



# Low-carbon buildings: How representative are LCA results at early design stages?

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## The Brf Viva Project begins

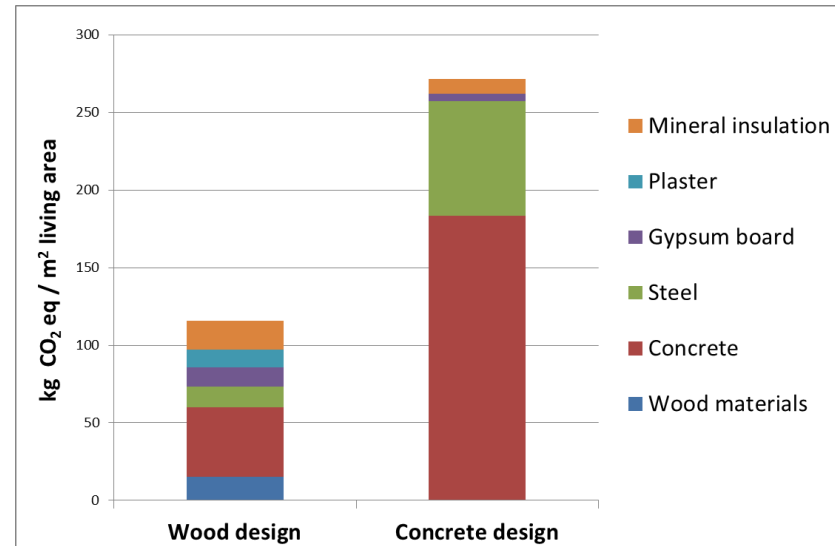


- What?
  - Multi-storey housing project
  - Gothenburg (Sweden)
  - Three buildings, 6000 m<sup>2</sup> living area
  - Living lab
- Who?
  - Riksbyggen
  - Universities and research institutes
  - Other stakeholders
- Focus on:
  - Energy efficiency
  - Social sustainability
  - Climate impact reduction



# The first knock on the door of Life Cycle Management

- A screening LCA
- Aim:
  - To start exploring low-carbon design alternatives
- Carried using:
  - Living area estimations
  - Material data from other projects
  - Generic LCI data





## Our project starts

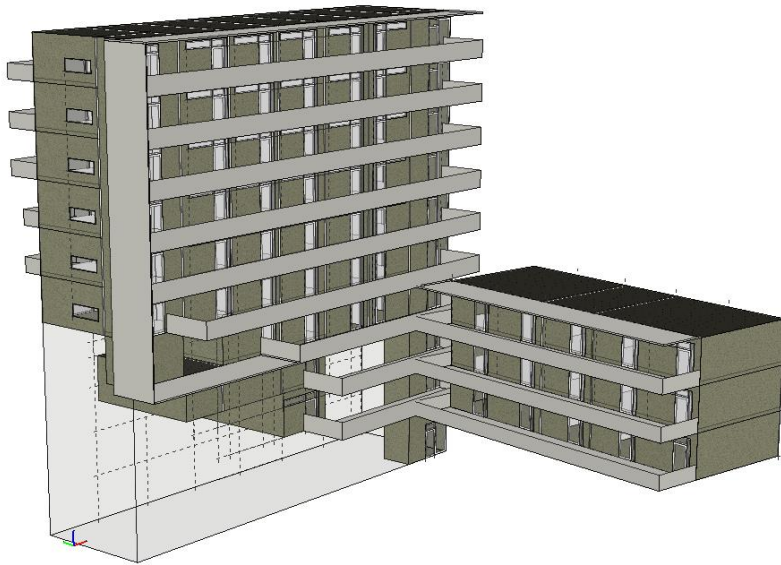
- Aim:
  - To provide designers with input and tools towards an optimized design regarding energy consumption, climate impact and energy efficiency.
- WP3:
  - Climate impact calculations for different design alternatives during the design process
  - Suggestions for climate impact reduction of the designs evaluated
- Financed by the Swedish Energy Agency



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## Second screenings



- Cradle-to-grave LCA of two building systems:
  - a massive timber CLT structure
  - a concrete structure
- Bill of materials estimated from architectural drawings
- Alternative “climate-smart” designs
- Explored effects of data choice:
  - Supplier-specific EPD data
  - Generic data (Ecoinvent), adapted to regional practices
  - Unmodified Ecoinvent data



## The concrete design

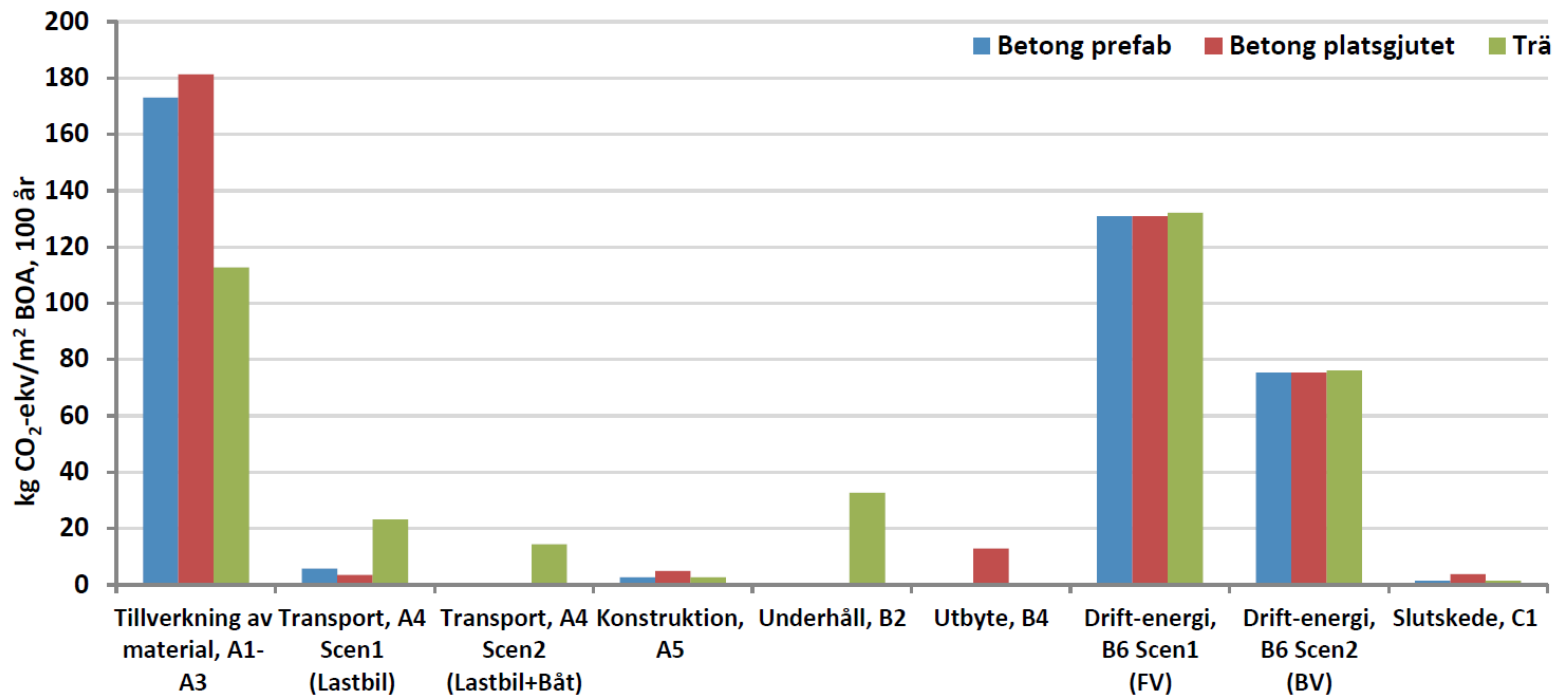
- Design features:
  - Concrete structure (prefab and cast in-situ)
  - EPS insulation
  - Gypsum board coverings
  - Cement with lower clinker content
  - Resource efficient elements
- Sensitivity analysis:
  - Concrete carbonation
  - Quality of internal concrete

## The wood design

- Design features:
  - CLT structure
  - Concrete foundation
  - Mineral wool insulation
  - Gypsum board and plywood coverings
  - Prefabricated elements
- Sensitivity analysis:
  - Transport mode and load factor for prefabricated modules

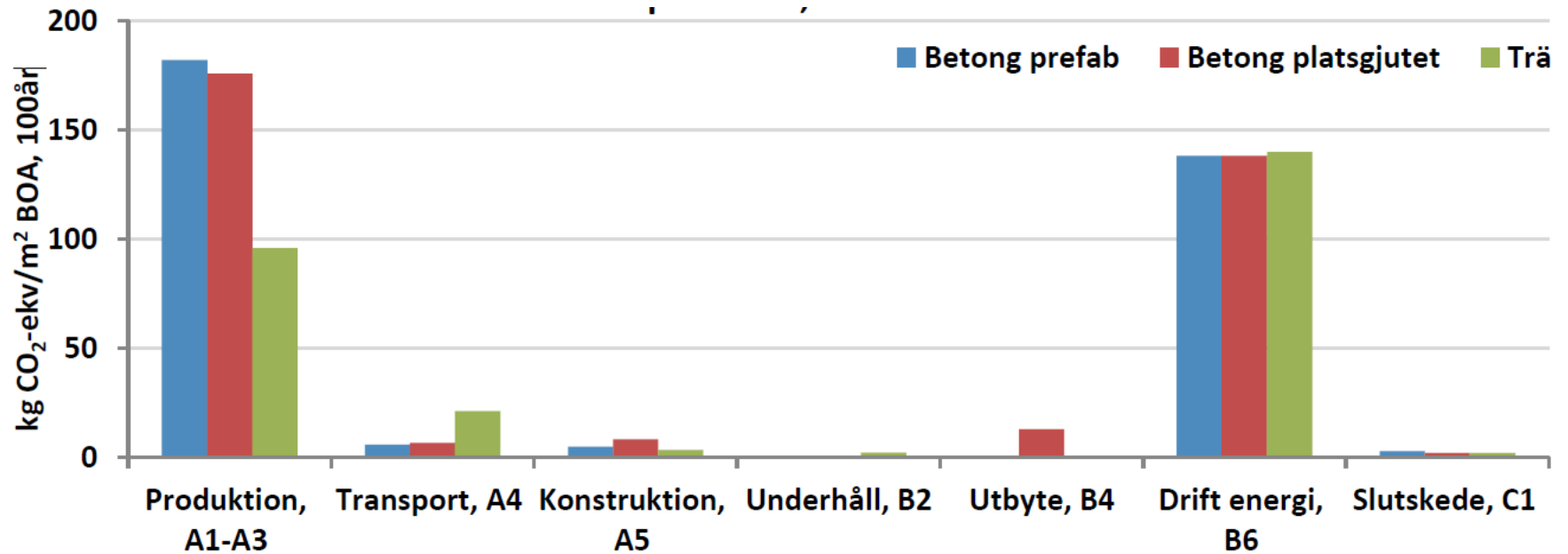


## Results (screening 2014)





## Results (refined, 2015)



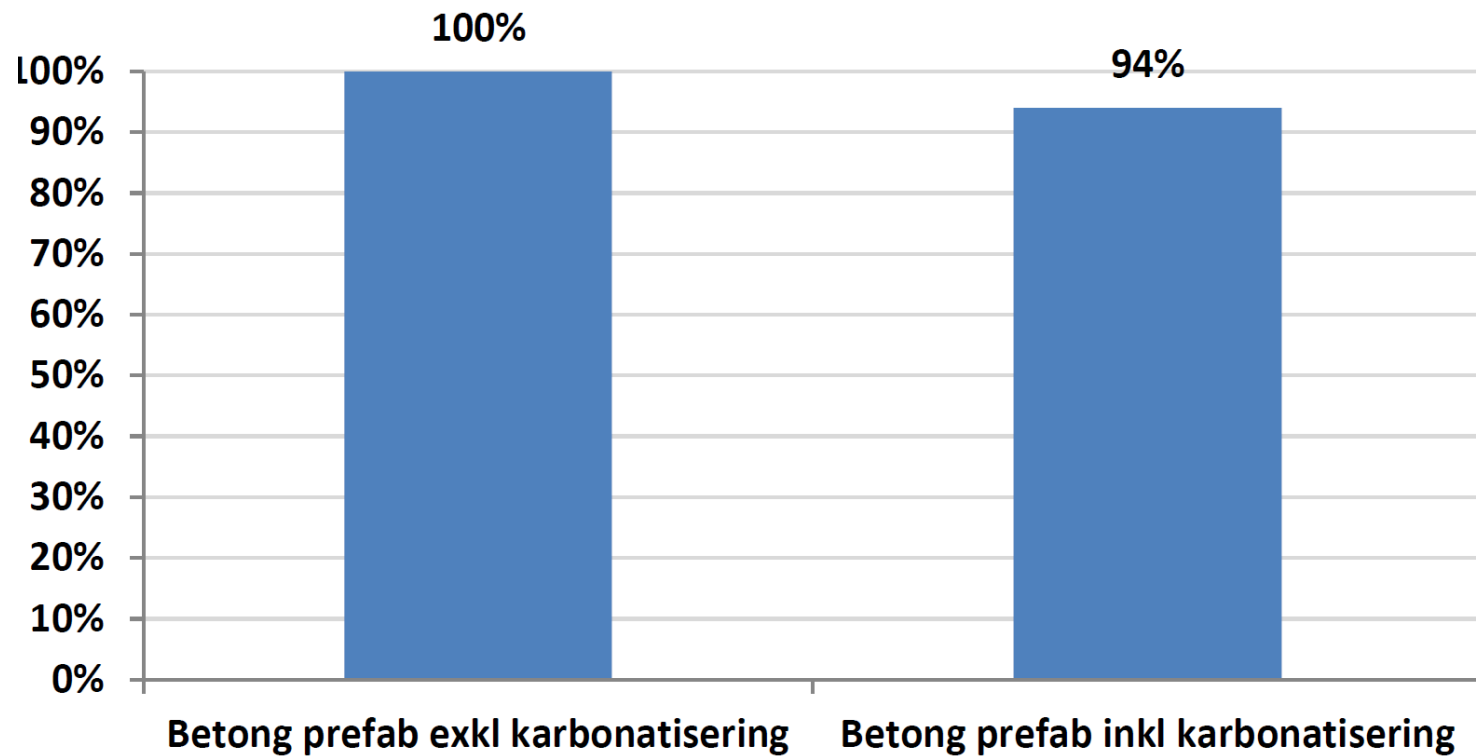




# Sensitivity analysis

## Concrete carbonation

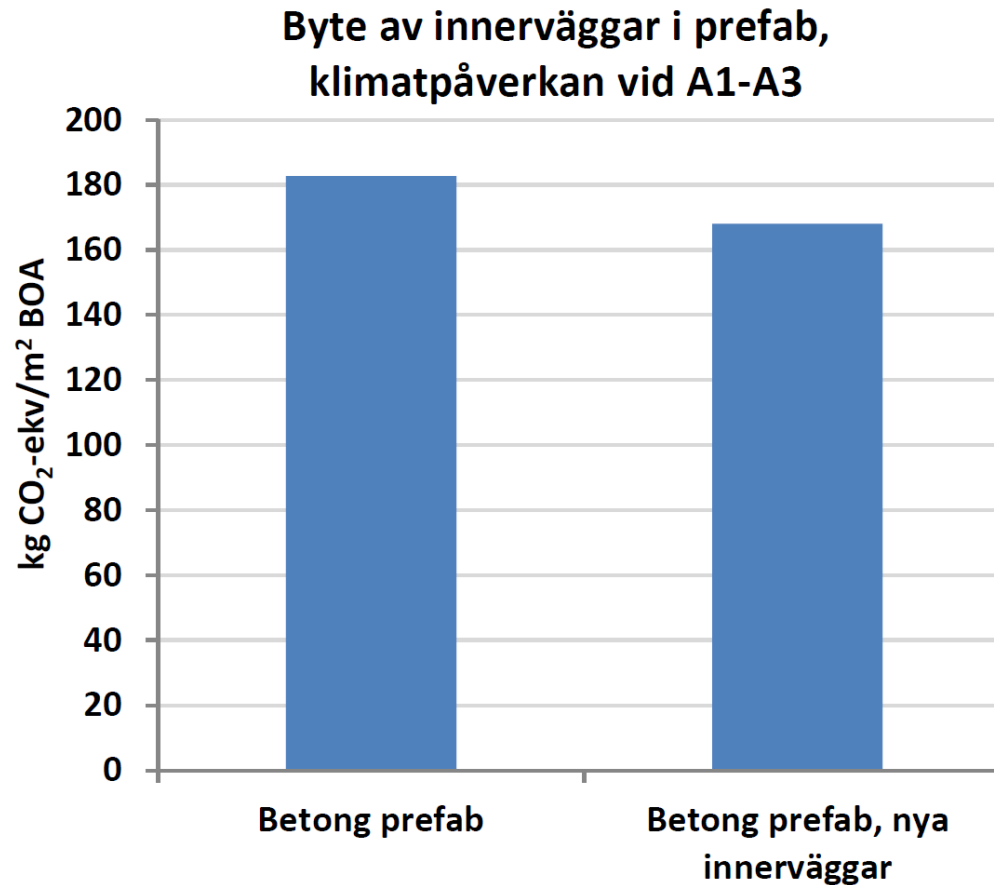
Inverkan av karbonatisering för prefab i A1-A3





# Sensitivity analysis

## Internal wall quality (concrete)

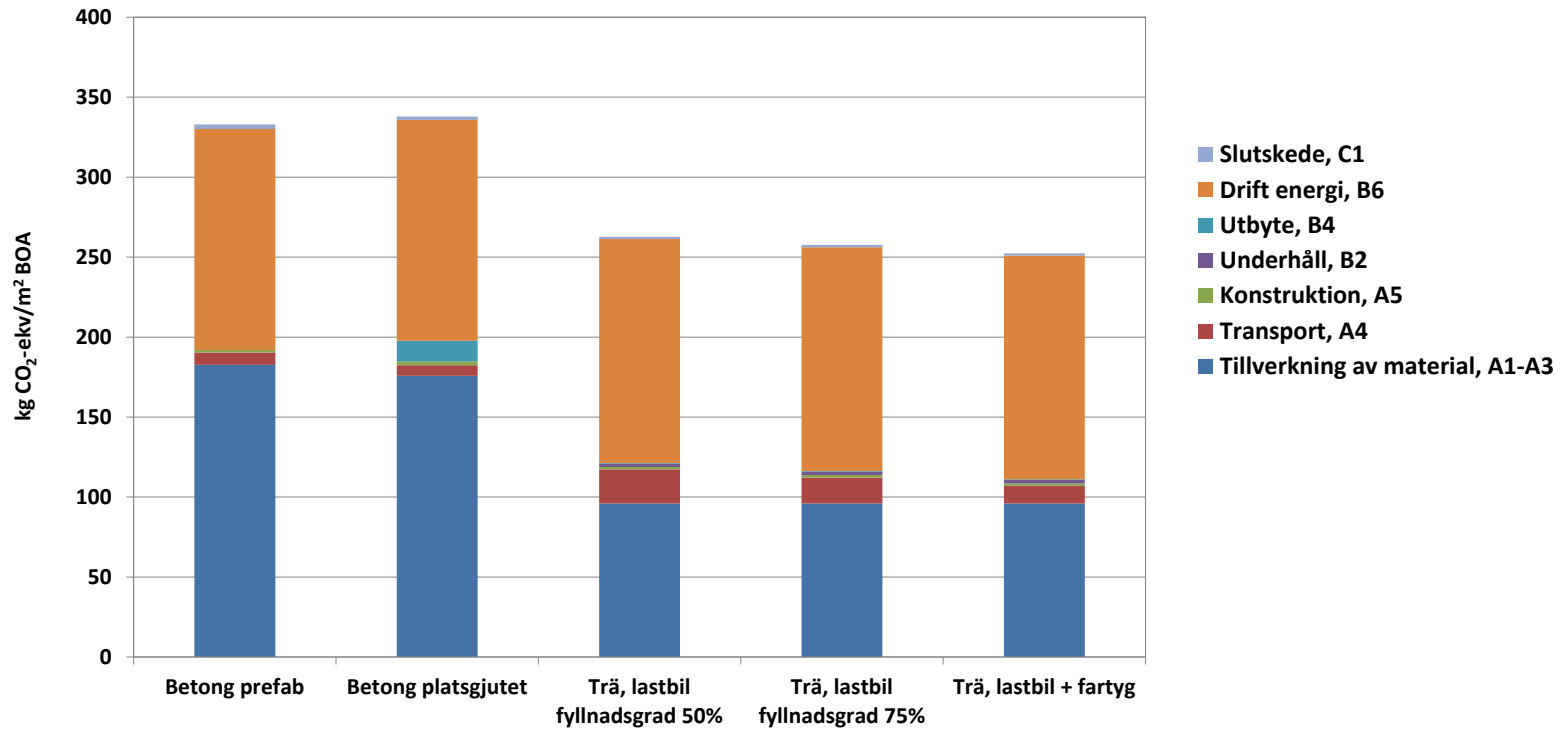




# Sensitivity analysis

## Transport of prefabricated elements (wood)

Känslighetsanalys, transportscenarier för trä, klimatpåverkan





## What is happening right now?

Riksbyggen chose concrete

Design with minimal climate impact, focus on hot-spots:

- Smart solutions for dematerialization (hollow core slabs, beams taking large loads)
- Low-impact reinforcement
- Optimizing of:
  - Proportion of clinker in cement
  - Proportion of cement in concrete
  - Service life of building elements
- Efforts to increase the share of renewable fuels in cement production



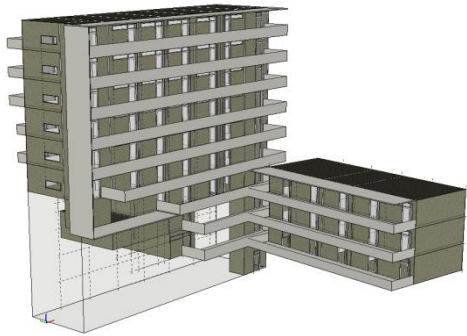


## Learning outcomes to share

- Early screening LCAs can be misleading (2012-2015)
  - Low level of detail
  - Reduced budget
  - Does not capture all possibilities for climate impact reduction
- Importance of data choice
  - Specific data are key for decision-making
  - EPDs and communication with designers
- Challenges:
  - To deliver robust results in time to influence decision-making
  - To communicate with all parts involved



## What is going to happen next?



- Final assessment of final design
- We will try to answer:
  - Were the screenings and estimations close to reality?
  - Did we make an impact?
  - Was LCA helpful?
- Planned publications:
  - One research report
  - One scientific article



**Thank you for your attention through all these years**

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