



BuiltHuB

Circular economy approach to building stock decarbonization



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EO BuiltHub

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Circular Economy in the EU

C&DW management



Introduction

- Waste, as defined by the Article 3(1) of the Waste Framework Directive (Directive 2008/98/EC), is composed by "any substance or object which the holder discards or intends or is required to discard".
- The management of this amount of waste can generate significant pollution and can be characterized by serious and several **environmental impacts.**
- In order to minimize the environmental impact, the EU waste management framework is based on the principle of "circular economy" that is developed in a hierarchy that establishes which the preferred program priorities based on sustainability are.

Circular economy in the European Union

Circular Economy

EU definition:

"a production and consumption model which <u>involves reusing,</u> <u>repairing, refurbishing and</u> <u>recycling existing materials and</u> <u>products</u> to keep materials within the economy wherever possible".

It is generally opposed to a traditional, linear economic model, which is based on a 'take-makeconsume-throw away' pattern.



2020 circular economy action plan:

- Communication with action plan
- Timeline and actions
- Revised and new legislative proposals
- Priority for the European Commission

EPBD & circular economy

- The EPBD requires all the EU member states to adopt the nearly Zero Energy Building (nZEB) as the standard for new constructions.
- The reduction of the operational energy requirements of the buildings and the installation of renewable energy systems will increase the **embodied impacts** attributable to the construction sector.
- The embodied burdens in new nZEB buildings can arrive to account for over the 50% of the total environmental impacts.
- Circular economy strategies can help in the containment of the burden shifting on embodied components.

Production of waste in Europe

Construction and demolition waste represents a significant part of the total waste produced in Europe (36% in 2018).



Source: Waste statistics - Statistics Explained (europa.eu)



Special waste production in Italy (Cárcel-Carrasco, 2021). Municipal waste is excluded.

Construction and demolition waste

 C&DW is defined by the European Directive 2018/851 as waste that derives from activities of construction and demolition including works on the private residential sector, educational buildings, hospitals, commercial and industrial sectors, and public procurements (included the project and maintenance of infrastructures).



Construction and demolition waste

 In general, the C&DW is composed by a mixture of different materials such as concrete, bricks, glass, wood, metals, gypsum and plastic but also hazardous substances such as asbestos and lead.



Construction and demolition waste

• C&DW typically comprises large quantities of inert mineral materials, with smaller amounts of other components.



Source: Paola Villoria Sáez, Mohamed Osmani, 2019.

Construction and demolition waste composition

Reference/ material	Pereira 2002 (Portugal)	Costa and Ursella 2003 (Italy)	Maña i Reixach 2000 (Spain)	Bergsdal et al. 2007 (Norway)	Wang et al. 2018 (China Shenzhen)	Heeren et al. 2019 (Switzerland)	Cárcel - Carrasco 2021 (Italy)
Minerals	58.3%	84.3%	85.0%	67.24%	-	58.0%	86.24%
Concrete	-	-	-	-	58.86%	17.0%	-
Bricks	-	-	-	-	29.26%	8.0%	-
Mortar	-	-	-	-	9.83%	-	-
Metals	8.3%	0.08%	1.8%	3.63%	2.05%	0.5%	13.0%
Timber	8.3%	-	11.2%	14.58%	-	8.0%	0.5%
Plastic	0.83%	-	0.2%	-	-	-	0.05%
Asphalt	10.0%	6.9%	-	-	-	-	-
Insulation	-	-	-	-	-	8%	-
Glass	-	-	-	-	-	0.5%	0.21%
Other	14.2%	8.8%	1.8%	14.55%	-	-	-

The classification used for C&DW is not uniform: different aggregations are detected!

European initiatives

EU Construction and Demolition Waste Protocol and Guidelines

The protocol is part of the CE Package, and its main aim is to increase confidence on the **quality** of C&DW recycled materials.

This goal can be achieved by:

- Improved waste identification, source separation, and collection
- Improved waste logistics
- Improved waste processing
- Quality management
- Appropriate policy and framework conditions



EU Construction & Demolition Waste Management Protocol

September 2016

European indicators

Recovery rate of construction and demolition waste

- This indicator is determined as the ratio between construction and demolition waste which is prepared for re-using, recycling or material recovering, including backfilling operations, and the construction and demolition waste treated as defined in Regulation (EC) No 2150/2002 on waste statistics.
- **70%** C&DW recovery rate represents the target set by the Union for 2020.

Notes:

- The indicator covers the waste category 'Mineral waste from construction and demolition' (EWC-Stat 12.1).
- Only non-hazardous waste is considered.
- What about the other components of C&DW?



C&DW recovery rates in EU countries in 2018 (Eurostat).

Recovery potential of C&DW materials

No potential	Low potential	Medium potential	High potential
(0%)	(<50%)	(~ 50%)	(>50%)
Clay bricks (cement-based mortar), steel rebars and connections, asphalt, plastic pipes (water and sewage), plastic roof sheets, plastic floor mats, electric-cable insulation, plastic windows, concrete (pipes and drainage, water treatment and storage tanks and sea and river defense units), non- ferrous metal components (curtain walling, cladding, copper pipes, zinc sheets for roof cladding).	Mineral wool, gypsum wallboard, steel rebar in pre-cast concrete, structural steel, timber trusses, concrete in- situ, concrete (fencing, cladding, staircases and stair units), glass components (windows).	Steel cladding, steel cold formed sections, steel pipes, pre-cast concrete, slate tiles, timber floorboards.	Clay bricks (lime- based mortar), steel rebar, structural steel, concrete building blocks, concrete paving slabs and crash barriers, clay roof tiles, concrete (fencing, cladding, staircases and stair units), stone paving, stone walling.

Source: UN IRP, Resource Efficiency and Climate Change. Material Efficiency Strategies for a Low-Carbon Future.

Summarizing...

- C&DW represents a significant percentage of the special waste produced in the European Union.
- C&DW is composed by a variety of materials that are characterized by a **different recycling/recovery potential.**
- The amount of material that can be recovered from C&DW depends on different factors (typology, separation factors, demolition procedures, ...).
- It is sometimes very difficult to separate C&DW components if the demolition is not designed for separation at source or if buildings are not designed for deconstruction.
- Quality checks are also necessary to verify the technical performance of secondary/recycled materials.





BuiltHub objectives

Data requirements about C&DW

BuiltHub Objectives

- The BuitHub platform can provide relevant data and information to inform and support circular economy strategies and practices in the construction sector.
- Such data and insight should have a focus on material recovery and recycling of **Construction and Demolition Waste**.
- The desired information regards:
 - I. C&DW volumes per member state,
 - II. potential for recovery of waste,
 - III. potential savings (benefits) of such a recovery in terms of environmental impacts and costs.
- The data provided should aim at supporting further analyses, as well as the development and application of new eco-design tools based on life-cycle assessment (LCA) and life-cycle costing (LCC).

Data about C&DW production and composition

- Estimates about C&DW production: waste generation per m² of demolished or retrofitted building
- 2. Material composition of C&DW in different UE member states





Source: Digvijay Pawar & Rohit Sawant, 2020. (North America, Europe, Asia-Pacific, and LAMEA) Source: Statistics Norway, 2021.

Data about C&DW recovery potential

- 1. Innovative demolition methodologies: how to make it easier for demolition? What are the **separation factors**?
- 2. On-site waste management operations for materials separation
- **3. End-of-life management of material flows**: reuse, recovery, recycling, energy valorization, disposal



Data to build C&DW business models

- 1. Valuable **business models** of waste and secondary materials
- 2. What are the selling prices of C&DW materials flows?

Activity	Price €/ton
Withdrawal of inert material	7 €/ton mixed inert 10 €/ton soil
Selling of secondary material	3-7 €/ton secondary inert aggregate for road substratum
Selling of natural sand	15 €/ton
Selling of natural gravel	10 €/ton

Source: Giorgi et al 2019 IOP Conf. Ser.: Earth Environ. Sci. 225 012065

Marketplaces for C&DW

<u>restado.de</u> is the largest marketplace for reclaimed construction materials in Europe. The materials come from deconstruction or oversupply. Typical materials include bricks, wood, tiles, windows, doors and façade elements.

Countries: Germany, Austria, Switzerland.



Landfill taxation

Country	Tax for C&DW €/tonne
Austria	9.20
Belgium	56.05 - 113.01
France	30.00
Germany	-
Lithuania	3.00
Netherlands	13.11
Poland	33.00
Portugal	4.27
Slovakia	0.33
Slovenia	2.2
Spain	0.5 - 4

Source: Paola Villoria Sáez, Mohamed Osmani, 2019.

Life Cycle Thinking & innovative practices

- Through Life Cycle Thinking we can identify opportunities for lowering environmental impacts across all life cycle stages avoiding burden shifting or trade-offs.
- The Life Cycle Environmental Impact Assessment (LCIA) can help in the determination of the environmental benefits deriving from the reuse and recovery of recycled materials in the construction sector.
- Environmental benefits can include non-renewable energy savings, fossil fuels depletion containment and the reduction of GHG emissions.
- Is it possible to achieve cradle-to-cradle economy on C&DW? On all materials?



Source: Andrea Belleri, 2017.



Let's keep in touch

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