INFINITE
BUILDINGRENOVATION
Industrialised envelope solutions

Life Cycle Sustainability Assessment of Industrialized Renovation Solutions

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Industrialized retrofit

- **The challenge:**
  - Buildings and construction account for 36% of final energy use and 39% of process and energy-related carbon dioxide emissions (UN)
  - At least 3% of the building stock has to be renovated each year in order to mitigate the effects of climate change on our cities and reach the decarbonisation targets for 2050 (EU)
- **Traditional retrofits:**
  - Assembly and installation predominantly on-site
  - are the norm
  - do not capture economies of scale well
- **Industrialized retrofits:**
  - Industrialized component assembly off-site
  - Quick installation on-site
  - industrialization and mass customization can take retrofits to scale

Industrialised Envelope Technologies

Prefabricated wooden based facade-roof

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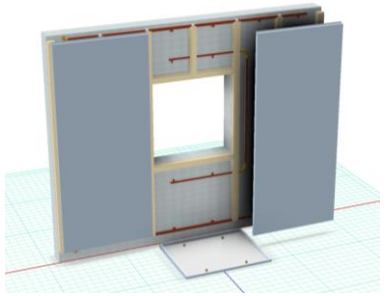
Claddings

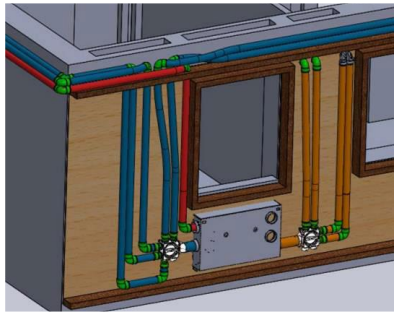
Integrated elements

BIPV (PhotoVoltaic) kit

BIST (Solar Thermal) kit



Energy and Fresh air distribution



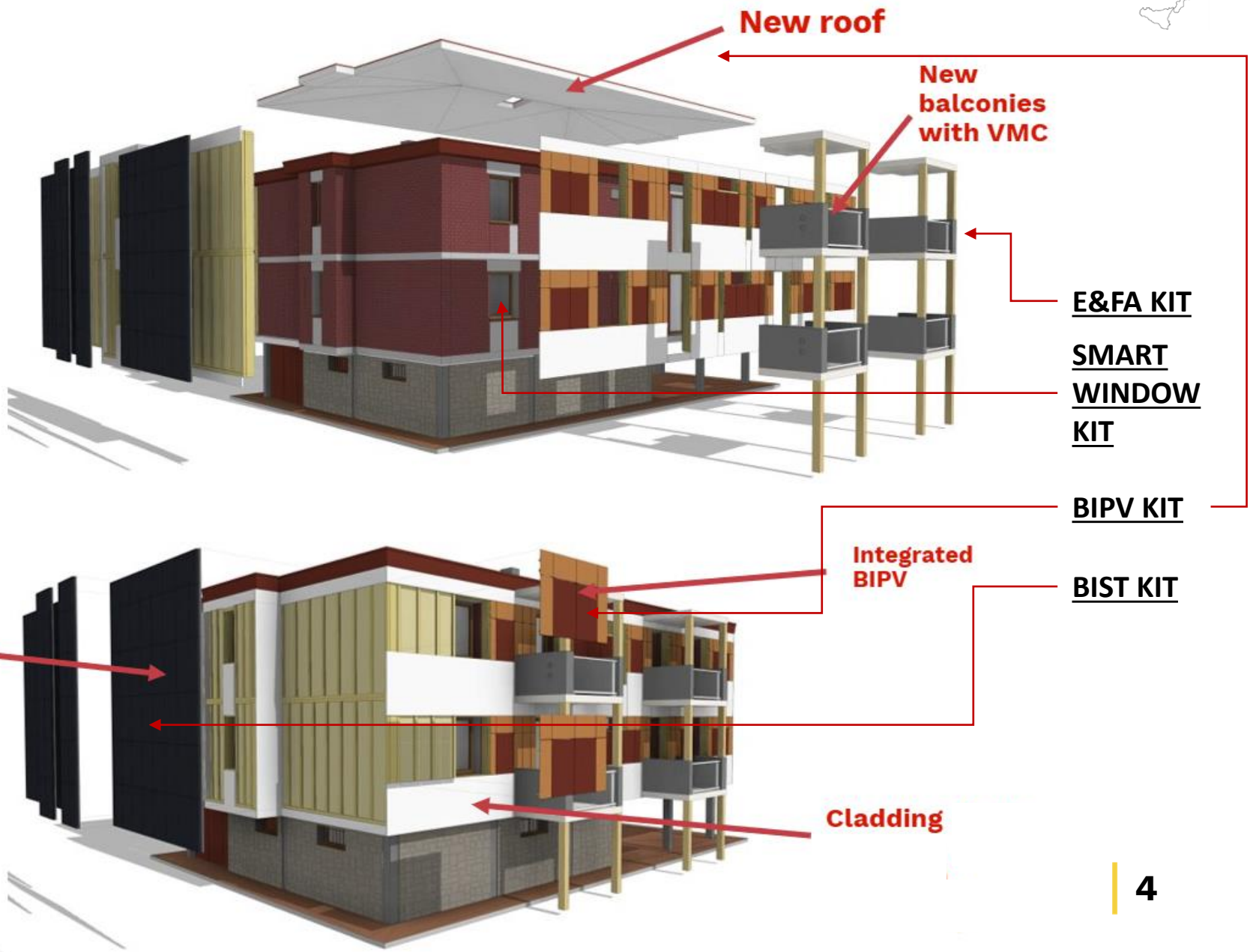
Smart Glazing

INFINITE – ITALIAN DEMO

Retrofit Idea

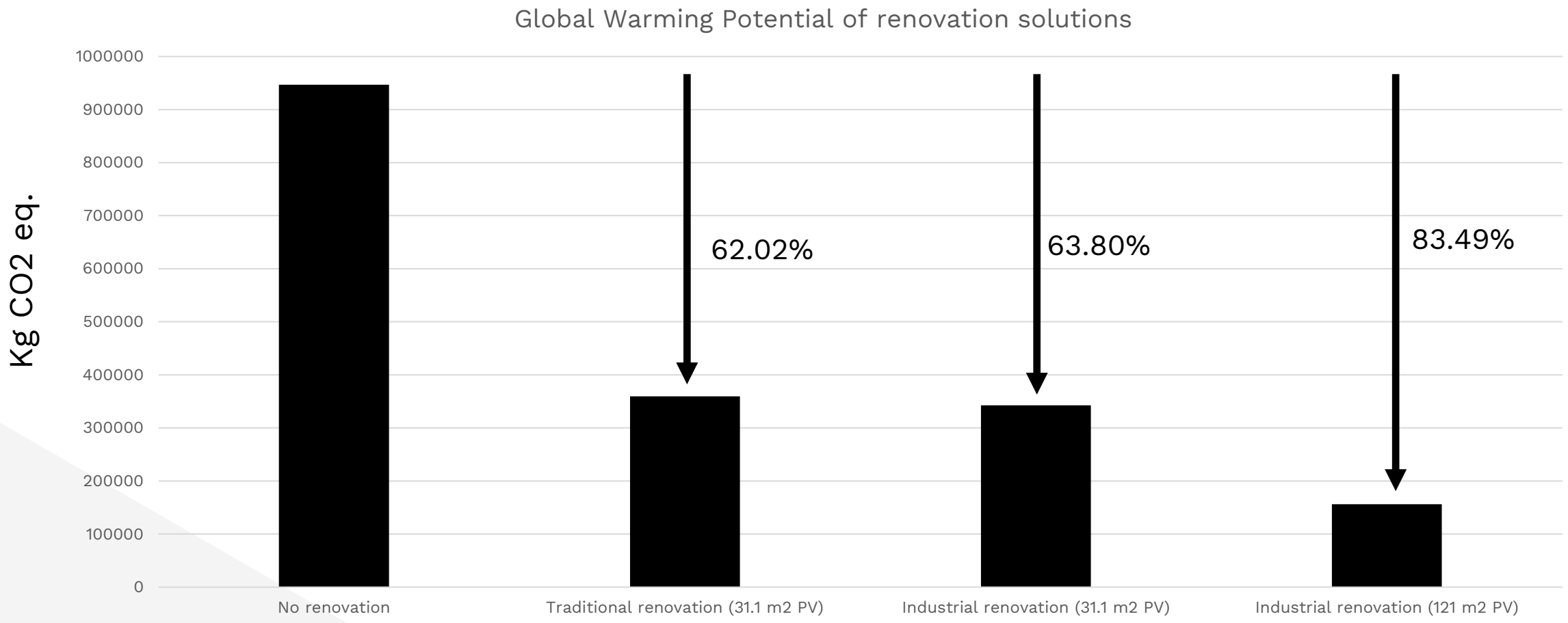
Facade

Rubner prefabricated façade



INFINITE – ITALIAN DEMO

INFINITE results – Global Warming Potential



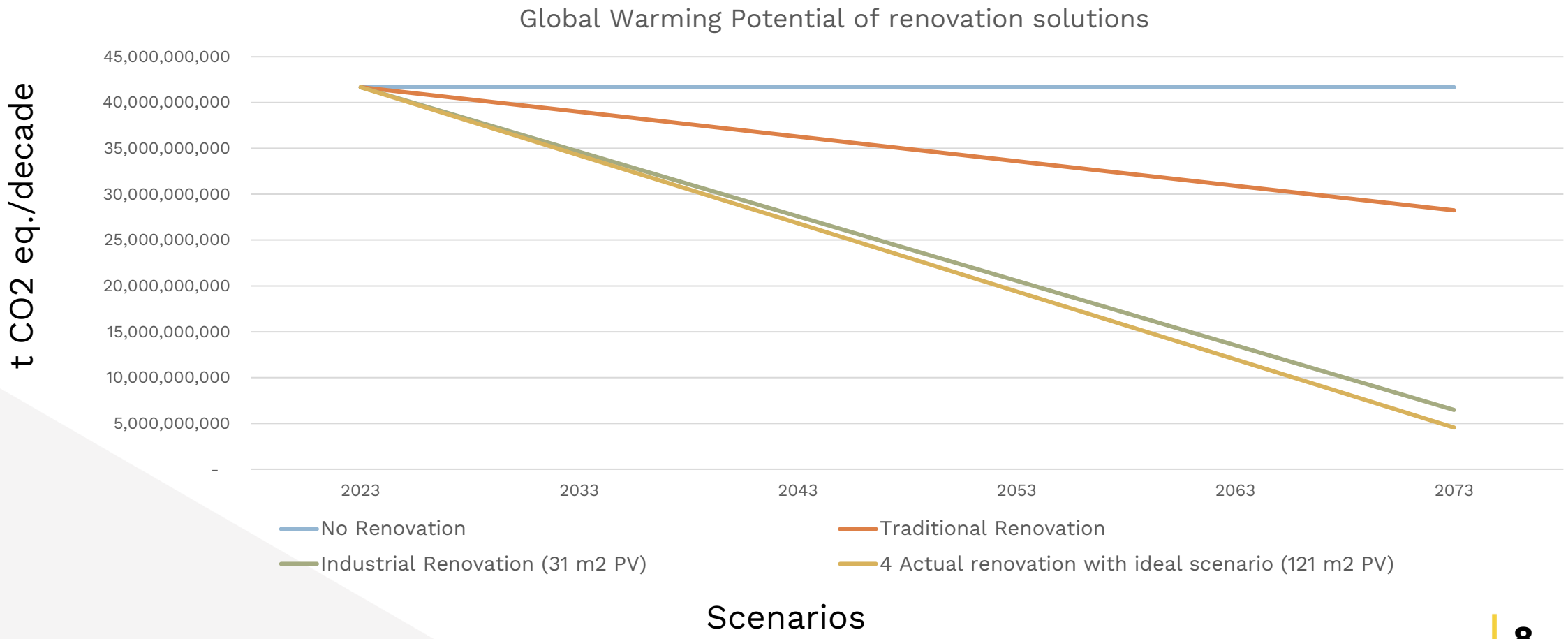
Functional Unit: providing a living environment to the inhabitants of a building over a reference study period of 50 years

Scale up of INFINITE results over time

- A central benefit is the elevated speed of industrialized renovation compared to traditional renovation
- These benefits only become visible over time
- Assumptions for scenario:
  - Current renovation rate (traditional): 1% [1]
  - Industrial renovation rate: 2% (based on data from INFINITE project)
  - Building stock in EU: 220 million buidings [1]

[1]https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_1836

INFINITE results scale up over time



LCSA Research questions

- What are the environmental, social and economic hotspots in industrial renovation?
- How does the reusability of these elements affect the products sustainability?

Design for dissassembly in building facades

- Design for Assembly/Disassembly method by Nobatek applied to building facades
- Main improvements:
  - modular and standardized components
  - Minimal integrated parts/compounds
  - Use of reversible connections (mechanical fasteners, dry-jointing systems)
  - Choosing materials that are easily separable and recyclable (wood, glass)

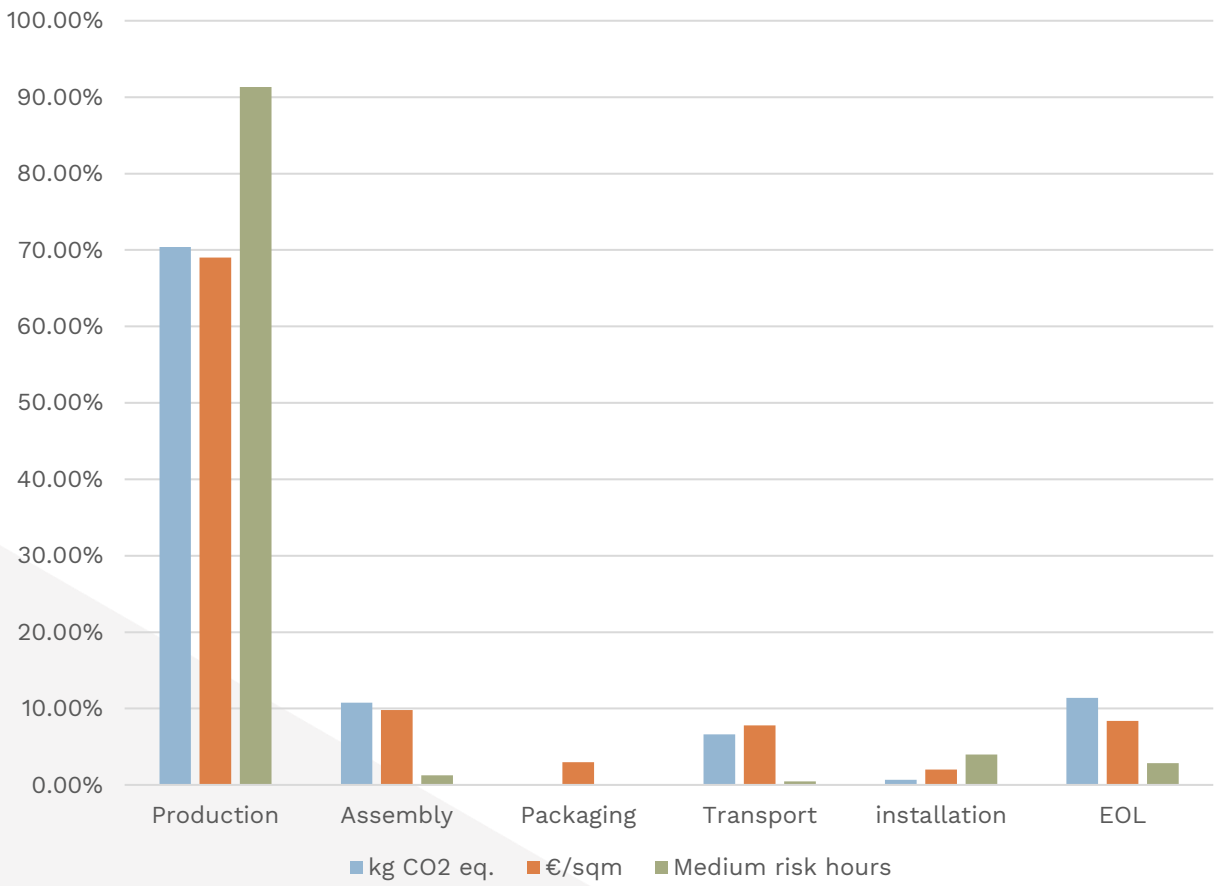
Methodology

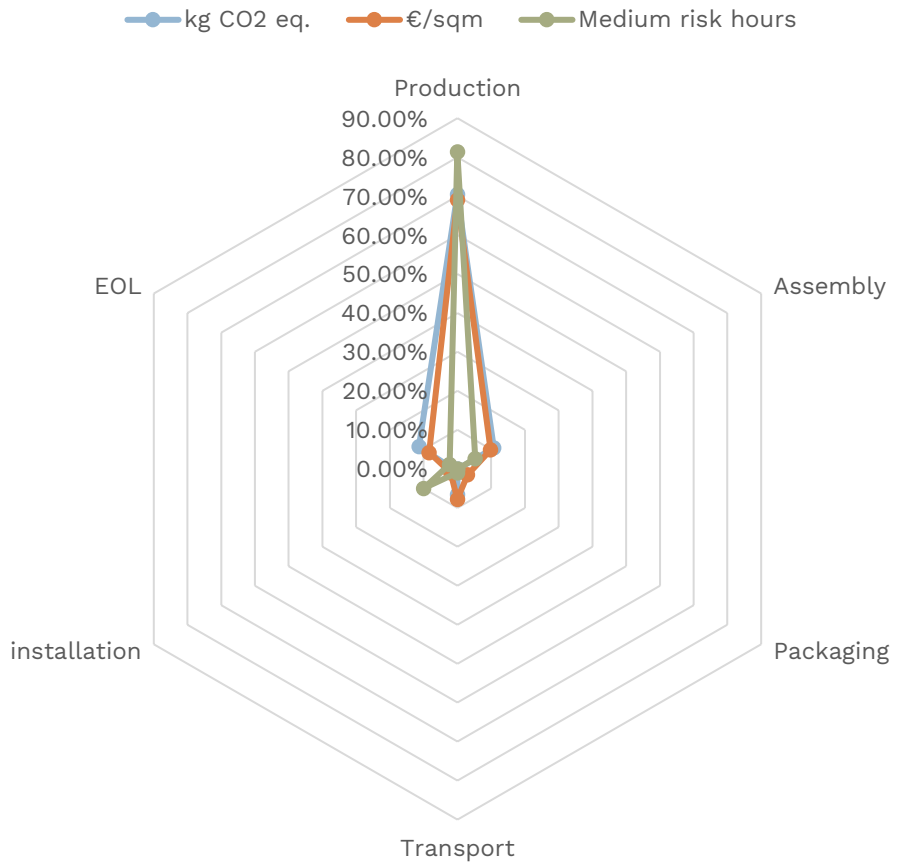
- Primary data collection of foreground system with first hand data
- **Background processes** were modelled with **Assumptions** were discussed with above mentioned partners

Environmental LCA	Social LCA	Life cycle Costing (LCC)
- Software: openLCA 2.0 - Database: ecoinvent 3.8 cut-off - Method: EF method v.3	Software: openLCA 2.0 Database: PSILCA 3 Method: Social Impacts Weighting Method	Software: eurac tool

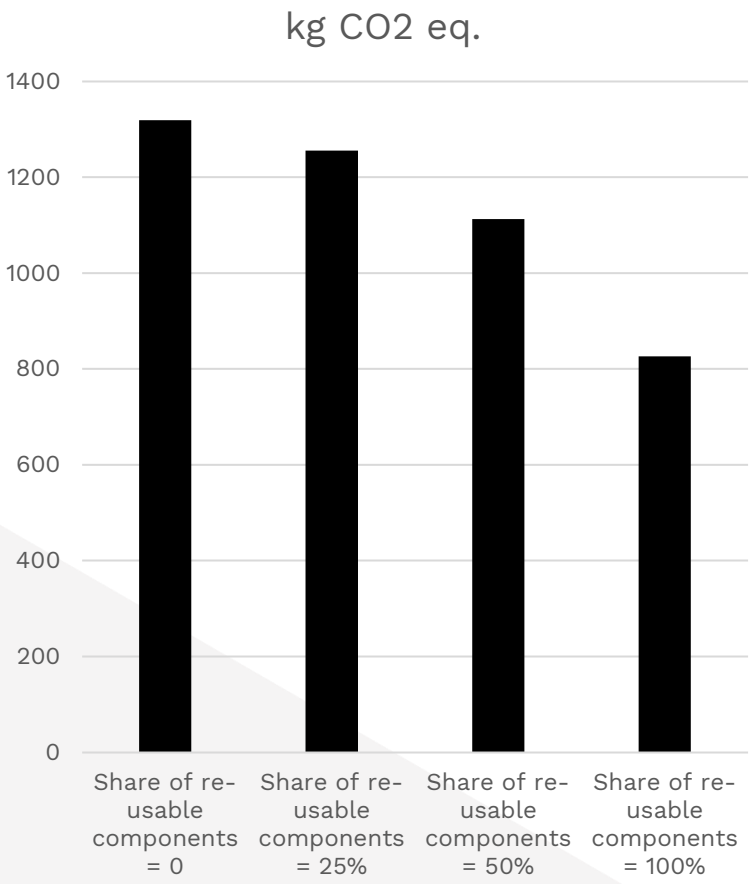
LCSA – life cycle hotspot analysis

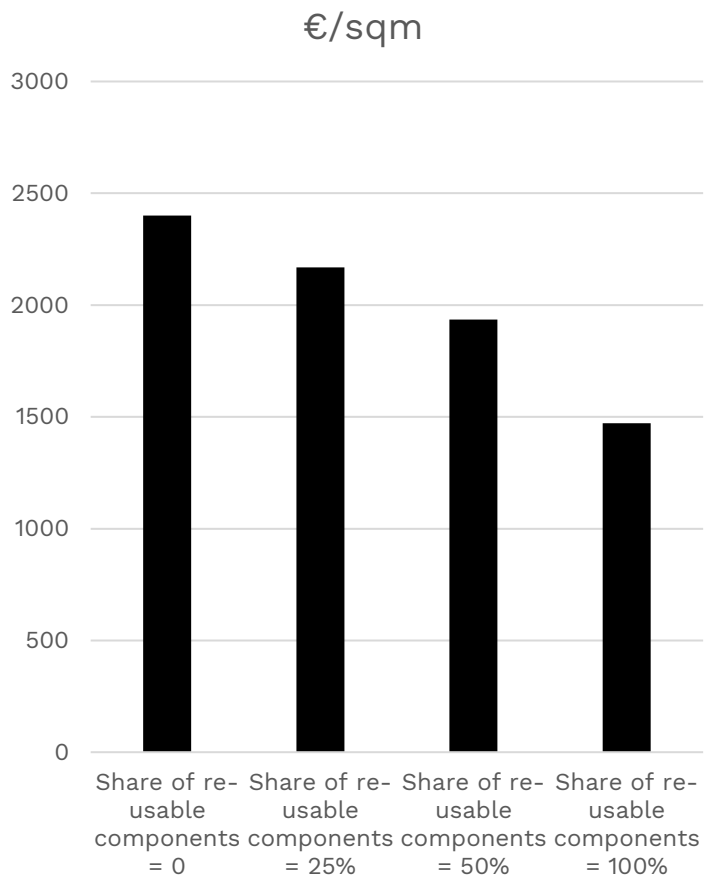
Selected indicators: GWP (kg CO2 eq.), LC-cost (€/sqm), risk of fatal accidents (medium risk hours)

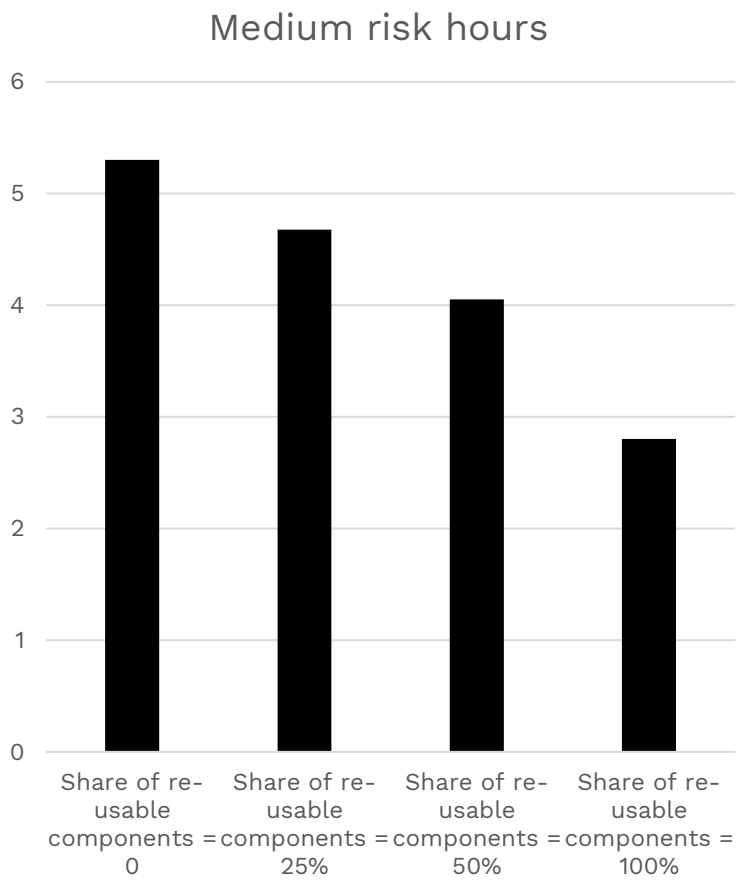




Comparison of shares of reusable components







Comparison of reduction rates

Scenario	Ecological reduction rate	Economic reduction rate	Social reduction rate
Recycling rate = 25%	4.80%	9.67%	11.77%
Recycling rate = 50%	15.64%	19.35%	23.55%
Recycling rate = 100%	37.33%	38.70%	47.10%

Conclusions

- **Regarding the industrialized building sector:**
  - Industrialized building renovation solution are very useful for the improvement of all dimensions of sustainability
  - Impacts of the life cycle phases on the impacts are similar for the three dimensions of sustainability
  - The percentage of risks of fatal accidents is comparatively high in production and installation
  - Reusable facades are very useful to improve the facades sustainability, especially for social impacts
- **Regarding (open)LCA data:**
  - Better data for industrialized renovation needs to be gatheres. It is questionable if the used data from traditional manufacturing is transferable to industrialized building renovation

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Thank you!

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