



**CIRCULARITY IN THE
BUILT ENVIRONMENT:
CASE STUDIES**

A COMPILATION OF CASE STUDIES FROM THE CE100

APRIL 2016

ELLEN MACARTHUR FOUNDATION

The Ellen MacArthur Foundation was created in 2010 to accelerate the transition to a circular economy. The Foundation's work focuses on four areas: insight and analysis, business and government, education and training, and communication. The Foundation collaborates with its Global Partners (Cisco, Google, H&M, Intesa Sanpaolo, Kingfisher, Philips, Renault, Unilever), and its CE100 network (businesses, universities, innovators governments, cities and affiliate organisations), to develop circular business initiatives and build capacity.

CE100

The Circular Economy 100 is a pre-competitive innovation programme established to enable organisations to develop new opportunities and realise their circular economy ambitions faster. It brings together corporates, governments and cities, academic institutions, emerging innovators and affiliates in a unique multi-stakeholder platform. Specially developed programme elements help members learn, build capacity, network, and collaborate with key organisations around the circular economy.

CO.PROJECT

Co.Projects are opportunities for formal collaboration between CE100 members. Co.Projects are driven by members, for members, with a focus either on research initiatives or pilots. Co.Projects leverage the CE100 network with the aim of overcoming challenges, and exploring opportunities, faced by organisations making the transition to a circular economy that they may otherwise not be able to address in isolation.

BUILT ENVIRONMENT CASE STUDIES

The Built Environment Case Studies co.project is a collaboration between BAM, BRE, cd2e, London Waste & Recycling Board, Ouroboros, Tarkett, and Turntoo. This Co.Project's aim was to provide useful case studies for the CE100 community so they can understand what circularity in the built environment looks like, while showcasing CE100 member initiatives. The Co.Project team has now produced a pack of built environment case studies sourced from CE100 members. The pack of case studies will covers examples ranging from infrastructure, building projects, material usage, and relevant 'programmes'.



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Buildings as Material Banks (BAMB) submitted by BRE

Construction Reuse Platform: Bexleyheath submitted by Globechain

ROC A12 School: Carpet Lease submitted by Desso

Reviva shelving submitted by Marks & Spencer

Circularity in the Built Environment: Applying the ReSOLVE Framework

In the compilation of these studies, the Co.Project wanted to bring to life the **ReSOLVE framework** for the built environment. The ReSOLVE framework was introduced in *Growth Within: a circular economy vision for a competitive Europe*, a report by the Ellen MacArthur Foundation, McKinsey & Co., and SUN. The framework identifies six different ways that organisations and governments can think about applying circularity: **Regenerate, Share, Optimise, Loop, Virtualise, and Exchange**.

Each of the case studies highlights the elements from the ReSOLVE framework that are relevant in their project, material, or programme. The aim of this exercise is twofold:

- Demonstrate that “elements” of circularity already exist in many buildings and projects, therefore inspiring new projects to pick up on these elements and create a built environment that is holistically circular
- Better define each of the ReSOLVE framework elements for the built environment, across the conception, construction, use and deconstruction/recycling stages.

For the reader’s reference, a detailed explanation of each of the ReSOLVE elements, and what it means in the built environment, is included here. The examples included below are indicative and are not meant to be an exhaustive list.



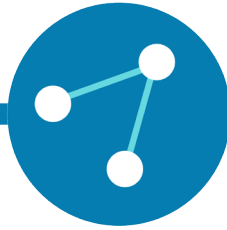
Regenerate.

REGENERATING AND RESTORING NATURAL CAPITAL BY:

- Safeguarding, restoring and increasing resilience of ecosystems
- Returning valuable biological nutrients safely to the biosphere (e.g. through anaerobic digestion or composting, enabled by the separation of technical and biological nutrients)

IN THE BUILT ENVIRONMENT

- Use of renewable energy to power buildings (Solar, Wind, Geothermal, Biomass, Tidal, Wave) – includes buildings as “energy generators” (e.g. solar panels on roofs)
- Land restoration (saving virgin land, building on brownfield sites...)
- Resource recovery (regenerate organic waste, compost production...)
- Renewable production systems (bio-gas production, electricity production...)



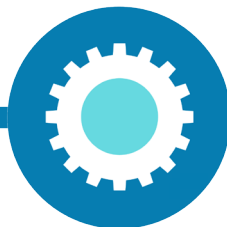
Share.

MAXIMISING PRODUCT UTILISATION BY:

- Mutualising the usage of assets (e.g. through sharing schemes or exchange platforms)
- Reusing assets (e.g. through resell, redistribution)

IN THE BUILT ENVIRONMENT:

- Residential sharing (peer-to-peer renting...)
- Infrastructure sharing (parking sharing, shared infrastructure areas, shared green areas...)
- Appliances / Tools sharing (sharing practises, sharing water...)
- Co-housing
- Office-sharing
- Shared water consumption (water treatment facilities)



Optimise.

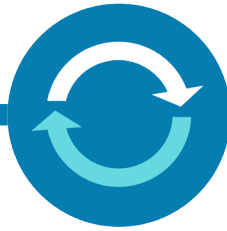
OPTIMISING SYSTEM PERFORMANCE BY:

- Prolonging products' use period (e.g. through repair/maintenance, design for durability and upgradability)
- Decreasing resource usage (e.g. increasing efficiency, designing out waste)
- Optimising the logistics system through implementation of reverse logistics

IN THE BUILT ENVIRONMENT:

- Industrial process, off-site production (prefabrication)
- Smart urban design (use inner-city vacant land, promoting compact urban growth, high-quality urban environments, integrated, sustainable and participative urban development...)

- Energy efficiency (Integration in the environment, Building envelope, equipment...)
- Water Efficiency (Reducing consumption grids, Re-circulation of water, Using closed water, Water re-use...)
- Material Efficiency (Renewable, Recycled, Recyclable, Non-toxic components, Lower energy content...)
- Reduction in transport



Loop.

KEEPING PRODUCTS AND MATERIALS IN CYCLES BY:

- Remanufacturing and refurbishing products and components (e.g. through design for/of disassembly)
- Recycling materials (e.g. through making the right material choices in the design process to ensure recyclability)

IN THE BUILT ENVIRONMENT:

- Optimisation of end-of-life of the building/materials (Durability, maintenance, repair, upgrades, removal, deconstruction, re-use...)
- Modularity of the building (Modular building techniques, multi-purpose volumes, flexibility in buildings...)
- Remanufacturing of materials (piece-by-piece demolition, material banks, stock management...)



Virtualise.

DISPLACING RESOURCE USE AND DELIVERING UTILITY VIRTUALLY BY:

- Replacing physical products with virtual services (e.g. e-books instead of books)
- Replacing physical with virtual locations (e.g. online shopping, video conferencing)
- Delivering services remotely (e.g. cloud computing and storage)

IN THE BUILT ENVIRONMENT:

- Tele-working
- Virtualisation of products
- Virtualisation of processes (BIM, digital mock-up, automated maintenance...)
- Smart appliances (smart home systems, connected appliances, efficiency for lights...)



Exchange.

SELECTING RESOURCES AND TECHNOLOGIES WISELY BY:

- Shifting to renewable energy and material sources
- Using alternative material inputs (e.g. cascading by using by-products or extracting biochemical feedstock from biological nutrients)
- Replacing traditional with advanced technical solutions (e.g. 3D printing)
- Replacing product-centric delivery models with new service-centric ones

IN THE BUILT ENVIRONMENT:

- Better-performing materials (advanced materials discovery)
- Better-performing technologies (e.g. 3D-printing, building management systems, electric engines)
- New products and services (e.g. multi-modal transport)

CASE STUDY: BUILDING PROJECTS

Rehafutur Engineer's House

SUBMITTED BY:

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LOCATION:

Loos-en-Gohelle (North of France, Unesco listed mining area)

PROJECT DESCRIPTION:

Reconversion of a historic house into office facilities, 400 m².

The whole demonstrative budget cost was a total of €1,580,000 of which €720,000 (45%) was dedicated for the re-construction and refurbishment (excluding outdoor layout, Architect's fee, monitoring, communication around the project and educational space).

KEY DATES:

April 2014 to June 2015 (13 months)

STAKEHOLDERS INVOLVED:

- Maisons & Cités – the landlord

- Architects ARIETUR
- Design & Build consortium made up 10 local SMEs
- Ekvation building cluster – long term tenant, communication and catalyst for the project

ADDITIONAL SOURCES OF INFORMATION:

- <http://www.rehafutur.fr/> (in French)
- 1 video present the whole project (in French)
- 7 videos are available on the website on technical subjects: thermal bridges treatment methods, ancient site pathology, overheating treatment, air tightness, eco-materials contribution, health and environmental quality criteria (in French).

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE ADDRESSED BY YOUR PROJECT?



Element 1: Regenerate

Rehafutur has used 8 different eco-materials to demonstrate the effectiveness of renewable insulation materials as part of the CAPEM (Cycle Assessment Procedure for Eco-impacts of \Materials) project. Insulation made out of vegetal: Wood fibre, flax fibre, hemp bricks, expanded cork; made out of animals: sheep wool; from: loose-filled cellulose, recycled textile, recycled cellular glass.

REASONING:

To demonstrate the effectiveness of renewable insulation materials as part of the CAPEM (Cycle Assessment Procedure for Eco-impacts of Materials) project.

BENEFITS:

- Comfort and health (indoor air quality) monitoring would enable quantitative results, including hygrothermal behaviour of the insulation materials. Each façade is monitored to measure the thermal resistance of the insulation materials on-site (including the roof). Comfort parameters are also monitored; room temperature, relative air humidity and carbon dioxide levels.

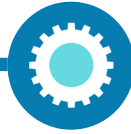
CHALLENGES:

- The interface between different materials posed technical difficulties (a different material was used for each wall to monitor and compare the performance)
- Using non-standard materials posed problems due to the lack of knowledge amongst trades people. Hemp blocks proved to be the most difficult for installation. Training was undertaken on the work site to upskill the teams involved.

LESSONS LEARNT:

- Collaboration between stakeholders is essential. A lack of communication between

trades people and material suppliers meant that the sheeps wool was installed in an inefficient way – this could have been avoided which would have reduced the cost of installation.



Element 2: Optimise

- Rehafutur has been designed and built to be extremely energy efficient during the use phase, requiring only 34 kWh.m² annually for heating. For instance, to obtain the BBC Standard of low-energy consumption renovations of existing buildings, the maximum consumption of primary energy is 104 kWh/m² per annum, in Northern France.
- This has been achieved by:
 - Installing a thick insulation layer to maximise performance of the building envelope
 - Managing the thermal bridges by separating all internal load bearing walls from the external walls to avoid gaps in the insulation material
 - Using a dual flow ventilation system with heat recovery via a heat exchanger.

REASONING:

- To make the building efficient during the use phase so that it has less environmental impact but is also less expensive to run.
- Rehafutur is located in a socio-economically challenged area, where “fuel poverty” is a real issue.

BENEFITS:

- Economic benefit throughout the life time of the building (reduced operating costs)
- The house used to burn off 1,000 litres of fuel each year; after renovation, the insulation is such that the heating demand is very low at 34 kWh/m² a year
- For comparison purposes, a 23 kW boiler is now enough to heat the 320 m² building (which is usually the size of a boiler for a 100 m² flat).

CHALLENGES:

- Technical challenges in the separation of internal load bearing walls from external walls.
- Coordination of different tradespeople to achieve specific training on the worksite with all the teams was undertaken on this issue.
- Interior insulation compulsory as the building is on the UNESCO list of world heritage sites.

LESSONS LEARNT:

- Air tightness training would have been undertaken earlier and been more vigilant on the chaining of the operational steps – not all the performance objectives were achieved here.



Element 3: Loop

REUSE OF EXISTING MATERIALS:

- 2 marble fireplaces were moved during the refurbishment process to become ornamental features in public rooms.
- 62 m² of spruce floorboards. The hundred year old spruce floorboards were meticulously dismantled to make way for high-performing floor insulation, and re-layed after cleaning.
- 18 m² of multicoloured cement tiles were reused as features.
- 350 m³ of rubble was stored at the rear of the house and reused to level the parking spaces and access paths.

Rehafutur also used three different insulation materials using recycled materials: cellulose, textile (locally produced), and cellular glass.

REASONING:

- To keep the high heritage value of the building (floorboards, fireplaces, tiles).
- To save money and nuisance in the case of the rubble. This method avoided 17 semi-trailers to carry the debris to a landfill.
- To demonstrate the effectiveness of insulation materials using recycled materials as part of the CAPEM project.

BENEFITS:

- Benefits were economic (e.g. saving money on carrying debris/rubble to landfill), as well as related to aesthetics and comfort
- The developers found that in reusing materials, the majority of the budget goes towards labour costs rather than in the purchase of new, virgin materials – which is a positive for a region in need of employment: as exemplified below:
- Floorboard reuse:
 - Labour resources required: 137 hours for 1 carpenter-joiner (removing / cleaning / laying back)
 - Financial resources required: removing / cleaning / laying back – €5,480
 - Transport: €250.
- Tile reuse:
 - Labour resource needed: removing – 2 days (2 tilers), cleaning and sanding down – 4 days (1 tiler) and laying back – 3 days (2 tilers). The whole operation cost €7,000 euros of labour

- If the tiles were laid using “new” cement tiles, €8,000 euros would have gone towards the material itself!
- Furthermore, in certain instances the developers were not able to find “new” materials that were at the quality that the reused materials would offer them: e.g. plain pine floorboards

CHALLENGES:

- Since this was the first time reusing floorboards and tiles for the trades people, disassembly was very difficult – they are used to simply demolishing the floorboards in other projects! This required a real change of mentality.

LESSONS LEARNT:

- We would have liked to have reused all of the heating systems (including the old radiators) but the designers and tradespeople weren’t ready for this!

Additional Information

WHY WAS CIRCULARITY INTEGRATED IN THE PROJECT?

The Rehafutur Engineer’s house project responds to the challenge that France faces in renovating existing building stock to high energy efficiency standards. Rehafutur aims to offer solutions for the renovation of the typical mining housing in the region which have specific high energy, environmental, economic and social requirements. Given the building’s significant heritage value, it was important for the team to reuse as much as possible whilst ensuring the longevity of the site – so circularity was a strong element from early on. Demonstrating circular solutions at Rehafutur has a huge multiplier effect as there are approximately 70,000 mining houses still occupied in Northern France.

There was a particular focus on the use of building materials from renewable sources (animal and vegetal) and from recycled material, as it is a demonstration site of the North-West European CAPEM (Cycle Assessment Procedure for Eco-impacts of Materials) Project. CAPEM brought together the expertise of 11 partner organisations to improve the production, distribution and use of eco-materials. Rehafutur implemented several insulation solutions using bio-based and recycled materials – with minimal environmental impact and no negative health impact – readily available on the market. The building will be monitored to evaluate thermal performance and comfort in winter and summer.

HOW WAS CIRCULARITY INTEGRATED INTO THE PROJECT AND WHAT WERE THE OVERALL CHALLENGES?

The management team were very collaborative when it came to working towards circularity, especially since there was a desire to increase skills amongst building professionals to influence future projects. With this demonstration site, the cluster Ekwation will continue to engage in partnerships with regional Enterprises, laboratories, schools, universities and education centres, stakeholders and policy-makers in order to offer them a complete tool to exhibit, test and understand the process of renovating the ancient housing stock in the region (especially mining housing).

The main technical challenges lies in managing the interface between the different insulation types with the air-tightness system. Training sessions were held on the work site on air-tightness with all trades people to make this intricate system work, so collaboration was key to the success to the project.

ON-SITE COURSES INCLUDED:

- Technical approach of air tightness: regulatory and labels – 4 hours at the beginning of the building process.
- Practical approach: products application in a container where they can have an air tightness testing inside the container – 7 hours in the course of the building process.
- Analysis of the first air tightness testing: solutions to improve the results – 4 hours after the air tightness testing.

WHAT WERE THE ADDITIONAL BENEFITS OF CIRCULARITY IN THE PROJECT?

- The construction workers were very proud to work on the project, with continuous visits and communication around the building site. Those who set the insulation materials were used to eco-materials but enjoyed working with the flax fibre enough that they've made themselves a tool to cut it.
- Through this project, partnerships were developed with regional enterprises, laboratories, schools, universities and education centres, stakeholders and policy-makers – offering them a complete tool to exhibit, test and understand the process of renovating ancient housing in a way that suits the region.

WHAT COMES NEXT?

- Energy consumption will be monitored to compare the technical choices in use in the building and confirm the achievement of energy efficiency requirements, identifying areas for potential improvement. The effective energy consumptions will be analysed and compared to the theoretical figures. All the data will be available for review in the exhibition area of the building.

SPECIAL MATERIALS USED

- A recycled material called Metisse was used for the insulation. This regional material is made out of old clothes (mainly cotton).
- <http://www.isolantmetisse.com/> (in French)

rēhāfutur
ensemble, agissons pour un habitat responsable



CASE STUDY: BUILDING PROJECTS

Queen Elizabeth Olympic Park

SUBMITTED BY:

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PRIMARY CONTACT:

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LOCATION:

London, United Kingdom

PROJECT DESCRIPTION:

- Queen Elizabeth Olympic Park, in London, United Kingdom, is a sporting complex built for the London 2012 Olympic and Paralympic Games, situated to the east of the city adjacent to the Stratford City development. This was a district scale regeneration project.
- The Park was designed on two distinct levels, one that focused on creating a place suitable to host the Games and another to create a successful new piece of the city after the games. The emphasis was on the legacy design and as such this was set as the base, with an overlay during the Games, to be removed afterwards in the transformation phase.
- The London Legacy Development Corporation (LLDC) inherited responsibility for the area after the Games and are responsible for the ongoing regeneration of the Park and surrounding area. LLDC took on the environmental targets set for construction by the Olympic Delivery Authority (ODA), to be supplemented by their own targets as

policies and the industry evolves over time.

- The waste target for contractors is 95% diversion of non-hazardous waste direct to landfill with an additional target of 50% materials reuse.

KEY DATES:

2008 – Present

STAKEHOLDERS INVOLVED:

- Olympic Delivery Authority (ODA)
- London Legacy Development Corporation (LLDC)

ADDITIONAL SOURCES OF INFORMATION:

- Learning Legacy documents <http://learninglegacy.independent.gov.uk/>
- ICE report on the temporary venues; <http://www.icevirtuallibrary.com/doi/pdf/10.1680/cien.2011.164.6.59>
- ICE report on the bridges; <http://www.icevirtuallibrary.com/doi/pdf/10.1680/cien.2011.164.6.23>

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE STRONGLY ADDRESSED BY YOUR PROJECT?



Element 1: Optimise

Designing out waste should be the first step to addressing waste in construction in order to reduce the amount of waste that is generated in the first place. It also has the added benefits of the potential to reduce material cost and costs associated with onsite waste management and processing.

The designers of the Podium café followed the waste hierarchy during the design process and identified 4 specific ways that enables waste to be designed out;

- Timber frames were changed to cross-laminated timber as this can be manufactured offsite in controlled conditions which reduces re-working and onsite waste.
- Deep foundations were changed to a shallow raft foundation, reducing the excavation level by 275mm. This reduced the amount of excavated material to be disposed of, which would have probably been sent off-site as the Park overall had a surplus of excavated material.
- Studded steel drilled piles were changed to precast concrete driven piles which reduced the amount of waste.
- Finally, BIM modelling and coordination of services was undertaken to minimise

logistical clashes and enable the preformation of holes which again reduces rework and the amount of onsite waste generated.

The construction team were also able to reduce waste further by their arrangements with suppliers including takeback of cross-laminated timber packers for reuse by the supplier and a subcontractor pallet takeback scheme.

The Olympic Stadium was designed to be a very light structure and ultimately to be partially deconstructed before a legacy operation as a full Stadium was a viable option. The minimalist structure of the Olympic Stadium was designed to be extremely light and resource efficient, using 90% less steel than the Beijing 2008 *Birds Nest* Stadium. For example:

- Reuse of surplus gas pipeline for the compression truss structure saved 2,500 tonnes of new structural steel and enabled a cost saving of approximately £500,000.
- Utilisation of a new blockwork technique reduced the amount of steel support required, saving £40,000.
- 104,000 tonnes of recycled crushed concrete was reused after being used onsite for a temporary platform, eliminating the need to import this quantity of virgin aggregate and saving £1 million and more than 20,000 lorry movements.

This was partly due to the fact that plans for its legacy use were built into the final designs; this included the upper tiers being removed after the Games and the Stadium reduced to a 20,000 seat capacity athletics bowl. The Stadium structure was supplemented by an overlay of Phthalate-free PVC panels to ensure it had an aesthetic appeal for the duration of the Games, while not adding a large amount of extra material. Subsequently there was interest in the Stadium as the home of a football team and so prior to the winning bidder, West Ham UFC, moving into the Stadium, planned work to dismantle the stadium during the Park's transformation phase was replaced with strengthening works due to the extension of the Stadium roof.

The London Aquatics Centre was designed as much of the rest of the Park was, with a permanent legacy building beneath a temporary overlay that would be revealed in transformation. There were a number of steps taken to design out waste:

- Offsite/modular construction to minimise onsite waste
- Just-in-time ordering
- Pre-fabrication
- Pre-deconstruction auditing and material assignment
- Ordering to precise specification (to avoid over-ordering)
- Design for deconstruction and reuse with similar functionality
- Regular review of programme to understand what materials were available and when
- Correct storage of materials to avoid degradation



Element 2: Loop

DESIGNING FOR REUSE

The hosting of the games presented a challenge of how to provide an area and venues suitable for an international event that had a very short lifespan without constructing any 'white elephants'.

As with the venues, the parkland pathways were designed to enable the movement of large crowds for the Games but then to be reduced to a more fitting size in legacy mode where the numbers of people visiting the Park at one time were expected to be lower. There were a number of ways in which these have been designed for reuse:

- The timber decking on the bridges was screwed in rather than nailed or glued to allow for easier removal of bridge sections
- The Central Park Bridge which featured the colourful 'confetti' style matting was laid down so that it could be easily pulled up during the narrowing works to the bridge and reused. The contractor responsible for this task was Lagans who then donated the matting to a school for use in their playground.
- Two reused construction logistics bridges have been repurposed, with one being relocated to the north of the Park from its location during the Games along Stratford high street, as tarmacked bridges to allow the Lee valley Velo Park's road circuit to cross the River Lea.

The long timescales between planning and design and transformation of the area to its legacy mode mean that situations can change over the years which can have an effect on construction and deconstruction plans. For example, the use of the Stadium as an 60,000 capacity arena has meant that the bridges to Stadium Island have not been reduced in size as was originally planned. Bat and bird boxes that were placed in the middle of the bridges, to be revealed when the temporary sections were removed, will have to be moved to ensure animals can easily use them.

ASSET DISPOSAL

During the construction of the Park it became clear that achieving high material reuse targets would be challenging. A number of contractors were able to achieve high levels of reuse of materials but this was variable over the site dependent on a number of factors including:

- Match of supply and demand of materials
- Type of material being removed during the works and quantities available
- Knowledge of and engagement with community organisations or charities
- Level of sensitivity in which assets were removed

These lessons learned through the Olympic build resulted in a decision being taken to establish an Asset Disposal Contract, as a way of running an overarching project available to be used by all LLDC projects that would incentivise reuse through a profit share arrangement with its users. It also allowed LLDC to have a more holistic approach to gifting of assets as we could prioritise community reuses that help in working towards our priority themes.

Over 40 community organisations have been gifted assets ranging from the Aquatics Centre's temporary seating to a telephone box to timber.

The key elements of the contract and process are listed below:

- The contract is based on a profit share agreement with the contractor that allows LLDC to specify the disposal route of the asset (either sold or gifted), the timescale for disposal and the profit share (based on specified limits).
- The contract is set up to incentivise the contractor to gain the greatest return for the assets that are sold and has KPI's relating to reuse and recycling rates and avoidance from landfill in line with LLDC's corporate targets for construction.
- One of the key objectives of this contract is the ability to gift assets to the community. This is integral to LLDC as it is a way to provide community benefit and extend the life of materials through upcycling, reuse or refurbishment. LLDC leads this strand of the contract through our reuse website, www.freeusable.co.uk.
- As a public body, LLDC has a responsibility to dispose of our assets in a fair and transparent process. To enable this we have created a form for any group to complete when requesting the free issue of assets advertised on freeusable.co.uk, this form asks for information about the group and how their work aligns with the priority themes of environmental sustainability, sport and healthy living, community engagement (including jobs and training) and inclusivity and accessibility.
- The response is then reviewed by members of the Sustainability and Community Engagement teams (company/charity numbers are checked against information on Companies' House and the Charity Register) with recommendations put to the Executive Director of Regeneration and Community Partnerships for approval.
- An agreement is signed with community organisations that provides legal transfer of the assets to that community group, to be used for the intention set out in the form submitted to LLDC. It also states that in the event that the group no longer has a use of the assets, the group will ensure that they are properly disposed of, reused or recycled as a way of encouraging good practice.

There have been a number of lessons learnt through running the asset disposal contract that have differed from what was expected when the contract was envisaged;

- Maintaining an accurate asset register proved to be essential. Sign in/out processes for assets being placed into storage are essential to enable a smooth asset sales or gifting process.
- Protecting the value of assets through careful removal and storage is essential to achieving re-use and/or sales values. Unless assets are removed sensitively and stored

correctly their reuse value can decrease rapidly, for example, flood lights that are cut from the lighting columns or stored exposed to the elements will need the electricians checked and potentially re-wired before they can be reused. Careful removal of assets is usually more labour intensive than quick removal of assets.

- LLDC involvement in the gifting side to the contract was more time intensive than was originally envisaged.

Some challenges in facilitating and reporting on reuse are:

- Matching supply and demand. During transformation we were lucky enough to have a storage space not far from the Park in which to hold assets until they were able to be reused on the Park or until we found external reuses for them. Unfortunately, this is not always the case and in London where space comes at a premium and as the Park develops we are unable to do this to the same degree.
- Facilitating community reuse. Without the appropriate networks in place, reaching community groups is challenging. It is not enough to have a website where your assets are available; you need to promote it to local people through various networks. LLDC has been fortunate in this as we have our own community networks which include local businesses and arts and culture groups and have been supported by external bodies such as Sport England in our efforts to find new homes for some of our assets.
- Organising collections of assets. This can take a large amount of administrative time as groups are often at the mercy of favours and payment in kind to be able to collect assets.
- Reporting on the levels of reuse the contract is achieving has brought up its own challenges associated with which unit of measurement you use. The weighbridge that had been installed during the Olympic build was removed before the Games and estimating the weight of assets was not practical. We instead opted to report on asset reuse on a unit basis, which is not ideal as one light fitting and one porta cabin will have very different properties, though it does provide a way of reporting on the levels of reuse that can be attributed back to what those individual assets were.

EXAMPLES OF ASSET REUSE BY LLDC AND CONTRACTORS:

1. **Hub67 (onsite re-use).** Hub67 is a community hub located in Hackney Wick that has been created by reusing nine modular cabins that were used during the Games as a temporary high street for the athletes. The hub is a prime example of how assets can be re-purposed; it also made use of cladding material, fencing and timber removed from the Park during transformation and won the Blueprint award for Best Sustainable Project or Product in 2015.



2. **Warm up running track (donation)** The warm-up running track was laid down without the use of tarmac as a binding agent which allowed it to be lifted back up in lanes with minimal damage so that it could be reused by British Athletics for temporary and permanent athletics tracks as needed.
3. **FO6 bridge (Central Olympic Park) narrowing works (donation)** During transformation works this bridge was reduced to its legacy size which involved the removal of 39 tonnes of colourful confetti pattern rubber matting. The contractor, Lagans, re-laid the matting in a Holy Family Primary School in Omagh, Northern Ireland.
4. **FO3 bridge (North Park) narrowing works (donation)**
 - The timber decking and scaffold structure was reused on other projects outside of the park by PHD Scaffolding Ltd and their building division.
 - Construction of gabion whisksers to the bridge abutments used material taken out by other works across the Park and stored temporarily on LLDC land and as such no additional materials were imported.
 - The lamp columns were donated to a local skate park and the re-usable rubber was donated to two primary schools.
5. **Tree planters (onsite re-use)** There have been a large number of trees planted on the Park, some of which are currently planted in wooden planters that have been created from timber removed from the temporary elements of the bridges. They have been planted in this way to allow for ease of re-location once development platforms begin construction, while providing a more pleasing environment in the short term.
6. **The Podium (formerly called the South Park Hub) Reuse initiatives included:**
 - Cross laminated timber offcuts donated to Art in the Park
 - Reuse of clean human health layer material for backfilling excavations
 - Excess pallets donated to a pallet reuse organisation

We have also sold a number of assets for reuse as part of the asset disposal contract; these include items such as bollards, service pods, a boot wash and chemical testing kits.



“Building on the achievements of “the most sustainable Games ever” the Legacy Corporation places environmental sustainability at the heart of all we build and all we do. Reuse of materials is a very important strand of this and we’ve set a target of 50% reuse. This case study highlights how we’ve been able to meet this target and to prolong the life of materials and equipment through the asset disposal contract and the hard work of our contractors.”

Paul Brickell, Executive Director of Regeneration and Community Partnerships.

CASE STUDY: BUILDING PROJECT

Brummen Town Hall

SUBMITTED BY:

Sabine Oberhuber, Co-Founder, Turntoo

PRIMARY CONTACTS:

Turntoo / RAU, Thomas Rau, info@turntoo.com



LOCATION:

Brummen, Netherlands

PROJECT DESCRIPTION:

- Netsurface: 3,000 m²
- Construction Costs: €3.7 million
- Due to concerns over frequently shifting municipality borders, the municipality of Brummen commissioned a building for a service life of 20 years.
- The answer to this proposal was a design made for disassembly and consistent use of reusable and renewable, high quality construction materials.
- The building's foundation is a historic structure dating back to 1890. The qualities of the historic building kept intact, restored where necessary and connected to a new addition with a glass roof.
- Approximately 90 per cent of the materials in the newly added space can be dismantled and reused at the end of its service life. After this period, only the original

1890 building will remain on the site.

- The building also received the first materials passport turning it into a raw materials depot in which the details of every piece are known, including their destination in a second life for some elements.
- After opening its new doors 2013, the town hall received a Dutch Award for Sustainable Architecture.

KEY DATES:

2011 (final competition) / 2013 (completion building)

STAKEHOLDERS INVOLVED:

- Client: Municipality of Brummen
- Architect: RAU
- Circular economy expert: Turntoo
- Builder: BAM Utiliteitsbouw

ADDITIONAL SOURCES OF INFORMATION:

- www.rau.eu/portfolio/gemeentehuis-brummen/

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE STRONGLY ADDRESSED BY YOUR PROJECT?



Element 1: Loop

MODULAR / RE-CONSTRUCTIBLE DESIGN

REASONS:

- Merging municipalities into larger entities is an on-going process in the Netherlands.
- Due to concerns about building a townhall, which may have no function in the future, the community of Brummen commissioned a building with a life-span of 20 years.
- The answer to this proposal was a building made for disassembly, consistent use of reusable and renewable, high quality construction materials.
- The design facilitated renting the building to the municipality under a 20-year service contract that guarantees circularity at the end of the intended user period.

BENEFITS:

- Approximately 90 per cent of the materials in the newly added space can be dismantled and reused.
- The modular design not only enables easy disassembly, but it also resulted in significant reduction of the construction time.

- The building's foundation is a historic structure dating back to 1890 that will remain unchanged after the dismantling of the circular extension.

MATERIALS & MODULARITY

REASON:

- Rather than using cheap materials, the building minimises the use of concrete and incorporates a variety of high quality reusable materials, which will be dismantled and returned to their manufacturers at the end of the building's life.
- For example the pre-fab wooden components can be easily dismantled and reused in a new building.
- Interestingly, manufacturers asked for several minimal, yet very intentional, design changes so that the components would have an easier case for their second-life application.
- For example the timber supplier wanted to provide timber of larger dimensions because it will be easier to reuse in 20 years when he gets the materials back.

BENEFITS:

- The systems were developed in co-operation with manufacturers to enable easy disassembly in conditions that maximizes their material-, component- and product-value after the 20-year period.
- Due to the modular design, failures in the construction proces were minimised and construction time was significantly shorter than planned.

CHALLENGES:

- In order to reach the envisioned result and convince suppliers, intense involvement of a circular economy expert team (Turntoo) and close co-operation between architect, circular economy expert and builder was needed to guide the design and construction process.

LESSONS LEARNT:

- Involving suppliers at a very early stage in the design phase resulted in a very high degree of circularity of the building.
- The fact that the wooden beams were made larger not thinner, made the team realise that KPIs in a circular economy are not necessary the same as in a linear model, where less not more material would have been considered an achievement.

MATERIALS PASSPORT

REASON:

- The vision to conceptualize the townhall as a raw materials depot - a temporal organization of construction materials - made it a necessary and logic step to create a raw materials passport in order to enable the reuse of all components after the dismantling of the building

BENEFITS:

- All details of the building are known and documented, including their destination in a second life.

CHALLENGES:

- The Brummen townhall was the first building in the world conceived as a raw materials depot and equipped with a materials passport. The novelty of the concept made it a challenge to convince the client of the necessity of a materials passport and to obtain all the necessary data from suppliers.

LESSONS LEARNT:

- The project led to a completely new way of looking at buildings and the way the temporary function they offer can be facilitated through a modular and circular building
- It introduced the concept of products and buildings as a materials depot. It also made the team realise that current models of linear depreciation are not in line with circular value preservation.



“For us circularity means facilitating the permanent consequences of temporary options. A truly circular building is a as raw material depot, through modular and reconstructible design, documented in a raw materials passport. The Brummen Townhall was the first building in the world conceived as such a materials depot.”

Thomas Rau, CEO Turntoo and RAU

CASE STUDY: BUILDING PROJECT

Liander head office

SUBMITTED BY:

Sabine Oberhuber, Co-Founder, Turntoo

PRIMARY CONTACTS:

Turntoo / RAU, Thomas Rau, info@turntoo.com



LOCATION:

Duiven, Netherlands

PROJECT DESCRIPTION:

- Redeveloping an existing cluster of buildings into a 24,000 m² head office for energy grid company Liander, housing more than 1500 workers.
- Re-utilising more than 80% of the raw materials from the original structures and designing the newly added structures in a way that they are fully reconstructible in the future.
- Fitted with solar panels and underground water for thermal storage, the structure is energy positive and actively redistributes excess power to the local grid.

KEY DATES:

21.12.2011 (final competition) / 31.08.2015 (completion building)

STAKEHOLDERS INVOLVED:

- Client: Alliander
- Architect: RAU
- Developer and general contractor: VolkerWesselsVastgoed (30 years energy & maintenance contract)
- Circular economy expert: Turntoo
- Interior design: Fokkema & Partners
- Technical installations advisor: Innax
- Landscape design: Kuiper Compagnons
- Structural engineer: Van Rossum R.I.
- Main building contractor: Boele&vanEesteren
- Main technical installations contractor: Homij

ADDITIONAL SOURCES OF INFORMATION:

- www.alliander.com
- www.rau.eu
- www.turntoo.com
- <http://www.vwvastgoed.nl/>
- <http://circulatenews.org/2015/12/liander-a-vision-for-circular-architecture/>

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE STRONGLY ADDRESSED BY YOUR PROJECT?**Element 1: Loop****RE-USE OF WOODEN ELEMENTS OUT OF SCRAPWOOD FOR FACADES.****REASONS:**

Upgrade scrapwood, which was otherwise destined to be burned, to be used for interior façade elements (which constituted 50% of the total façade).

BENEFITS:

Avoid using new materials, with production energy and material waste.

CHALLENGES:

Fire regulation was a challenge, as well as organising the upgrade process from waste to product.

LESSONS LEARNT:

There is much value to create by upgrading waste to (beautiful) products.

FULLY MODULAR, RECONSTRUCTIBLE STEELROOF CONSTRUCTION

REASONS:

The aim was to create a safe, transportable, lightweight and fully reconstructible, steel-roof construction to cover the existing buildings.

BENEFITS:

By asking a roller-coaster company we were able to create a fully circular steel roof and save 30% steel in comparison to a traditional construction.

CHALLENGES:

Finding the right company which understood the design challenge.

LESSONS LEARNT:

Circular design needs companies able to think in different ways, companies able to provide novel solutions might not always be found in amongst traditional suppliers.



Element 2: Exchange

MATERIALS PASSPORT

REASON:

To document all the used materials, components, elements for maintenance, finances, and future use.

BENEFITS:

Knowledge about used materials (quantity and quality) and the possibilities for maintenance, repair, refurbishment, re-use, remanufacturing, recycling.

CHALLENGES:

Gathering information from producers and contractors

LESSONS LEARNT:

The delivery of the required information should be incorporated into the building contract with the general contractor.



Element 3: Regenerate

ENERGY POSITIVE BUILDING

REASON:

Create a building which produces all the energy needed to operate the building and enable all user processes. In addition start producing energy early enough to enable an energy positive construction process.

BENEFITS:

Avoided using fossil fuels for the operation of the building and user processes

CHALLENGES:

The biggest challenge was the amount of solar panels needed for a building of 24,000 m² with 1,500 users

LESSONS LEARNT:

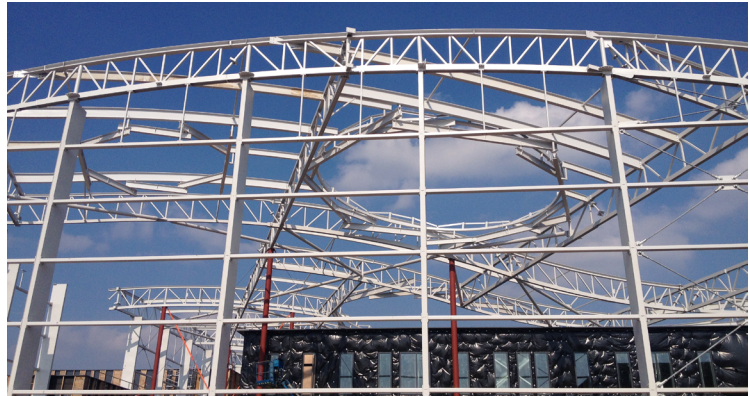
It is beneficial to install as many panels as soon as possible so that the energy produced can contribute to the process of constructing the building itself

Additional Information:

The energy grid company Liander has transformed its headquarters into a remarkably sustainable building and energy positive complex, becoming the first renovation project in The Netherlands to obtain the BREEAM-NL outstanding sustainability certificate. RAU architects have been responsible for the renovation of the existing buildings and the extension, which houses 1500 workers. Circularity has been an integral part of the design, transforming the building into a material depot where materials are temporarily stored rather than just being a conglomeration of materials with a limited life cycle.

The existing complex was composed of six different constructions, which are almost entirely maintained (over 80% of the original surfaces remain). A large atrium covered by an iconic roof connects the six different volumes visually, programmatically as well as logistically, creating a continuous urban-like space which facilitates encounters and communication among employees. The shape of the roof is derived from studies for the optimization of natural ventilation, which reinforce the air circulation. The large glass façades and the circular skylights provide the adequate amount of daylight, and strengthen the relation with the landscape, contributing to a healthy and inspiring workspace. Maintaining the façades of the existing buildings was important from a reutilization standpoint, therefore, a second “skin” is placed in order to avoid heat losses, reducing the energy demand. The existing windows are kept in all the façades except the inner ones, where larger operable windows are placed, creating a close visual relation with the atrium and allowing natural ventilation.

Sustainability is understood as an optimization of the system: fewer materials, less energy, less CO₂. Therefore, three principles were established as design strategies: conservation and reuse of the existing materials, minimization of material use, and employment of materials that can later on continue their biological or technical life cycle. The design of the roof is an example of how these strategies were implemented. A roller coaster company helped with the design of the metal structure, achieving a lighter construction, reducing the unnecessary use of raw materials and allowing disassembly for later reuse. The new facades attached to the existing volumes are built using waste wood that comes from the old cable coils and utility poles found in the terrain. This not only gives a characteristic and fresh appearance to the building but also establishes a bond between the building and the company.



A roller coaster company helped with the design of the metal structure, achieving a lighter construction, reducing the unnecessary use of raw materials and allowing disassembly for later reuse. The new facades attached to the existing volumes are built using waste wood that comes from the old cable coils and utility poles found in the terrain. This not only gives a characteristic and fresh appearance to the building but also establishes a bond between the building and the company.

A circular building is a temporary aggregation of components, elements, and materials with a documented identity, recording their origin and possible future repurposing, assembled in a certain form, which accommodates a function for an established period of time. Liander is the first circular building in the Netherlands, and the “material passport” is the document that specifies the types and amounts of all the materials present in the building, both preexisting and new. By providing materials with an identity and adequate information, waste is prevented. The document includes information about who has handled the materials, where they were temporarily stored and ways in which they can be reused.

The building is both effective and efficient, providing an energy surplus which can be redistributed into the local grid. This has started a Green Alliance in the community and stimulates other companies in the area to take a more sustainable approach. The solar panels, covering the parking spaces deliver 1.5 million kWh annually, and the ground heat/cold storage accumulates the excess. Since the solar panels were placed first, it was possible to achieve an energy positive building site for the first time in the Netherlands.



By commissioning the steel-roof to a roller-coaster company we saved 30% of steel.

Thomas Rau, CEO Turntoo and RAU

Resource Efficient House

SUBMITTED BY:

Nick Ribbons, Project Manager – Public Sector, Zero Waste Scotland

PRIMARY CONTACTS:

Nick Ribbons, nick.ribbons@zerowastescotland.org.uk



LOCATION:

The Resource Efficient House is in the Building Regulations Establishment (BRE) Innovation Park at Ravenscraig (BRE Ravenscraig), a former steelworks near Motherwell, North Lanarkshire, Scotland.

PROJECT DESCRIPTION:

- The 3-bedroom house is a modular building that was constructed off-site using structural insulated panels (SIPs). It is airtight, highly insulated and utilises a range of resource efficient building fabrics to achieve low energy costs and net zero carbon emissions. The house design also considered the whole life through to deconstruction, re-use and recycling of its components.
- Resource Efficient House aims to promote and encourage the construction of environmentally sustainable and affordable family homes across Scotland. It does this through quality, repeatability and sustainable design.

- The build cost for this one-off demonstrator was around £148,000. It is estimated that this cost would be greatly reduced if houses like this were produced on a commercial scale.

KEY DATES:

21 August 2012: Resource Efficient House invitation to tender issued.

8 October 2012: Deadline for tender submissions.

23 November 2012: Partnership between Zero Waste Scotland (ZWS) and Tigh Grian Ltd. formally announced.

21 January 2013: Margaret Burgess, Minister for Housing, breaks ground on site.

6 February 2013 – 24 April 2013: Construction to practical completion.

10 May 2013: Resource Efficient House Exhibition Opens at The Lighthouse, Glasgow.

16 July 2013: Exhibition closes.

TBC: Deconstruction

STAKEHOLDERS INVOLVED:

Zero Waste Scotland (investment, project management)

BRE (investment)

Architecture + Design Scotland (A+DS) (advisors)

Tigh Grian Ltd (design and build)

Nühaus (building fabric)

Machin Associates Ltd. (design)

DWA Landscape Architects (garden design)

GP Plantscape (garden landscape)

Castle RePaint (paint supplier)

Milestone Eco Design (kitchen producer)

ADDITIONAL SOURCES OF INFORMATION:

www.resourceefficientscotland.com/house

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE STRONGLY ADDRESSED BY YOUR PROJECT?



ELEMENT 1: REgenerate

REASONS:

- The house was built on previously contaminated land, once home to a steelworks. It was heavily remediated using a capping layer of 2 metre thick clay.
- A grey water recovery system was fitted to collect and reuse water from the bath and shower.

- Installation of solar photovoltaic (PV) panels to reduce the house's reliance on grid-electricity by harnessing the sun's energy.
- Biomass boiler to provide thermal space heating.

BENEFITS:

- Utilisation of brownfield land that would otherwise remain disused.
- Reduction of the requirement for 'clean' water and reduces the potential for environmental stress.
- Reduced carbon emissions, reduced utility bills and improved fuel security. The occupier may also benefit from subsidies such as Feed-in Tariffs (FITs). Solar panels are also highly visible and may encourage homeowners that see them to explore renewable energy.
- The biomass boiler provides heat from a renewable fuel source (wood pellets). In addition to eliminating reliance on fossil fuels for heating this improves fuel security and does not require the premises to be attached to the existing gas network, reducing overall development costs.

CHALLENGES:

- The remediation works cost between £30 - £40 million and took several years to complete.



ELEMENT 2: Optimise

REASON:

- The house was designed to use energy efficiently. SIPs with a high-density polyurethane insulation core were used to construct walls with a low U-value (the higher the U-value the more readily a material loses / transfers heat). Lower U-values of material result in reduced heat loss and improved resource efficiency.
- Although not an environmentally friendly product the polyurethane can be recycled when the house is deconstructed.

BENEFITS:

- The benefits for this are 3-fold:
 - environmental – reduced consumption of natural resources and prevention of pollution;
 - economic – reduced energy bills for residents;
 - and social – improved thermal comfort for residents, improved well-being and/or increased likelihood in remaining at residence.

CHALLENGES:

- To meet the tight project schedule the pods left the factory before they were 100% completed. This meant when they arrived onsite additional work had to be done.

LESSONS LEARNT:

- Time should be taken at the start of the project, before construction begins, to carefully plan and understand what is required to complete each stage of the process. This will enable timings to be correctly estimated.



ELEMENT 3: Loop

REASON:

- The construction of a typical 3-bedroom house can result in around 14 tonnes of waste. Structural pods were constructed off-site and included kitchens, bathrooms, tiling and paintwork. This approach helped to reduce construction waste disposed to landfill to 0.09 tonnes and achieving a recycling rate of 97%.
- 100% of the waste produced in the manufacture of the pods was recycled.
- Off-site fabrication also helped reduce the costs associated with the management and disposal of materials.
- Durable kitchen worktops were made from recycled plastic waste to reduce the consumption of virgin materials.

BENEFITS:

- Modular construction allows complete control of costs and waste in addition to providing certainty of delivery as this is not dependent on weather.
- The reduction of waste and higher volume of site based work helps reduce carbon emissions associated with transportation as fewer journeys need to be made.
- Using recycled material for the worktops reduces the consumption of virgin materials as well as providing a durable, antimicrobial surface.

CHALLENGES:

- Too much focus on the modular construction aspect of the build led to a lack of focus in other areas such as the roof construction. This coupled with adverse weather conditions resulted in a delay in the roof being finished and the house being watertight.

LESSONS LEARNT:

Each component of the construction process, no matter how large or small, needs to be carefully managed.

ADDITIONAL INFORMATION:

Zero Waste Scotland is Scotland's resource efficiency and circular economy expert. It promotes the importance of conserving resources and retaining them within the economy at the highest value possible. It also supports businesses, third and public sector organisations to do the same.

This project is a clear demonstration that resource efficient homebuilding can be commercially viable, without compromising the design aesthetic and build quality. Many of the aspects of circularity and resource efficiency built into the project, such as prefabrication and off-site construction help to save money.



“There are so many memorable elements in the house that visitors will remember and take away with them.”

David Kelly, Associate Director, BRE

CASE STUDY: INFRASTRUCTURE PROJECTS

Bus Boarder Platform

SUBMITTED BY:

Zicla

PRIMARY CONTACTS:

Alfredo Balmaceda, Co-Founder and Principal Consultant, Zicla, abalmaceda@zicla.com



LOCATION:

- The project has been developed in Barcelona but the BUS BOARDER PLATFORMS have been installed in Barcelona itself, Palma de Mallorca, Málaga, Sevilla, etc. in Spain and Reims, Strasbourg, etc. in France. Between 2010 and 2015, Zicla sold more than 265 bus boarder platforms; a surface equivalent to five olympic swimming pools.

PROJECT DESCRIPTION:

- The BUS BOARDER PLATFORM is a raised platform that improves accessibility at bus stops
- The platform is comprised of a collection of interconnected units, an external curb that provides high visibility both during the day and night due to its painted strips and detachable connector grids that adjust to the original curb
- The platform is made with highly resistant, durable, 100% recycled and recyclable PVC plastic obtained from electric cable sheathing, pipes, hoses, etc.
- It is easily installed on the existing pavement with minimal disruption to pedestrians and traffic.

- Between 2010 and 2015, ZICLA improved accessibility at 265 bus stops installing BUS BOARDER PLATFORMS; this meant the use of 364 tonnes of recycled PVC and the saving of 686 tonnes of CO₂ eq. compared to virgin material.

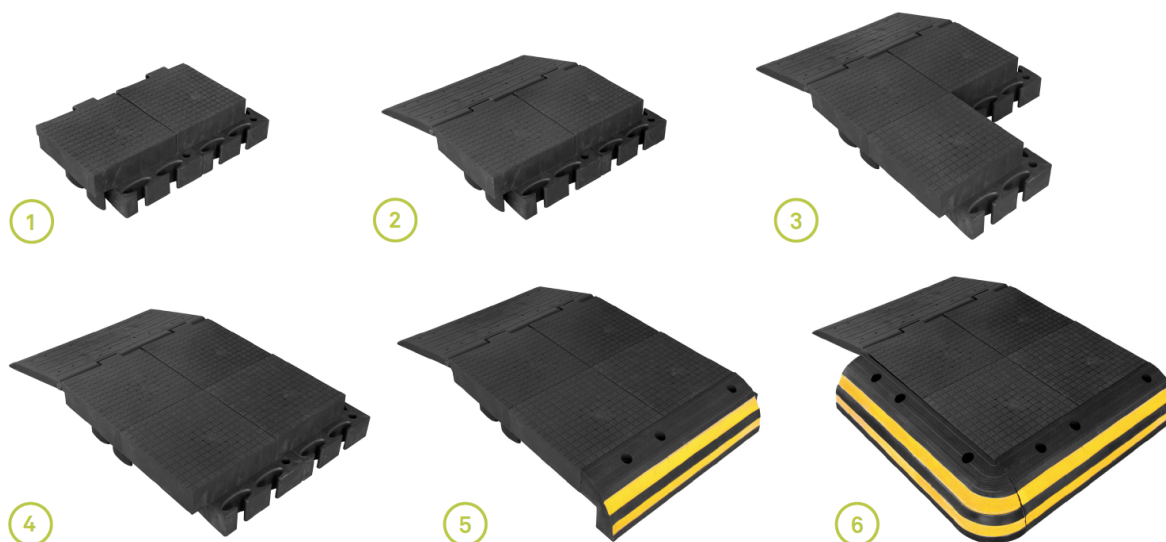
KEY DATES:

- The project began in 2009 and the first prototype was installed in 2010.
- The industrial production began in 2010 and it is still continuing today.

STAKEHOLDERS INVOLVED:

In order to develop a comprehensive briefing of the new product, ZICLA looked for the participation of all the main stakeholders of the product value chain:

- City councils (as potential future consumers of the product). The first pilot installation was done with the collaboration of the Hospitalet de Llobregat City Council
- Transportation Authority of the Barcelona Metropolitan Area (as a potential future consumer of the product)
- Waste generators (as providers of the waste needed for the production of the new material to be used in the fabrication of the bus-boarder platform)
- Injection industry (as providers of the technology needed to inject the different parts of the bus-boarder platform)
- Industrial designers (as the designers of the different parts of the bus boarder)



ZICLA is the owner of the resulting product which has been properly patented in the UE:

Patent.

Oficina Española de Patentes y Marcas:
200930858

Design registration.

Ohim: 001757261-0001/2

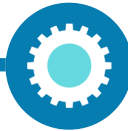
The United States Copyright: Tx 7-906-875



ADDITIONAL SOURCES OF INFORMATION:

- Video: https://www.youtube.com/watch?v=_8Wvn0zAhDI

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE ADDRESSED BY YOUR PROJECT?



Element 1: Optimise

- **Industrial process - prefabrication:** the BUS BOARDER PLATFORM is integrated by several prefabricated plastic elements that can be easily assembled and disassembled like a puzzle
- **Smart urban design:** The BUS BOARDER PLATFORM helps to improve accessibility at the bus stops of the cities making them much more comfortable and safe.
- **Material efficiency:** Use of recycled materials from post-consumer and post-industrial PVC plastic waste.
- **Reduction in transportation of materials:** The modular design of the BUS BOARDER PLATFORM allows efficient transportation of materials due to the ease with which the different elements can be contained in pallets



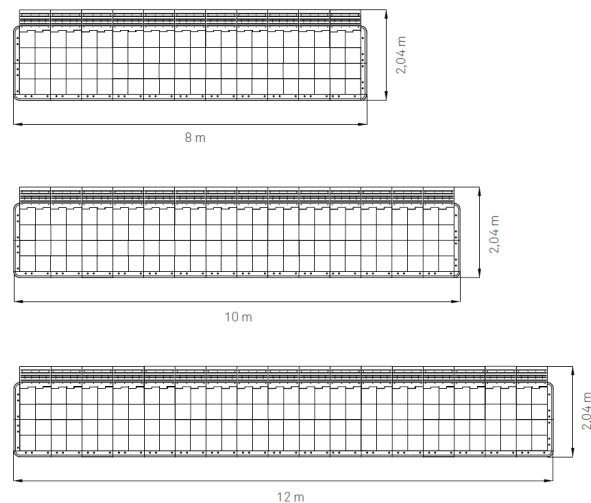
Element 2: Loop

- **Durability:** The use of recycled PVC warrants significant durability due to the excellent response of PVC to exposure to weathering: UV radiation, changes of temperature, presence of water or ice etc.
- **Repair:** Due to its modularity, the BUS BOARDER PLATFORM can be easily repaired in parts.

- **Removal:** The BUS BOARDER PLATFORM can be easily removed and transported to a new location when it is needed thanks to straightforward dismantling and the reduced weight of the different parts (12 kg at maximum), allowing easy handling without the use of special equipment
- **Re-use:** Every element of the BUS BOARDER PLATFORM can be re-used many times due to the durability of the material
- **Recyclable:** the BUS BOARDER PLATFORM elements are 100% recyclable. In fact, ZICLA offers to recycle used parts in Spain. That means that, when a bus boarder platform for any reason comes to its end of life, ZICLA will accept it at zero cost to be reused as a raw material again.
- **Modularity:** The BUS BOARDER PLATFORM is completely modular. The different pieces can be assembled and disassembled very easily allowing for different configurations depending on the available space.
- **Flexibility in construction:** Once the BUS BOARDER PLATFORM has been assembled, its dimensions can be modified very easily by adding a new row to make it wider or longer.

OVERALL REASONING:

- Circularity is in the DNA of our company. All our products are made from recycled feedstock and they are also recyclable. We work in projects addressing the upcycling of waste incorporating the concept into existing industrial processes
- Circularity aligns with ZICLA's business strategy. Our products are part of systems designed to solve urban problems like accessibility or safety in bike lanes using recycled and recyclable materials derived from waste (which is otherwise landfilled or incinerated)



OVERALL BENEFITS:

The product shows that waste materials could be used to the fabrication of products that improve life quality in urban environments. Our BUS BOARDER PLATFORM plays a key role in the improvement of accessibility and safety at bus stops.

- Reduction of CO₂ emissions: the use of recycled plastic PVC allows reducing the CO₂ emissions up to 124 kg of CO₂ eq/m² compared with the use of virgin PVC material
- The comparison between BUS BOARDER PLATFORM by ZICLA vs the concrete prefabricated platform using the LCA methodology showed that a ZICLA platform had a lower impact than a precast concrete one with the same surface:
 - Lower consumption of resources
 - Minor acidifying effect

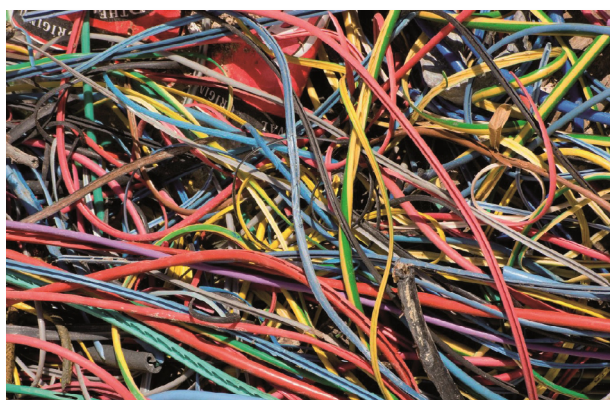
- Minor effect of eutrophication
- Minor impact on global warming
- Minor effect of destruction of the ozone layer
- Minor human toxicity

OVERALL CHALLENGES:

The briefing for the BUS BOARDER PLATFORM was very strict:

- Easy to assemble and disassemble
- High mechanical resistance with the minimum weight
- Adaptability to the pavement surface
- Visibility
- Durability and minimum maintenance
- Ergonomic (minimum weight of the different elements)
- Easy to transport – palletization
- Minimum environmental impact
 - Reusable
 - Recycled material
 - Recyclable
- The selection of the recycled material was complicated as it had to be a post-consumer recycled material (electrical cable sheathing, hoses, synthetic textiles, etc.)

The most important barrier to solve was to find a recycled material with high durability that could also be flexible and should be injectable (for production). Electric cable plastic covering was an undesirable sub-product of the recovery of copper from old cables. The first industrial tests done with this material were not successful and indicated the need to design and develop a new material formed by this residual stream but mixed with other post-industrial PVC plastic waste like pipes, hoses.



OVERALL LESSONS LEARNT:

- The BUS BOARDER PLATFORM is subjected to a continuous process of improvement as it needs to adapt to different regulations depending on the country where it is installed.

- The most important lesson has been that there are a lot of urban problems that could be solved using recycled products. This is a fantastic way to transform waste generated by cities in innovative recycled products that can be used by the same cities.
- The main lessons learnt during the process of developing the new recycled material to be used in the production of the bus boarder platform were the following:
 - It was necessary to find the different types of plastic PVC waste (Electrical cable sheathing, hoses, synthetic textiles, etc.) which properly mixed in different proportions allow obtaining the expected mechanical properties of the final product.
 - It was desirable to minimize the previous waste treatment of the different types of plastic PVC waste (shredding, washing, sieving, etc.) in order to reduce to a minimum the cost and the environmental impacts.

What comes next?

The main steps of the bus boarder future improvement will be:

- The main modules and pavement ramp can include an optional tactile flooring surface to comply with local regulations.
- Smart gadgets: people waiting for the bus will have the opportunity of capturing information using their mobiles.
- Apps: Apps will be developed in order to show people in a city which bus stops have been properly adapted and are accessible.

Additional Information:

- Award, 2011 Design for recycling
- Ecolabel, Environmental quality warranty
- Certificates, “Design for all Good practice”

ZICLA[®]

“We want to expand our horizons and go much further, realizing the potential of the circular economy while maximizing impact in each territory. We want to take advantage of the local industry and existing technology to bring our bus boarder platform to cities around the world.”

Alfredo Balmaceda, Co-Founder & Principal Consultant, Zicla

CASE STUDY: BUILDING MATERIALS/COMPONENTS

Pôle de Police Judiciaire / Judicial Police Compound

SUBMITTED BY:

Elodie Jupin, ReSTART Program Manager, Tarkett

PRIMARY CONTACTS:

Elodie Jupin, ReSTART Program Manager, Tarkett (elodie.jupin@Tarkett.com)



LOCATION:

Pontoise, Oise Valley, France

PROJECT DESCRIPTION:

- The Pôle de Police Judiciaire is a High Environmental Quality Building / Bâtiment Haute Qualité Environnementale (HQE)
- The Pôle de Police Judiciaire was designed according to HQE principles, following targets in order to achieve an HQE Certification
- Throughout the whole project and its design, the engineering consulting firm SLH kept circular economy principles and high environmental quality in mind, as well as the users comfort
- The compound was designed to be flexible, modular, durable and sustainable
- In order to achieve HQE certification, the compound had to be designed to follow strict principles

- Surface: 38,182 m² SHOB (gross), 27,000m² SHON (net)
- Total costs (estimate): €50 million

KEY DATES:

- Project awarded to Architect Firm December 2009
- Building delivery by May 2015
- Inauguration date in May 2015

STAKEHOLDERS INVOLVED:

- Client: Ministère de l'Intérieur
- Deputy: Ministère de la Défense – Secrétariat Général pour l'Administration
- Service d'Infrastructure de la Défense (ESID IDF)
- Contractor / Architect: Groupe 6
- Engineering BET HQE: SLH and Sorane

ADDITIONAL SOURCES OF INFORMATION:

- <http://www.entreprendre-cergypontoise.fr/fr/actualites/actualites-pourquoi-cergy-pontoise/item/les-experts-du-pjgn-arrivent-a-cergy-pontoise.html>
- <http://groupe-6.com/fr/projects/view/27>
- <http://www.assohqe.org/accueil/>



WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE ADDRESSED BY YOUR PROJECT?



Element 1: Optimise

- The following examples of optimisation can be seen in the development of the compounds:
 - Low Energy Consumption building to lower fossil fuel usage, preserving resources, 50% less energy consumption than a “usual” building
 - Natural ventilation in spring and summer
 - Double flow ventilation with heat exchange in winter reducing the labs energy consumption by 80 to 90%
 - Optimised natural light
 - Optimise drinking water consumption implementation of a rain water management system diverting it from sewage
 - Easy to install materials (especially flooring)
 - Regular cleaning and maintenance protocols result in low water consumption



Element 2: Loop

RATIONALE:

- The building site was targeted to be a clean site (“chantier propre”) / zero waste: construction waste management (as certified by a third party as of March 2016)
- Need for materials with recycled content
- The stakeholders needed to consider:
 - Careful choice of material with low to no sanitary and environmental impact
 - High indoor air quality to reduce pollutions at the source / low VOCs

BENEFITS:

- A sustainable comprehensive flooring solution, combining a product designed according to cradle to cradle principles and a take-back service. When it came to the decision on the flooring of the compound, working with Tarkett’s representatives, it became obvious that iQ Natural coupled with the recollection ReStart program was the most appropriate solution.

- Working with a sustainable supplier: Tarkett, since 2010, has been engaged in developing circular business models and applies Cradle to Cradle® principles. iQ Natural, has been designed and produced according to Tarkett's closed loop circular design approach, addressing each step of the product's life: selection of good materials, resource stewardship during the production phase (water and energy reduction, renewable energy), people-friendly spaces during the use phase (indoor air quality and healthy environment), reuse and recycling after use (ReStart program).
- This means that products are designed with "good materials": materials that respect people's health and the environment, based on abundant or rapidly renewable resources or recycled content and that are recyclable

SO, WHY TARKETT IQ NATURAL AND RESTART? HOW DID IT ANSWER TO THE PROJECT'S NEEDS? AND WHAT WERE THOSE NEEDS?

When choosing flooring for an HQE building the main criteria are:

- *Optimum durability of the product:* iQ Natural is one of the most durable homogeneous Vinyl flooring on the market. Using the dry buffing maintenance methodology restores the surface's properties
- *Indoor Air Quality thanks to extremely low VOCs:* Tarkett's iQ range has TVOC (Total Volatile Organic Compounds) levels $<10\mu\text{g}/\text{m}^3$ *, 100 times below the strictest standards
- *Healthy indoor environment with good materials respecting people's health:* iQ Natural is phthalate free. A bio plasticizer is used.
- *Acoustic comfort:* iQ Natural offers good acoustic properties
- *Optimised water consumption in cleaning and maintenance:* Tarkett's cleaning protocols based on dry buffing are very low in water consumption. This unique cleaning protocol reduces water consumption by 18%, electricity consumption by 20% and the use of detergent is 2.3 times lower than with traditional floor cleaning regimes
- *Recyclability and upcycling:* Tarkett's products are eco designed to ensure their recyclability. iQ Natural contains 25% recycled material. New products are manufactured using a high percentage of material collected through ReStart and post-industrial waste management systems
- *Building site waste management / optimization / upcycling:* putting the ReStart take-back scheme in place on the construction site ensured that any installation offcut would be collected from the site and shipped back to Tarkett for reuse on its production line. For instance, on this particular case more than 95% of the offcuts collected have effectively been reused in new flooring production. By doing so, Tarkett closes important loops and addresses resource scarcity issues – especially fossil fuel depletion.

With Tarkett there is also the guarantee that the way the products are manufactured meet the same requirements of the HQE framework: low water consumption, closed loop water systems, use of renewable energy, controlled low emissions, optimized waste management.

ISO certifications 9001 / 14001 and OSHAS 18001 of all production sites.

CHALLENGES:

- Careful planning and design is necessary when working on such projects. The main difficulty lies in the fact that requests from different stakeholders might be in contradiction with one another. Tarkett solutions allow for design and aesthetics to be combined with stringent norms and regulations compliance

- Architectural demands might not be in compliance with regulations. Conciliating the two can prove to be very challenging. However, flooring suppliers like Tarkett provide helpful information on their products and solutions. Websites are well documented and kept up to date which makes it easy to find any needed information
- Site waste management can be challenging, it is important to install dedicated bins for each material, making sure that there is no cross contamination. Fitters and installers must be properly trained to sort the material and place them in the right bins thus maximizing collect to reuse ratios

LESSONS LEARNT:

- The pre-study phase is crucial, it was necessary to spend a lot of time understanding the different parties requirements and how they should fit into a HQE project
- Working within a tight budget was not particularly difficult as solutions providing good circular framework are more and more readily available. Information is key in the very early stage of such projects.



THE ULTIMATE
FLOORING EXPERIENCE

“With a high cohesion between the will to care for both the origin of materials as well as for their end of life, the use of a PVC based flooring using recycled material like iQ Natural and the implementation of a collection scheme for installation offcuts became obvious. We asked for the ReStart program to be put in place on the building site. From the beginning of the floor installation Tarkett had a dedicated container on site. They also took care of the fitters’ training and made regular quality checks on the offcuts sorting. The methodology used allowed for a very high quality initial sorting leading to an upcycling rate far superior to those reached with more traditional methods.”

Xavier GILLARD, Service Environnement de SLH Ingénierie

CASE STUDY: BUILDING MATERIALS/COMPONENTS

BioBuild: structural façade panel in biocomposite materials

SUBMITTED BY:

Guglielmo Carra, Senior Engineer & EU Technical Leader Materials Consulting, Arup

PRIMARY CONTACT:

Guglielmo Carra, Senior Engineer & EU Technical Leader Materials Consulting, Arup,
guglielmo.carra@arup.com



LOCATION:

Companies from various European countries contributed to the successful development of the biocomposite façade panel. The final product is located in Germany, in the form of mock-up, to undertake testing related to fire performance/mechanical performance and durability.

PROJECT DESCRIPTION:

- BioBuild has been a collaborative R&D project developed amongst Arup and 12 other European companies and institutions involving architects, materials scientists, manufacturers and testing laboratories. The project had a budget of about €8 million, partly funded by the European Commission.
- The project aim has been to design and build high performance biocomposite building systems and components to reduce embodied energy with respect to benchmark solutions and reach a lower cost. Materials used to manufacture the panel are made of a mix of natural fibres, extracted from flax, hemp and jute plants, and natural resins, derived from residual waste from sugarcane and soy harvesting.
- As part of the project, the first biocomposite structural facade panel in the world has been designed and built.

- The panel is 4m in height, 2.3m in width, and has a variable thickness through the height. It can be used for both residential and office buildings.

KEY DATES:

- December 2011 to May 2015 for a total of 42 months of duration.
- The final prototype of the panel was showcased at EcoBuild in London, in March 2015.
- In March 2015, Arup and GXN, alongside all the project partners contributing to the development of the panel, received the JEC Innovation Award for the “best innovation in composite for construction” in 2015.

STAKEHOLDERS INVOLVED:

Amongst the 12 EU companies involved, the main stakeholders for the development of the external façade panel have been:

- Arup, that led the design and engineering,
- GXN Innovation, that designed the system,
- Fiber-Tech, that manufactured the panel,
- NetComposites, that coordinated the project.

ADDITIONAL SOURCES OF INFORMATION:

- <http://biobuildproject.eu/>
- <http://www.asce.org/magazine/20150317-self-supporting-biological-composite-facade-unveiled/>
- <http://www.archdaily.com/605300/arup-and-gxn-innovation-s-biocomposite-facade-wins-jec-innovation-award>

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE ADDRESSED BY YOUR MATERIAL?



Element 1: Regenerate

REASONS:

- The external façade panel is composed of two biocomposite skins, external and internal. Biocomposite materials are made by the combination of natural fibres and biological resins. Both fibres and resin can be obtained from fast growing plants – regenerating in short cycles of 3 to 4 months – and from residual agricultural waste.

BENEFITS:

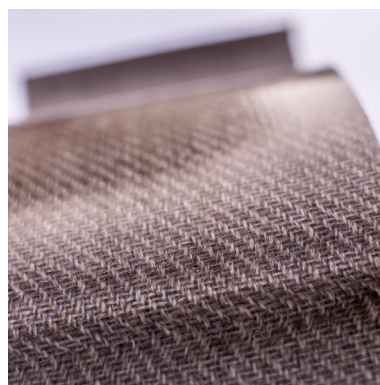
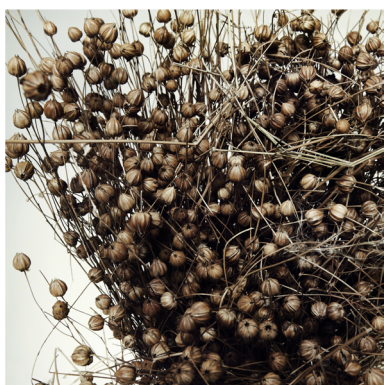
- Focusing on the life cycle of building systems and components, the use of biocomposite reduces resource depletion by enabling a circular model in which local plants can be utilised to make architectural products, eventually feeding back into the biological cycle at the end of life. Current scenarios for end of life include either shredding the biocomposite, consequently used as mulch, or incineration.

CHALLENGES:

- Some of the biopolymers currently available on the market have a low biological content, therefore their use as fertilizer at the end of the life cycle might be challenging.

LESSONS LEARNT:

- There is a need to fully understand the chain of production for biocomposite materials to define current limitations to the end of life scenario of biocomposite.

**Element 2: Share****REASONS:**

- Growth in the use of biocomposites would naturally trigger a sharing process, where natural waste from agriculture and maintenance of green areas becomes a source of raw materials for the production of advanced composites.

BENEFITS:

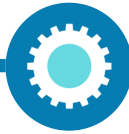
- The main benefits are related to the reduction of CO₂ released in the atmosphere during incineration of natural waste that is instead encapsulated in the biocomposite for a longer period of time.
- Additionally a new business model can be generated, where natural waste is sold as a resource for manufacturing of materials therefore acquiring additional value.

CHALLENGES:

- Currently agricultural waste represents a source of energy through incineration therefore the viability of an alternative business model still has to be proved.
- Additionally biocomposite from agricultural waste might result in lower mechanical performance with respect to composites obtained from flax, jute and hemp traditionally used for the purpose.

LESSONS LEARNT:

- The potential of using biomaterials in construction is high and there is a strong need for discussing and exploring both the technical potential and the economic implications of their use in building construction.



Element 3: Optimise

RATIONALE:

- The use of biocomposite has positive mechanical and physical properties for building construction systems and components.

BENEFITS:

Major benefits related to the use of biocomposite in construction are:

- Lightness (density of about 1200 kg/m^3) while demonstrating a high strength comparable to traditional oil based composites and aluminium.
- Low thermal coefficient (about $0,2 \text{ W/m}^2\text{K}$) therefore conducting less heat compared to metals and reducing the risks associated to thermal bridges in buildings facade.
- Free form. The use of biocomposite allows reaching highly complex shapes.
- Biocomposite materials generally have a low cost of production; the cost of the basic materials used for production, such as flax, jute and hemp plants – these are cheap natural resources
- Calculations of the embodied energy in biocomposite has shown a reduction with respect to traditional building materials, such as aluminium and oil based composites, between 10% and 30%.

CHALLENGES:

- Properties of biocomposite materials might not be homogeneous, due to the fact that manufacturing processes are not yet industrialised, and there is a lack of quality assurance procedures.
- Fire performance for biocomposite materials still limits their application for high-rise buildings.

LESSONS LEARNT:

- Need to engage in the design process with all stakeholders to identify comprehensive solutions that take into consideration the limitations of an industry and material that, despite rapid growth, is still under development.

**Element 4: Loop****REASONS:**

- Biocomposites are a viable option with respect to traditional construction materials in terms of design flexibility and durability.

BENEFITS:

- Design flexibility is achieved through the free-form ability of the materials.
- Additionally, the façade system has been designed for disassembly, therefore the biocomposite skins can be removed at any stage of the building life to be either maintained or replaced.
- At the same time the project investigated opportunities to integrate more durable resins and fibres in a single laminate alongside a protective layers.

CHALLENGES:

- Despite a large amount of testing that has been performed on biocomposite materials, their durability shall be proven in real case applications. As the material has been rarely used, until now, in building applications there is no actual proof of long lasting performance.
- Additionally the willingness to increase the durability of the materials, might result in either the reduction of the biological content, partially replaced by fillers, or the use of protective coatings.

LESSONS LEARNT:

- Development of new materials requires a large amount of testing, that might be uneconomical if not backed by a real case application in construction

Additional Information**WHAT WAS THE MOTIVATION FOR DEVELOPING BIOCOMPOSITE BUILDING PRODUCTS?**

The main aim for developing biocomposite building products has been to move away from the concept that building construction only relies on non-renewable materials sources, albeit recyclable. The use of fast growing plants allows us to conceive a new generation of materials that are constantly regenerated and become an endless resource.

WHAT'S NEXT?

The construction sector must reflect the urgency of change by developing alternative materials solutions to improve the sustainability and quality of buildings. The use of biocomposite has the potential to support this change and the BioBuild project demonstrated that it is possible to develop solutions that comply with the stringent building construction standards. However the use of biocomposite is still subject to special approval process, since the material is not included in building codes. It is therefore important to gather consensus from the large scientific and engineering community to create new opportunities for using such materials in future projects.



“The BioBuild project – through the collaborative effort of architects, engineers, materials scientists and manufacturers – proved the viability for the effective use of natural composite materials in construction. Biocomposites demonstrate mechanical and physical performance comparable to traditional materials while reducing resource depletion. This is possible through a circular model where fibres and resins from fast growing plants are used to make architectural products and feed back into the biological cycle at the end of their life cycle.”

Guglielmo Carra, Senior Engineer & EU Technical Leader Materials Consulting at Arup.

CASE STUDY: PROGRAMMES

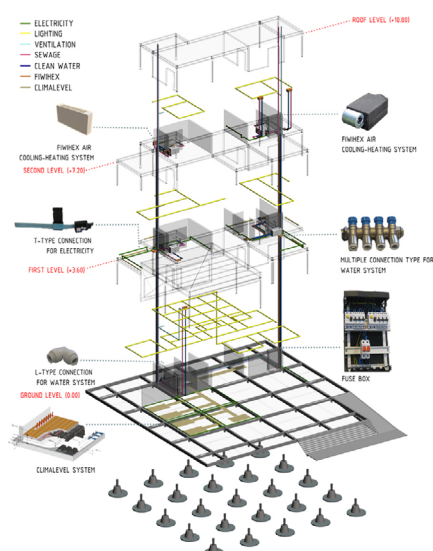
Buildings as Material Banks (BAMB)

SUBMITTED BY:

Gilli Hobbs, Strategy Director, Building Futures, BRE

PRIMARY CONTACTS:

Gilli Hobbs, Strategy Director, Building Futures, BRE (Gilli.Hobbs@bre.co.uk)



©Elma Durmisevic

LOCATION:

16 Partners in 8 EU Countries

PROJECT DESCRIPTION:

- This EU funded BAMB project brings 16 parties throughout Europe together for one mission – enabling a systemic shift in the building sector by creating circular solutions
- The project is developing and integrating tools that will enable the shift: materials passports and reversible building design – supported by new business models, policy propositions and management and decision-making models
- During the course of the project these new approaches will be demonstrated and refined with input from 6 pilots
- The BAMB project started in September 2015 and will progress for three and a half years as an innovation action within the EU funded Horizon 2020 programme (receiving €10 million from the programme)

KEY DATES:

September 2015 to February 2019

STAKEHOLDERS INVOLVED:

- Brussels Environment (IBGE-BIM)
- Environmental Protection Encouragement Agency (EPEA Netherlands)
- Vrije Universiteit Brussels (VUB)
- Flemish Institute for Technological Research (VITO)
- Building Research Establishment (BRE)
- Zuyd University
- IBM Netherlands
- Sunda Hus i Linköping AB
- Ronneby Municipality
- Technical University of Munich
- University of Twente
- University of Minho
- Sarajevo Green Design Foundation
- Drees & Sommer
- BAM Construct UK
- Aurubis Bulgaria

ADDITIONAL SOURCES OF INFORMATION:

- www.bamb2020.eu
- Twitter - @bamb2020
- Facebook - bamb2020

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE ADDRESSED BY YOUR PROJECT?



Element 1: Loop

Improved deconstruction and resource optimisation at end of life.

BENEFITS:

- Improved health and safety for demolition contractors (they will know what is in the building and how to safely deconstruct it).
- Improved source segregation and take back by suppliers back into same/similar product manufacture, thus reducing requirement for primary feedstock.
- Recovery can happen well before demolition and within a leasing approach as part of the business plan and management of the building, products, etc.

CHALLENGES:

- Uncertainty in associated cost and values over long periods of time – especially if trying to link to takeback schemes for specific products/materials.

- Developing the necessary links within the value chain to enable these continuous loops to be implemented; one missing link and it doesn't work.

LESSONS LEARNT:

- These challenges will be addressed throughout the BAMB project
- The *prevention approach* is crucial: i.e. a different way of designing, producing and managing materials, products, systems which will enable recovery through repairing, remanufacturing, recycling, etc. and enable the creation of continuous loops within the construction industry / across industries – contrary to a lot of circular economy project within the Built Environment right now, BAMB is not focussing on the end-of life but on a prevention / anticipation in order to eradicate waste and manage resources, materials, products, and systems.



Element 2: Share

REASONS:

- A key objective of BAMB is to facilitate the reuse of materials, products and components across multiple building applications
- Greater awareness of design implications and the ability to track products, and their performance data, across each use are key to this.

BENEFITS:

- The benefits of reusing building products, e.g bricks, all the way up to entire systems, e.g. building façades, can significantly reduce environmental impact by displacing new products.
- Additional economic and social benefits are thought to be derived but these have yet to be quantified; however, since materials, products, etc. can be recovered properly their residual value is assumed to be higher than it is today.

CHALLENGES:

- Aside from the data issues, there are weaknesses in understanding and articulating the whole life costs and values across one building's life cycles, let alone several life cycles. This is very important to get right since the business benefits of 'circularity' cannot be calculated for traditional vs. alternative approaches at the moment.

LESSONS LEARNT:

- BAMB will explore several business models in more detail and also has 6 pilots built into the 3.5 year programme. These will help to inform and enhance assumptions to develop alternative costing and valuing approaches in the built environment.



Element 3: Virtualise

REASONS:

- BAMB's outputs will be largely digital – including a material passport database, reversible building design codes and a Building Information Modelling 'plug in'.

BENEFITS:

- Impacts and benefits of improved 'circularity' across the building life cycle should become more transparent.
- Digitalisation is crucial in order to foster exchange of information to improve circularity within a complex sector and quickly evolving society.

CHALLENGES:

- Obtaining robust and accurate data at input stage, maintaining and accessing this data across a long period of time i.e. the building life.

LESSONS LEARNT:

- User requirements analysis is still ongoing and is being used to inform development of the outputs.

Additional Information

The BAMB project is multifaceted and has the following work packages:

WP1 - Developing a blueprint for dynamic and circular buildings and materials upcycling

WP2 - Developing Materials Passports and corresponding database & platform

WP3 - Developing Reversible Building Design tools for dynamic and circular buildings

WP4 - Testing BAMB results through prototyping and pilot projects

WP5 - Facilitating future applications and exploitation of BAMB results

WP6 - Communication & dissemination

WP7 - Project management and coordination

There are many opportunities for others to get involved, primarily via the Stakeholder Network that is being set up.

During the Launch event of the Stakeholder Network six Special Interest Groups will be introduced. These groups bring together stakeholders for direct feedback and exchange of ideas focussing on:

1. Materials Passports
2. Reversible Building Design

3. Building Information Modelling (BIM)
4. Circular Building Business Models
5. Policies and Standards
6. Case Studies and Pilots



Co-funded by the Horizon 2020
Framework Programme of the
European Union



“The Buildings as Materials Banks (BAMB) research project brings 16 partners from 8 European countries together for one mission, to move the building industry towards a circular economy.”

Gilli Hobbs, Project Partner, BRE

CASE STUDY: PROGRAMMES

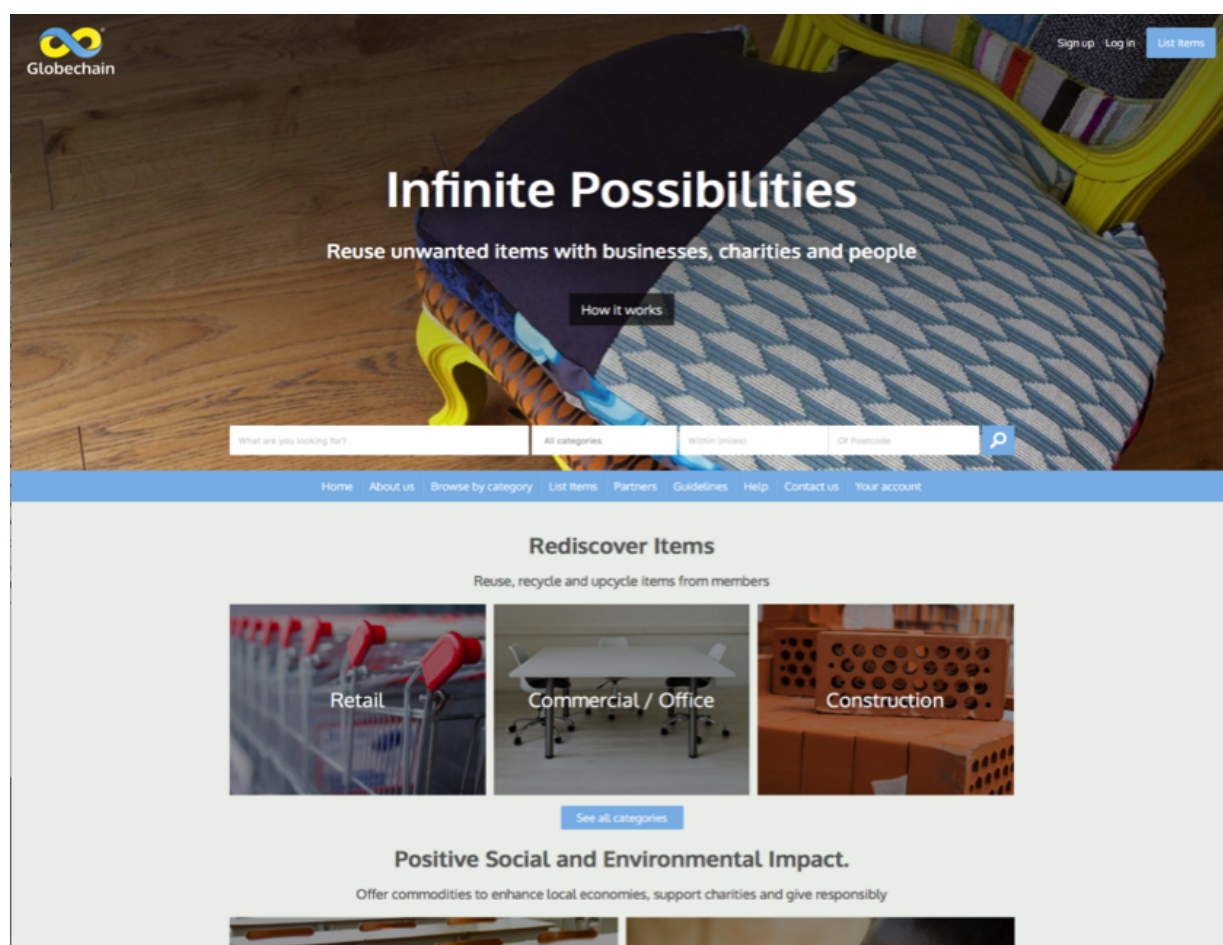
Construction Reuse Platform: Bexleyheath

SUBMITTED BY:

May Al-Karooni, Founder and CEO, Globechain, may@globechain.com

PRIMARY CONTACTS:

May Al-Karooni, Founder and CEO, Globechain, may@globechain.com



LOCATION:

The project was implemented in the borough of Bexley, Kent on a housing association site project managed by Keepmoat using the Globechain online platform.

PROJECT DESCRIPTION:

- Globechain is a reuse platform that connects corporates to charities and SMEs to create a social impact audit.
- Globechain worked alongside Keepmoat, a national construction company, which specialises in new build homes, community development and regeneration.
- Keepmoat in London focuses on refurbishment, and Globechain has worked with the company to run a pilot to see how unwanted items that are removed from properties may be redistributed to redirect from landfill, while finding uses for old materials and therefore improving social, economic and environmental impacts.
- The project looked at how quickly items were taken, the timing of how quickly members requested the items, how internal operations adapted to the use of the site, and from a commercial perspective, the cost savings created from diverting the goods from landfill.
- The refurbishment involved turning old flats into temporary care homes for the elderly and disabled.
- Keepmoat staff were registered and trained on how to use the Globechain system and the most effective ways to promote items. The importance of behaviour change for employees was also emphasized to maximise the benefits of the platform; to accomplish this and how to manage expectations of members taking the items and the communication between them.

KEY DATES:

Dec 2015 – Feb 2016

STAKEHOLDERS INVOLVED:

- Keepmoat Limited – Contractor and Globechain user
- Globechain (UK) Limited – Platform / operator
- London Borough of Bexley – Client

ADDITIONAL SOURCES OF INFORMATION:

<https://www.globechain.com/>

<https://www.keepmoat.com/>

<https://ccsbestpractice.org.uk/>

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE ADDRESSED BY YOUR PROJECT?



Element 1: Share

REASONS:

- Enables residential sharing of items that would otherwise be waste furniture and materials. Reusing them throughout their technical lifetime (second-hand), and prolonging their life through maintenance, repair, and design for durability.

BENEFITS:

- Keepmoat was able to reduce its costs, making a saving on waste disposal and increase community engagement and social impact by offering the unwanted items from their regeneration and refurbishment project to local charities and social enterprises; benefiting a range of causes from medical heart research to helping charities improve the quality of life of the terminally ill.

CHALLENGES:

- The main challenges faced was coordinating the items being removed from properties and the ability for charities to collect. Often sites do not have storage space and items need to be removed from the site. Members who request items via Globechain must come at specific dates as requested by Keepmoat.
- Changing the behaviours of project managers on site can also be challenging as some may not have been open to new ways of working; a lack of proficiency with technology may be difficult for some as, although straight forward to use, not all staff regularly use laptops and computers.
- Keepmoat, however, was aware of the potential benefits and savings to be made and embraced the changes to adapt and record their findings for their own CSR reporting, as well as being committed to guiding those who use the platform through the process.

LESSONS LEARNT:

- Adaptation by innovative companies such as Keepmoat can aid a change in behaviour and working operations on site. Head office / board buy-in is a must and an understanding of the objectives, aims and outcomes of a company must be met when using technological platforms.
- Service design and user experience proved an important enabler to helping companies such as Keepmoat to adapt with efficiency, ease and convenience.
- It was also revealed that not only can Globechain help to reduce waste on sites, and provide materials for SMEs and charities, Keepmoat can also utilise the platform to collect materials for their Community Impact Team which supports vulnerable residents.

WHY WAS CIRCULARITY INTEGRATED INTO THIS SITE?

Circularity has been integrated onto this site as a pilot for potentially rolling out to all other suitable sites. It was initially introduced to look at what items Globechain users may be interested in and how items can be re-used; the aim was to help people benefit from the materials taken while also lowering the company's expenditure on skips. Many of the users of Globechain are charitable organisations, which also encouraged Keepmoat to use the Globechain platform. Keepmoat also has new company targets in place to reduce total waste arising and no longer only focuses on reducing waste from landfill.

WHAT WERE THE IMPLICATIONS FOR THE IMPLEMENTATION OF THE PROJECT?

- Strong investment of employees' time was required in order to understand the platform, ensure site managers are invested in the programme
- Due to some of the requirements of the construction site, the items should have been available on a set date but these ended up being spread out over a period of time - it is important when using the site to try and manage exactly when items will be available for collection to get the full benefit of the system and ensure synergy between items being removed and those ready for collection
- A dedicated project manager of the site would maximise the volume of materials that can be collected and re-used.
- There is also a membership cost so it is important to ensure the reduction in volume of waste outweighs the membership, which if managed correctly should be achievable.

WHAT ADDITIONAL BENEFITS WERE DERIVED FROM THE PROJECT?

The benefits Keepmoat derived from this platform were a reduction of total waste and handling of controlled waste. Items that were collected ranged from medical equipment, such as shower seats and grab rails, to electrical products such as microwaves and fridges as well as upholstered chairs and furniture. 451 kilos were diverted from landfill with an approximate saving of around 25% of the costs incurred in waste disposal. This was also of great interest to the client and added value to the scheme.



WHAT COMES NEXT?

With the success of the project, Keepmoat is interested in implementing this throughout its projects and sites. An internal communication strategy needs to be designed and implemented within Keepmoat. In order for this to be successful, Keepmoat would have to develop a procedure for all sites to be able to inform the sustainability team of what items will be removed. It will be necessary for this to be a slightly bespoke process; each site will have unique needs.

Globechain will also be incorporated into Keepmoat's processes in bringing on board partners whether that be on an official supplier panel etc.

Additional Information

- Twitter: @Globechain
- Reuse Platform website: www.Globechain.com
- Partner Website: www.keepmoat.com



“Our use of Globechain in this project is exactly the kind of innovative approach to sustainability that we are currently implementing across the company. Waste and resource efficiency is a key part of our new five-driver approach to environment and sustainability at Keepmoat and when you consider the wider impact that this scheme has had on our business and for the community we are working for, the benefits are very clear to see. We look forward to working with Globechain again in the very near future.”

Andy Merrin, Head of Energy and Innovation at Keepmoat

CASE STUDY: PROGRAMMES

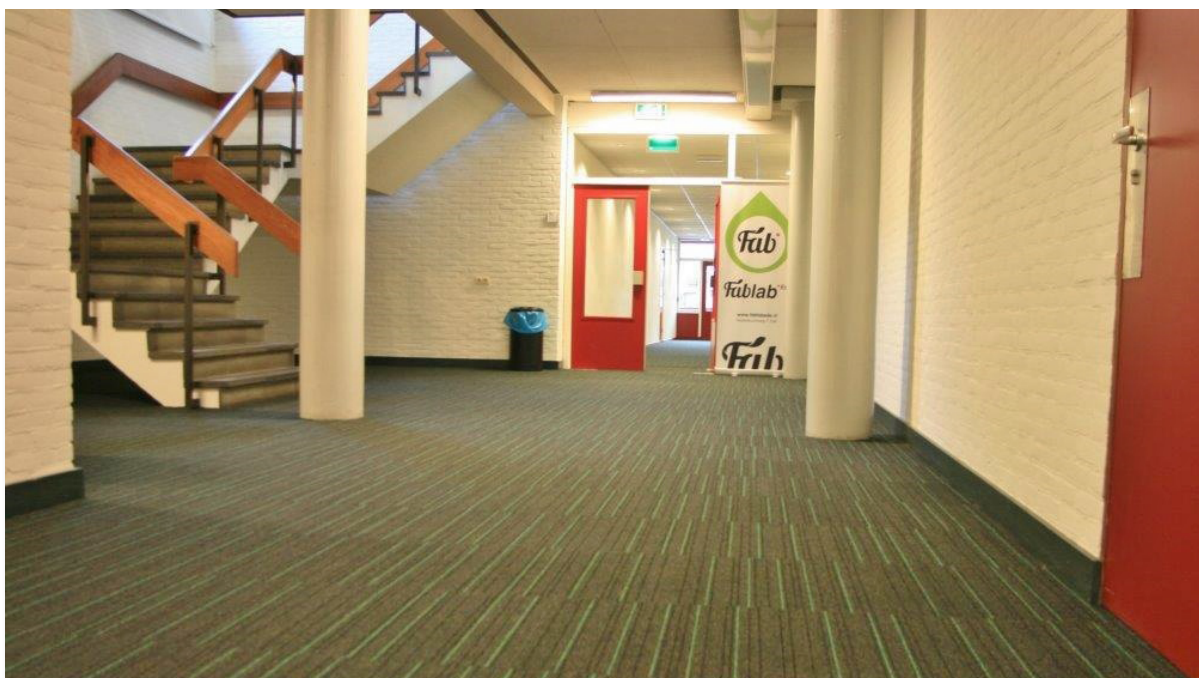
ROC A12 School: Carpet Lease

SUBMITTED BY:

Marjolijn Verleg, Communications Manager, Desso

PRIMARY CONTACTS:

John van Mook, Group Sales Controller, jvmook@desso.com



LOCATION:

Ede, Netherlands

PROJECT DESCRIPTION:

Installation of a new carpet (850m²) at the ROC A12 School in Ede, Netherlands

KEY DATES:

June 2013 – December 2013

STAKEHOLDERS INVOLVED:

Desso (a Tarkett Company) – Carpet Manufacturer

Van Voorst projektendienst – Installer

ROC A12 School – Customer

DLL – Global Financial Solutions Company

ADDITIONAL SOURCES OF INFORMATION:

- www.roca12.nl

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE STRONGLY ADDRESSED BY YOUR PROJECT?

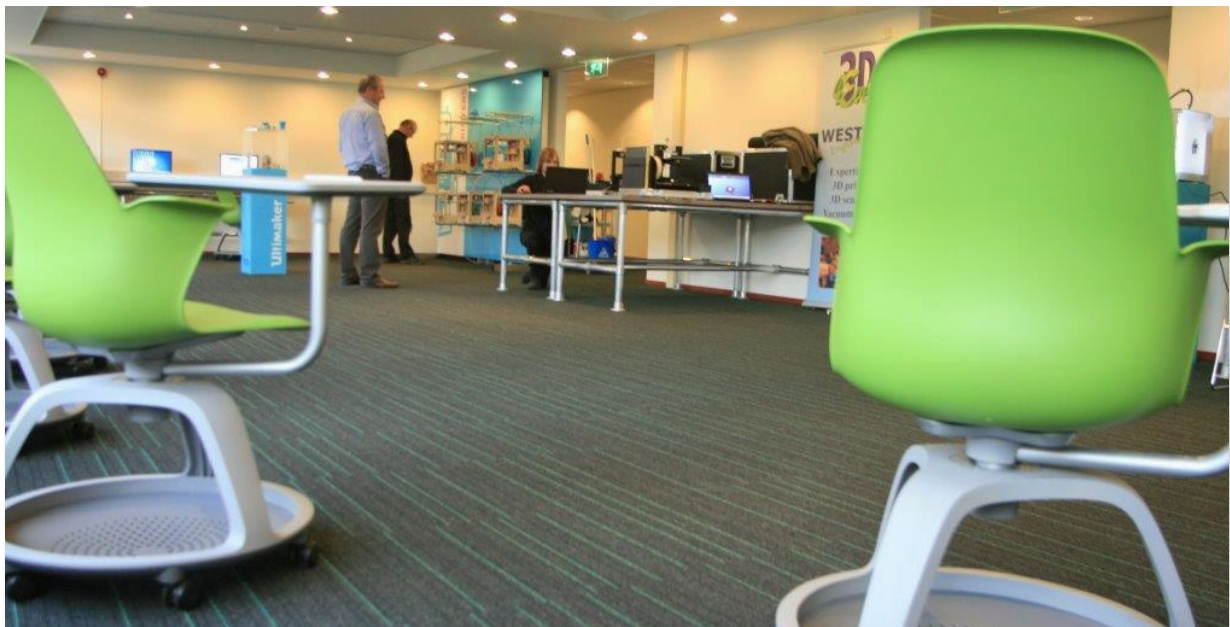


Element 1: Loop

REASONS:

Desso, a Tarkett company, has been implementing its visionary goal of transitioning to the circular economy since it adopted its Cradle to Cradle® strategy in 2008. As a leading high quality carpet company, Desso passionately believes that smart business is about delivering commercial success in a truly sustainable way, positive to people, planet and profits.

A core part of Cradle to Cradle® principles is to develop circular closed loop manufacturing, in which goods are designed to be returned at the end of their first life cycle. The materials are considered nutrients for the next life cycle either through production (technical) or the earth (biosphere). C2C also means ensuring the materials used are positive for the environment and human health, relevant for all product cycles. Therefore, products were assessed and designed against C2C environmental and human health criteria, with the help of C2C consultancy EPEA. In this case, the customer, the ROC A12 wanted to procure its flooring in a positive, sustainable way and act as a role model to its students. A Carpet Lease™ program that underpins the shift to circularity, was a great example of this sustainable vision. In addition, carpets designed to contribute to good indoor air quality were offered.



BENEFITS:

On average, we spend 90% of our time indoors, so it is imperative that any building takes the health and wellbeing of its occupants into account. Especially in a school, where the goal is to provide the ultimate learning environment for its students, this is even more important. As such ROC A12 was quickly convinced of the benefits which Desso's C2C certified AirMaster® carpet offered in terms of reducing the amount of fine dust in the indoor air. In fact, Desso AirMaster is four times more effective than regular carpets at retaining the fine dust. In addition, the carpet tile is delivered with a C2C Gold Certified EcoBase™ backing, consisting

of C2C-assessed material ingredients, denoting that they have been assessed as positive to human health and the environment against C2C criteria. Designing with healthy materials in this way helps to ensure the product is positive to people and planet both during its use and when it's taken back for recycling or reuse. In the latter case, the backing is 100% recyclable in Desso's production process, with the purity of the materials acceptable for C2C upcycling, ensuring the maximum amount of material is transformed for a new life cycle. It was awarded a Gold C2C Certificate for reaching a level where 100% of the materials used are positively defined.¹

One of the effects of poor indoor air quality due to allergens and dust is to contribute to incidences of asthma. In the US, for example, nearly 1 in 13 children of school-age has asthma, the leading cause of absenteeism from schools due to chronic illness, according to the United States Environmental Protection Agency.² This makes it imperative to develop solutions that improves air quality indoors and to be able to prove that it has a positive benefit.

In that light, Desso works with research organisations to examine the impact of the DESSO AirMaster® in the school environment and two recent studies in schools have demonstrated the positive benefits. One experiment,³ commissioned by the Dutch province of Gelderland showed that having a Philips air purifier and a DESSO AirMaster® carpet in a classroom reduced the concentration of fine dust as measured over a two week period and more specifically, that the smallest particles⁴ of dust – those more potentially harmful to human health because of their size – were reduced by 60-90 % during the weekend when there was less traffic and 30-50 % during the week. In another study, also in a Dutch school,⁵ Desso worked with research organisation, TNO to establish the impact of the AirMaster® carpet on fine dust concentration (PM10) in comparison to smooth floors. The test was carried out across several weeks in almost identical classrooms. The report concluded that the concentration of PM10 had been significantly reduced and that the carpet had performed more effectively than smooth floors when dust concentrations were at their maximum such as during cleaning.

CHALLENGES:

The most challenging part was to make sure that products can be brought into a loop, by designing them to be disassembled, and ensuring there is a system in place to take back the products at the end of their use. Desso has changed the way it designs its products in line with C2C principles and in order to make disassembly and recycling possible. A take back

1 Positively defined = all ingredients have been assessed as either Green (optimal) or Yellow (tolerable) according to the Cradle to Cradle® assessment criteria. As described in Cradle to Cradle® CertifiedCM Product Standard Version 3.1.

2 <http://www.epa.gov/iaq-schools/why-indoor-air-quality-important-schools>

3 Radboudumc report / Influence of a combined dust reducing carpet and compact air filtration unit on the indoor air quality of a classroom, P.T.J. Scheepers, J.J. de Hartog, J. Reijnaerts, G. Beckmann, R.B.M. Anzion, February 2013

4 "The Buildings as Materials Banks (BAMB) research project brings 16 partners from 8 European countries together for one mission, to move the building industry towards a circular economy." – Gilli Hobbs, Project Partner, BRE

5 TNO report / Onderzoek naar de werking van DESSO AirMaster® in de praktijk / Case study on the functionality of DESSO AirMaster® - Dr. J. Duyzer, M.M. Moerman - TNO 2013 R11203

programme was introduced in 2008 and subsequently a recycling facility was created in 2009, called Refinity®. Different country markets encouraged the return of post-consumer carpet material to Desso's Refinity® plant, so that it could be recycled or reused.



Element 2: Exchange

REASONS:

Desso demonstrates its commitment to shifting to the circular economy by launching a service-based leasing model for its carpets, one of the drivers of the transition to circular models away from the asset-owning linear model. ROC A12 wanted to prove its commitment to the circular economy in a practical and useful way.

BENEFITS:

The Desso Carpet Lease™ program also offered ROC A12 more financial flexibility and gave them better control over their monthly costs for this item. There was no need to invest up-front, take out a loan or make a provision for unknown future costs; ROC A12 knew exactly what the outgoings were going to be at the time of purchase and in the future. With Carpet Lease™, Desso also ensured ROC A12 that the material streams would never end, as Desso can keep track of its assets much more effectively this way, enabling it to plan for the carpets' eventual return for recycling, remanufacturing or reuse.

The Carpet Lease™ program not only paves the way for the circular economy, it also offers customers more flexible financial options, enabling them to manage their monthly costs more effectively. In addition, customers will be purchasing products with healthy C2C materials such as carpets with the DESSO EcoBase® backing, a polyolefin material that is 100% recyclable and fully positively defined in accordance with C2C standards. So, the customer simply needs to select a lease period for five or seven years. At the end of the leasing period, Desso carefully removes, takes back, disassembles and recycles the carpet into new flooring through its ReStart® take back program and Refinity® recycling facility. Most carpet tiles will last for at least ten years. With this leasing arrangement, customers have the option to change their carpet for a new one earlier than that. And regular checks are made through the leasing period to see if some of the tiles need replacing.

CHALLENGES:

An aspect of Dutch law meant a new way had to be found to show that the carpet during the leasing period was still owned by Desso and could therefore be taken back for recycling later. Dutch law states that a carpet immediately becomes part of a building. The owner of the building, therefore, owns the carpet. With the help of our partner, the global financial solutions company, DLL, we found a solution. Instead of gluing the carpet tiles to the floor, we now install them as 'loose lay' tiles and semi-fix them to the concrete by using an environmentally friendly Velcro-type solution, QuickFix. This makes it easier to remove the carpet tiles later when they need to be taken back. Desso also had to give each tile an ID number, identifying it as loose lay and not part of the building. These actions helped to convince the legislator that the carpet was jointly owned by Desso and DLL, setting the foundation for its eventual take back and recycling, and the successful launch of its new circular economy leasing initiative.

LESSONS LEARNT:

Desso had to convince the school that leasing could provide an effective route to a circular economy. We were able to convince them after having invited them to our offices for a day to tell them in person why we had taken such a radical step to transform our business model along Cradle to Cradle® lines, promoting the use of healthy, closed loop systems.

Additional Information:

Back in 2008, when Desso launched its 2020 Cradle to Cradle® strategy, Prof. Dr. Michael Braungart of EPEA stressed that the process of change was a long one, saying that “you cannot be perfect from Day One”. This was very good advice. The fact is that all elements of the business and internal culture as well as relationships with stakeholders needs to be reimagined and remodelled. A good example of this is the leasing model developed with the support of DLL. It challenges the traditional way of selling our carpets, and therefore requires a completely new sales and financing package and a new conversation with our customers. Underlining the whole shift is the knowledge that by putting people and planet on an equal footing to profits makes you more profitable as well as resilient and that it improves the customer proposition. It adds value, as demonstrated in this case. But you must break through any scepticism that this is about altruism or a “nice to have” approach or public relations. It’s not. It’s about smart and sustainable business now and in the future. We have to make this case every step of the way across the value chain, with customers, with suppliers, amongst our management, marketing, design, sales and production teams and more. It’s an exciting challenge and a crucial one. Our lesson is that you cannot underestimate the toughness of this challenge and the need to hold fast to your vision every step of the way.

WHAT COMES NEXT?

Our ambition is to roll out the program to the rest of Europe. In addition to the Netherlands, this leasing package is currently being marketed in the UK, Germany and France.

MATERIAL USED:

DESSO AirMaster® with EcoBase™ backing. After use this type of carpet can be recycled almost entirely for the production of new carpeting.

For more information, please visit <http://www.desso-airmaster.com/>



“As a Training Institute, sustainability and innovation are paramount to our business and the Cradle to Cradle® initiative is a natural progressive fit. With the introduction of the leasing service for the carpet tiles this provides us with more space to focus on other things.”

Ad Kuivenhoven, Head of Department Housing, Facilities and ICT Management ROC A12

CASE STUDY: PROGRAMMES

Reviva Shelving at M&S Yorks Monks Cross

SUBMITTED BY:

Jed Palma, Procurement and Supply, M&S Property Group

PRIMARY CONTACTS:

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LOCATION:

Marks & Spencer, Vangarde Retail Park, York, North Yorkshire YO32 9AE

PROJECT DESCRIPTION:

- The Reviva brand was created in 2008 by Wanzl; Reviva concentrates on remanufacture instead of refurbishment allowing the process to bring the asset back to life. Wanzl are a key supplier of shop fit out items to the retail industry and have been a supplier of M&S for over 10 years.
- The unique Reviva process provides a cost-effective and environmentally friendly alternative to new products
- The process is available for all steel-based retail and industrial equipment which includes shelving, roll cages, waste bins and steel lockers

- Reviva concentrates on remanufacture instead of refurbishment allowing the process to bring the asset back to life

KEY DATES:

June 2014 – present

STAKEHOLDERS INVOLVED:

- Client: M&S
- Supplier: Storetec
- Manufacturer: Wanzl

ADDITIONAL SOURCES OF INFORMATION:

- http://www.wanzl.com/en_DE/
- <http://www.wanzl-news.co.uk/47-ms-food-hall-chooses-reviva-for-york-monks-cross/>

WHICH OF THE RESOLVE FRAMEWORK ELEMENTS ARE ADDRESSED BY YOUR PROJECT?



Element: Loop

REASONS:

- Reviva just made sense. There is plenty of equipment going into M&S stores and as those stores flourish for years and see millions of visitors, stores get re-merchandised and moved around, eventually, they grow tired looking and even damaged. Reviva guarantees brand new looking equipment at half the cost and carbon usage compared to manufacturing completely brand new equipment.

BENEFITS:

- The cost is half the price versus building brand new equipment and it's 55% less CO₂ to "Reviva" a product.
- Removing the waste that would be produced if we were to manufacture from scratch.
- Reduced overhead for the supplier and this reduces unit cost for us and gives the equipment another 5 years worth of life.

CHALLENGES:

- The main challenge lies in getting equipment back from stores. Traditionally store equipment at the end of its life was back hauled en mass to an M&S warehouse facility prior to disposal. We have needed to implement a process whereby equipment suitable for Reviva is separated from the mass return.
- It has been a challenge to make sure stores understand that there is a proper channel for sending in equipment that can be reused; our stores have limited on-site storage and often take the first opportunity to dispose of unused equipment.

LESSONS LEARNT:

- Reviva provides a quicker way to get equipment for a new store or store undergoing a refurbishment. This supports a reduced project delivery timeframe.

Additional Information:

Sustainability is the central theme of the M&S Monks Cross store in York – and the Food Hall was the first in the UK to specify Wanzl UK Group's 'Reviva' brand shopping trolleys alongside remanufactured Wire Tech shelving.

This has contributed substantially to the reduction of the store's carbon footprint while at the same time reducing costs and maximizing the service life of valuable equipment assets for M&S.

Storetec supplied 120 bays of Reviva Wire Tech shelving to the Monks Cross Food Hall along with 350 Reviva shopping trolleys including the 70 litre Light Shopper, EL 130 and EL 212 trolleys. This procurement route saved 51% in capital costs for these items.

The Reviva process uses about half the amount of CO₂ used in the manufacture of equivalent new products and provides a considerable cost saving. All Reviva products are sold with a factory-backed warranty and leave the 'proudly British' Tibshelf remanufacturing facility with a Union Jack quality emblem.

M&S

wanzl
Future Retail MADE BY WANZL

“The Reviva philosophy rejects the notion of the throw-away society and is in keeping with the ‘waste not, want not’ message which is prominent in the Monks Cross store. In an extremely competitive UK retail market we believe Reviva is the very much the right thing to do – both environmentally and economically.”

Tony Barber, Managing Director of Storetec



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The Circular Economy 100 (CE100) is an Ellen MacArthur Foundation initiative.