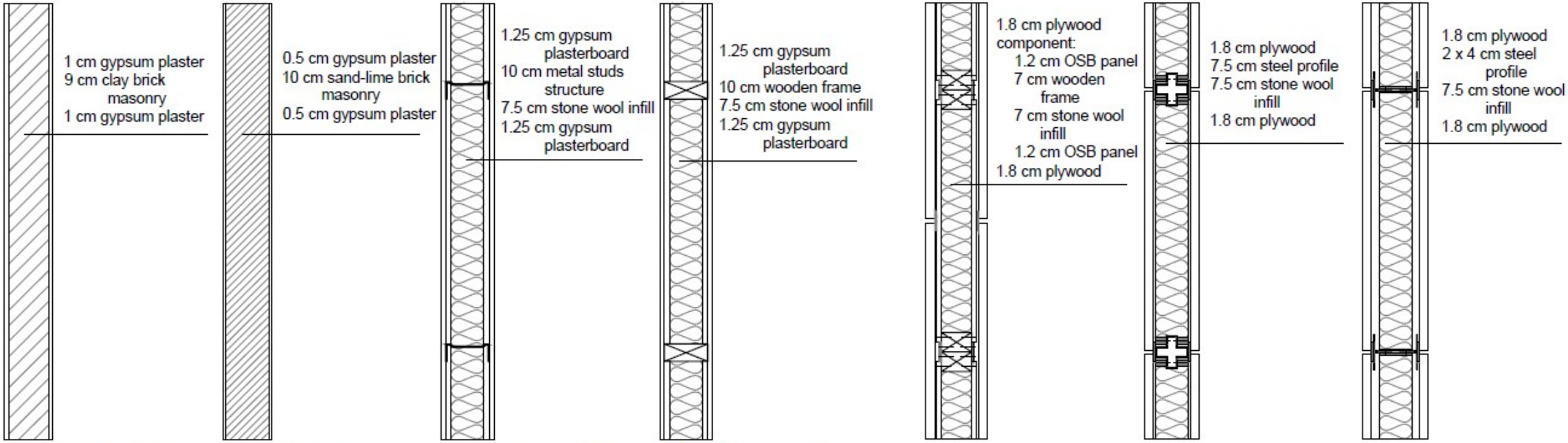
Consequential LCA of demountable and reusable internal wall assemblies: a case study in a Belgian context

SBE19 - Graz

M. Buyle, W. Galle, W. Debacker, A. Audenaert

- Assess environmental consequences introduction **demountable and reusable internal wall assemblies**
- Effect **methodologic choices** consequential LCA
- Multiple **end-of-life scenarios** to account for sub-optimal use wall assemblies

Functional unit | 1 m² space dividing wall covering a period of 60 years, meeting the Belgian regulations



Wall 1. Solid clay brick masonry

Wall 2. Solid sand-lime brick masonry

Wall 3. Drywall on metal stud structure

Wall 4. Drywall on wood frame structure

Wall 5. Woodbox wall

Wall 6. Cross-shaped metal studs

Wall 7. Combined L-shaped metal studs

Methods

Case description

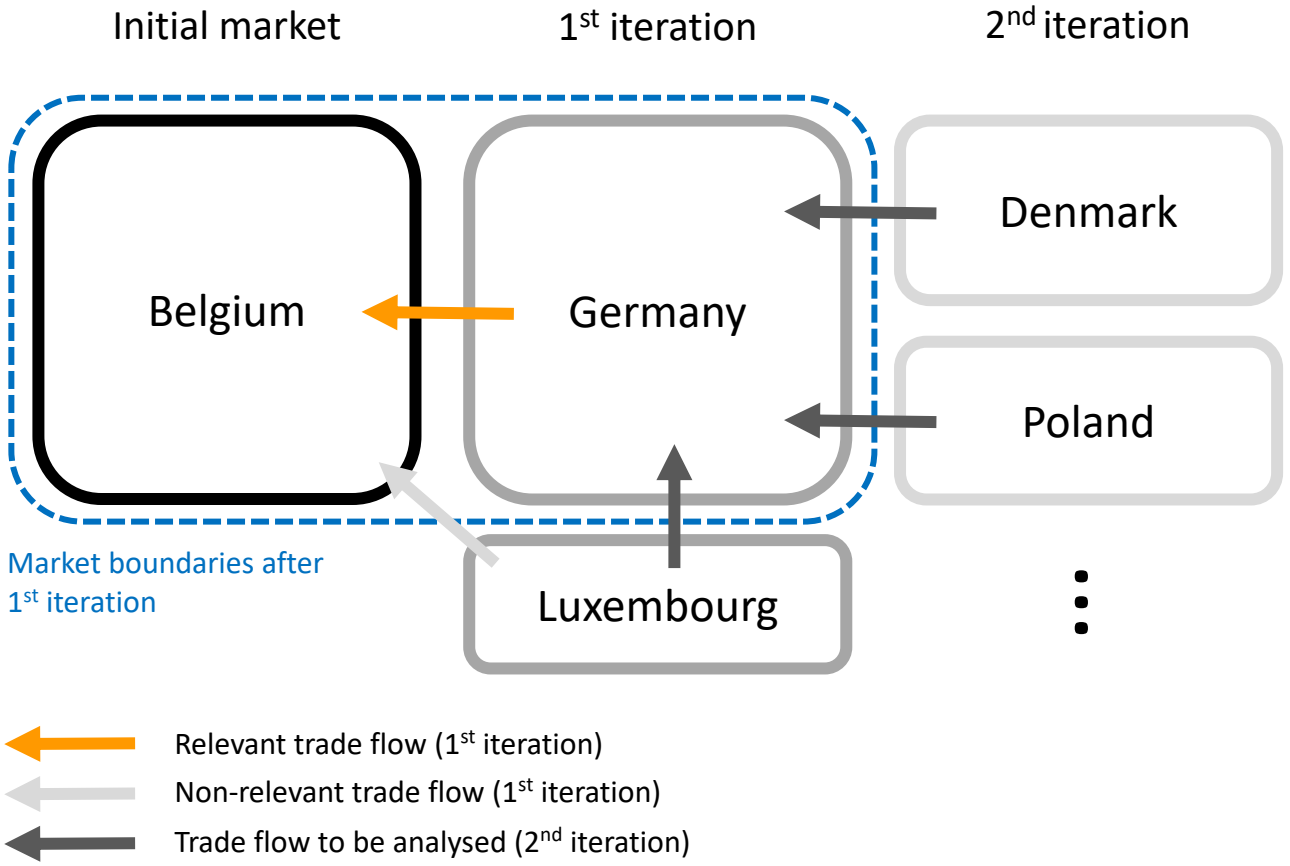
4-step procedure Weidema *et al.* (2009) as guideline

Geographical market boundaries:
Iterative procedure (bottom up) vs. **network analysis** (top down)

Marginal supplier identification:
retrospective vs. **prospective** data

End-of-life scenarios to account for user behavior

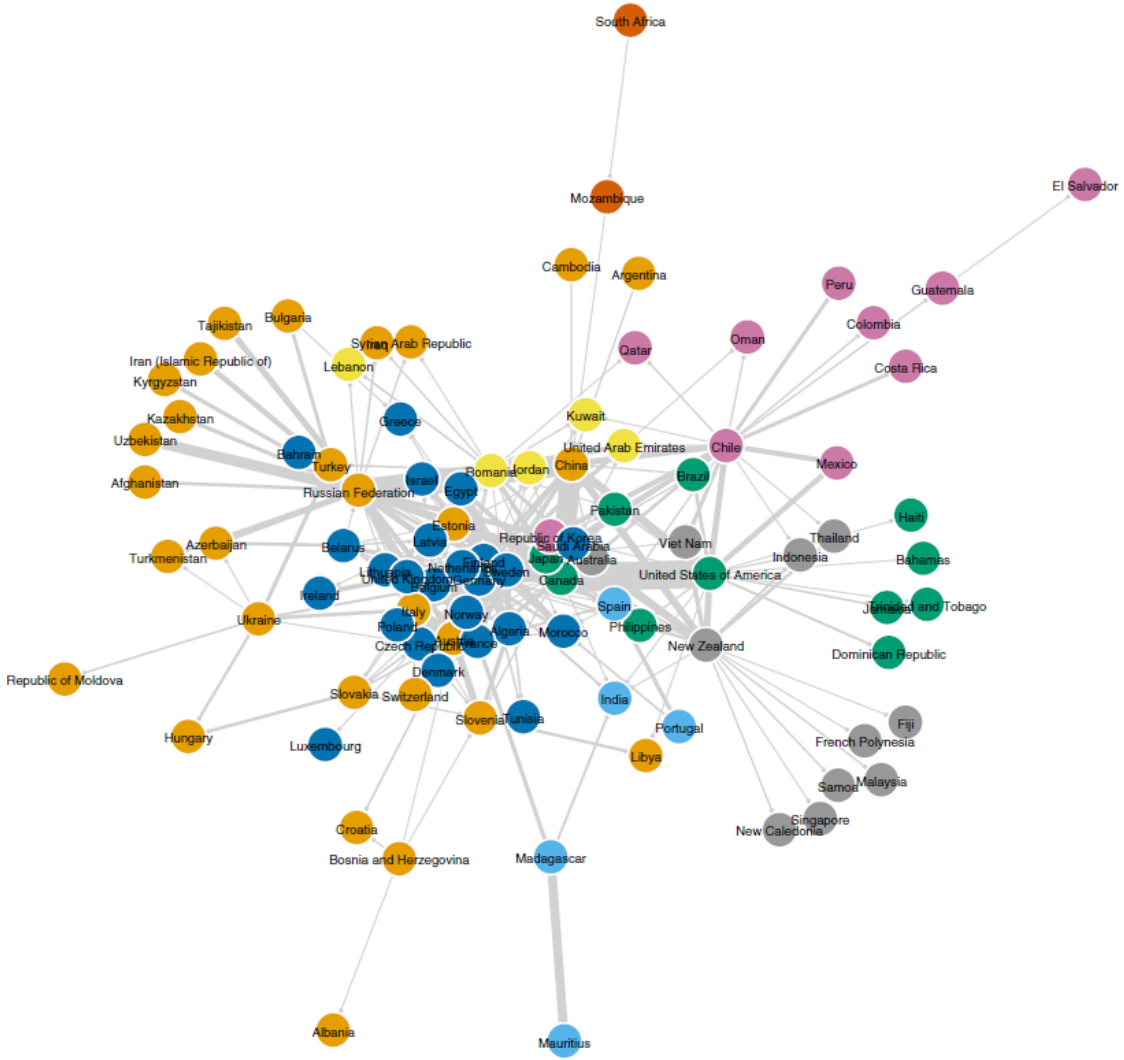
Weidema et al., *Guidelines for application of deepened and broadened LCA*. Deliverable D18 of work package 5 of the CALCAS project; Rome, Italy, 2009



Methods

Market boundaries – bottom up

Buyle et al., *Identifying marginal suppliers of construction materials: consistent modeling and sensitivity analysis on a Belgian case*.
Int. J. Life Cycle Assess. 2018, 23, 1624–1640

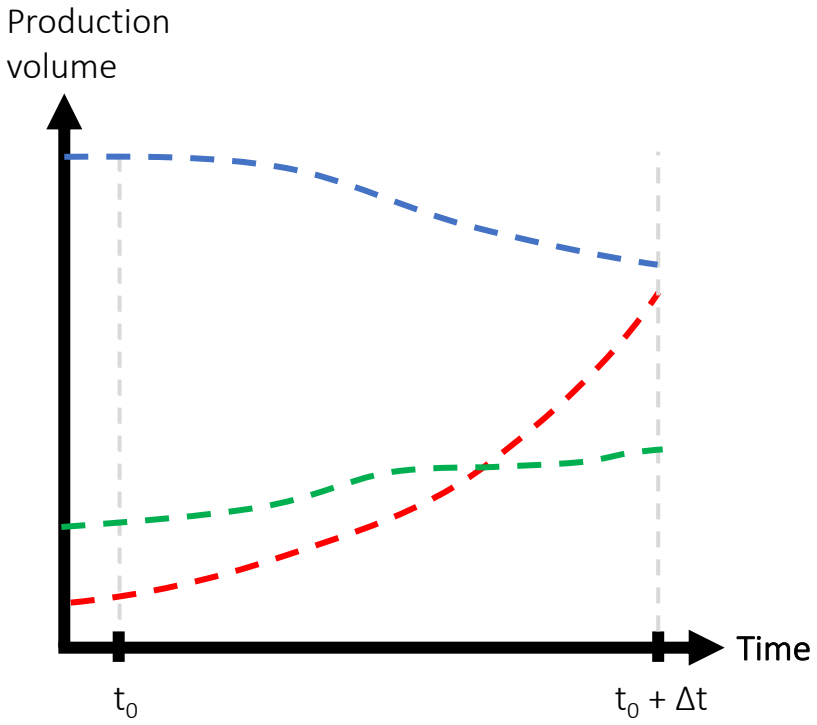


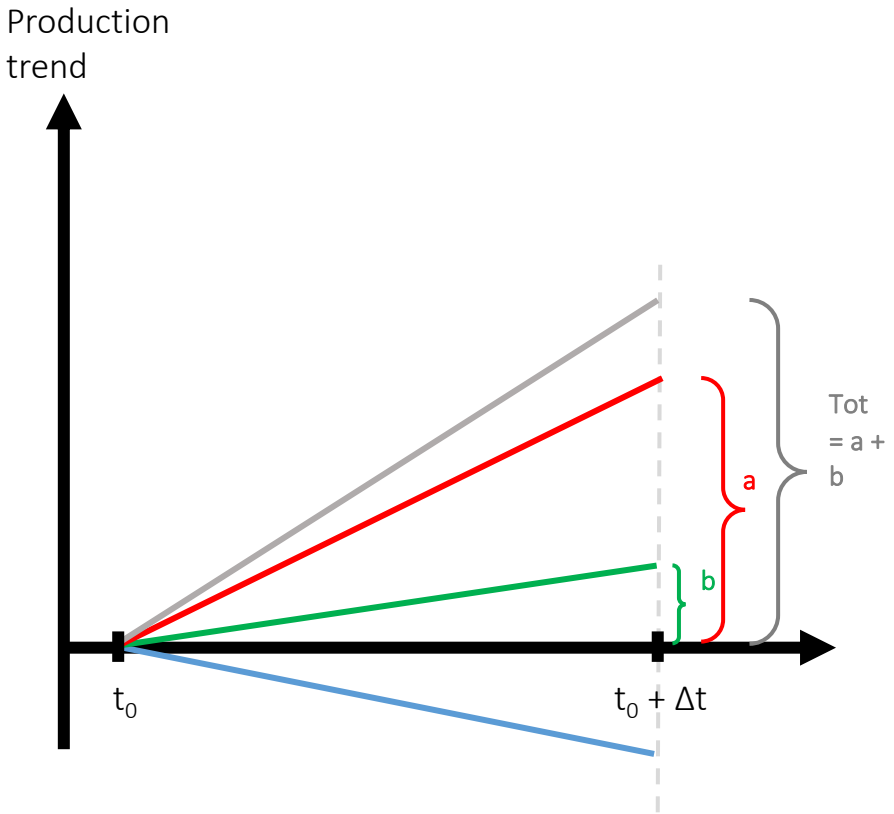
CLCA of reusable wall assemblies
Matthias Buyle

Methods

Market boundaries – top down

Pizzol & Scotti, *Identifying marginal suppliers of wood products via trade network analysis*.
Int. J. Life Cycle Assess. 2017, 22, 1146–1158





Supplier A
Supplier B
Supplier C
Sum positive increments

Supplier A **75%** $= \frac{a}{a+b} = \frac{3}{3+1}$

Supplier B **25%** $= \frac{b}{a+b} = \frac{1}{3+1}$

Supplier C **0%**

Methods

Marginal supplier identification

4 scenarios

RETRO[IT]
PRO[IT]

RETRO[NA]
PRO[NA]

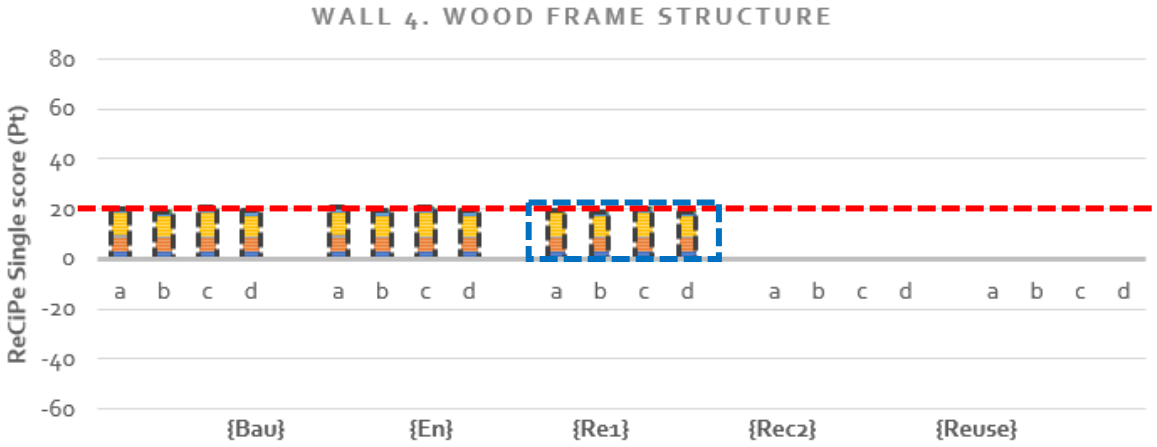
Marginal mixes electricity, gas, coke and coal

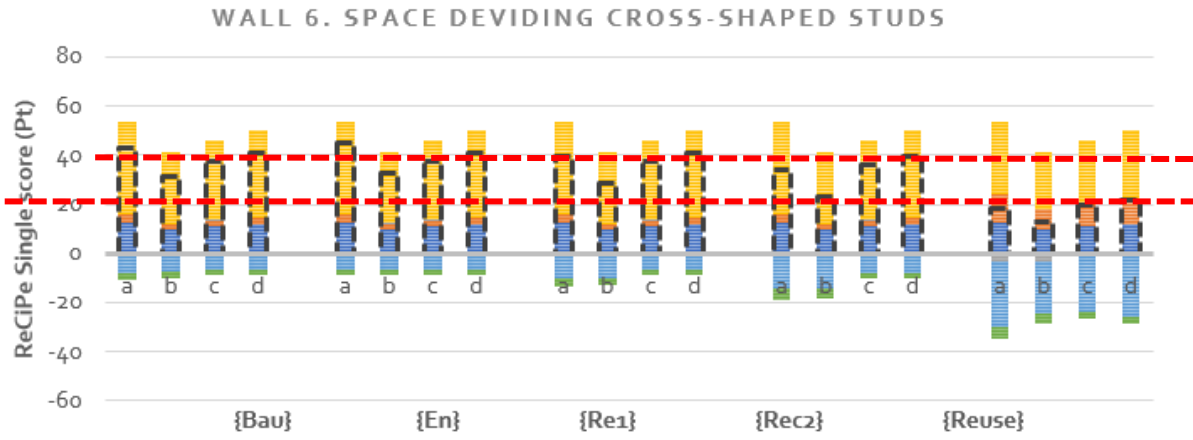
Yields and direct land use based on climate zone, dominant species and forestry practice

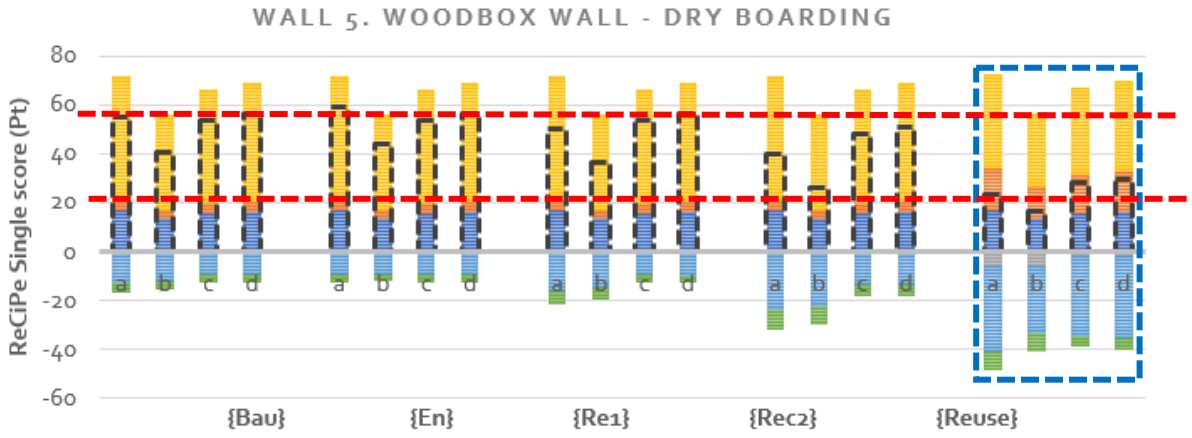
Transport modes, distances

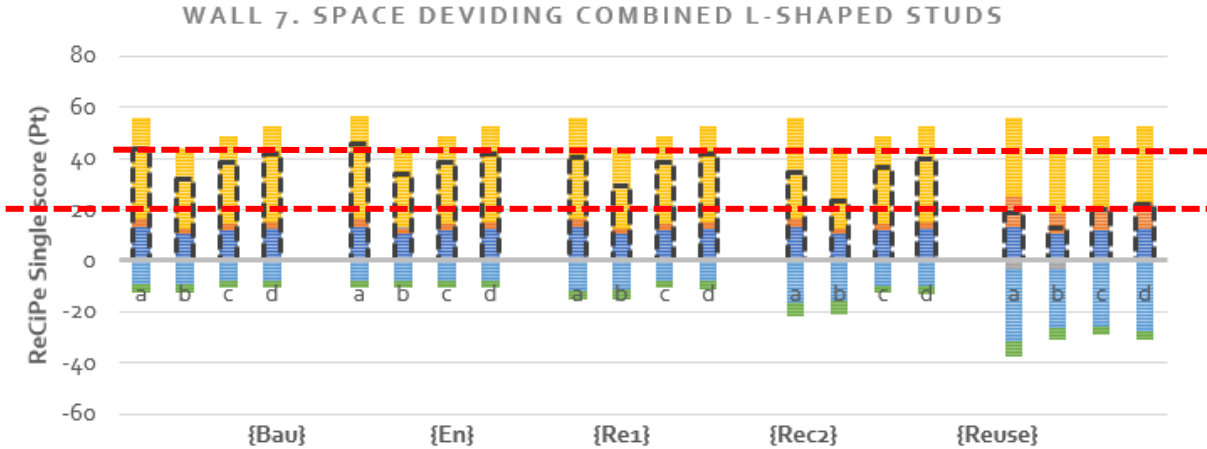
{Bau}	current practice in Belgium
{En}	All combustible waste to waste incineration with energy recovery. {Bau} scenario for non-combustible waste
{Rec 1}	Improved recycling practice anticipating future technological developments
{Rec 2}	further improved recycling practice, including higher recycling rates and off-site reuse, enabled by Design for Change
{Reuse}	Components are used again directly in the same building without any additional treatment or transport

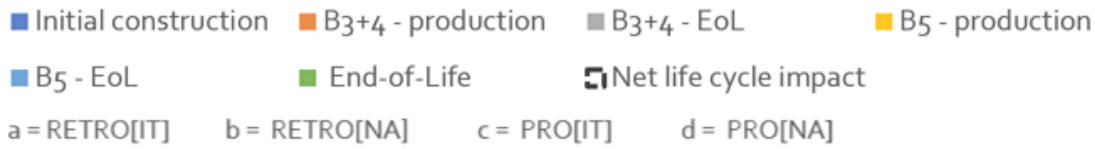
End-of-life scenarios





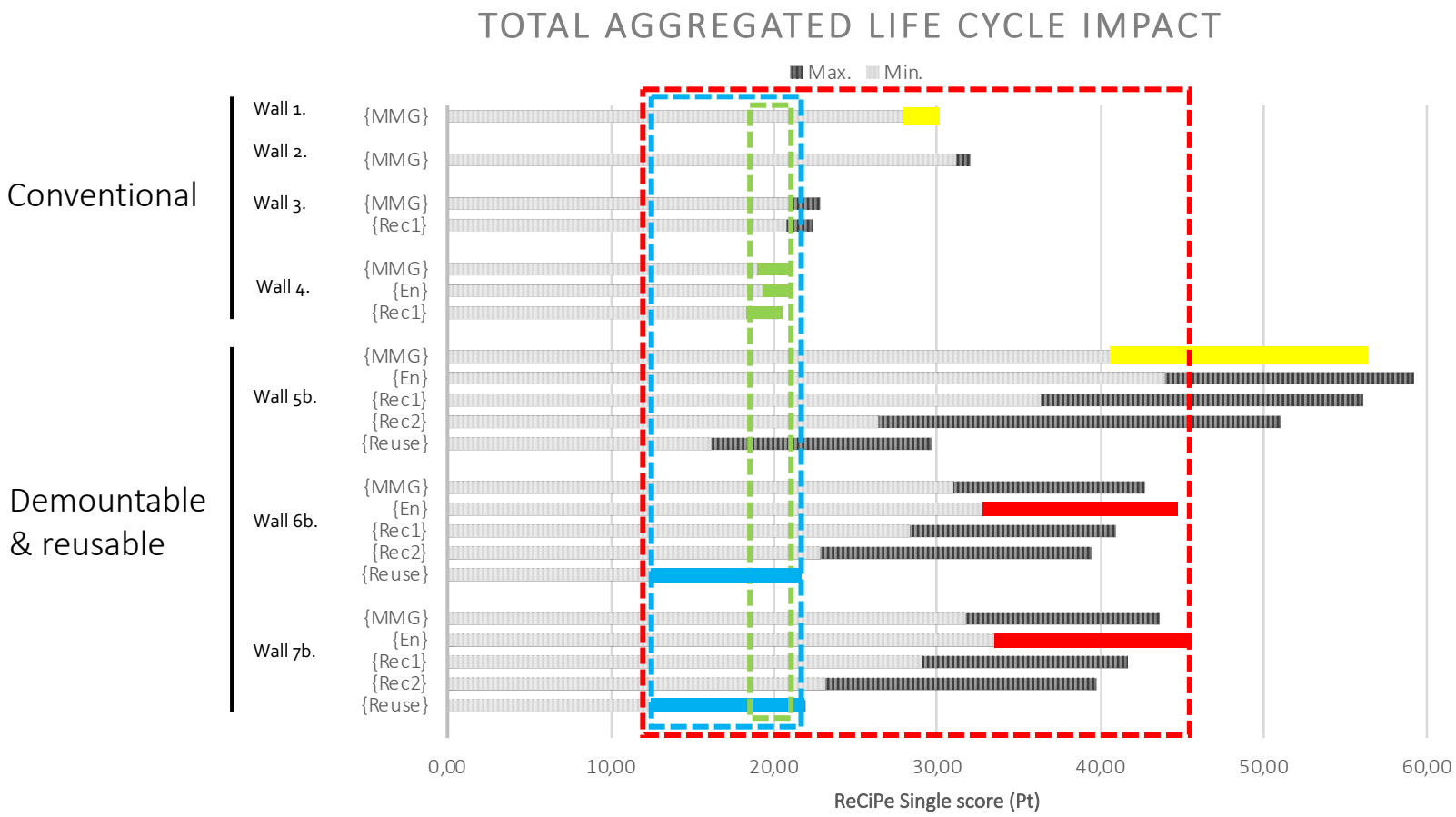






Results

Impact per life cycle phase



Results

Aggregated impact

- Trends in production volume as **proxy for competitiveness**
- Marginal suppliers at **country level**
- Detailed assessment **not always needed**
- Different **TRLs** of the designs

Limitations & opportunities

- **Straightforward procedures** were proposed, relying in ‘easily’ accessible data
- Reusable designs **more sensitive** to modelling assumptions
- Two **reusable designs** perform better or at **least similar** compared to conventional walls, but **optimal use** is key

Final conclusions

Thank you for the attention!

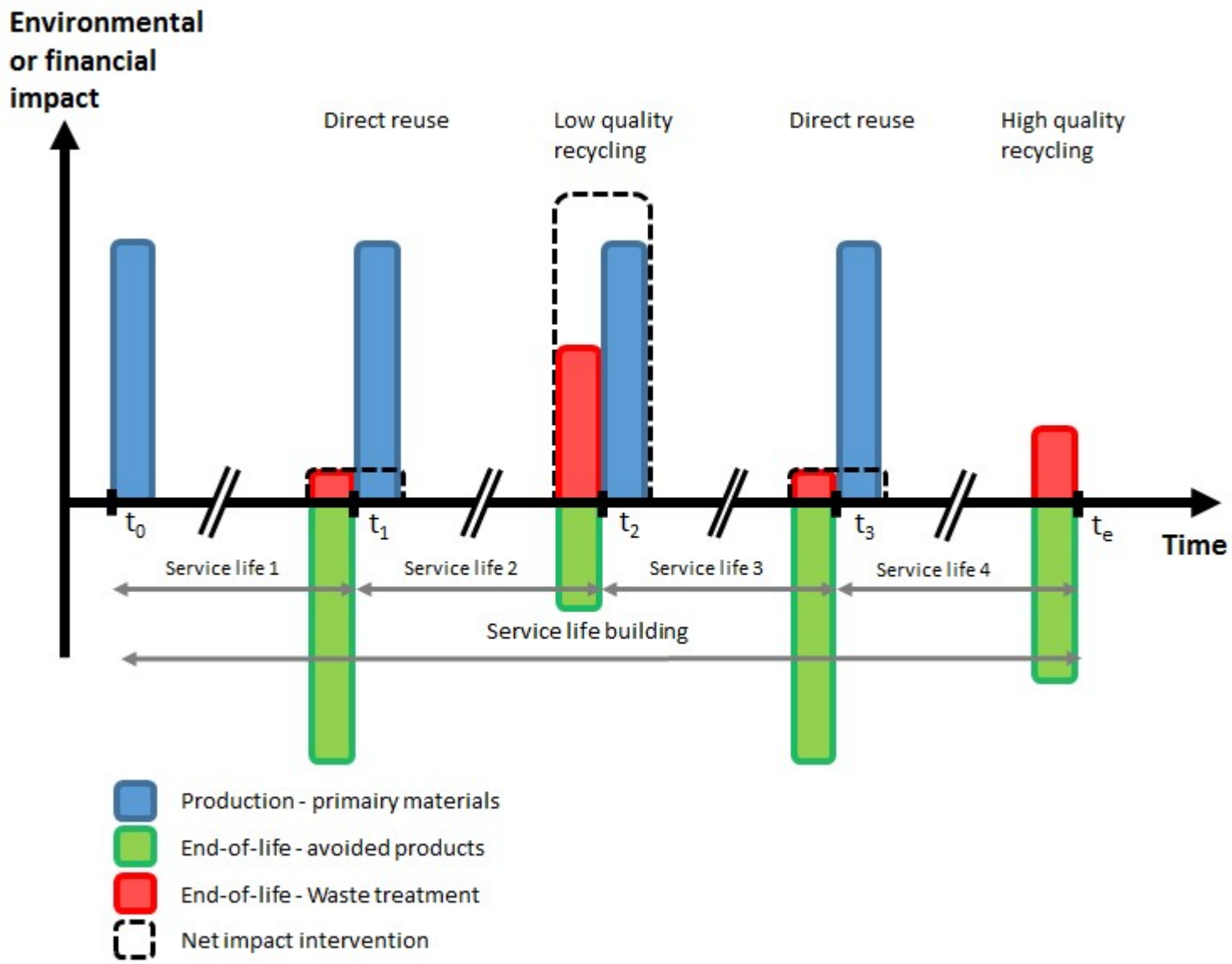
Questions?

Annexes

Properties	Iterative procedure	Network analysis	Sacchi (2018)
Market boundaries	Iterative procedure (step 1)	Network analysis (step 1)	Supply chain modelling (single step)
Sensitive suppliers	Regression analysis (step 2)	Regression analysis (step 2)	
Modelling approach	Bottom-up	Top-down	Bottom-up
Perspective on development	Retrospective (markets) Retro- & prospective (sensitive suppliers)	Retrospective (markets) Retro- & prospective (sensitive suppliers)	Retrospective
Advantages	Thresholds: easy to adapt method to goal and scope Prospective data possible Starting from a specific location of demand	Thresholds: easy to adapt method to goal and scope Prospective data possible Markets: hierarchy in trade partners	Equilibrium: no need for thresholds Indirect transport and losses No dominance of a single supplier with a weak trade link
Disadvantages	Markets: no hierarchy (no distinction between 'strong' and 'weak' trade links) Possible dominance of a single supplier with a small trade connection	Markets: not suitable for products with limited trade	Prospective data not possible

Evaluation methods

Sacchi, *A trade-based method for modelling supply markets in consequential LCA exemplified with Portland cement and bananas*. Int. J. Life Cycle Assess. 2018, 23, 1966–1980



Life cycle replacements

Sacchi, *A trade-based method for modelling supply markets in consequential LCA exemplified with Portland cement and bananas*. Int. J. Life Cycle Assess. 2018, 23, 1966–1980