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Circular construction

Katarzyna Jagodzińska

27/04/2023

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List of contents

- Circular economy, circular building;
- Design-for-adaptability, design-for-disassembly;
- Circular economy vs carbon footprint;
- Mesuring circularity;
- Chosen legal regulations;
- Case studies;
- New roles and responsibilities in circular construction.

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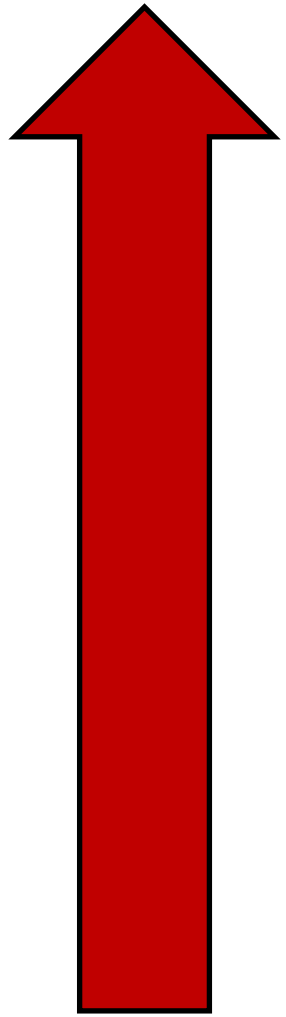
The 10 R's framework

R0	**Refuse**	*Make a product u*
R1	**Rethink**	*Increase the inter*
R2	**Reduce**	*Increase the effic*
R3	**Reuse**	*Reuse keeping th*
R4	**Repair**	*Repair to restore*
R5	**Refurbish**	*Restore an older*
R6	**Remanufacture**	*Use parts of a dis*
R7	**Repurpose**	*Use parts of a dis*
R8	**Recycle**	*Process materials*
R9	**Recover**	*Energy recovery a*



sonably

Expand product's lifespan

e function

nt function

Energy and material recovery

erials/products

, its by-products)

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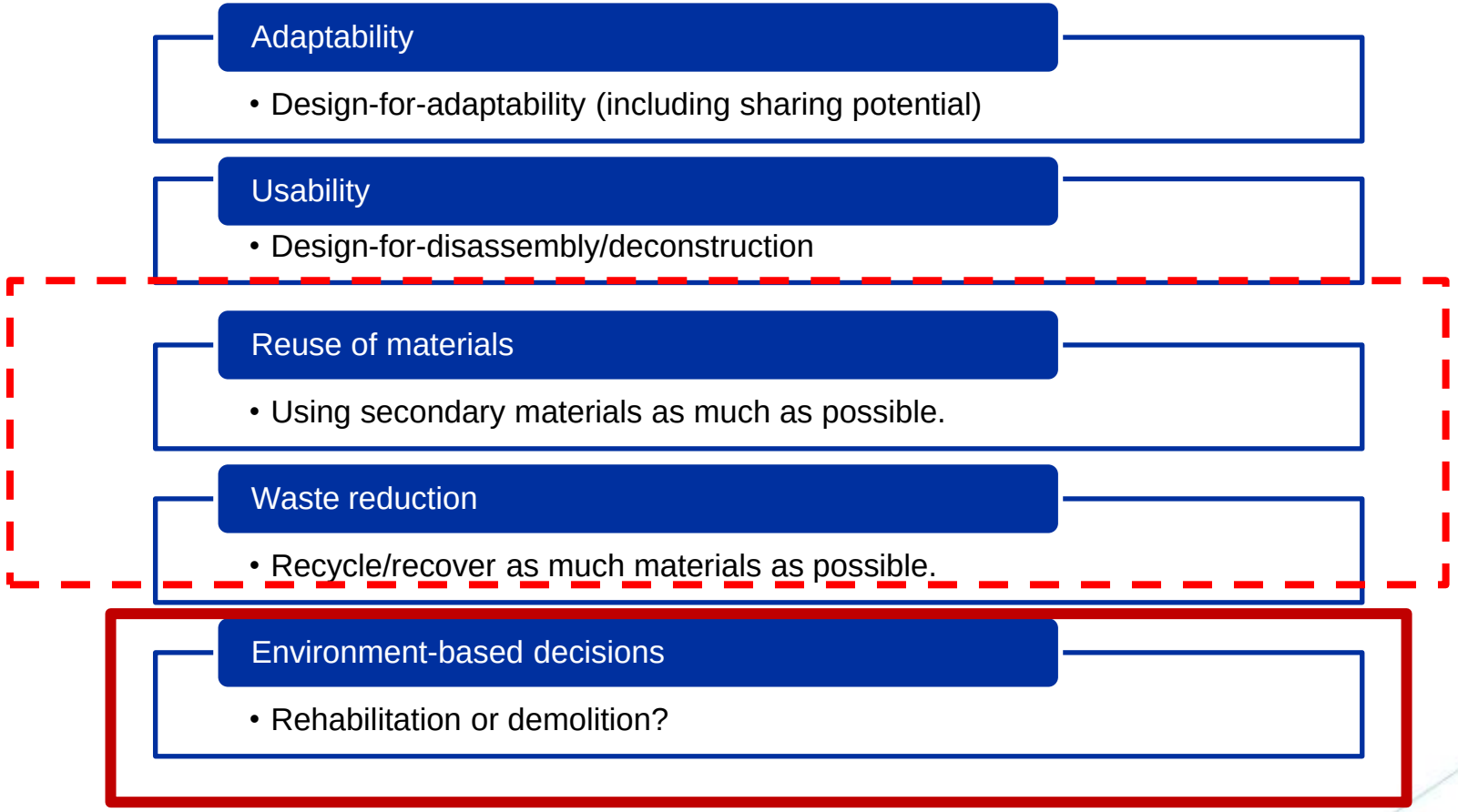
Circular building



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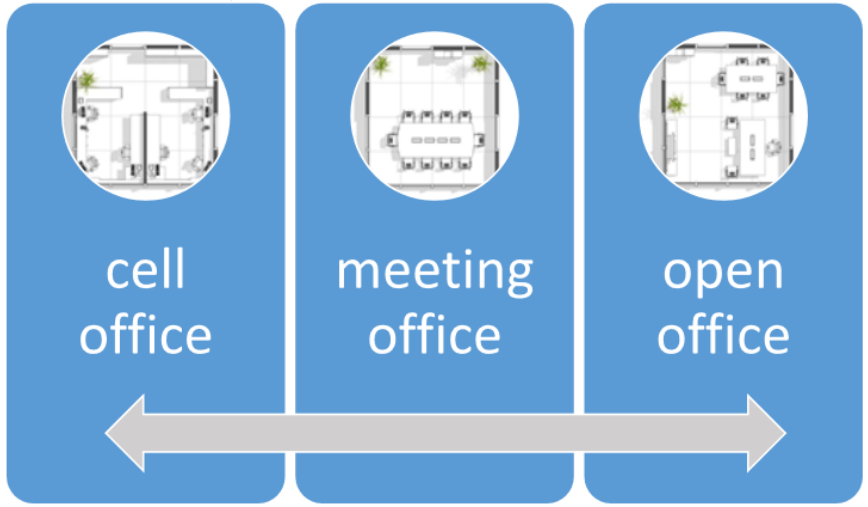
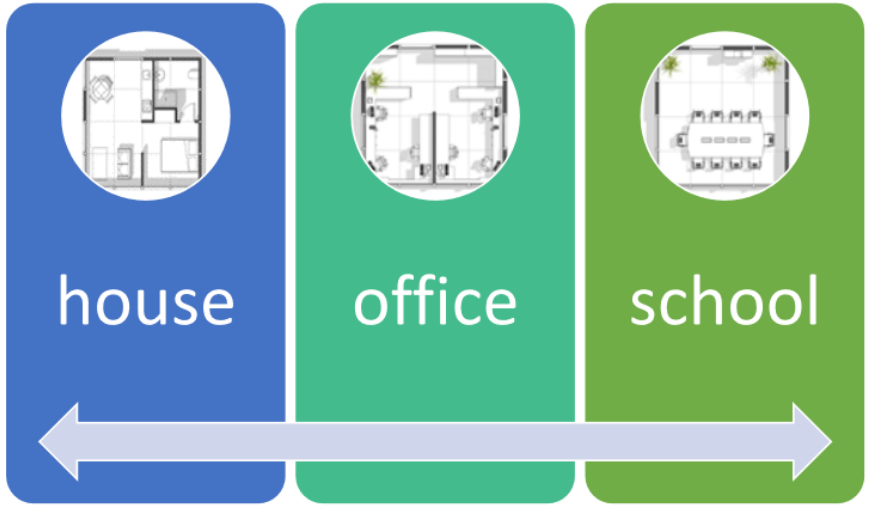
Design-for-adaptability

Monofunctional transformation*



Transfunctional transformation*



The Elephant, Netherlands

* Elma Durmisevic, Reversible Building design guidelines – WP3 Reversible Building Design (Report WP3|10|UT from the BAMB project)

Design-for-adaptability cont.

Multidimensional transformation*

B.R.I.C.

* Elma Durmisevic, Reversible Building design guidelines – WP3 Reversible Building Design (Report WP3|10|UT from the BAMB project)

Design-for-disassembly

Triodos Bank office, Netherlands

Petite Maison, Luxembourg

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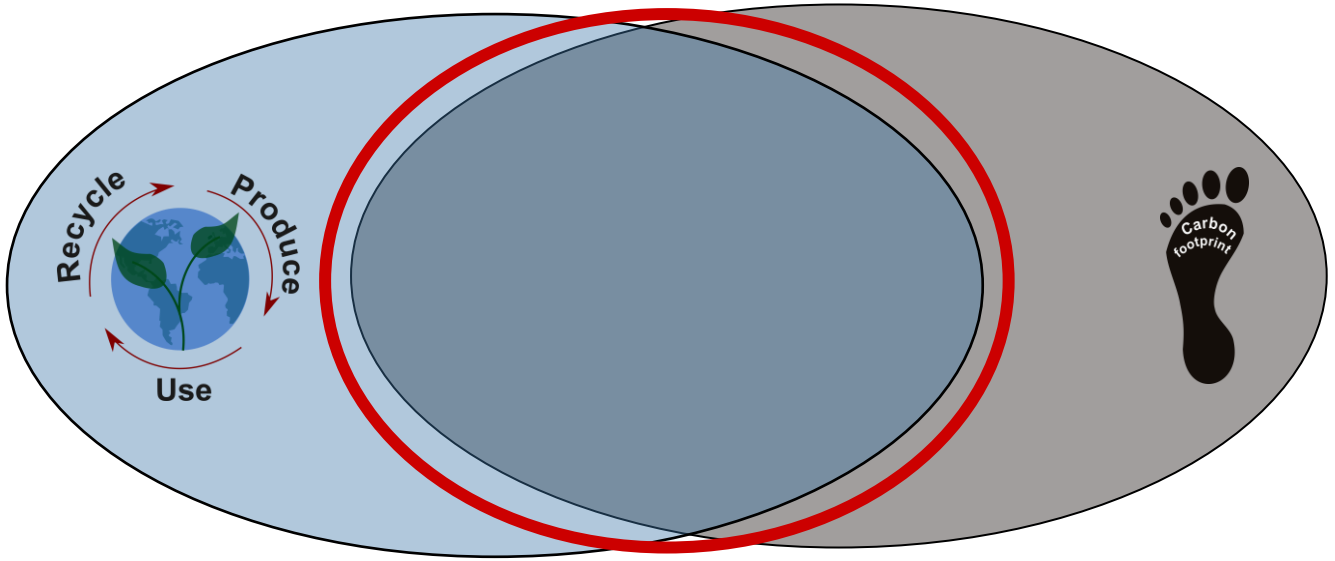
Does CE always minimise C emissions?



low carbon circular economy

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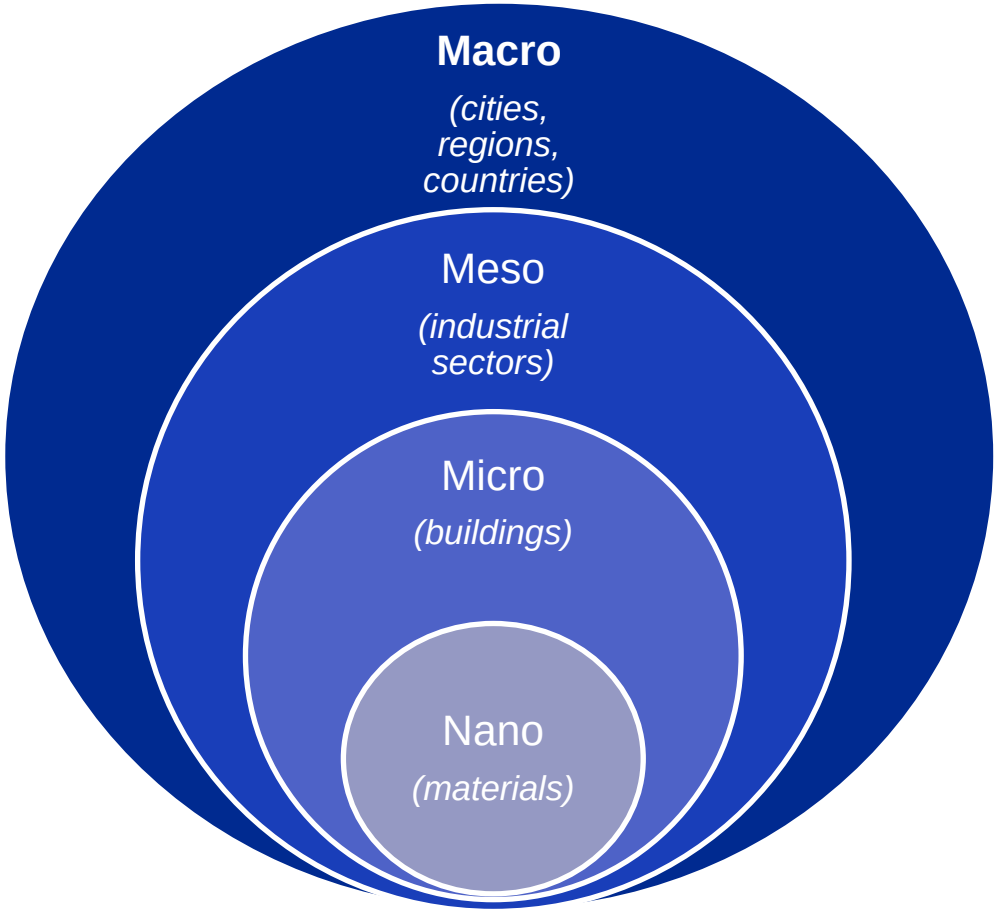
Measuring circularity - Scale



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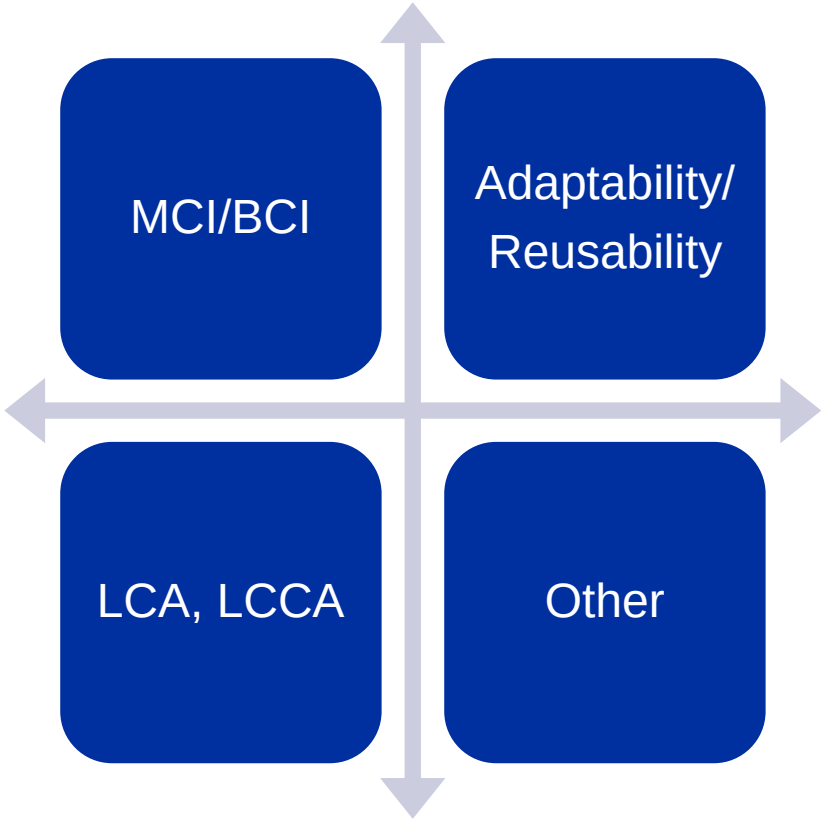
Measuring circularity – Base framework



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Measuring circularity – Aspects covered

1. Technical cycle.
2. Biological/renewable cycle.
3. Recycling efficiency.
4. Functional lifetime.
5. Disassembly.
6. Reusability index.
7. Adaptability.
8. Energy use.
9. Emissions.
10. Water use.
11. Heritage.
12. Economic aspects.

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Current barriers

- Lack of knowledge and experience;
- Laws and building regulations;
- Lack of procedures to document/certify secondary materials/products;
- Who bears the risk?
- What about economics? Cultural bias;
- Lack of market/databases with avialable materials.

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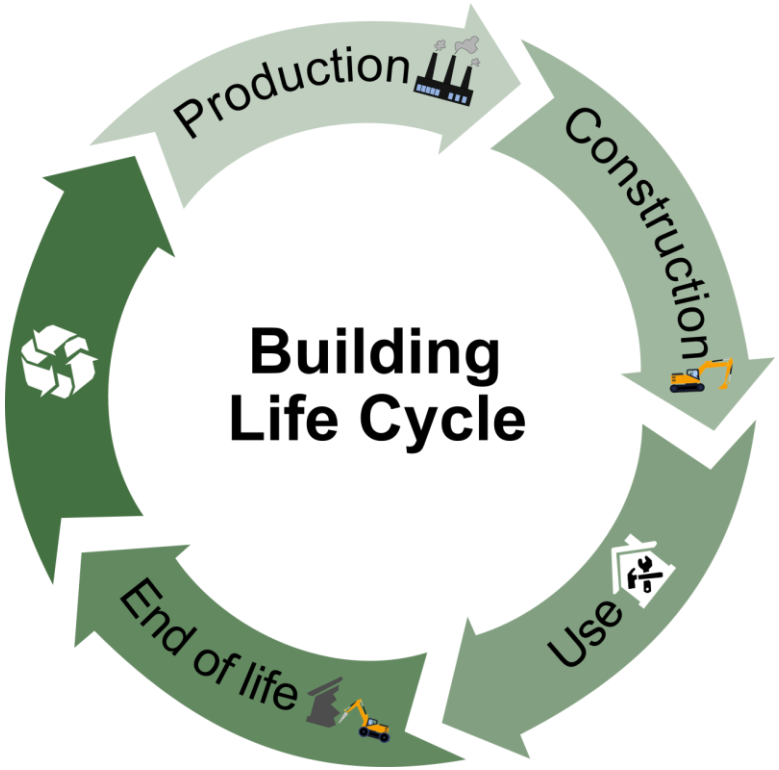
The life cycle of a building



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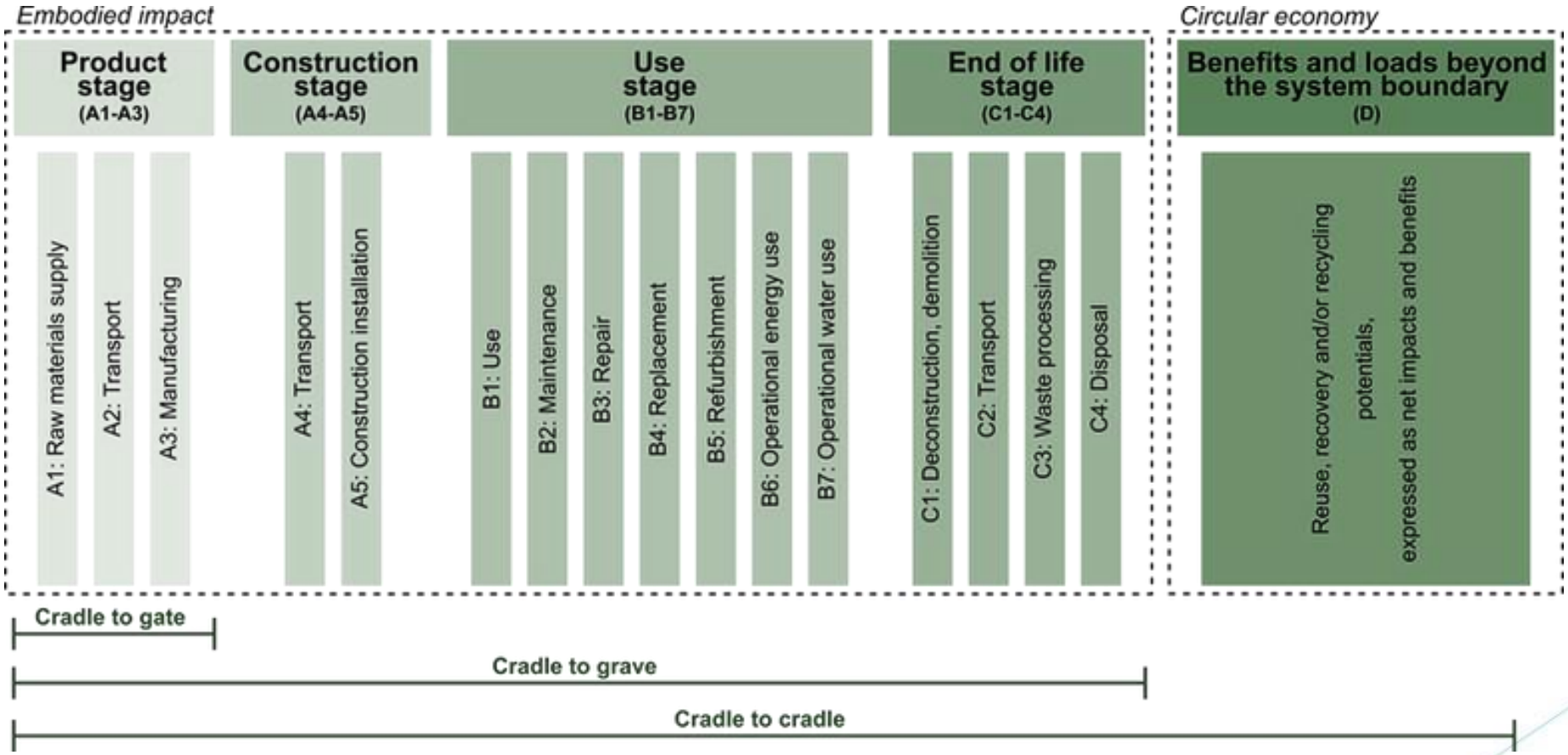
LCA cont.



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Circularity in LCA

	Denmark	Finland	Iceland	Norway	Sweden	EU
A1-A3 Raw materials, transport, manufactoring	Zero ✔	Zero ✔	TBD	Zero, but if there is Global Warming Potential from processing of the reused products it must be counted (not if negligible i.e GWP from washing the reused products)	Zero ✔	Not defined
A4/A5 Transport to site, installation	Not declared	Either generic values from national database *** or calculate exact emissions ✔	TBD	Either 300 km, generic values* ✔	Either generic values from national database or calculate exact emissions **** ✔	Not defined
B2 Maintenence	Not declared	Not declared	TBD	Maintainance is included	Not declared	Not defined
B4 Replacement	Zero	Replacement to a new product	TBD	Replacement to a new product	Not declared	Not defined
C1/C2 Demolition works, transport	Not declared	Included according to the scenarios in the national database	TBD	Not declared	Not declared	Not defined
C3/C4 Waste management, final disposal	Zero	Included according to the scenarios in the national database	TBD	Not declared	Not declared	Not defined

*https://lca.no/transportkalkulator/

** Replacements are included, an assumption has to be made that if a reused product will be replaced, it will be replaced to a new functionally similar product (not another reused product)

***Finish national database: CO2data.fi

****Swedish national database: Climate database from Boverket - Boverket

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Examples of circular buildings

Kristian Augusts Gate 13, Norway
Credit: Kyrre Sundal/Mad arkitekter

Drangar, Iceland

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Kristian Augusts Gate 13, Norway

Kristian Augusts Gate 13, Norway
Credit: Kyrre Sundal/Mad arkitekter

- focus on reuse and design-for-disassembly;
- almost 80% of the materials were reused;
- reusing of existing building;
- „material providers” from < 5 km.

Kristian Augusts Gate 13, Norway cont.

Windows dismantled from a housing project in Kvaernerbyen.
Photo: Resirqel Facade extension, designed with 1) New windows, 2) Used windows. Illustrations: Mad architects

Around 60% costs and 90% of CO2eq emissions saved due to windows reusing.

Kristian Augusts Gate 13, Norway cont.

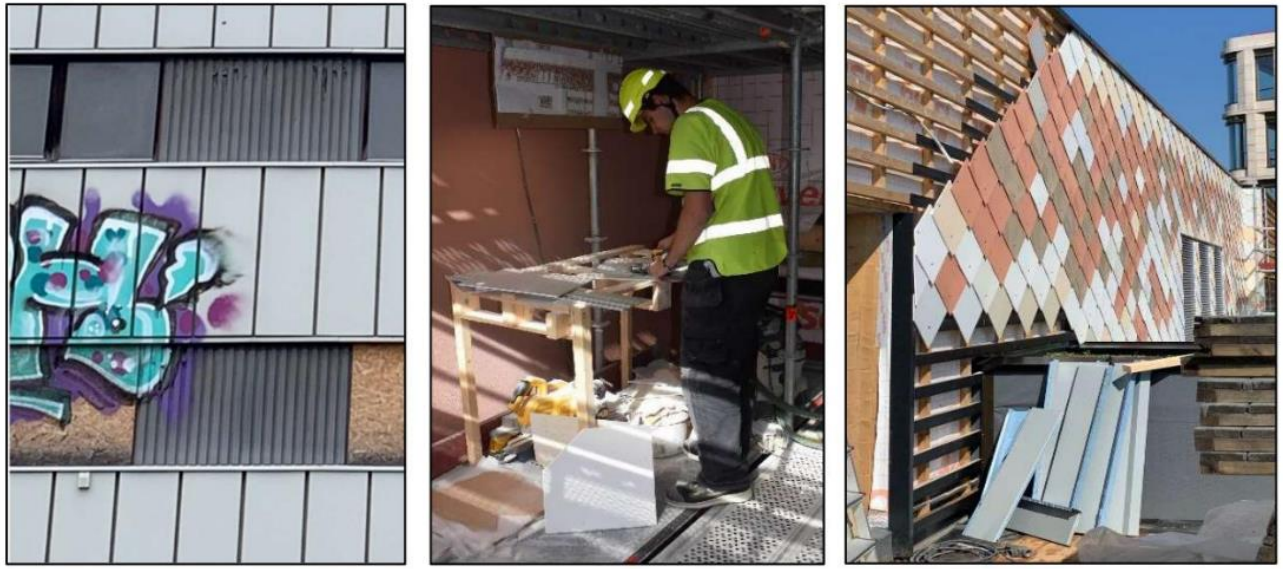
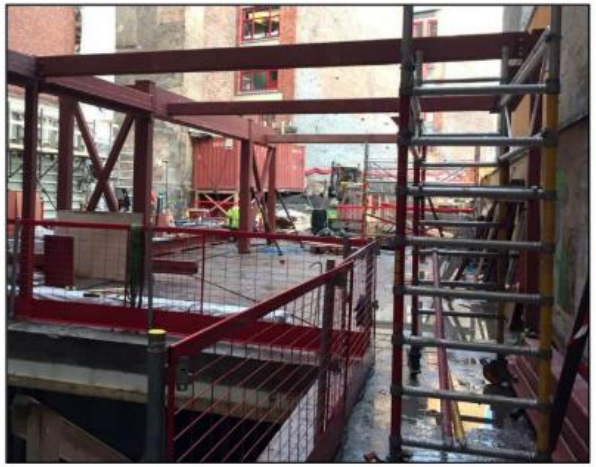


Photo from inspection, Oppsal nursing home. Photo:
Randi Lunke Cutting and assembly work. Photo: Anne S
Nordby Facade panels during installation. Photo: Randi Lunke

Around 97% of CO2eq emissions saved due to facade panels reusing.

Kristian Augusts Gate 13, Norway cont.



Installation of used steel on site. Photo: Stokke Stål

Around 49% higher costs but 97% of CO2eq emissions saved due to steel reusing/recycling.

Kristian Augusts Gate 13, Norway cont.

Original radiator in KA13. Photo: Anne S Nordby

Storage before flushing and pressure testing. Photo: Anders Sand

Sanitary equipment in the original building, under storage and installed in KA13. Photo: Anne S Nordby

Complete assembly after processing. Photo: Randi Lunke

Used fire hose cabinet from DEG8 mounted in KA13. Photo: Anne S Nordby

Resource Rows, Denmark

Lendager's ResourceRows in Copenhagen

Circl, Netherlands

"Circl" pavilion in Amsterdam

- focus on reuse, design-for-diassembly, and design-for-adaptability;
- insulating material from 16,000 pairs of jeans;
- plaster in the basement made out of textiles;
- wooden structure (beams) an be disassembled and reused;
- sliding walls.

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Drangar, Iceland

*Drangar before and after the renovation**

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Drangar, Iceland cont.

The former farmhouse

The former tractor shed

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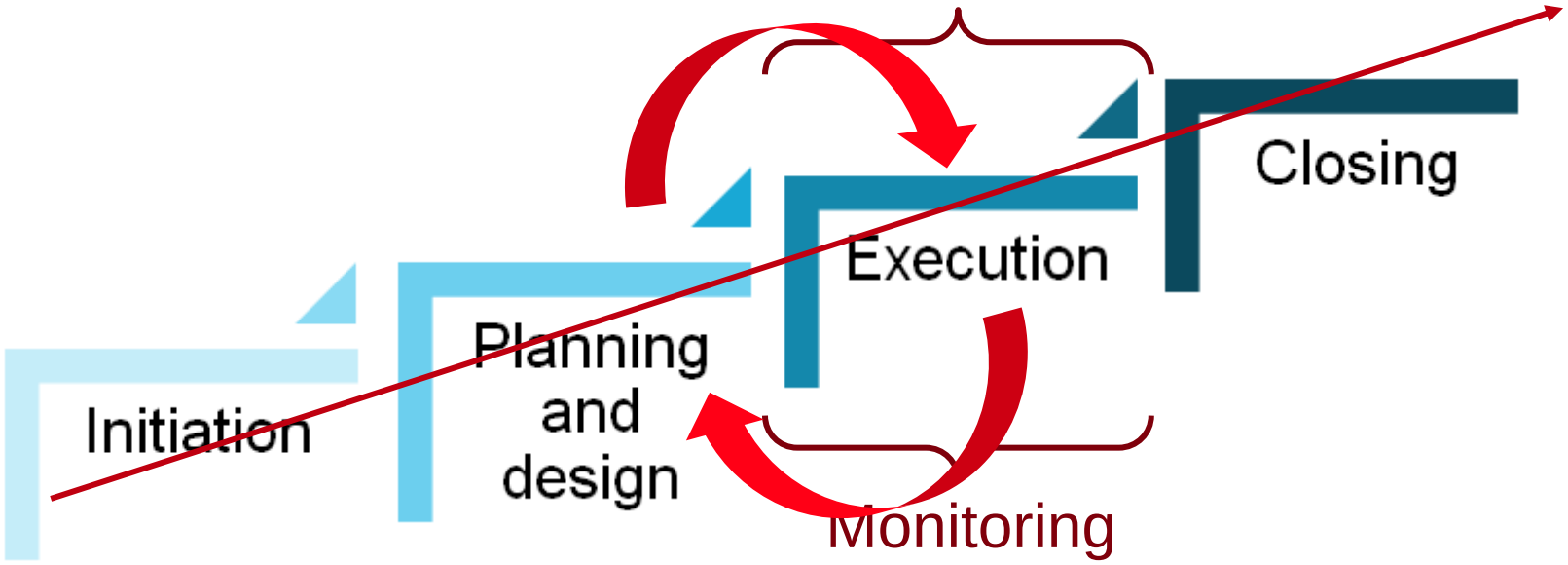
Project flow



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Project actors

Planning and design

Monitoring

Execution

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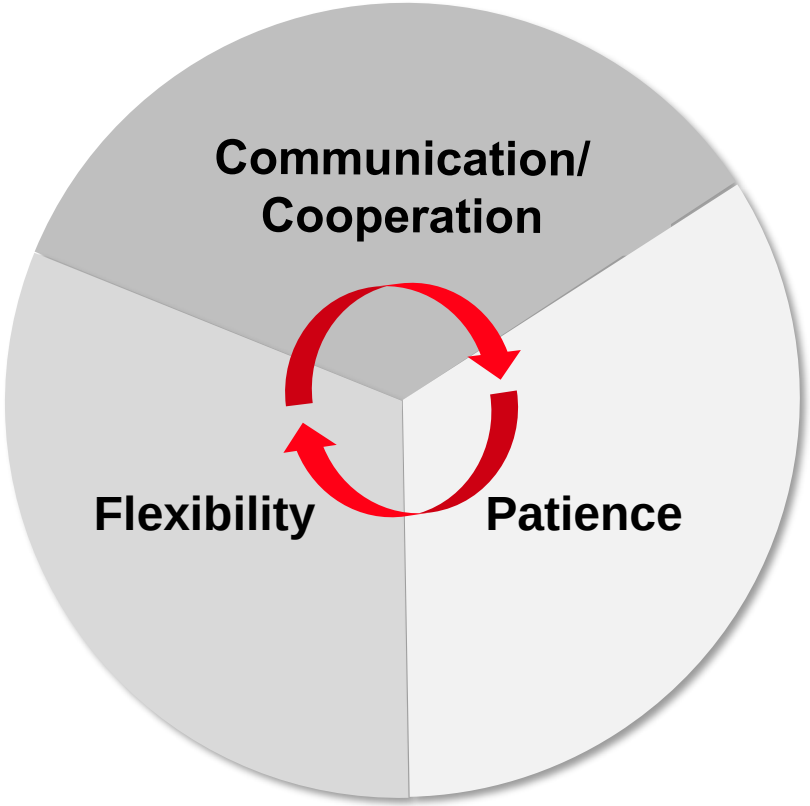
Three pilars of transition to CC



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Project actors in circular construction

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Wraping up

„see possibilities, not limitations”

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Thank you for your attention

kjag@graennibyggd.is

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