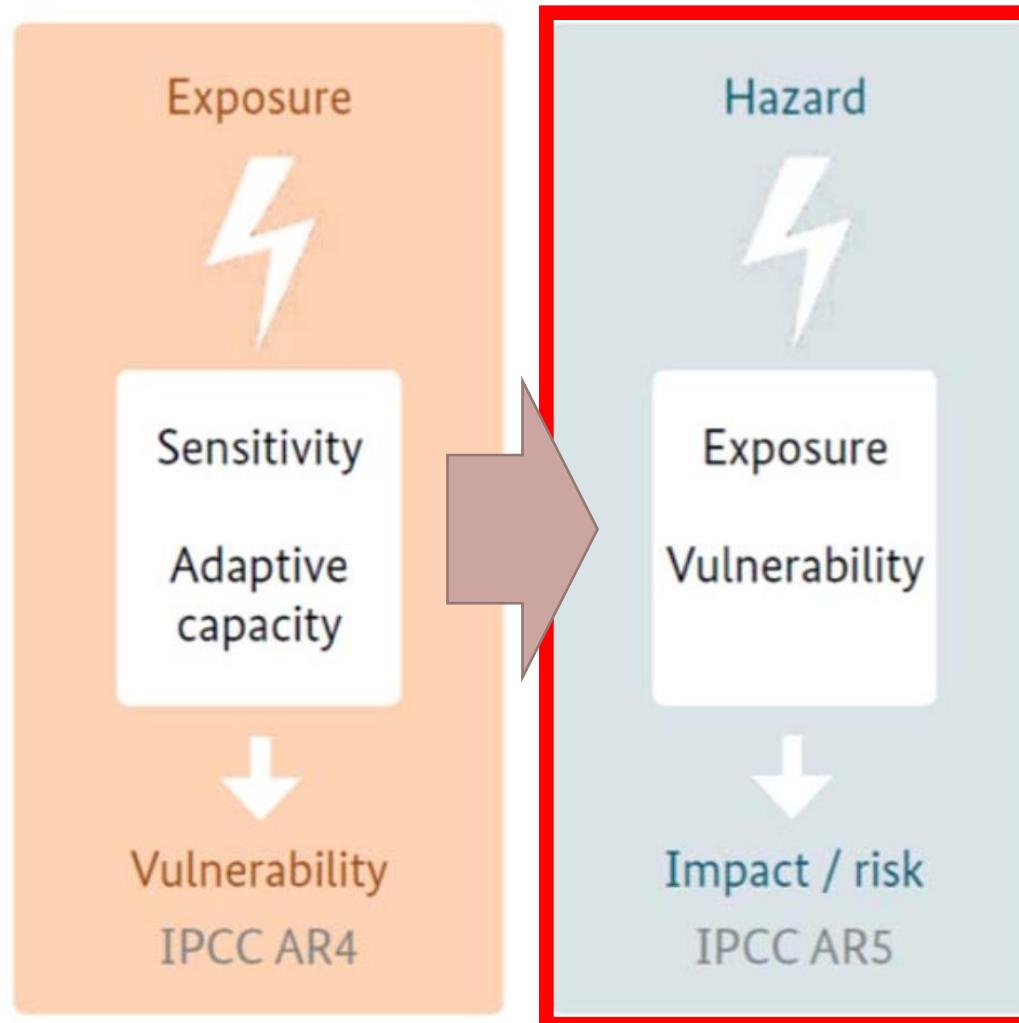


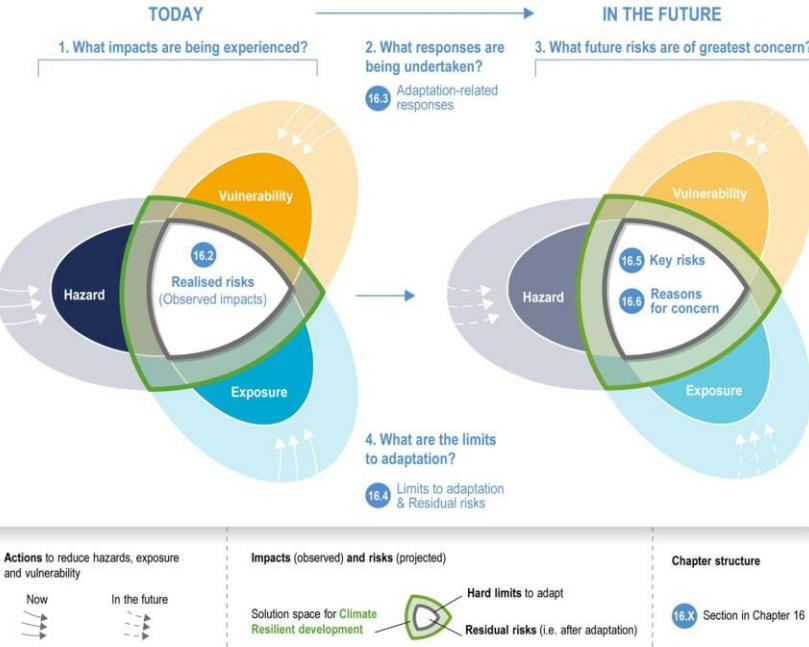
CLIMATE RESILIENCE

INTEGRATING MITIGATION, ADAPTATION AND SUSTAINABLE DEVELOPMENT PATHWAYS

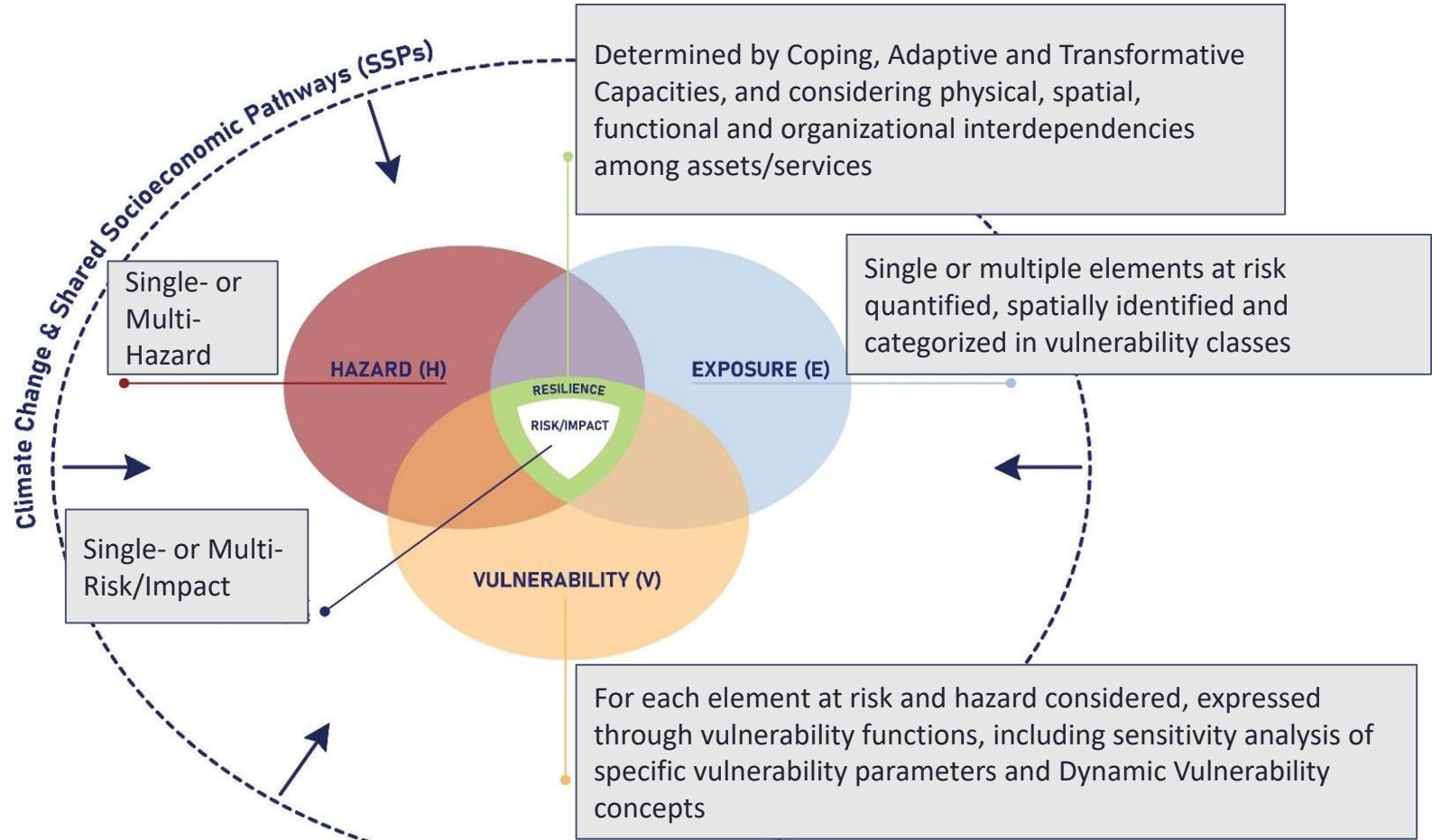
Mattia Leone
PLINIVS Study Centre, University of Naples Federico II (PLINIVS-LUPT)

EVOLUTION OF THE GENERAL FRAMEWORK FOR CLIMATE CHANGE IMPACT ASSESSMENT





Conceptual framework for climate risk/impacts assessment and “climate resilient development” implementation (IPCC, 2022).



Both the urgency and the complexity of the climate change crisis require actions at a new depth and scale.

Our report provides a solutions framework that successfully combines strategies to deal with climate risks (adaptation) with actions to reduce greenhouse gas emissions (mitigation) which result in improvements for nature's and people's well-being – for example by reducing poverty and hunger, improving health and livelihoods, providing more people with clean energy and water and safeguarding ecosystems on land, in lakes and rivers and in the ocean.

This solutions framework is called Climate Resilient Development.

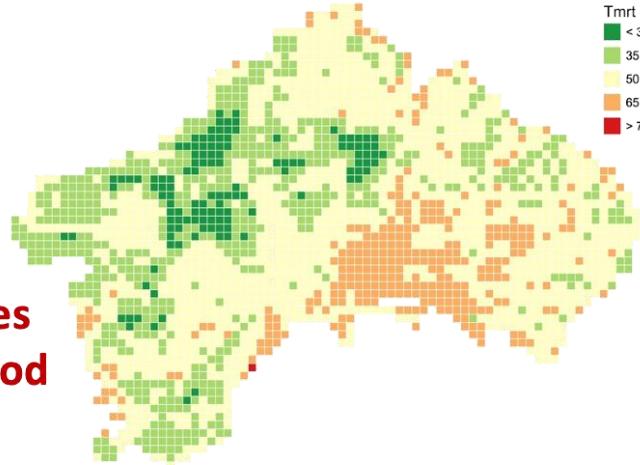
Both the urgency and the complexity of the climate change crisis require **actions at a new depth and scale.**

Our report provides a solutions framework that successfully combines strategies to **deal with climate risks (adaptation)** with actions to **reduce greenhouse gas emissions (mitigation)** which result in **improvements for nature's and people's well-being** – for example by reducing poverty and hunger, improving health and livelihoods, providing more people with clean energy and water and safeguarding ecosystems on land, in lakes and rivers and in the ocean.

This solutions framework is called **Climate Resilient Development.**

SCENARIO: rcp 8.5 frequent, 2011 - 2040, Tair 34 °C, frequency 2,766

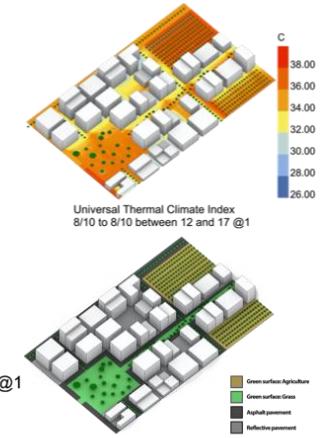
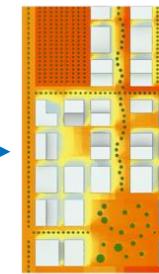
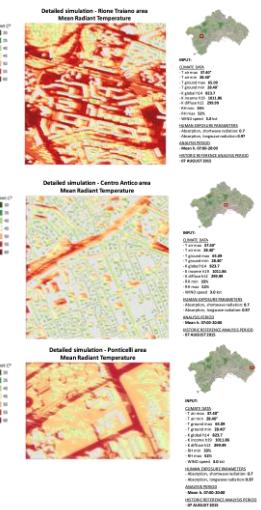
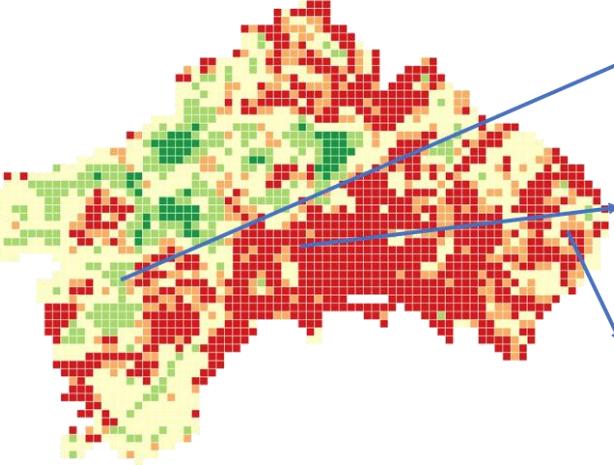
Tmrt °C
 █ < 35
 █ 35 - 50
 █ 50 - 65
 █ 65 - 70
 █ > 70



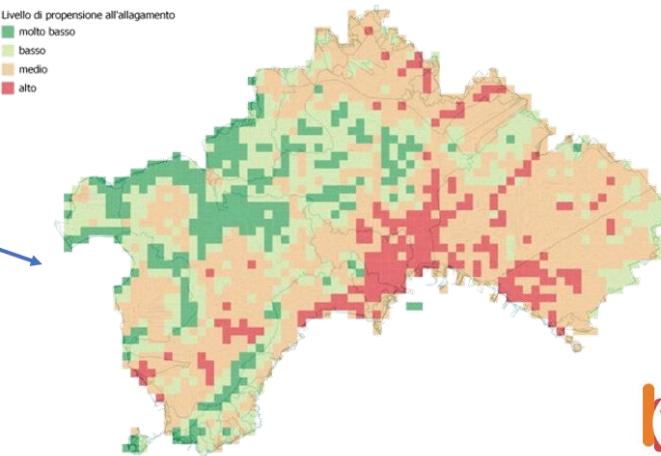
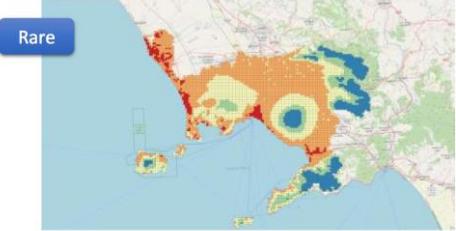
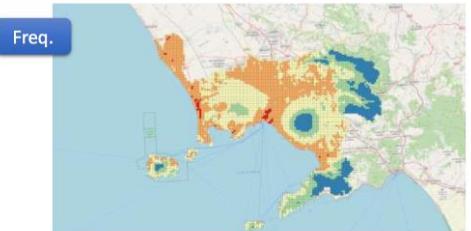
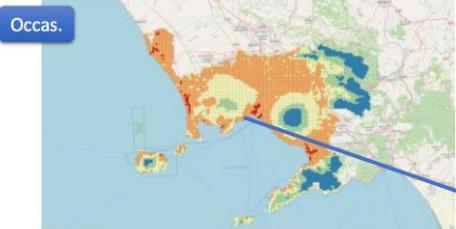
Heat Waves Pluvial Flood

SCENARIO: rcp 8.5 rare, 2041 - 2070, Tair 41 °C, frequency 0,066

Tmrt °C
 █ < 35
 █ 35 - 50
 █ 50 - 65
 █ 65 - 70
 █ > 70



Universal Thermal Climate Index
8/10 to 8/10 between 12 and 17 @1



**Multi-scale
modelling**



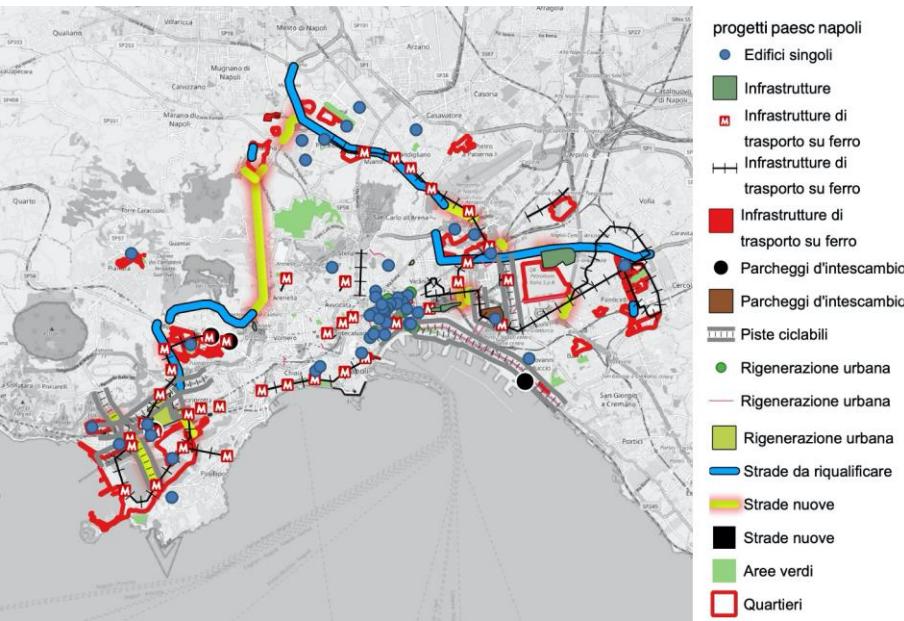


Figura 1: Classificazione dei progetti e interventi in corso nel Comune di Napoli (fonte: PLINIVS-LUPT)

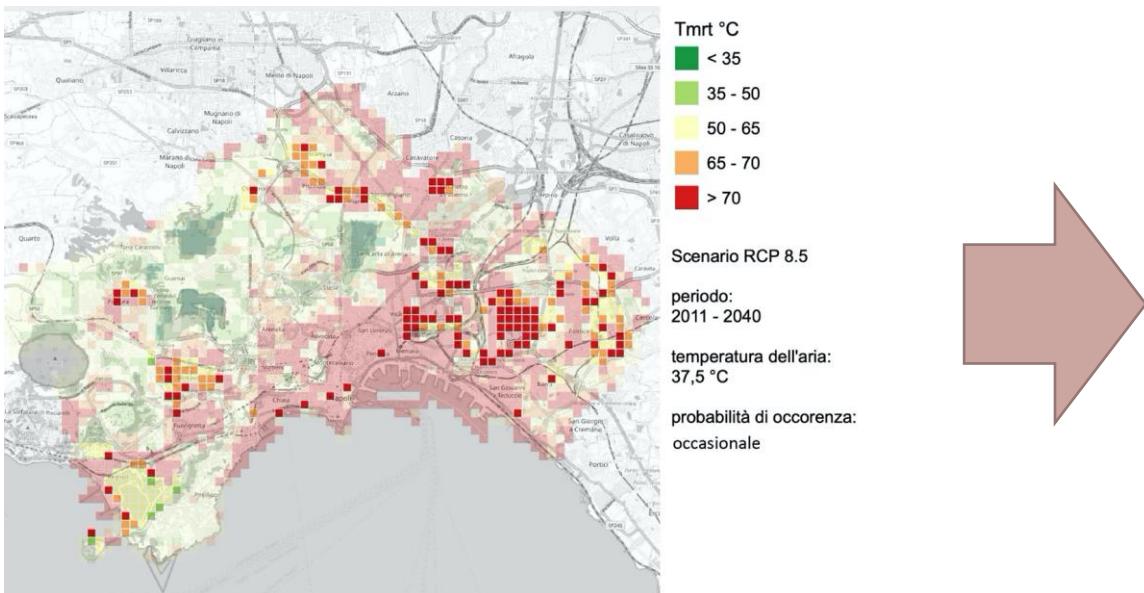


Figura 1: Evidenziazione delle celle interessate da interventi in corso o programmati, relativamente ai valori calcolati di Temperatura Media Radiante (Tmrt) (fonte: PLINIVS-LUPT)

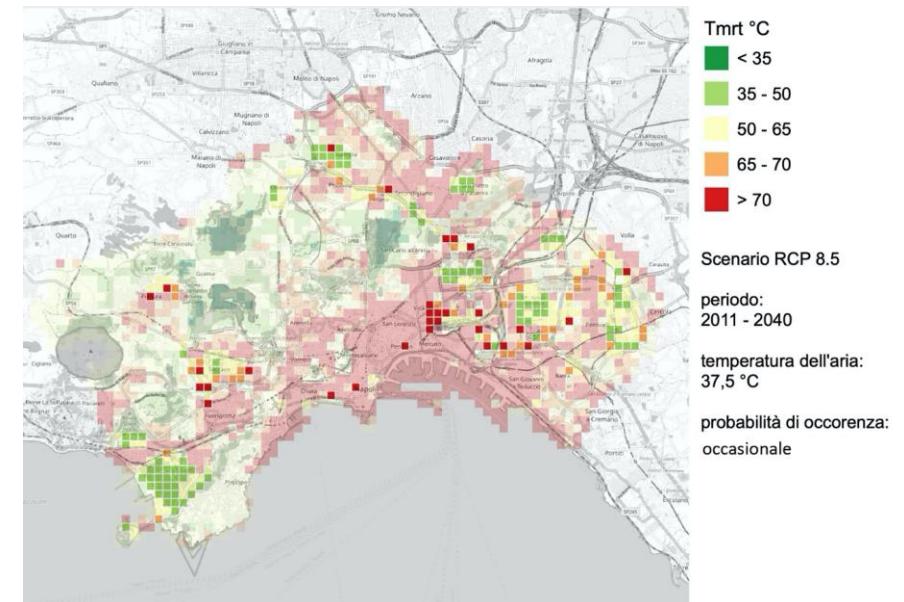
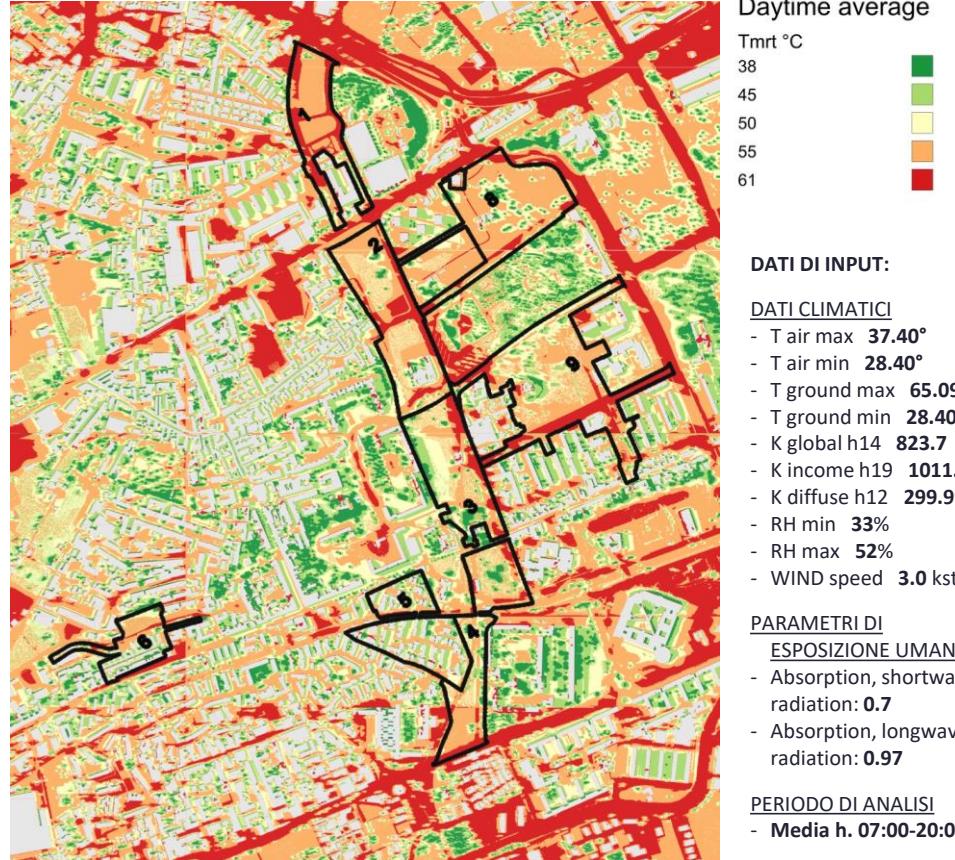
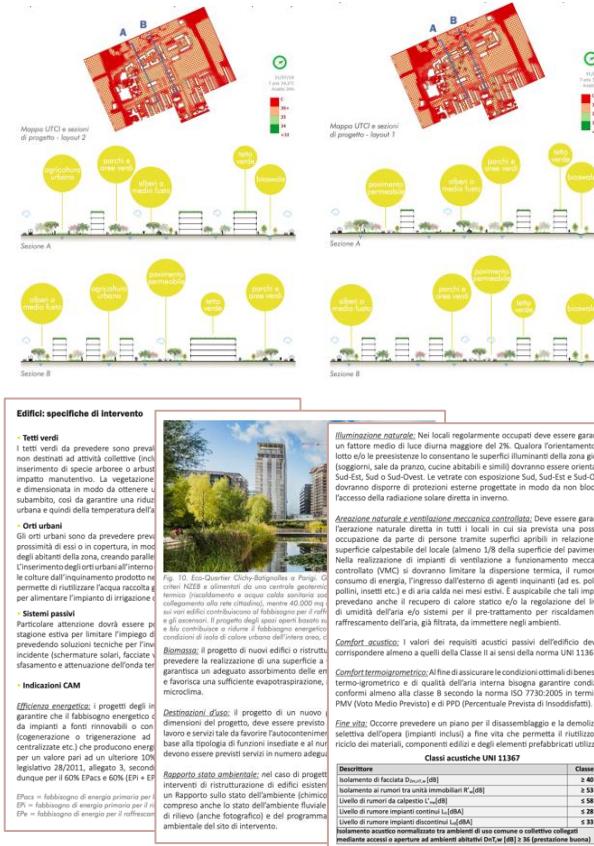
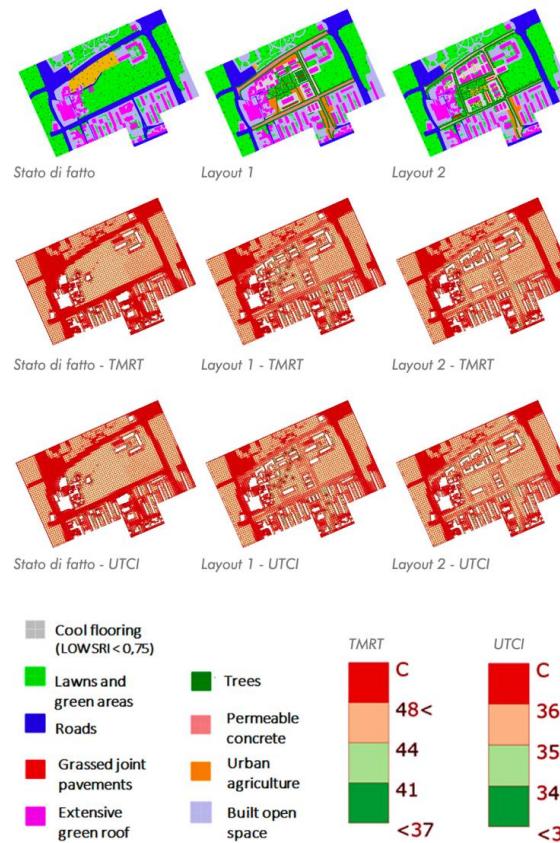
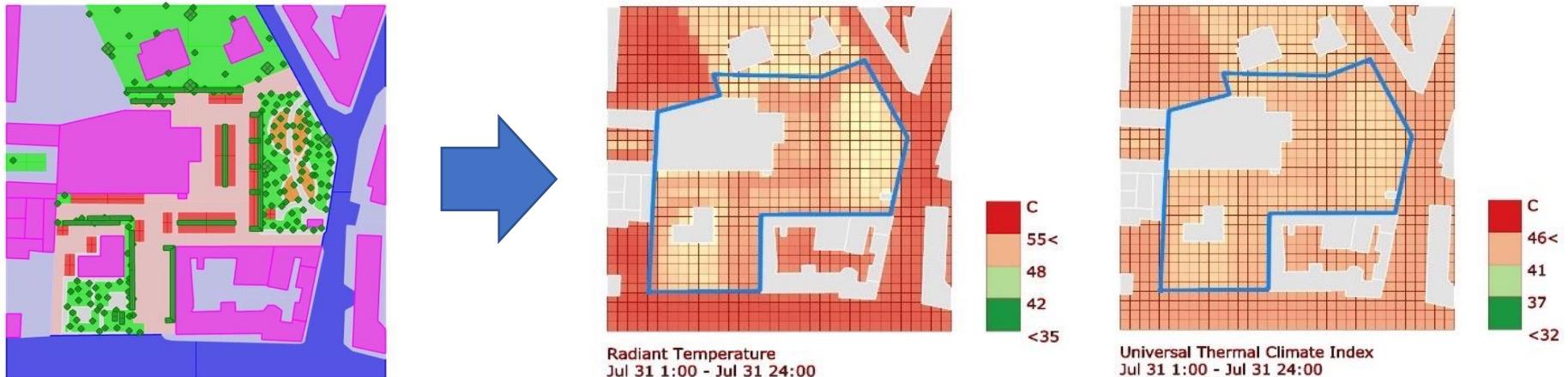


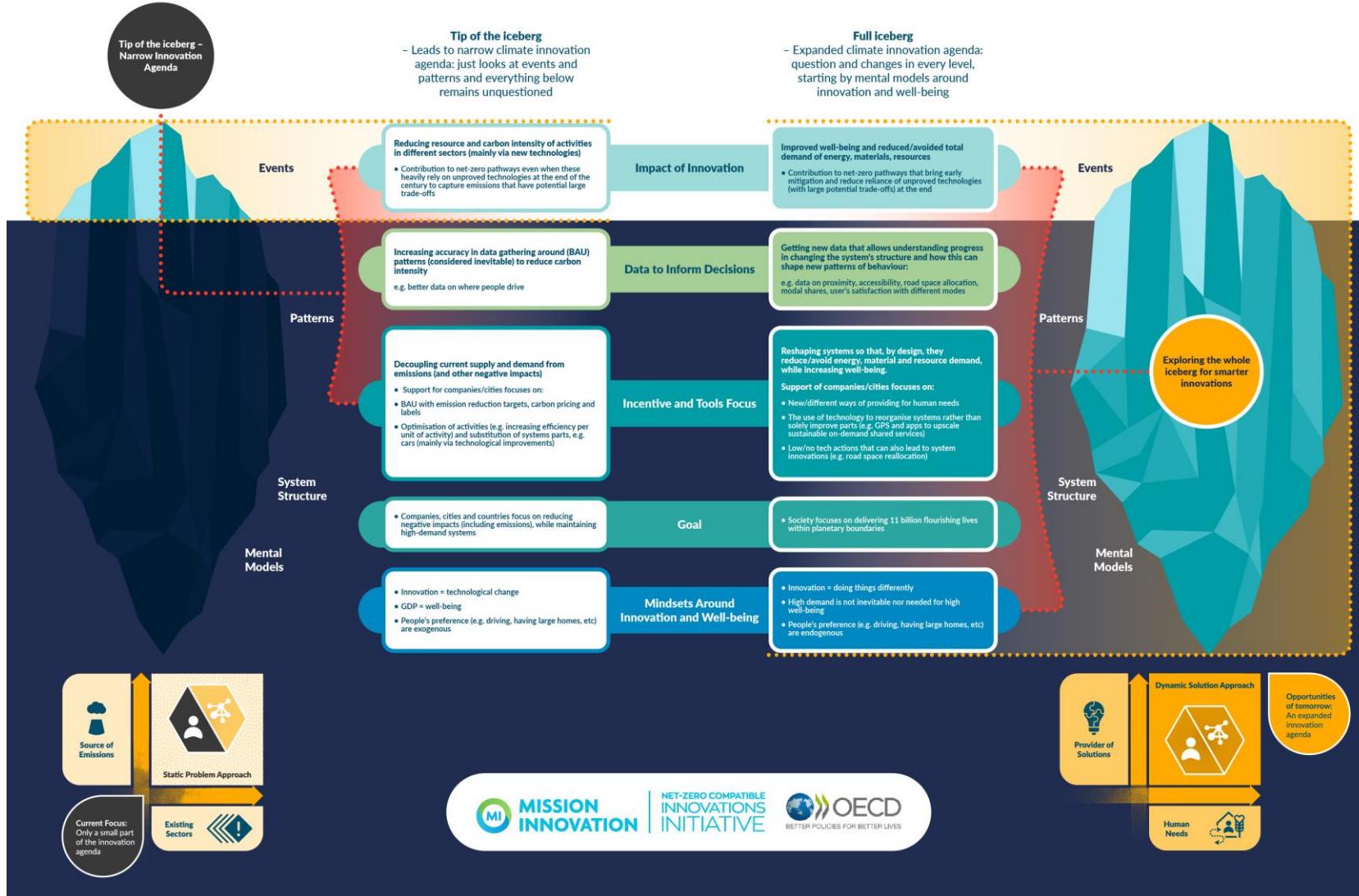
Figura 1: Analisi dei progetti e interventi in corso con indicazione del potenziale miglioramento delle condizioni di isola di calore, indicatore Temperatura Media Radiante (Tmrt) (fonte: PLINIVS-LUPT)





Minimum Environmental Criteria (CAM land cover and urban drainage)	PERFORMANCE	BENCHMARK	RESULT
Minimum green cover ratio	48%	40%	●
Minimum tree cover ratio	40%	40%	●
Minimum permeable surface	68%	60%	●
CLARITY indicators (Urban Heat Island and Outdoor Comfort)	PERFORMANCE*	BENCHMARK	RESULT
TMRT _{2018_baseline}	43,6	≤44	●
UTCI _{2018_baseline}	34,7	≤35,5	●
TMRT _{2020-2040_RCP45}	47,3	≤47	●
UTCI _{2020-2040_RCP45}	40,4	≤40,5	●
TMRT _{2020-2040_RCP85}	48,7	≤48,5	●
UTCI _{2020-2040_RCP85}	43,1	≤43	●

Support to Strategic Environmental Assessment of urban plans (EU-SEA Directive)

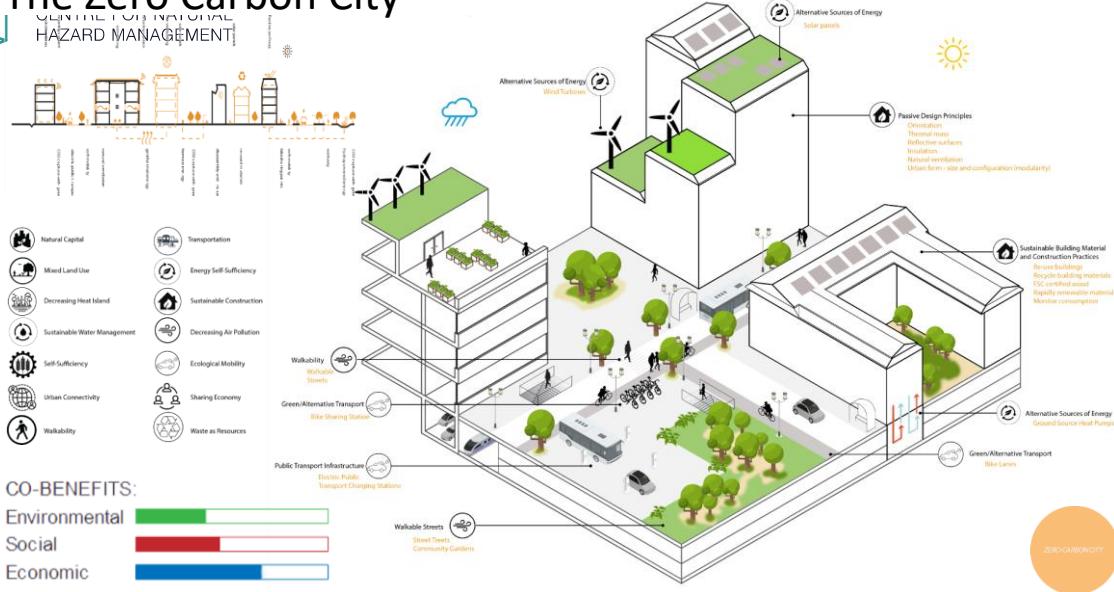


The Full Iceberg Model (source: OECD, Mission Innovation).

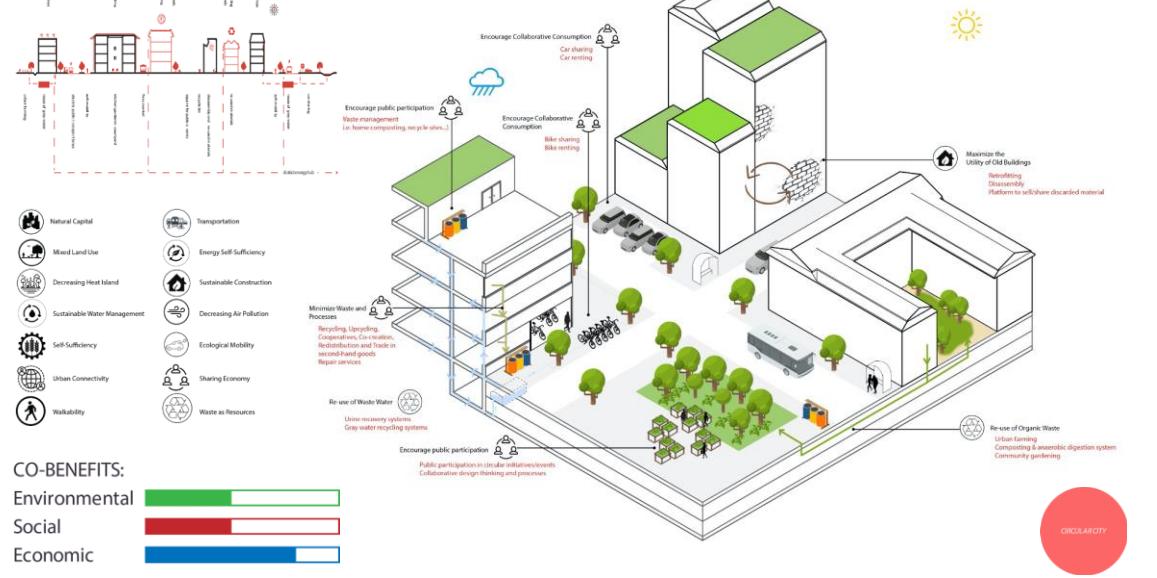


The Zero Carbon City

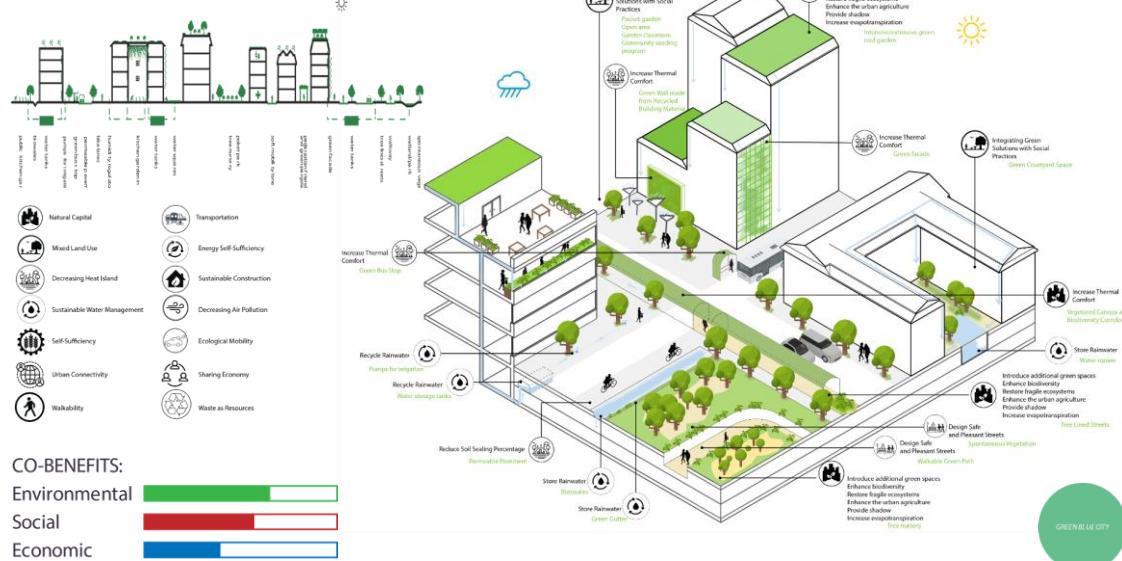
CENTRAL TO INTEGRATED
HAZARD MANAGEMENT



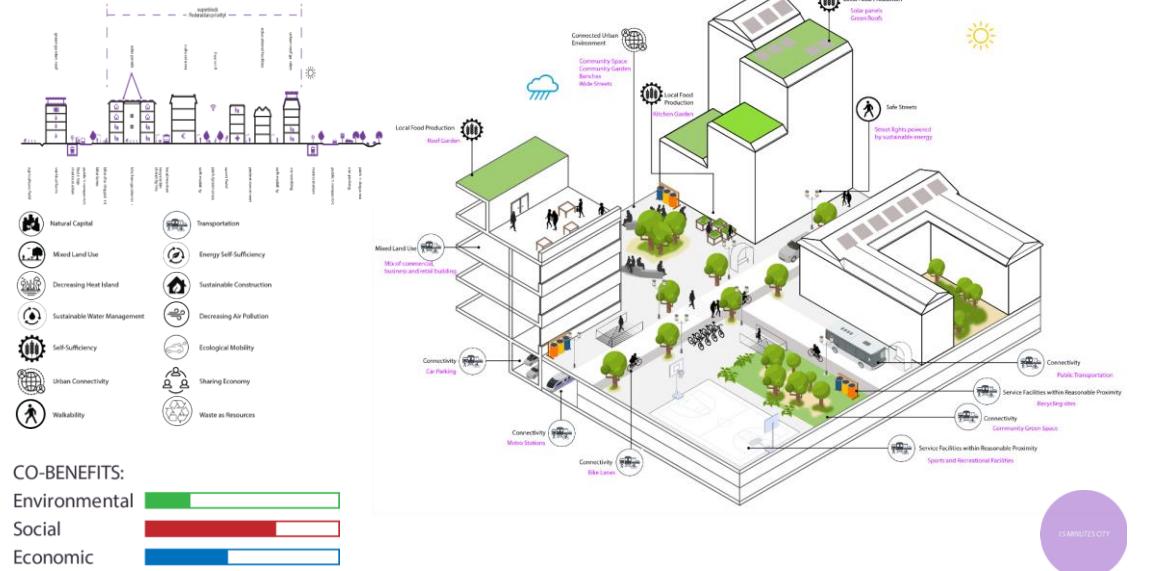
The Circular City



The Green Blue City



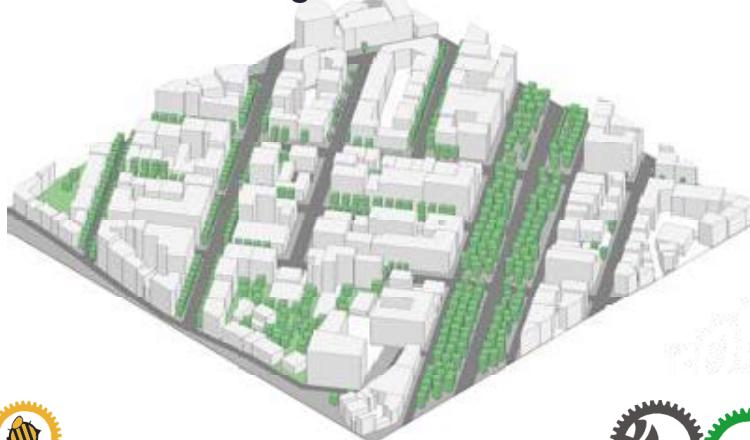
The 15 Minute City



3D modelling tools input data

- **Geometries (RHINO 3D model)**
- **Outdoor surfaces information**
 - Landcover
 - Thermal characteristics (albedo, thermal emissivity, etc.)
- **Trees information**
 - Dimensions
 - species
- **Buildings' features**
 - Building program
 - Envelope, roof and floor construction
 - Window to Wall Ratio(WWR)
 - HVAC systems

INPUT 3D MODEL IN RHINO



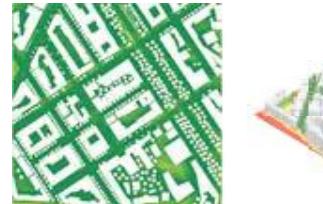
OUTDOOR THERMAL COMFORT TOOL



ENERGY CONSUMPTION ANALYSIS TOOL

3D modelling tools output data

- **Thermal comfort analysis**
 - Mean Radiant Temperature (TMRT) [°C]
 - Universal Thermal Climate Index (UTCI) [°C]
 - Indoor Predicted Mean Vote [PMV]
- **Energy analysis**
 - End Use Intensity [kWh/m²y]
 - Renewable energy production potential [kWh/y] W
- **Carbon analysis**
 - Carbon Footprint of Building Materials [tCO₂/y]
 - Carbon storage potential from vegetation [tCO₂/y]



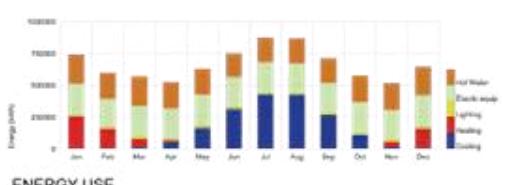
MEAN RADIANT TEMPERATURE



UNIVERSAL THERMAL CLIMATE INDEX



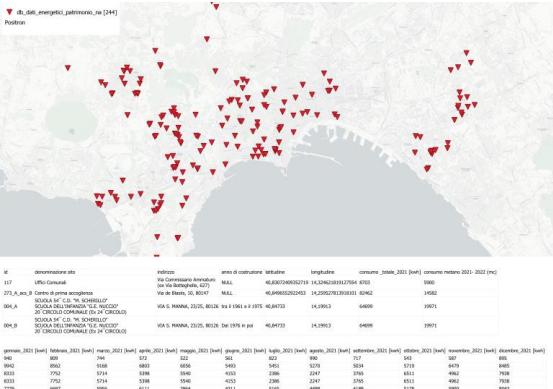
Total Zone Electric Equipment Electricity Energy (kWh)
1/1 to 12/31 between 0 and 23



City-scale energy consumption

Dati di input:

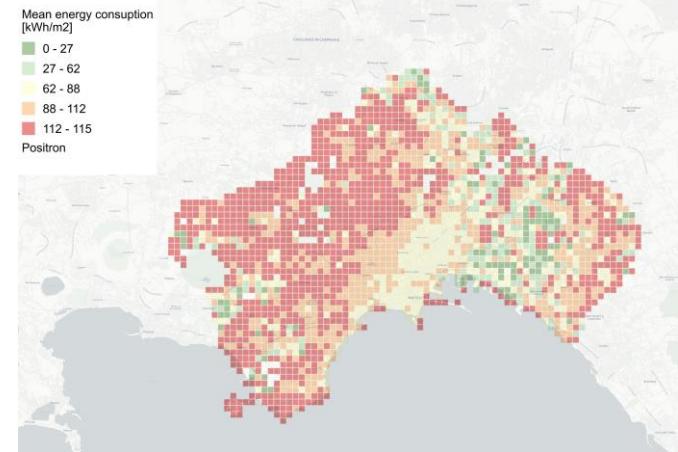
Consumo energetico del patrimonio edilizio del Comune di Napoli



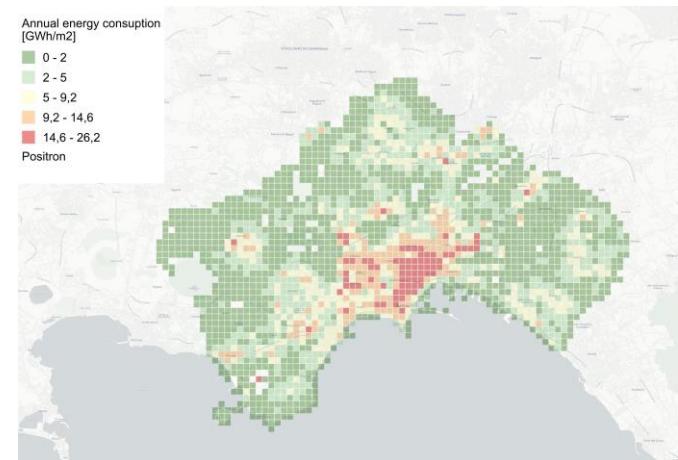
Selezione di edifici tipo



Output



Consumo
Energetico
Medio
per cella al m²



Consumo
Energetico
Totale Annuo

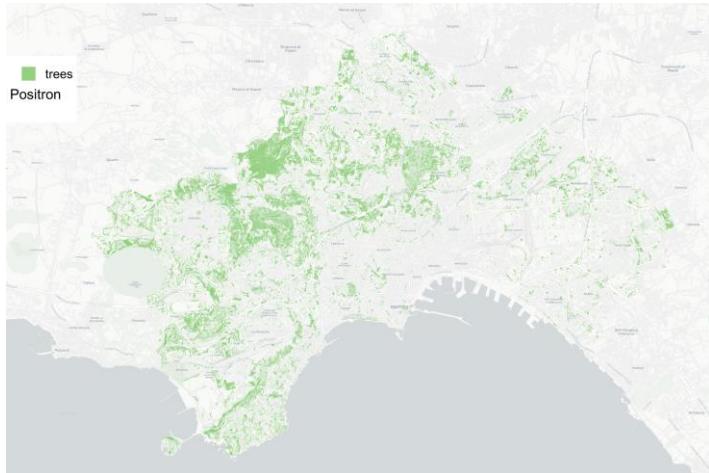
City-scale PV production potential from roofs



CO₂ storage potential from trees

Dati di input:

Individuazione alberi della città di Napoli



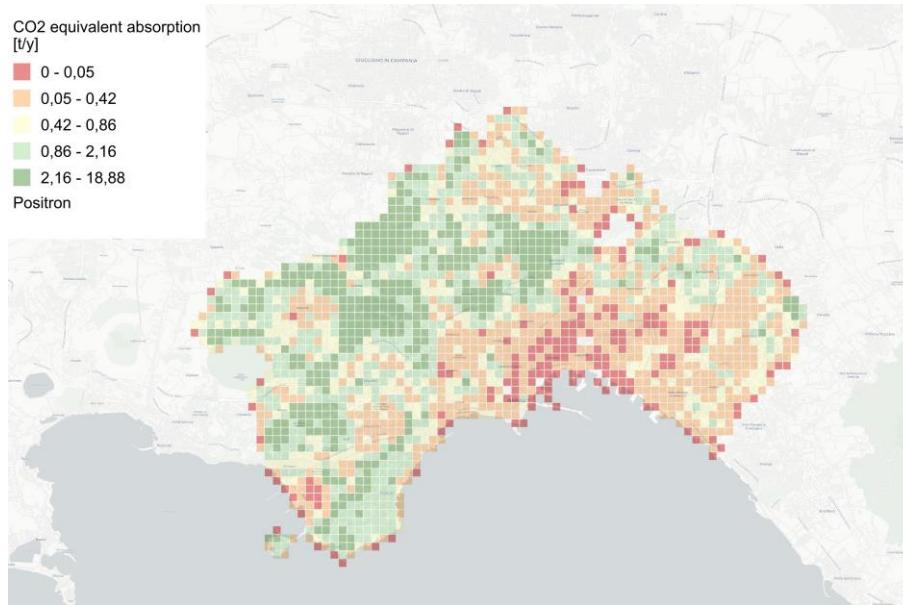
Output

Potenziale di assorbimento di CO₂ equivalente (t/anno)

CO₂ equivalent absorption
[t/y]

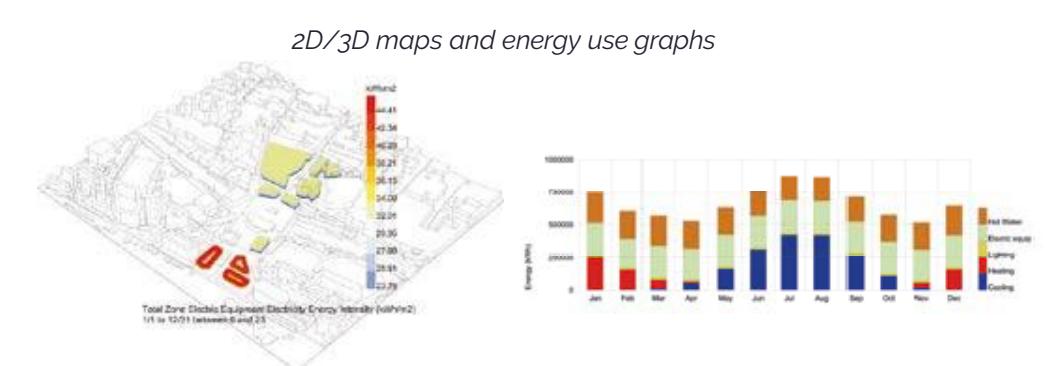
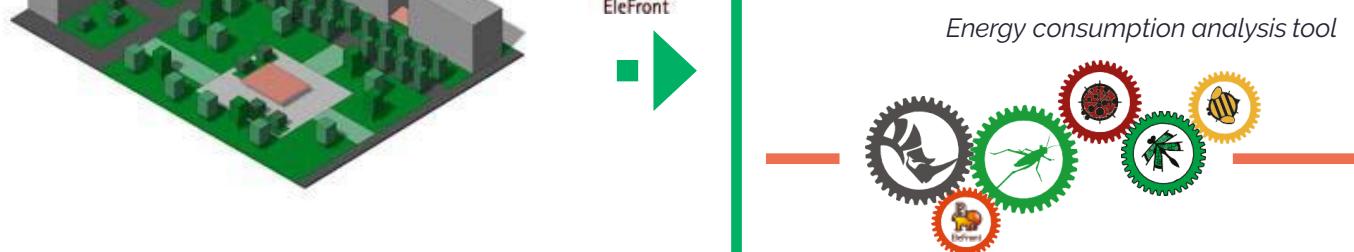
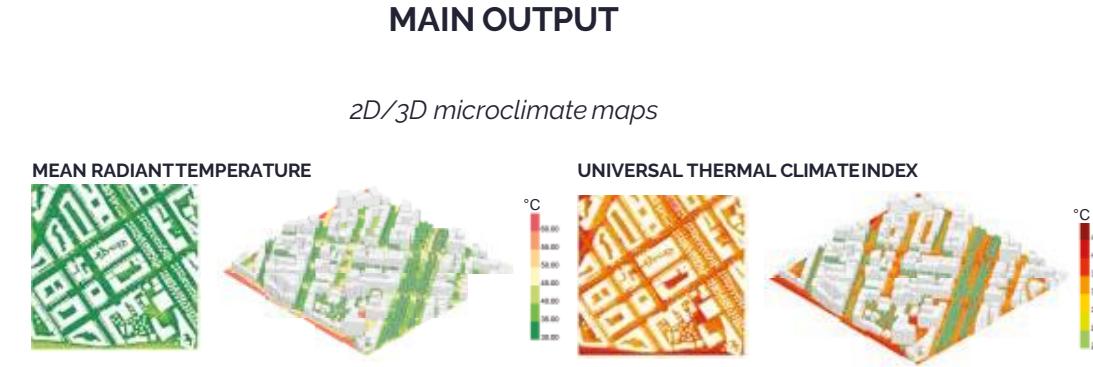
- 0 - 0,05
- 0,05 - 0,42
- 0,42 - 0,86
- 0,86 - 2,16
- 2,16 - 18,88

Positron

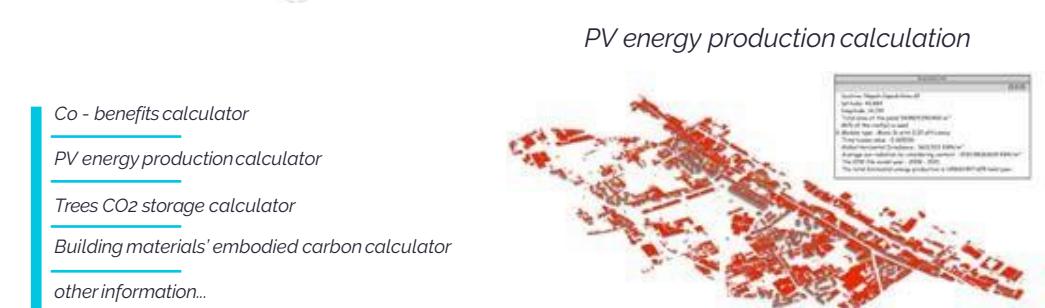


CLIMATE-RESILIENT NEIGHBOURHOOD CONFIGURATOR

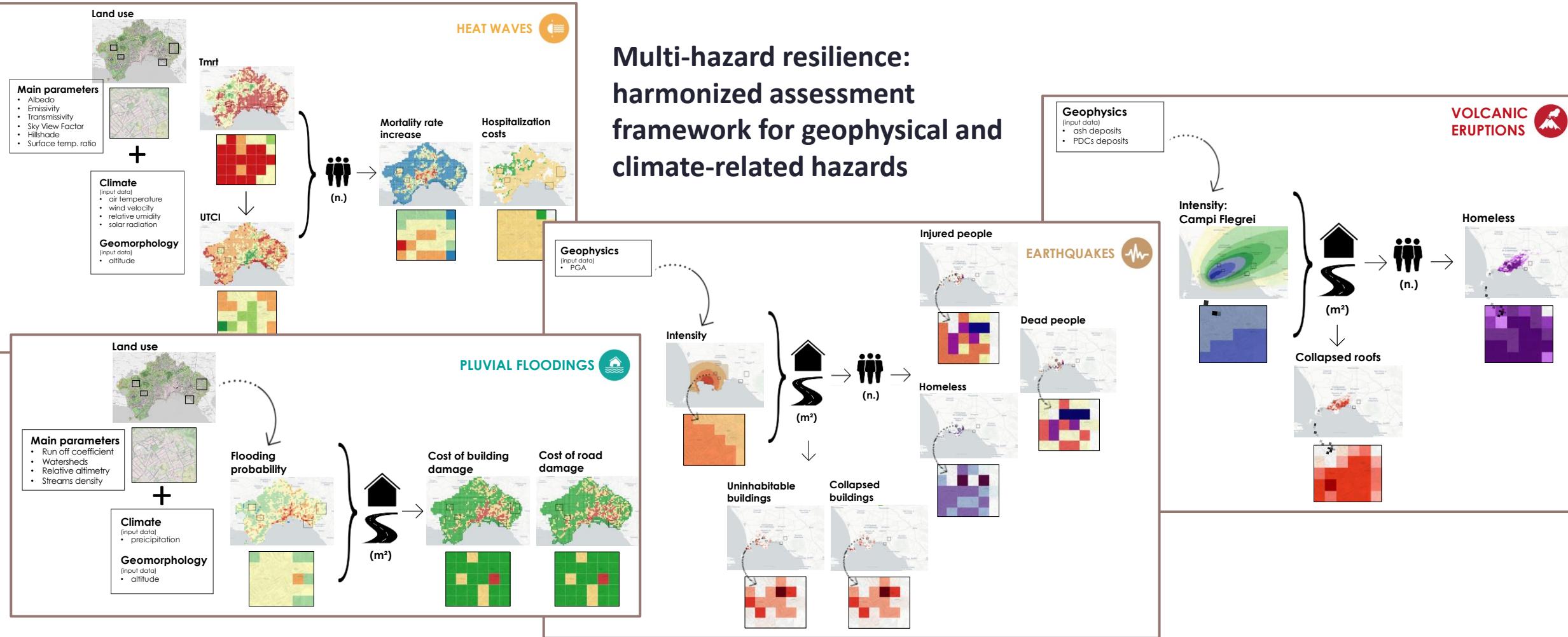
INPUT
Mass model + Information in RHINO

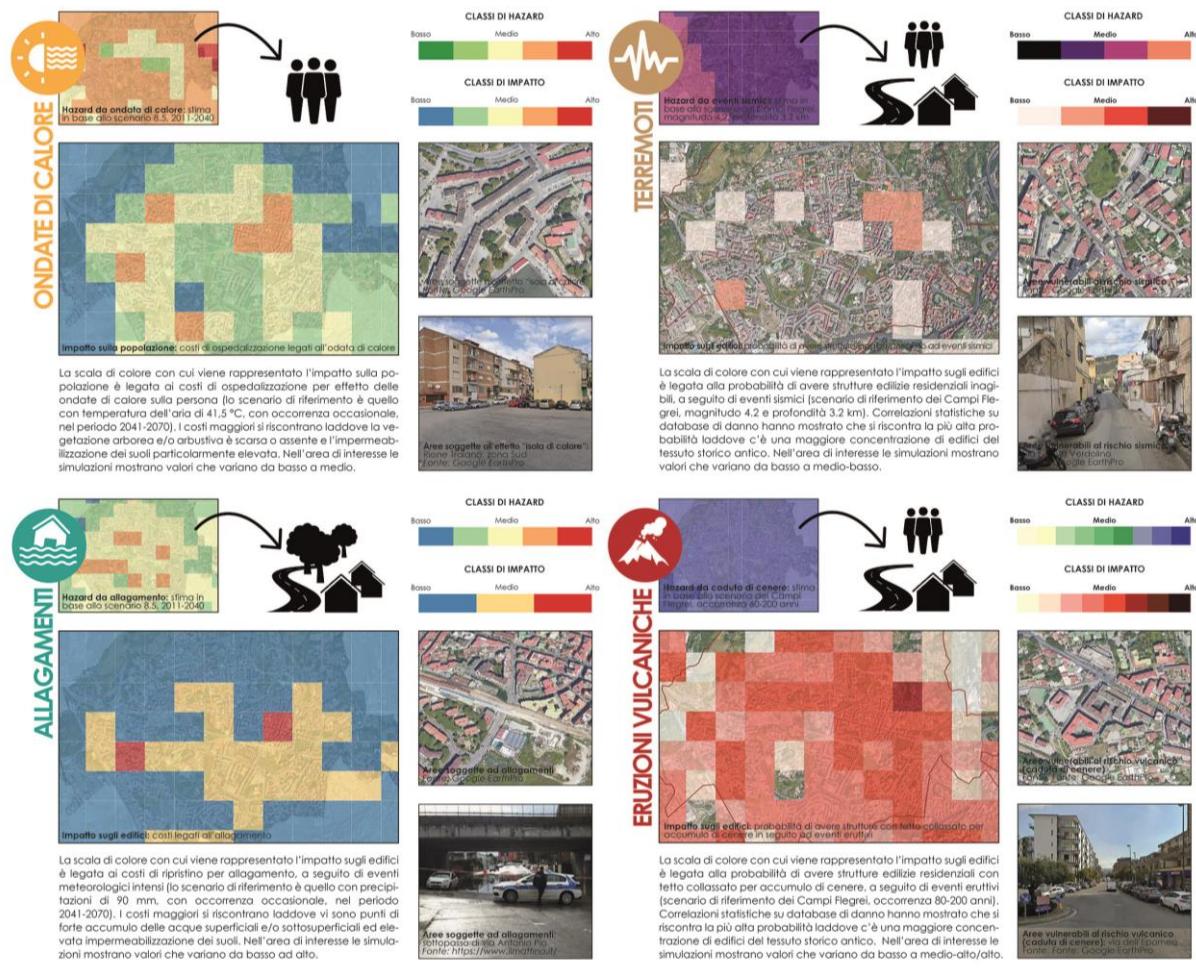
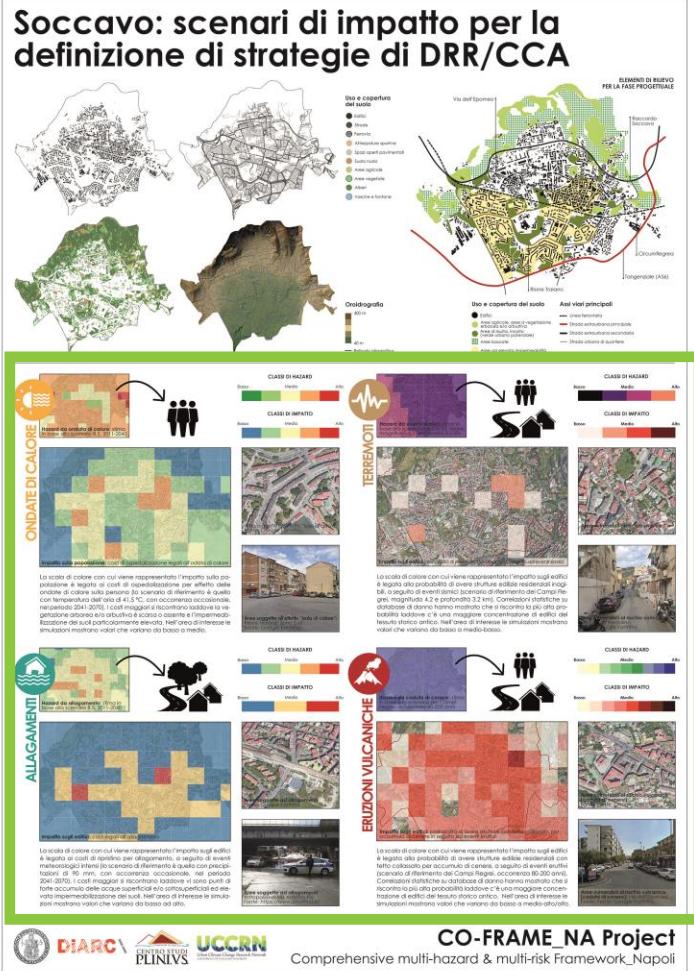


- Co - benefits calculator
- PV energy production calculator
- Trees CO₂ storage calculator
- Building materials' embodied carbon calculator
- other information...

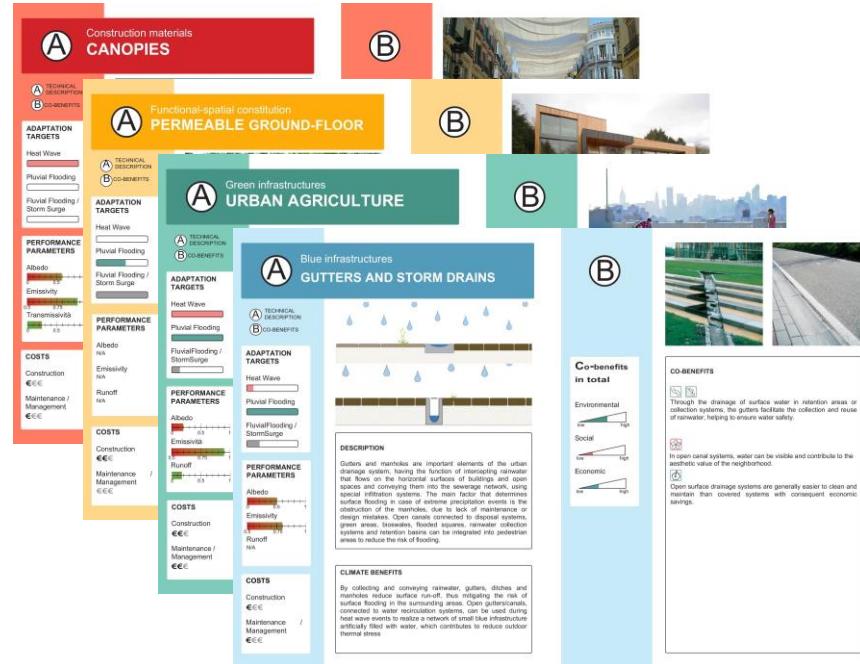


Multi-hazard resilience: harmonized assessment framework for geophysical and climate-related hazards





Climate-resilient technical solutions



Geohazard-resilient technical solutions

