ZAG

ZAVOD ZA GRADBENIŠTVO SLOVENIJE

SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE

# Roles of the reference service life (RSL) of buildings and the RSL of building components in the environmental impacts of buildings

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# INTRODUCTION

- Buildings are complex entities and have long and unpredictable lifespans. LCA, therefore, while providing an indication of environmental impacts, includes inherent **uncertainties**.

- Dealing with uncertainty in LCA is important, because different studies on the same issue could yield different results (different parameters, scenarios, etc)

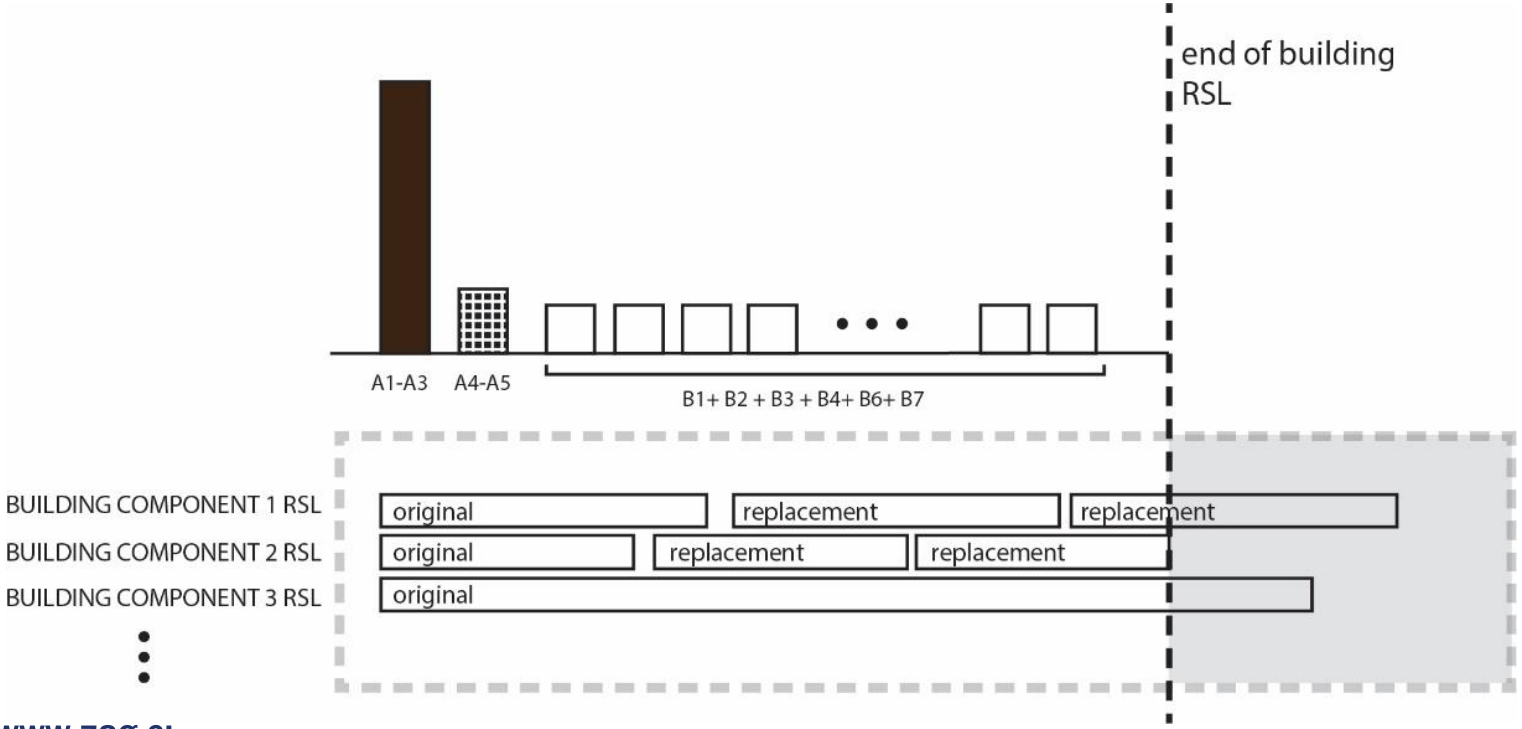
- Neglecting uncertainty can have a major impact on the understanding of the problem being analysed, skewing outcomes or misleading decisions based on the analyses

# INTRODUCTION

- Uncertainty in LCA (Lloyd and Ries)
  - Parameter uncertainty
    (process inputs, environmental discharges, and technology characteristics)
  - Scenario uncertainty
    (functional units, valuation and weighting factors, **service life**, geographical scales, natural contexts, allocation procedures, waste-handling scenarios, etc.)
  - Model uncertainty
    (models for deriving emissions and characterization factors)

# REFERENCE SERVICE LIFE

- RSL is defined as the period during which a building/component  is in use
- RSL building ≠ RSL component
- RSL can vary greatly depending on the source



# REFERENCE SERVICE LIFE

The RSL of a component can be acquired from different sources :

- individual EPDs (cradle to gate, or cradle to grave);
- client requirements and current practices;
- product and component manufacturers' information;
- existing applicable standards such as ISO 15686
- conventional service life in a national context or within an LCA software package for buildings.

# REFERENCE SERVICE LIFE

RSL regulations in European countries

| Country | RSL Source for building components | Standard, legislation or part of the national assessment method | RSL of the building defined in relation to the main structural material | RSL of the building defined in relation to the building's use |
|---|---|---|---|---|
| Austria | Nutzungsdauerkatalog baulicher Anlagen und Anlagenteile 2012 [10] | Legislation | no | no |
| Belgium | Durées de vie dans MMG2017/TOTEM [11] | National assessment method | yes | no |
| Czech | SBToolCZE [12] | National assessment method | yes | no |
| Germany | Nutzungsdauern von Bauteilen für Lebenszyklusanalysen nach Bewertungssystem Nachhaltiges Bauen (BNB) [13] | National assessment method | no | no |
| Slovenia | Pravilnik o standardih vzdrževanja stanovanjskih stavb in stanovanj [14] | Legislation | yes | no |
| Spain | Documento Básico SE Seguridad structural [15] | Legislation | no | no |
| Switzerland | SIA 2032 [16] | Standard | no | no |

# REFERENCE SERVICE LIFE

RSL of building components of Slovenia, Austria and EOTA*

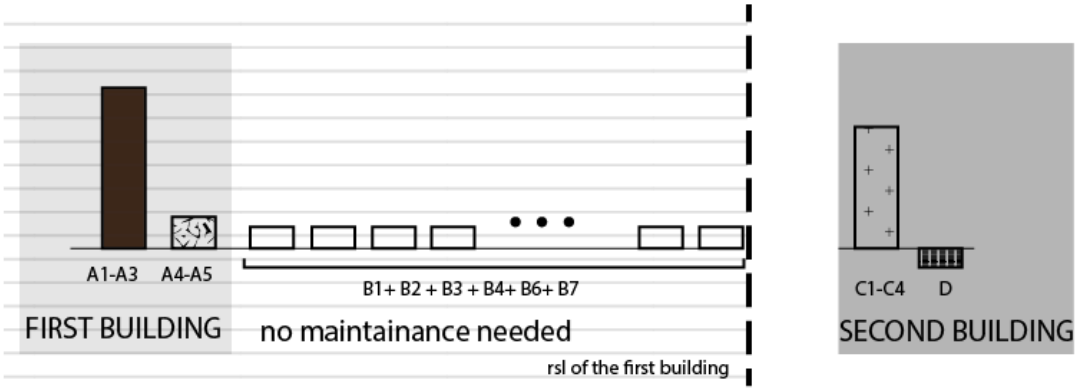
| Building elements | Slovenia | Austria | EOTA |
|---|---|---|---|
| Foundations | 90 | 60 | 100 |
| External walls (above ground) | 80 | 100 | 100 |
| External door | 50 | 30 | 25 |
| Windows | 50 | 30 | 25 |
| Internal wall construction (supporting) | 80 | 100 | 50 |
| Partition wall (non-supporting) | 50 | 30 | 25 |
| **Internal door** | **50** | **30** | **25** |
| Floors (structural) | 80 | 50 | 50 |
| Ceilings | 80 | 80 | 100 |
| Roof structural construction | 70 | 60 | 50 |
| Stairs and ramps (structural) | 50 | 70 | 50 |
| Water system | 40 | N/D | 25 |
| Sewage system | 40 | N/D | 50 |
| Electrical system | 40 | N/D | 25 |
| Heating system (heat producer) | 20 | N/D | 25 |
| Heating system (heat distribution) | 25 | N/D | 25 |
| Ventilation system | 20 | N/D | 25 |
| **External finishing coat** | **40** | **30** | **25** |
| External thermal insulation (compact facade) | 30 | N/D | 25 |
| Roof cladding - inclined roof | 30 | N/D | 25 |
| Internal finishes (walls, floors) | 30 | 30 | 10 |

*Europena Organisation for Technical Assessment

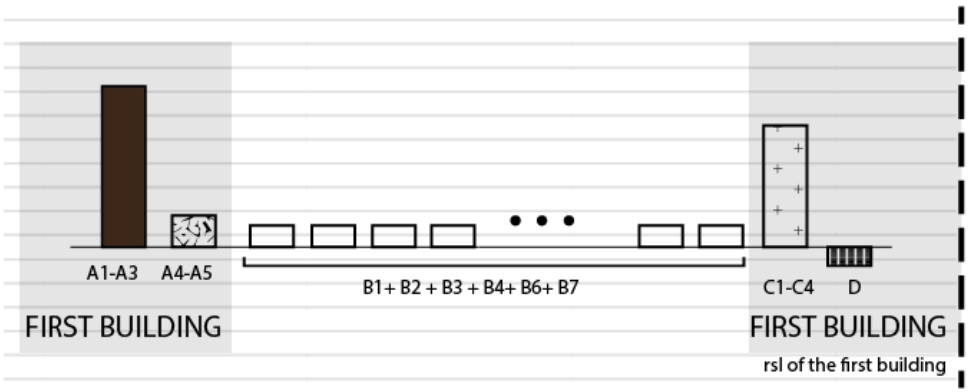
# COMPARISON OF ENVIRONMENTAL IMPACTS OF COMPONENTS CALCULATED WITH DIFFERENT RSL DATABASES

Two scenario are considered

- „REUSE“ SCENARIO




- „END OF LIFE“ SCENARIO



# COMPARISON OF ENVIRONMENTAL IMPACTS OF COMPONENTS CALCULATED WITH DIFFERENT RSL DATABASES

Two scenario are considered

- „REUSE“ SCENARIO: **the internal wooden door**, which can be reused in a second building.
  - Environmental impacts of the replaced door can therefore be divided between the life cycles of two buildings.

- „END OF LIFE“ SCENARIO: **external finishing coa**t can not be further reused in a second building
  - environmental impacts of the finishing coat asigned to one building

# COMPARISON OF ENVIRONMENTAL IMPACTS OF COMPONENTS CALCULATED WITH DIFFERENT RSL DATABASES

Oekobaudat data for the GWP impact category, used in this study

**Internal wooden door (1pcs)**

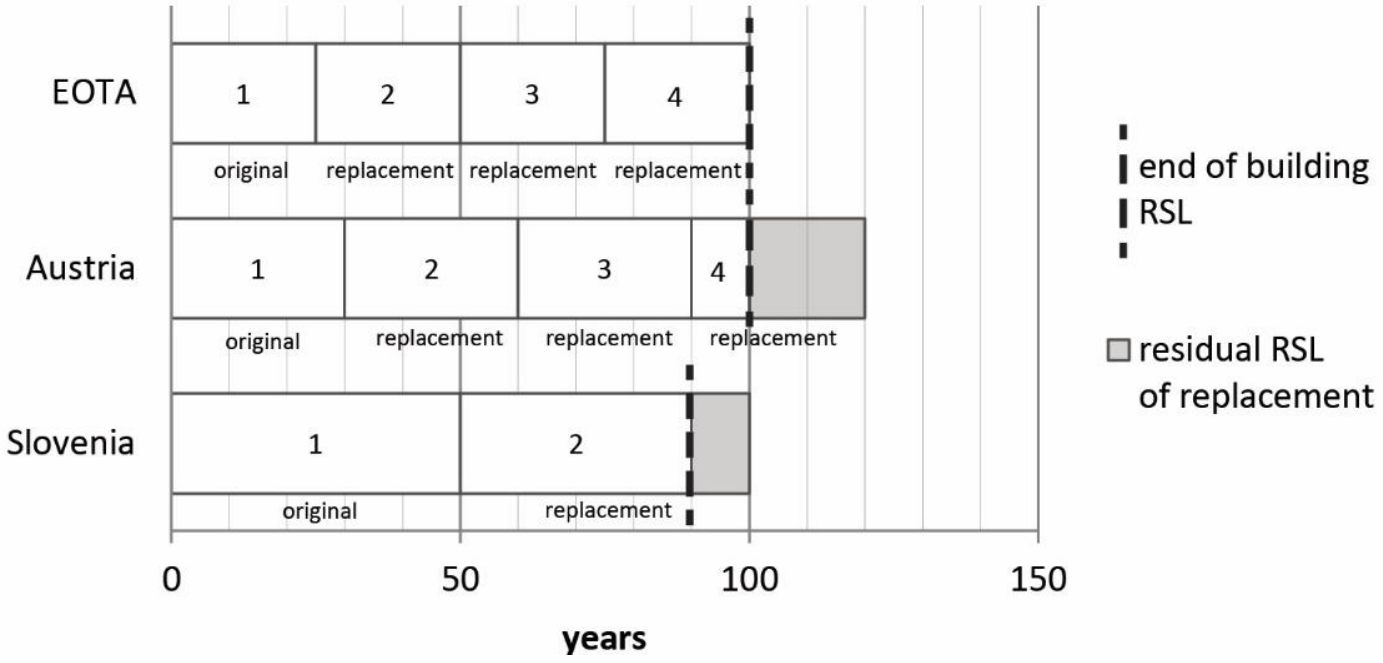
| Indicator | Unit | Provision of raw materials A1 | Transport A2 | Production A3 | Transport C2 | Waste treatment C3 | Elimination C4 | Recycling potential D |
|---|---|---|---|---|---|---|---|---|
| GWP | kgCO(2)-Eq | -43,8 | 1,19 | 28 | 0,0792 | 101 | 2,6 | -40,1 |

**External finishing coat (1 kg)**

| Indicator | Unit | Production A1-A3 | Transport A4 | Installation A5 | Elimination C4 | Recycling potential D |
|---|---|---|---|---|---|---|
| GWP | kgCO(2)-Eq | 1,22 | 0,199 | 0,0289 | 0,0112 | -0,0193 |

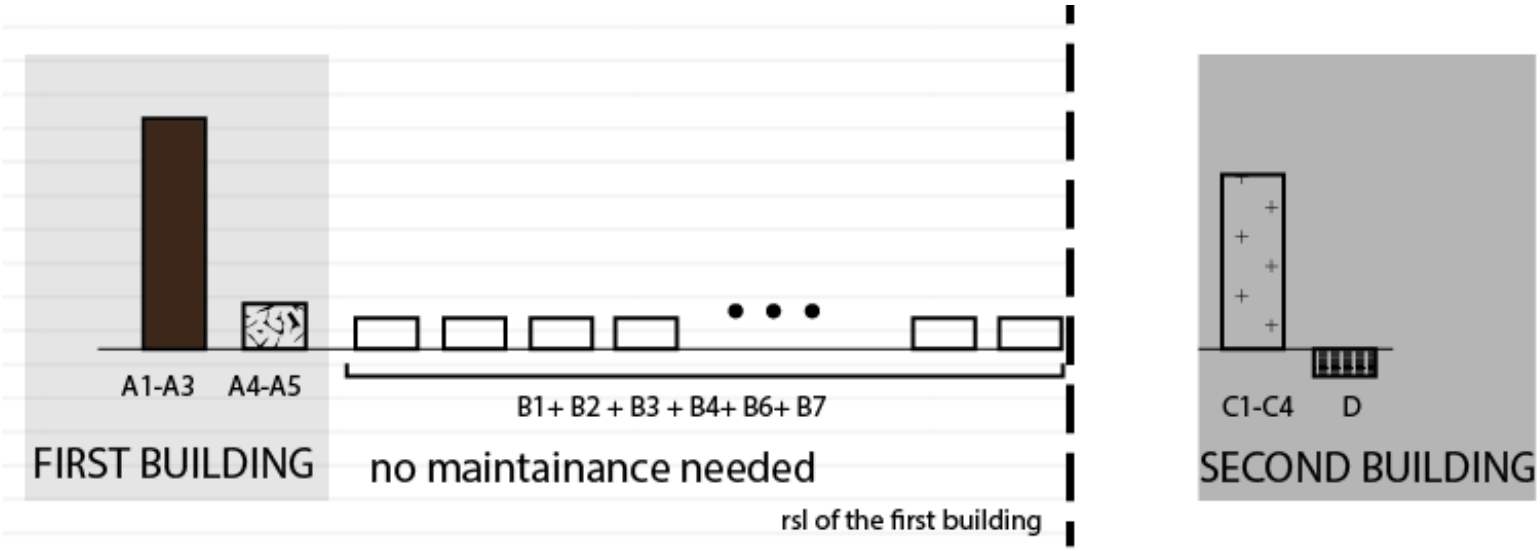
# INTERNAL WOODEN DOOR

Internal door replacements in the RSL of the building according to the selected RSL databases



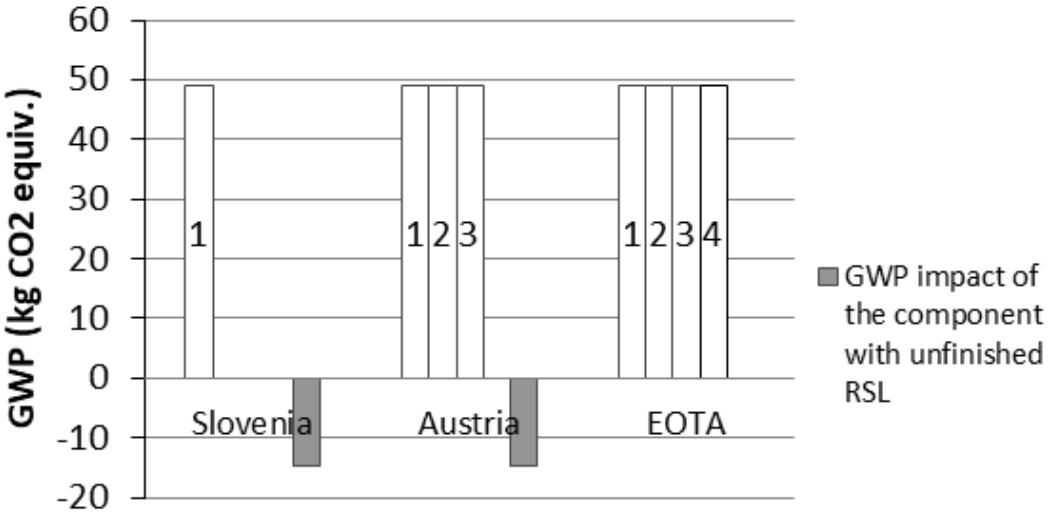
# INTERNAL WOODEN DOOR

- Production phase is assigned to the first building
- „End of Life“ phase is asigned o the second building where the door is reused
- No maintainance

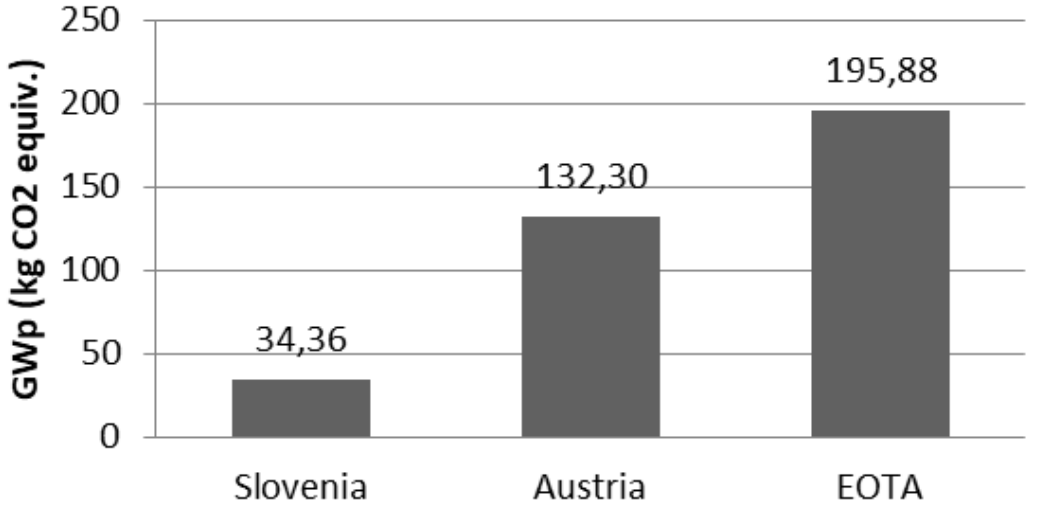


# INTERNAL WOODEN DOOR

GWP emissions of each internal door(original + replacements) during the RSL of the building

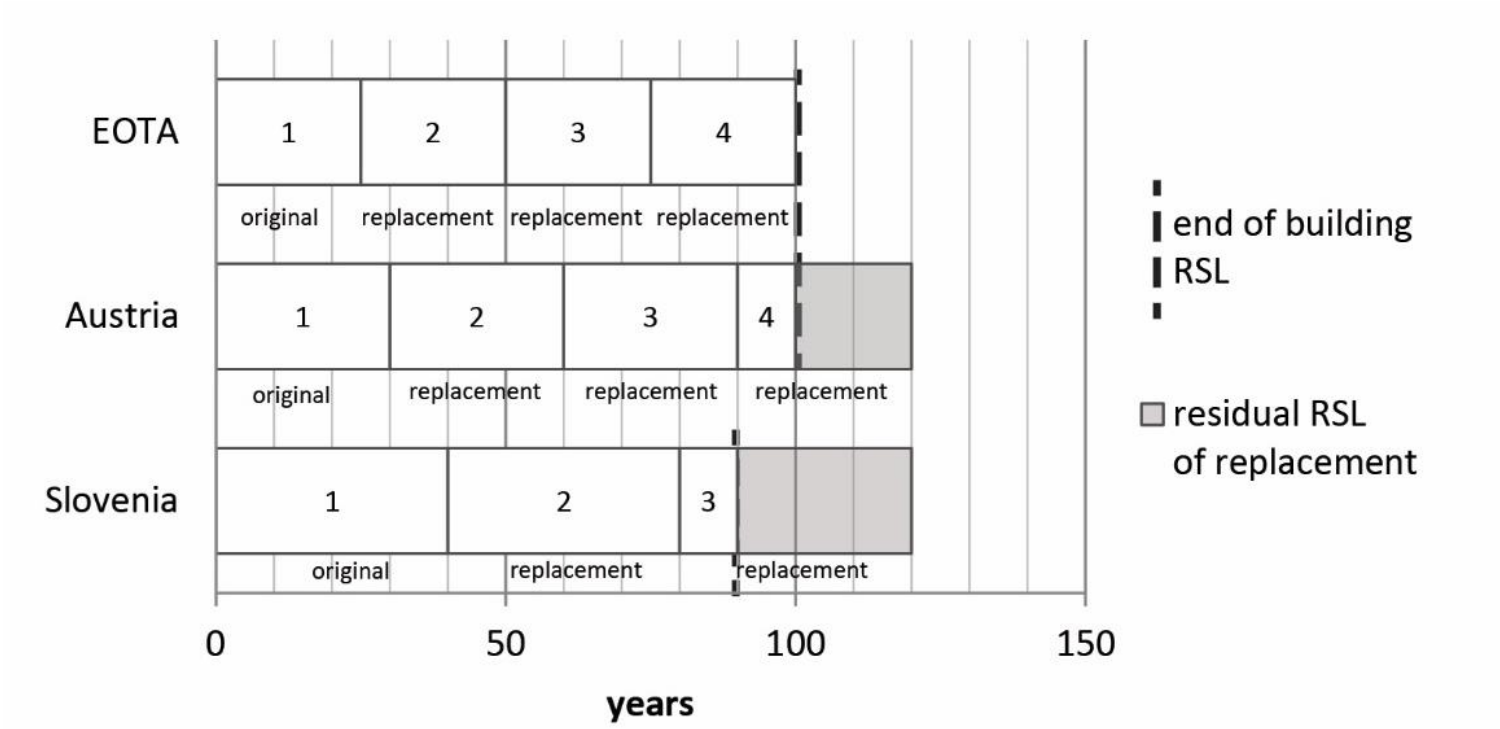



Total GWP emissions for each internal door(original + replacements) during the RSL of the building according the selected RSL databases



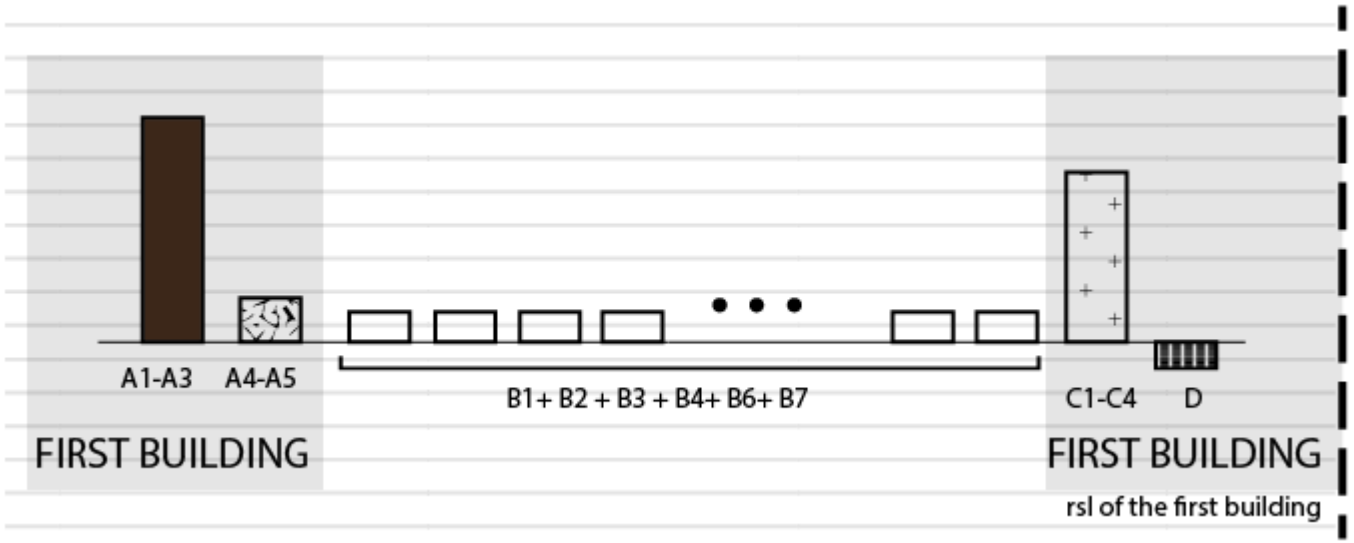
# EXTERNAL FINISHING COAT

External finishing coat replacements in the RSL of the building according to the selected RSL databases



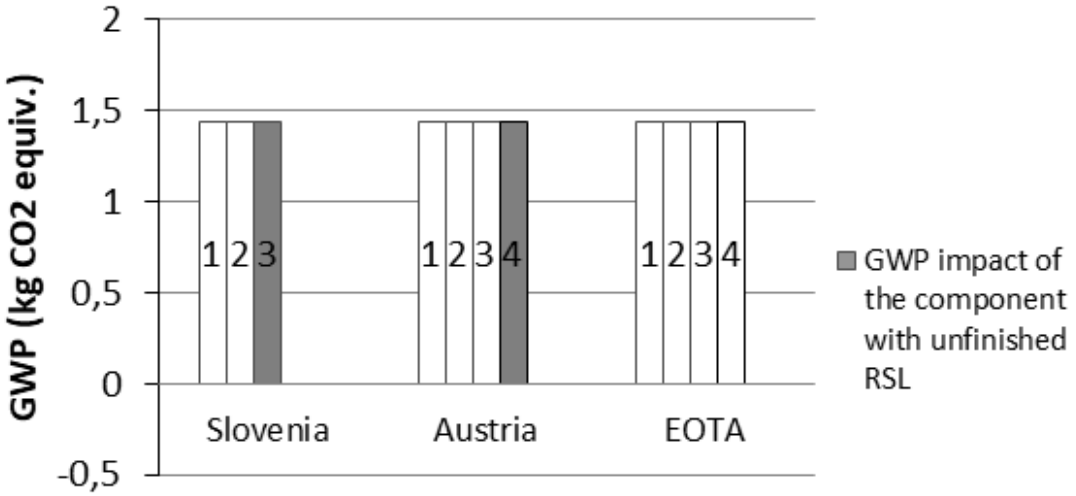
# EXTERNAL FINISHING COAT

- Production phase is assigned to the first building
- „End of Life“ phase is asigned o the first building since external finishing coat typically is not reused
- No maintainance

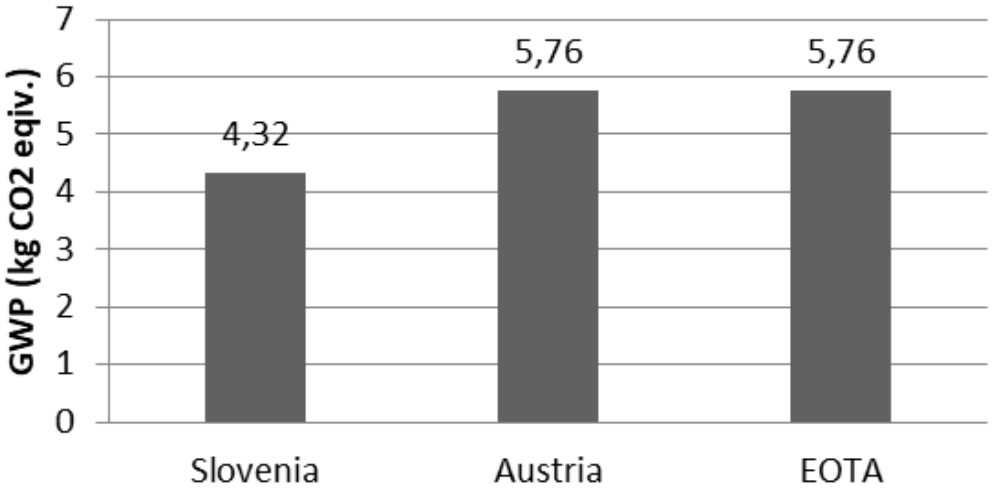


# EXTERNAL FINISHING COAT

GWP emissions of each kg of finishing coat (original + replacements) during the RSL of the building




Total GWP emissions for each kg of finishing coat (original + replacements) during the RSL of the building according the selected RSL databases



# CONCLUSIONS

- Reference service life (RSL) of a building and its components can have a **significant influence on the results** of the LCA analysis of a building

- For ensuring a reliable comparison between analyses it is extremely important that the **RSL data is clearly presented**

- **RSL databases should be harmonized.** RSL values of the individual materials, building components and buildings can be selected from many sources and are not completely comparable.

# CONCLUSIONS

- The environmental impacts of the component strongly depend on the **reuse scenario.**

- This case study confirms that the scenarios for the reuse of individual components must also be **methodologically consistent and clearly presented**.

- Due to the differences in the selected European RSL databases and the predicted scenarios the results of the environmental impacts in a life cycle of a building can vary a lot

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