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

Influencing decision-making processes in public energy efficiency projects: wider benefits as a driver for deep building renovation

Sustainable Places 2021

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The EERAdata Project

- EERAdata operationalises the Energy Efficiency First principle by assessing and quantifying relevant technical, economic, socio-economic and environmental variables, indicators and impacts across relevant sectors and markets.

- European Horizon 2020 Research Project from 2019 until 2021

- 9 Partners, 6 Countries, 3 Climate-Areas, 1 Decision-Support Tool

- 3 Practical partners case study data and test cases:
  Andalusia, Spain
  Copenhagen, Denmark
  Velenje, Slovenia

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Outputs of EERAdata

1. Scientific calculation methodologies to assess energy efficiency benefits in the economic, social and environmental sectors

2. Parameter and indicator list for socio-economic and LCA assessment

3. Decision Support Software which is supporting decisions through wider benefits assesment

4. Comprehensive database with default and proxy values

5. Implementing Guidelines

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Municipalities as rolemodel

"Municipalities have a uniquely role to encourage and deploy energy efficiency measures"
[IPEEC]

"Given the local nature of buildings and related policy environments, cities and regions are key actors to champion energy efficiency in buildings." [OECD]

Municipalities have the unique ability
- to pilot innovative approaches and technologies,
- to leverage their authority on building regulations and public procurement.
- to effectively communicate to their citizens

Municipalities are also:
- the closest level of government to the people.
- politically obliged to invest in EE [EU directives, national law, climate change goals)
- consumers, managers of energy networks, and potential energy producers.

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Wider Benefits Assessment as a driver

1. City governments must develop the right policy framework for implementation.
   → Assessment of socio-economic benefits creates broad factbase on all effects Energy Efficiency
   → Wider benefits help to create a long-term strategy, tackling policies and political goal
   → Wider benefits assess the impact of building energy efficiency on the full scale of public services and intervention on: social, environmental and economic level

2. Local budgets must be reallocated towards energy efficiency projects
   → Monetisation of wider benefits leads to lower payback periods
   → Several revenue streams can be quantified
   → Macro- and microeconomic impact will be assessed

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Wider Benefits Assessment as a driver

3. Municipalities must increase capacity, awareness, or knowledge to identify energy efficiency opportunities, shape policies, and leverage investments.
    → The EERAdata software shows the mutual dependencies and directness of effects
    → The used methoodlgy is very transparent and shows the probability of effects and visualises them in easy to understand bar charts and numbers

4. Municipalities must be made aware of the opportunity energy efficiency represents.
    → Quantification, ranking and evaluation of the single impacts of building energy efficiency helps to show opportunities, potential specifically for a single building and the municipality
    → Practical application, best practice examples and case studies also generate numbers that show the full potential of building renovaiton

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Challenges of Wider Benefit assessment

- Big data gaps, especially in social effects
- Existing data is :
  - uncertain and barely available on local or building level
  - mostly from national or international studies, experiments or theoretical models
  - very specific (medical treatment, influence of indoor climate etc
  - Scattered from different sources, departments, locations
- Lack of experience and rarely integrated in planning and decision making
- Lack of best practice examples
- Creation of new data takes time and is complex
- No holistic models available yet

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The EERAdata

Decision Support Tool

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EERAdata DST Integration

- Integration of the tool into existing environments
- Integration into work-flows
- Integration into data-streams
- Integration into existing policies
- Integration within the data protection of the municipality / region

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Collecting data

Real data (From Municipality)
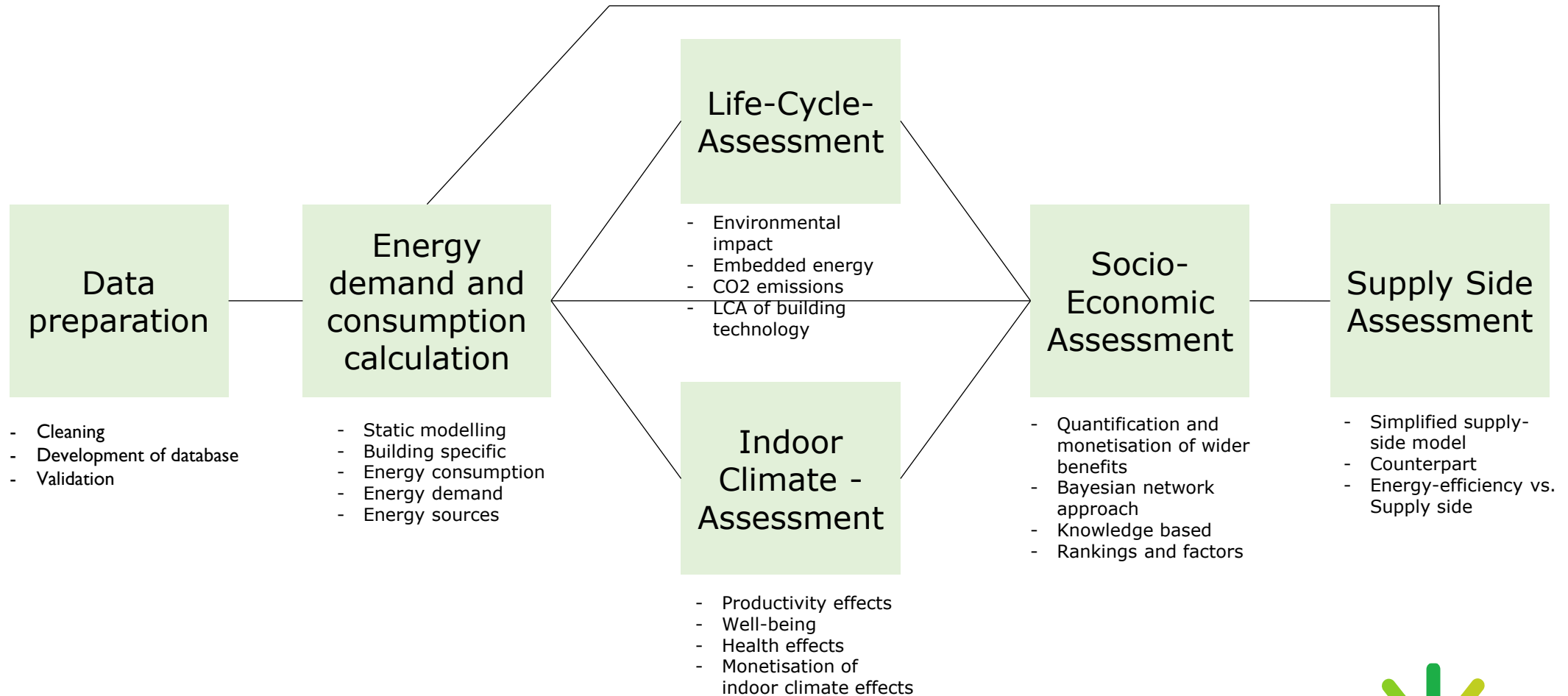
Data describing the project building

e.g. coordinates, building materials, geometry, fuel source, heating system, ventilation system, window size, occupancy, lighting system, energy use, electricity use, building age, internal termperatures, etc.)
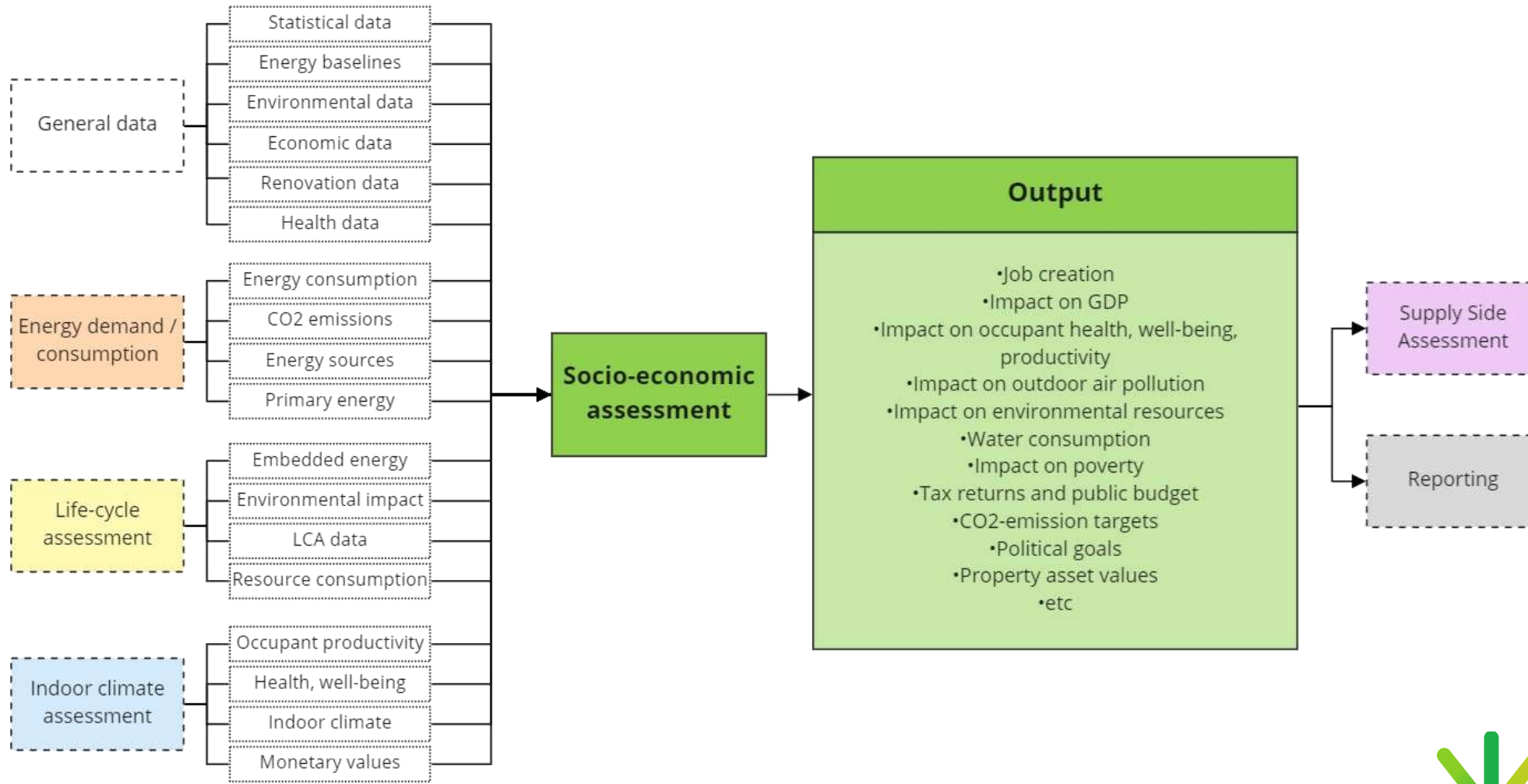
Default data (from EERAdata)

We define defaults for all datasets, in case the municipality does not monitor or assess the parameters. Defaults are based on international values or scientific models and will be adjusted to the local characteristics and building types

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What do we assess?

Data preparation
- Cleaning
- Development of database
- Validation

Energy demand and consumption calculation
- Static modelling
- Building specific
- Energy consumption
- Energy demand
- Energy sources

Life-Cycle-Assessment
- Environmental impact
- Embedded energy
- CO_2 emissions
- LCA of building technology

Indoor Climate - Assessment
- Productivity effects
- Well-being
- Health effects
- Monetisation of indoor climate effects

Socio-Economic Assessment
- Quantification and monetisation of wider benefits
- Bayesian network approach
- Knowledge based
- Rankings and factors

Supply Side Assessment
- Simplified supply-side model
- Counterpart
- Energy-efficiency vs. Supply side

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Socio-economic module

Modelled topics

- **Energy cost estimation:** Heating and electricity cost assessment €/m²year

- **Particulate Matter Emissions:**
PM10 emissions per energy source g/kWh*year, g/Building*year

- **CO2 Cost assessment:** Assessment of social CO2 cost, Emission Trading cost and National CO2 Tax costs

- **Job creation through energy efficiency investment:** Assessment of numbers of jobs created for the total project investment

- **Tax returns for public energy efficiency investment:** Trade and Income tax returns for the municipality

- **Risk of fuel poverty through household energy cost:** Alleviation of fuel poverty through energy cost savings

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Case Study: Applied Energy efficiency measures

Measures to improve the envelope		
Type of measure	Depth	Values
Add insulation to roof	Ambitious renovation	U-Value: 0,2 W/m²K Material: XPS
Add insulation to exterior walls	Ambitious renovation	U-Value: 0,19 W/m²K Material: XPS
Exchange windows	nZEB renovation	U-Value: 0,8 W/m²K g-Value: 0,4
Add External shading devices	nZEB renovation	Blinds between panes Shading factor: 0,15
Measures to improve the building technology		
Type of measure	Depth	Energy efficiency
Add air conditioning system	Quality class 2, fan efficiency increased	added energy consumption, tbd
Upgrade heating system	Biomass (10% share of non-renewable energy to harvest biomass)	Efficiency Number: 1.52 Primary Energy Factor: 0.4
Upgrade water heating system	Biomass (10% share of non-renewable energy to harvest biomass)	Efficiency Number: 1.52 Primary Energy Factor: 0.4

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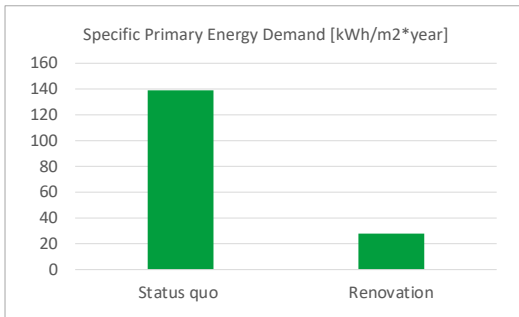# First Results: Energy demand

Final Energy Demand (kWh/m²*year)

Specific Final Energy Demand [kWh/m2*year]
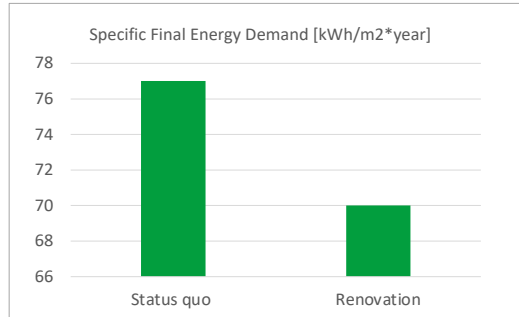
Data tables

Final Energy demand	kWh/m²*year	kWh/year
Status quo	77	501,270
Renovation	70	455,700

Primary Energy Demand (kWh/m²*year)

Specific Primary Energy Demand [kWh/m2*year]

Data tables

Primary Energy demand	kWh/m²*year	kWh/year
Status quo	139	904,890
Renovation	28	182,280

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Results: Socio-economic module

List of benefits for case study

Energy related savings	Result	20 year assessment
Total Heating cost savings for selected building €/year	1,139.25 €	22,785.00 €
Total Electricity cost savings for selected building €/year	tbd	tbd
Socio-economic savings	Result	20 year assessment
Total CO_2 cost (ETS, Tax, Social) savings /year	17,621.19 €	352,423.87 €
Trade tax return to public budget € - one-time benefit	2,468.24 €	2,468.24 €
Total income tax returns for real building size €	7,126.62 €	7,126.62 €
Societal socio-economic savings	Result	20 year assessment
Reduced unemployment spending / year	112,969.86 €	112,969.86 €

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Results: Payback Periods

	Payback time (years)
Payback time including societal benefits	6.57
Payback time including socio-economic benefits	12.09
Payback time without wider benefits	140.20
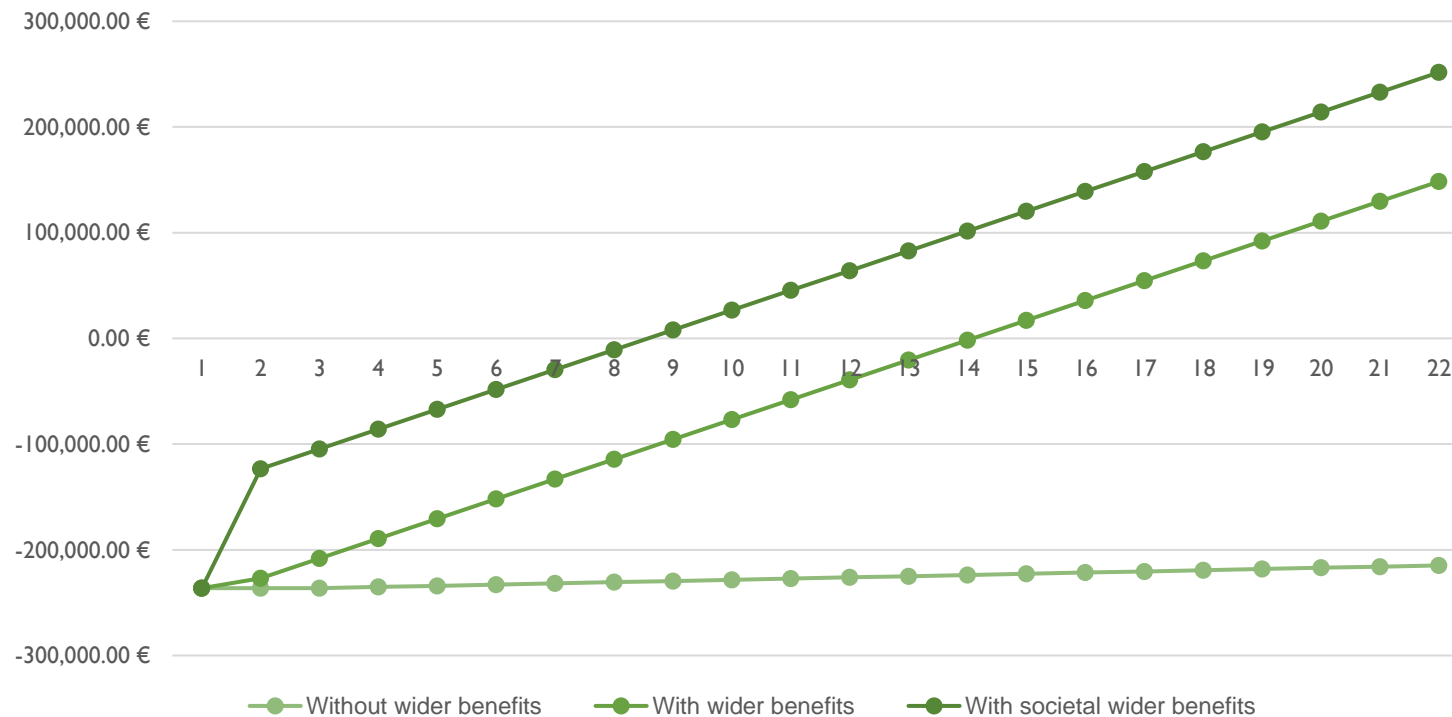
Legend: Without wider benefits — With wider benefits — With societal wider benefits

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Thank you

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