Promoting reduction of energy demand and climate adaptation through integrated simulation tools and indicators: A recent case study

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EERA European Energy Research Alliance

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Levi Cases

Dipartimento di Pianificazione Design Tecnologia dell'Architettura

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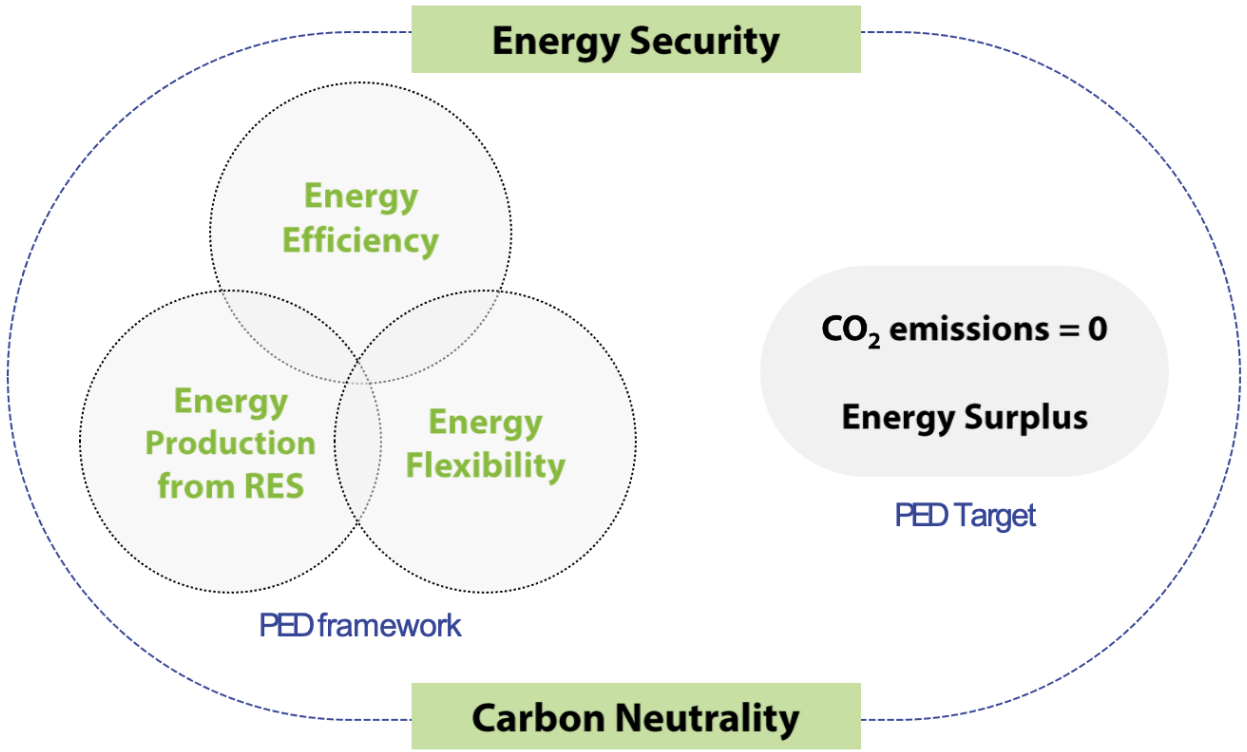
Introduction_research field



[Motivation and Background]

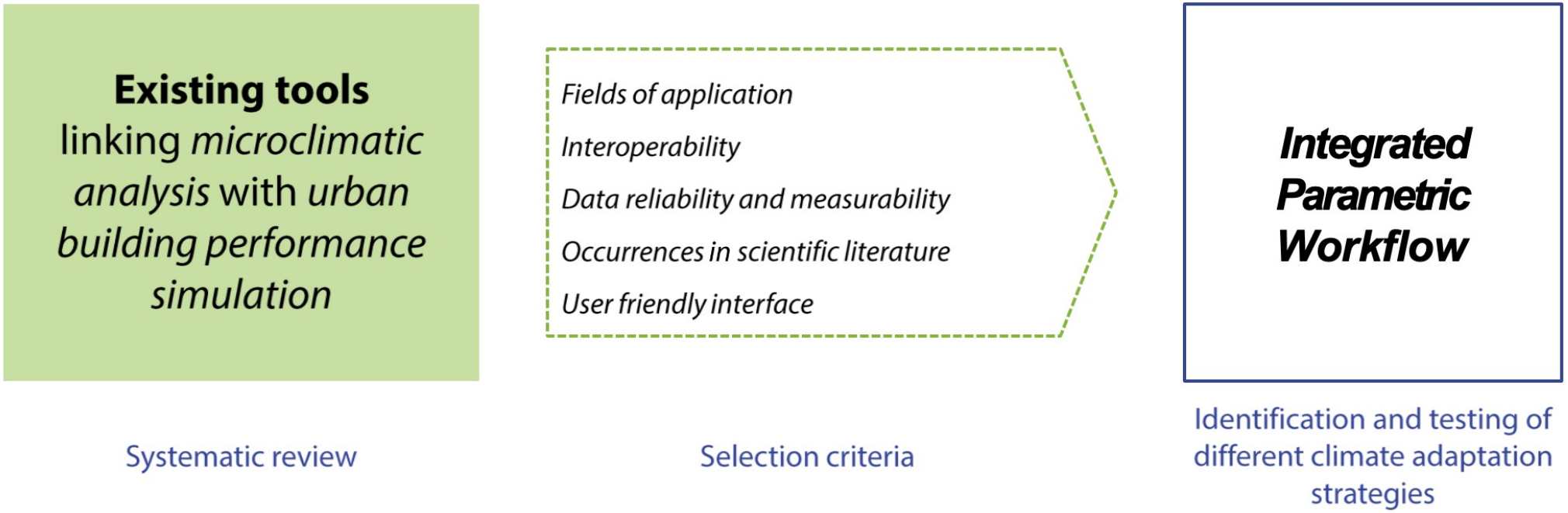
Tackling intertwined challenges

How to manage the intertwined challenges deriving from progressing PEDs in climate change scenarios both considering adaptation and mitigation strategies?

Which existing tools and evaluation methodologies might support practitioners and decision-makers in implementing climate resilient PEDs?

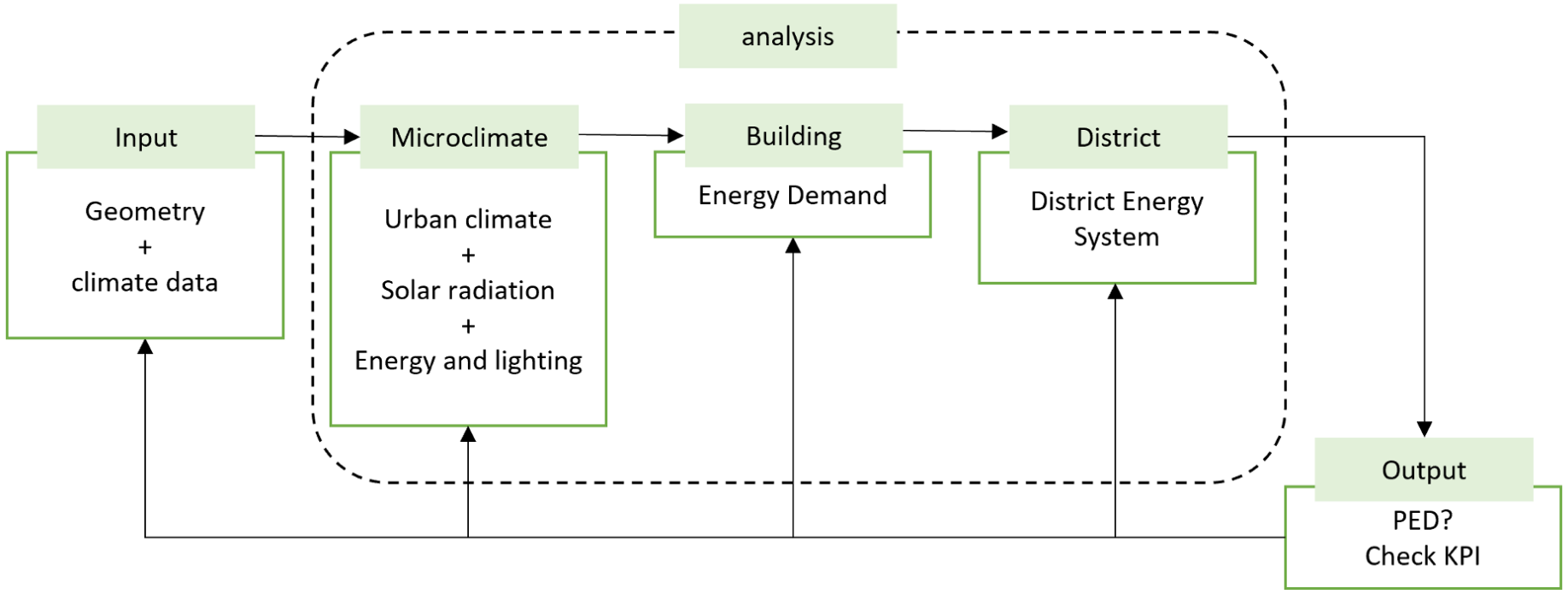
[Research Questions]

Towards an integrated parametric workflow



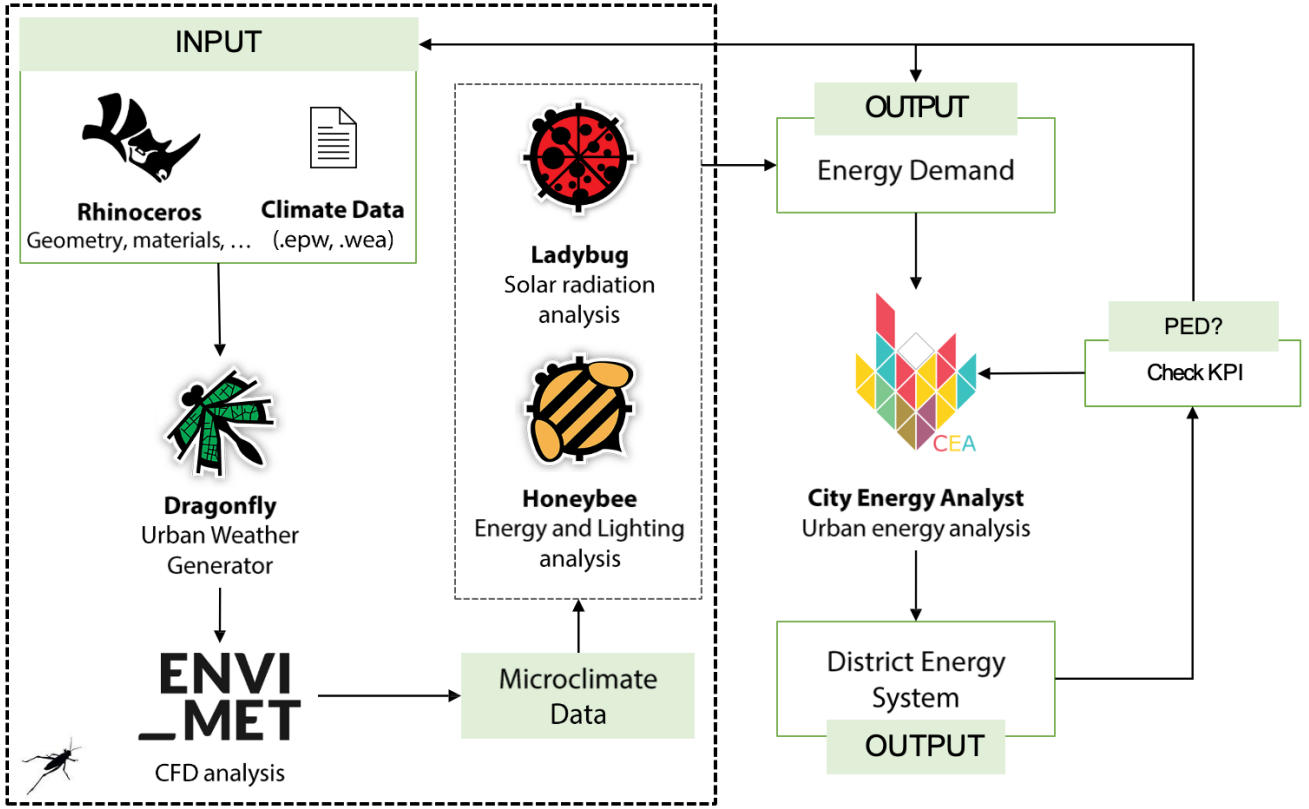
[Methodology]

Multiscale approach



[Methodology]

Looking for interoperability



[Methodology]

Case study

Residential cluster, Ludvika, Sweden – Boreal climate area (Dfb)

[Methodology]

Microclimate analysis

Microclimate analysis

Criticalities and potentials

Climate-adaptive multiscale design strategies
- Permeable surfaces
- Tree Planting

Energy Demand reduction

Future Scenarios
- Thermal comfort and human wellbeing
- Energy system optimization (climate mitigation)

Climate resilient PED

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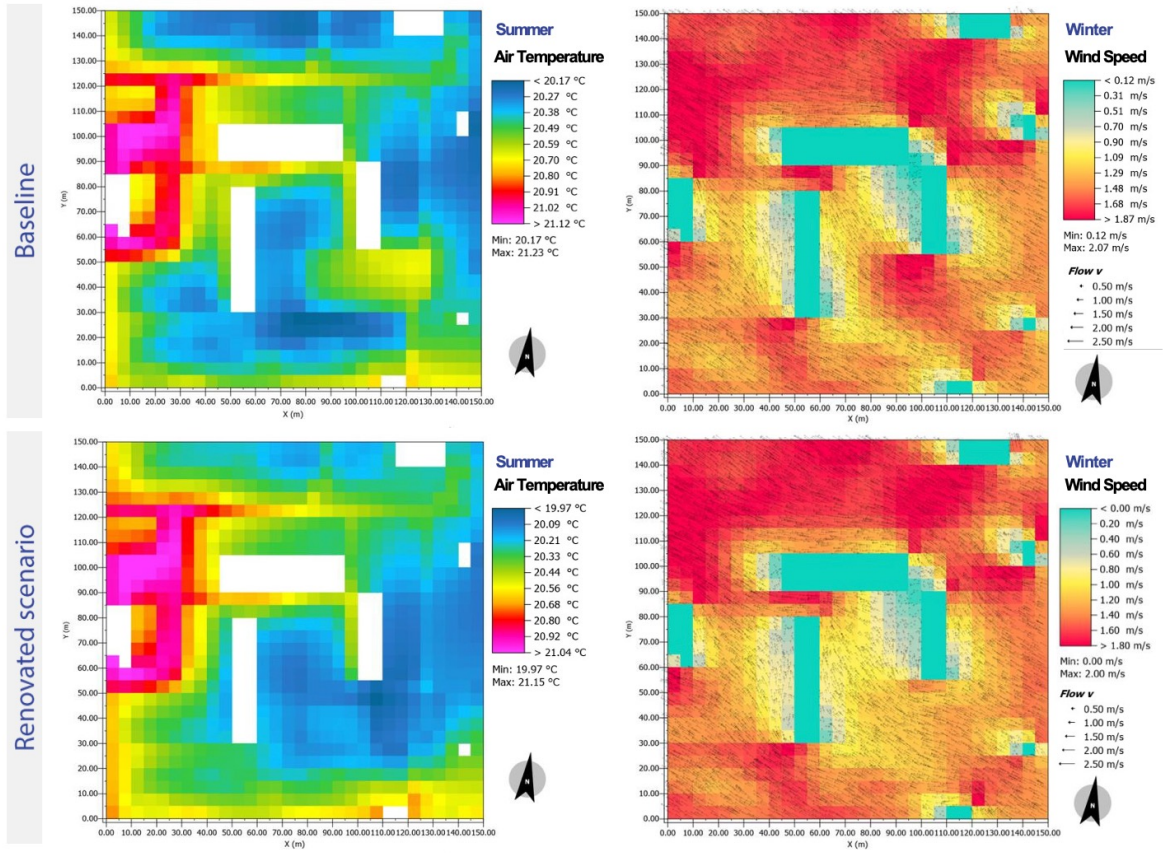


[Results]

Energy performance

Microclimate analysis

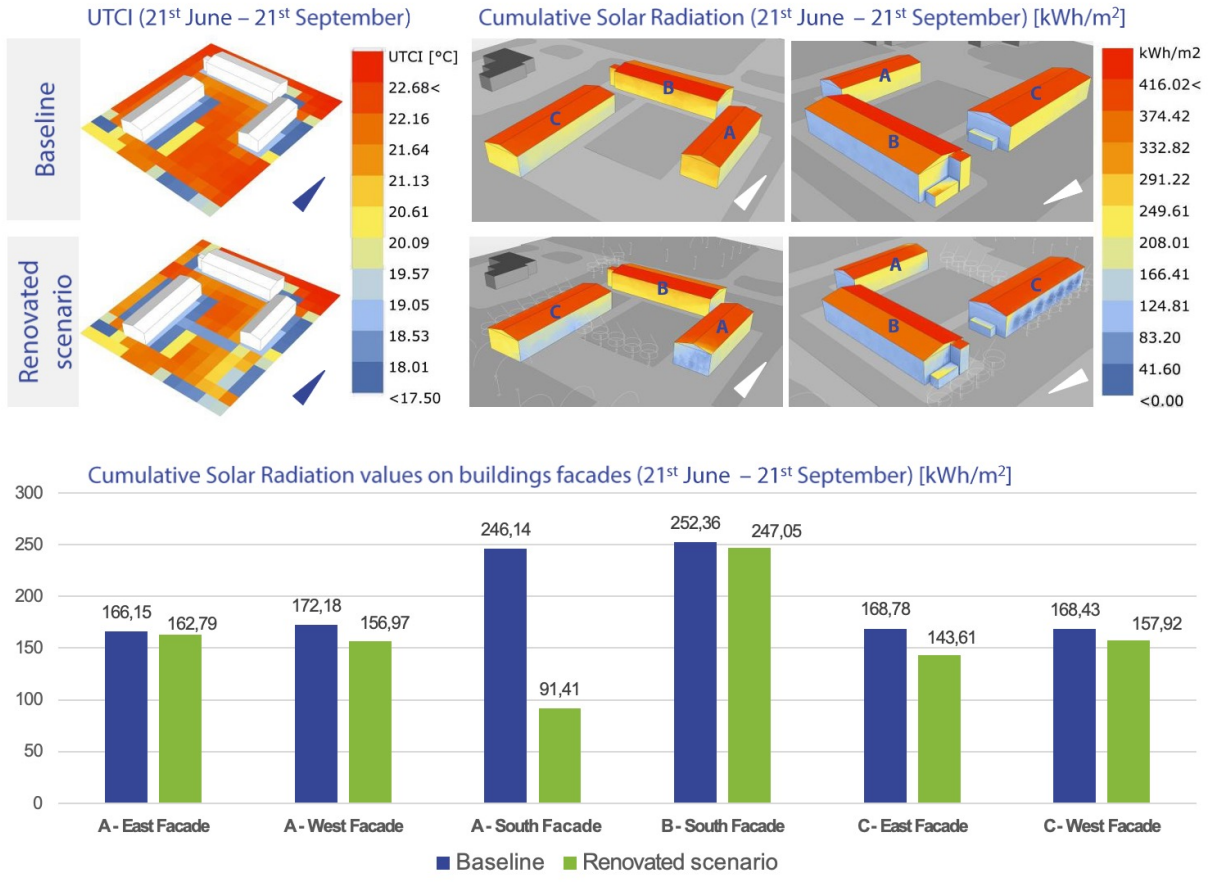
→ **Criticalities and potentials**

Climate-adaptive multiscale design strategies
- Permeable surfaces
- Tree Planting

→ **Energy Demand reduction**

Future Scenarios
- Thermal comfort and human wellbeing
- Energy system optimization (climate mitigation)

→ **Climate resilient PED**



[Results]

Scenarios and interactions

Microclimate analysis

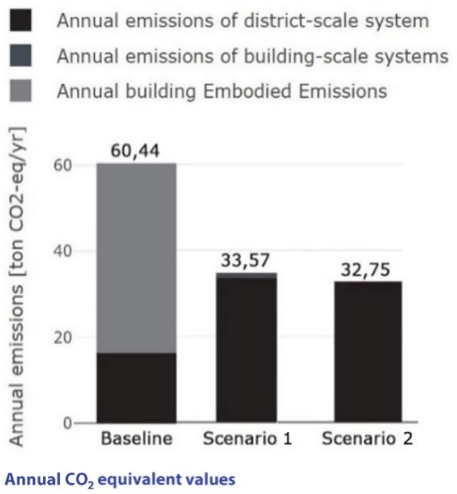
→ **Criticalities and potentials**

Climate-adaptive multiscale design strategies
- Permeable surfaces
- Tree Planting

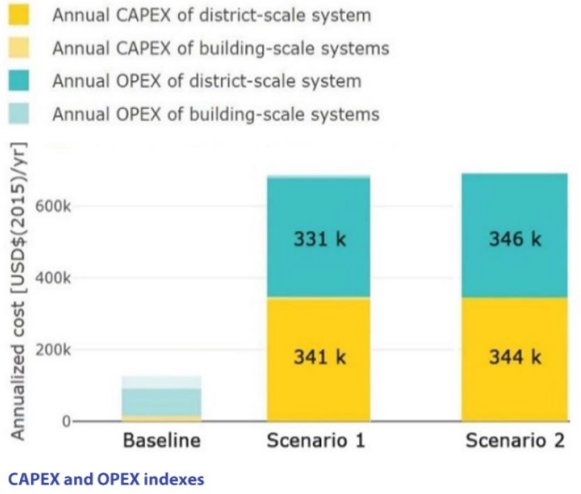
→ **Energy Demand reduction**

Future Scenarios
- Thermal comfort and human wellbeing
- Energy system optimization (climate mitigation)

→ **Climate resilient PED**



Annual CO_2 equivalent values



CAPEX and OPEX indexes

[Results]

Multiple benefits from integrated approach

- The conducted research was designed to explore the contribution of climate-adaptive nature-based strategies and solutions to the microclimatic environment, energy demand reduction, and the overall social ecological performance of the neighbourhood.
- According to the conducted simulations, the proposed solutions would reduce the cold winter ventilation up to 36%, while the lower summer solar radiation would provide higher outdoor and indoor comfort levels, and a consequent energy demand reduction for cooling up to 9%.
- Through permeable pavements, the run-volumes would be reduced up to 57%, benefitting accessibility and liveability of open spaces.
- Furthermore, the newly proposed tree species would improve the air quality, increasing the pollutant sequestration capacity up to 15% for the CO_2, 9% for the ozone, 8% for the nitrogen dioxide, and up to 30% for the PM_{10} particles.
- Connecting the residential cluster with the closest commercial building (second scenario) recorded a lower value of annual emissions of district-scale system, requiring estimated yearly actualized financial expenditures in relation to CAPEX and OPEX equal to 344 kUSD/year, and 346 kUSD/year, respectively.

[Results]

Targeting practitioners, and decision makers

Simplifications and **user interpretations** could provide an acceptable error gap in order to avoid time consuming calculation and data measuring

Coupling BPS and CFD analysis in an integrated workflow can inform planners and decision-makers for energy masterplanning at district and urban scale

Integration of GIS- and BIM-based tools favors the interoperability and reliability of information needed to define **future scenarios** at district scale

[Take home messages]

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