

**TAL  
TECH**

## **RENOVATION AND DIGITAL TRANSFORMATION**

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**BACKGROUND**



# CONSTRUCTION AND BUILT ENVIRONMENT IMPACT

## Impact on Environment

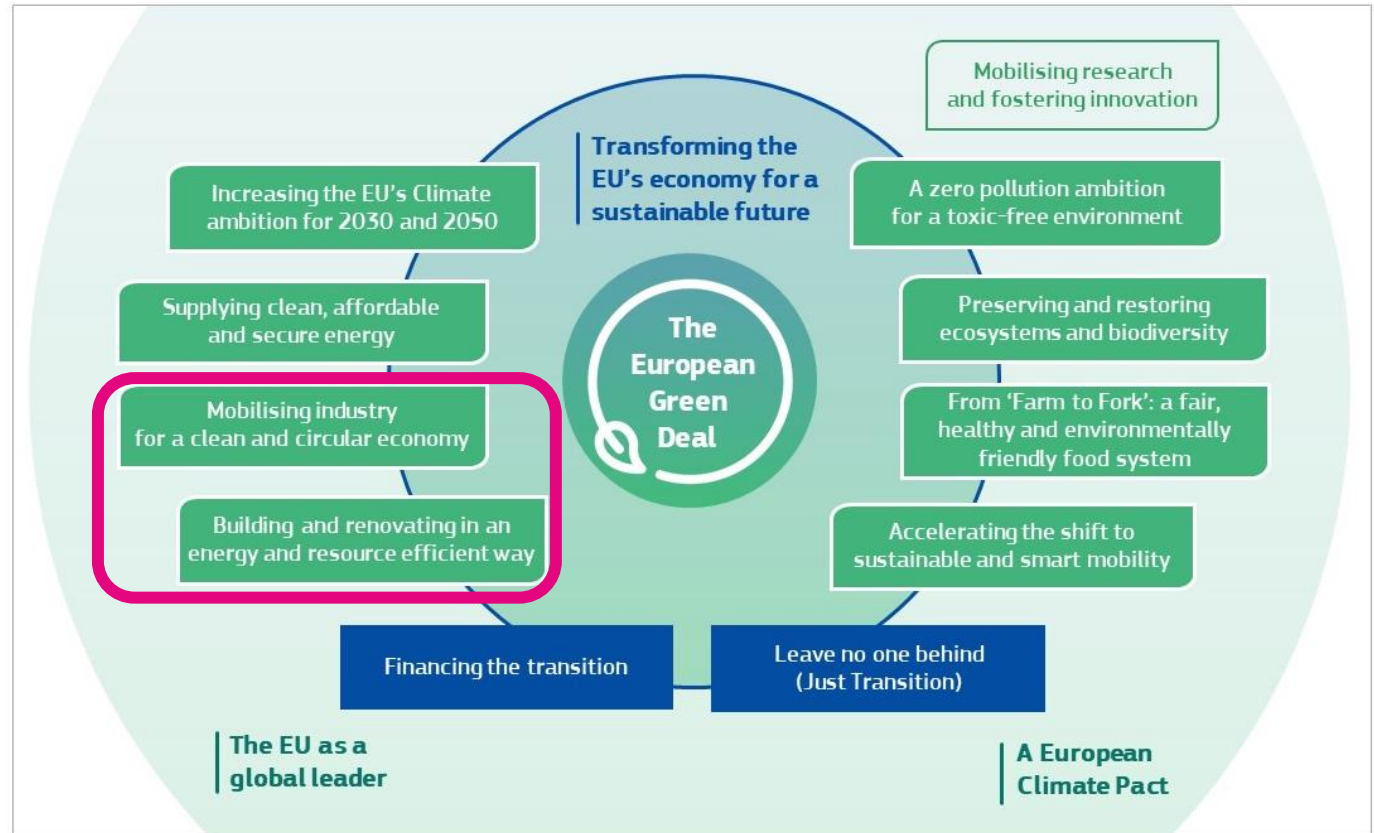
- 40-50% of raw material is consumed in construction globally, [OECD](#)
- Construction creates an estimated one-third of world's waste ([link](#))
- The construction sector in Europe accounts for more than 40% of Europe's energy consumption and 36% of CO2 emissions

## Housing and Building Stock

- 1.6 billion people worldwide live in inadequate conditions ([link](#))
- Ca 80% of today's buildings in Europe will still be in use by 2050
- Ca 75% of buildings are not energy efficient

(Renovation Wave, [link](#))

# PARIS AGREEMENT TO GREEN DEAL



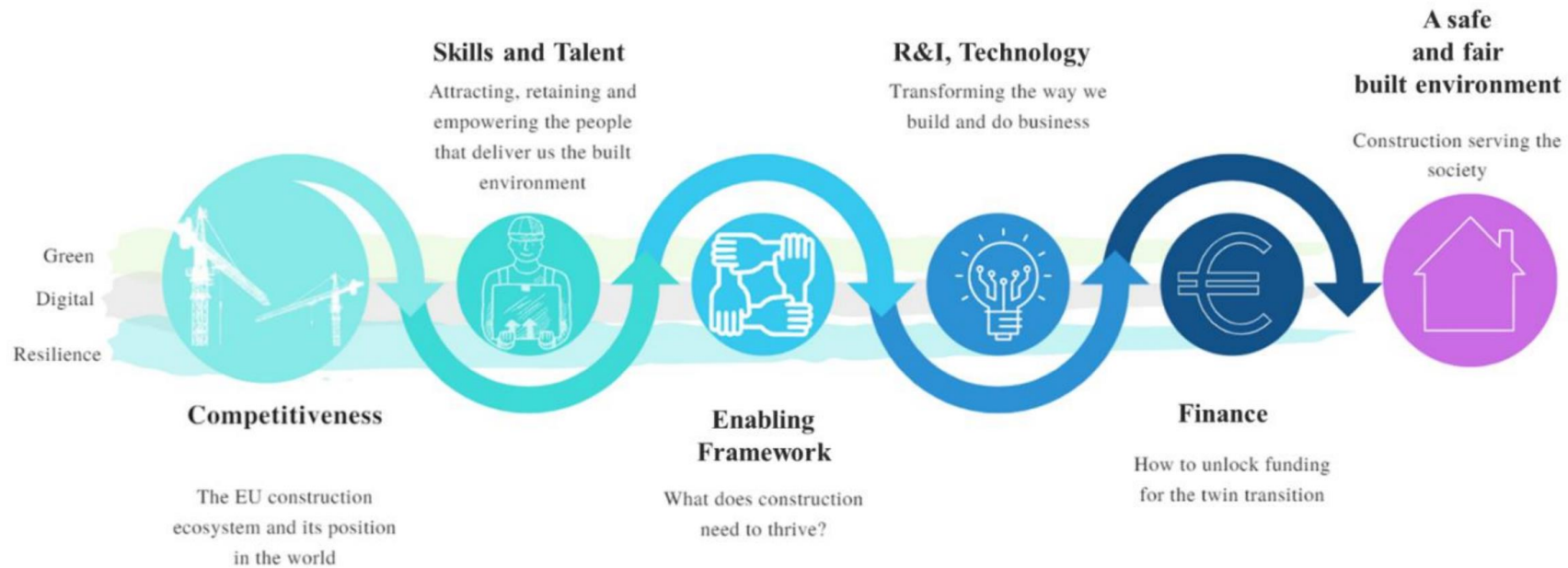
# TO SUSTAINABLE CONSTRUCTION AND BUILT ENVIRONMENT

- **Reducing unnecessary consumption and waste:** energy, material, land, water
- **Changing the nature of necessary consumption:** from fossil to renewable
- **Collaboration:** from individual to multiple
- **Digitalization:** processes, products, and services



# RENEWAL OF EUROPEAN INDUSTRIAL STRATEGY

- The European construction industry needs to transform **business models, value,** and **supply chains** to become the engine of a **green, digital,** and **sustainable** European economy.
- **The construction transition pathways blueprint (European Commission, 2023d):**



# RENOVATION WAVE – A STRATEGIC MEASURE

## Renovation Wave Priorities



Tackling **energy poverty**  
and **worst-performing**  
**buildings**



Renovation of  
**public buildings**

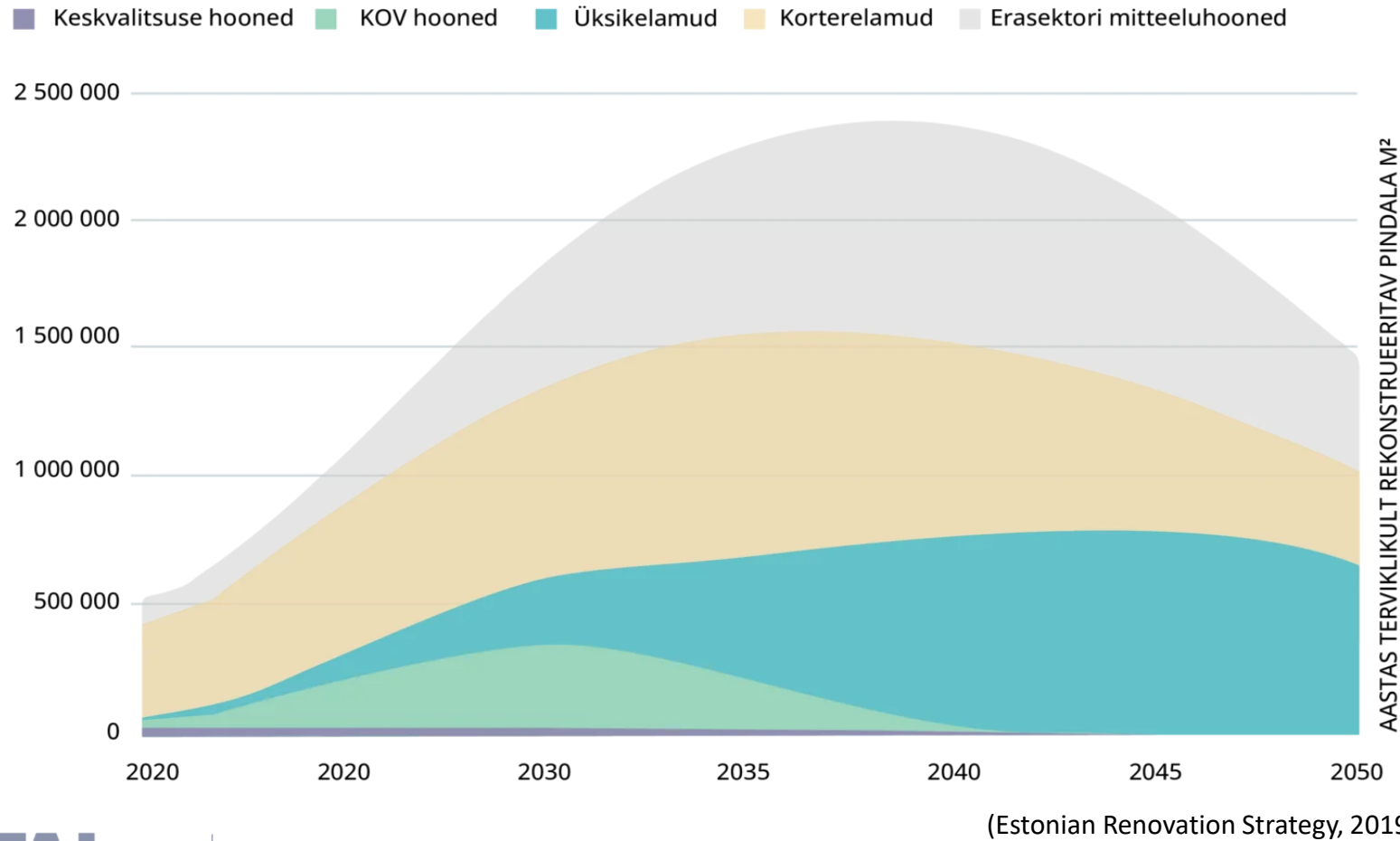


Decarbonisation of  
**heating and cooling**

**Save heating and cooling energy ca 90% and electricity up to 20%**



# RENOVATION GRAND CHALLENGE

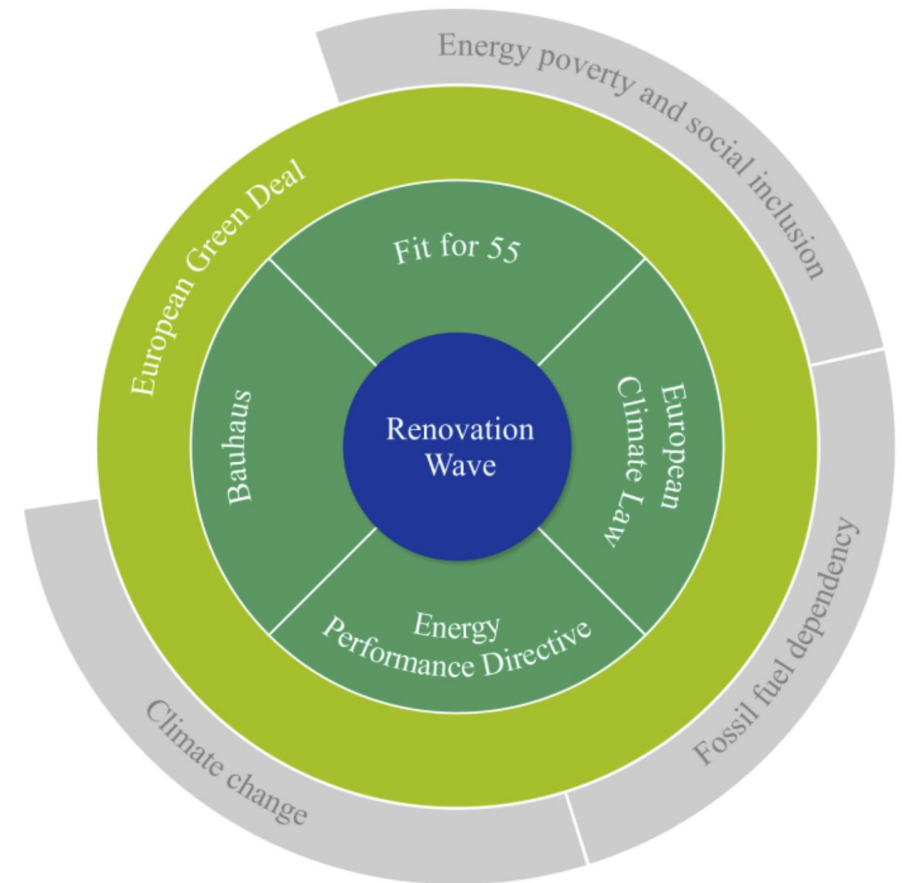


## Renovation Capacity and Capabilities

- Current average renovation rate in EU is 1%
- Low interest from the demand and supply side
- Current capabilities, processes, and technologies not fit for purpose

# LOCAL AUTHORITIES AS ORCHESTRA CONDUCTORS

- Local authorities need to take the lead role in the neighborhood or district approach ([link](#)).
- **“Cities should play the role of orchestra conductors – rather than musicians.”**
  - They have an important role in facilitating: making demand and supply meet, supporting house-owners and SMEs in their renovations, via One-stop-shops and online platforms.”
- Initiatives to support local authorities in implementing the renovation wave include financing programs, funding programs operating via grants, and technical assistance programs



Source: ÖIR GmbH, 2022

# ENERGY PERFORMANCE OF BUILDINGS (RECAST)

(CONSOLIDATED COMPROMISE TEXT, 20.12.2023)

- The EPBD recast represents an action plan for renovating the EU's building stock and reducing energy consumption and CO2 emissions to reach a climate-neutral Europe by 2050.
- **Member states are expected to implement:**
  - Whole Life Carbon Declarations; National Renovation Plans; Renovation Passports; Energy Performance of Buildings Database; Digital Logbooks; Circular Construction; Smart and Nature-Based Solutions; Renewable Energy; Audits; Independent Control Systems; Material passports

# ENERGY PERFORMANCE OF BUILDINGS (RECAST) - > LCA

(CONSOLIDATED COMPROMISE TEXT, 20.12.2023)

- National roadmaps for carbon limits of buildings by 2027
- Whole life carbon declaration for new buildings from 2028
- Roadmaps for the decarbonization of building stocks from 2030
- Declaration of carbon storage and removal in and on buildings
- Declaration first required for buildings over 1000m<sup>2</sup>; and after 2030, for all new buildings.
- Carbon footprint calculation will follow standard EN 15978 and Level(s) framework.
- The Commission may publish a delegated act for clarifying the calculation method.

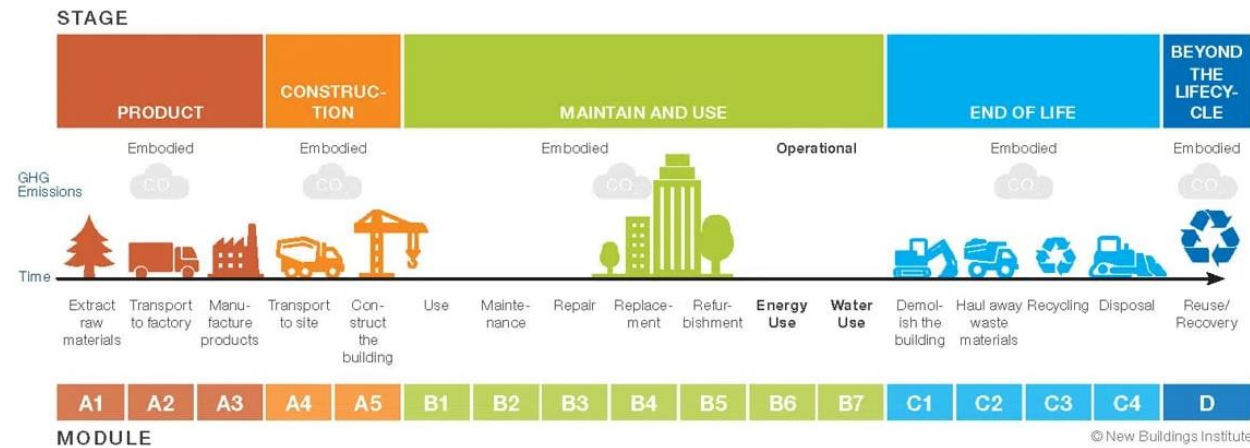


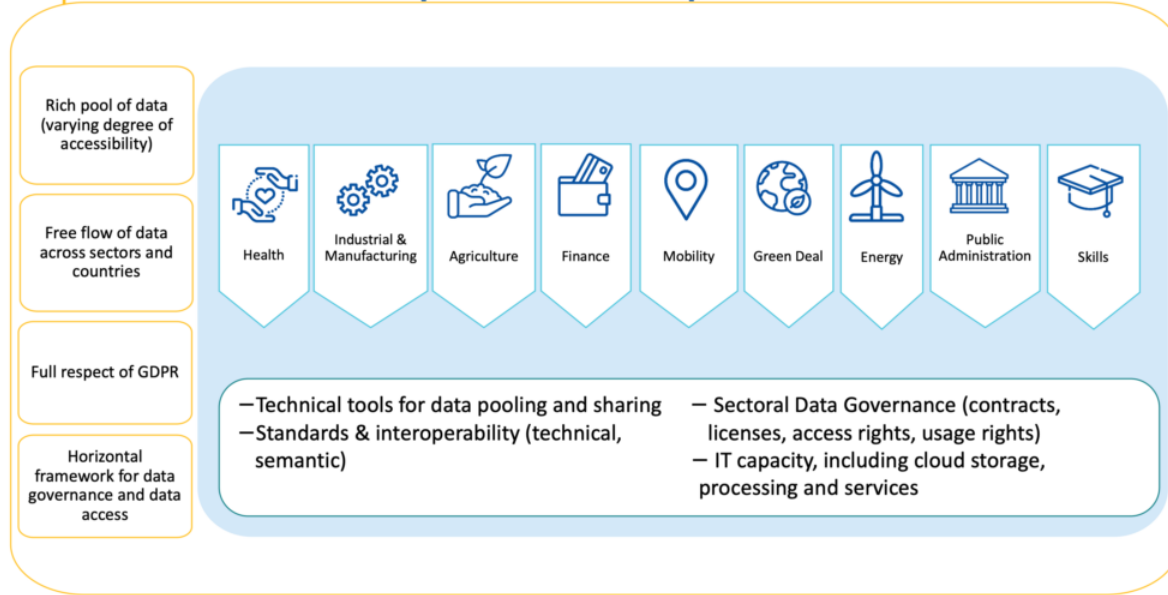
FIGURE 1: LIFECYCLE STAGES  
Data source: BS EN 15978:2011



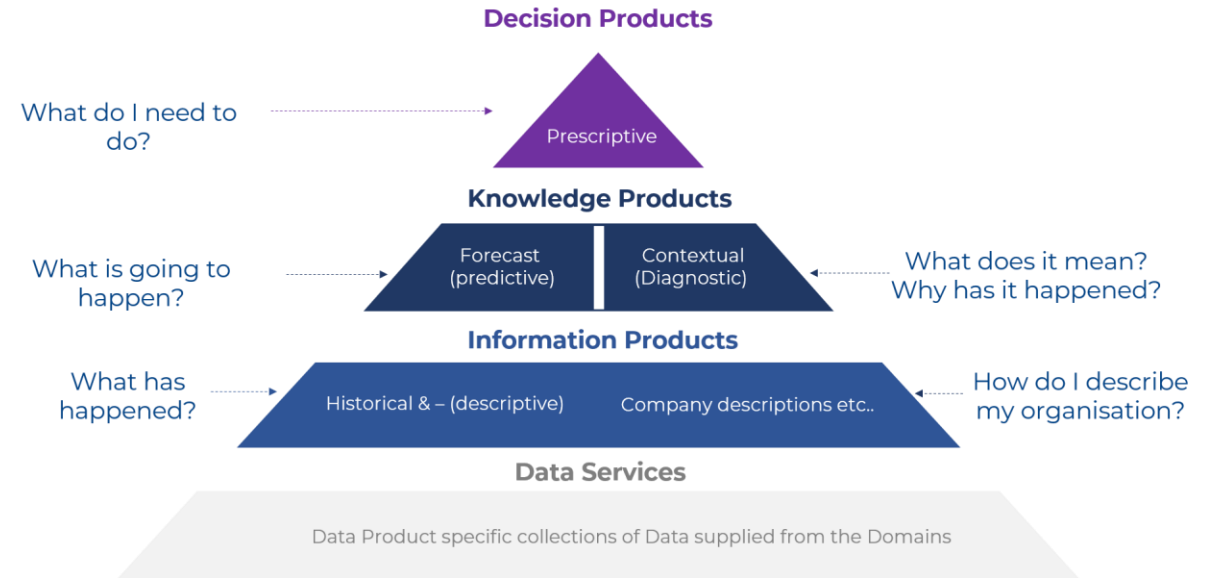
# SHIFTING PERSPECTIVES

# SHIFTING PERSPECTIVES: FROM LOCAL ISOLATED DATA TO DATA SPACES

## Common European data spaces



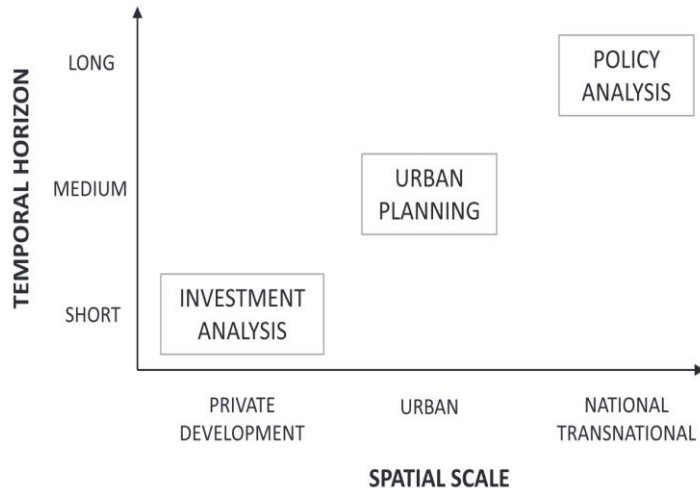
<https://dataspaces.info>



(Dataception, 2022)

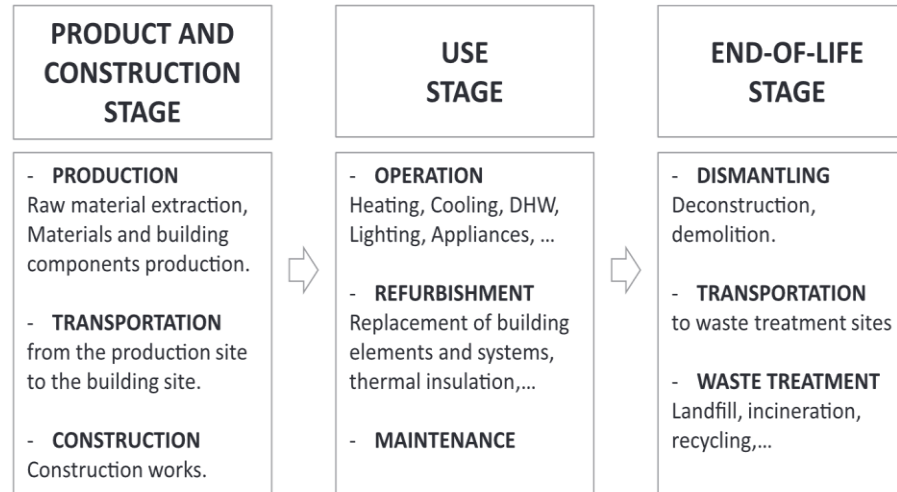
# SHIFTING PERSPECTIVES

## From Single Site to EU Building Stock



(Moffatt, 2004)

## From Use Phase Energy to Whole Life Carbon



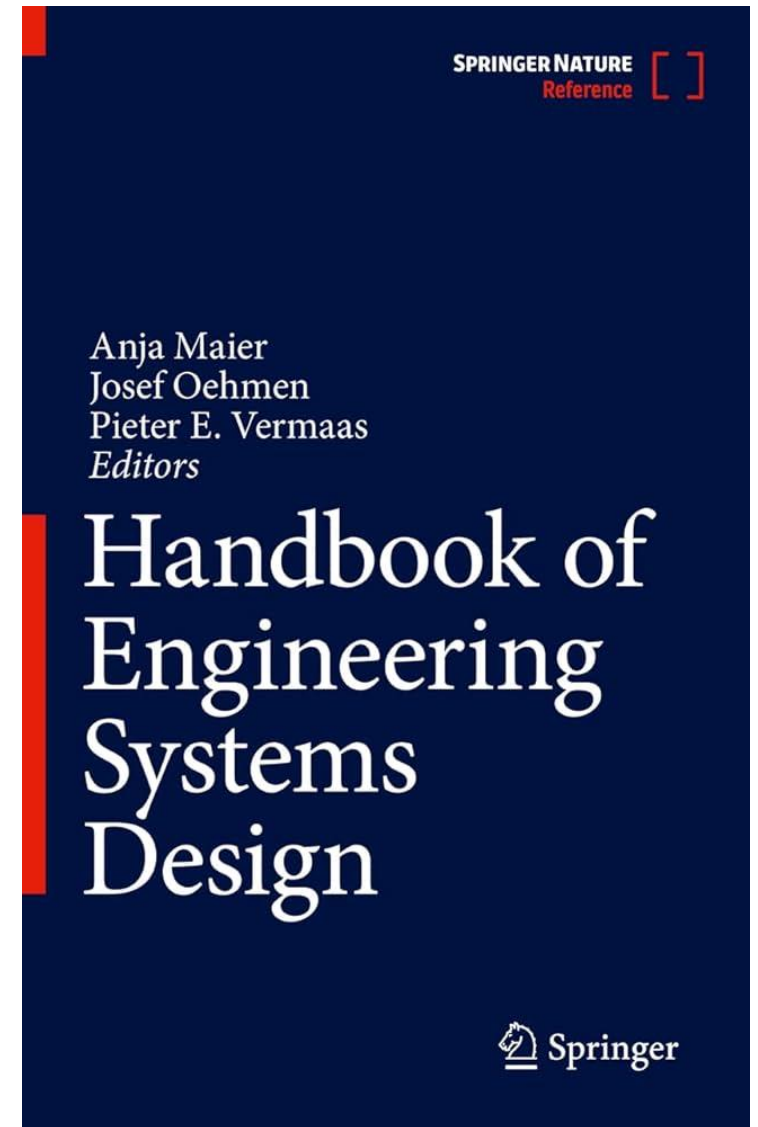
(Mastrucci et al., 2017)

## From Technical to Social-Technical



# ENGINEERING SOCIO-TECHNICAL SYSTEMS

- Socio-Technical Systems Engineering (STSE) is an approach to design.
- The underlying premise is that systems design should take into account both social and technical factors.
- In Socio-Technical Systems Engineering (STSE), data, modeling, and simulation play a crucial role in understanding and designing complex systems and behavior.







# EUROPEAN DIGITAL CONSTRUCTION TRENDS

# DIGITAL CONSTRUCTION TRENDS IN EU

- The construction industry is one of the least digitalized industries
- Potential using technology to address grand challenges:
  - Labor shortage
  - Resource efficiency
  - Sustainability
  - Productivity
- In the EU, the utilization of construction technologies is speeding up




Ref. Ares(2021)2699252 - 22/04/2021



# DIGITAL CONSTRUCTION TRENDS IN EU

**Data acquisition**




Sensors

Internet of Things

3D Scanning

**Automating processes**




Robotics

3D Printing

Drones

**Digital information and analysis**



Building information modelling

Virtual / Augmented Reality

Artificial intelligence

Digital Twins



Ref. Ares(2021)0699252 - 22/04/2021

European Construction Sector Observatory

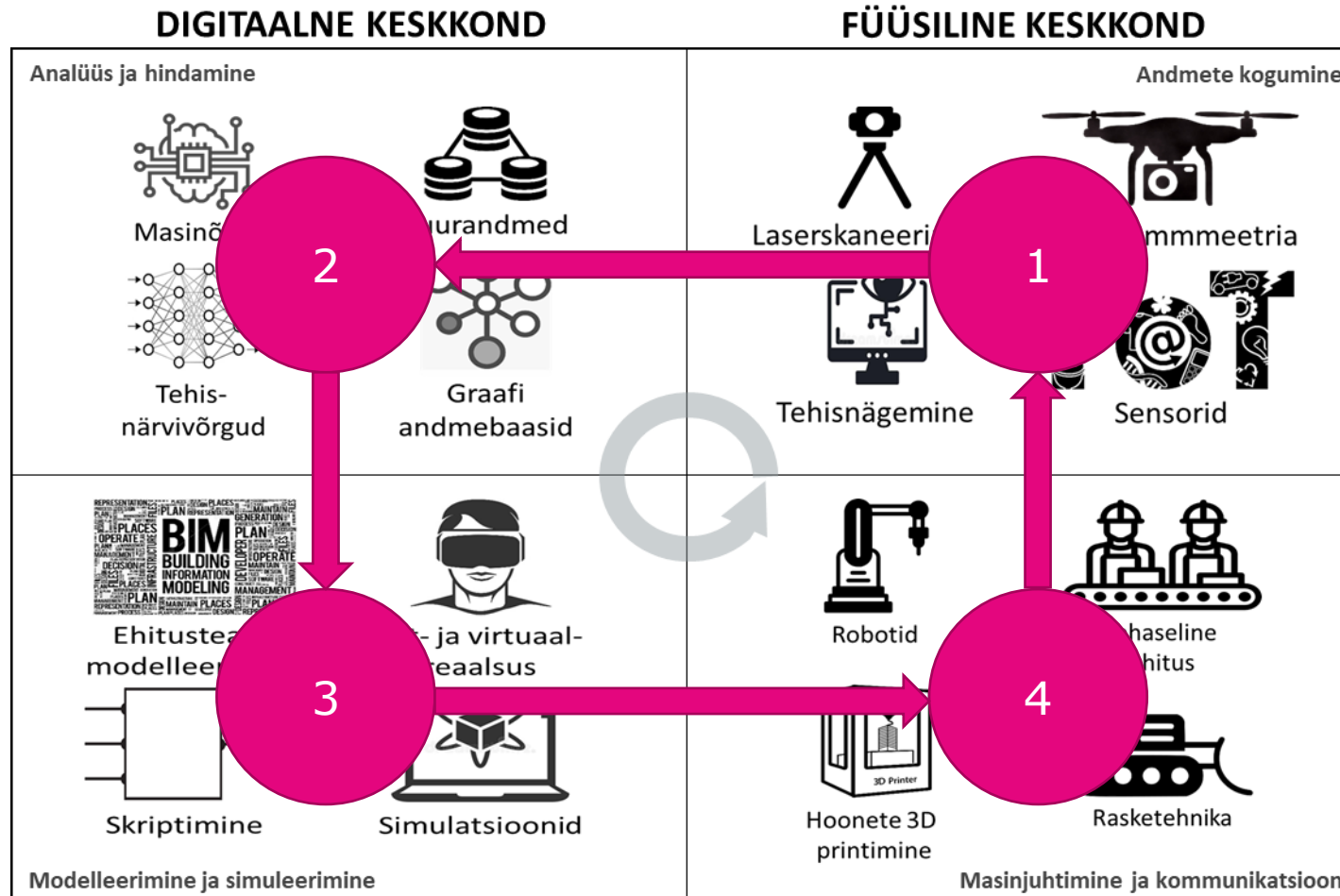
## Digitalisation in the construction sector

Analytical Report

April 2021



# DIGITAL TWIN CONCEPT



(Pikas, 2020)

## TECHNOCRATIC IMPROVEMENTS

*“The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency.”*

*“The second is that automation applied to an inefficient operation will magnify the inefficiency.”*

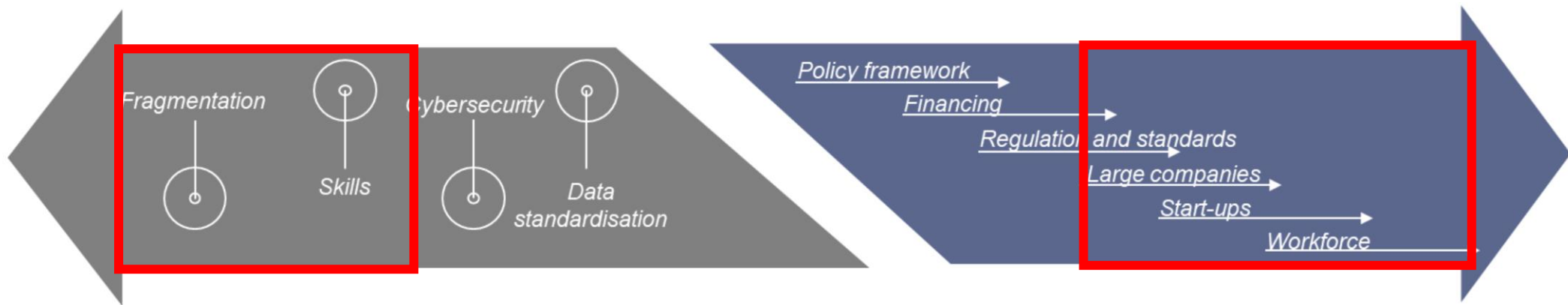
Bill Gates



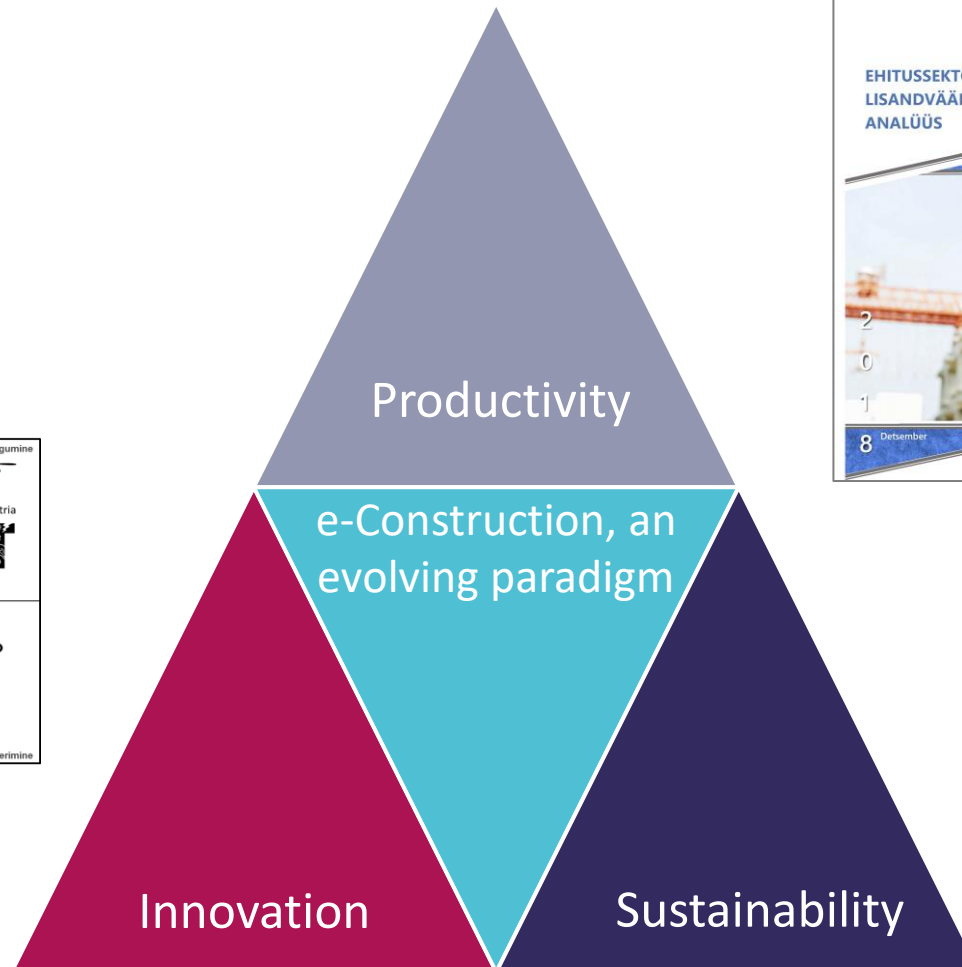
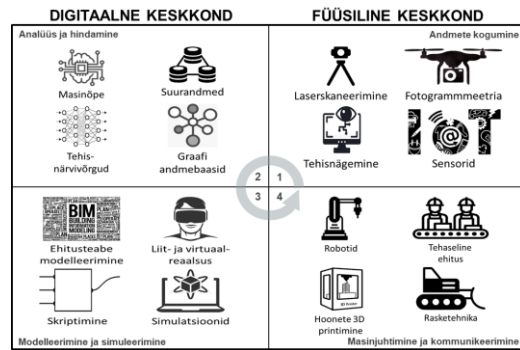
# BARRIERS AND DRIVERS

## Barriers

## Drivers



# E-CONSTRUCTION: AN EVOLVING PARADIGM





# **DIGITALIZATION DRIVERS IN ESTONIA**



# ESTONIAN E-CONSTRUCTION REGISTRY

## residential office building (EHR code 101041740)

### General information of the building

Type of building ⓘ	building
Name of the building ⓘ	residential office building
Building register code ⓘ	101041740
Type of ownership ⓘ	immovable property
Main purpose of use ⓘ	Other residential building with three or more apartments (11222)
Building address	Harju county, Tallinn, Nõmme district, Turu plats 5

### Data from the land register

### Data from the state real estate register

### Purposes of building use

### Location and parts of the building

### Dimensions of the building

### Building constructions and materials

### Technical indicators of the building

### Building documents

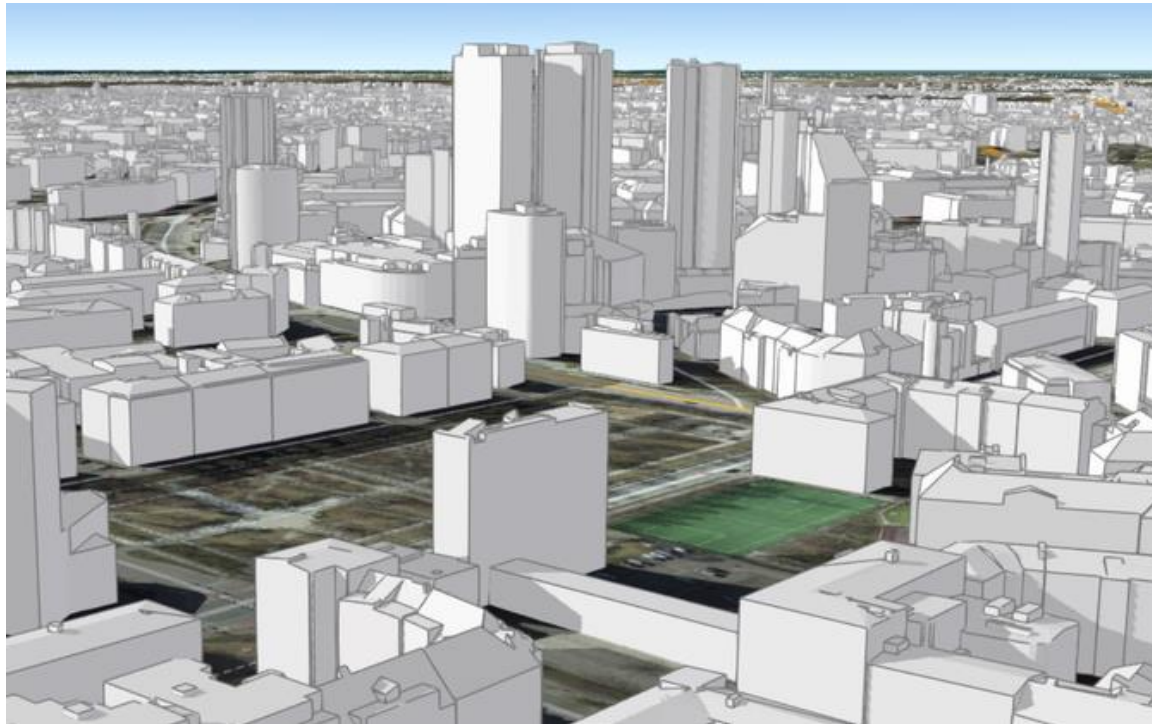
### Building energy labels

### Archive data of the building



[Link](#)

# DIGITAL TWIN MODELS AND BIM-BASED PERMITTING



## BIM upload and check module

Uploader Results

Filter: success warning error

- MinimumInscribedCircleCheck (74 0 8 X)
- MinimumAreaCheck (39 0 43 X)
- MinimumSpaceHeight (80 0 2 X)
- MinimumDoorHeight (77 0 0 X)
- AtLeastOneDoorInSpace (79 0 3 X)
- MinimumDoorWidth (77 0 0 X)



MAJANDUS- JA  
KOMMUNIKATSIOONI-  
MINISTEERIUM

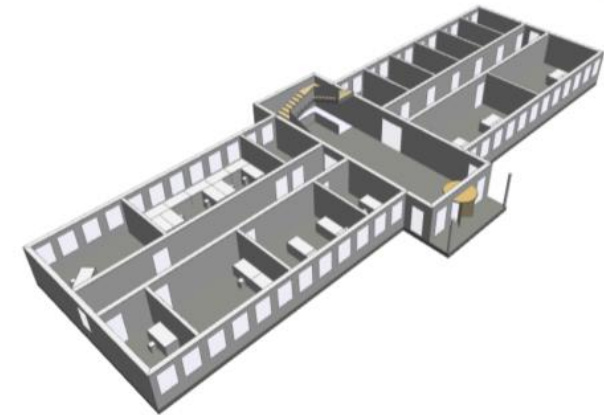
Reachu



List of floors:

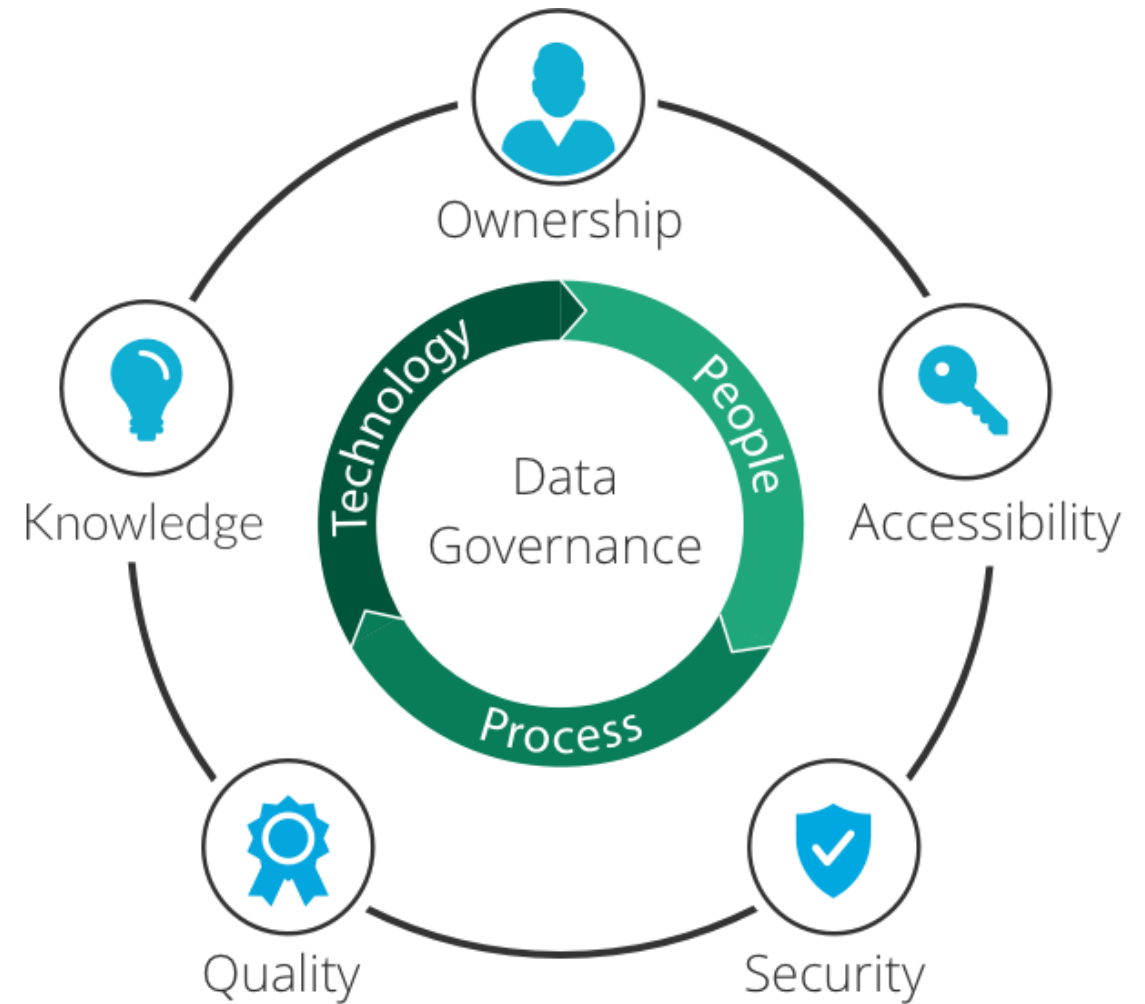
Roof Level  
2. Level  
1. Level  
Ground Level  
Basement

Reset view

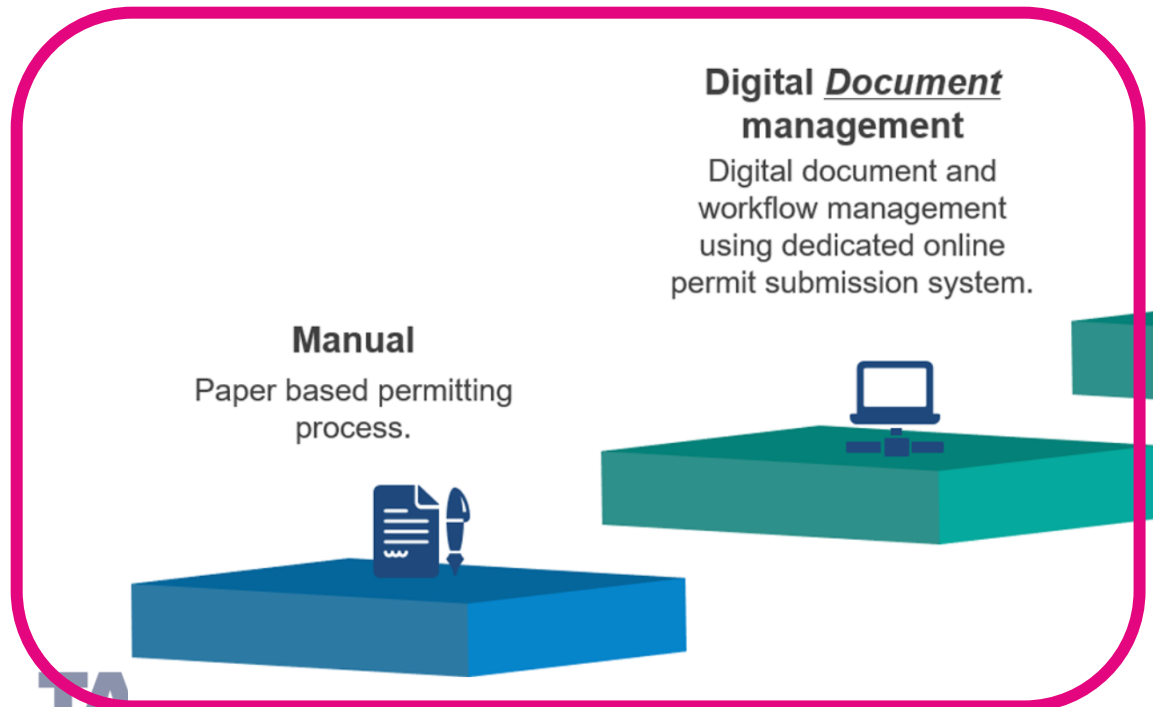


# NATIONAL DATA GOVERNANCE FOR ALL REGISTRIES

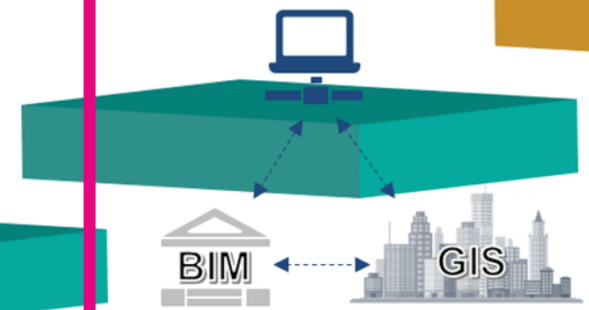
- All national registries need to describe their digital services
- Implement information management, including data governance, principles, processes and methods
- Same applies to the Estonian building registry or e-construction platform



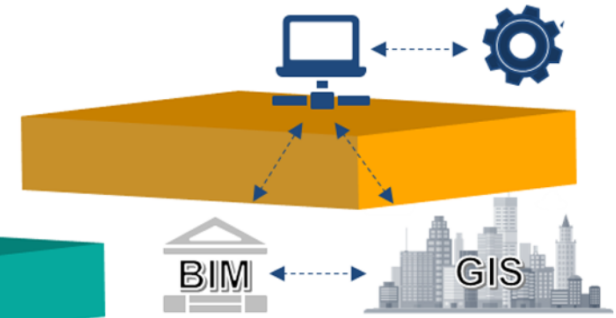
# NEED A SHIFT FROM DIGITAL DOCUMENT MANAGEMENT TO INFORMATION MANAGEMENT AND AUTOMATION



**Digital Information management**  
Digital information and workflow management on the level of the building (BIM) and the city (GIS), through an online permit submission system.



**Automated**  
A decision support system for building permitting, integrating BIM and GIS technology for automated plan checking and design review.

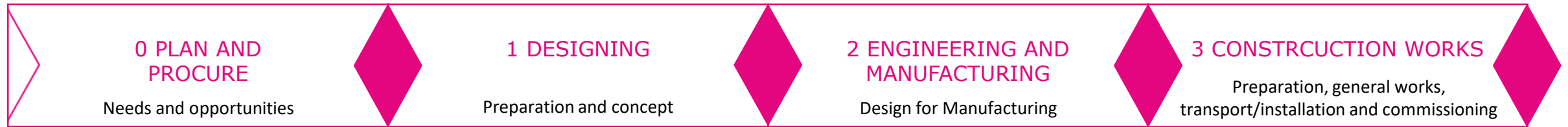


(Bloch and Fauth 2023)



# **DIGITALIZATION AND RENOVATION IN ESTONIA**

# COMMON PROCESS FRAMEWORK FOR INDUSTRIALIZED RENOVATION FOR SINGLE BUILDINGS



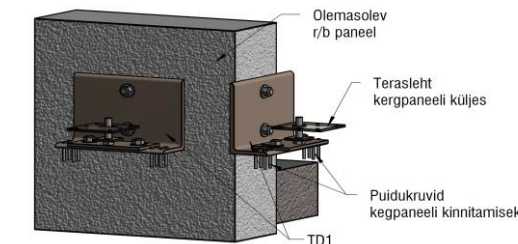
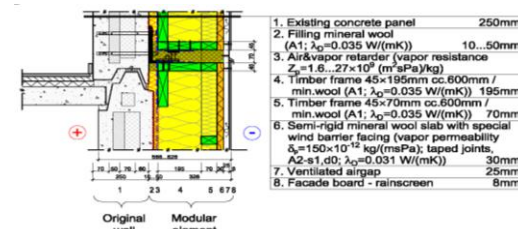
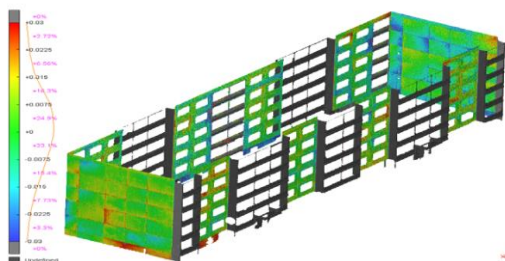
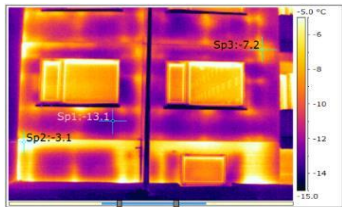
Need

Contract

Permit

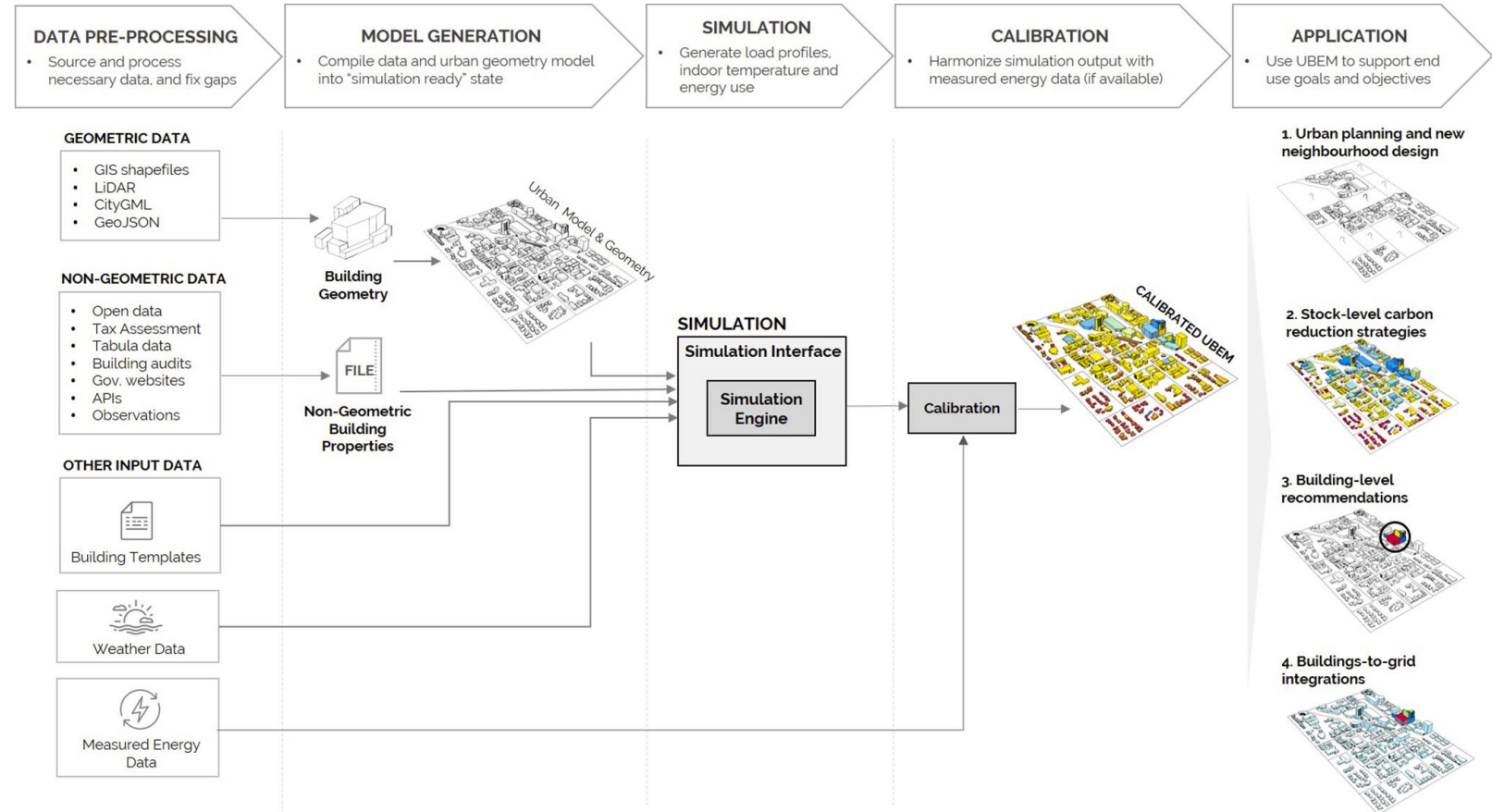
Detailed design and manufactured elements

Renovated building

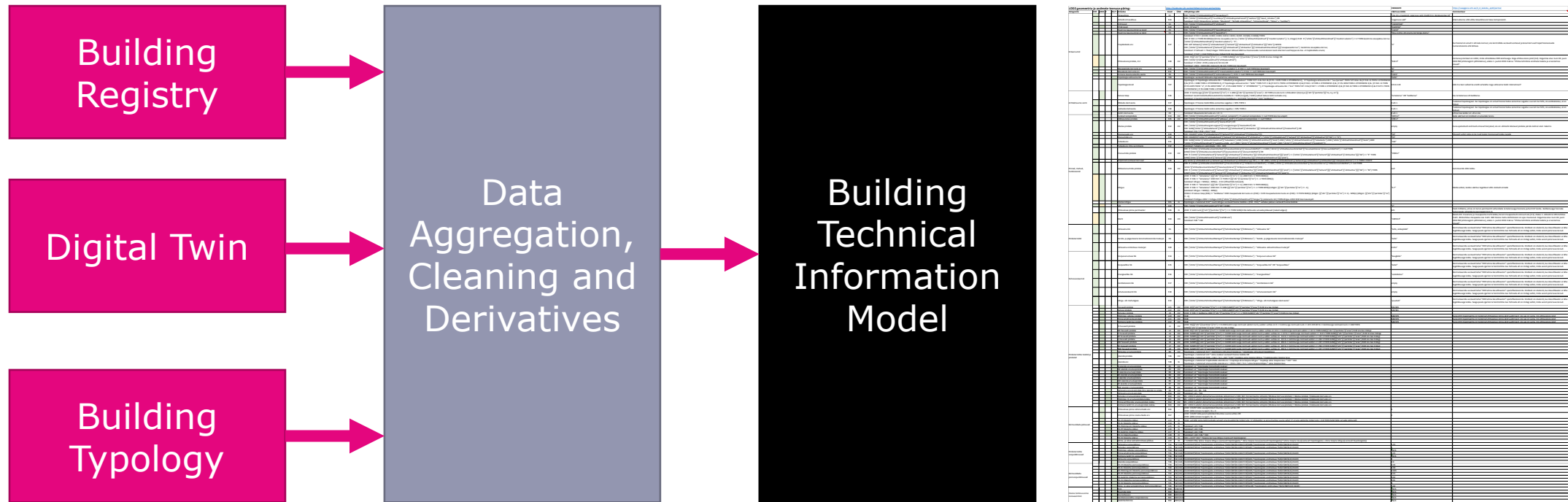


# RESTO OBJECTIVES AND KEY CONCEPTS

- **Objective:** Support local authorities and large real estate owners to evaluate the energy performance of buildings and plan and develop energy efficient renovation strategy and estimate the impact on the city/neighborhood level.
  - Data-based strategic decision-making
  - City or real estate portfolio climate neutrality by 2050
  - Reduction of energy consumption
  - Extending the lifetime of buildings
  - Renovation in phases
  - Investment needs and impact
  - Co-operative procurement
- **Key concepts:** Existing databases, reference models, calculation calibration against measured energy consumption, renovation measures, renewable energy production and donation, design requirements, co-operative procurement



# DATA AGGREGATION AND MANAGEMENT



102 values derived from Building Registry, Digital Twin LOD2 and Building Typology



# DATA CLASSIFICATION, MODELLING AND SIMULATION



# DATA CLASSIFICATION, MODELLING AND SIMULATION

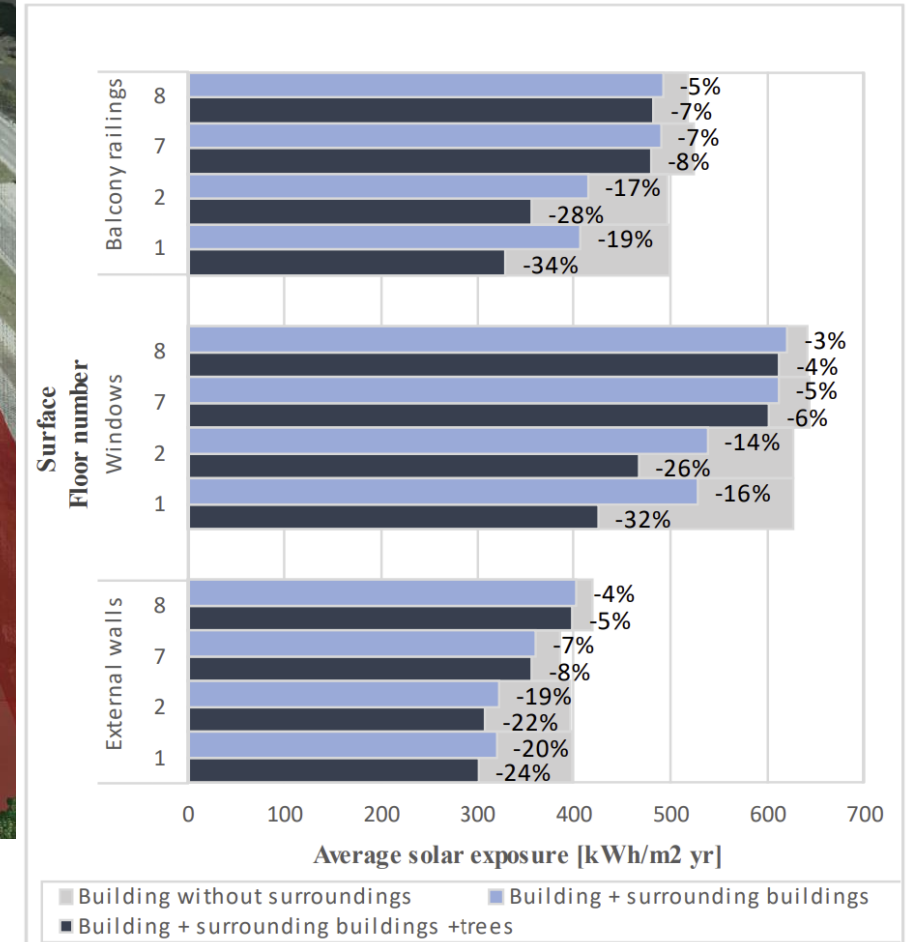
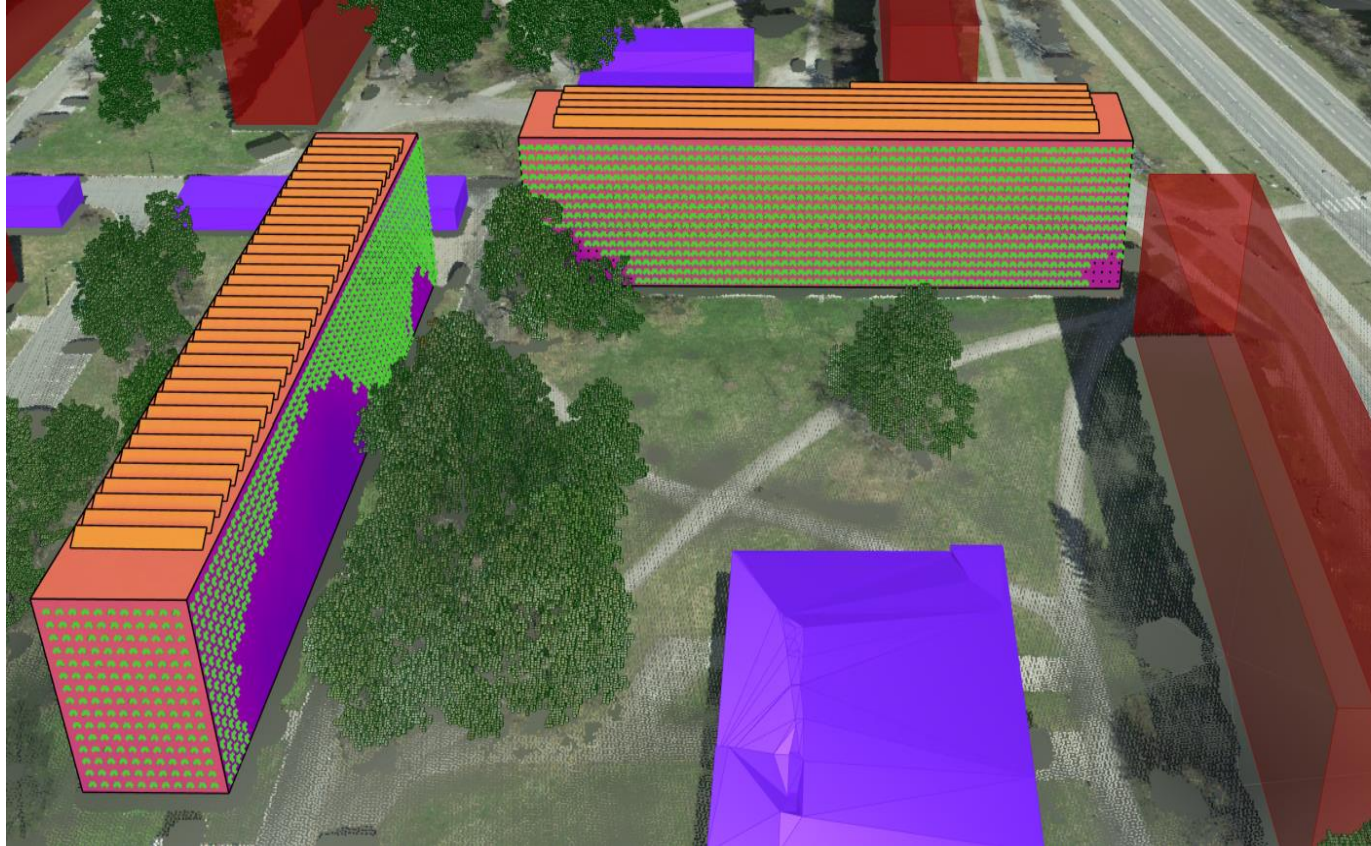
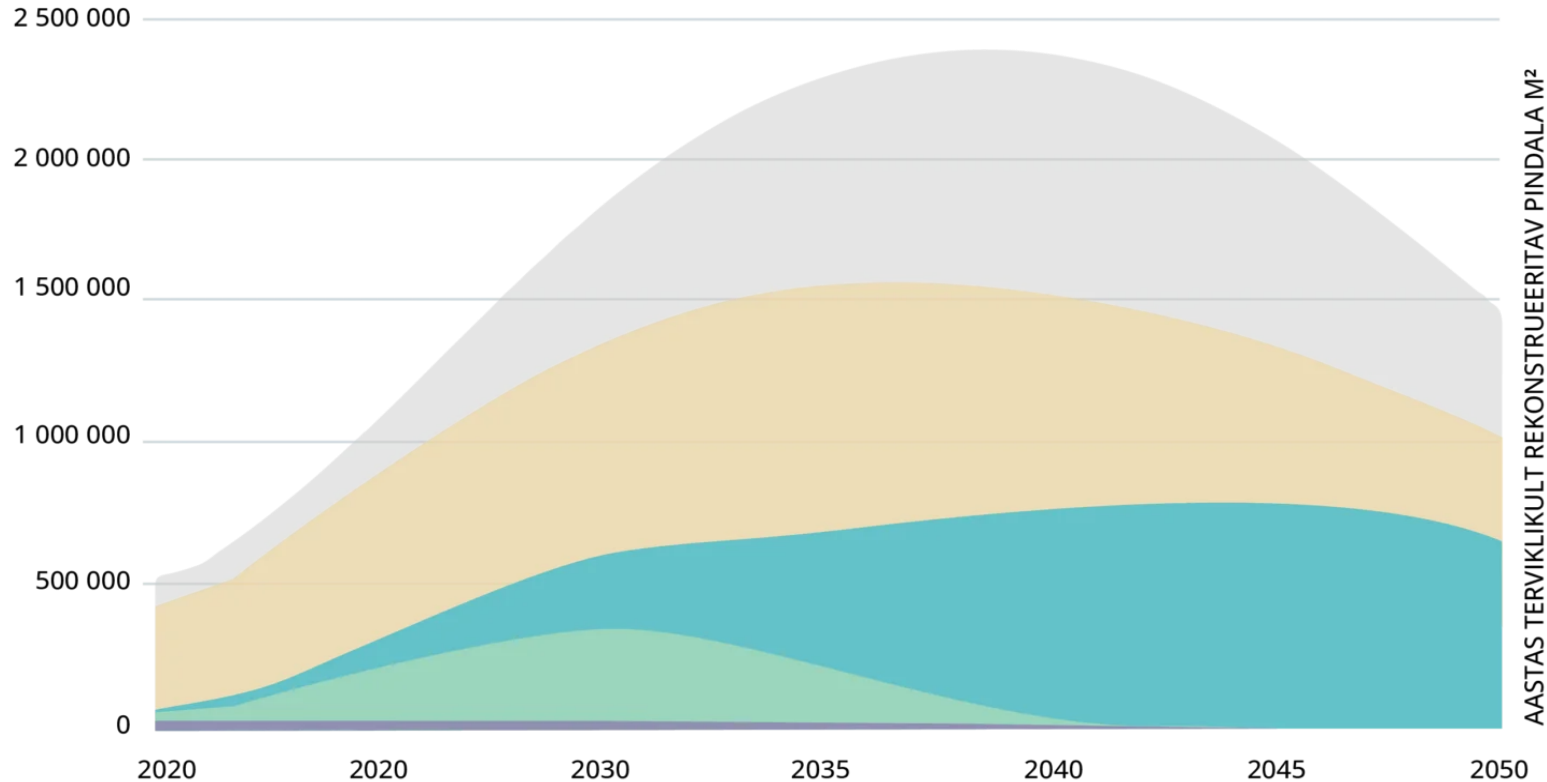


Figure 6: variations in solar exposure across different surfaces and floors of lod3: scenario II (reference case) vs. scenarios III and IV.

# PERSONAL START GRANT PROJECT: DEVELOPING RENOVATION GOVERNANCE FRAMEWORK

■ Keskkvalitsuse hooned 
 ■ KOV hooned 
 ■ Üksikelamud 
 ■ Korterelamud 
 ■ Erasektori mitteeluhooned



AASTAS TERVIKLIKULT REKONSTRUEERITAV PINDALA M<sup>2</sup>

(Estonian Renovation Strategy, 2019)

## New Perspectives in Renovation

- Current renovation strategy is focused on the demand side and energy
- Estonian Green Tiger on LCA lacks production management considerations and competencies
- Lean principles of production leveling and continuous improvement could be scaled to national level



# **SUMMATIVE CONCLUSIONS**

## SUMMATIVE CONCLUSIONS

- Climate Crisis is rapidly changing perspectives
- Digitalization as a key enabler for construction green transformation
- Things, developments, and disciplines that have been separate and distinct up to now need to be integrated for the sake of the challenge, and thus, the role of research, besides technical development and piloting, will get even more important.

What you do makes a difference, and you have to decide what kind of difference you want to make.

Dr Jane Goodall, Scientist & Activist



# TAL TECH

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