

# **EERAdata** DATA-DRIVEN DECISION-SUPPORT TO INCREASE ENERGY EFFICIENCY THROUGH RENOVATION IN EUROPEAN BUILDING STOCK

Operationalising the “Energy Efficiency first Principle” on municipal and regional level

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847101

# EERAdata Project

- EERAdata will operationalise the EEfP on a municipal and regional level
- It assesses the multiple benefits that arise through energy efficiency measures applied on single buildings
- It will create a software solution and related database which helps municipalities and regions to perform these assessments



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# Operationalising the EEfP on local level

- Broader justification for energy efficiency investments
- Identifying economic and monetary benefits for various stakeholders
- Argument and motivation for more comprehensive energy efficiency measures
- Changing the role of buildings
- Increasing well being and health
- Quantifying the impact of building renovation on societal issues (fuel poverty, environmental pollution, climate change, etc)



# Operationalising the EEfP on local level

## Barriers of EE implementation

- Assessment only focus on energy savings
  - High initial investment costs
  - Decision based on political or personal drivers
  - Short term planning
  - Lack of capacity and resources for detailed cost-benefit analysis supporting decision-making
  - Complex funding procedures
  - Low knowledge, time, experience, motivation of staff
  - EE investments are considered high risk investments.
  - Scattered projects, which are often limited to shallow renovation with small measures.
- } Long payback periods

→ Public decision makers are mostly not aware of the multiple benefits (health, productivity, etc.) of deep renovation and energy efficiency measures and cannot evaluate ecological, employment or societal benefits.



# Operationalise the EEfP

## EERAdata outputs

1. Scientific calculation methodologies to assess EE in the economic, social and environmental sectors
2. Parameter and indicator list for socio-economic and LCA assessment
3. Data collection guidelines and templates
4. Assessment and Decision making tool
5. Comprehensive database with default and proxy values
6. Implementing Guidelines



# EERAdata Implementation

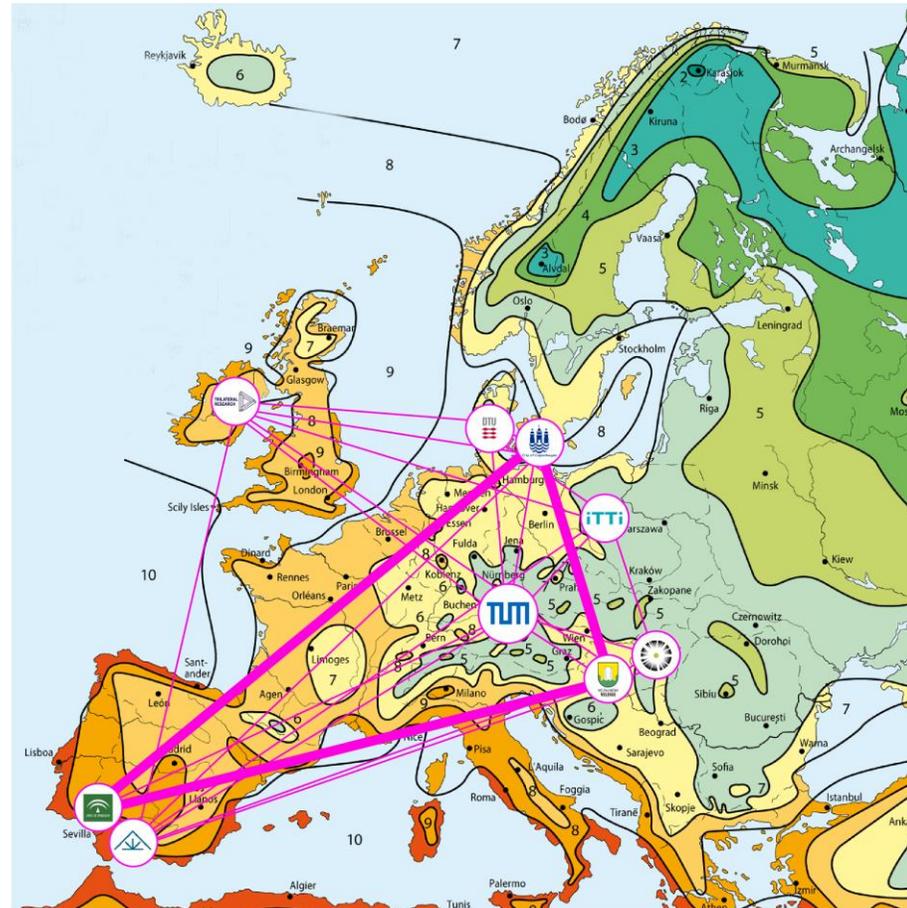
3 Clusters for Implementation

Strong Stakeholder network

Collaboration outside the consortium

Workshops

Symbiosis with other projects



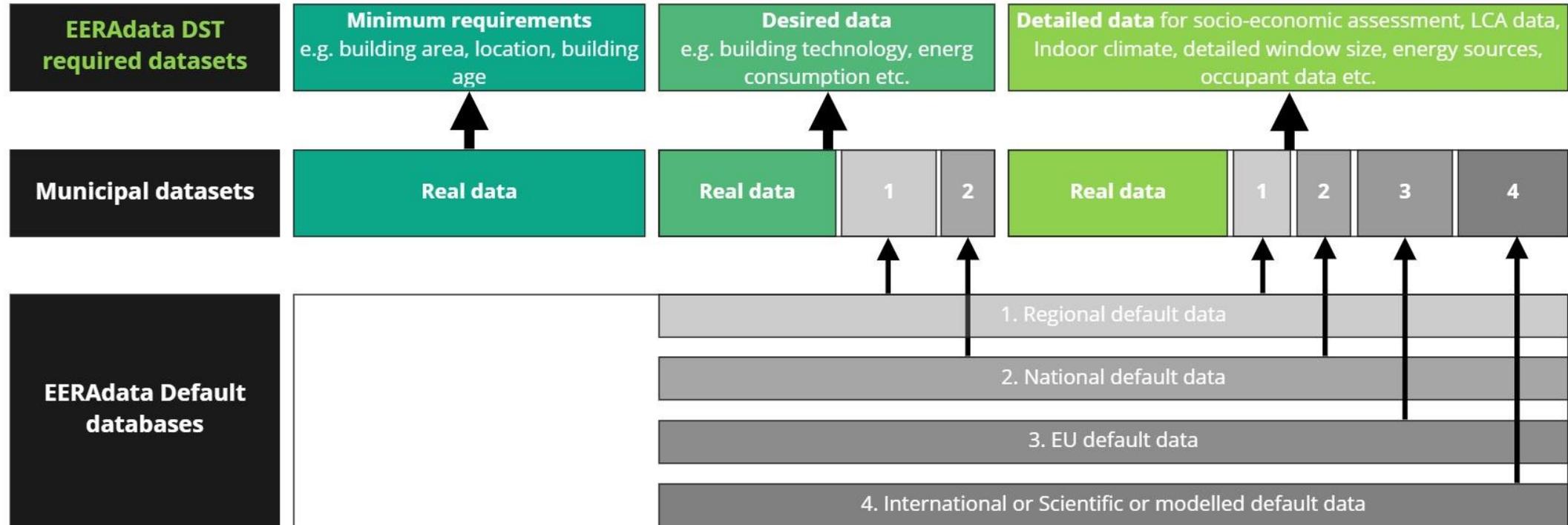
**Partner municipalities will participate** to the design of the tool and test its application in **regional pilots**.

The pilots will be part of a **wider process of stakeholder engagement** aimed at ensuring the usefulness of the different instruments, their applicability across different geographical and economic contexts, and its adoption **beyond the life-span of the project**.



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# Data gaps and default data



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# Definition of minimum required data

Variables	Data Type	Description
Building_ID	Integer	Building identification number
Building_Use	String	Building category (administrative, educational, healthcare, cultural and sport)
BuildingAge	Datetime	Year in which building was constructed
FloorArea	Integer	Used area of the building
BuildingWidth	Float	Width of the building
BuildingLength	Float	Length of the building
NumberofStoreys	Integer	Number of storeys in the building
RoomorBuildingHeight	Float	Room height or building height
GroundSurfaceArea	Integer	Surface area of the base plate

Variables	Data Type	Description
Timezone	Integer	Timezone for each municipality
Location	Integer	Coordinates of each municipality
WeatherData	Integer	Weather data 365 days a year for each municipality
MonthlyMeanGroundTemperature	Float	The mean ground temperature for every month for each municipality
ShieldingClass	String	Shielding classification for buildings in each municipality
TerrainClass	String	Terrain categories for buildings in each municipality (TC1, TC 1.5, TC 2, TC 2.5, TC 3)



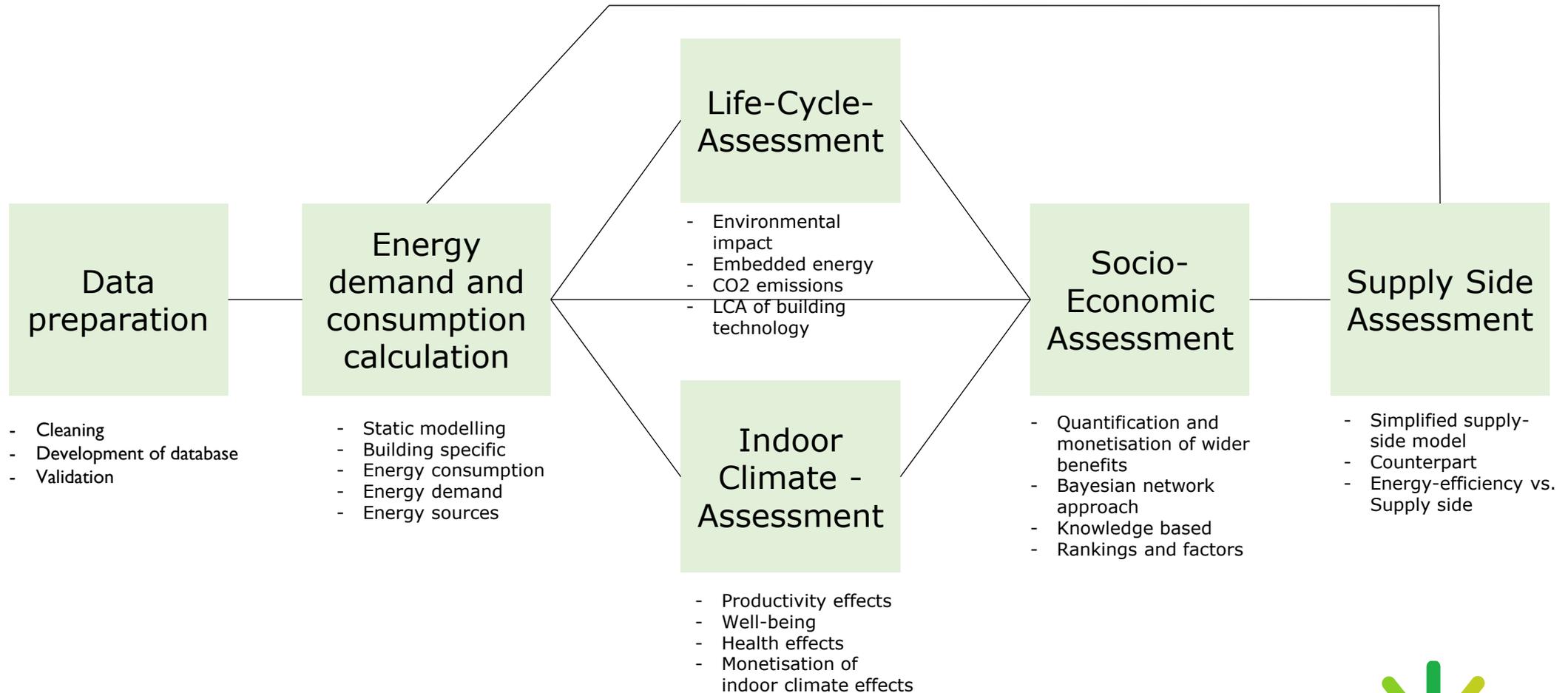
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# Default and proxy data

- **Building specific, municipal/Local default data**  
24 parameters on building characteristics, location, building technology, energy sources
- **Climate and Weather Data**  
7 parameters on average outdoor temperatures, heating and cooling degree days, outdoor air speed, terrain, etc
- **Renovation Measure Data**  
24 parameters on renovation measures like insulation of roof, walls, basement, exchange of windows, upgrade of heating system, integration of ventilation, etc.
- **Life Cycle Assessment Data**  
117 LCA datasets on materials, embedded energy, primary energy consumption, building technology, construction elements, etc.
- **Socio-economic data**  
Over 60 datasets on job creation, construction economy, tax rates, household income, labour cost, particulate matter emissions, emission cost, procurement processes, etc.



# What do we assess?



# Case Study – Renovation case

## Status quo

- Location: Velenje, Savinja, Slovenia
- Building use: School
- Year of Construction: 1970
- Relatively good energy performance
- Location of Building: Urban
- Net Building Area: 6.510 m<sup>2</sup>
- Number of floors: 5
- Heating: District heating, non-renewable

## Weather / Climate:

- Lowest Outer Temperature: -16 °C
- Average Outer Temperature: 7.9 °C
- Set Indoor Temperature: 20°C



# Case Study – Renovation case

## Renovation measures

### Envelope

Add insulation to roof	U-Value: 0,2 W/m <sup>2</sup> K, Material: XPS
Add insulation to exterior walls	U-Value: 0,19 W/m <sup>2</sup> K, Material: XPS
Exchange windows	U-Value: 0,8 W/m <sup>2</sup> K . g-Value: 0,4
Add External shading devices	Blinds between panes, Shading factor: 0,15

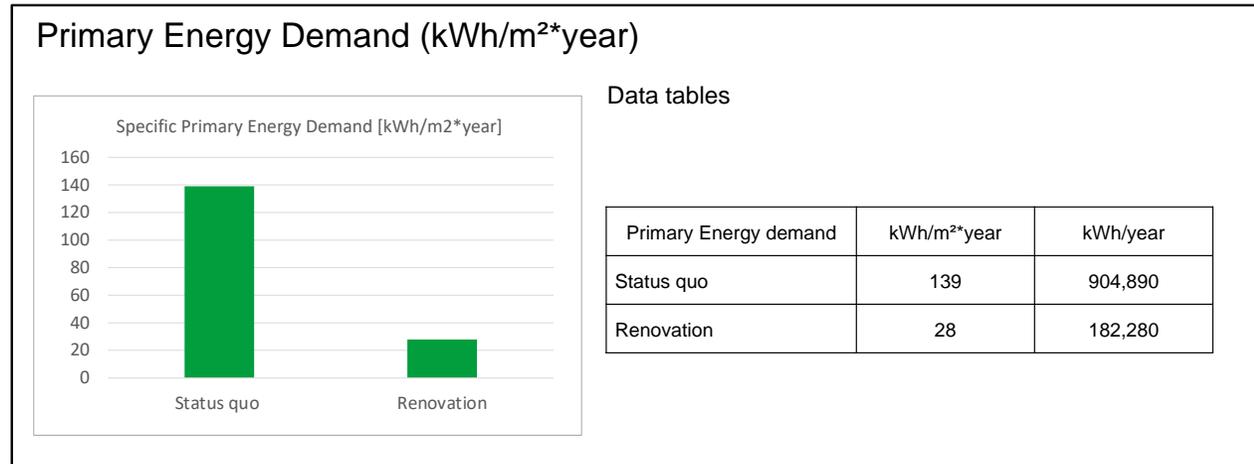
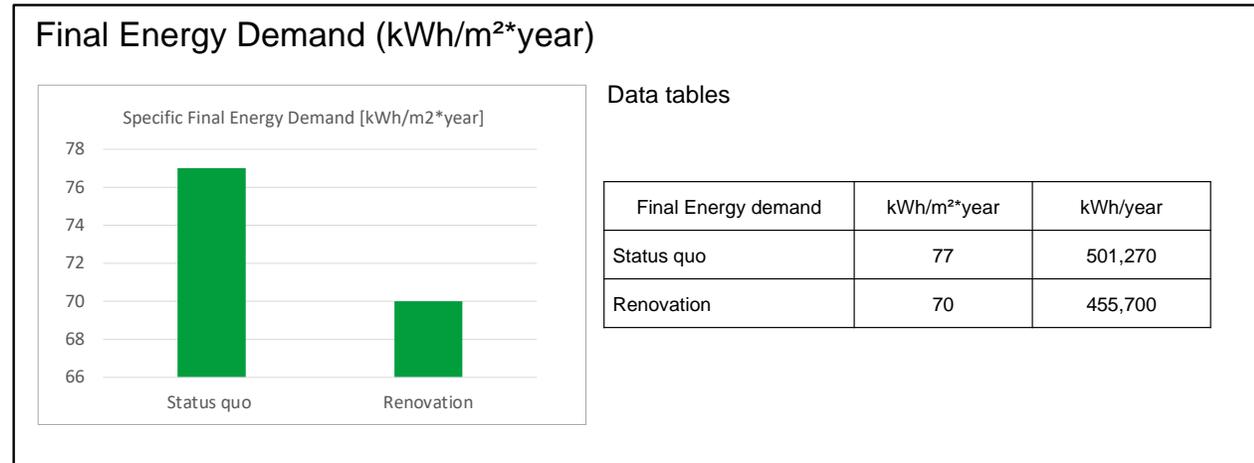
### Building Technology

Add ventilation and air conditioning system	Quality class 2, fan efficiency increased
Upgrade heating system	Biomass (10% share of non-renewable energy to harvest biomass)
Upgrade water heating system	Biomass (10% share of non-renewable energy to harvest biomass)
Upgrade lighting system	LED + Lighting Controls for all areas

Estimated specific investment Cost / m <sup>2</sup>	-40.80 €
Estimated total investment Cost	-236,395.20 €



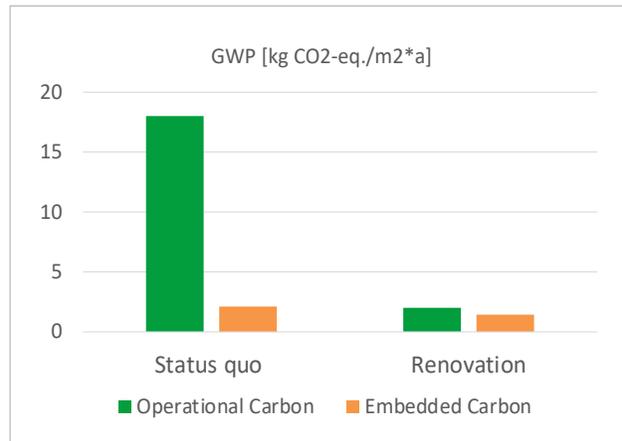
# Results: Energy Demand Module



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# Results – LCA benefits

CO<sub>2</sub> Emissions (kg CO<sub>2</sub>-eq./m<sup>2</sup>\*year)

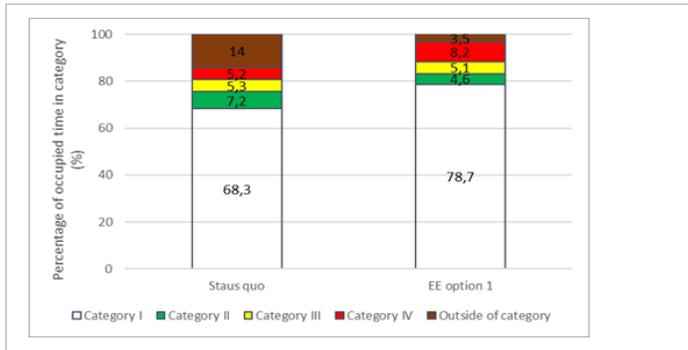


Data tables

Emissions	Kg CO <sub>2</sub> -eq./m <sup>2</sup> *year	
	Operational	Embedded
Status quo	18	2
Renovation	2.1	1.4

# Results: Indoor Climate module

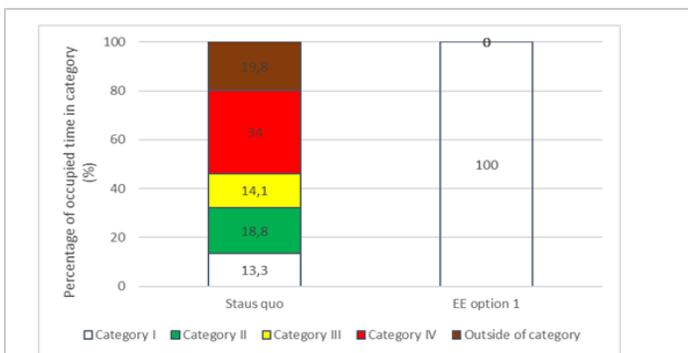
% time in IEQ quality category, temperature



Data table

	Category I	Category II	Category III	Category IV	Outside of category
Status quo	68.3	7.2	5.3	5.2	14
EE Option 1	78.7	4.6	5.1	8.2	3.5
EE Option 2					
SS Option 1					

% time in IEQ quality category, CO2



Data table

	Category I	Category II	Category III	Category IV	Outside of category
Status quo	13.3	18.8	14.1	34	19.8
EE Option 1	100	0	0	0	0
EE Option 2					
SS Option 1					



# Results: Indoor Climate module

## Annual number of sick days of teachers and performance

	Annual number of sick days per teacher due to the classroom air quality (days)
Before renovation	1.8
After renovation of the envelope	1.8
After renovation of the envelope and the building services	0

	Average annual pupil performance decrement due to the classroom temperature (%)
Before renovation	91
After renovation of the envelope	91
After renovation of the envelope and the building services	92

# Results: Indoor Climate module

## Combined monetary benefits of improved indoor climate

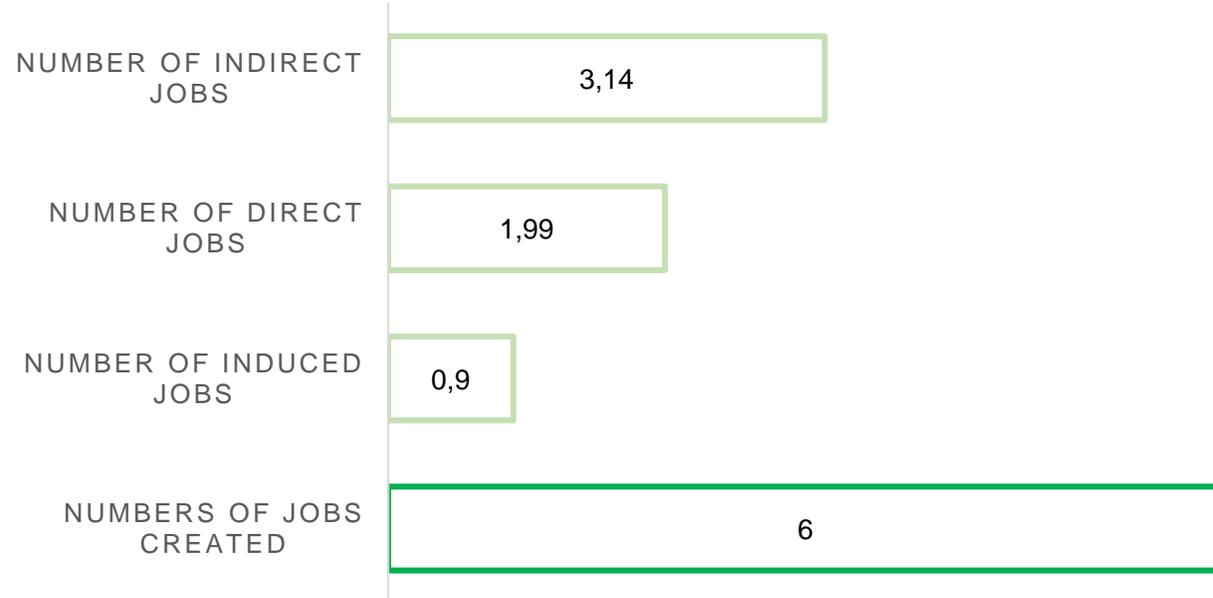
	Before renovation	After renovation of the envelope and building services
NPV of reduced illness absence among pupils (M€)	-	0.97
NPV of reduced illness absence among teachers (M€)	-	0.11
NPV of higher learning performance due to better indoor environment while in school (M€)	-	1.0
NPV of higher learning performance due to reduced absence from school (M€)	-	0.15
Total NPV (M€)	-	2.23



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# Results: Socio-Economic Module

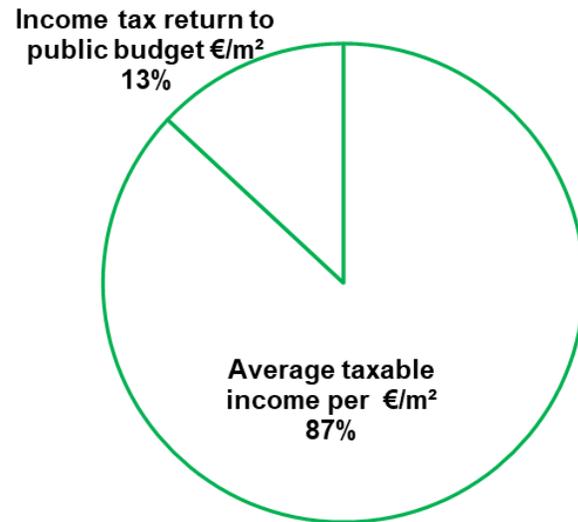
## Job Creation



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# Results: Socio-Economic Module

## Municipal tax returns



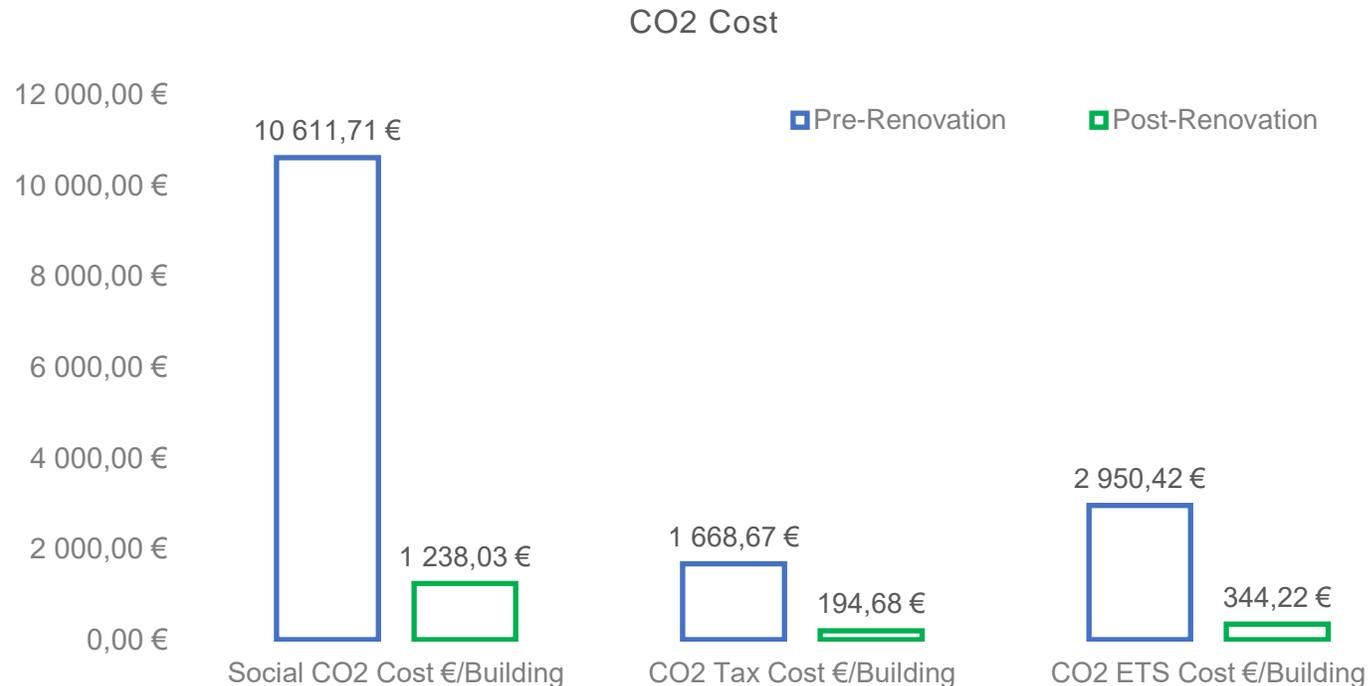
Total Trade tax return to public budget for project € 2 468,24 €

Total Income tax returns for project € 7 126,62 €



# Results: Socio-Economic Module

## CO2 Cost savings



# Results – Payback periods

## Without benefits

- Energy cost reduction

## With wider benefits

- Reduction of sick-days
- Tax returns (income and trade tax)
- Reduction of CO2 emission cost (tax, ETS, social)

## With societal benefits

- Increase of performance
- Job creation
- Reduction of unemployment expenditure

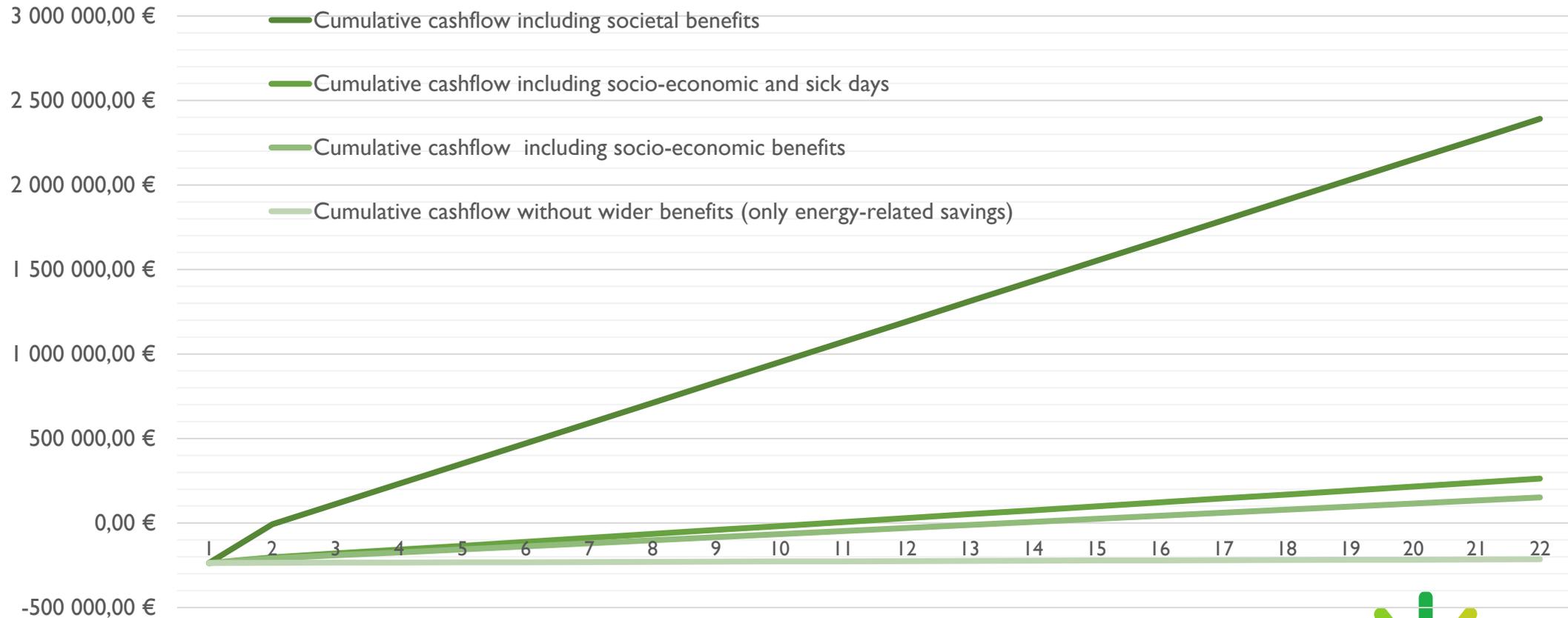
Payback period (discounted, considering the present values)	Years
Payback time including societal benefits	0,99
Payback time including indoor climate sick day reduction	9,72
Payback time including socio-economic benefits	12,57
Payback time without wider benefits (only energy-related savings)	215,80

Including energy price development, emission cost and discount rates per country



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# Results – Payback periods



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# Decision Support Tool

EERAdata Beta Tests København

PROJECTS BUILDINGS PARAMETERS PROCESSING ADMIN HELP CONTACT

en sebastian.botzler eeradata\_expert

Project: test [7]

DETAILS BUILDINGS CALCULATIONS OPTIONS RESULTS

### Calculation units

addNewRenovationItemConnection

Filter Clear Assign

Edit	Calculation unit
<input type="checkbox"/>	ENERGY_DEMAND [2]
<input type="checkbox"/>	LCA [ENERGY_DEMAND DIMENSIONING_TBS_COMPONENTS ] [4]
<input type="checkbox"/>	SUPPLY_SIDE [ENERGY_DEMAND LCA SOCIAL_ECONOMIC ] [6]
<input type="checkbox"/>	SOCIAL_ECONOMIC [] [5]

Number of items: 4

1 < 1 > 2 Items per page: 1000



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# Tool architecture

**You can register for in-depth testing now!**

Data for 1-5 buildings is sufficient.  
Template and additional information is provided by us  
Feedback workshop

Contact: [botzler@tum.de](mailto:botzler@tum.de)



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EERAdata

# Thank you

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