemicals that are used in the process are environmentally friendly.

3.1.3.5 How energy and water intensive is the pulping process? Energy is used to transport the books to the commercial recycler and to operate the industrial shredder. It is no more energy-intensive than other single-stage industrial processes. There is water used in the pulping process (deinking process). The overall usage of water will vary based on the mills processing it. Most mills run a closed-loop water system – where the water gets filtered and reused again in the system with very little freshwater needs. Energy used to pulp the shredded material is much less than trying to de-fibre virgin wood products.

[2]Definition from CEPI EN643 which is the grading of paper: Paper, as typically generated by offices, shredded or un-shredded, printed, may contain coloured papers, with a minimum 60 % wood-free paper, free of carbon and principally free from carbonless copy paper (CCP)/no carbon required (NCR), less than 10 % unbleached fibres including manila envelopes and file covers, less than 5 % newspapers and packaging

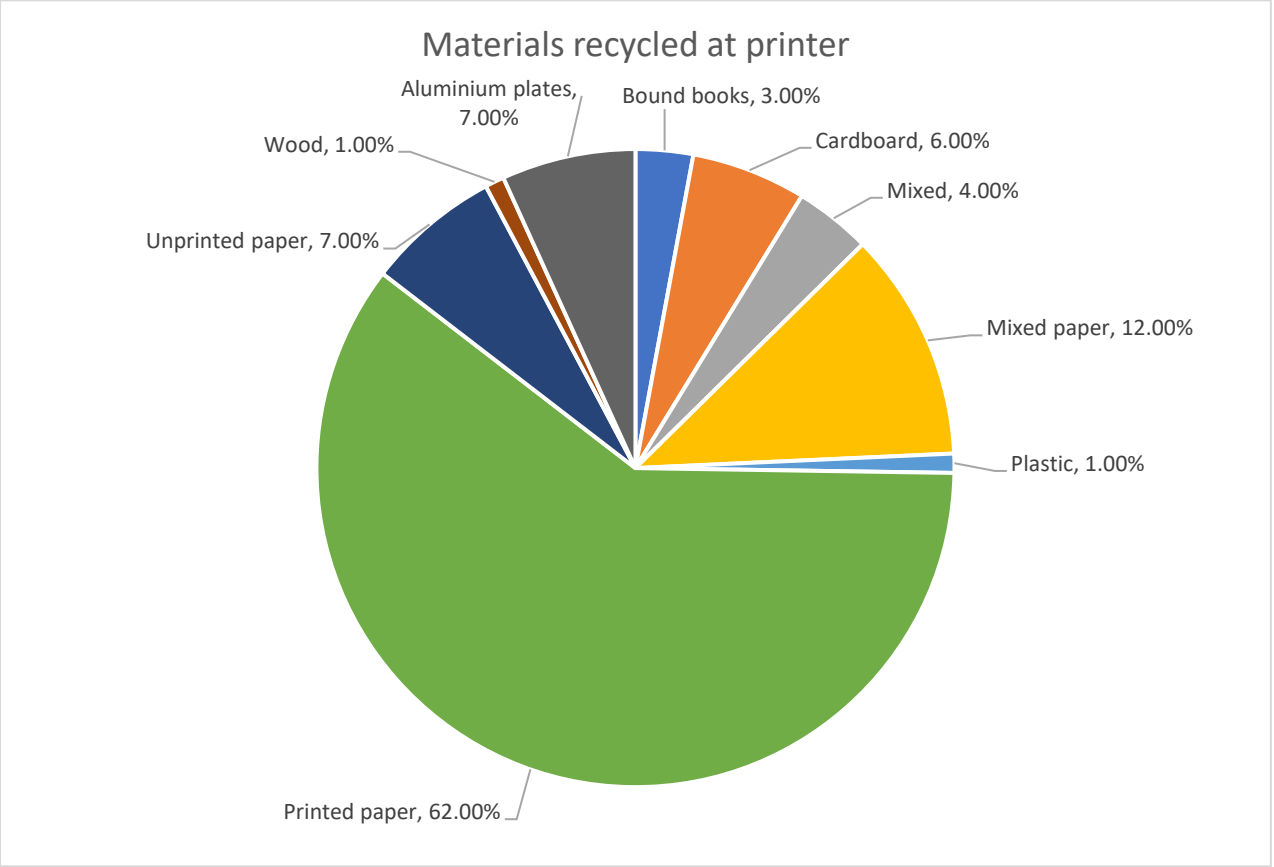
3.1.3.6 When books get shredded in their entirety, how do the mills then filter out the laminates, and what happens to these plastics? The laminate is chopped up in the shredding process, then the downstream mill that uses the recycled material employs a series of filters that remove the laminate. Apparently, there is some variability in different mills' ability to deal with the laminate: more sophisticated mills have better processes for removing it, which allows those more sophisticated mills to make higher quality recycled products.

3.2 Printers

Printers are set-up to recycle as much as they can as part of the manufacturing process. Printers work continuously to reduce the wastage generated and look for reusable alternatives, and as well as phase out or eliminate materials that are harder to recycle, such as cover laminations, varnishes and foils, and plastics used in packaging.

Paper is collected and separated at the various stages of the printing process, which includes spoilages (printed pages that aren't fit to be used in a book), make readies (printed pages that are created when setting up the printing press to run at its optimum for ink coverage and quality) and over production. This means virgin paper, which has the highest recycling value, is not mixed with paper that has been printed on. That in turn is separated from the offcuts from trimming books and covers. All materials collected are recycled using an approved recycling company that provides certificates of what has happened to the waste. The following table outlines all that is recycled at a printer, and averaged across the T&FWG printers that supplied data.

Recycled materials	Average %
Bound books	3.0 %
Cardboard	6.0 %
Mixed	4.0 %
Mixed paper	12.0 %
Plastic	1.0 %
Printed paper	62 %
Unprinted paper	7.0 %
Wood	1.0 %
Aluminium plates	7.0 %



The hazardous waste material, such as Chemicals and Inks are also disposed of in a safe and responsible manner using approved companies under the REACH (Registration, Evaluation, Authorisation, and Restriction of Chemicals) regulations. This is governed by law as to how hazardous materials are disposed of.

3.3 Paper Merchants and Mills

We approached a number of paper merchants and mills to see what data they could provide us regarding the papers they either sold or manufactured. We also sent a survey to those who agreed to complete a questionnaire around their processes. The following response comes from Holmen based in Sweden. Holmen manufactures its paper from trees that are grown around its own mills specifically for paper. Although the survey was quite long, due to the limited number of questions that could be answered the following detail the main points of Holmen's response.

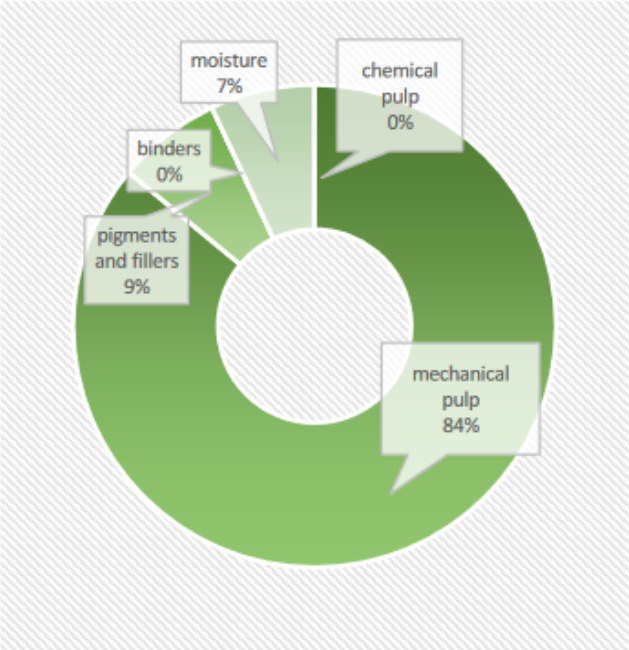
Question	Holmen response
Top 5 most produced brands?	Business sensitive information that we cannot share. We produce uncoated papers among them Holmen BOOK. For more example of papers we produce, please visit our Download centre
Do you know where the pulp is sourced from?	Own plantation - our mills are integrated mills which means that pulp is produced on site.
Can the paper be recycled? If yes, how?	Customer can recycle in normal disposal (at curb side, recycling bins)
Can the paper be recycled in printed book form?	We can only vouch for the paper and not any following treatment at the printing site that can/might affect the recyclability

Does the paper have any sustainable credentials or accreditations? If yes, please explain?	ISO 14001 (the mills), Paper Profile, Carbon Footprint, EU Ecolabel, Ecovadis Platinum level (the mills) among others. Please see our download centre

If you would like to see a full copy of the questionnaire then please email info@bic.org.uk.

The diagram below shows product data for an average Holmen Braviken Book Paper:

PRODUCT COMPOSITION



This product contains biomass carbon, equivalent to 1533 kg of CO2 per tonne of product.

10 Toes of CEPI Framework	Fossil CO_2 (kg per tonne paper)	Biogenic CO_2 (kg per tonne paper)
1. Carbon sequestration in the forest		
2. Carbon stored in the product		-1569
Net sequestration of biomass carbon		
3. GHG emissions from pulp and paper production	17.4	
4. GHG emissions associated with producing virgin or recovered fibre	27.1	
5. GHG emissions associated with producing other raw materials	21.5	
6. GHG emissions associated with purchased or sold electricity and steam	17.2	
7. Transport-related GHG emissions	14.9	
8. GHG emissions attributable to product use (e.g. printing)		
9. GHG emissions attributable to end-of-life-management of products		
10. Avoided emissions		
Total fossil CO_2 emissions	**98**	

3.4 Warehouses and Distributors

From the UK distributor that we spoke to warehousing is now paper-free (excluding the actual book product). They use an Auto-Pack – Pack crushing method to pack the books. This physically reduces empty space within packaging/boxes, holding the contents more securely, and requiring significantly less void filling material. This also reduces the overall size of packaging, resulting in more packages per pallet, resulting in more packages per lorry, and hence fewer lorry journeys to deliver books to their destination. This all helps in reducing the carbon footprint created by onward journeys.

When it comes to recycling; packaging (cardboard, paper, plastics) received through the goods-in process is sorted (black plastics separated), and the remaining re-used as packing/filling material within the despatch and returns processes. Efforts are made to try to not use external recycling channels, and equally to not use new packing/filling material where possible.

LPR (License Plating – box level manifests) are in use for all in-group company deliveries between internal warehouses and publisher warehouses. This is where re-usable totes (solid plastic boxes) are used for all products moving between group sites. This is being expanding to cover publishers/suppliers where publisher/supplier can accommodate. Highest recycled content cardboard packaging sourced. Currently minimum 65% and maximum of 100%.

3.5 Freight Forwarders

From the UK Freight Forwarder that we spoke to a Freight Forwarder will usually offer an end-to-end service for moving goods, usually internationally, from a manufacturer to a business customer. In order to do this, they will either supply and/or subcontract services from other speciality businesses, for example warehouses, trucking companies, shipping lines, airlines, customs brokers. Services provided may cover imports, exports, or cross trade movements. Different sectors within the supply chain will each have their own organisation that manages their trading standards and liabilities.

When it comes to recycling there are various options and processes in operation:

- In the EU there are very specific pallets that will be stamped with EUR. These are known as exchangeable Euros, and when a delivery is made by the freight forwarder, they will collect the same number of empty pallets in return.
- Some individual UK warehouses will work on a pallet swap, which is great for weekly deliveries if you, but fuel consumption needs to be factored in if only delivering/collecting a few at a time.
- Books are a heavy, dense product, and as such require good quality pallets. Pallets are sold in different grades: Books require the use of A-grade, with closed boards on the top to stop the bottom layer getting damaged. These pallets are generally recycled within the industry, and of course the wood has value as the pallet quality begins to deteriorate.
- Shrink-wrap too is widely recycled; investigations have been made between the freight forwarder and The Book Chain Project to find a compostable product. One was found, but it was considered that it was not a perfect product as it decomposes into micro plastics.
- Shipping containers with their heavy steel and wood construction can end up as site huts and even housing.
- Freight forwarders do not generally have to deal with the cardboard cartons, but these are easily recycled with normal household waste.
- Even overstocked or damaged books are generally pulped and recycled.

It is clear from our investigations, and reassuring to note that there is very little that cannot be recycled from a freight forwarder's perspective.

3.6 Booksellers

The following information has kindly been provided by Waterstones with regards to their bookshops and their warehouse, Book Hub.

Waterstones shops

- All shops have a regular recycling collection arranged for paper/cardboard and other recyclables with their local council,
- Bins across the Waterstone's estate and at head office are separated into recyclable/non-recyclable
- Plastic totes (plastic boxes) are used wherever possible to deliver to shops and for returns and these totes have a long lifespan – each tote is used potentially hundreds of times in the parcel network,
- They encourage their suppliers to deliver to their warehouse in reusable totes wherever possible – all the main suppliers do this, and empties are returned to the suppliers for future deliveries,
- Where suppliers and Waterstones deliver to shops in cardboard packaging this card is recycled locally, used for returns or as packaging for internet customers in those shops that do internet fulfilment.

The Book Hub

- Unipart measure everything it recycles, from all sources, and currently achieves a 97.85% recycling rate, up from 96.7% in 2021. Unipart logistics has been a zero waste to landfill operation since 2016. The circa 2% waste that cannot be recycled goes to a local Refuse

Derived Fuel (RDF) Plants where it is then used as fuel to power the cement kilns rather than using fossil fuels.

- Returned books are shredded and recycled where they are not replenished to stock. In 2021 the Hub recycled 198 tonnes of books. There is full visibility and governance around the downstream recycling process. Unipart measures all of the waste that it generates. Store returns can include waste items as well as books, waste is separated into separate streams for recycling.
- Items like backing for parcel labels that currently is not recyclable, and make up the c2% waste – the Waterstones team are actively trying to source a sustainable solution for challenges like these
- The total of all waste streams that Unipart manages amounts to an average of around 70 tonnes per month in the UK

3.7 Libraries and Library Suppliers

Public and academic libraries select and order printed books and other material for their collections from a variety of sources. This can be directly from a publisher, from bookshops, from individual content creators or via specialist suppliers/aggregators to libraries.

Processing library material is for the purpose of protection (physical and for security) and identification of items for the library and users of libraries. Processing is done by aggregating suppliers and matched by libraries themselves for materials processed in-house. Typical processing includes:

- Plastic covering
- Process grids
- Date labels
- Barcodes
- Classification/loan status labels
- Ownership stamps
- RFID tags or other security triggers

Much of this processing, in particular plastic covers intended to extend shelf-life, inks for printing, RFID (Radio Frequency Identification) components etc. have an impact on the recyclability of library books and other formats of material such as audio-visual resources.

Both the public and academic library sectors (and the students and public they support) are keen to reduce their environmental impact. Some are already questioning the need to cover all or any library materials, and libraries are in search of coverings which have a lesser detrimental impact.

Processed materials are delivered to libraries by couriers contracted by the aggregators, or directly from other suppliers. Deliveries from the major library suppliers are generally consolidated but there is an environmental impact here as well.

Deliveries in themselves create a lot recycling if boxes are not re-used. This recycling (mostly of cardboard, but also paper like delivery notes) is likely to be handled locally by local authority collections.

Materials are received by the library, checked, and processed in-house if necessary. They then go into library circulation or onto the shelves as reference items. The average “lifespan” of a library book varies, depending on currency, usage (circulation), how it is bound and how it is treated by users and technologies that automate handling (such as book sorters). A rough guide for public libraries is circa

40 loans or 5 years for paperbacks, and 7 years for hardbacks. These figures are likely to be higher for academic libraries, depending on subject area.

At the end of useful life, books may be replaced by more up to date editions, repaired in-house if they are still repairable or disposed of in a variety of ways:

- Offered to other libraries
- Offered to users via book sales or giveaways
- Sold on the secondhand marketplace
- Collected by companies like Awesome Books, Betterworld Books The Book Rescuers or Anybook.biz, some of whom return a percentage of the value of items they sell to the library (which may reinvest that in new stock) and/or also donate a small percentage to a charity. They then undertake to responsibly recycle what is left. These services are usually free to libraries, with boxes supplied and collections arranged.
- Dispose or recycle locally

Some kinds of library stock are not attractive to the organizations that will take material and are also difficult to recycle. These include directories, bound journals, reference materials available online, material likely to go out of date quickly etc. At scale, these are likely to be sent for recycling/pulping at specialist recycling organizations or else it might end-up in landfill.

3.7.1 Library Suppliers

As library suppliers are aggregators rather than producers of content the waste and recycling issues are mainly centred around packaging: as they receive books in from publishers or wholesalers and as they dispatch books out to libraries. Initiatives relate to both the recycling of these materials and the reduction of them in the first place. Between those two events there is a degree of handling, which also has an impact.

3.7.2 Books in

The majority of packaging associated with deliveries of books from publishers and wholesalers can be recycled. Common practice is for the library suppliers to contract this out to a third-party so it is possible that the volume of recycling is being recorded by the recycler, but we do not have the actual data to hand. Most library suppliers are taking any suitable recyclable filler material from these deliveries and reusing it when sending packages out to libraries.

In 2021 Browns Books piloted issuing reusable crates for larger scale suppliers to reduce the reliance on cardboard and plastic packaging to begin with. They have used a similar approach with large supply projects (e.g., replacing an entire library stock following a fire) but suitably robust crates are not available so there was no net environmental gain.

3.7.3 Book processing

Most libraries receive books as 'shelf-ready' where the supplier adds protective coverings, date labels, spine labels, stamps, etc. The main impact comes from the plastic coverings, which take three main forms:

- Plastic wallets – these don't always stand up to library use for larger-sized books but can be completely removed from the book at the end of life. Browns Books note that this plastic can be recycled up to 7 times before it becomes unfit for the purpose, at which point it can be recycled into general purpose black plastic.
- Hard laminate covering – this adheres directly to the cover and provides a lot more stability for large paperbacks. However, because of the glues involved they cannot be recycled and there is no realistic alternative.

- Soft plastic covering – this also adheres directly to the cover but does not give the same sturdiness to the book. It is not recyclable either, but alternatives, such as Pello Bio book foil are becoming available that are at least fully biodegradable. They are a bit cloudy compared to the material currently in use and are also more expensive, in part because they are not widely used. Both Browns and ProQuest report they have started looking at these materials for specific customers.

Both hard and soft coverings come on a paper backing, which is not recyclable. However, Browns report that the manufacturer is investigating a process where this backing can be converted to fuel.

An issue raised in discussions with both Browns and ProQuest is that a change of behaviour on the part of customers will greatly support the viability of greener initiatives. The costs of using greener materials can be partly mitigated if they can be rolled out across the board. In addition, some libraries may be able to reduce the amount of plastic material used (biodegradable or otherwise) by reviewing their requirements. Anecdotally, plenty of customers still require things that may not really be necessary because 'that's what we've always done'. An example could be protective coverings for hardbacks.

And finally, it should be noted that where library suppliers overstock books by mistake, these are usually donated to local charities or community projects.

3.7.4 Books out

Cardboard boxes for deliveries tend to be branded with the supplier details and will be fully reusable or recyclable. They do not contain staples and will be made from a high percentage of recycled material along with material from FSC (Forest Stewardship Council) certified sources. The same can be said of any 'new' filler material used. As noted earlier, much recyclable filler is reused from publisher/wholesaler deliveries.

Plastic tape used for boxes is an associated issue and non-plastic alternatives have been investigated. One issue is that recycled tape needs to use gum rather than glue. Some customers point to Amazon here for best practice but they have to use machines for this, which has other environmental impacts not immediately obvious to the customer.

All library suppliers also offer consolidated deliveries to customers, which reduces the amount of packaging required in the first place. Most libraries are happy to wait a few more days for delivery and the suppliers also offer urgent services for the exceptional orders that cannot wait.

3.7.5 Non-library supply via the SUPC (Southern Universities Purchasing Consortium) framework

The SUPC framework agreement also facilitates the ordering of print books by departments, who may purchase key texts at discount to distribute to students. There is also a facility for a university to appoint a supplier who may sell books direct to staff and students. Neither of these routes requires any 'library processing' and Blackwell's operate a buy-back scheme for textbooks so they can be reused rather than recycled or disposed of. This accounts for approximately 28,000 books per year.

4 Books recycled from home

Currently this area would appear to be more complicated than the processes outlined above. It all depends upon the local authority that collects the recycling and rubbish in an area of the UK. Some councils are very good and separate out the books found in recycling, and these are passed onto local charity shops for resale or organisations that will arrange for the books to be recycled in the same manner as books and materials from a printer.

Awesome Books is an organisation that collects books from various sources, such as councils and charity shops, and either resells them or has them recycled. Of the 250,000 books they receive a day[3] half are fit for reselling and the rest are recycled. Of the half that are recycled this is where the question "What is a book?" comes into play. A lot of the 'books' that they receive are notebooks, diaries and old directories that are only ever going to be recycled. All books, no matter what they are, which are put into the rubbish bin that are a problem as they will end up in landfill. It has been estimated[4] back in 2014 that 3 billion books a year were going to landfill, but this number has reduced considerably since then. So, it looks as though there are definitely opportunities here to educate people as to what also can be recycled if this isn't happening already.

5 Innovation

During this project, we also learned about the areas that organisations are looking at to help the recycling process, such as:

- Reducing plastic in all of our packaging from suppliers (paper tape, paper wrap instead of bubble wrap etc). It should be noted that replacing plastic with paper is not always the best option as paper alternatives may require more material to be used to deliver the same quality as plastic products, and therefore other materials are being looked at for different packaging options,
- Reduction of the use of plastic across the book industry supply chain, and the drive to find alternatives,
- Reducing lamination and finish wastage where possible,
- Sustainability to be at the forefront of a book's design e.g., innovative design can help reduce plastic use in children's books etc.,
- Need to develop an educational program to help people understand how to recycle 'books' from home,
- Expanding use of rail transportation across Europe, rather than using trucks to move books around, as part of an eco-friendlier approach to transportation.

6 Conclusions

The purpose of this project was to assess the recycling and waste programs that are used in the book industry in the UK, with some international aspects being quoted as well and report on the materials being disposed of vs recycled, and the carbon footprint impact. This would then give us an indication of how much is being recycled, their carbon footprint, sustainability, and general green credentials. How has this project delivered against its purpose?

We have been able to examine the whole book industry supply chain, but it has proved difficult to gather actual data, as organisations are understandably reluctant to provide sensitive data, which is why some information has been provided simply as a percentage. There are varying opinions from the T&FWG on if we should look at the carbon footprint of a book itself, or be looking at the Green House Gas Protocol and Scope 3 emissions therefore not going down to in the individual book. Also, how the carbon footprint is actually measured is a point of contention, as it is not the same for all organisations, and for some materials it is not possible to obtain carbon footprint data. This all leads to potentially inaccurate, or misleading calculations, with some parts of the supply chain not being included, such as information from ink manufacturers as they have not calculated their carbon footprint yet. Taking

[3] From a conversation with Simon Mackay, Head of Books at Awesome Books
[4] A report written by Simon Mackay, Head of Books at Awesome Books

this into account, it might be argued, that there is a very good case for having just the one, global end-to-end carbon calculator for the book industry supply chain.

What we have found is that across the supply chain the various sectors are working hard to recycle, and this is often close to 100% of materials. In these cases, it is the packaging, and associated materials that are being reused, or recycled in the supply chain processes. This is a conscious approach to working with environmental concerns and the desire to recycle as much as an organisation can in day-to-day processes. The reason the recycling figure is not 100% is due to the materials, such as some plastics and pallet wrap that simply can't be recycled at the moment. Work continues to find alternatives to materials that can't be recycled, but this is an ongoing process. The challenge comes when decisions are made not to use a route that allows for the recycling of books, such as putting books in the rubbish and not the recycling bin.

When it comes to actual books themselves, we can see that they are being 100% recycled if they are in the closed loop of either being pulped from over stocking, and/or books being returned to the warehouse. It is after a book has been purchased that variation to its end-of-life occurs. These can vary from being put on a shelf for life, passed on to other people, given to a charity shop, resold, put into domestic recycling or waste. From a library or charity shop perspective the book will end up in a recycling scheme.

When a book is recycled it is likely to be used in the making of packaging or other tissue paper products. There is a small risk of contamination of glue and plastic, but in the main these are removed in the recycling processes. The materials that need to be removed in the recycling process are glues, plastics, and foils. All these need to be looked at in Part 2 of the project when we are looking at designing a book from the outset, as to how can we reduce and mitigate these contaminates. Using alternative materials to make sure a book could be designed to be 100% recyclable.

In answer to the question of if this project has delivered on its aim the T&FWG are very pleased to have discovered how much recycling is going on in the book supply chain industry. In some cases, this is almost 100% with constant improvement being looked for. There are still areas that need to be looked at in greater depth, and these will be covered in Parts 2 and 3 of the overall BIC Design for Recycling Project, but this is a very good starting point to go forward.

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