



Shaping a Circular Sustainable Future

Module 9

Waste as a Resource in Circular Economy

Circular Economy in the Construction Industry



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Summery



Within this module the trainee will gain an understanding of what the opportunities associated with material reuse are and how this can be applied to their industry. they will also recognise some of the barriers that exist within a national context. They will also become familiar with some material digital marketspaces as well as becoming familiar with the concept of buildings as material banks. This will all then be related to Multi-functional Green Roofs Facades and Interior Elements.



Objectives/Learning Outcomes



- 5 – Design with products and materials that can be easily reused or recycled after use
- 16 – Enable second hand sale of multifunctional roof/façade products through marketplaces or services
- 19 – Transform waste products and materials from multifunctional roofs, façades or interior elements for reuse, or as a last resort into lower value products in the same industry
- 20 – Use waste products and materials from construction demolition projects that have been processed and recycled
- 21 – Collect products and materials for reuse or recycling in roofs, façades or interior elements from outside construction



Objectives/Learning Outcomes



- 22 – Transform waste products and materials from multifunctional roofs, façades or interior elements for reuse outside construction, or as a last resort into lower value products outside construction
- 23 – Use waste products and materials from outside construction that have been processed and recycled
- 48 – Employ a regional construction digital marketplace for construction resources
- 58 - Reduce waste as much as possible during production
- 73 – Organise logistics and storage of secondary materials, whilst aiming to reduce waste



Objectives/Learning Outcomes



- 78 – Assess quality of materials to be reused from multifunctional green roofs, façades, and interior elements (audit of waste)
- 79 – Trade secondary materials and products on digital marketplaces



Content



- Waste as a Resource
 - Implementing material reuse
- Digital marketspace
- Material Banks
- Application for Multi-functional Green Roofs Facades and Interior Elements



Waste as a Resource



Waste as a Resource



The EU Data Centre on Waste compiles waste data at European level.

- According to data for 2010 for 29 European countries (i.e. EU-28 and Norway), around 60 % of the waste generated consisted of mineral waste and soil, largely from construction and demolition activities and mining.
- For metal, paper and cardboard, wood, chemical and medical waste and animal and vegetal wastes, each waste type ranged from 2 % to 4 % of the total.



Source: <https://www.eea.europa.eu/publications/signals-2014/articles/waste-a-problem-or-a-resource>

Waste as a Resource



Around 10 % of the total waste generated in Europe consists of what is known as 'municipal waste'

- Waste generated mainly by households, and to a lesser extent by small businesses, and by public buildings such as schools and hospitals.

In 2012, 481 kg of municipal solid waste was generated per person in the 33 member countries of the European Environment Agency (EEA). There is a slight downward trend from 2007 onwards, which can be explained partly by the economic crisis affecting Europe since 2008.



Source: <https://www.eea.europa.eu/publications/signals-2014/articles/waste-a-problem-or-a-resource>

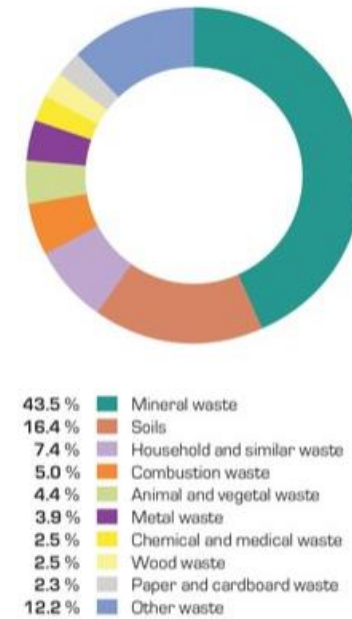
Europe's waste streams

In total, about 2500 million tonnes of waste was generated in the EU-28 and Norway in 2010. Here is an overview of where the waste came from and what it was composed of.

Waste streams by source



Waste streams by type of waste



Source: Eurostat 2010 data on EU-28 and Norway



Source: <https://www.eea.europa.eu/publications/signals-2014/articles/waste-a-problem-or-a-resource>



On average, we generate 157 kg of packaging waste per capita in the EU.



Every year, the generation of some 74 million tonnes of hazardous waste is reported in the EU.



Electrical and electronic equipment is the fastest growing waste stream in the EU, estimated to reach 12 million tonnes a year by 2020.

Sources: EEA, Eurostat, European Commission
Read more: www.eea.europa.eu/waste



Irish Context

The construction industry accounts for approximately

- 50% of materials used on the planet,
- 48% of all waste generated in Ireland

Very little of this waste is currently reused, or even recycled. Where recycling does take place, it is often in the form of downcycling, creating aggregates and backfill at best.



Source: <https://www.igbc.ie/the-irish-green-building-council-launches-a-pilot-scheme-to-increase-reuse-of-construction-materials/>

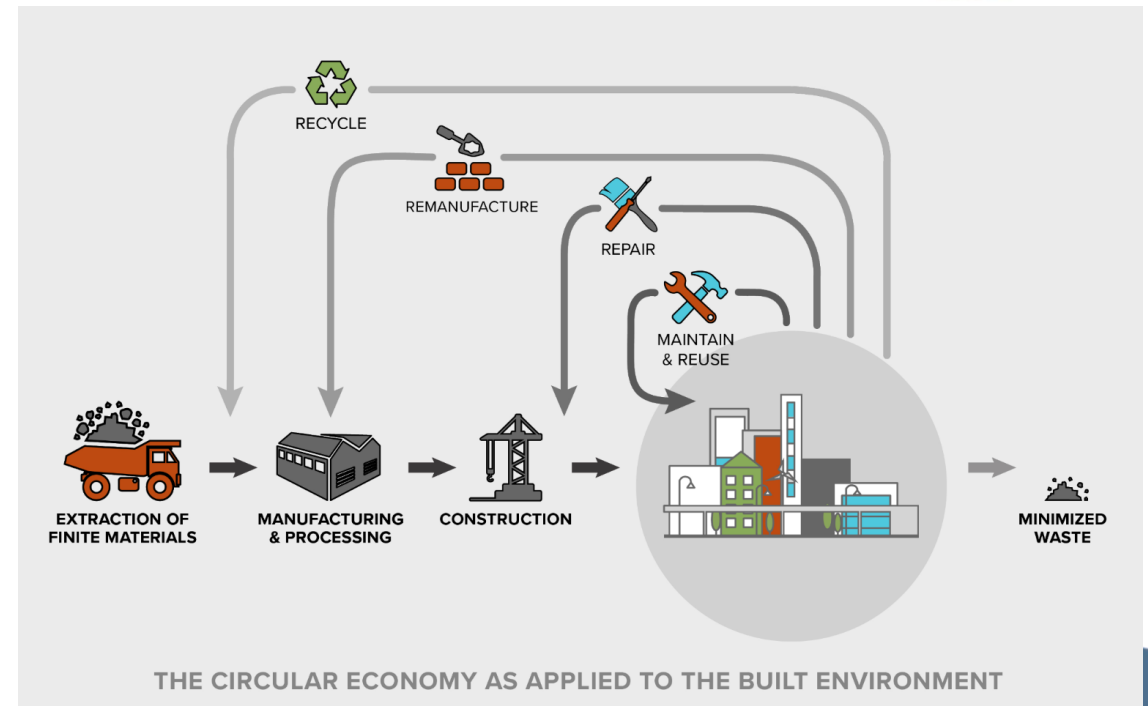
Irish Context



The objective of the pilot (**Construction Materials Exchange (CMEx) project**) is to demonstrate a

- feasible
- transparent
- fair
- user-friendly

system for the reuse of construction materials that would otherwise enter the waste stream.



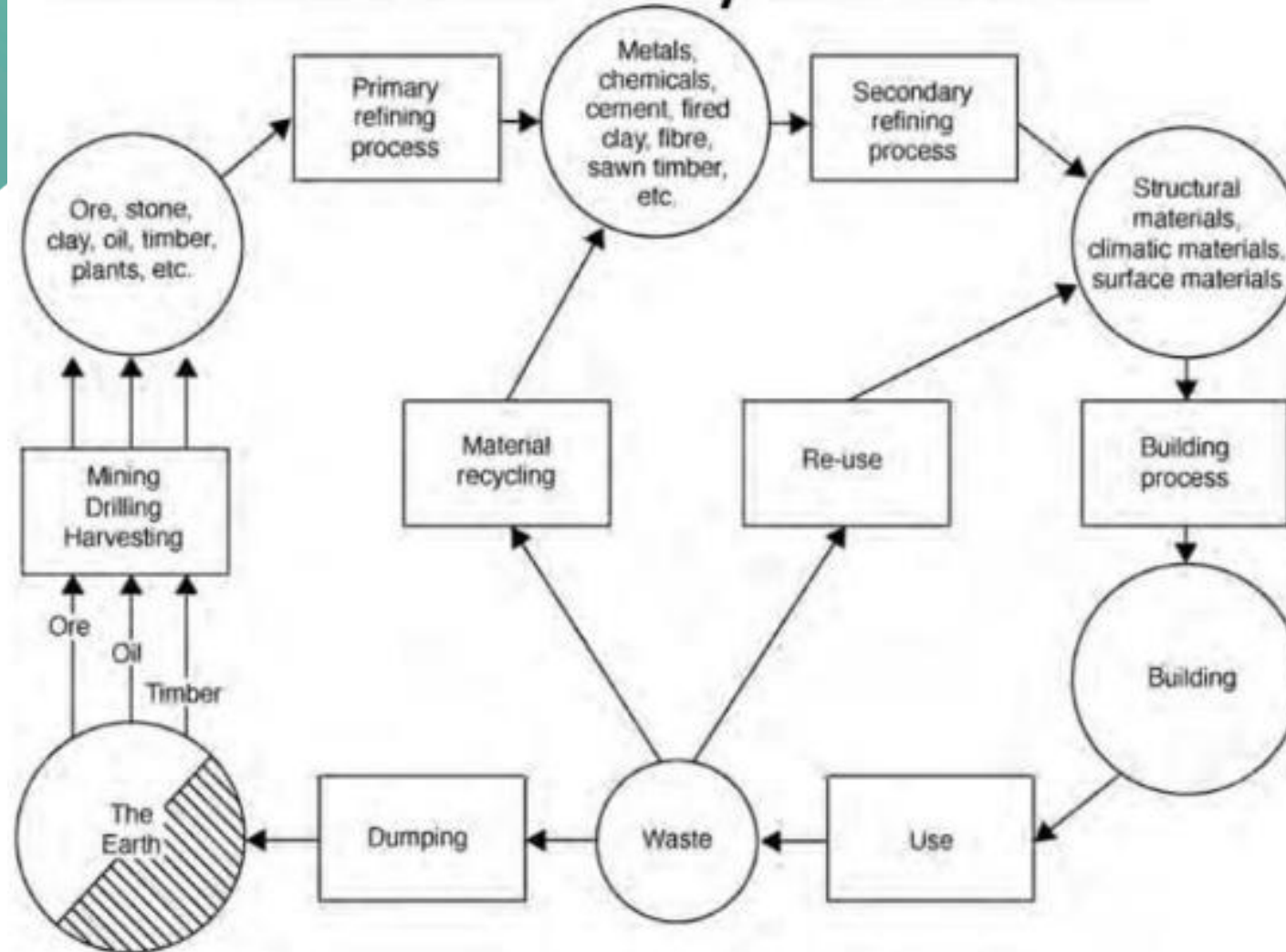
Source: <https://hickokcole.com/lab-microgrants/waste-less/>



Source: <https://www.igbc.ie/the-irish-green-building-council-launches-a-pilot-scheme-to-increase-reuse-of-construction-materials/>

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Material Resources: The Cycle of Materials



Source:BERGE, B., (2009) the ecology of building materials 2nd ed

Circular Economy & Waste

- The construction sector consumes 42 billion tonnes of resources annually, making it the most material-intensive sector.
- The construction sector also produces about one-third of all global waste, most of which is not recycled or reused, but ends up in landfills.



Source-Google Search



Source:<https://www.circle-economy.com/resources/building-a-circular-construction-sector-is-hard-but-it-is-happening>

Circular Economy & Waste



Construction and Demolition (C&D) waste is waste from any building works, demolition and development (including transport infrastructure).

- The remainder includes concrete, brick, tiles, metal, glass, wood, plastic and metal.
- Excavated soil and stone is the largest element of construction and demolition waste at approximately 85%
- The quantity of C&D waste generated and collected in Ireland increased to 8.8 million tonnes in 2019

CONSTRUCTION AND DEMOLITION WASTE

STREAMLINE BY-PRODUCT NOTIFICATION AND END-OF-WASTE DECISION MAKING PROCESSES

REVISION OF THE 2006 BEST PRACTICE GUIDELINES FOR C&D WASTE

WORKING GROUP TO DEVELOP NATIONAL END-OF-WASTE APPLICATIONS FOR PRIORITY WASTE STREAMS

The infographic is a vertical rectangular box with a dark green header. It contains three main sections, each with an icon and text. The first section has an icon of a recycling loop with a checkmark and a cross, and text about streamlining processes. The second section has an icon of a document with a magnifying glass, and text about revising guidelines. The third section has an icon of three people, and text about a working group for national applications.

Source: <https://www.gov.ie/en/publication/c305a-construction-and-demolition-cd-waste/>



Circular Economy & Waste



- Most of the C&D waste collected in Ireland in 2019 was backfilled (82 %), while 10 per cent went for disposal and only 7% per cent was recycled. This reflects the large proportion of soil and stones in C&D waste.
- Recycling was the main treatment operation for metals (100%) and waste bituminous mixtures (64%).
- It is notable that only 39% of segregated wood, glass and plastic waste was recycled in 2019 while 54% went for energy recovery (incineration)

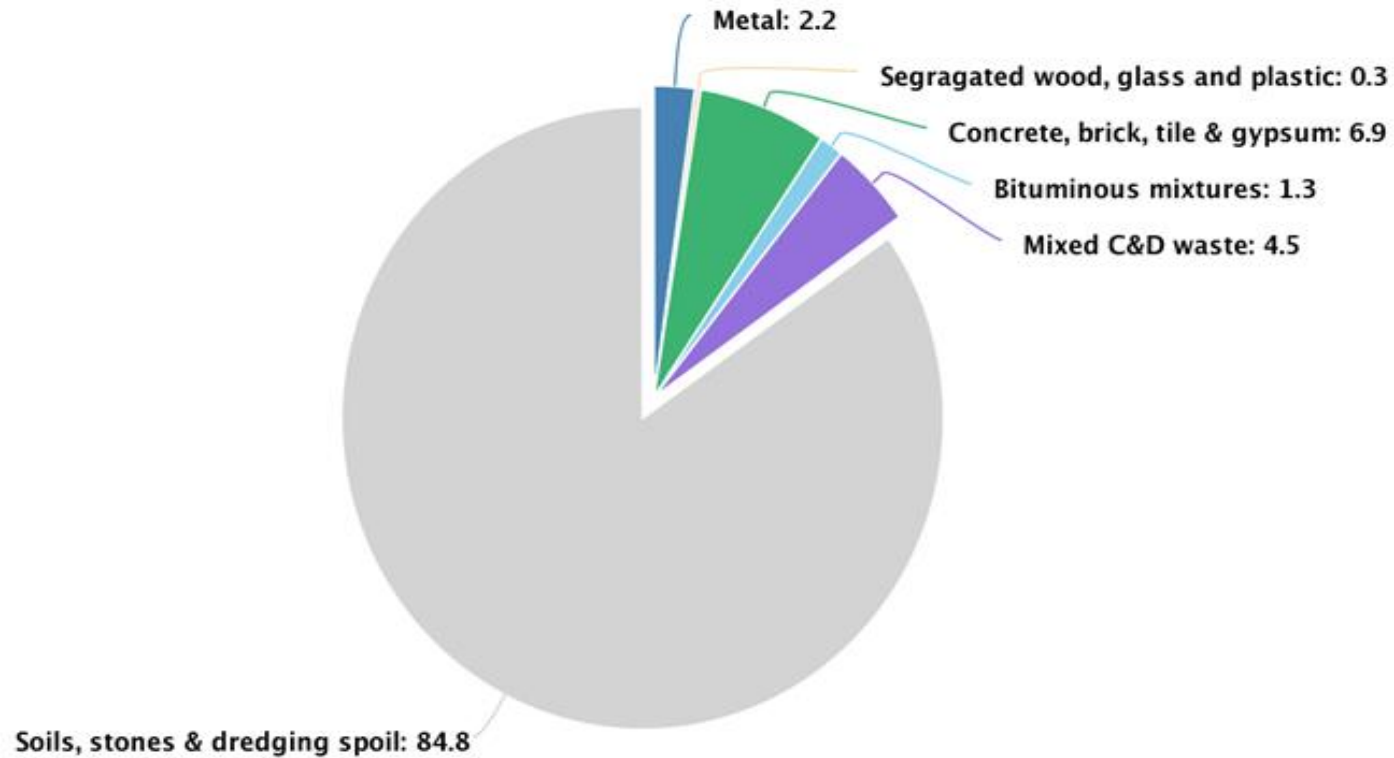


Source: <https://www.gov.ie/en/publication/c305a-construction-and-demolition-cd-waste/>

Circular Economy & Waste



Figure 2. Composition of C&D waste material collected in Ireland, 2019



Highcharts.com



Source: <https://www.gov.ie/en/publication/c305a-construction-and-demolition-cd-waste/>

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Circular Economy & Waste - Example



Plasterboard
Recycling
Service (PRS)
<https://www.gyproc.ie/services/plasterboard-recycling-service>



Circular Economy & Waste - Example

Expanded polystyrene (EPS)

EPS is used for packaging and insulation

Offcuts and waste are shredded, then heated and compressed into a solid mass, reduced to 10% of its' original size, for resale and re-use.

It is exported to manufacture insulation to Spain, Portugal and Germany.

12% of EPS currently recycled globally

Waste Matters (Ireland) Ltd

https://www.youtube.com/watch?v=zDfdya7iUVY&ab_channel=WasteMatters



Recycling system at (LOETB) National Construction Training Centre at Mount Lucas, Ireland



Enablers for Reuse



- Increased community awareness and education on recycled products.
- Develop supportive regulations, policies and specifications.
- Facilitate sustainable programs.
- Promote product certification.
- Advocate targeted technologies and innovative practice.



Source: https://www.researchgate.net/figure/Emergent-model-on-barriers-and-enablers-for-using-recycled-C-D-waste-products_fig4_346258505

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Barriers for Reuse



- Increased costs of energy and transport.
- Lack of knowledge on recycled products.
- Limited technologies for waste recovery.
- Low quality and possible contamination.
- Lack of market availability of the products.
- Limitations caused by specifications, standards and permits.
- Limited acceptability and negative perception.



Source: https://www.researchgate.net/figure/Emergent-model-on-barriers-and-enablers-for-using-recycled-C-D-waste-products_fig4_346258505

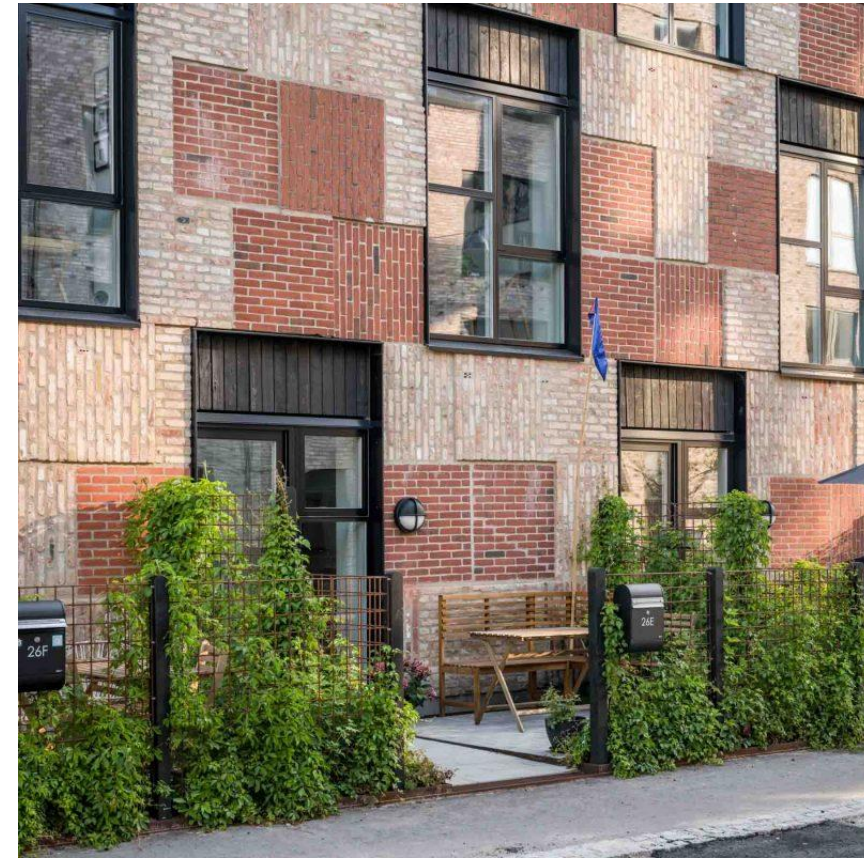
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Lendager Group - Resource Rows Project Oerestad, Copenhagen



The Resource Rows is using upcycled bricks and waste wood, a recycled concrete beam used as a bridge and old windows and waste wood as rooftop community gardens huts with an atmosphere of allotment gardens.

A significant and innovative concept is to reuse brick facades from abandoned structures in the new building, saving as much as 29% CO2 by upcycling only 10% of all building materials.



Source: <https://lendager.com/project/resource-rows/>

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Limerick 2020 - OPERA SQUARE

Limerick, Ireland



It's one of the country's biggest projects involving the recycling and reuse of construction rubble in which over 1,000 tonnes of

- stone
- brick
- cobblestone
- old doorways
- gates

have been salvaged.



Source: <https://www.limerickleader.ie/news/planning/690157/update-issued-on-progress-to-develop-iconic-limerick-site.html>

Source: <https://www.rte.ie/news/regional/2022/0414/1292354-limerick-opera-recycling/>

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740



Limerick 2020 - OPERA SQUARE

Limerick, Ireland



Sixteen old buildings, many of them Georgian, and of important historical significance, are being retained for use as living accommodation, but huge volumes of material which would otherwise go to landfill, are also being harvested for reuse in other building projects throughout the Opera Site and greater Limerick.

Further information and image source - <https://limerick2030.ie/opera-site/>



Evening view of the library viewed from Opera Square



Source: <https://www.rte.ie/news/regional/2022/0414/1292354-limerick-opera-recycling/>

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Digital Marketplace



What is a Digital Marketplace

In simple terms, digital marketplaces connect multiple sellers with multiple buyers via an online platform. They exist across a wide range of operating models, including price comparison sites, affiliates, online auction platforms, lead generators, cashback sites, sales platforms and classifieds. Some marketplaces adopt multiple models to serve multiple needs.



Source: <https://www.pymnts.com/news/retail/2019/digital-marketplaces-consumer-needs-gig-economy/>



Source: <https://www.pwc.co.uk/industries/technology-media-and-telecommunications/insights/digital-marketplaces.html>

Types of a Digital Marketplace

1. Business-to-consumer (B2C) marketplaces
2. Business-to-business (B2B) marketplaces
3. Peer-to-peer (P2P) or consumer-to-consumer (C2C) marketplaces
4. Consumer-to-manufacturer (C2M) or consumer-to-business (C2B) marketplaces
5. Service-to-consumer (S2C) marketplaces



Source-<https://www.telcoprofessionals.com/blogs/9924/1228/the-new-digital-marketplace?mobile=1>



Source:<https://www.the-future-of-commerce.com/2021/05/12/digital-marketplaces/>

Benefits of a Digital Marketplace



Easy to use. Online platforms are usually user friendly and human focused.

Access to a ready customer base. Supports connections with target audience and can remove barriers that may exist outside of these platforms.

Fulfillment, payment, and logistics. Payment and supply is easy and straightforward. It can also support buying local removing waiting times.

Innovation. Allows for new products, concepts or material used to be shared easily in one place with other professionals.

Marketing, analytics, and personalization. Easy to tailor your search or direct you towards a target audience from one place.

Global reach. Can allow for connections and sales to happen internationally where necessary, however, it is often better and more sustainable to purchase locally.



Source: <https://www.the-future-of-commerce.com/2021/05/12/digital-marketplaces/>

Examples of Digital Marketspaces in Construction

Digital marketplaces have a place in the construction industry going forward. They not only allow for easy access to expert reusable and more sustainable materials they also help to guide consumers to local business and suppliers.

The benefits of employing digital market spaces are similar to the benefits that can be seen in the second hand clothing market already, such as reduced material loss and longer lifetimes of products. This can lead us to a more sustainable future and circular future for the construction industry.



Source-<https://cobuilder.com/en/digitising-construction-data-classification-systems-and-data-templates/>



Ireland CMEx Project

The CMEx project is a pilot scheme to demonstrate a

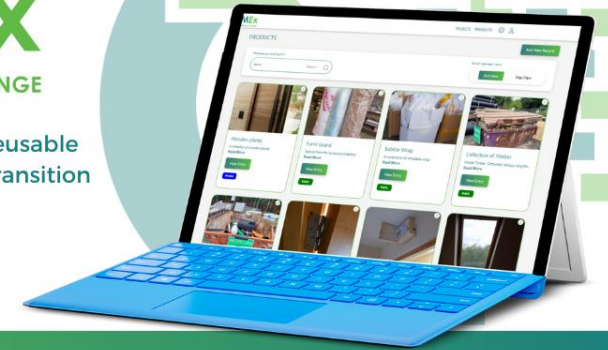
- feasible
- transparent
- fair
- user-friendly system

for the reuse of construction materials that would otherwise enter the waste stream.

BUS
GoCircular



Trade excess building materials or reusable waste materials from projects and transition to a circular economy.



Source: <https://www.igbc.ie/wp-content/uploads/2021/12/CMEx-One-page-Flyer.pdf>

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Ireland CMEx Project



The project will identify and track resources through the supply chain;

- identify the potential value of matching materials
- apply these insights to steer organisational processes towards supporting a circular economy.

It will identify materials from the waste stream with the potential for diversion to reuse and develop mechanisms to enable reuse through an online platform that generates materials passports, facilitates material matches, and utilises blockchain technology to document transactions.



Source: <https://www.igbc.ie/wp-content/uploads/2021/12/CMEx-One-page-Flyer.pdf>

Excess Materials Exchange Platform



Excess Materials Exchange (EME) is a young and innovative technology company. They find new high-value reuse options for materials or (waste) products for companies. Far too many valuable resources and materials are wasted or ill-designed in the current paradigm, for which the planet must pay a heavy price. Isn't that a waste?

EME aims to accelerate the global transition to a circular economy – and play a part in creating a more viable planet. By showing the financial and ecological value of materials. By challenging companies to design and produce their goods in a more efficient and circular manner.



Source: https://excessmaterialsexchange.com/en_us/

Excess Materials Exchange Platform



The digital platform unlocks the maximum potential of your company's materials, products and waste streams by matching them to their highest value uses. The best part about that? It's better for your profits as well as the planet. In our experience, material flows increase by 110% on average in financial value, and the ecological footprint reduces by 60% on average. Four tools are instrumental to our method of working:

1. Resources Passport
2. Tracking and Tracing
3. Valuation
4. Matchmaking



Source: https://excessmaterialsexchange.com/en_us/

Material Banks



Presentation



Material Banks

A material bank is essentially a stockpile or store of materials for future use.

In construction this can take the form of a building, this change in the way we think about a building can help us to view a building as something that can continue its life after the initial use is complete.

This can pair with Material Passports or Design for Disassembly for added value.



Source-https://www.youtube.com/watch?v=3EKddd_dAt0
Follow link to watch video





BAMB



In the Project BAMB – Buildings As Material Banks 15 partners from 7 European countries were working together with one mission –

- Enabling a systemic shift in the building sector by creating circular solutions.

Today, building materials end up as waste when no longer needed, with effects like

- destroying ecosystems
- increasing environmental costs
- creating risks of resource scarcity



Source:https://excessmaterialsexchange.com/en_us/

BAMB

To create a sustainable future, the building sector needs to move towards a circular economy.

Whether an industry goes circular or not depends on the value of the materials within it – worthless materials are waste, while valuable materials are recycled. Increased value equals less waste, and that is what BAMB is creating – ways to increase the values of building materials.



BAMB - BUILDINGS AS MATERIAL BANKS



Source: https://excessmaterialsexchange.com/en_us/

BAMB

BAMB will enable a systemic shift where dynamically and flexibly designed buildings can be incorporated into a circular economy. Through design and circular value chains, materials in buildings sustain their value – in a sector producing less waste and using less virgin resources. Instead of being to-be waste, buildings will function as banks of valuable materials – slowing down the usage of resources to a rate that meets the capacity of the planet.



BAMB
BUILDINGS AS MATERIAL BANKS



Source: https://excessmaterialsexchange.com/en_us/

Application for Multi-functional Green Roofs Facades and Interior Elements



Caixa Foundation - Madrid, Spain - Herzog & De Meuron

Situated in the heart of Madrid's cultural district, the Caixa Forum Museum vertical garden was designed and created by Patrick Blanc using his Le Mur Végétal system. The adjacent square is accessible to the public who can walk up, touch, and explore over 15,000 plantings on the hydroponic living wall.

Nearly 300 different species were chosen by Patrick Blanc who had to keep in mind Madrid's very demanding seasons – very hot in the summer and cold in the winter.



Source: <https://www.greenroofs.com/projects/caixa-forum-museum-vertical-garden/>

Caixa Foundation - Madrid, Spain - Herzog & De Meuron

Question One

Taking into account all parts of the building here, what are some examples of reuse of waste that could have been utilised in the construction of this building?

Consider how the plants are attached, the materials used and the demolition of the building that may have stood here previously.



Source: <https://www.esmadrid.com/en/tourist-information/caixaforum-vertical-garden>

Caixa Foundation - Madrid, Spain - Herzog & De Meuron

Question One

If this project was to be demolished, what opportunities would present themselves with the waste materials?



Source: <https://architizer.com/projects/caixaforum/>



Source: <https://www.esmadrid.com/en/tourist-information/caixaforum-vertical-garden>

QUIZ/ASSIGNMENT/ACTIVITY



Assessment / Exam



EXTRA READING/STUDY



Activity



EXTRA READING/STUDY



For Further Case Studies and Training Material Please Follow the Link Below

https://docs.google.com/spreadsheets/d/1DTte4Ph8pQ4IKzYGFt2_S-d1Z_Rmd9-i/edit?usp=sharing&oid=112148808974461842163&rtpof=true&sd=true



EXTRA READING/STUDY



BAMB - Building as Material Banks

<https://www.bamb2020.eu/topics/reversible-building-design/>

Urban Mining: The Future of Material Sourcing

<https://www.malbaproject.com/post/urban-mining-the-future-of-material-sourcing>





<https://busgocircular.eu/>



Follow us



<https://twitter.com/BusGoCircular>



<https://www.linkedin.com/company/busgocircular>



<https://www.youtube.com/channel/UCXu4Rjs5WDXBE-yqda5kt5A>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Colophon

Copyright © 2021 by BUSGoCircular consortium

Use of any knowledge, information or data contained in this document shall be at the user's sole risk. Neither the BUSGoCircular Consortium nor any of its members, their officers, employees or agents shall be liable or responsible, in negligence or otherwise, for any loss, damage or expense whatever sustained by any person as a result of the use, in any manner or form, of any knowledge, information or data contained in this document, or due to any inaccuracy, omission or error therein contained. If you notice information in this publication that you believe should be corrected or updated, please get in contact with the project coordinator.

The authors intended not to use any copyrighted material for the publication or, if not possible, to indicate the copyright of the respective object. The copyright for any material created by the authors is reserved. Any duplication or use of objects such as diagrams, sounds or texts in other electronic or printed publications is not permitted without the author's agreement



Partners



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740