

ENERGY IN BUILDINGS

EMEA 2024
Europe, the Middle East & Africa

SESSIONS:

- SUSTAINABILITY
- HEALTH & SAFETY
- DECARBONIZATION
- TECHNICAL SOLUTIONS
- DIGITAL ENVIRONMENT

A SYSTEMATIC APPROACH FOR ASSESSING CLIMATE RESILIENT BUILDINGS AND CITIES

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ReMED

Interreg
Euro-MED



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the European Union



Acknowledgments

The work is performed in the frame of an INTERREG Euro-MED project **ReMED** - Towards Climate Resilient Mediterranean Cities (<https://remed.interreg-euro-med.eu>) in a collaborative effort of **9 partners** from **5 EU countries**, including *University of Malta (Malta)* as Lead Partner, *Ministry for Gozo (Malta)*, *iiSBE ITALIA R&D (Italy)*, *Municipality of Genova (Italy)*, *National Observatory of Athens (Greece)*, *Municipality of Crikvenica (Croatia)*, *Foundation CIEDES (Spain)*, *Municipality of Malaga (Spain)*, *Municipality of Fylis (Greece)*.

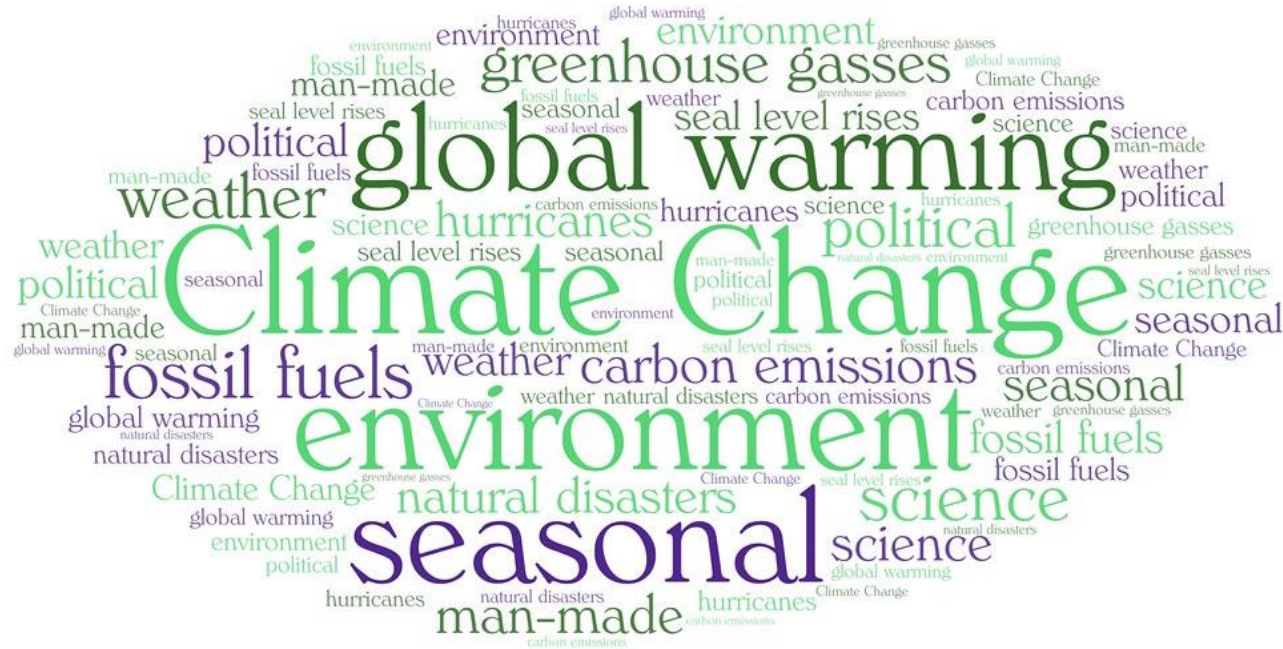
The thematic project (**1/2024 – 9/2026**) is Promoting Green Living Areas, in the Interreg Euro-MED Programme Priority 2: Greener MED for promoting climate change adaptation and disaster risk prevention, resilience, taking into account eco-system based approaches.

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Problem(s) ...

There is growing scientific evidence that

Human activities have been & are impacting climate change resulting to long-term shifts in temperatures & weather patterns



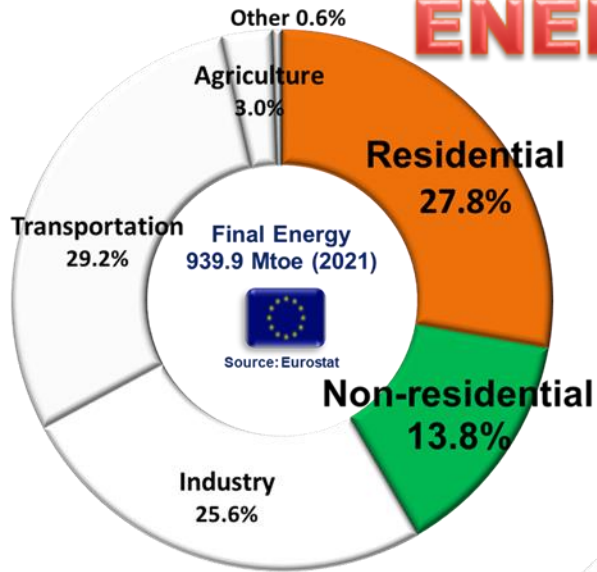
Ref: Field, C.B. et al., *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, The Intergovernmental Panel on Climate Change (IPCC). <https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-to-advance-climate-change-adaptation>

Buildings & Cities: Major Part of the Problem(s) ...

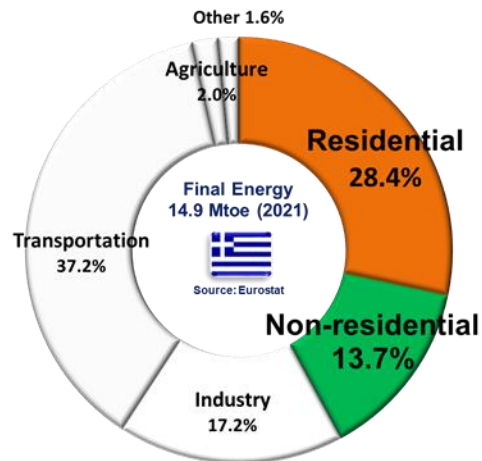
41.6%(EU) 42.1%(GR)

Final Energy Consumption

ENERGY



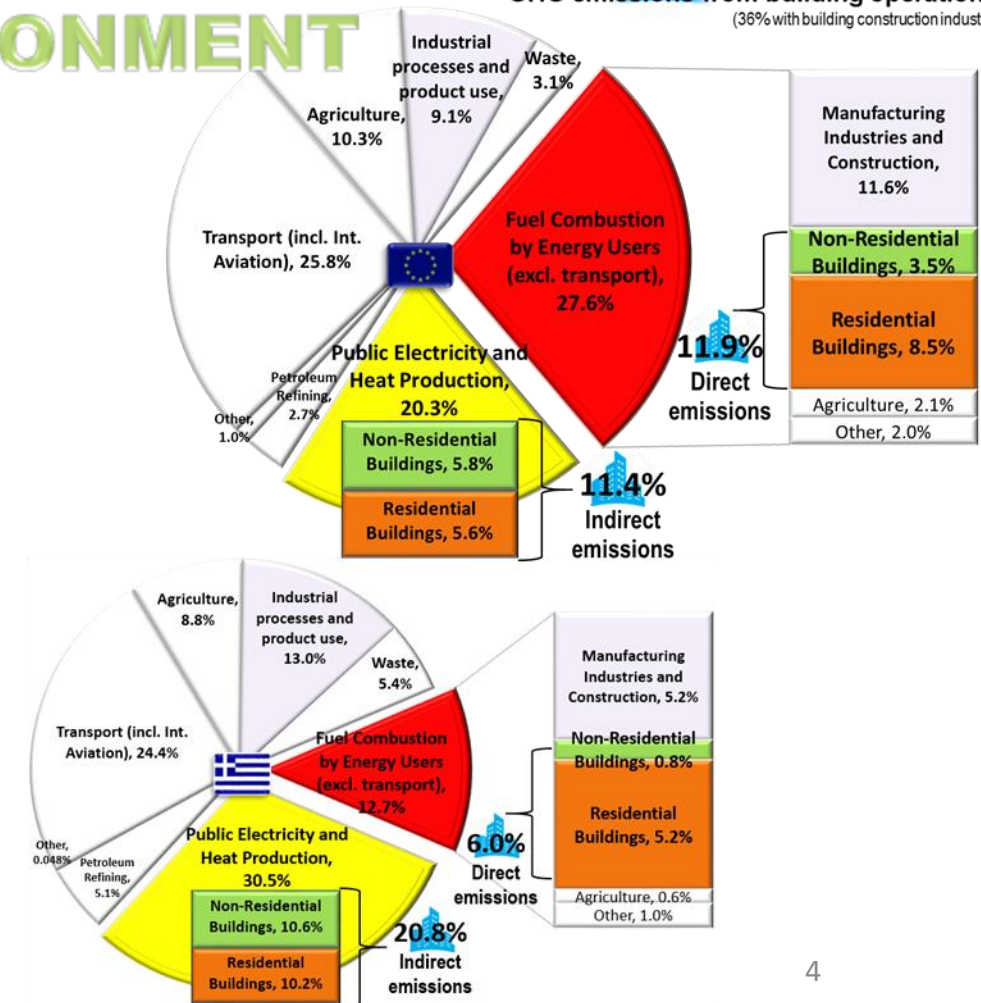
1 Mtoe = 41.868 GJ = 11,630 kWh



23%(EU) 27%(GR)

GHG emissions from building operations
(36% with building construction industry)

ENVIRONMENT



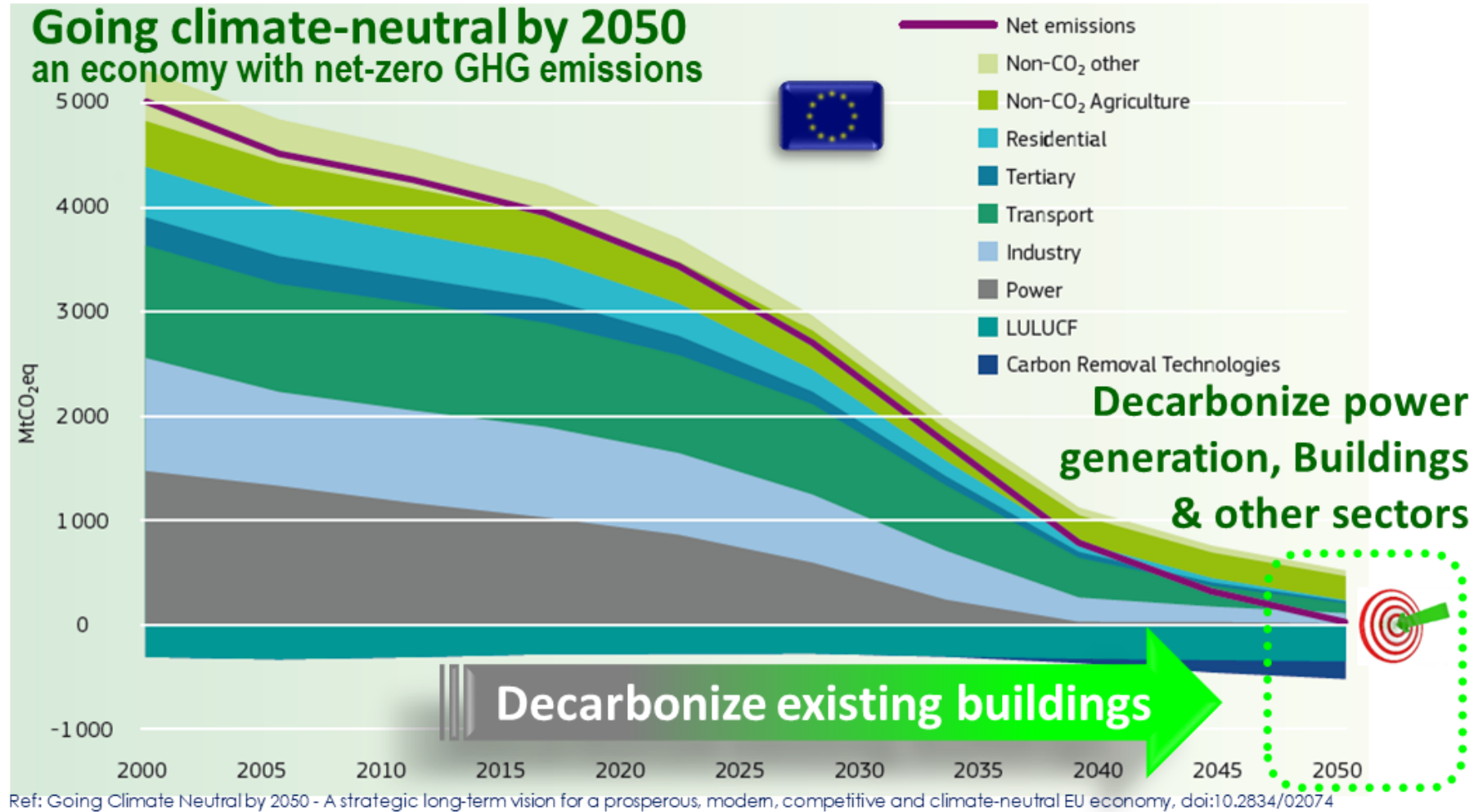
Source: EU Country datasheets, July 2021

ENERGY IN BUILDINGS 2024
Europe, the Middle East & Africa

Buildings & Cities: Major Part of the Solution ...



MITIGATION



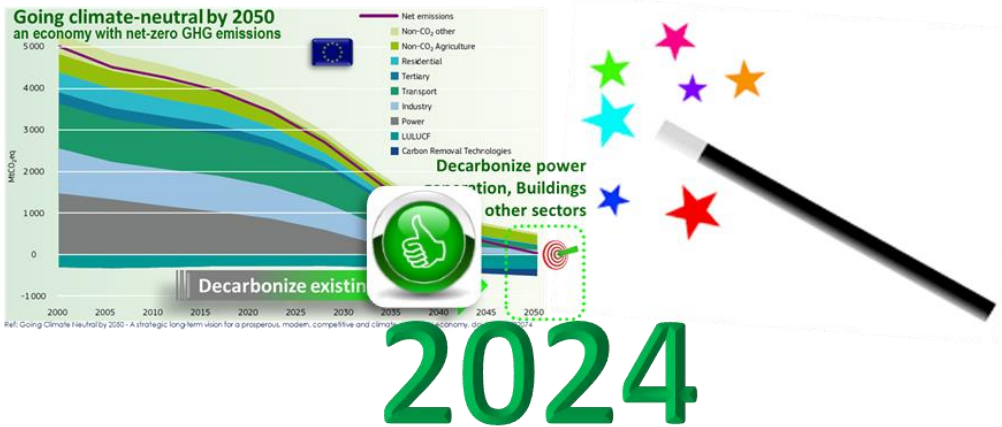
Buildings & Cities are **at Risk from Impacts of Climate Crisis** (a long-term problem-crisis)



MITIGATION ...



ADAPTATION to the impacts that we can expect now & in the future



Long lifetimes of GHG in the atmosphere ranging from a few to several decades, will have near & long term implications

BE PREPARED



DISASTERS: severe alterations in the normal functioning of a community due to hazardous physical events as a result of natural climate variability and anthropogenic climate change.



HAZARDS: potential occurrence of climate-related physical events or trends that may cause damage and loss, e.g. the frequency and/or magnitude of floods.



EXPOSURE: presence of people, infrastructure, or other assets in places that could be adversely affected by physical events and are subject to potential future harm, loss, or damage.



VULNERABILITY: natural tendency or predisposition to be adversely affected as a result of their capacity to anticipate, cope with, resist, and recover from adverse effects of physical events.

Natural Hazards

INTENSE
EXTREME **More** **FREQUENT**

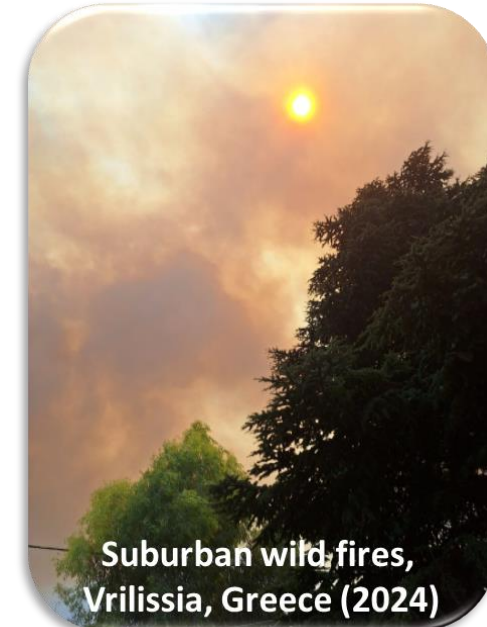
Natural hazards due to climate change are among the main challenges that urban systems are facing throughout the world, including:

- Heatwaves
- Extreme temps
- Droughts
- Flooding
- Forest fires
- Sea-level rise
- Saline intrusion
- etc

- Temperature
- Wind speed
- Precipitation patterns
- Snow storms
- etc



BE PREPARED



Urban Resilience



The **capacity of cities to function regardless** of the encountered **climatic stresses or shocks**, enabling **people** (particularly the poor and vulnerable) to **survive & thrive safely**.

- *Ability of urban systems to **anticipate, prepare for and respond** to climate-related disruptions, while **maintaining essential functions & recovering** swiftly.*

How do we decide?



How do we assess?

- *Encompass a **multifaceted approach** that includes **enhancing physical infrastructure, fostering social cohesion, and promoting economic stability**.*

Building Resilience – The first step



Withstand impacts of extreme natural events, maintain sufficient services through & after the events, maintain critical MEP services & structural integrity.

- *The ability of a building to maintain required functionality during & after extreme weather and extraordinary events.*

How do we decide?



How do we assess?

- ✓ ***High performance buildings & sustainability contribute to resilience of energy grids to withstand disruptions.***
Lower building demand for HVAC & lighting, increase share of on-site renewables, higher on-site energy storage, higher equipment efficiency, automatic controls & demand response with smart technologies, building-integrated micro-grids, etc.

Building Resilience

(7.0.5). A new long-run marginal emission rates (LRMER) jurisdictional option is added with the calculation guidelines and tables in Normative Appendix D.

- f. **Indoor Environmental Quality:** Soil-gas control requirements are improved to reflect current industry practices that incorporate ANSI/AARST mandated soil-gas control measures in new building construction projects. This adds new requirements associated with soil-gas testing and mitigation standards for multifamily buildings. The resilience of a building is improved with the ability to adjust ventilation quickly and easily in response to air-quality-related emergency conditions. This requirement is for a control system that will provide a centralized method of either shutting down, minimizing, or maximizing the ventilation supplied to a building in response to conditions such as nearby wildfires or chemical spills (shutdown) or a pandemic (maximize). **MERV 13 filters are now required in outdoor airstreams for all buildings located in nonattainment areas.**
- g. **Materials and Resources:** Prescriptive and performance paths are eliminated and are now alternatives under “Material Selection.” A consideration for reusing materials is added to Section 9.3 Standard

Example



Moving Forward – Need Method/Tool

Building

Neighborhood

City

- Develop innovative **methods** & open access **tools** to raise the capacity of public authorities in **developing, implementing and monitoring adaptation measures** at building and urban scale



Sustainability Assessment Method-Tool



Assessment systems & indicators in EU to assess the risk & vulnerability to climate change at urban scale



National methods-tools-indicators



Sustainability Indicators that Support Building Resilience

Building Scale	Issues	Categories
A—Site and Infrastructures	A.1—Site Regeneration and Development	A.1.1 Protection and restoration of wetlands (expert assessment, score); A.1.2 Protection and restoration of coastal environments (expert assessment, score); A.1.3 Reforestation for carbon sequestration, soil stability and biodiversity (expert assessment, score); A.1.6 Shading of buildings by deciduous trees (%); A.1.7 Use of vegetation to provide ambient outdoor microclimate (expert assessment, score); A.1.8 Use of native plant types (%)
	A.2—Urban Design	A.2.1 Efficiency of land use through development density (%); A.2.3 Impact of orientation on the passive solar potential of building (expert assessment, score); A.2.4 Impact of site and building orientation on natural ventilation during warm seasons (wind pressure differential in Pa); A.2.5 Impact of site and building orientation on natural ventilation during cold seasons (wind pressure differential in Pa)
	A.3—Project Infrastructures and Services	A.3.1 Supply, storage and distribution of surplus thermal energy amongst buildings (%); A.3.2 Supply, storage and distribution of surplus electrical energy amongst buildings (%); A.3.3 Supply, storage and distribution of surplus hot water amongst buildings (%); A.3.4 Supply, storage and distribution of surplus rain water amongst buildings (%); A.3.5 Provision of facility to produce energy from solid waste (expert assessment, score); A.3.10 On-site treatment (expert assessment, score); A.3.11 On-site treatment of liquid sanitary waste (%)
B—Energy and Resources	B.1—Life Cycle Non-Renewable Energy	B.1.1* Primary energy use (kWh/m ² /yr); B.1.2* Final thermal energy use (kWh/m ² /yr); B.1.3* Final electrical energy use (kWh/m ² /yr); B.1.4 Energy from renewables to total primary energy (%); B.1.5* Renewables in final thermal energy use (%); B.1.6* Renewables in final electrical energy use (%); B.1.7 Use of renewable energy for all building operations (kWh/m ² /yr); B.1.8 Use of non-renewable energy for all building operations (kWh/m ² /yr)
	B.2—Electricity Peak Demand	B.2.1 Electrical peak demand for building operations (W/m ²); B.2.2 Scheduling of building operations to reduce peak loads on generating facilities (W/m ²)
	B.4—Potable, Rain, Grey-Water	B.4.1 Water consumption for indoor uses (m ³ /m ² /yr); B.4.2 Water consumption for irrigation purposes (m ³ /m ² /yr); B.4.3 Use of water for irrigation purposes (m ³ /m ² /yr); B.4.4 Use of grey-water systems (m ³ /m ² /yr); B.4.5* Potable water consumption for indoor uses (m ³ /occupant/yr)
C—Environment	C.1—Impact on Project Site	C.1.1 Recharge of groundwater through permeable paving or landscaping (%); C.1.2 Changes in biodiversity on the site (expert assessment, score); C.1.3 Adverse wind conditions at grade around tall buildings (expert assessment, score)
	C.3—Other Local and Regional Impacts	C.3.6 Annual thermal changes to lake water or sub-surface aquifers (°C); C.3.7 Contribution to Heat Island Effect from roofing, landscaping and paved areas (invariance °C)

D—Indoor Environmental Quality (IEQ)	D.1—Indoor Air Quality and Ventilation	D.1.4 CO ₂ concentrations in indoor air (ppm); D.1.5 Effectiveness of natural ventilation during cooling season (ach); D.1.6 Effectiveness of natural ventilation during intermediate seasons (ach); D.1.7 Effectiveness of natural ventilation during heating season (ach); D.1.8 Air movement in mechanically ventilated occupancies (m/s); D.1.9* Ventilation rate (L/s/m ²)
	D.2—Air Temperature and Humidity	D.2.1 Time outside of thermal comfort range (%); D.2.2* Thermal comfort index (PPD %); D.2.3 Appropriate air temperature and relative humidity in mechanically cooled occupancies (expert assessment, score); D.2.4 Appropriate air temperature in naturally ventilated occupancies (expert assessment, score)
	D.3—Daylight and Illumination	D.3.1 Appropriate daylighting (expert assessment, score)
E—Service Quality	E.1—Safety and Security	E.1.1 Risk to occupants and facilities from fire (expert assessment, score); E.1.2 Risk to occupants and facilities from flooding (expert assessment, score); E.1.5 Maintenance of core building functions during power outages (days)
	E.4—Flexibility and Adaptability	E.4.5 Adaptability to future changes in type of energy supply (expert assessment, score)
	E.5—Operation and Maintenance	E.5.1 Operating functionality and efficiency of key facility systems (expert assessment, score); E.5.2 Appropriate maintenance for maintenance of long-term performance (expert assessment, score)
F—Social, Cultural, and Ethical	F.1—Social Aspects	F.1.2 Access to direct sunlight from living areas of dwelling units (%)
	F.2—Culture and Heritage	F.2.3 Provision of public open space compatible with local cultural values (expert assessment, score)
	F.3—Perceptual Aspects	F.3.3 Sway of tall buildings in high wind conditions (m)
G—Economy	G.1—Operational Cost	G.1.6 Investment risk (expert assessment, score)

Green Vegetation
Land Use
Energy Storage
Surface Water Management
Water use
Electrical Peak Demand
Air Quality
Thermal Comfort
Daylight
Flooding
Fire
Building Resilience During Power Outages

NATIONAL CALCULATION TOOLS

EUI kWh/m² kg CO₂eq./m²

IEQ PMV PPD

Manage a plethora of INDICATORS

 Bicycle paths (m)/resident

 Use of public transportation (%)

 % of waste

 Bins/resident

 SAFETY

 ... many more ...

Existing Knowledge



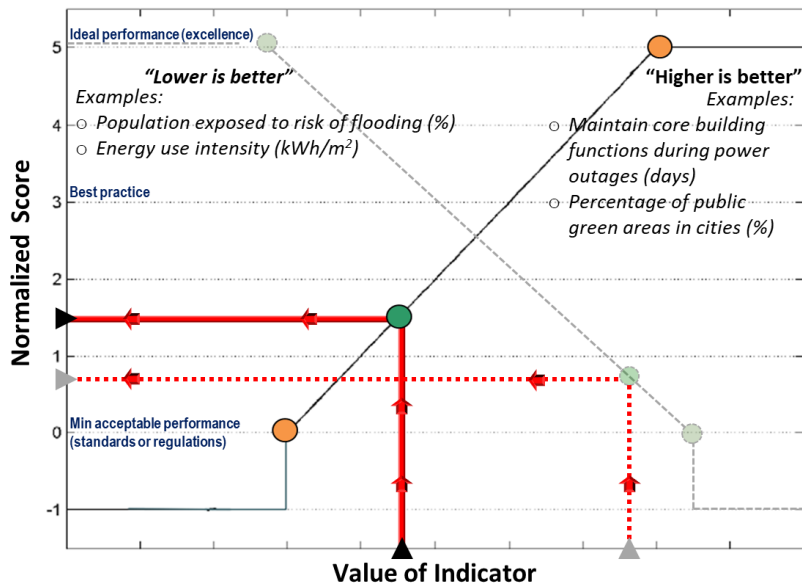
Sustainability Assessment Method-Tool



Benchmarking & Normalizing

- Handle diversity of indicators (e.g. different units & orders of magnitude)
- Adapt to local conditions (e.g. climate, building practiced, standards, advancement)

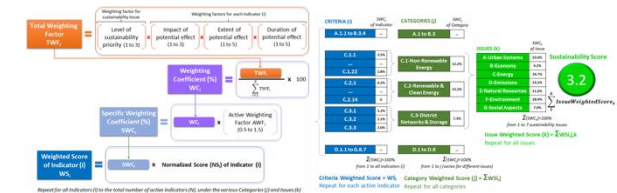
● Benchmarks (min acceptable performance, or best practice)
Adopt Indicator's value to local context



Example



Weighting & Scoring



$$HV^{WHV} \times EV^{WEV} \times VV^{WV}$$

Example

- HAZARD Value = 0.8
- EXPOSURE Value = 0.9
- VULNERABILITY Value = 0.61

RISK LEVEL = 0.72

(rather negative)

- W_{HV} weight of HV → 0.25
- W_{EV} weight of EV → 0.25
- W_V weight of VV → 0.50

Risk Assessment

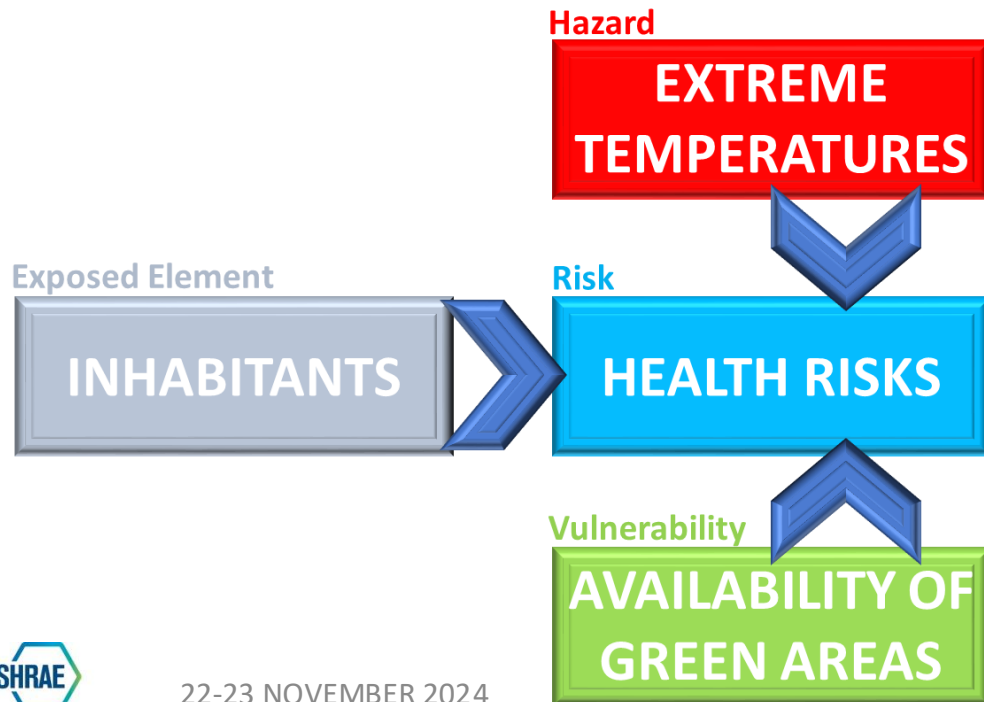
Adapt indicators to consider

- **HAZARD:** *Extreme Hot Temperatures*
- **EXPOSURE:** *Inhabitants*
- **VULNERABILITY:** *Availability of green areas to calculate the RISK: on health of inhabitants*

Example



HAZARD	EXTREME HOT TEMPERATURES	
RISK CATEGORY	RISK FOR INHABITANTS' HEALTH	
Risk Components	Value	Weight
Hazard	0,80	0,25
Exposure	0,90	0,25
Vulnerability	0,61	0,50
CATEGORY RISK LEVEL	RATHER NEGATIVE 0,72	



Existing Knowledge

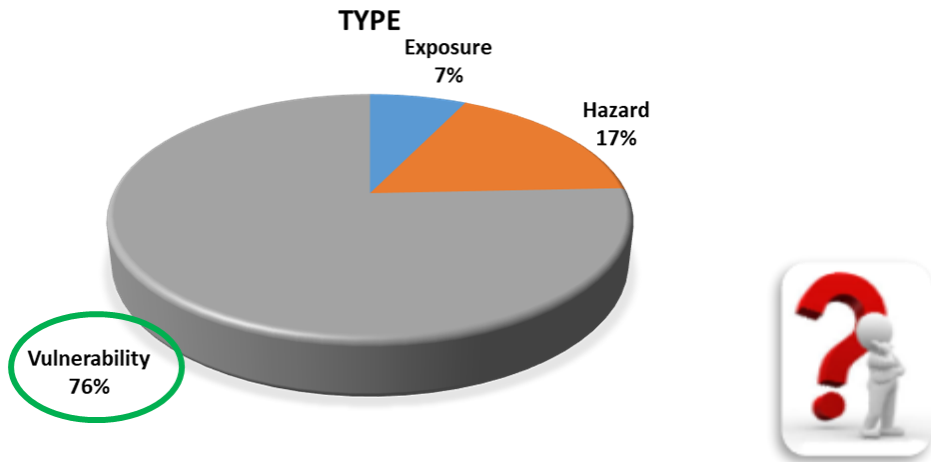
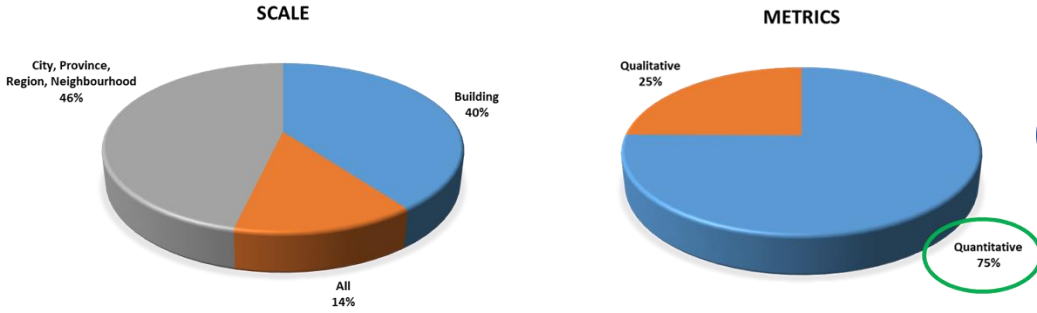


Assessment systems & indicators in EU to assess the risk & vulnerability to climate change at urban scale



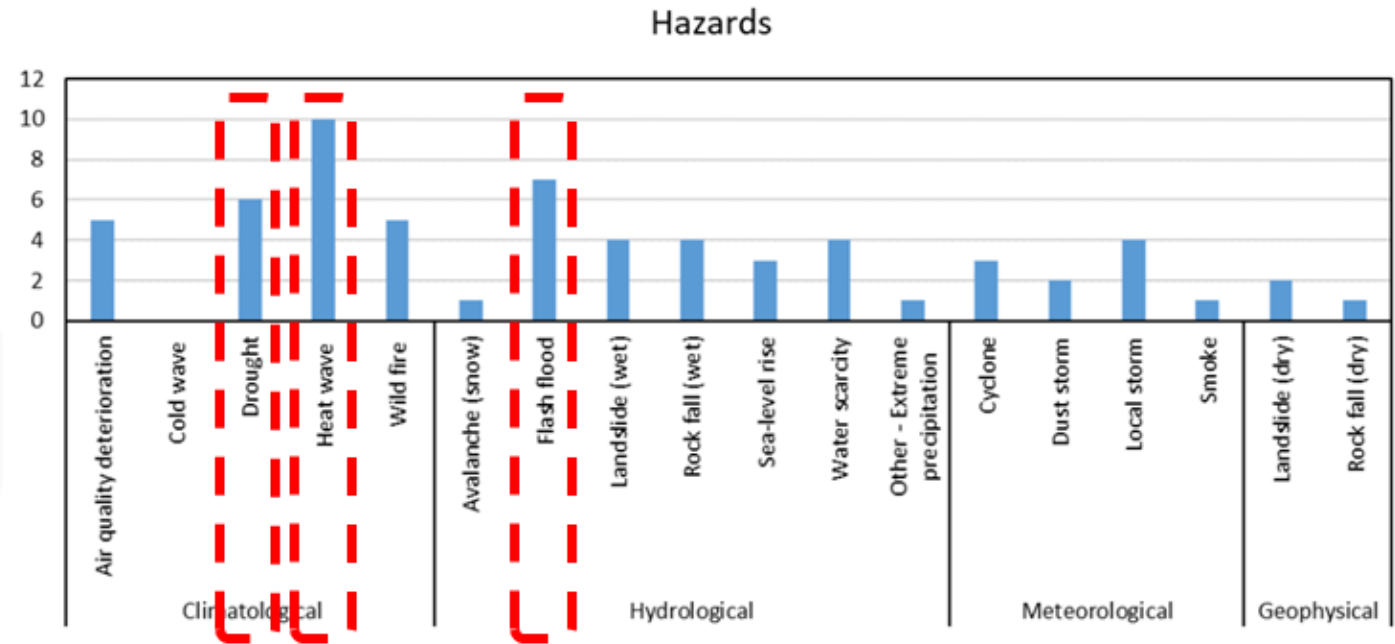
National methods-tools-indicators

(181) Indicators



Most frequent hazards from existing methodologies:

- Heat waves
- Flash floods
- Droughts



Hazards related to the existing methodologies

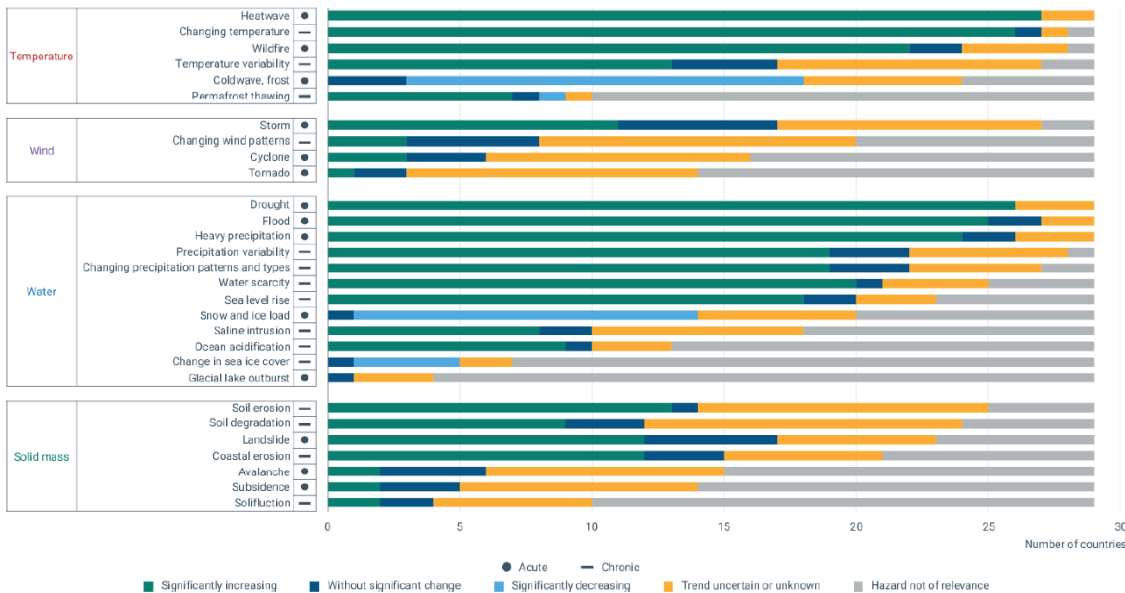
National Adaptation Actions

The EU Regulation 2018/1999 on the Governance of the Energy Union and Climate Action helps EU MS **organize national adaptation actions in support of national energy & climate plans.**

Ref: Regulation (EU) 2018/1999 <http://data.europa.eu/eli/reg/2018/1999/oj>



What are the most important hazards ?



EU reported key future hazards

- **Changing temperature:** a chronic hazard (slow onset events) with the most significant change in the future
- **Heatwaves:** an acute chronic hazard (extreme weather events)
- **Precipitation and/or hydrological variability**
- **Drought**

Ref: EEA. Is Europe on track towards climate resilience?



National Adaptation Actions

The EU Regulation 2018/1999 on the Governance of the Energy Union and Climate Action helps EU MS **organize national adaptation actions in support of national energy & climate plans.**

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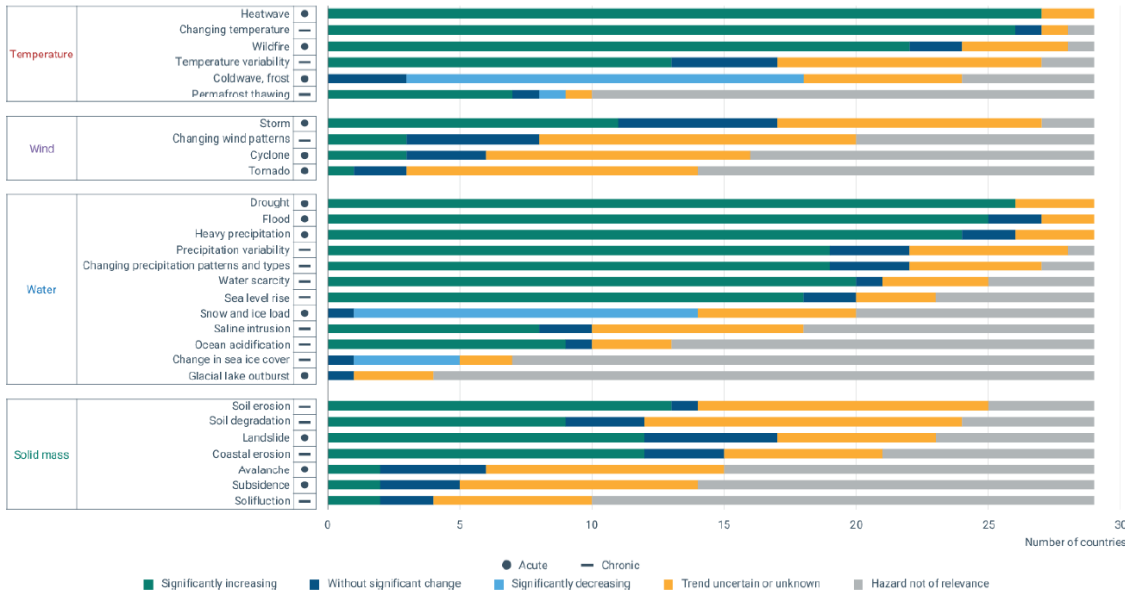


What does the future look like?



➤ Most EU MS expect to increase in frequency and/or intensity of most temperature- and water-related hazards, e.g.

- Heat waves,
- Wildfires,
- Droughts,
- Heavy precipitation,
- Flooding,
- Water scarcity



EU reported key future hazards

Ref: EEA. Is Europe on track towards climate resilience?





Where we are ...

- Define **indicators** for Vulnerability Criteria & Exposure; **Benchmarks**
- Integrate in open access **Tools** for municipalities & professionals

Where we are going ...

- Perform *four Case Studies – Pilots; Validate method-tools*
- Prepare **Training Material**
- Develop overarching **Decision Support Framework** to help cities:
 - ✓ **Understand & Assess** the level of **climate risk** at urban and building scale
 - ✓ **Design** optimal climate adaptation measures in relation to **local conditions**
 - ✓ **Implement** climate **adaptation measures** through suitable policy instruments
 - ✓ **Monitor & Evaluate** the results of adaptation measures over time



Project (1/2024 – 9/2026)



Bibliography



ReMED - Develop Building & City open access **Tools** to support municipalities & professionals assess and understand the level of climate risk at urban and building scale. <https://remed.interreg-euro-med.eu/>



SMC - *Sustainable Med Cities - Enhance the capacity of public administration in delivering, implementing and monitoring efficient measures, plans and strategies to improve the sustainability of cities, neighborhoods and buildings.* <https://www.enicbcmed.eu/projects/sustainable-med-cities>



CESBA MED *Sustainable Mediterranean Cities - A common sustainability assessment framework at urban scale and an innovative decision making process to support the development of energy efficiency plans for public buildings in the context of their surrounding neighborhoods.* <https://cesba-med.interreg-med.eu/>

CESBA MED Deliverables (in Greek) <https://groupenergyconservation.com/cesba-med-deliverables-in-greek/>



EEA – European Environment Agency, *Climate change impacts, risks and adaptation.* <https://www.eea.europa.eu/en/topics/in-depth/climate-change-impacts-risks-and-adaptation>



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Hellenic Chapter

TEE

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