Opportunities for CDW reduction by reuse of building elements

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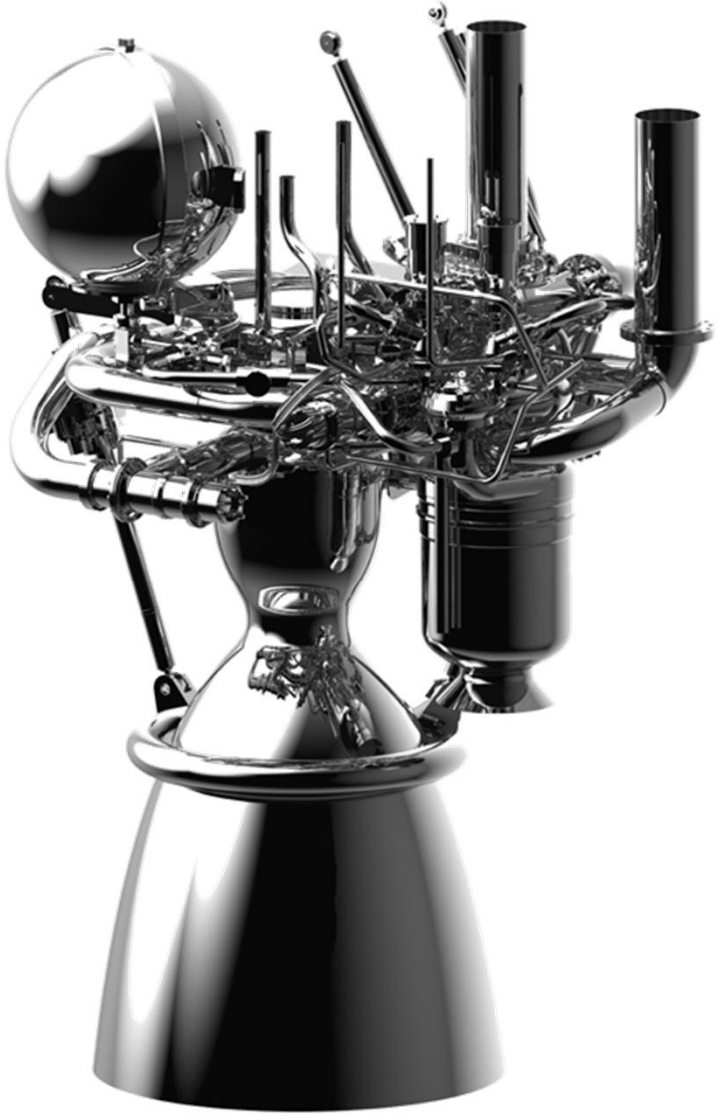


Picture credits: ArianeGroup Holding

February 27, 2014

Construction-waste recycling gets a boost

TECHNOLOGY › CLEANTECH & ENERGY › RECYCLING

The purpose of VTT's project is to look at how used building components and construction waste can be utilised more extensively.

LEHTIKUVA / MATTI BJÖRKMAN

Waste or not waste?

1975: Directive 75/442/EEC defines waste as: **“any substance or object which the holder discards or intends or is required to discard”**

1997: European Council confirmed that **waste prevention** should be the first priority of waste management

2002: Decision 1600/2002/EC calls for revision of waste legislation and clarification of the **distinction between waste and non-waste**.

2008: Directive 2008/98/EC introduces **End of Waste** concept

2018: Directive 2018/851 says that: **“Member States shall take measures to prevent waste generation”**, Finnish National Waste Plan has target **“Reducing the volume of construction and demolition waste”**

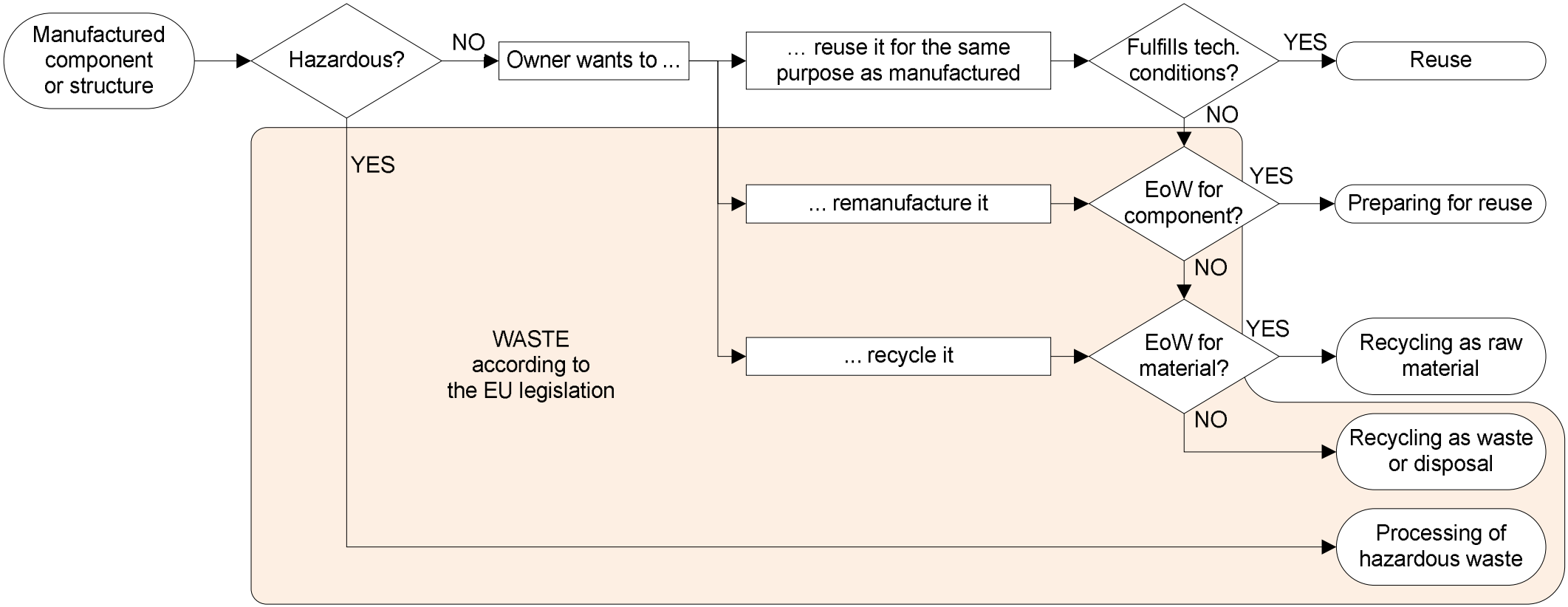
Waste or not waste?

We propose definition:

Component or structure maintain its product status in case:

- it is used for **the same purpose** and the end user is known
- its **technical requirements** are fulfilled
- it is **not further processed** (remanufactured) other than cut, cleaned….
- it is **not regarded as hazardous waste** (hazardous substances should be below their limit values related to the whole product) and **its use does not lead to overall adverse environmental or human health impacts** (e.g. leaching hazardous substances due to deteriorated coating)

Waste or not waste?



Example: Gamle Mursten

CE marking of bricks through ETA and EAD

ETA = European Technical Assessment
EAD = European Assessment Document
EOTA = European Organization for Technical Assessment

Picture credits: Gamle Mursten ApS

No previous experience in Denmark about CE marking of a waste related material due to lack of applicable harmonized standard

Steps (supporting documentation):

- Background study on historical bricks (previous manufacturing methods, quality requirments/controls, LCA…)
- A Factory Product Control (FPC) system developed for the processing of bricks for reuse
- Development of guidance for reuse of bricks (target group: architects, project managers….)
- Guidance on control systems and test methods to be used in FPC
- Communication plan to target groups

Example: Structural steelwork

Picture credits: Gamle Mursten ApS

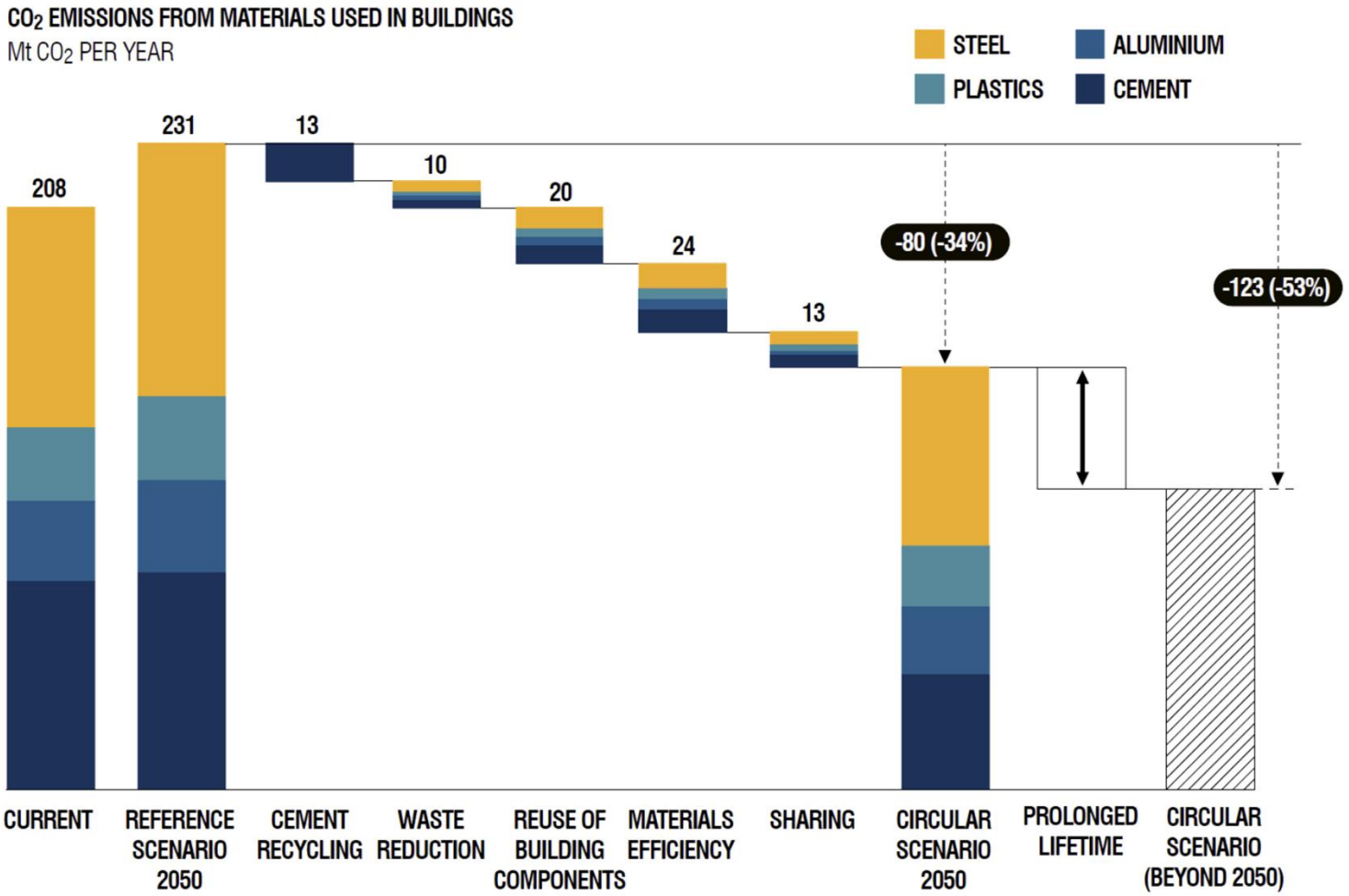
CE marking of the fabricated steel components

Structural steelwork is fabricated from the constituent products (plates, sections, …) needs to be CE marked according to EN 1090.

Constituents themselves are CE marked (e.g. EN 10025 for hot-rolled products).

The proposal for new EN 1090 allows using non-CE marked constituents if their properties are tested.

Building stock environmental value



Source: SITRA 2018

Building stock economic value

627 t mixed waste
318 t crushed concrete
76 t metals
14 t treated wood debris
11 t untreated wood debris

61 k€ labor cost
18 k€ disposal cost
15 k€ revenue from metals

Bricks, tiles, ...
Panels, columns, ...
Beams, trusses, ...
Boards, panels, ...
Cladding, windows ...

>61 k€ labor cost
<18 k€ disposal cost
70 k€ revenue from metals
??? other revenue

The decision comes before demolition

Picture credits: Paul Kamrath

Pre-demolition audits

EU Guidance

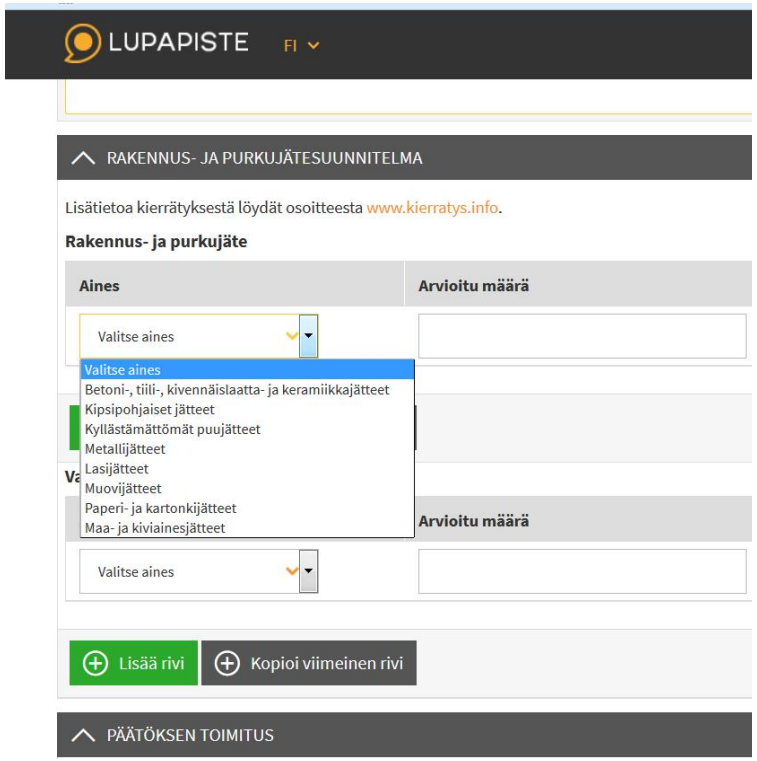
Published in 2018, translated to Finnish

Finnish Guidance

In development expected in 2019

Electronic reporting

In development expected in 2019



Vision of the future reusable buildings

High end-of-life value

Future owners aware of the value of their property at its end of life. Supply chain actors actively offering reusable components for sale before the deconstruction.

Reusable Building Information Models

BIM objects for the new building design equally sourced from the product manufacturers and second-hand material dealers.

Reversible and scalable design

Buildings will be designed for deconstruction and reuse. The evolution of future building requirements (e.g. relocation loads, thermal insulation) will be anticipated.

VTT's projects on components reuse

Repetitive Utilization of Structural Elements

Re USE

2017-2020

PROGRESS

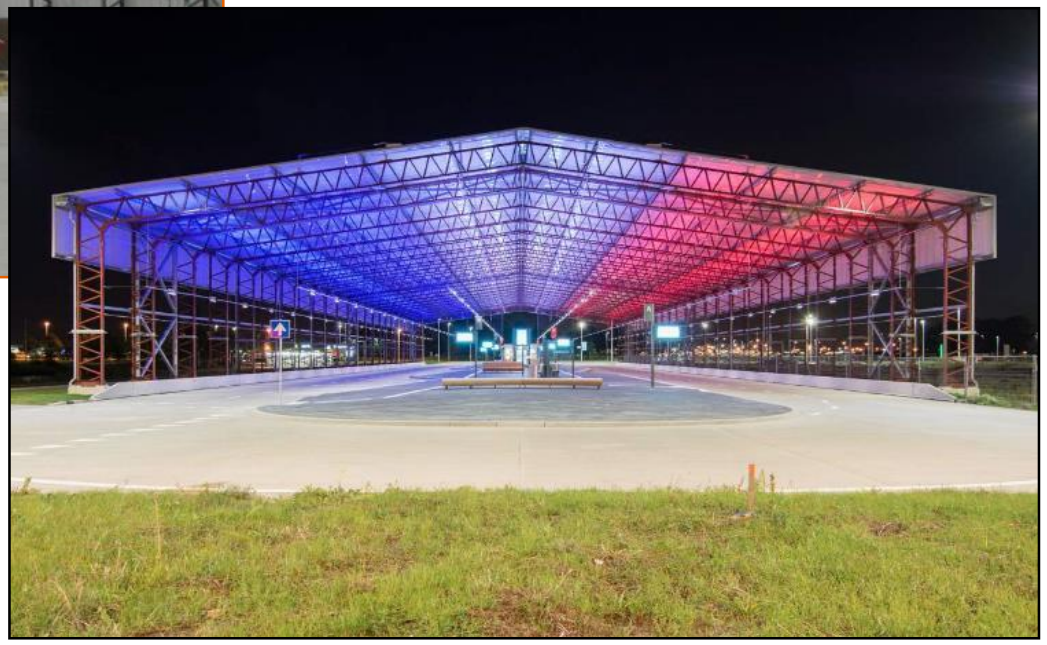
PROVISIONS FOR GREATER REUSE OF STEEL STRUCTURES

Reuse of building structures

1942 London

1958 Rotterdam

2015 Schiphol



Reuse of bridges

1958: Brussel's World Fair
1959: "Zoo-Brücke" in Duisburg
2000: Bridge further south the A3

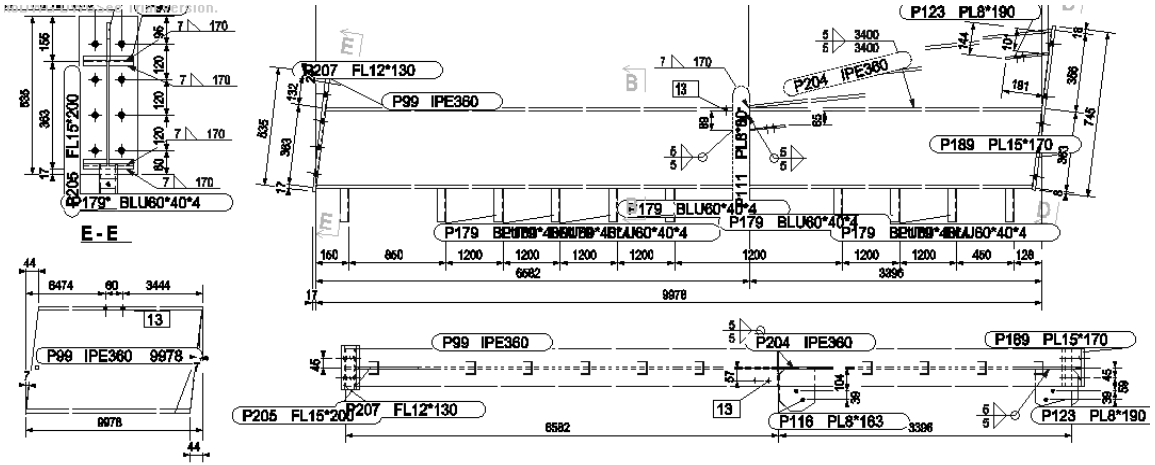
Environmental value of reuse

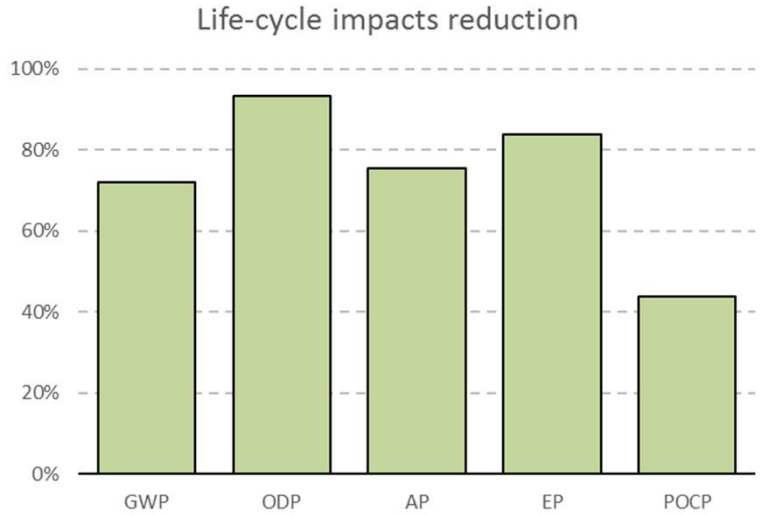
Three existing methods to calculate environmental impacts:

- Worldsteel's LCA methodology — *under revision at the moment*
- CEN/TC-350 (EN 15978, EN 15804) — *new mandate and EN 15804 (2018)*
- Product Environmental Footprint (PEF) — *in pilot phase*

The most problematic is accounting for the future savings (e.g. design for reuse) in Module D of EPDs. PROGRESS project has developed a solution for this.

Example of calculated savings compared to traditional recycling (Hradil et al., EUROSTEEL 2017)





Economic impact of steelwork reuse

Example of the LCC model outcome

	New steel and recycling[1)]	New or reused steel and reuse (reconditioning)	New or reused steel and reuse (re-erection)	New or reused steel and reuse (in-situ)
LCC (A-C)	2329 €/t	2444 €/t	2444 €/t	2076 €/t
LCC (D)	-200 €/t	-409 €/t	- 869 €/t	- 1501 €/t
Total LCC (A-D)	2129 €/t	2036 €/t	1576 €/t	575 €/t
Price of the steel	673 €/t (new) and 409 €/t (reclaimed)			
Price of the components	1329 €/t (new) and 869 €/t (reclaimed)			
Price of the structure	2019 €/t (new) and 1501 €/t (used)			
Residual value	-111 €/t	-17 €/t	443 €/t	1444 €/t
Depreciation rate (27 y)	3.91%	3.73%	2.89%	0.94%

The worst case scenario was nearly equivalent to the new material production, however, there are possible savings:

Fabrication	up to 27%
Additional modifications	up to 14%
Testing	up to 7%
Additional transport	up to 1%

PROGRESS project is investigating quality checking and component tracing (reduces testing costs), product design (reduces re-fabrication costs), building design (reduces additional modifications) and online marketing (reduces transport/handling).

Expected research outcomes

Design guides	Design from reused elements Design for deconstruction and reuse
Methodologies	Assessment of reusability Declaration of environmental impacts Economic assessment
Protocols	Pre-demolition inspection Deconstruction protocol Material testing protocol
Tools	Online trading portal and possibly 1-3 smaller tools
Case studies	Testing of methods and protocols Design for improved reusability Design from reused elements

Acknowledgements

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