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TO MODULE D OR NOT TO MODULE D?

The relevance and difficulties of considering the recycling potential in building LCA

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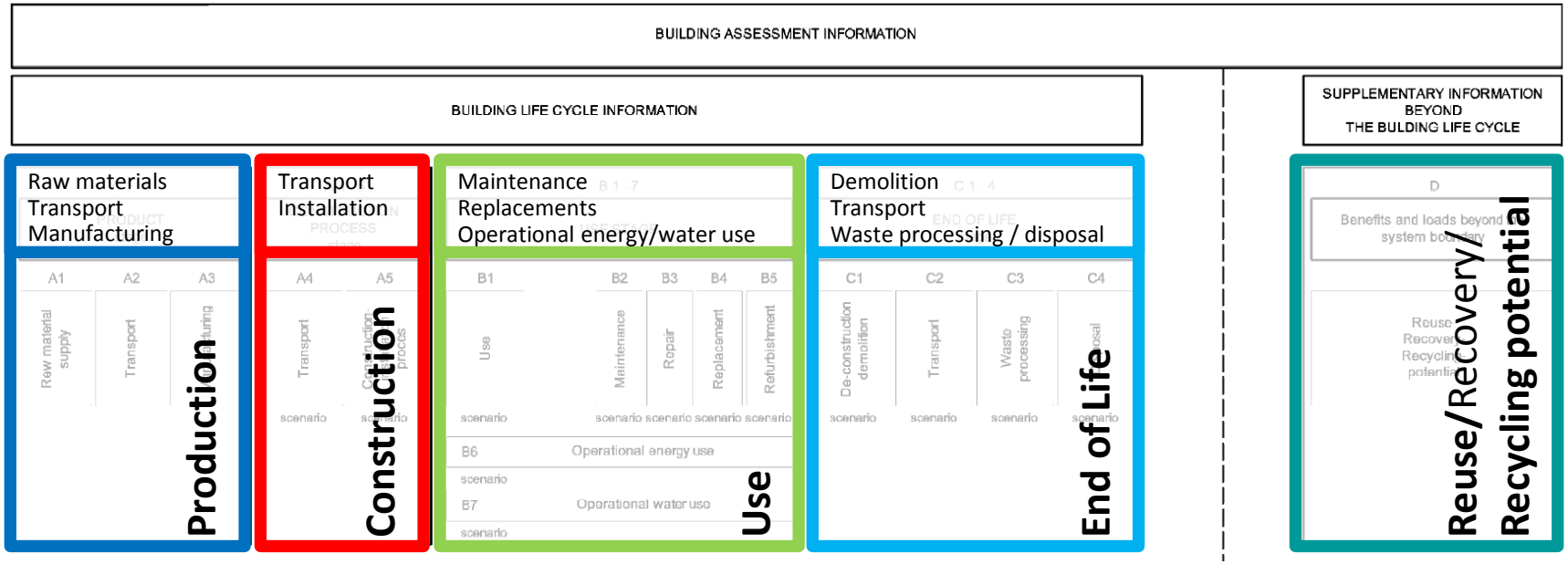
Overview presentation

- Introduction
- What is module D ?
- Case study: building LCA
- Points of attention and difficulties module D
- Conclusions

Introduction

Framework EN 15804 / EN 15978



CRADLE TO GRAVE

MODULE D optional

Introduction: what is module D ?

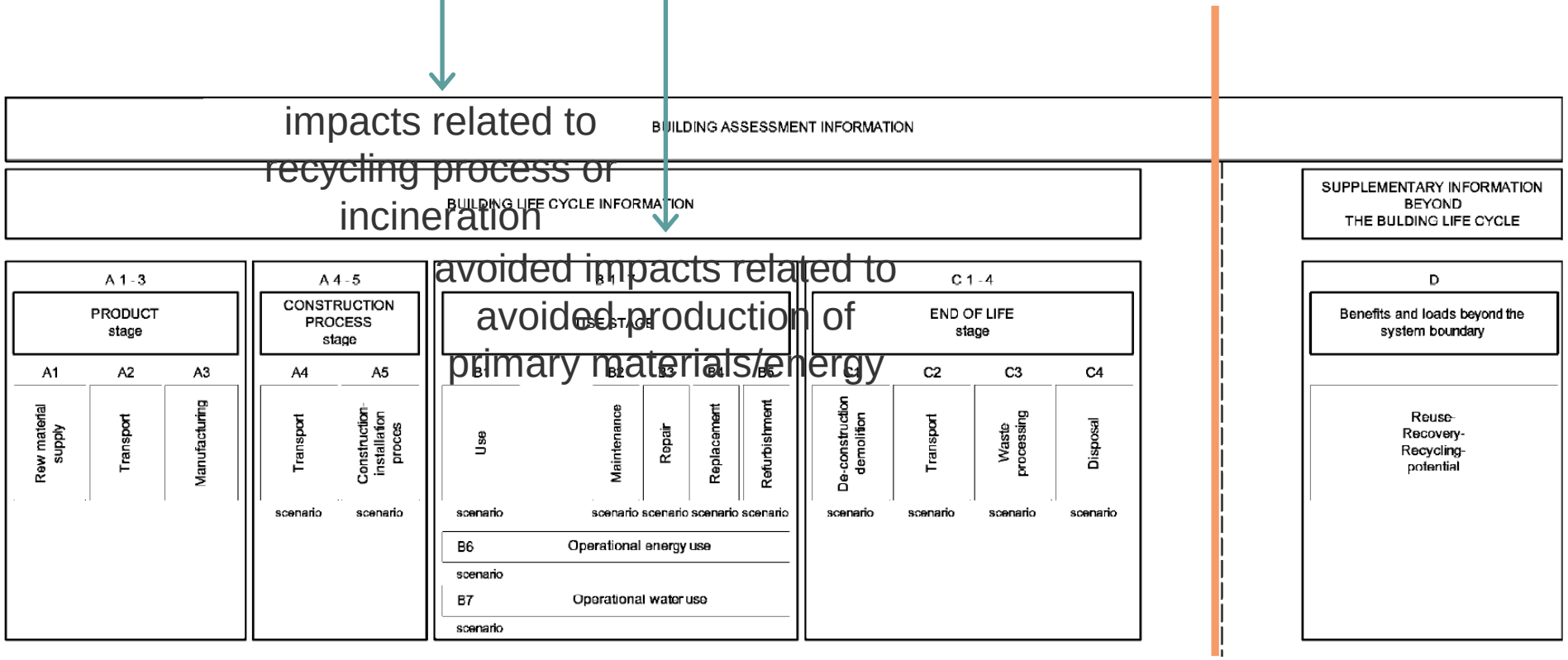
Module D in EN 15804 / EN 15978

= environmental **loads** and **benefits** **beyond** the buildings life cycle

resulting from…

- recycling of materials
- reuse of products
- (recovery of) energy leaving the product system

after the
end-of-waste point
(system boundary)



Problem and goal

Module D

- Not often included in LCA
- Argued to be important for metals
- What is impact for other building materials?

Relevance of including module D in building LCA ?

- Impact compared to other life cycle stages
- Points of attention in calculating module D

→ Case study analysis

Case study

Existing building

- multi-family house: 3 apartments + commercial space
- 4 storeys
- Main composition:
  - Brick walls
  - Sloped roof with ceramic tiles

Building renovation with steel roof

- Main structure of existing walls and floors
- Insulated from inside (system wall, mineral wool, gypsum boards)
- Aluminium windows and doors
- Interior walls (system wall, min wool, gypsum boards)
- Steel roof structure and steel roof covering

Methodology LCA

Life cycle assessment at building level

- Cradle-to-grave
- Including module D

Methodology

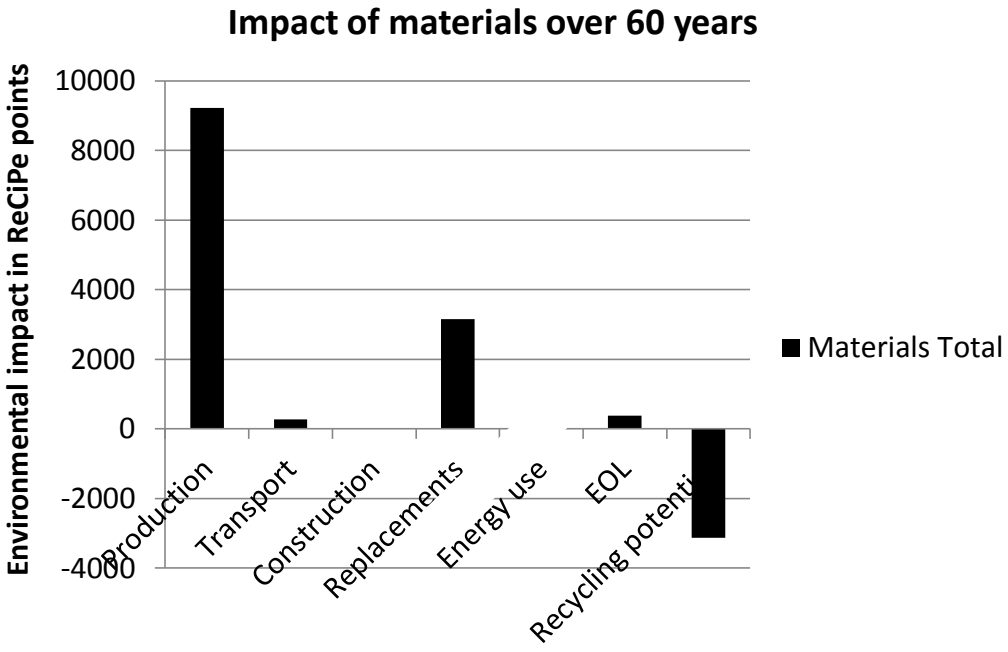
- Principles ISO 14040, EN15804, EN 15978
- Software Simapro, Ecoinvent v2.2
- Impact method: ReCiPe Endpoint / Hierarchist

- RSL of 60 years
- Including replacement for SL < RSL
- Excluding technical installations
- EOL scenarios based on Belgian average (current)
- Waste incineration:
  - Loads within the system boundaries
  - No potential benefits from energy production (lack of data + small fraction of materials)

Results LCA – total building

Module D in total building

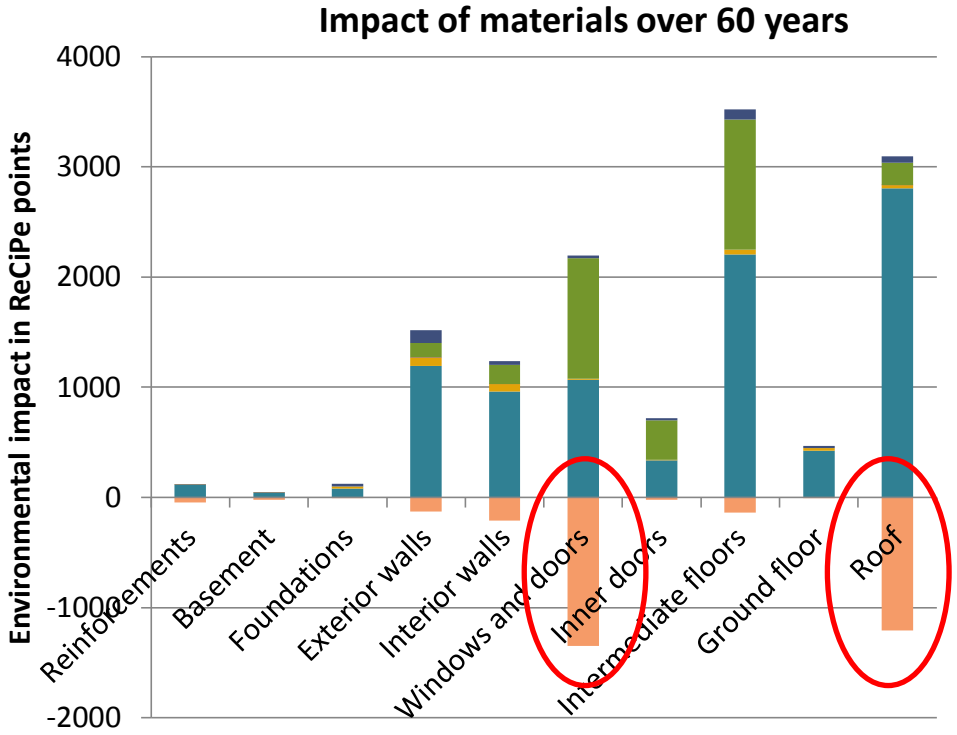
- order of magnitude of replacements
- module D > construction phase and EOL phase

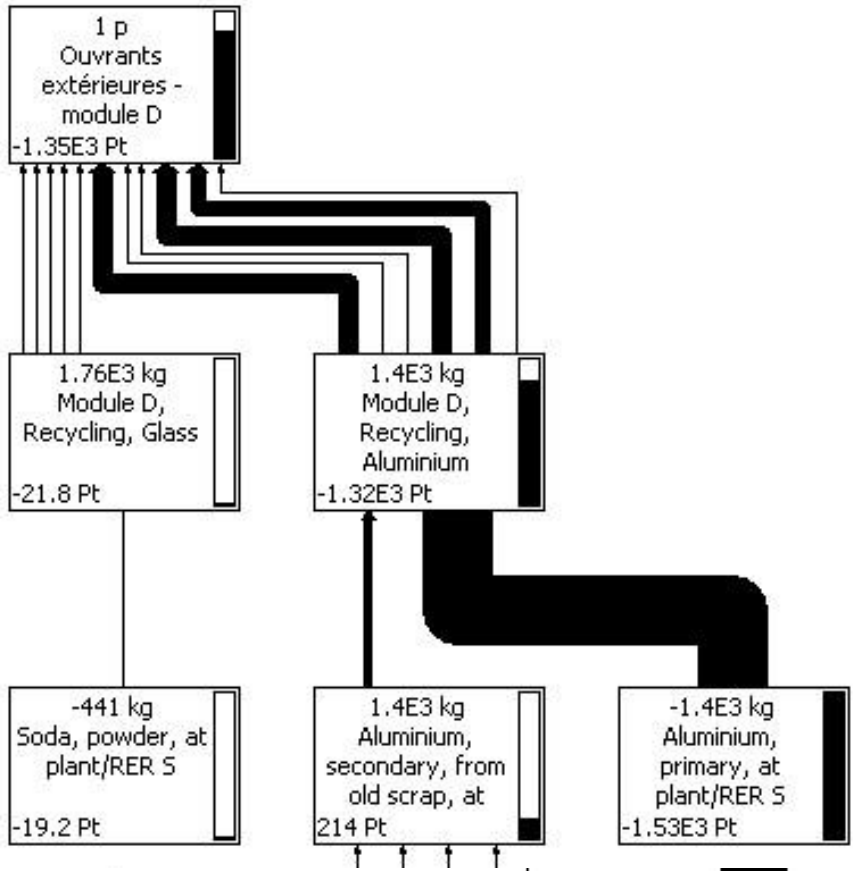


Results LCA – building elements

Module D

- Steel roof → 98% related to steel
- Aluminium windows → 98% related to aluminium
  (despite RR of 70% for glass panes)



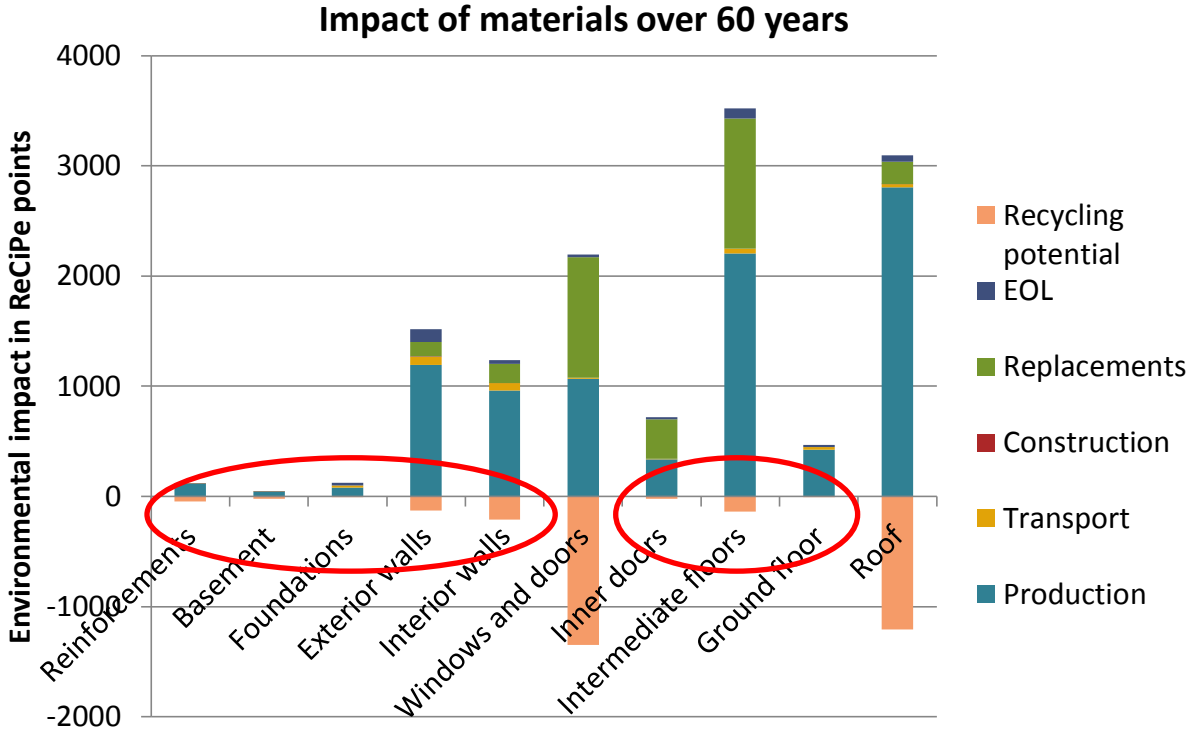


Results LCA – building elements

Module D

- SMALL for other building elements
  - Low recycling rate in practice (e.g. mineral wool, gypsum board)
  - Low benefits related to recycling (e.g. concrete, bricks)
  - Renovation case with existing floors and walls

High recycling rate ≠ high module D impact
→ Module D does not tell the whole recycling story



Points of attention module D

System boundary

Functional equivalence

Strong insight in production processes

Points of attention module D

According to **EU waste framework directive** (2012)

System boundary

- Definition of end-of-waste stage (EU waste framework directive)
- Not always easy to define

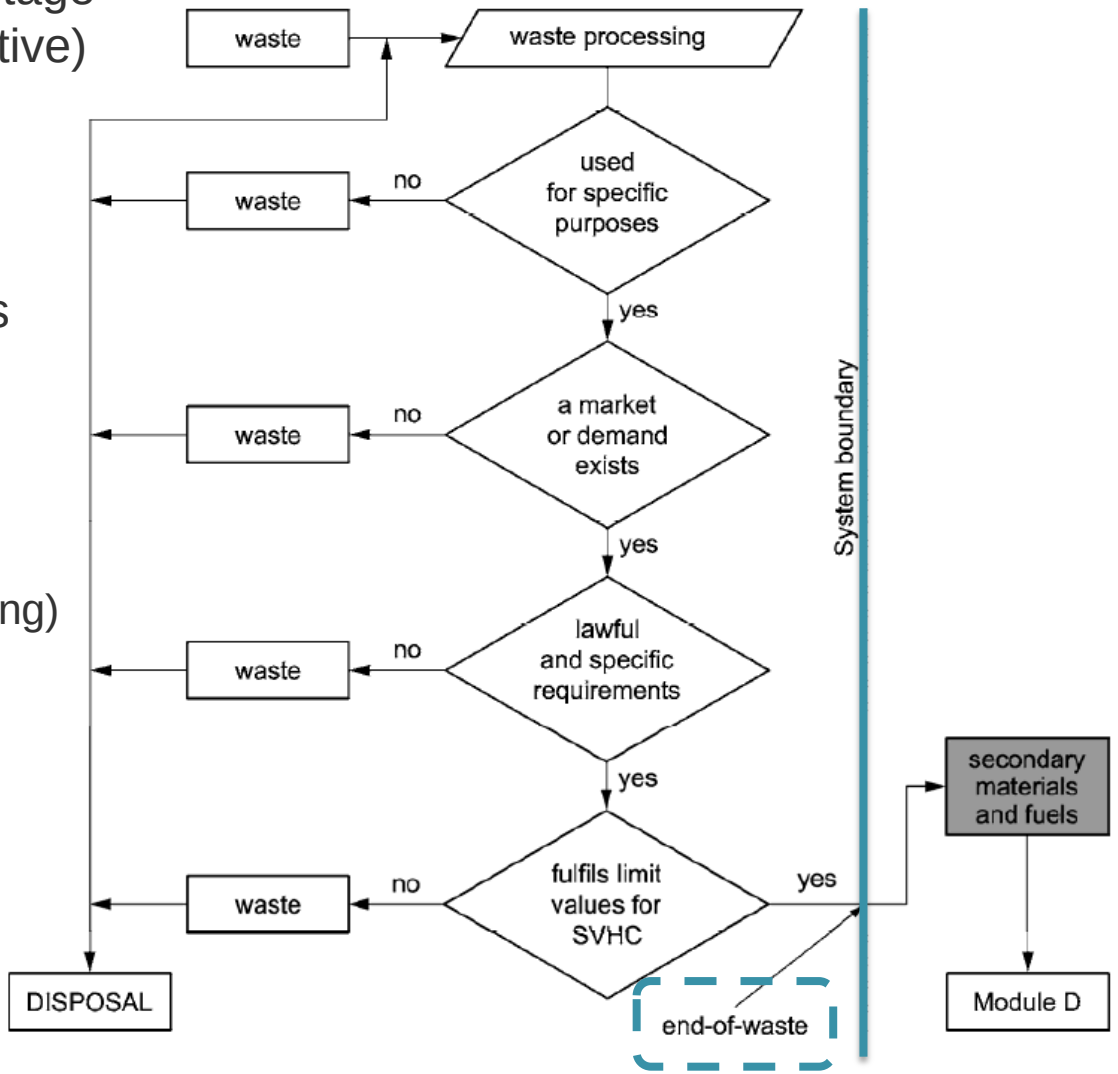
- EXAMPLE:
  reuse of construction debris from concrete

  Crushing
  - EOW after crushing

  → Module C3 (waste processing)

  - EOW before crushing

  → Module D (pre-recycling)



Points of attention

Functional equivalence

- "secondary material […] can be declared as substituting primary production […] when it has reached functional equivalence of the substituted primary material"

cannot always be defined unambiguously

- Difficulty
  - Recycling potential not always clear
    - which material is it substituting?
  - Possibility of different recycling routes
    - e.g. recycling of glass
      → used for production of float glass
      → used for production of glass wool insulation
  - Possibility of different substituting materials
    - e.g. secondary concrete aggregates for roadworks
      → substituting: river granulates
      → substituting: granulates crushed at local mine

Points of attention

Strong insights in primary and secondary production processes

- Impact of « recycling process » (e.g. transport, grinding,…)
- Yield
  - e.g. 1kg steel scrap produces less than 1kg secondary steel
- Value correction factor
  - E.g. secondary plastic can only be used in lower grade applications (downcycling)
- Theoretical primary production process
  - e.g. glass cullets are used for production of primary float glass
  - e.g. steel scrap is used in “primary” production of steel

Conclusions

Module D in building LCA

- Consideration of module D can be significant in building LCA
- For case study:
  - module D > transportation phase
  - module D > construction phase
  - module D > end of life phase

BUT…

- In this case module D is strongly related to use of metals
- Further study is needed (e.g. benefits from energy recovery or export)
- High recycling rate ≠ high module D impact

SO does not necessarily tell something about recycling potential

Points of attention in calculating module D

- End of waste point
- Functional equivalence
- Data availability recycling and production process

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