



Report on detailed business cases for upcycling.

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Executive Summary

The idea that one man's trash can be another man's treasure should be the concern of every one of us. We can no longer have a strategy that relies heavily on disposing of rubbish to landfill, as we must meet local, national and European targets in upcycling and recycling waste. If present trends continue, the amount of waste produced per year will double in twenty years' time. The project was carried out to ascertain the key resource streams with potential for upcycling. The aim is to identify, select and implement upcycling solutions for the main waste streams of companies located in the business districts targeted in our partner cities.

The need to develop an Upcycling Waste Strategy is driven by a variety of factors, as detailed below:

- Desire to obtain additional value through upcycling
- Rising waste and recycling/upcycling costs.
- Consideration of alternative waste collection and treatment/disposal options.
- Desire to improve recycling and upcycling rates.

The Upcycling project gave rise to a range of business cases. These business cases were recognised as having major benefits and these included:

- Minimise general waste production.
- Conversion of waste to new consumable products
- Introduction of food waste segregation.
- Ongoing monitoring of new products that can be upcycled.



1. Introduction.

1.1 Objective.

The purpose of the first work package (WP1), of which this business case report is the second part, is to develop knowledge, tools and capacities for SMEs, business support actors and cities to enable the broad adoption of upcycling solutions of business waste at local business area level.

This work will deliver the insights and tools that allow us to identify, select and implement upcycling solutions for the main waste streams of companies located in the business districts targeted in our partner cities. This paves the way for the delivery of concrete pilots, demonstrating various business cases and solutions for upcycling of business waste in practice (WP2).

A key step in the transition to large-scale upcycling of business waste is for companies to understand that it is possible and that it actually makes business sense.

The objective for this report is to create detailed business cases for a diverse selection of the solutions found in D1.3.1., focusing on waste streams with most potential or urgency in each pilot area (from D1.2.3; f.i. in terms of volume, costs, environmental & societal impact).

These cases show SMEs the conditions to create feasible and advantageous routes to position their waste as a resource for circular processes or products.

1.2 Background.

The term upcycling refers to the reuse of a material that would otherwise be a waste. The material is instead transformed into a new product of greater value than the original material. This value can be technical, economic, and societal, and comes without burdening people and the environment. The new product may have a similar function to its previous life, or it may be something completely new. In comparison to recycling, upcycling is considered more environmentally friendly. For materials such as fibres and plastics, recycling is a limited process as it breaks the fibre and polymer chains. This results in a downgrading of the material over time. While there are disputes around how many cycles a material may be recycled for, the end result is the same: there comes a point when recycling with current technology is no longer viable. With fibres that are made from biological materials, they can be returned to the earth. Plastics are more problematic and are burnt for energy, although technology in this area is improving at pace.

In recent years upcycling has become a key component of waste reduction, being considered part of the 'Reuse' segment of the waste hierarchy "Reduce, Reuse, Recycle and Recover" 4R Framework.

Upcycling is a component of the advance towards a circular economy. This is in contrast to the linear economy where once a product comes to the end of its life, it is disposed of. A circular economy is one where resources are kept circulating at their highest value for as long as possible. The Ellen MacArthur Foundation states that the circular economy is based on three principles:

1. Design out waste and pollution
2. Keep products and materials in use
3. Regenerate natural systems



Upcycling for the purpose of this project focuses on the second principle stated above. Whilst this is largely considered to be an upstream activity, many of the case studies are new businesses and therefore are operating less traditional business models. Educating customers is frequently a key component of marketing these products, therefore the case studies can be considered to be circular and sustainable.

The case studies investigated for this report have the benefit of creating social, environmental and economic value.

M. Henry et al. / Journal of Cleaner Production 245 (2020) 118528

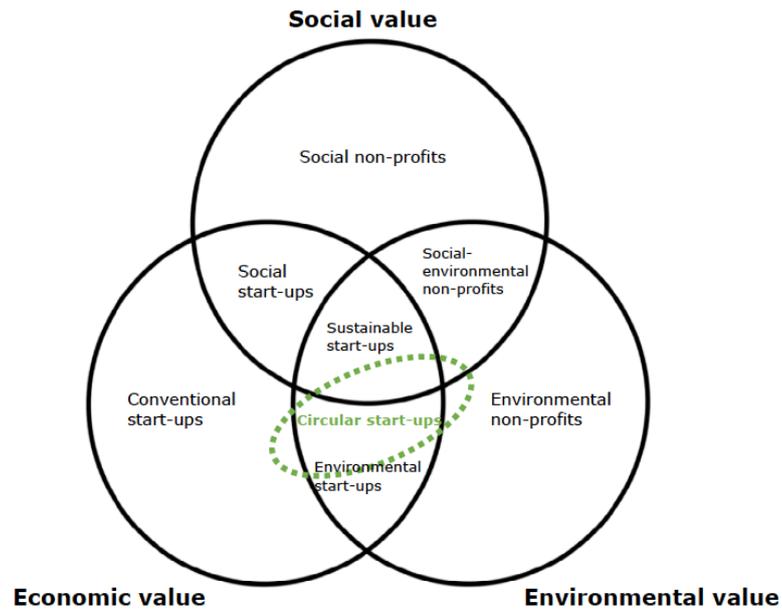


Fig. 1. The relationships of circular start-ups with other types of enterprises.

2.1 Waste data and financial analysis.

Audits were completed to each of the partner areas during 2020 and 2021. The pandemic meant that some audits were completed over the telephone or through online surveys rather than face-to-face. This meant data was not always complete. Binit completed the Norwich audits which meant we had direct experience of the process.

We used questionnaires as a method of data collection and the key information collected included size of the company, type and quantity of waste produced, waste collector's information, method of recycling, seasonal differences and costs of recycling. All the data were then collated in a spreadsheet for reporting.

The data were cleaned and analysed, condensing into uniform metrics of measurement for all businesses (e.g kg/month, litres per month, tonnes/year, litres/year, pieces/year, tonnes/year, Prices/week). This allowed us to create parameters of cost for each material per unit of collection in each of the partner areas. This was combined with standard price list data for each area where it was available.



2.2 Qualitative interviews.

The waste audit data collected was quantitative. Our experience of the process in Norwich meant that we understood that the numbers did not show the level of enthusiasm of those interviewed, or any interesting tales. Therefore we conducted telephone interviews with auditors who conducted the research in other partner areas.

We interviewed people in the Netherlands, France and the UK and tried to understand their data collection process and their thoughts on the barriers of upcycling from conversations with businesses. The aim was to gather qualitative data and understand the level of enthusiasm from the businesses they audited.

2.3 StartUpCycle Weekend.

Binit helped to create the Norwich StartUpCycle weekend that was held in July 2021 after a number of covid-related delays. StartUpCycle was a unique weekend hackathon event from [Sync the City](#), Norwich BID, and [University of East Anglia](#), where teams collaborated to create an upcycling start-up. This eco-hackathon aimed to establish a circular economy in Norwich.

To promote the event, we created factsheets for the leading 12 materials, including a description of the material, its normal physical state and collection method and an indication of the volumes available in Norwich. These factsheets were available to the teams along with sample materials. The materials were chosen for either volume, or the problem caused by them in the Norwich area and therefore the willingness to participate in upcycling: Cardboard, carpet, coffee cups, coffee grounds, demo lenses, food waste, glass, orange peel, pallets, polywrap/plastic film, textiles and wasted hops.

Around 70 talented people gathered in a circus tent in the middle of Chapelfield Gardens, Norwich, to tackle the 48-hour #StartUpCycle challenge. Their mission was to create businesses from scratch that could help industries in Norwich convert their waste streams into income streams. The teams were given a crash-course in the circular economy, benefited from expert mentorship from industry experts including the Binit team, and were set a mission: to create an upcycling start-up from concept to pitch.

Over the course of the weekend Binit provided expert mentoring and advice around the waste industry, practical and legal support for suggested projects and business development support including work with teams on their business model canvas, support in financial modelling, advice on practical viability and feedback and tips for the pitch event.

The six teams and their projects are listed below and case studies can be found towards the end of the report:

- Scoop – Don't skip it. Scoop it! An app designed to enable business to business upcycling, using a sophisticated algorithm that combines convenience and cost.
- Waystr – Products you want, from stuff you don't, in the city you love. A hyperlocal marketplace for buying and selling upcycled products, designed to bring businesses and customers together.
- Meco – Good for you and the planet. Upcycling cardboard waste into convenient work from home laptop stands, designed to improve posture and reduce landfill.
- Zing – Making peel more appealing. Inspired by Changpi, a traditional dried mandarin peel, Zing takes discarded orange peel and transforms it into a tasty snack, with a natural pep.



- Palletable Floor – Forever flooring, UpCycle to Order. Sustainable and aesthetic floor tiles made from discarded pallets, for the eco-conscious home.
- Breathe Trainers – Protecting your soul. Breathable trainers made from discarded masks and PPE. A last-minute entrant, Breathe was a team made up from the UEA Ambassadors working the event!

2.4 Business models and case studies.

Four different business models are examined; sharing waste, trading waste, upcycling waste and recycling waste. We also describe the business model of platforms to facilitate these business models. Commentary is given on the environmental, financial and social or local aspects of the business model. Then a case study or studies illustrate the business model in more detail. The businesses gave brief descriptions of their “trash” to “treasure” journey. We include a table looking at the different key stages of the model: material, storage, collection, process, product need and route to market.

Case studies have been created from interesting projects the Binit team found while auditing, referrals from project partners and the final projects from the StartUpCycle weekend. These are intended to inspire new circular entrepreneurial activity.

There are three layers of activity:

1. Micro activity - between businesses
2. Meso activity - across a local area such as a town or industrial park
3. Macro activity - across a region or nation.

3. Materials Summary.

Each location had a different number of businesses surveyed for the type and amount of waste streams generated.

Country	Area/region	Number of audits completed	Observations
Belgium	Oostende	35	Predominantly industrial/light industrial
France	Roubaix	75	Predominantly industrial/light industrial
Netherlands	Den Haag	81	Predominantly industrial/light industrial
Netherlands	Ijmond	228	Predominantly industrial/light industrial
UK	Norwich	262	Predominantly retail and hospitality
UK	Kent	127	Predominantly retail and hospitality



This section describes the waste materials produced across all regions, with Residual (General Waste) and Dry Mixed Recycling waste streams being the top two in terms of weights. Data analysis has further established the top 5 material waste streams, based on weights, in all of the four partner countries surveyed for the project (see tables below).

NORWICH - UNITED KINGDOM		
WASTE STREAM	VOLUME (Litres)	DESCRIPTION
Residual (General Waste)	784,406	Includes all unsorted waste e.g hard plastics, sweet and crisp wrappers, polystyrene and soiled food wrapping.
Dry Mixed Recycling	478,836	Includes disposing of clean, uncontaminated recyclable material e.g. paper, cardboard, plastic and aluminium can all be mixed together in one container to be collected.
Food Waste	46,615	Includes all food, solid or liquid, that is discarded e.g. organic residues, food scraps, or edible food that has been thrown away for any reason.
Glass	35,020	It is discarded material from the glass manufacturing process or from used consumer products made of glass.
Cardboard	21, 747	It is a general term used to describe heavy duty packaging paper, of various strengths and grades. Includes all types of packaging.

KENT - UNITED KINGDOM		
WASTE STREAM	VOLUME (Litres)	DESCRIPTION
Residual (General Waste)	53,370	Includes all unsorted waste e.g hard plastics, sweet and crisp wrappers, polystyrene and soiled food wrapping.



Dry Mixed Recycling	15,505	Includes disposing of clean, uncontaminated recyclable material e.g. paper, cardboard, plastic and aluminium can all be mixed together in one container to be collected.
Food Waste	25,000	Includes all food, solid or liquid, that is discarded e.g. organic residues, food scraps, or edible food that has been thrown away for any reason.
Glass	44,404	It is discarded material from the glass manufacturing process or from used consumer products made of glass.
Cardboard	22,408	It is a general term used to describe heavy duty packaging paper, of various strengths and grades. Includes all types of packaging.

IJMOND - NETHERLANDS		
WASTE STREAM	VOLUME (Litres)	DESCRIPTION
Residual (General Waste)	515,584	Includes all unsorted waste e.g hard plastics, sweet and crisp wrappers, polystyrene and soiled food wrapping.
Paper	314858	It is a general term used to describe heavy duty packaging paper, of various strengths and grades. Includes all types of packaging.
Wood	105,250	This includes discarded wood products, whole trees, stumps, or pruned branches generated from park or street maintenance. Also includes by-products or un-used wood from the woodwork industry.
Scrap	655,45	Also known as steel scrap, it consists of discarded steel or steel products generally segregated by composition and size or 'grade' suitable for melting.



Rubble	62,014	This includes waste or rough fragments of stone, brick, concrete especially as the debris from the demolition of buildings.
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HAGUE - NETHERLANDS		
WASTE STREAM	VOLUME (Litres)	DESCRIPTION
Wood	306,000	This includes discarded wood products, whole trees, stumps, or pruned branches generated from park or street maintenance. Also includes by-products or un-used wood from the woodwork industry.
Residual (General Waste)	151,000	Includes all unsorted waste e.g hard plastics, sweet and crisp wrappers, polystyrene and soiled food wrapping.
Paper/Cardboard	86,500	It is a general term used to describe heavy duty packaging paper, of various strengths and grades. Includes all types of packaging.
Appliances	20,000	This waste generally consists of consumer appliances discarded due to reaching their end of shelf life/usage life.
Bulk Waste	20,000	This refers to waste types that are too large/bulky to be accepted by regular waste collection.

OOSTEND - BELGIUM		
WASTE STREAM	VOLUME (Litres)	DESCRIPTION
Paper/Cardboard	1,369,159	It is a general term used to describe heavy duty packaging paper, of various strengths and grades. Includes all types of packaging.



Residual (General Waste)	433,397	Includes all unsorted waste e.g hard plastics, sweet and crisp wrappers, polystyrene and soiled food wrapping.
PMD (Mixed Plastics)	56,549	Includes all non-bottle plastic packaging sourced from the domestic waste stream, and it includes rigid and flexible plastic items of various polymer types and colours that are typically found in the household waste bin.
Food Waste	20,665	Includes all food, solid or liquid, that is discarded e.g. organic residues, food scraps, or edible food that has been thrown away for any reason.

ROUBAIX - FRANCE		
WASTE STREAM	VOLUME (Litres)	DESCRIPTION
Ordinary Industrial Waste	83,300	It is waste generated by neither households nor the construction industry that is neither inert nor hazardous.
Cardboard	44,665	It is a general term used to describe heavy duty packaging paper, of various strengths and grades. Includes all types of packaging.
Used Water	26,062	Wastewater derived from many applications, in this case, mostly industrial.
Steel	14,550	Also known as steel scrap, it consists of discarded steel or steel products generally segregated by composition and size or 'grade' suitable for melting.
Polyester	14,167	It is a textile waste by-product mostly derived from stocking factories, webbings, spinnings and textile laboratories.

3.1 Prioritising waste materials

Considering waste streams by weight alone will not help to identify the material with the greatest potential for upcycling. There are a number of factors to be considered, which are listed in the table below. It is suggested that a value is placed against each of these factors, which will be specific to each partner area. This will then help each area to shortlist potential materials for upcycling.

Factors to consider when prioritising materials		
FACTOR	SCORE	RATIONALE
Weight	1-3	Is the material a significant waste in terms of weight?
Volume	1-3	Does the material need lots of space for storage e.g. plastics?
Economic cost of raw material equivalent	€/kg	If this material is upcycled, will it displace an expensive raw material?
Economic cost of disposal/recycling	€ per kg/litre	Is this material expensive to recycle or dispose of?
Environmental impact of disposal option	1 - 5	Landfill-1; Incineration-2; Energy from Waste-3; Recycling-4; Composting-5
Distance travelled to disposal option	km	Distance from waste producer to bulking/transfer station and then to final disposal option.
Is it a problem locally?	Y/N	Very specific to each area; space, odour, local industry issue etc



Is there social value potential in the upcycling option?	N/A	Examples include: job creation; job creation targeting specific vulnerable groups; training and upskilling; providing a new service or product that supports other local businesses.
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4. Financial Summary.

Having analysed data from the audits, we identified cost as one of the main barriers that prevent businesses from upcycling their waste. The tables below present indirect and direct cost data for the partner countries. By analysing the following data we aim to establish what is financially viable for upcycling businesses.

4.1 Indirect Costs.

The cost of a waste management service can be more than just the cost of collections. A poor service can take staff time in chasing for missed collections, querying invoices and asking for help to increase recycling. The table below demonstrates the potential additional cost per week in each partner country based on three scenarios.

The best case scenario is one where there is no chasing customer service, but an hour of staff time spent in total each month in separating wastes into different streams. The middle scenario assumes one or two missed collections that need chasing and increased contamination that needs clearing. The worst case scenario is a poor level of service, with frequent missed and overflowing bins and the need for staff to be rearranging space to accommodate the waste, as well as spending considerable time chasing the contractor.

Table 4.1.2 : Indirect costs of waste management

Country	Minimum wage	Best case assumption	Middle case assumption	Worst case assumption
	€	1 hour per month = per week	1 hour per week = per week	3 hours per week = per week
England	€10.47	€2.42	€10.47	€31.39
France	€10.24	€2.36	€10.24	€30.73
Netherlands	€10.24	€2.36	€10.24	€30.73
Belgium	€ 6.20	€1.43	€6.20	€18.60

Some other indirect costs that go into waste disposal are wasted raw materials, energy and water consumption costs.



4.2 Direct costs for the 5 largest material waste streams by weight.

We analysed the waste audit data for all partner projects with the aim of understanding the range of direct costs experienced by waste producers to dispose of different materials. The data points were limited and in some cases non-existent. This means the tables below are indicators of costs, but not statistically robust.

NORWICH - UNITED KINGDOM			
WASTE STREAM	COSTS (€ ¹)/WEEK / 1100 LITRES		DIRECT COSTS INCLUDE:
	LOWER END	HIGHER END	
Residual (General Waste)	15.97	35.87	Payment for waste disposal, bin bags, bins, landfill tax, skip hire and haulage charges
Dry Mixed Recycling	15.97	42.26	Payment for recycling, bin bags, bins, skip hire and haulage charges
Food Waste	2.94	19.96	Payment for waste disposal, bin bags, bins, skip hire and haulage charges, oil recycling charges
Glass	8.81	48.13	Payment for recycling, bins, skip hire and haulage charges
Cardboard	23.48	40.50	Payment for recycling, bins, skip hire and haulage charges

KENT - UNITED KINGDOM		
WASTE STREAM	COSTS (€ ¹)/WEEK / 1100 LITRES	DIRECT COSTS INCLUDE:

¹ *£ to € conversion as of Aug 19, 2021, 06:05 UTC

	LOWER END	HIGHER END	
Residual (General Waste)	4.97	187.41	Payment for waste disposal, bin bags, bins, landfill tax, skip hire and haulage charges.
Dry Mixed Recycling	5.08	53.60	Payment for recycling, bin bags, bins, skip hire and haulage charges.
Food Waste	Not enough data	133.86	Payment for waste disposal, bin bags, bins, skip, hire and haulage charges, oil recycling charges.
Glass	6.07	134.01	Payment for recycling, bins, skip hire and haulage charges.
Cardboard	8.03	96.48	Payment for recycling, bins, skip hire and haulage charges.

OOSTEND - BELGIUM			
WASTE STREAM	COSTS (€) / WEEK / 1100 LITRES		DIRECT COSTS INCLUDE:
	LOWER END	HIGHER END	
Residual (General Waste)	7.28	50.00	Payment for waste disposal, bin bags, bins, landfill tax, skip hire and haulage charges
Paper/Cardboard	12.72	124.65	Payment for recycling, bin bags, bins, skip hire and haulage charges
PMD (Mixed Plastics)	4.17	105.00	Payment for waste disposal, bin bags, bins, skip hire and haulage charges, oil recycling charges



Food Waste (Packed and Unpacked)	Not enough data	791.14	Payment for recycling, bins, skip hire and haulage charges
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IJMOND - NETHERLANDS			
WASTE STREAM	COSTS (€) / WEEK		DIRECT COSTS INCLUDE:
	LOWER END	HIGHER END	
Residual (General Waste)	25	Not enough data	Payment for waste disposal, bin bags, bins, landfill tax, skip hire and haulage charges.
Paper	-20	25	Payment for recycling, bin bags, bins, skip hire and haulage charges.
Wood	2	50	Payment for waste disposal, bin bags, bins, skip hire and haulage charges, oil recycling charges.
Scrap	Inconclusive	540	Payment for recycling, bins, skip hire and haulage charges.
Rubble	Not enough data	Not enough data	Payment for skip hire and haulage charges.

HAGUE - NETHERLANDS			
WASTE STREAM	COSTS (€) / WEEK		DIRECT COSTS INCLUDE:
	LOWER END	HIGHER END	
Wood	23.19	28.73	Payment for waste disposal, bin bags, bins, landfill tax, skip hire and haulage charges.



Residual (General Waste)	2.92	21.10	Payment for recycling, bin bags, bins, skip hire and haulage charges.
Paper/Cardboard	2.10	9.51	Payment for waste disposal, bin bags, bins, skip hire and haulage charges, oil recycling charges.
Appliances	Not enough data	Not enough data	Payment for recycling, bins, skip hire and haulage charges.
Bulk Waste	5.75	Not enough data	Payment for bins, skip hire and haulage charges.

ROUBAIX - FRANCE			
WASTE STREAM	COSTS (€) / WEEK		DIRECT COSTS INCLUDE:
	LOWER END*	HIGHER END	
Ordinary Industrial Waste	-3466.94	Not enough data	Payment for waste disposal, bin bags, bins, landfill tax, skip hire and haulage charges.
Cardboard	72.3	Not enough data	Payment for recycling, bin bags, bins, skip hire and haulage charges.
Used Water	70.7	Not enough data	Payment for waste disposal, bin bags, bins, skip hire and haulage charges, oil recycling charges.
Steel	Not enough data	Not enough data	Payment for waste disposal, bin bags, bins, landfill tax, skip hire and haulage charges..
Polyester	-179.32	Not enough data	Payment for recycling, bins, skip hire and haulage charges

*The negative values indicate cost-saving.

Data collection for waste stream cost determination was strongly mired by lack of data points and estimated costs rather than accurate costs. Conversion from monthly/yearly data to weekly data may have caused slight inaccuracies and there seems to be a vast range

between the lower and higher ends. Many waste streams had no cost data collected at all. This clearly indicates that companies were not as forthcoming to share the cost data with the auditors due to policy reasons, or perhaps not being aware themselves of the costs. This was especially true when interviewing large businesses having multiple branches where all cost data was stored at the company HQ. This also indicates that across the different partner countries, prices differ due to the open-market policy, the number of competitors present as well as the type of services provided for a particular cost.

5. Interview summary.

Overall, 4 interviews were conducted by Binit student staff between 26th July 2021 and 6th August 2021. 3 student auditors interviewed were based in the Netherlands, out of which 2 conducted audits for the Hague region. A French project partner was also interviewed.

Below are the generalised findings across all the interviews:

- Interviews were done over the phone as well as going to the site when permitted by the region's laws. One student was only able to do interviews/correspondence through email.
- Data collected on site was more accurate and quantitative as compared to the data collected over the phone. There were fewer missing points and companies were more forthcoming to auditors, especially in regards to cost data sharing. Correct quantities were shared and there was more enthusiasm towards the project.
- General mistrust was observed between small businesses and larger waste collection companies. Most businesses were not fully aware of the costs or the services they were paying for.
- Barriers to upcycling were found to be: costs (expensive for waste collectors to come), not knowing who to connect with for upcycling some products, scepticism towards the recycling companies.
- Drivers of upcycling were found to be: saving the environment, making money off their wastes, reduced storage of waste on company sites.
- All regions have an open market operating for waste collection companies with the local municipalities providing legislative and general guidance. Costs of recycling/disposing of different waste streams was found to be competitive and company-specific. Indirect costs were difficult to determine as it differed for each region and business type.
- Concluding remarks: Start of project was difficult due to the lockdown restrictions. However, towards the end, a core group of businesses were identified wanting to save the environment and wanting to identify upcycling streams. Framing it differently in terms of economic gains for business to participate in this yielded more entrepreneurs + businesses to join in. Need to connect businesses with each other to gain traction in upcycling ideas.

Key issues with data gathering and analysing were due to little or no information about the cost of recycling by the business owners and workers. The lack of understanding of the direct costs was surprising and meant that there were no data points for many material streams and a small number of data points in a large number of the material streams. This means the parameters provided are guidance only and not statistically robust.

The market structure in each partner country was checked for levels of competitiveness. All have both private operators and local authorities/municipalities offering waste management services to businesses.



6. Business Models and Case Studies.

6.1 Introduction.

For a business model to be sustainable it needs to consider three elements:

1. The value proposition: what pain is the business solving and for whom.
2. The value creation and delivery: activities, resources, partners and distribution channels
3. The value capture: the financial model.

This section of the report describes different business models. It does not consider the value proposition, but explains how the model works.

As described in the sections above, the most challenging area to describe has been the value capture. This was highlighted in the final report for activity 1.3.1 and is visible in all the waste audit data and was clear in the qualitative interviews. A lack of data around actual costs and a lack of understanding across all project areas of those actual costs has meant that the financial model is generalised across all business case types, rather than specific to each.

We believe that as many of these business cases are breaking new ground, the only way to test a financial model robustly is in the real world by seeing what the market will pay. This was tested briefly in the Norwich Start UpCycle Weekend and is evident in existing products described below. Local market costs, the local supply of the raw material and the local demand for the finished product are all highly variable and therefore no standard model can be created, only parameters given.

The key barrier to upcycling is the legislation around the transport, handling and processing of materials deemed a waste. This includes the processing of a waste to turn it into a product. Whilst there may be case studies below where the legal standing is uncertain, we believe it is important to include them because there is clearly widespread support across the EU for the circular economy and a greener economy. We believe this means that constructive conversations will be possible with the relevant authorities to ensure any activities, if proposed, are legally compliant.

6.2 Business Model A: Sharing waste.

Description

It is possible for some businesses to share waste as a micro activity. We were unable to find much data, but the example most commonly cited is that a coffee shop 'lends' its used coffee grinds to a mushroom grower. The mushroom grower uses these grinds as a substrate for growing and gives them back when a growing cycle is complete. The growing process removes much of the moisture, and therefore the weight, of the coffee grinds. This reduces the final cost of disposal for the coffee shop who is the original waste producer.

Environmental

When waste is 'shared' it becomes a raw input for another business. This displaces a virgin material and therefore has a lower environmental impact. The weight or volume of the 'shared waste' may be reduced, which reduces the amount of waste sent for final disposal.



Financial

There is a verifiable reduction in waste costs if the waste producer is charged by weight. This is not the case in all areas, and may even change between areas. Where the waste is removed on a 'per bin' basis, a weight reduction will not reduce cost. The waste as a substrate is assumed to be at no cost to the mushroom grower and therefore, assuming transport costs are low or negligible, there is a cost-saving.

Local or social

Shared waste is likely to only work at a very local level. It is likely to be a transaction between two businesses and therefore benefits will be felt locally.

6.2.1 Case Studies

Coffee Grounds Used To Grow Oyster Mushrooms

Coffee grounds are organic material and can serve as a breeding ground for mushrooms. The grounds are collected from companies that, in many cases, use more than 50 kilograms of coffee beans per week. The grounds are suitable for growing oyster mushrooms. They are used in the kitchen, such as mushrooms, or are used to make bitterballen. The companies that grow oyster mushrooms also have "starter packs" for growing oyster mushrooms at home.

The grounds are composted at the end of their life as a substrate.

Material	Storage	Collection	Process	Product need	Route to market
Any. Example coffee grounds	Source-segregated. Often internally in small quantities and potentially bulked in a larger outdoor bin.	Unknown	None. Transfer into bags for mushroom growing.	Yes. Mushroom growers are commercially successful.	Unknown

6.3 Business Model B: Trading waste products.

Description

Products may reach the end of useful life for one consumer but still be usable in the same, or a different form, for another user. These products or materials can then be traded before becoming waste. Sometimes the products may need small repairs, but they are used for a similar purpose. A good example may be pallets that are bought by a middle company and resold again as pallets. This is most commonly a meso or macro activity.



Environmental

Traded waste products or materials displace the new version of the product or material that may be made from virgin materials, thereby reducing environmental impacts. Traded products or materials make most financial sense in limited geographic areas and may therefore have lower transport miles and associated emissions.

Financial

There is a verifiable reduction in waste costs if the waste producer is charged by weight or volume. There may be a financial benefit to the waste producer if the trader buys the material or product. It is likely that the second user of the traded goods receives the item for less cost than a new version.

Local or social

Traded products and materials are likely to have greatest financial benefit at a local or meso level where transport costs are lower. Shorter distances will have a beneficial environmental benefit.

6.3.1 Case Studies

Too Good To Go

UK-based app that allows retailers to list their food surplus that may be close to expiry at the end of each day and make it available to app users at a greatly reduced cost. This reduces the amount of food they waste and therefore the disposal costs, while at the same time generating income from products with a short shelf-life.

<https://toogoodtogo.co.uk/en-gb>

Material	Storage	Collection	Process	Product need	Route to market
Food	Source-segregated, indoors in its packaging	by purchaser	List food on the app	Identified need and market	Through social media and word-of-mouth

6.4 Business Model C: Upcycling end-of-life materials.

Description

Materials that are at the end-of-life for one business are collected and processed into another product, or for another use, by a second business, normally in a low-tech manner. These products are of a higher value than the material as a waste.



Environmental

This business model works at two scales. The first is micro, or very local, with smaller volumes of material. The second is for higher volumes of material that are often by-products of industrial processes and are normally included in industrial symbiosis programmes. This is normally a meso scale activity with industrial processes being co-located, often in eco parks. In both cases, the waste material displaces a raw material in a process or product, which decreases environmental impact. In both cases, it is expected that the transport impact is considerably reduced.

Financial

Any charge made on the waste producer for the collection of the material must be of equal value to the current charge experienced. The price point of the final product will include the processing and sales and marketing activities. The sale price will be equal to or less than the raw material equivalent. Therefore these activities should be financially viable.

Local or social

Micro upcycling activities are most likely to result in the creation of a new product, which may have job creation outcomes and support other local businesses. Industrial symbiosis tends to be advantageous for environmental and financial reasons.

6.4.1 Case studies.

Meco - Norwich BID Start UpCycle Weekend

Cardboard is one of the largest waste materials produced by weight and volume in Norwich. At the same time office space is being reinvented as we move to hybrid working post-pandemic. Not only are people working on laptops in offices, they are also working on the move, and suffering ergonomically as a result. Desks are the wrong height, laptop screens are too low and backs and necks are constricted. Enter Meco.

Meco was created at the Start UpCycle Weekend and built by the designers at Flomotion Studios. It is a lightweight, reusable, simple laptop or computer riser that can be put on any surface to turn it either into a standing desk or to simply raise laptops to a better and more comfortable level.

Meco has 2 designs, the Move and the Mini. The Move is a more robust riser to turn a table into a standup desk. Designed for multiple uses and aimed at the corporate buyer, the M is an affordable solution.

The Mini is a lightweight, portable riser intended to be used on the move such as on trains or coworking spaces. It is cheap and small.

Both models are made from recycled material, cardboard, that has been upcycled locally. And best of all they are fully recyclable at the end of use, just pop them in any recycling bin.

Material	Storage	Collection	Process	Product need	Route to market
Cardboard	Source-segregated, indoors or in sealed	unknown	Removing tape, selecting best pieces,	Identified need and market	Through co-working spaces and local



	containers as needs to be kept dry		cut and assemble.		business community
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Palatable - Norwich BID Start UpCycle Weekend

Palatable makes forever flooring out of used pallets and scrap wood. Their aim is to help the trees and to solve waste wood. The flooring is made on a bespoke basis with the perfect finish and design for the customer. As well as upcycling pallets, Palatable also focuses on not damaging the environment and keeping track of their carbon footprint. Palatable will not be burning their wood. They will also be franchising locally so this means they will be using local wood in the local area that the flooring will be laid. This means nothing will be shipped or travelling across the country.

Palatable will be trying to use every part of the pallet but if they have any leftover wood, they will be recycling it and they will also be selling the nails. For every square meter of flooring, they can use 1 and a ½ pallets.

Palatables are hoping to work with people who are building eco houses, commercial business, events people and commercial businesses as well as individual buyers

Material	Storage	Collection	Process	Product need	Route to market
Pallets	Normally not in bins, but loose in yards. Best if dry before collection.	unknown	Disassemble and reassembly; paint	Identified 'nice-to-have' market	Through existing flooring retailers and online B2C.

Zing - Norwich BID Start UpCycle Weekend

Norwich is filled with local coffee shops - but walk down any street as the owners rattle their keys in the shop door and you'll see bags upon bags of leftover food from the day before ready to be piled in a bin lorry and taken to landfill, incinerators or, if you're lucky, a distant anaerobic digester. If you're signed up to Zing, the story couldn't be more different. Zing, the latest upcycle idea out of Norwich, promises to collect used food, starting with Orange peel, and turn it into a tasty mood-boosting snack. They not only taste great, they feel great too, since you could be buying a snack created from unused food, collected from the very same business you're buying from.

Zing's business model entails two revenue streams from both the collection of unused food and sale of upcycled products. Collections are made using local cargo-bike companies; specialists in the delivery and collection of local goods and operate carbon-neutral forms of transport at a low cost.

The first of the product line range is dried Orange peel, branded as 'Zing', flavoured with sugar and spices for a sweet or savoury snack that falls under similar product selections as dried Mango, apricot or berries. The target market are health and sustainable conscious



adults as well as business owners who sell locally sourced goods and who want to reduce their waste associated waste costs.

Material	Storage	Collection	Process	Product need	Route to market
Citrus fruit peel	Needs to be separate from other food waste	unknown	Dehydration and flavouring	Identified existing market in other territories	B2C sales online and via retailers.

Gökotta

Gökotta Tailorshop & Handcrafts provides services of altering, customising and repairing clothing. By using upcycled materials i.e. fabrics and clothes the company produces new pieces to sell or repair clothes for customers.

This way the company gives a second life to old pieces of garment and creates new, stylish clothing. As opposed to the popular fast fashion clothing producers, Gökotta offers unique, upcycled and environmentally friendly products.

Material	Storage	Collection	Process	Product need	Route to market
Textiles	Source-segregated, any container or bag	unknown	Bespoke tailoring	Identified market being served	Through existing retail outlet

Worn Office Chairs, NL

Worn office chairs are collected by watrest.nl. They are professionally refurbished and sold again. You will find companies that want these. They can make your office chairs like new again for 1/5 to 1/10 of the replacement value.

Huykman & Duyvestein

Huykman & Duyvestein manufacture orthopaedic shoes by using upcycled materials like Transparent PU foil, paraffin wax, used (orthopaedic) shoes, plaster casts and fine shavings of cork, leather strips, elastic strips, rubber and wood

Material	Storage	Collection	Process	Product need	Route to market
paraffin wax, used shoes, plaster, casts, cork, leather strips, elastic	Unknown	unknown	tailor-made orthopaedic shoes	Identified market being served	Through referral from specialist or GP



strips, rubber, wood					
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Eco Park in Salaise-sur-Sanne and Sablons

Chemical recycling and raw material transformation in an eco-park focussing on industrial wastes. The businesses are co-located to make shared infrastructure for energy supply and co-generation, solid waste treatment and reclaimed water².

6.5 Business Model D: Recycling end-of-life materials.

Description

Materials that are at the end-of-life for one business are collected and processed into another product by a professional, licensed reprocessing facility. These are industrial, regulated processes that operate at a meso or macro level. These products are a raw material for another process or product and are legally no longer a waste.

Whilst not upcycling, there are a number of issues with any process that involves plastic waste. Plastics are often contaminated, with fire retardants and dyes, for example. These contaminants may pose a risk to human health. In addition there are strict regulations around the use of plastics that may come into contact with food or toiletries. Therefore, products made from recycled plastics could be considered for this project, but it is a recycling, not a reuse activity.

Environmental

Recycling materials reduces the environmental impacts of landfill or energy-from-waste and displaces virgin raw materials in the supply chain.

Financial

Products and supply chains currently exist and many recycled plastics are competitive in terms of price with virgin equivalents. Therefore this is financially viable.

Local or social

Reprocessing of recycle is a capital-intensive industry and frequently owned and operated by large national, or international, companies. Local impact is greatest where there is a plant that may create jobs.

² Ribeiro, P.; Fonseca, F.; Neiva, C.; Bardi, T.; Lourenço, J.M. An integrated approach towards transforming an industrial park into an eco-industrial park: The case of Salaise-Sablons. *J. Environ. Plan. Manag.* 2018, 61, 195–213.



6.5.1 Case studies.

Coral Eyewear

Coral Eyewear creates sustainable eyewear from rescued fishing nets and recycled plastic. Glasses are sent in a sustainable packaging which is also recyclable. In addition, the frames can be indefinitely recycled and the company will recycle them if a customer sends them back. This way Coral Eyewear offers planet-friendly glasses as opposed to the majority of eyewear being produced from virgin plastic.

Material	Storage	Collection	Process	Product need	Route to market
Fishing net waste, predominantly nylon.	unknown	unknown	Sent to Italy for sorting and remelt in pellets.	Identified B2C market.	Existing brand online sales

6.6 Business Model E: Platforms to facilitate and educate.

Description

Materials that are at the end-of-life for one business need to be collected and processed into another product by a second business. There is a gap in the knowledge about materials available and those wanting them. One type of platform may attempt to manage this marketplace.

The second type of platform may raise awareness of the upcycled products and act as a B2C online shop and/or awareness raising, marketing and communication channel.

Environmental

The environmental impact of online platforms is dependent on the energy policies of the hosting platforms and servers.

Financial

Least viable as upfront investment is needed and revenue streams are hard to predict and may take a long time to start. See case studies below.

Local or social

Local platforms can be important in raising awareness amongst businesses and consumers about the potential opportunities in upcycling.



6.6.1 Case studies.

WatRest.nl - Netherlands

This is an initiative to help companies easily find a customer or solution for your leftover materials and residual products. That can be a recycler for your plastic, or a trader for your pallets. This allows companies to save or even earn money.

On the website you will find a guide to possible buyers of your leftover materials and remaining products. Within a few clicks you will find addresses and telephone numbers. Also take a look at the tips.

If your residual flow is not listed, you can send them an email and they can submit it to their students as an assignment for a course or graduation assignment.

Olio - household food sharing app

Whilst not targeting businesses the Olio app is a good example of a platform that was created to reduce waste by facilitating sharing, in this case, of food waste.

<https://olioex.com>

RecycleBlu

RecycleBlu is a platform that allows the trading of recyclate and is an example of a functioning marketplace.

<https://www.recycleblu.com>

Scoop - Norwich BID Start UpCycle Weekend

Scoop are here to solve a problem: far too much waste ends up in Landfills in the UK because producers don't know what they can upcycle or even how to do it. Likewise, upcyclers and potential upcyclers do not know what types of waste nearby businesses produce and how much of it could be made available to them so that they can make their upcycling ideas a reality.

The solution is Scoop - producers of materials are connected with consumers of goods through an online platform that prevents stuff from ever becoming waste in the first place. Using data such as the quantity, type, quality, availability and transportability of undesired goods, Scoop connects sellers with buyers to create a marketplace that reduces the overall amount of waste sent to landfill and enables the upcycling industry to grow. Intelligent data analytic software facilitates the exchange of upcyclable materials.

Scoop are aimed at the B2B market but also allow individuals to sign up and the online element of this business allows infinite scalability.



n/a	n/a	To be arranged by upcyclers in year one and unknown in year 2	Online marketplace	Identified need. Unknown if this is right solution until it goes to market	Hard. Online marketplaces need matching, high levels of supply and demand and are famously hard to get off the ground.
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Waystr- Norwich BID Start UpCycle Weekend

Norwich is filled with great shops all around the city, but unfortunately all these shops produce lots of waste materials. A lot of this waste gets sent to landfill or gets left around on the streets.

Waystr has come up with a solution to get businesses to upcycle their waste and then sell it to the people of Norwich through their platform online. The platform will be full of local business products and tips on how to upcycle waste at home. Waystr are partnering up with a local electric bike company to deliver the products but also are offering a click and collect service.

To demonstrate the products they are hoping to make planters out of pallets, these will be put around the city with a QR code stuck to it. The idea of this is to get the public to scan the QR codes which then comes up with information about how the product was made, how many different waste products were used and gives them an option to buy the same planter.

Material	Storage	Collection	Process	Product need	Route to market
n/a	For stock?	unknown	web education and physical events	Market research and audits show a lack of understanding about waste costs and impacts.	Through physical space interactions

7. The supply side business case.

There are three key reasons why businesses may want to be involved in upcycling projects: financial, environmental and local. Whilst the cost of waste management is important to business owners, it is believed that support for upcycling projects is more likely because of environmental and local factors.

Environmental

There are clear environmental benefits to any activity that keeps materials circulating for longer before they become a waste. Upcycling not only reduces materials going for final



disposal or recycling, it also turns them into higher value products. This reduces resource demand and the production of greenhouse gases associated with waste disposal.

Financial

The waste audits demonstrated that there is a poor understanding of the actual cost of waste management in terms of direct costs and little to no understanding in terms of indirect costs. There is therefore the potential that any new upcycling project may be able to save a business money by removing waste materials at a lower cost than existing methods.

Local or social value

Upcycling projects are most likely to be sustainable at a local level, because of the lower volumes of materials used. Once higher volumes of materials are needed in industrial-level processes, it is likely that they will be sourced through the existing waste management infrastructure where consistency can be guaranteed. Therefore new upcycling projects are most likely to operate at a local level. This can generate support for local job creation, the recirculation of money within the local economy and reduced transport and its associated emissions.

Involving local businesses

There is no template for involving local businesses in upcycling projects. There are a number of different ways of finding both the materials that can be upcycled and the businesses that may be involved in the upcycling. For example, a tender may be run that makes available one or more materials, or that asks for a facilitating organisation or platform. A competition or Start Up type weekend may be organised to encourage entrepreneurial activity. Support may be given to existing and new organisations to develop new, or expand current, upcycling activities. Signposting and bespoke support may be given to organisations that produce waste. The report has discussed criteria for prioritising which materials to focus on in section 3.1. The table below addresses some of the questions that businesses may have about joining.

Table 7.1: Questions businesses may ask about joining a pilot.

Waste is too expensive	Recycling is always cheaper than landfill or incineration. Upcycling may be cheaper still
I don't have the time	The pilots may make your waste collection system more efficient, which will take less time
I'm not interested in the environment	This project is supporting your local economy so you'll get some good publicity from joining in
Why should I join in?	There will be a load of publicity around this pilot so your business profile will be raised
Why should I join in?	You might learn something interesting or useful from another local business, or even another business in one of our partner areas.
Why should I join in?	This pilot is supporting the local economy



	and job creation, which is good for all of us.
How does this help the environment?	Upcycling changes a waste into a new product, which reduces waste and the GHG emissions that result from it. It also reduces the amount of raw materials we need to make stuff. That also reduces GHG emissions
Who is going to sort all this out? Won't it take me more time?	The project is fully funded by the EU and includes free support to businesses in terms of guidance around your waste.

