

Where if? Using spatial, building-stock- driven simulations to explore construction circularity strategies in Gothenburg, Sweden



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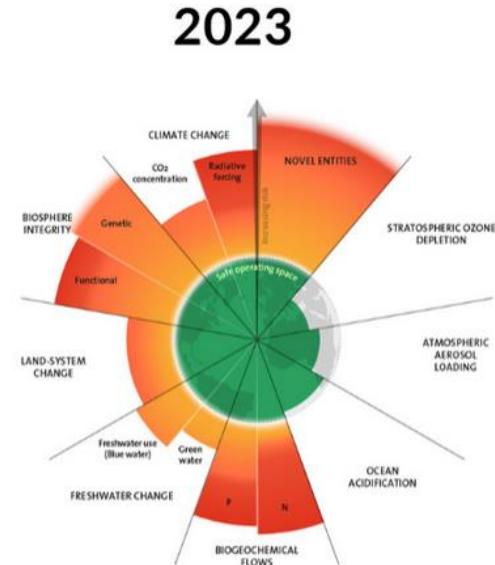
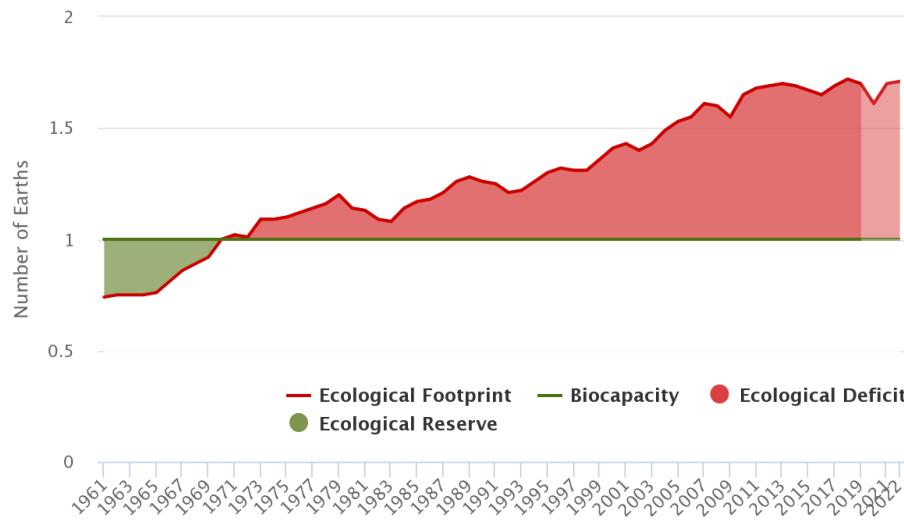
Questions



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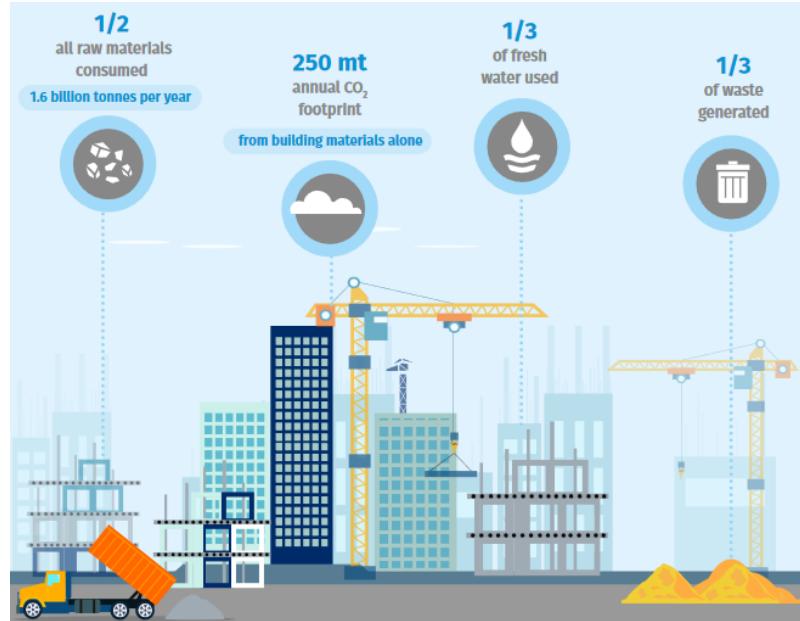
Living beyond Planetary Boundaries

- Since 1970, the world has extracted resources at a faster rate than its capacity to regenerate.
- Today, we consume 1.7 planets



9 boundaries assessed,
6 crossed

Relevance of the Construction sector



E C O S - FROM BARRIER TO ENABLER
TOWARDS A GREENER EU CONSTRUCTION PRODUCTS POLICY

Resource management target in EU

Commission Decision 2011/753/EU

- by 2020, the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste shall be increased to a minimum of 70 % by weight
- by 2025, the preparing for re-use and the recycling of municipal waste shall be increased to a minimum of 55 %, 60% and 65% by weight by 2025, 2030 and 2035 respectively

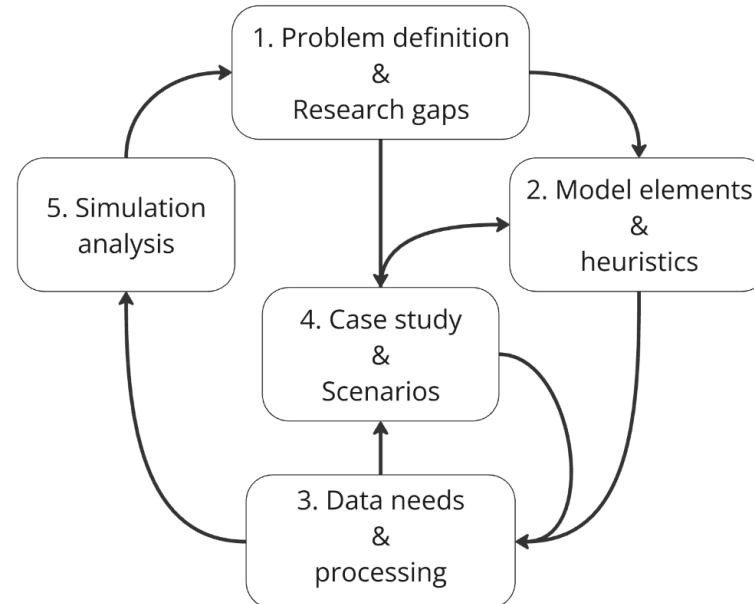
Aim of the study

To demonstrate the potential of MS-driven simulations for evaluating the environmental impacts of C&D activities in a spatially and temporally refined manner.

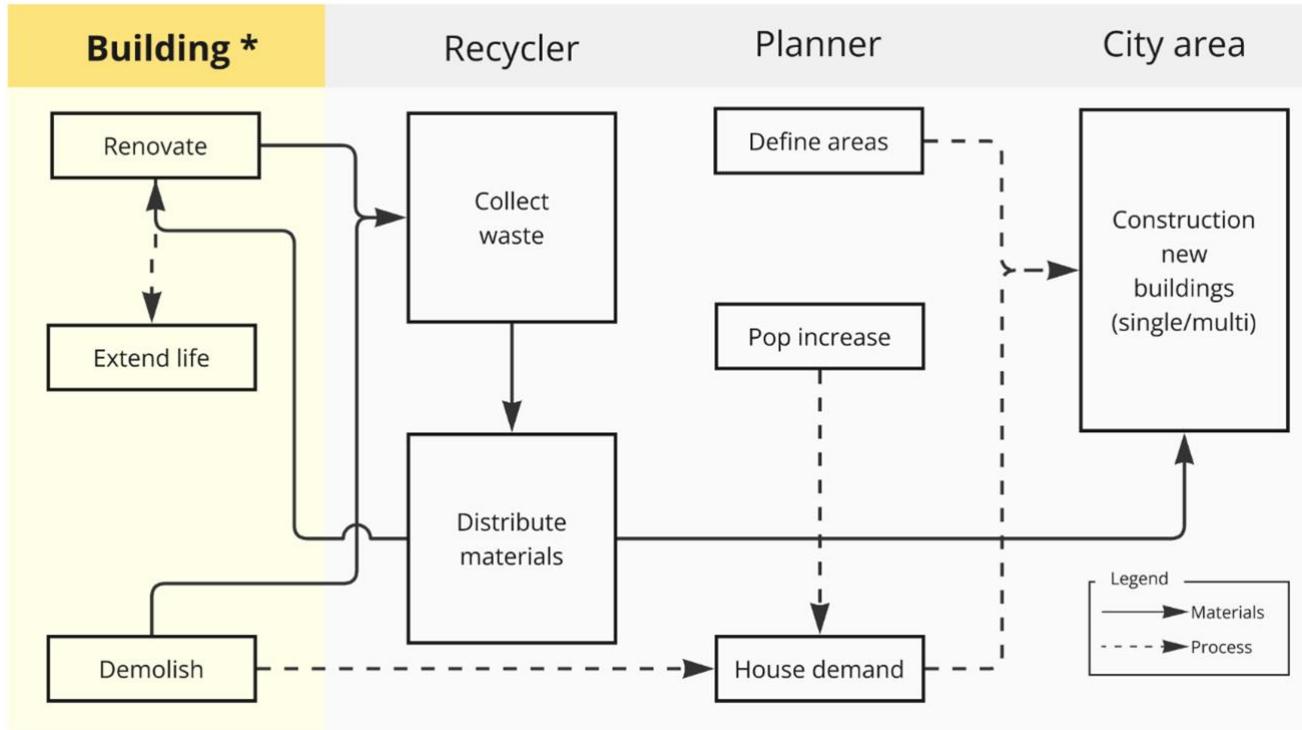
Objectives:

1. To develop a rule-based simulation that allows users to explore the implications of urban policies related to demolitions, renovations, material reuse, and building typologies.
2. To showcase the model's usefulness by exploring how introducing different policy scenarios can impact resource use and EC.

Framework of the study

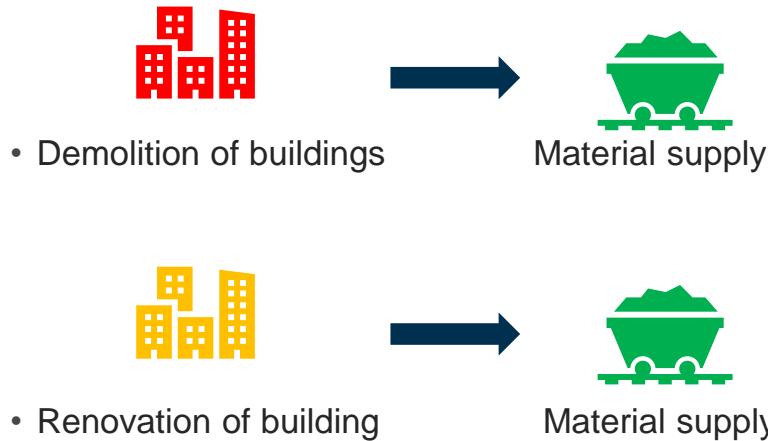


Aim of the study



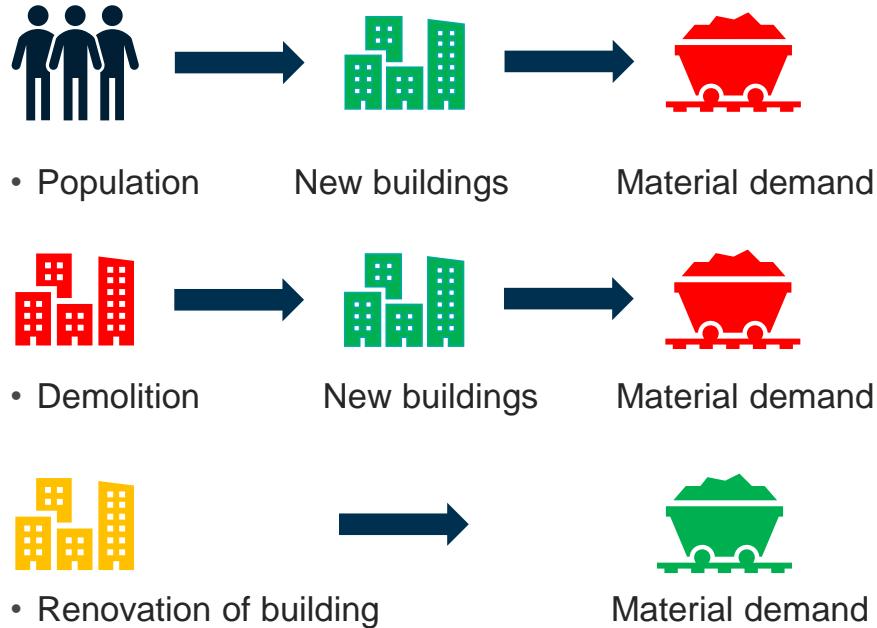
Conceptual development

Supply of materials

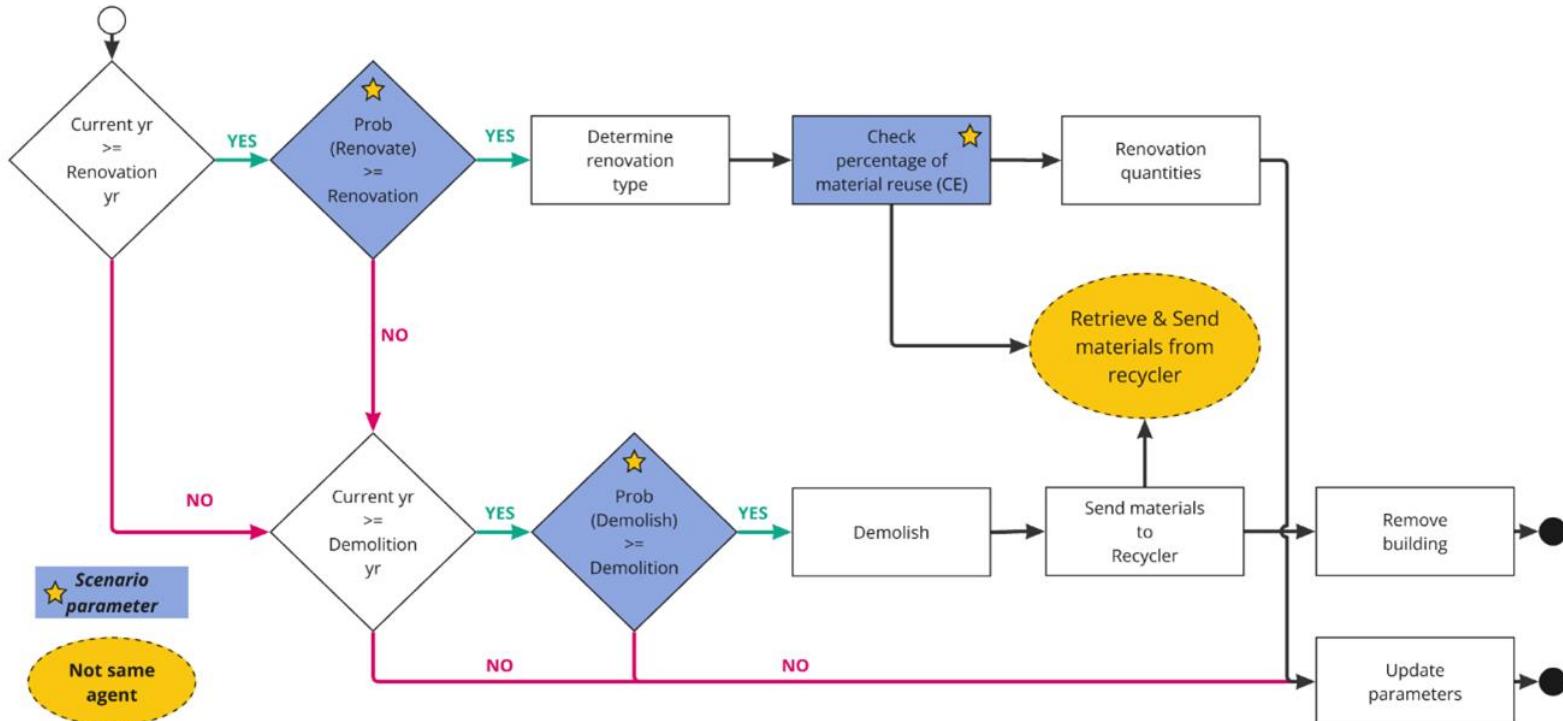


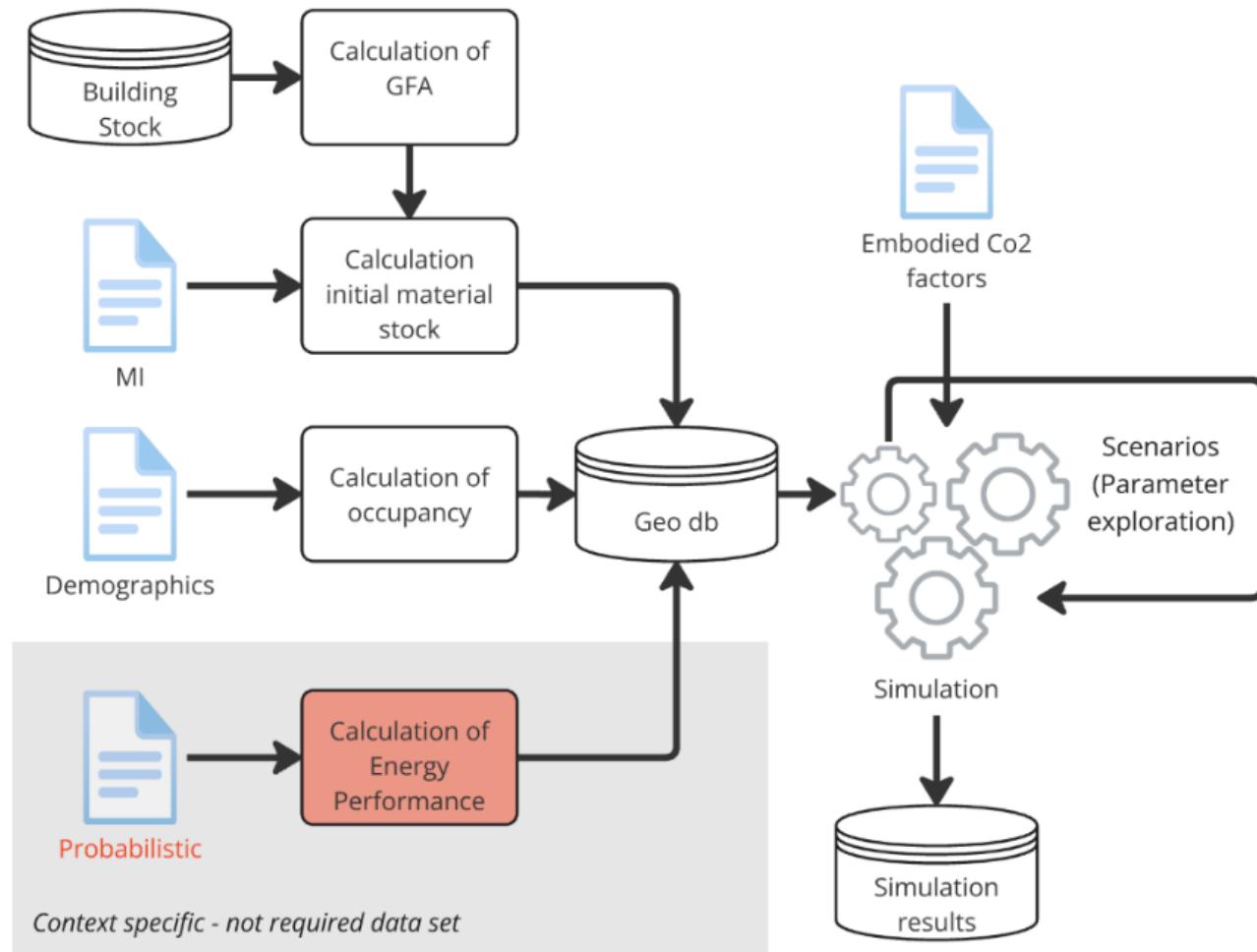
Conceptual development

Demand of materials

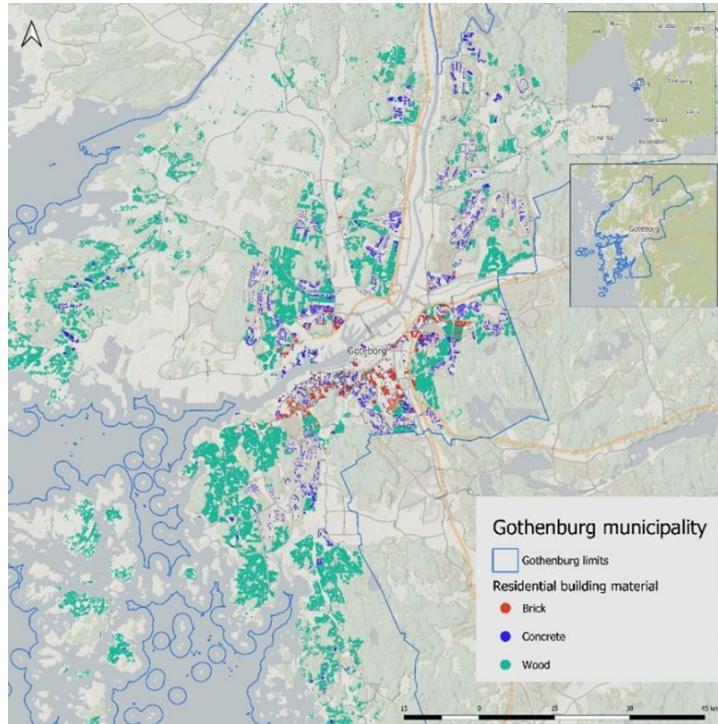


Buildings heuristics





Buildings in Gothenburg



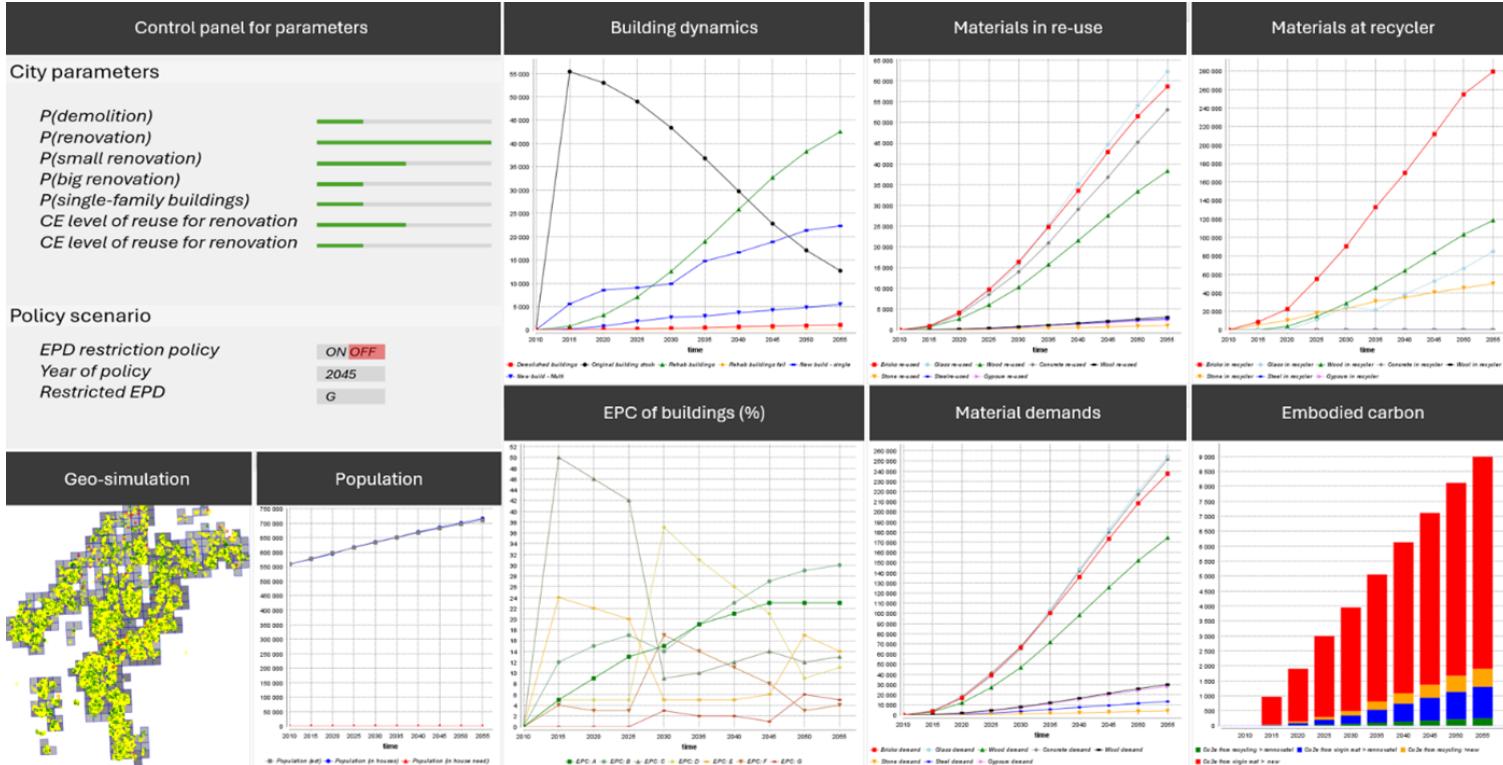
Buildings built after year 2000

Characteristics	Single family	Multi-family
Floors	1.5	3
N of buildings	4172	40
Construction Year	2004	2003
Footprint	120	221
Height	2.3	6
Gross floor area	173	665
Wood (Kg)	5192	17956
Wool (Kg)	8134	29262
Brick (Kg)	0	0
Concrete (Kg)	30460	434943
Stone (Kg)	0	0
Gypsum (Kg)	8653	11970
Glass (Kg)	346	1330
Steel (Kg)	2596	131015
Households	1	6

Embodied carbon factors

Material	Product name	Category	A1-A3 resources climate impact (CO2e/Kg)
Gypsum	Gypsum, standard plasterboard	Building boards	0.284
Concrete	Columns	Concrete	0.298
Brick	Bricks	Blocks and tiles	0.314
Glass	Floatglass (FG)	Windows, doors and glass	2.75
Steel	Stainless steel rebar, 72 % scrap based	Steel and other metals	4.75
Wool	Stone wool, facade board	Insulation	1.61
Wood	I-joist wooden beams	Solid woods	0.406
Stone	Stone-composite facade board, 18-20% w/w polyester binder	Building boards	1.86

Developed model



Parameter exploration

Every 5 years: 2015 – 2100: 18

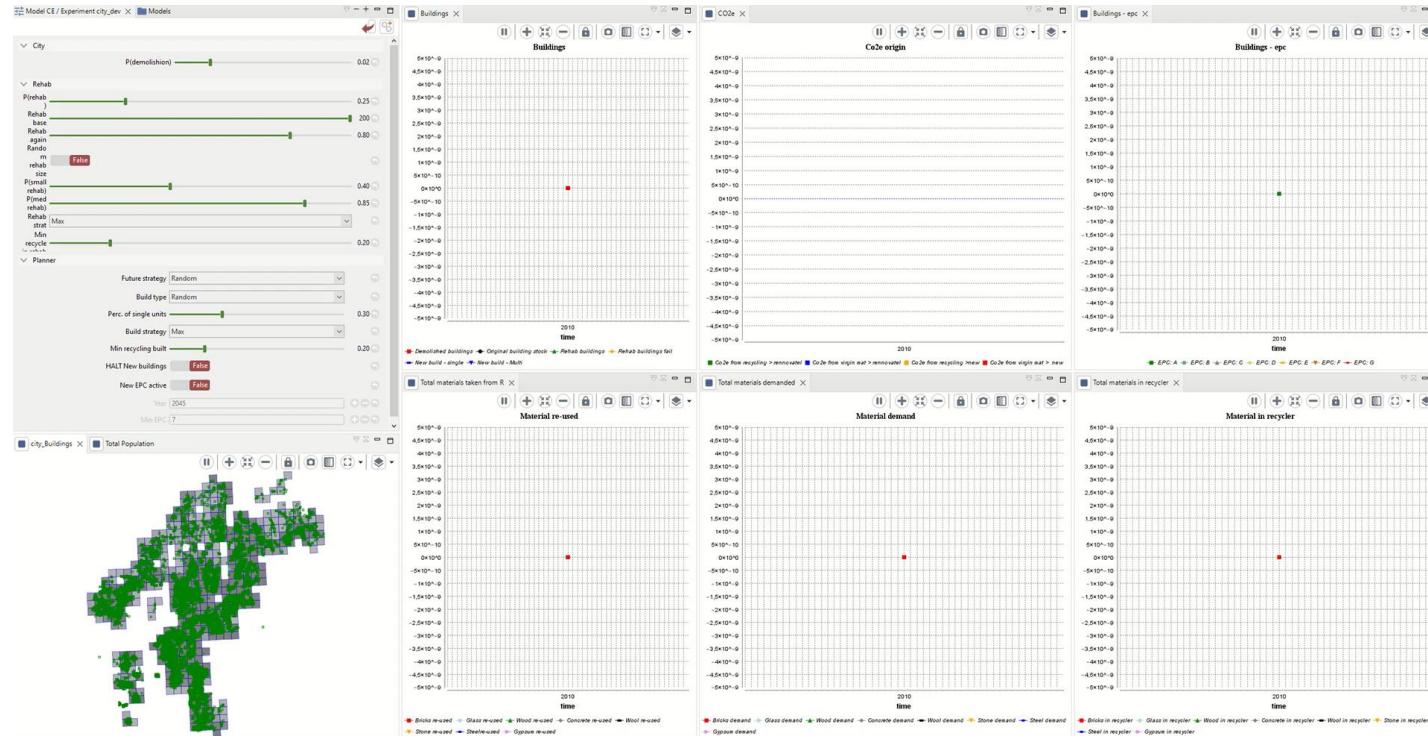
- Renovation 0, 25, 50, 75, 100
- CE new building 0, 25, 50, 75, 100
- CE renovations 0, 25, 50, 75, 100
- Single-family 0, 25, 50, 75, 100
- Demolitions: 0, 1, 3

Total 1875 x 10 -> 18,750 per 5year -> 337,500 obs

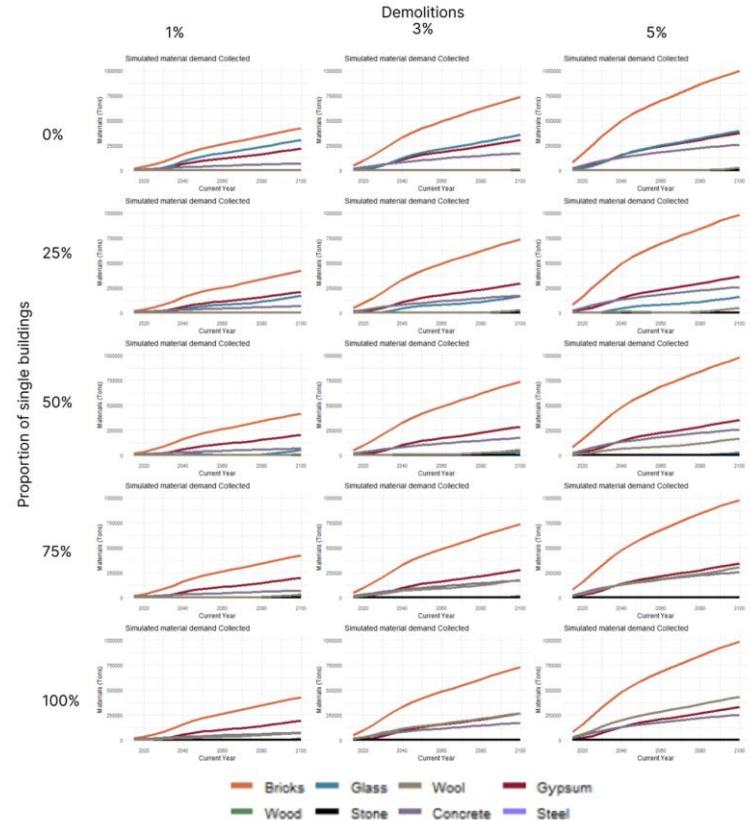
And policy scenario 1875 x 5 -> 9,375 per 5year



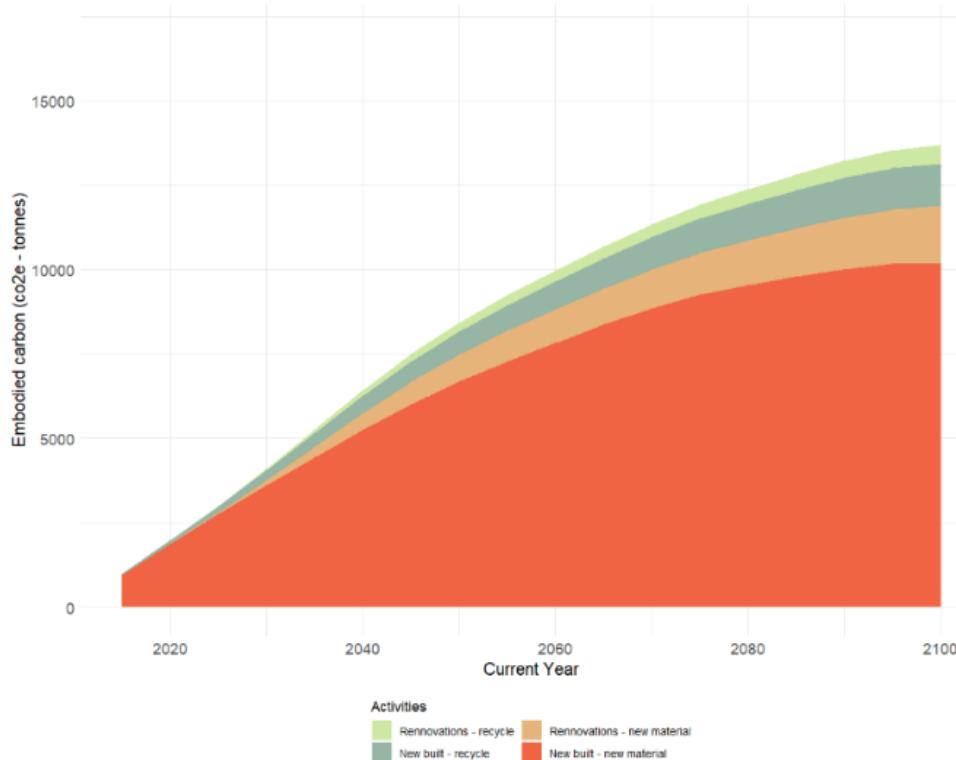
Developed model



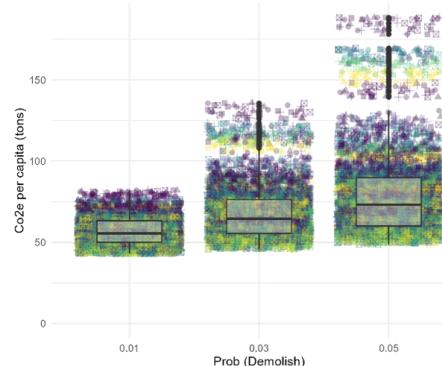
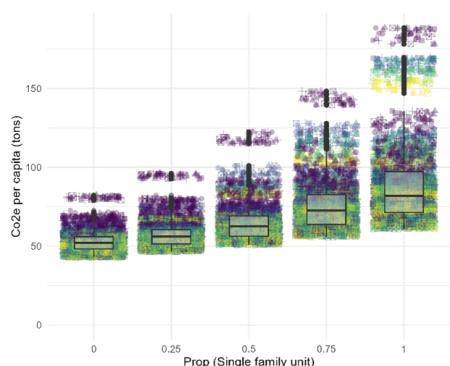
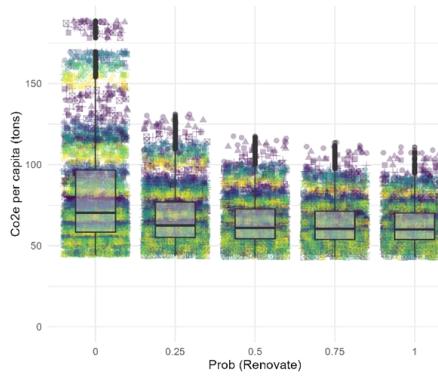
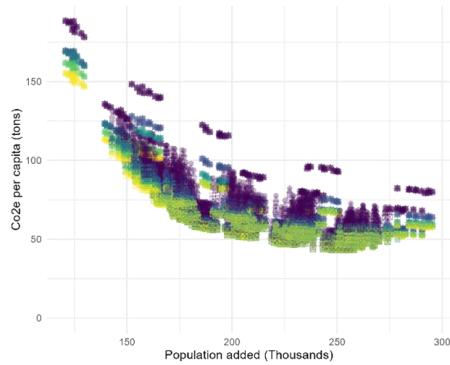
MS dynamics



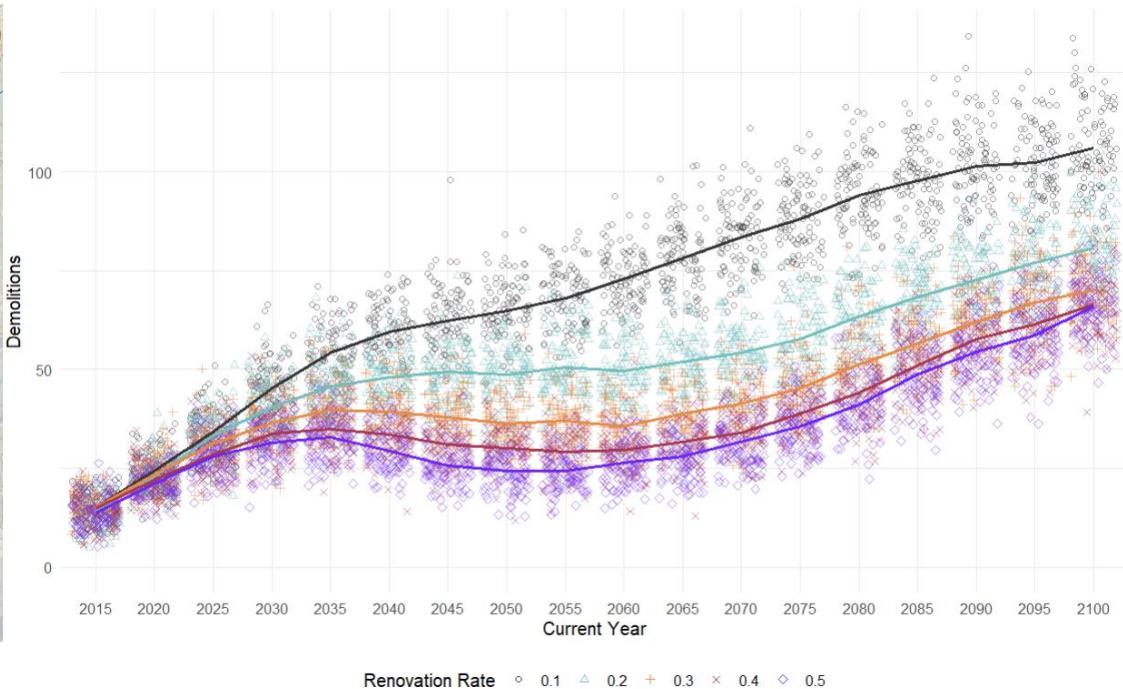
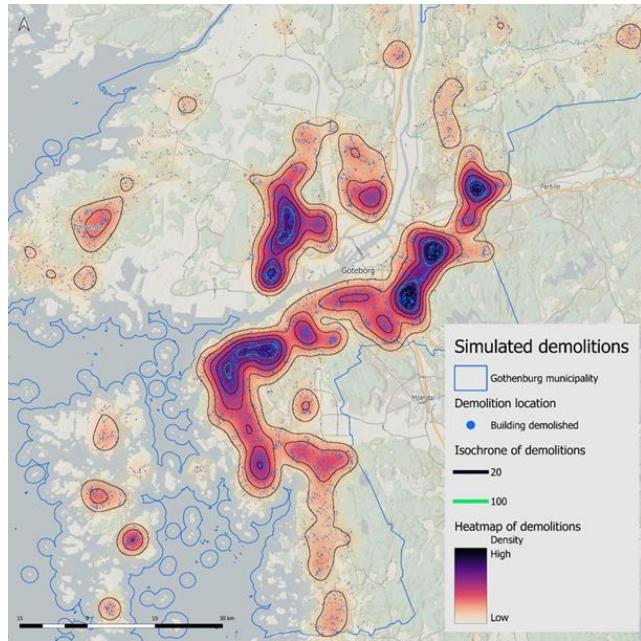
Embodied carbon at municipal level



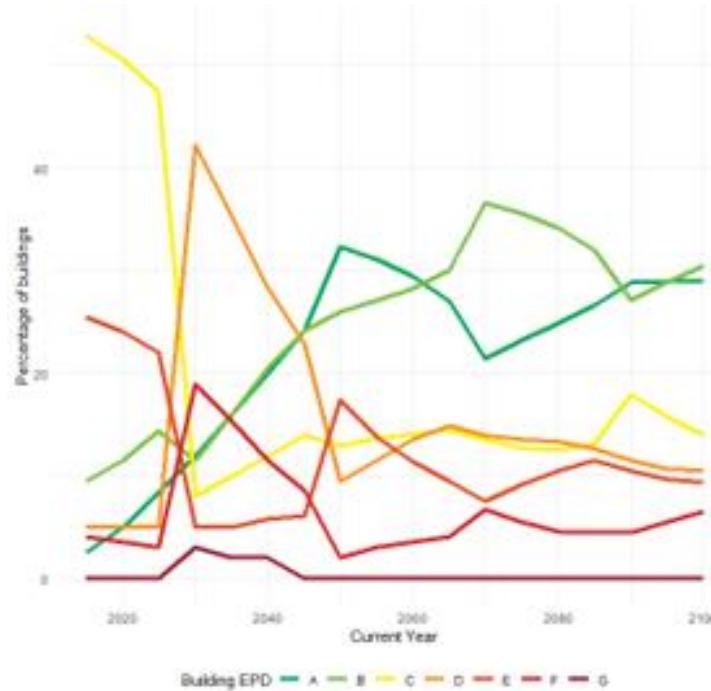
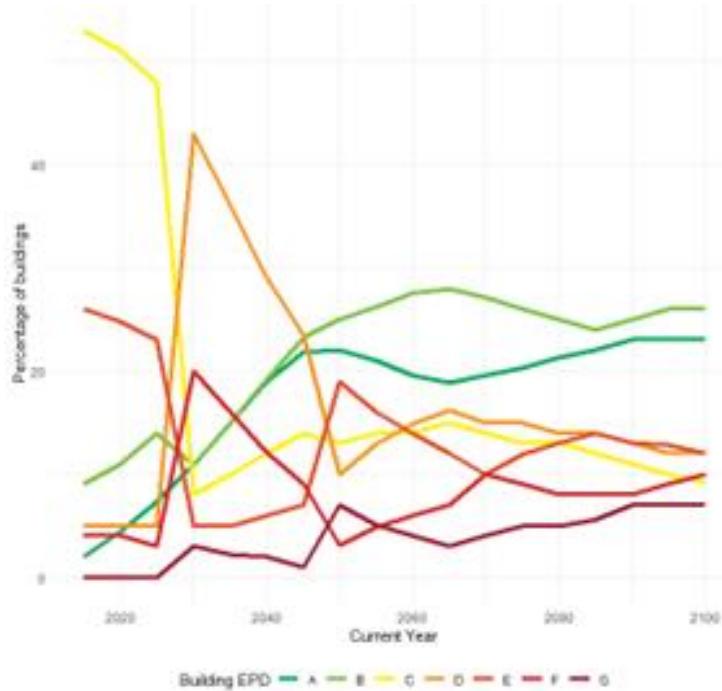
Demolitions and renovations



Demolitions and renovations



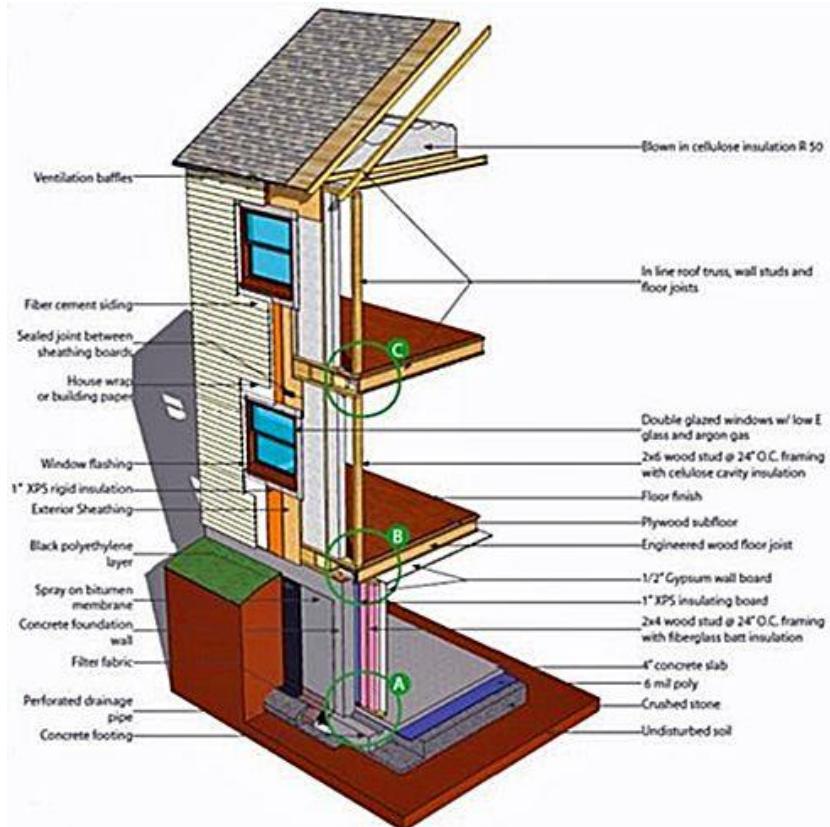
Policy scenarios



Contributions

- Estimate future scenarios of various CE strategies
- Determine spatio-temporal location of material needs and availability
- Develop a model with general heuristics that can be adapted to other case studies

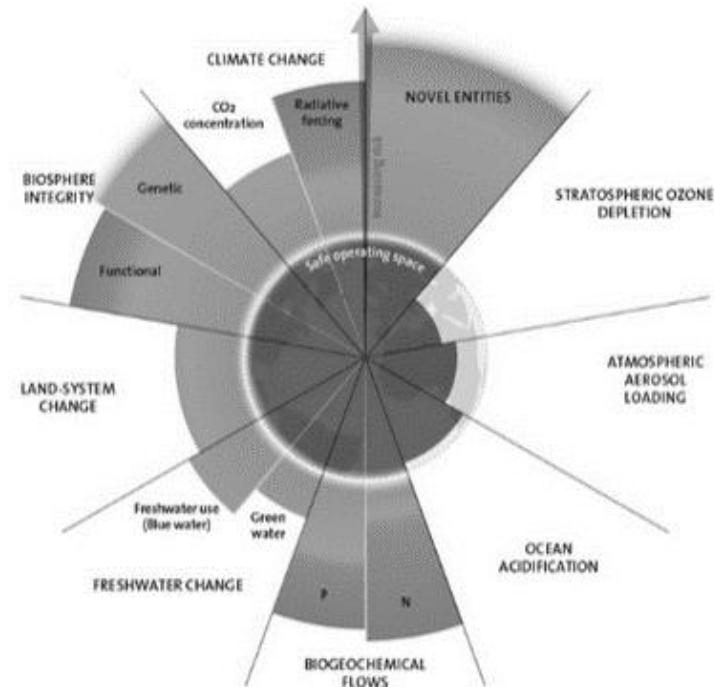
Future work – beyond materials



Future work beyond structure



Future work – beyond co₂



Thanks for listening

Jonathan
Cohen



Maud
Lanau



Jorge
Gil



Leonardo
Rosado

