Intersinstitutional EMAS days 2025

EUROPEAN COURT OF AUDITORS

Session 6: Adapting for tomorrow: EU strategies and some tools and examples in climate adaptation

C. Delayer & C. Ollier – ECA
J. Berckmans & K. Mattern – EEA
Xxx DG Clima & xxx Ramboll

Let's get more sustainable together!

Agenda

Introduction

Risk evaluation in the EU: is the EU ready and adapted to climate changes?

What is the EU framework on climate adaptation?

How was it applied until now?

Climate-ADAPT: a platform to share projects and example of climate adaptation

Technical guidance on adapting buildings to climate change

Q&A

2024 Amendment to ISO 14.001

Clause 4.1 Understanding the organization and its context

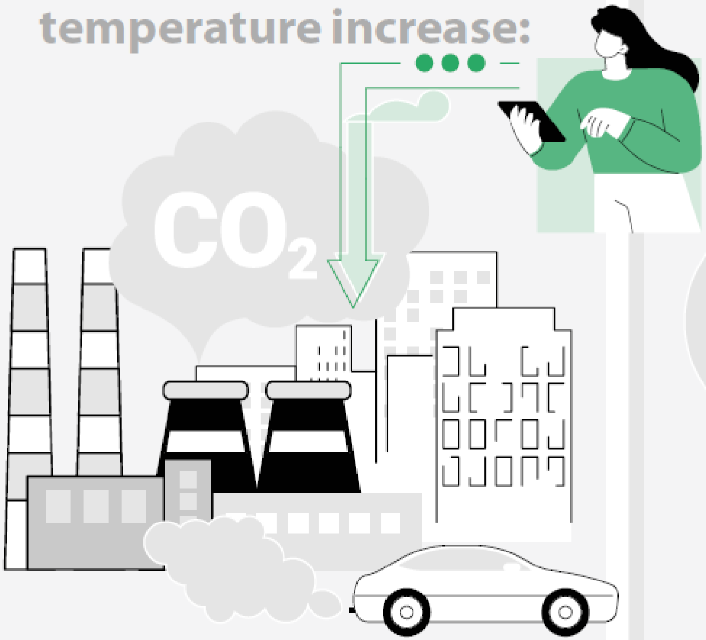
‘The organization shall determine whether climate change is a relevant issue.’

Clause 4.2 Understanding the needs and expectations of interested parties

‘NOTE Relevant interested parties can have requirements related to climate change.’

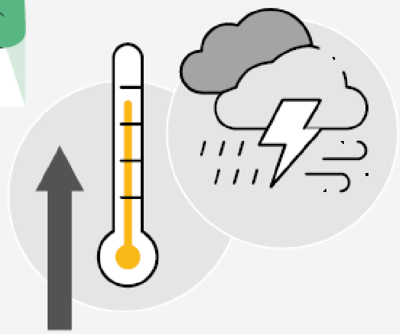
What is adaptation to climate change?

reduce
concentration of greenhouse gases to minimise temperature increase:



MITIGATION

CLIMATE CHANGE



reduce
climate change impacts:

ADAPTATION

- https://youtu.be/R2l6pydT2QQ

European Climate Risk Assessment

Julie Berckmans
EUCRA Coordinator & Climate data expert

EMAS Interinstitutional Days, 7 November 2024

European Environment Agency

European Environment Agency

For climate resilience and societal preparedness

European Climate Risk Assessment

Data and indicators for climate resilience

European Climate Data Explorer

Destination Earth & Digital Twin

Nature-based solutions

Economics losses and cost of inaction

Climate-ADAPT

European Adaptation Knowledge Platform

European Climate and Health Observatory

Mission on Adaptation to Climate Change

Reporting under Governance Regulation European Climate Law

National adaptation policy frameworks in Europe

International negotiations (UNFCCC)

Sub-national and urban adaptation

Just resilience

[Climate change impacts, risks and adaptation](#)

EUCRA: a comprehensive assessment of major climate risks facing Europe

to help identify **adaptation-related policy priorities** for the next Commission

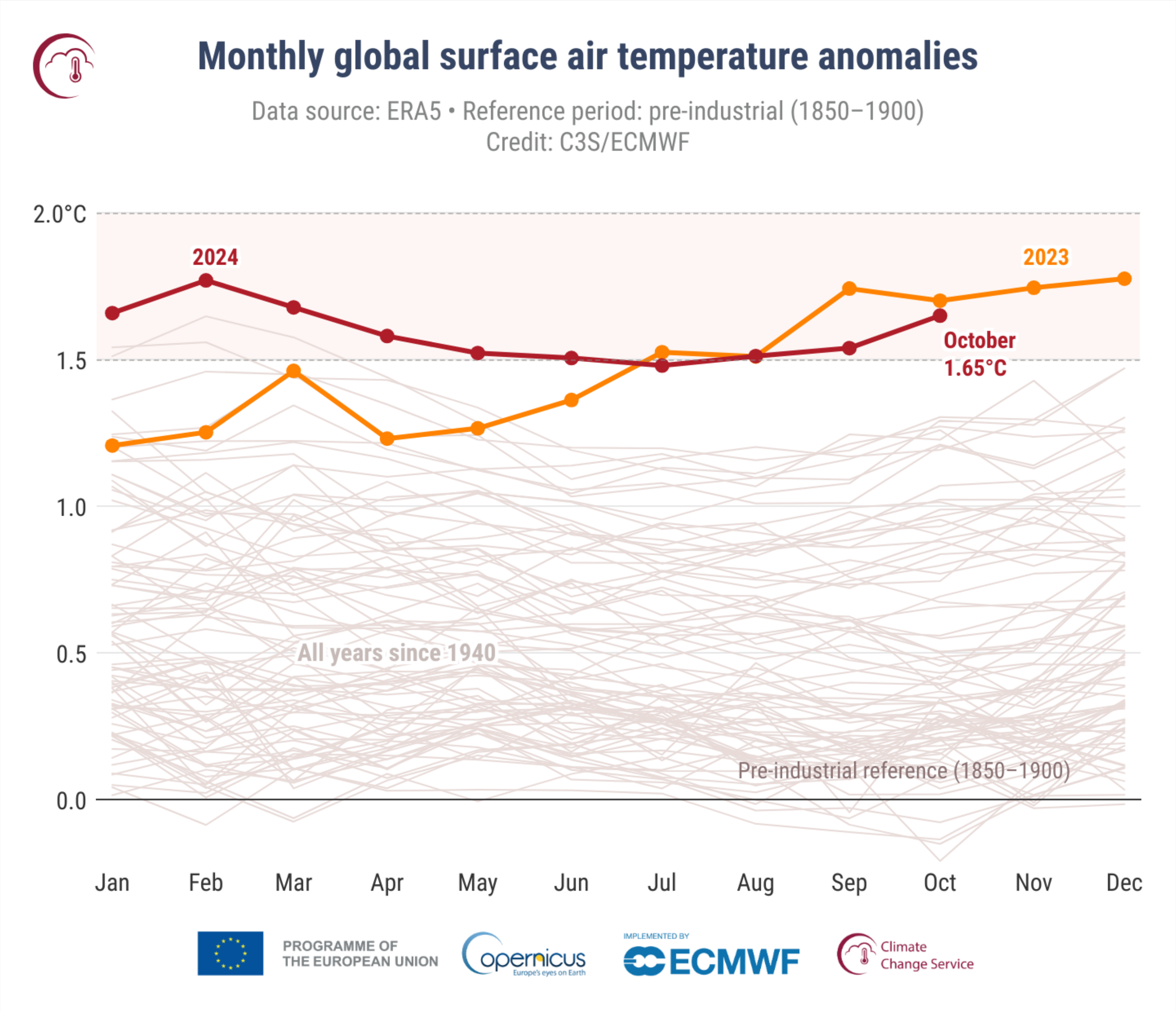
to inform the **further development of EU policies** in climate-sensitive sectors

to support the **prioritisation of adaptation-related investments** for the next Multi-annual Financial Framework

to provide a reference for conducting **national and regional climate risk assessments**
(including for EU Mission on Adaptation)

Europe is not sufficiently prepared for rapidly growing climate risks

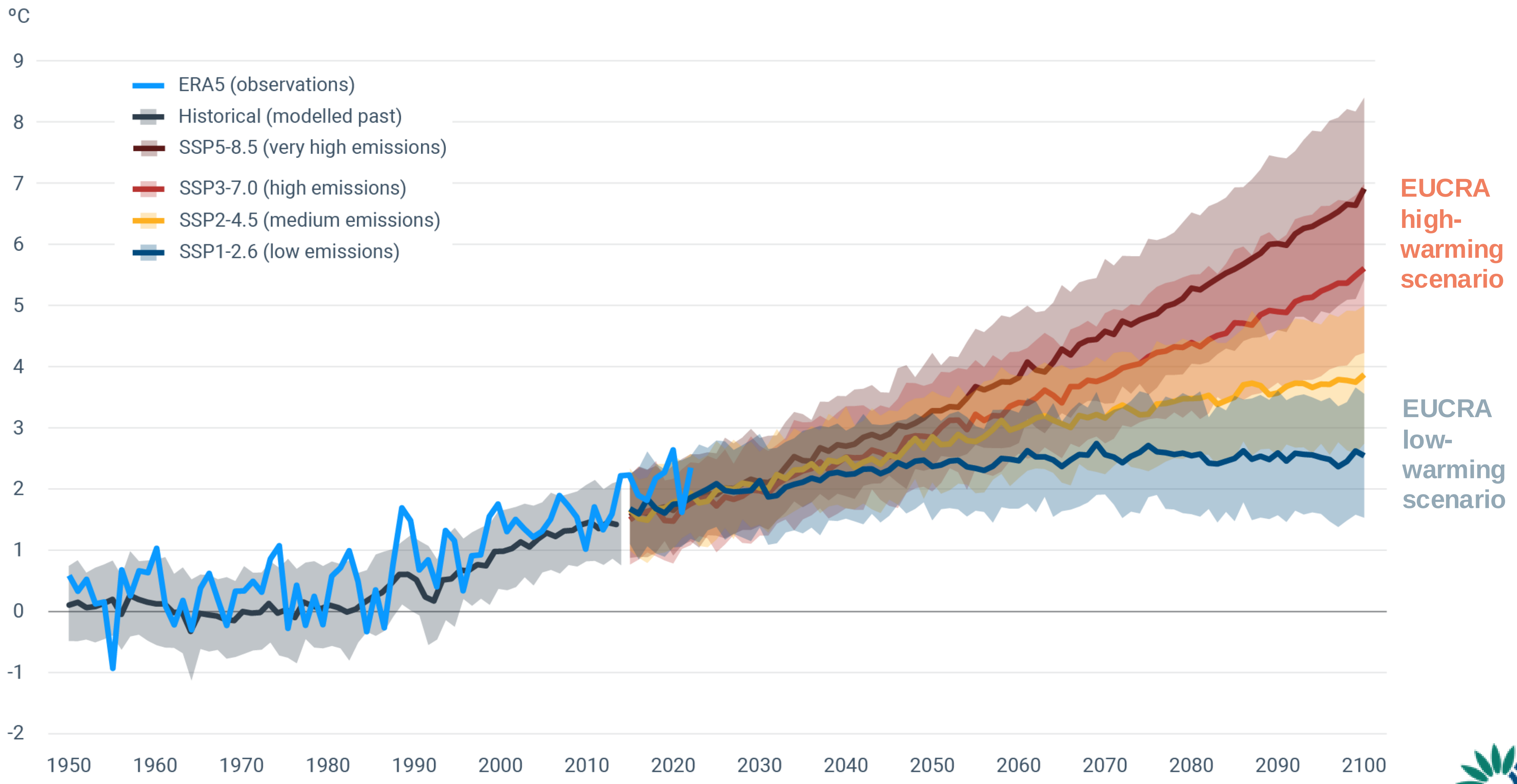
- Climate risks are growing rapidly as we approach 1.5 degrees global warming.
- Europe is the fastest warming continent.
- Climate risks are threatening ecosystems, water resources, food and energy security, infrastructure, financial stability, and people's health.



Global climate change: our current reality

- 2023 was the warmest year on record globally
- Each month from June 2023 to June 2024 has broken previous global records
- The summer 2024 was the warmest summer globally and in Europe
- Europe is increasingly experiencing unprecedented climate-related extremes

European warming projected to increase, but how much?

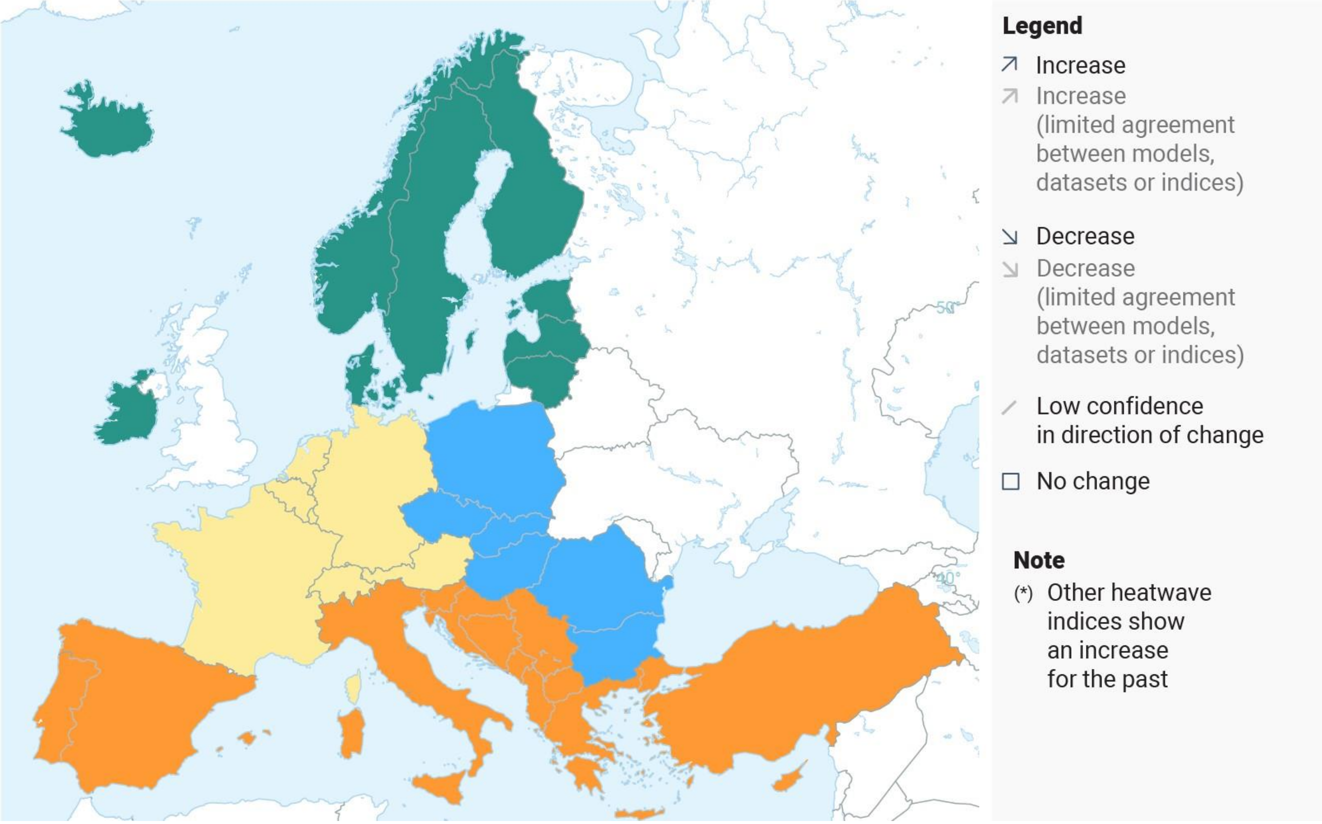


Source: Observed and projected temperature increase over European land area, Copernicus climate change service based on CMIP6

Climatic risk drivers are accelerating in all European regions

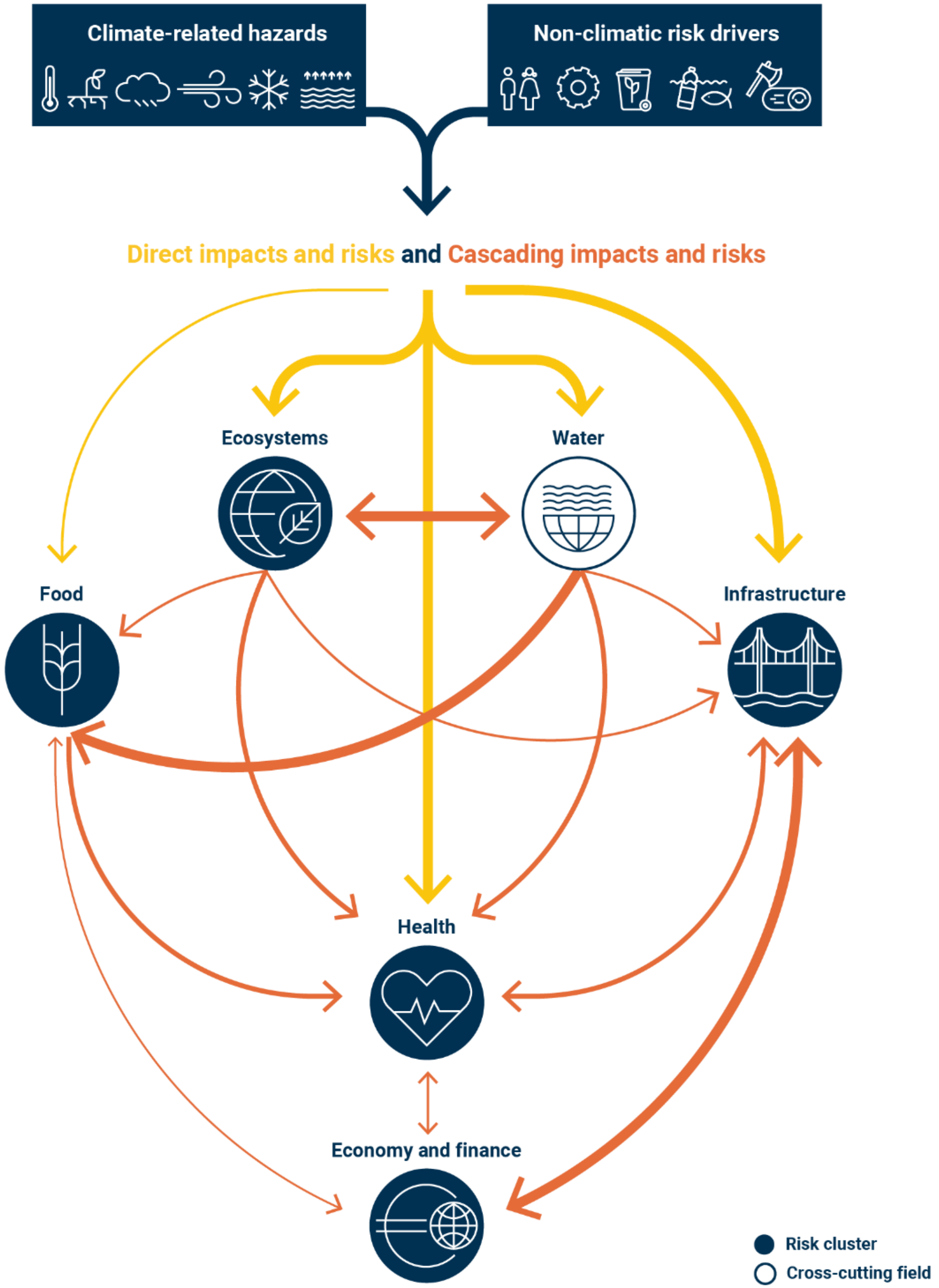
Land regions	Northern Europe			Western Europe			Central-Eastern Europe			Southern Europe		
	Past	Future		Past	Future		Past	Future		Past	Future	
		Low	High		Low	High		Low	High		Low	High
Mean temperature	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗
Heat wave days	□(*)	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗
Total precipitation	↗	↗	↗	↗	⁄	↘	↗	↗	⁄	↘	↘	↘
Heavy precipitation	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗	↗
Drought	↗	↘	↘	↗	⁄	↗	↗	⁄	↗	↗	↗	↗

European regional seas	Past	Future
Sea surface temperature	↗	↗
Sea level	↗	↗

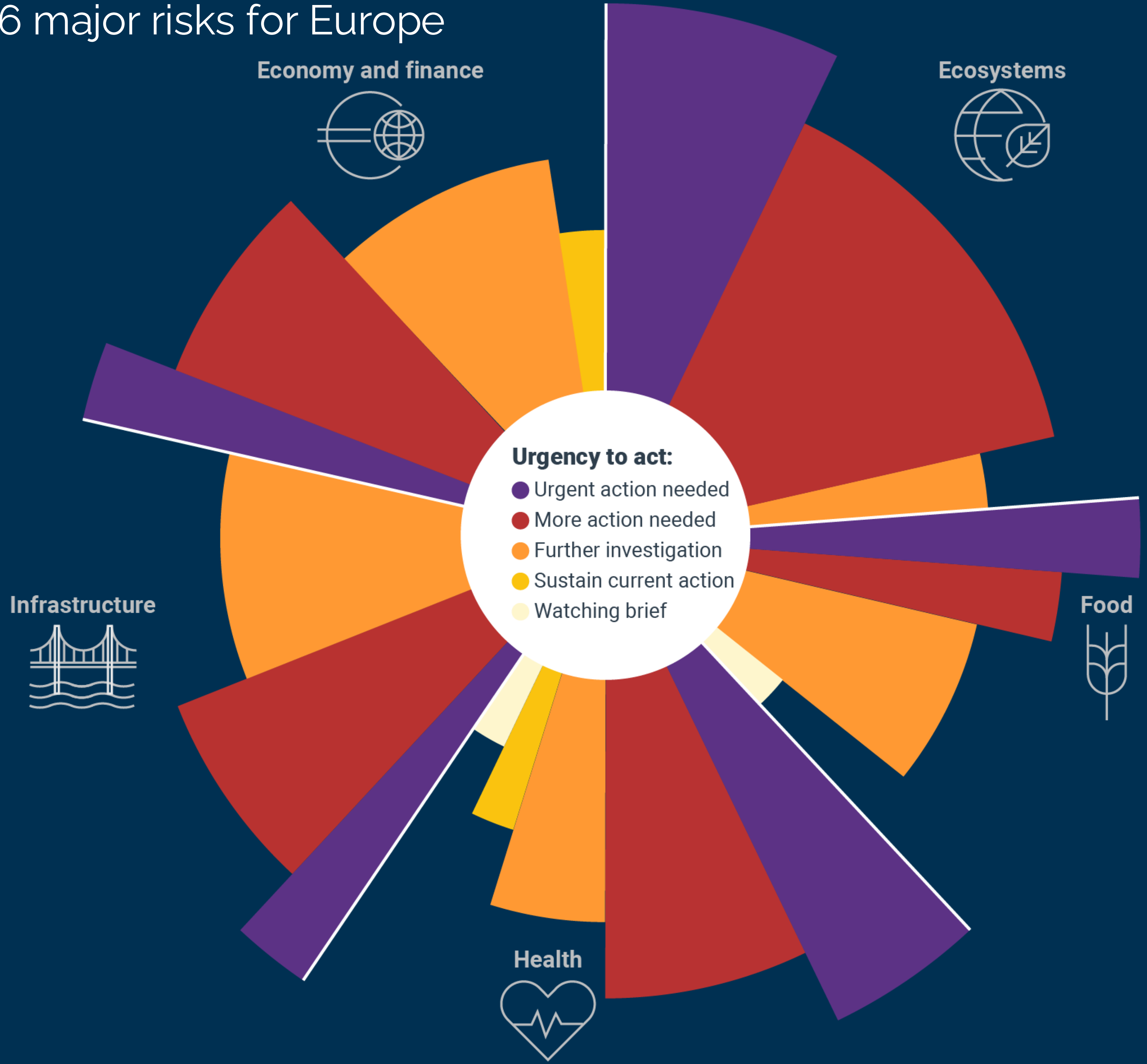


- **Europe is the fastest warming continent.**
- **Heatwaves** are getting worse.
- **Rain patterns** are changing, with both downpours and dry spells increasing in magnitude.
- **Sea level rise** is accelerating and threatening coastal regions.
- **Hotspot regions** for multiple climate risks:
  - Southern Europe
  - Low-lying coastal regions
  - EU outermost regions

Climate risks can cascade
from one system to another



36 major risks for Europe



- Urgent action is needed in all five risk clusters
- Almost all selected major risks can reach critical or even catastrophic levels during this century

European Climate Risk Assessment viewer

Major challenges in all five assessed risk clusters

Ecosystems

- Coastal ecosystems
- Marine ecosystems
- Biodiversity/carbon sinks due to wildfires (1)
- Biodiversity/carbon sinks due to wildfires
- Species distribution shifts
- Ecosystems/society due to Invasive species
- Soil health
- Aquatic and wetland ecosystems
- Biodiversity/carbon sinks due to droughts and insect outbreaks
- Cascading impacts from forest disturbances

Infrastructure

- Pluvial and fluvial flooding
- Coastal flooding
- Damage to infrastructure and buildings
- Energy disruption due to heat and drought (1)
- Energy disruption due to heat and drought
- Energy disruption due to flooding
- Marine transport
- Land-based transport

Food

- Crop production (1)
- Crop production
- Fisheries and aquaculture
- Food security due to higher food prices
- Food security due to climate impacts outside Europe
- Livestock production

Economy and finance

- European solidarity mechanism
- Public finances
- Property and insurance markets
- Population/economy due to water scarcity (1)
- Population/economy due to water scarcity
- Pharmaceutical supply chains
- Supply chains for raw materials and components
- Financial markets
- Winter tourism

Health

- Heat stress - general population
- Population/built environment due to wildfires (1)
- Population/built environment due to wildfires
- Well-being due to non-adapted buildings
- Heat stress - outdoor workers (1)
- Pathogens in coastal waters
- Health systems and infrastructure
- Infectious diseases
- Heat stress - outdoor workers

Note: (1) Hotspot region: Southern Europe

European Climate Risk Assessment viewer

EUCRA: main takeaways

- **Several major climate risks have already reached critical levels**
- **Almost all (34 out of 36) major climate risks could reach critical or even catastrophic levels** during this century under high warming scenarios
- **Societal preparedness is lagging behind** the fast increase in major climate risks
- We must **act now to increase our resilience** now and in the future
- **Climate adaptation policies** need to consider multiple policy objectives together
- Most of the major **climate risks are co-owned by the EU and its Member States**
- **Stronger EU policy action is urgently needed** to manage several major climate risks

EUCRA uptake by EU institutions and other stakeholders

European Commission

- 12 March: EC Communication
- 12 March: Press conference

European Parliament

- 12 March: Plenary debate
- 19 March: ENVI Committee

Council of the EU

- 25 March: Environment Council
- 17 June: Environment Council
- Council Working Partys on Environment, Energy, Health, Tourism, Industry, and Agenda 2030

Belgian Council Presidency

- High-level conferences on climate adaptation


Thank you
Contact us:
EUCRA@eea.europa.eu

Performance AUDIT

Climate adaptation in the EU Action not keeping up with ambition

7 November 2024 Céline Ollier

Why is climate adaptation to CC important?

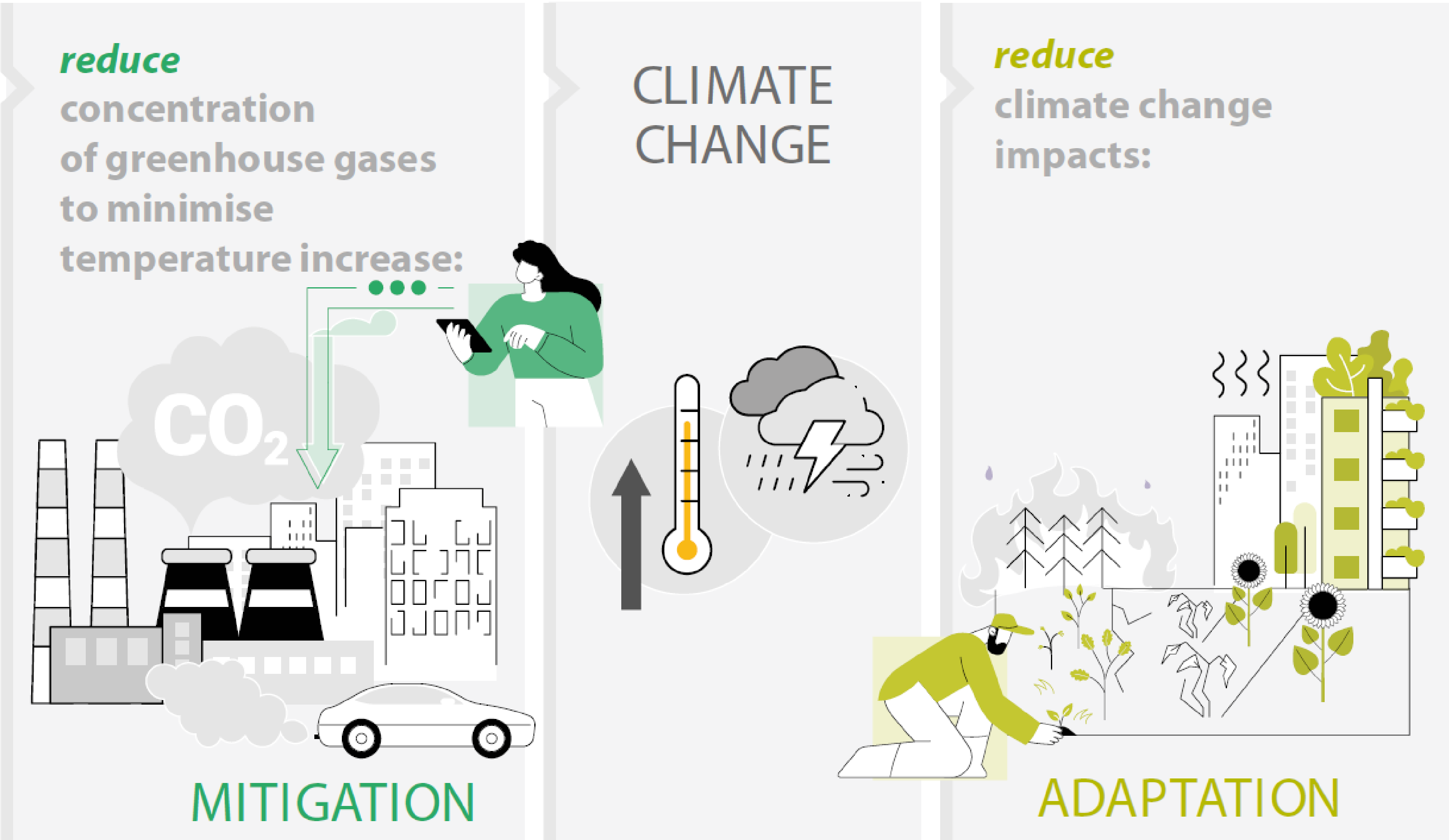
What did we look at?

What is the EU framework on adaptation? How was it applied until now?

EU financial support for climate adaptation

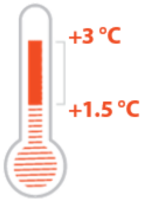
EU adaptation projects

What is adaptation to climate change?



Why climate adaptation to CC is important?

- Frequency and severity of extreme climate events is increasing
- Economic losses from extreme climate events are increasing



EU economic loss up to **€175 billion** per year

What did we look at?

➢EU climate adaptation framework

➢EU funding

What is the EU framework on adaptation?

International

Paris Agreement

- **Global goal** on adaptation
- Adaptation planning and monitoring
- **Cooperation** with developing countries

Sustainable Development Goal 13 – Climate Action: Take urgent action to combat climate change and its impacts

- Target 13.1: **Strengthen resilience and adaptive capacity** to climate-related hazards and natural disasters in all countries

European Union

EU Climate Law

- Enhancing **adaptive capacity**, strengthening resilience, reducing vulnerability to climate change
- **Coherent policies** on adaptation

Regulation on the Governance of the Energy Union and Climate Action

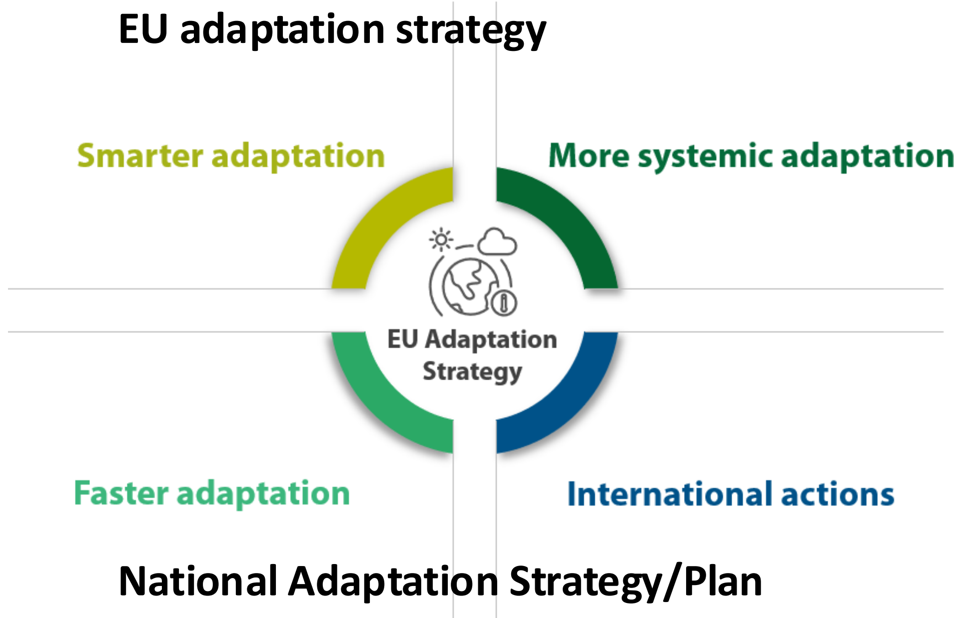
- **Reporting** on climate adaptation (articles 17 and 19)

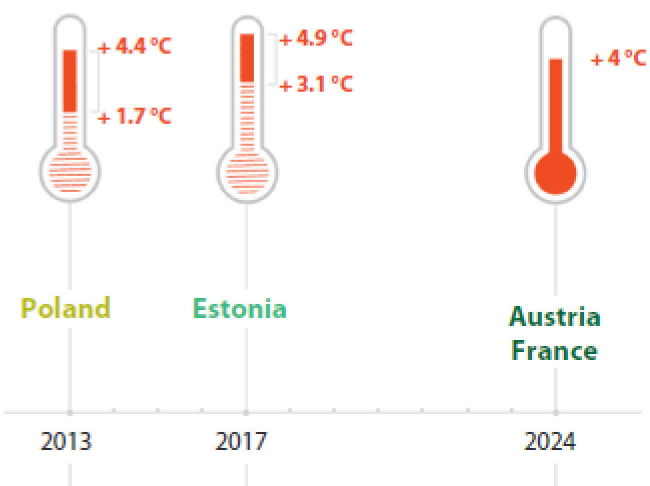
EU adaptation strategy and EU climate risk assessment documents*

- A climate-resilient Europe by 2050

How was it applied until now?

Sound EU adaptation framework…





National adaptation frameworks **consistent** with the EU adaptation strategy

Different projected temperature increase by 2100

Conflicting priorities at sectorial and regional level

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How was it applied until now?

But reporting had weaknesses…

- Descriptive/qualitative reporting

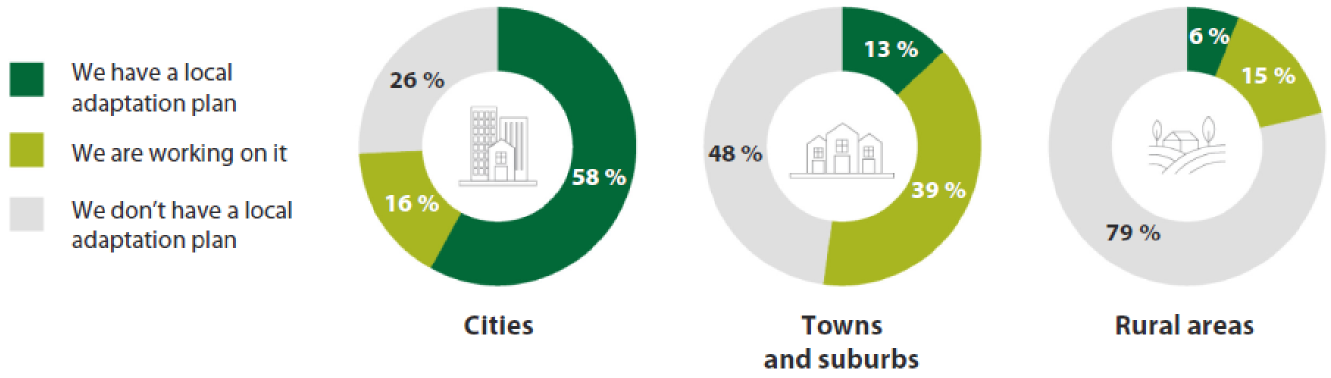
➢ **Difficult to assess progress made by member states in implementing their adaptation actions**

… and low local awareness

- **Most municipalities were not aware of:**

  - the different adaptation strategies and plans.

  - EU tools (CLIMAT-ADAPT, Copernicus, Covenant of Mayors)



EU financial support for climate adaptation

Challenges in tracking EU climate adaption fundings

- Several EU funds and instruments support climate adaptation:

- **EU budget** from €8 (2014-2020) to €26 billion (2021-2027):

- Agriculture (difficult to evaluate the EU support)

- Cohesion and regional development

- Research and innovation:

EU Mission on adaptation

- **Recovery and Resilience Facility**

EU adaptation projects

✓ 36 EU-funded projects analysed

Preference for short-term rather than long-term solution

each square = one project

- in line with EU adaptation strategy and increase adaptive capacity
- not in line with the EU adaptation strategy or do not increase the adaptive capacity
- not in line with the EU adaptation strategy and increase vulnerabilities
- no conclusion possible

EU adaptation projects

Flooding and water retention- promoting nature-based solution

Coastal erosion long term solution needed

EU adaptation projects

Irrigating water-intensive crops counter to climate adaptation

Climate adaptation means forest diversification

Mountainous areas- reduced snow poses challenges for ski tourism

Thank you
for your attention!

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Climate ADAPT

SHARING ADAPTATION KNOWLEDGE FOR A CLIMATE-RESILIENT EUROPE

Interinstitutional EMAS days Session 6

6 November 2024

EU support for adaptation practice through the European Climate Adaptation Platform (Climate-ADAPT)

European Environment Agency

Supported by the European Topic Centre on Climate Change Adaptation and LULUCF (ETC/CA)

European Environment Agency

Climate-ADAPT – Sharing knowledge for a climate resilient Europe

Jointly managed by European Commission and EEA

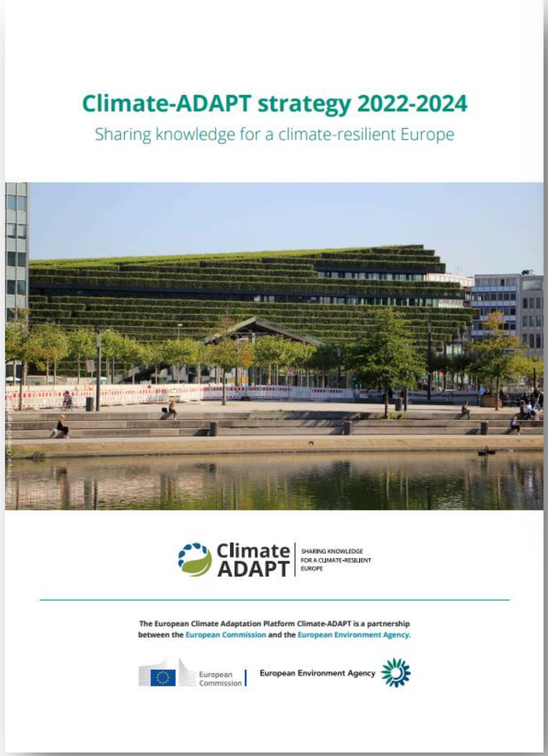
Knowledge for all steps of the adaptation policy cycle

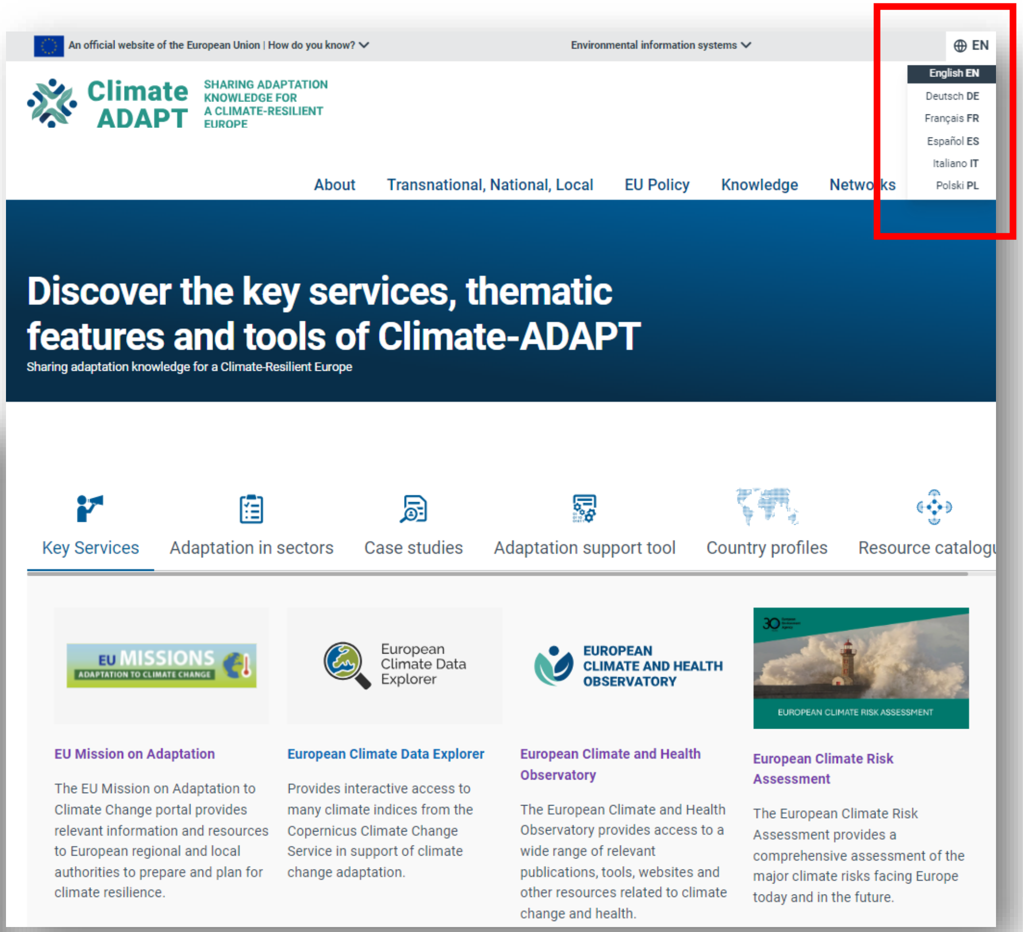
Target groups:
Decision-makers at all governance levels in EU and organisations supporting them

Outreach 2023:
Average weekly visits: 16 000
Average weekly page views 26 700

Developed under multiannual strategies

5 Multilanguage versions (automatic translation (DE, ES, FR, IT, PL)





Weblink Climate-ADAPT: https://climate-adapt.eea.europa.eu/

European Environment Agency

Overview on EU policies and actions per sector

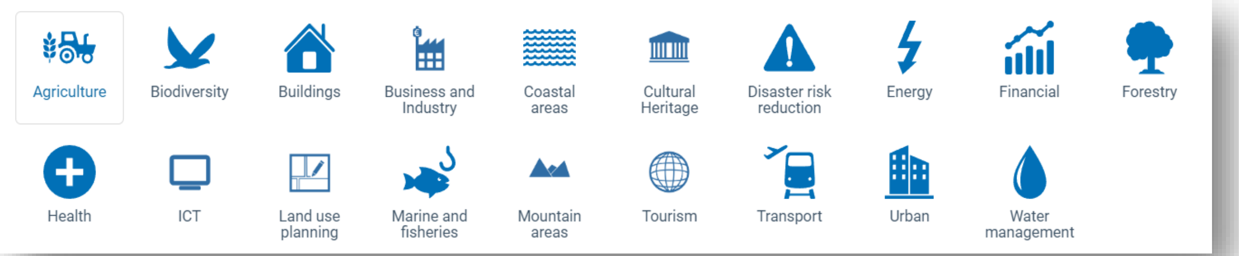
EU adaptation framework in 19 policy sectors

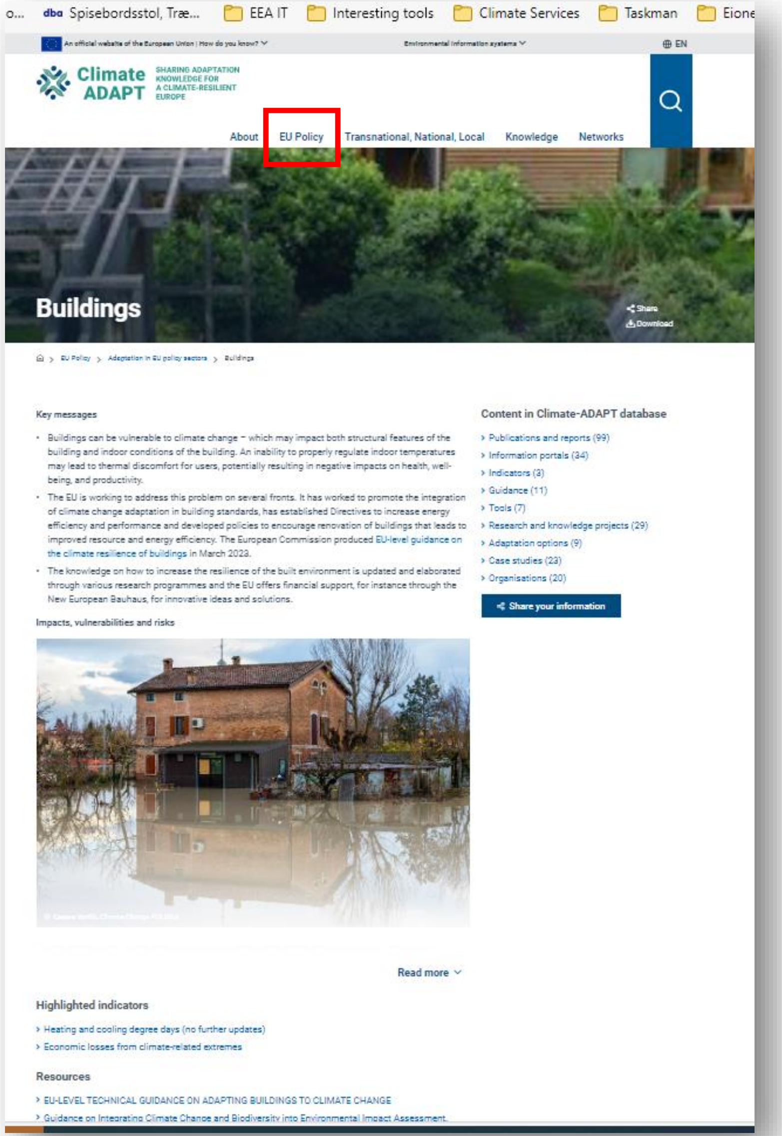
Structure:

(linked to the structure of the Adaptation Support Tool (AST))

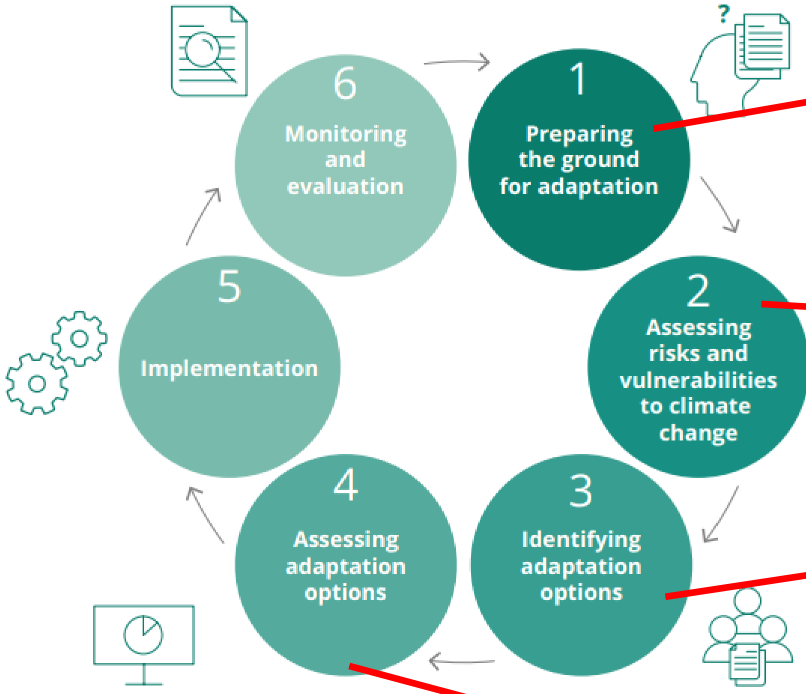
- Key messages
- Policy framework
  (focus on link to the EU Adaptation Strategy)
- Improving the knowledge base
- Supporting investment and funding
- Supporting the implementation of adaptation
- Monitoring, reporting and evaluation

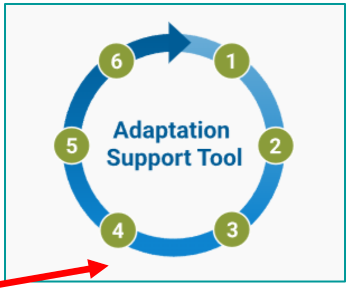
Indicators, resources and case studies



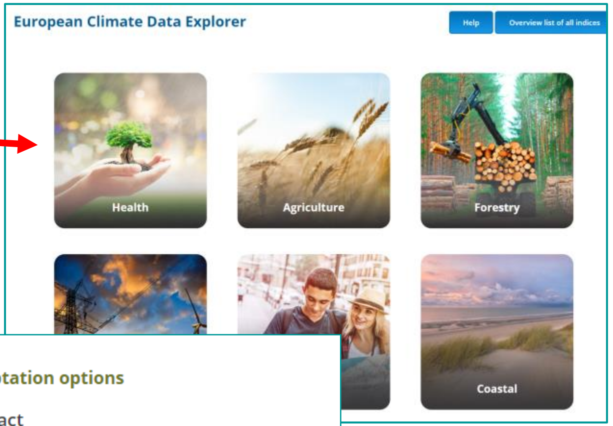


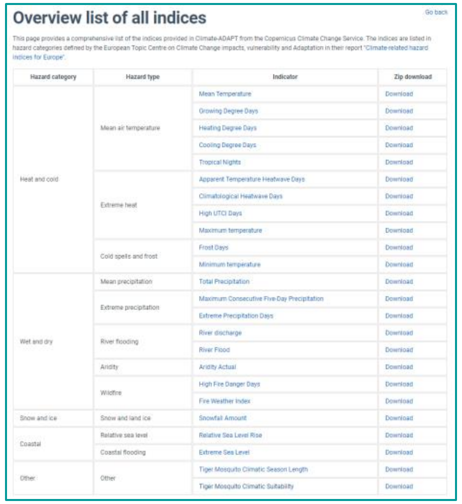
EU knowledge, complementary to national level platforms (I)



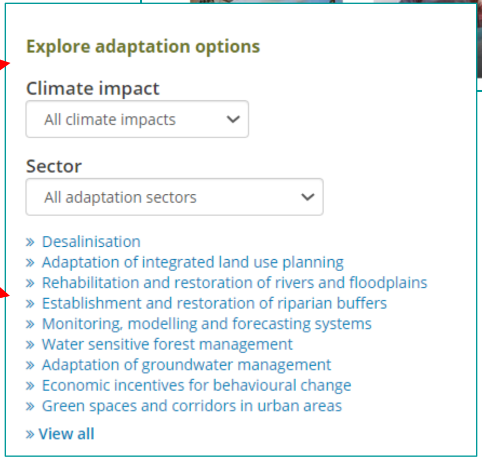


AST, RAST, UAST
Tool for designing the policy cycle at national/regional/urban level





ECDE
Copernicus climate data and indicators for various impacts on sectors (NUTS0-NUTS2)



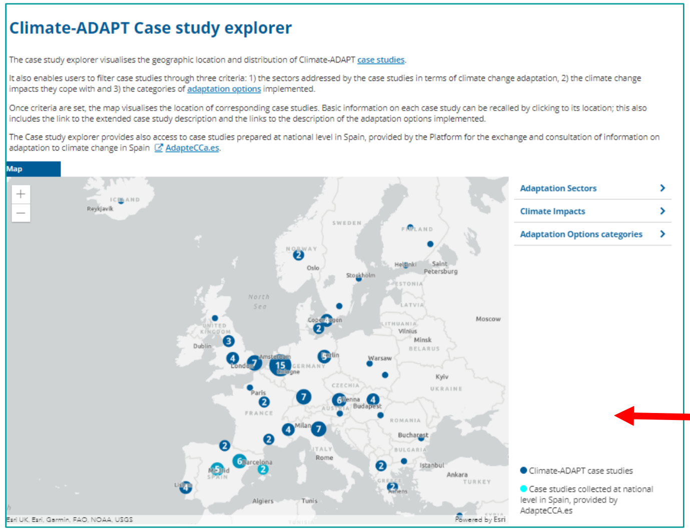
Catalogue of 58 adaptation options per impact and policy sector, type of measure (KTM)

[The Adaptation Support Tool]

European Environment Agency

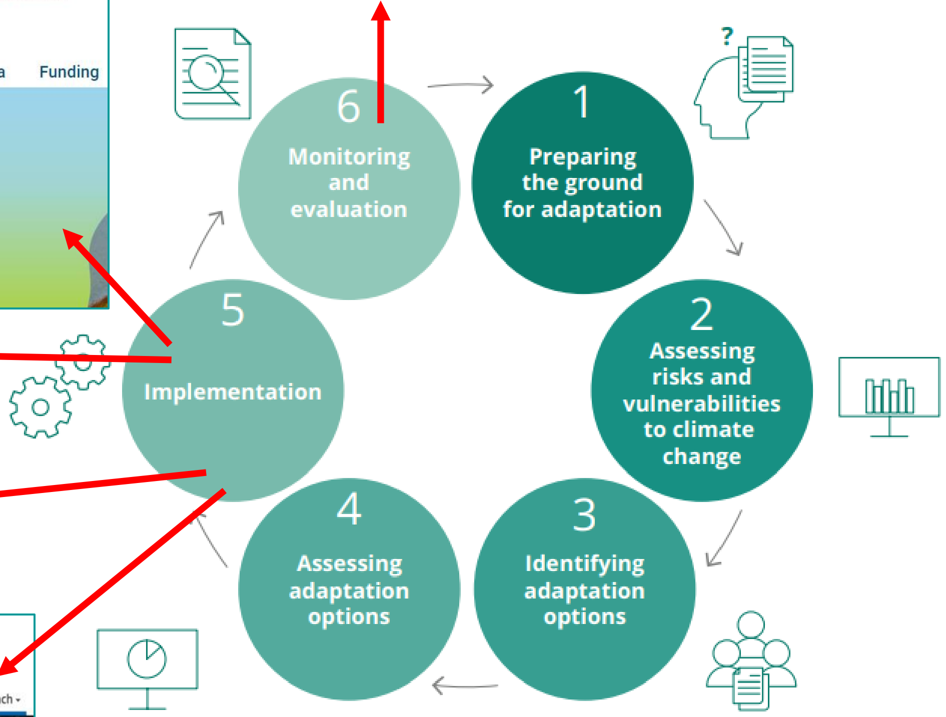
EU knowledge, complementary to national level platforms (II)

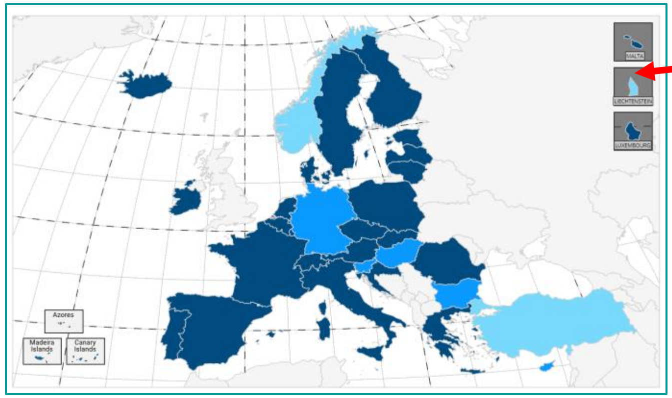
137 State-of-the-art case studies per sector, impact, location



EU Mission on adaptation Portal

Indicator frameworks (Q4 2024)





Structured overview on adaptation actions at EU, transnational and national level

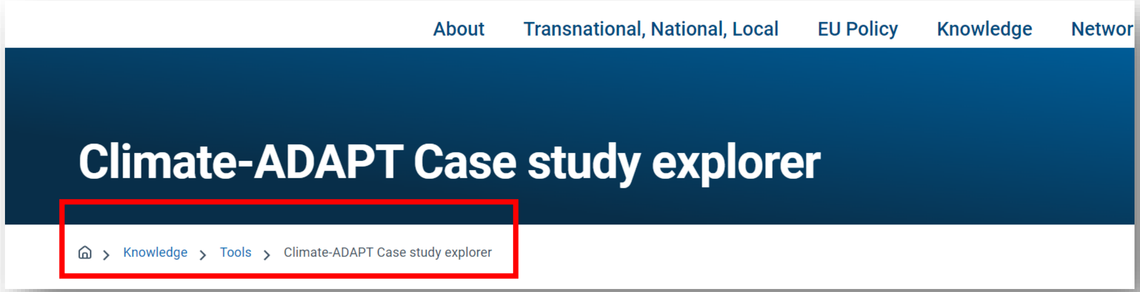
[The Adaptation Support Tool]

Knowledge and guidance for key vulnerable sectors

European Environment Agency

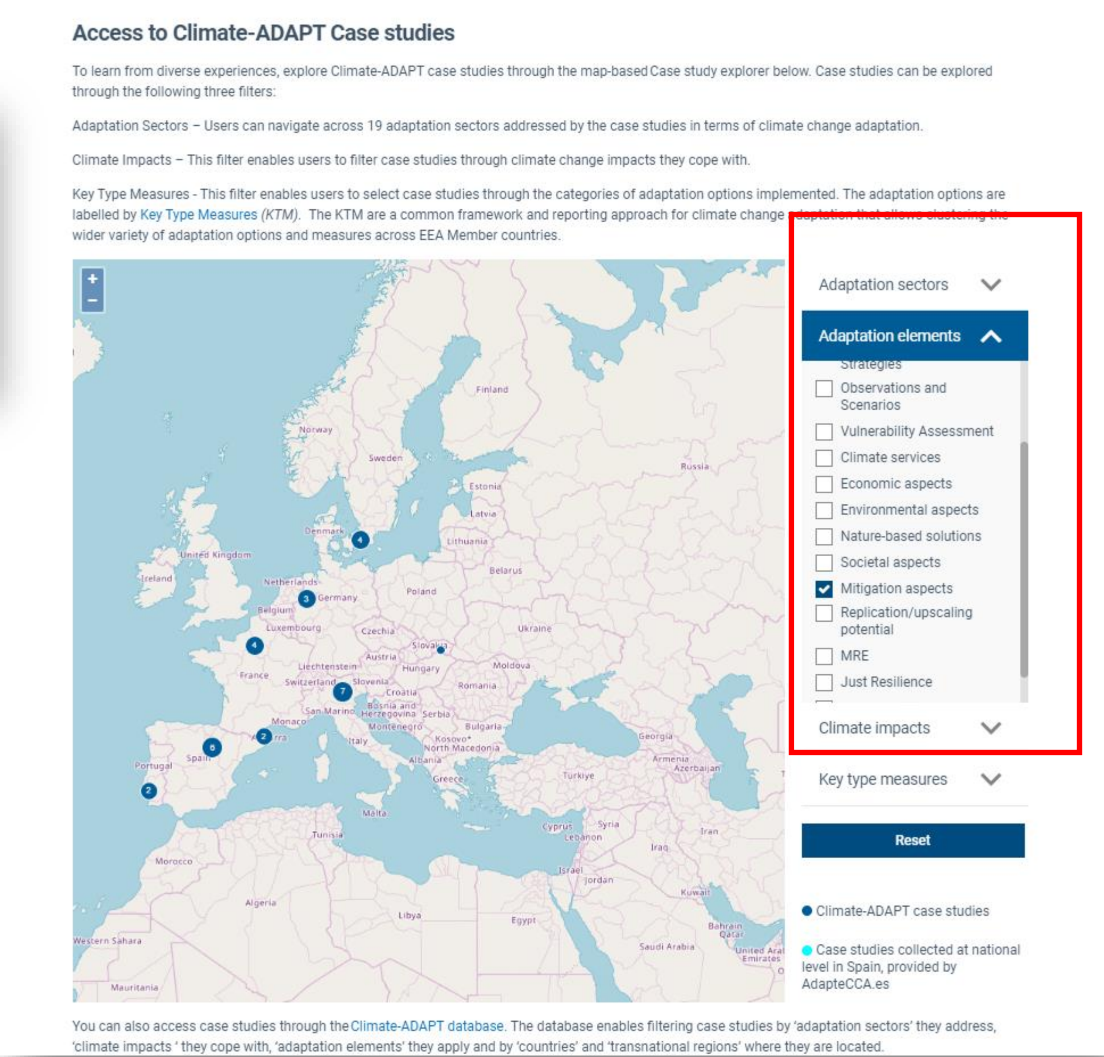
Climate-ADAPT Case study explorer

New knowledge searchable



Search for Climate-ADAPT case studies by

- geographic location,
- impacts addressed,
- policy sectors
- measures applied



New

Search for 6 learning aspects with new filter ‘Adaptation elements’

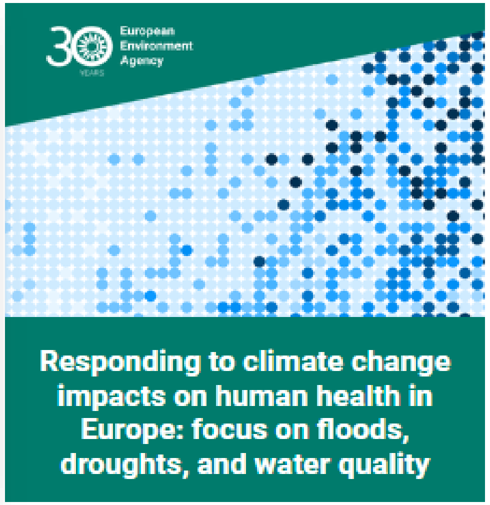
[Climate-ADAPT case study explorer](#)

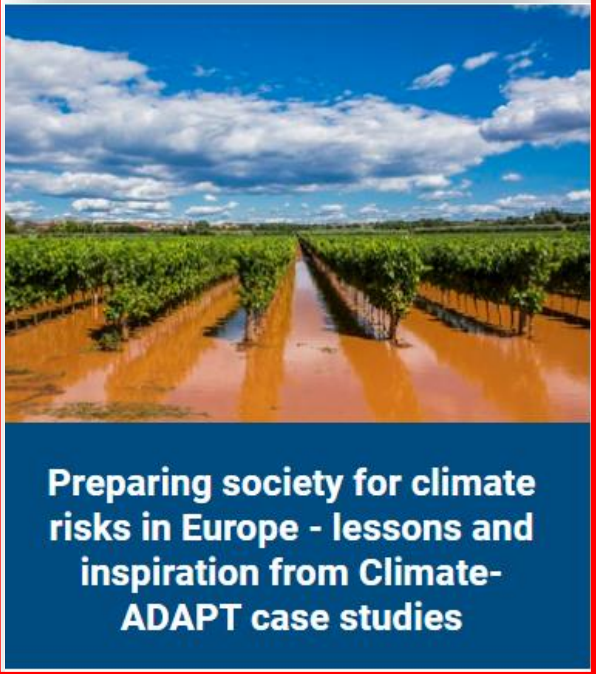
European Environment Agency

Objectives of the EEA Policy Briefing

The briefing

1. complements 2024 EEA reports and online products with practical examples to facilitate further action
2. supports learning on effective adaptation for societal preparedness
3. promotes using the broader catalogue of Climate-ADAPT case studies





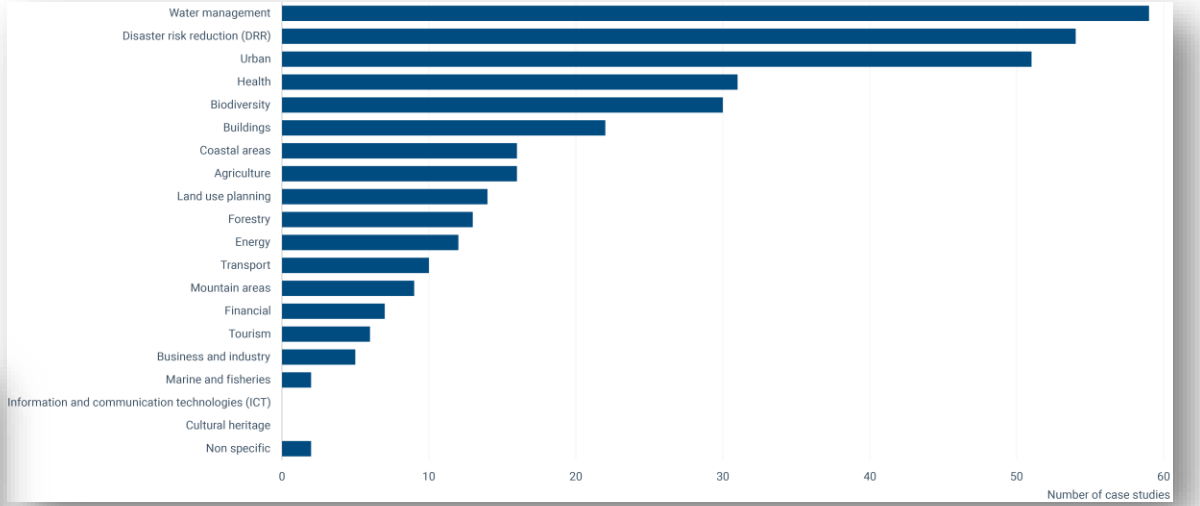
[Preparing society for climate risks in Europe - lessons and inspiration from Climate-ADAPT case studies]

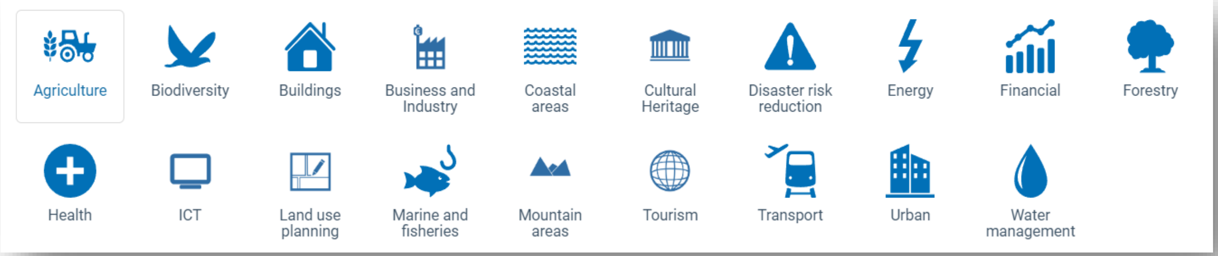
Support addressing climate risks across regions, governance levels and policy sectors

Policy sectors:

- Key vulnerable sectors reported by EU Member States (health, agriculture, forestry and biodiversity) addressed
- Health substantially increased, due to activities under the European Climate and Health Observatory
- Complementing new EU adaptation initiatives for 6 sectors with practical evidence through new case studies (ongoing)
- Coverage of the marine and fisheries, forestry, financial, transport and energy sectors to be further improved

Climate-ADAPT case studies per policy sector





Peri-urban Sonian beech forest, Belgium and the Water saving strategy Bosco Limite, Italy: for many types of northern as well as southern and coastal forests, building up a diversity of tree species helps distribute vulnerabilities, since not all tree species are susceptible to the same stress, such as drought or erosion at the same time.


© Frederik Vaes

Intercommunal trauma centre, in Schleiden, Germany: a region provides free short- to long-term psychosocial support to citizens and emergency service workers to mitigate the mental health impacts of extreme evens such as heavy rain and resulting flood events.


© Cesare Barillà, Climate Change PIX/EEA

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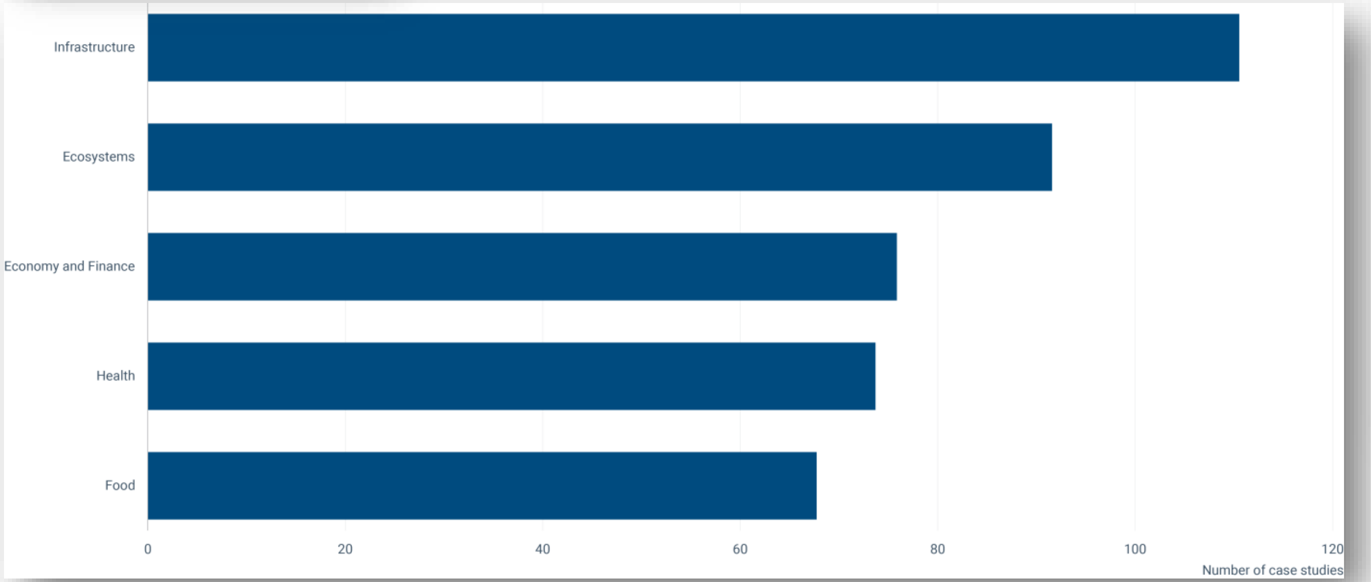
Support addressing climate risks across regions, governance levels and policy sectors

Addressing risks identified in EUCRA:

- Climate-ADAPT case studies can inspire action for 36 EUCRA risks
- Often several risks simultaneously addressed
- 2 risks related to food security in the food cluster and some risks in economy and finance cluster not yet covered



Source: EEA, 2024

Number of case studies per adaptation option	Adaptation options addressing the risks for Infrastructure	Pluvial and fluvial flooding	Coastal flooding	Damage to infrastructure and buildings	Energy disruption due to heat and drought	Energy disruption due to flooding	Marine transport	Land-based transport
1	Adaptation measures to increase climate resilience of airports	X		X				X
3	Integration of climate change adaptation in drought and water conservation plans				X			
3	Adaptation of fire management plans			X				
8	Adaptation of flood management plans	X	X					
2	Integration of climate change adaptation in coastal management plans		X					
7	Integration of climate change adaptation in land use planning	X	X	X		X		X
2	Adaptation options for electricity transmission and distribution networks and infrastructure				X	X		
2	Adaptation options for hydropower plants				X	X		
10	improved design of dikes and levees	X	X			X		
3	Afforestation and reforestation as adaptation opportunity	X						
25	Awareness raising campaigns for stakeholders' behavioural change	X	X	X	X	X	X	X
3	Beach and shoreface nourishment		X					
15	Capacity building on climate change adaptation	X	X	X	X	X	X	X
1	Cliff stabilisation and strengthening		X					
2	Climate proofed construction and design standards for road infrastructure			X				X
8	Crises and disaster management systems and plans	X	X	X	X	X		X

Finance | Food | Ecosystem | Human Health | Infrastructure

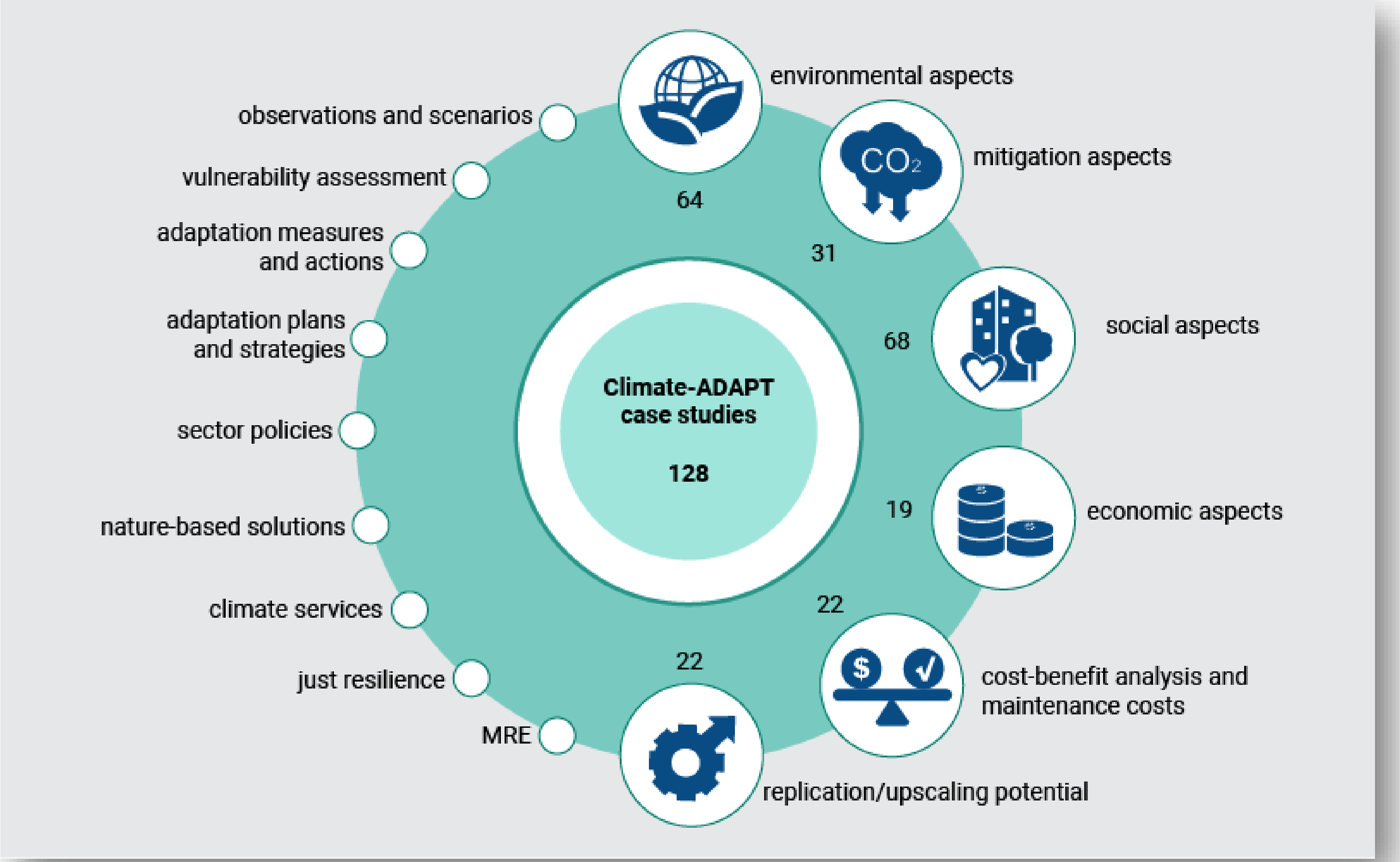
Source: ETC CA, 2024

European Environment Agency

Learning opportunities on implementing adaptation with synergies

Showcasing learning on

- mainstreaming of adaptation
- avoiding maladaptation
- making adaptation efficient
- Implementing adaptation at scale



EEA, 2024

Comparing costs and benefits of adaptation actions can be improved in Climate-ADAPT case studies

- 23 out of 128 studies with quantitative information about either costs or benefits or both, with varying degrees of accuracy
- Maintenance costs often crucial for the success of adaptation actions, pose a risk of discontinuing the activity if they are too high. Few case studies consider maintenance costs.

Flood protection Prague, Czechia case study needs to cope with uncertainties linked to future water-related extreme events. It presents one of the most comprehensive and detailed CBAs. It applied a range of cost-benefit comparisons under different severity scenarios and return periods.

The Hydropower plant flood risk management France case study explicitly considered maintenance costs and described a solution with negligible or zero maintenance costs.

Climate-ADAPT and its subsites

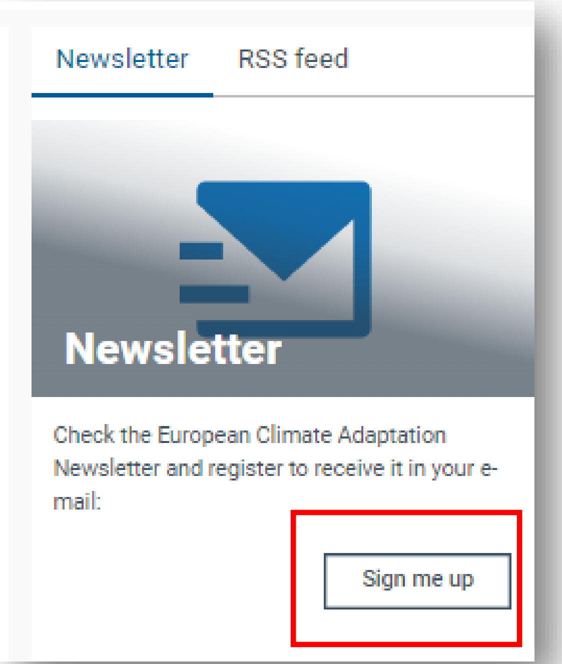
Climate-ADAPT
https://climate-adapt.eea.europa.eu/

New Climate-ADAPT newsletter subscription:
https://subscriptions.eea.europa.eu/newsletter-subscription-climate-adapt

Feedback/questions:
climate.adapt@eea.europa.eu

European Climate and Health Observatory
https://climate-adapt.eea.europa.eu/en/observatory

EU Mission on Adaptation to Climate Change Portal:
https://climate-adapt.eea.europa.eu/en/mission



Paving the way for climate-resilient buildings

RAMBOLL
Bright ideas.
Sustainable change.

European Commission

Presenting expert

Oliver has a career as a chartered engineer delivering sustainable buildings and strategic advisory within the built environment.

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Agenda

1. What can be found in the
   EU-level Technical Guidance and Best Practice Guide for adapting buildings to climate change?

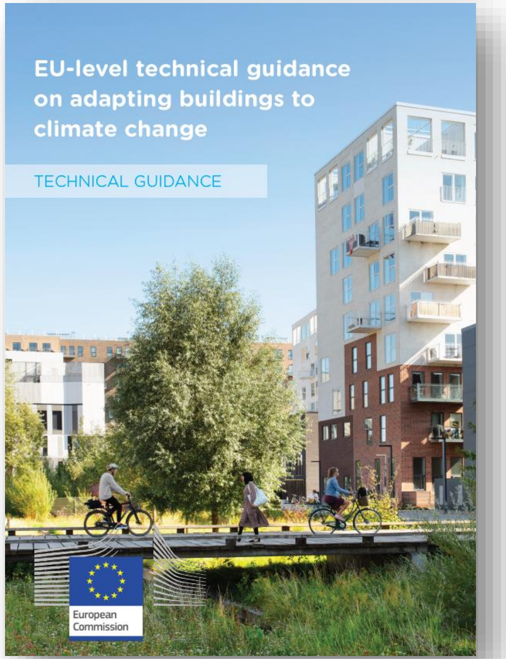
2. How a climate risk and vulnerability assessment can help your buildings become climate change resilient?

3. How to use the Best Practice Guide to identify adaptation solutions for a building

4. Audience Q&A

What can be found in the Technical Guidance and Best Practice Guide?

What can be found in the Technical Guidance and Best Practice Guide?



POLICY & STANDARDS REVIEW

- European Policy & Standardization Environment Adaptation Review
- Climate Resilience in Structural Design Review

RISK ASSESSMENT & RATING REVIEW

- Climate Vulnerability & Risk Assessment Methodology
- Climate Resilience Rating Approach

BEST PRACTICE GUIDANCE

Best Practice for enhancing Climate Resilience

Includes:

- Case studies
- Solutions for each project stage
- Building sector actors

Download

Climate change is reshaping the world

Northern Europe

In the western part of northern Europe, climates vary from maritime to maritime subarctic climates. The northern and central areas of the Northern European region are characterised by subarctic climates. Summers in this region are typically mild and humid. Winters are typically humid and cold, with snow covering the ground in the most northern areas.

Heat & Cold

- Mean **surface temperature** and **extreme heat** events are anticipated to **increase**, with a high level of confidence.
- **Cold spells** and **frost events** are predicted to **decrease** with a high level of confidence.

Wet & Dry

- **Mean precipitation levels** have been increasing and will continue to do so, with a high level of confidence.
- **Heavy precipitation** and **pluvial flooding** have been **increasing** and will continue to do so, with a high level of confidence.
- **River flooding** has been **decreasing** and may, with a medium level of confidence, continue to do so.
- There is low confidence in the direction of change for the quantity of landslides, aridity, droughts (hydrological, agricultural and ecological) and fire weather.

Wind

- A **downward trend** has been observed in **mean wind speed,** which is expected to continue with medium confidence.
- **Severe windstorms** may **increase**, with a medium level of confidence.
- Tropical cyclones and sand and dust storms are not relevant in this climatic zone.

Snow & Ice

- A **decrease** in **snow, glacier, ice sheet,** and **permafrost,** and lake, river and sea ice has been observed. This trend is expected to carry on in the future with a high level of scientific confidence.
- There is low confidence in the direction of change for heavy snowfall, ice storms, hail and snow avalanches in this climatic zone.

Coastal

- Relative **sea-level, marine heatwave** and **ocean acidity** are all predicted to **increase** in the future, with a high level of confidence.
- There is no past noticeable trend in coastal flood and erosion but there is high confidence in their future increase.

Source: IPCC Interactive Atlas Regional Synthesis

Western & Central Europe

Western Europe has an oceanic climate influenced by the Gulf Stream. The region is characterised by cool to warm humid summers and cool, wet winters with often overcast skies. Prolonged frost periods are rare. Hot summers have historically been rare;, however heat waves have increased in frequency and intensity in recent years.

Central Europe is characterized by a more continental climate, with colder long-lasting winters and hot summers.

Heat & Cold

- **Mean surface temperatures** and **extreme heat events** have been observed to be **increasing**. These are anticipated to continue increasing in the future, with a high level of confidence.
- **Cold spells** and **frost events** are predicted to continue **decreasing** in the future, with a high level of confidence.

Wet & Dry

- **Mean precipitation levels** have been increasing but there is a low level of confidence in future change.
- **River flooding, heavy precipitation** and **pluvial floods** have been **increasing** and will continue to do so, with a high level of confidence.
- **Hydrological, agricultural** and **ecological droughts** and **fire weather** is expected to increase with medium confidence.
- There is low confidence in the direction of change in landslide and aridity.

Wind

- **Mean wind speeds** have been observed to be **decreasing**, however there is low confidence in the direction of future changes.
- **Severe windstorms** may **increase**, with a medium level of confidence.
- There is a low level of confidence in the direction of change in sand and dust storms. Tropical cyclones are not relevant in this climatic zone.

Snow & Ice

- A **decrease** in **snow, glacier, ice sheet, and permafrost**, and **lake, river** and **sea ice** has been observed. This trend is expected to carry on in the future with a high level of scientific confidence.
- There is low confidence in the direction of change for heavy snowfall, ice storms, hail and snow avalanches in this climatic zone.

Coastal

- An **upward trend** has been observed in **relative sea-level, marine heatwave** and **ocean acidity**, which is predicted to continue upwards in the future with a high level of confidence. Whilst there is no past noticeable trend in **coastal flood** and **erosion**, there is high confidence in their **future increase.**

Source: IPCC Interactive Atlas Regional Synthesis

Mediterranean

The Mediterranean climate is characterized by dry summers and mild, wet winters and a generally hilly landscape. In the dry summer months, precipitation can become extremely scarce. Continental areas of the Mediterranean can be particularly hot and semi-arid (Natura 2000, n.d.).

Heat & Cold

- An **upward trend** has been observed in **mean surface temperature** and **extreme heat**, which is predicted to continue upwards in the future with a high level of confidence.
- There has been a **decrease** in **cold spells** in this climatic zone and this is predicted to continue with a high level of confidence. **Frost events** are also predicted to **decrease** with a high level of confidence.

Wet & Dry

- **Mean precipitation levels** are expected to **decrease,** with a high level of confidence for change in the future.
- **River flooding** has been **decreasing** and may, with a medium level of confidence, continue to do so.
- **Aridity, droughts (hydrological, agricultural and ecological)** and **fire weather** are predicted to **increase** in the future, with a high level of confidence.
- There is a low level of confidence in the direction of change for landslides.
- **Heavy precipitation events** and **pluvial flooding** are anticipated to **increase**, with a medium level of confidence.

Wind

- A **downward trend** has been observed in **mean wind speed**, which is expected to continue, with a high level of confidence.
- **Severe windstorms** may **increase**, with a medium level of confidence.
- There is a low level of confidence that the number of sand and dust storms will change. Tropical cyclones are not relevant in this climatic zone.

Snow & Ice

- A **decrease** in **snow, glacier, ice sheet, and permafrost,** and **lake, river** and **sea ice** has been observed. This trend is expected to continue in the future, with a high level of confidence.
- There is a low level of confidence that the quantity of heavy snowfall, ice storms, hail and snow avalanches will change in this climatic zone

Coastal

- An **upward trend** has been observed in **relative sea-level, marine heatwave** and **ocean acidity**, which is predicted to continue upwards in the future, with a high level of confidence.
- There is high confidence in **coastal flood** and **erosion increasing** in the future.

Source: IPCC Interactive Atlas Regional Synthesis

Summary

Each climatic zone within Europe is anticipated to experience an increasing number of heat wave, storm, heavy precipitation, and flooding events. Droughts and wildfires are anticipated to increase in Western & Central Europe, and the Mediterranean in particular.

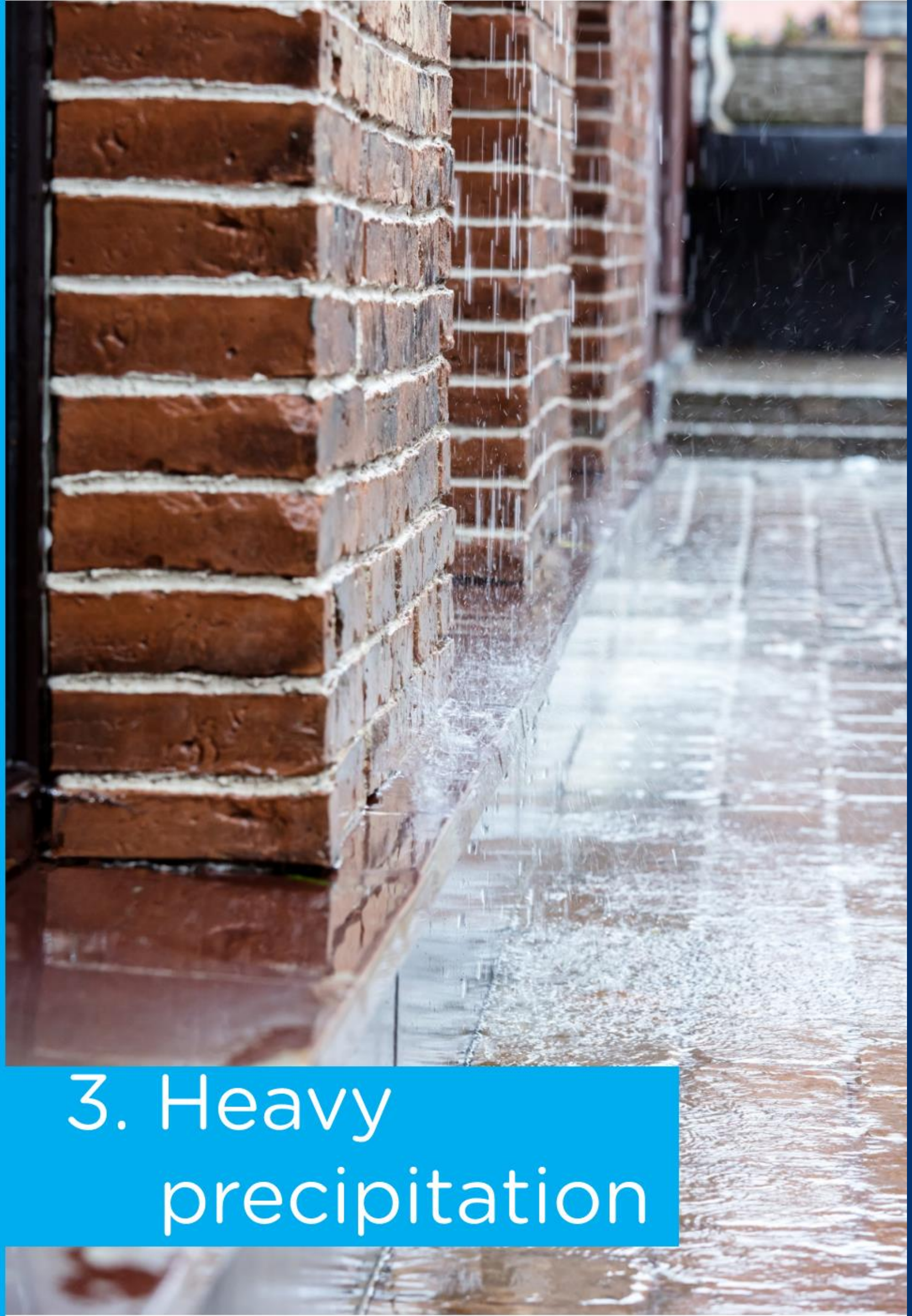
Best practice building adaptation solutions will therefore have to improve resilience against these climate-relates hazards.

Climate change is reshaping the world

	Temperature-related	Wind-related	Water-related	Solid mass-related
Chronic	Changing temperature (air, freshwater, marine water)	Changing wind patterns	Changing precipitation patterns and types (rain, hail, snow/ice)	Coastal erosion
	Heat stress		Precipitation or hydrological variability	Soil degradation
	Temperature variability		Ocean acidification	Soil erosion
	Permafrost thawing		Saline intrusion	Solifluction
			Sea level rise	
			Water stress	
Acute	Heat wave	Cyclone, hurricane, typhoon	Drought	Avalanche
	Cold wave	Storm (including blizzards, dust and sandstorms)	Heavy precipitation	Landslide
	Wildfire	Tornado	Flood (coastal, fluvial, pluvial, ground water)	Subsidence
			Glacial outburst	

1. Heat wave

2. Storms



3. Heavy precipitation

4. Flooding

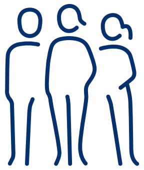
5. Subsidence

6. Drought

What does the best practice guidance cover?

Guidance on climate adaptation measures at the building scale across the climatic regions of Europe

Present adaptation solutions



Orientate stakeholders across the building industry to the actions that they can take to improve building performance

Support the development and alignment of key EU policies

Meet Matilda

Stranded assets

How a climate vulnerability and risk assessment can help your buildings become climate change resilient.

Why conduct a Climate Vulnerability and Risk Assessment (CVRA)?

Tool to identify where there is a need to adapt to future climate change

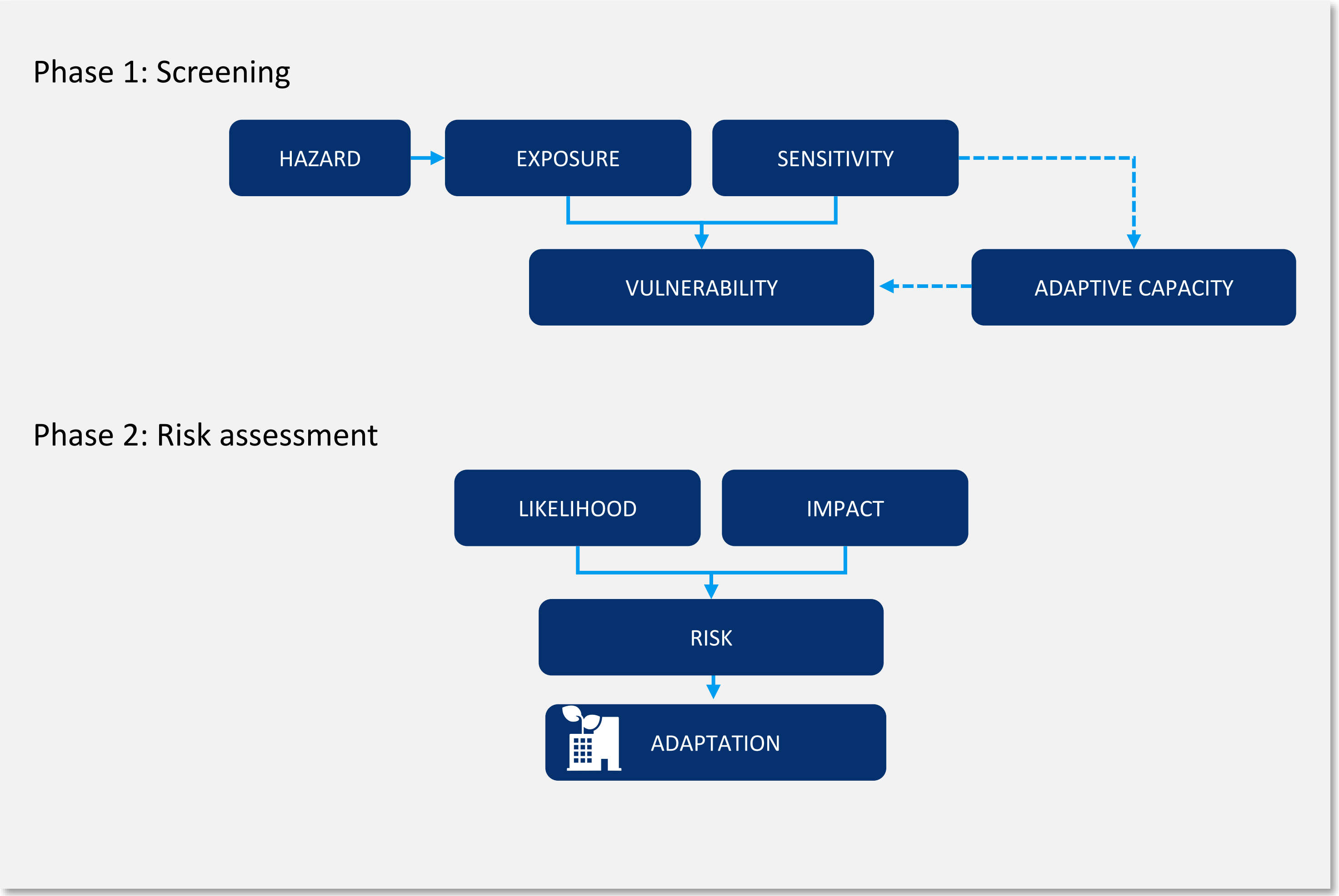
Provide a summary of key hazards to inform prioritisation of design measures

Requirement of EU Taxonomy regulation (for alignment with any of the 6 objectives)

Inform financial disclosure (e.g. Task Force on Climate-related Financial Disclosures)

Climate Vulnerability & Risk Assessment Methodology

- Summary of existing approaches to CVRA that are potentially relevant to buildings.
- Identifies core elements required and modifications needed to complete a CVRA for a building.
- A practical, phased approach is suggested.



CVRA in Practice: Matilda's building

CVRA in Practice: Matilda's building

STEP 0: INITIAL SCREENING
Which hazards can be scoped out?

STEP 1: EXPOSURE
To what extent would the site be exposed to the relevant hazards?

STEP 2: SENSITIVITY
To what degree would the building be affected if the hazard occurred?

STEP 3: VULNERABILITY OUTCOME

	HEATWAVES	FLOODING	STORMS	SUBSIDENCE
Vulnerability rating	High	Medium	Medium	~~Low~~

CVRA in Practice: Matilda's building

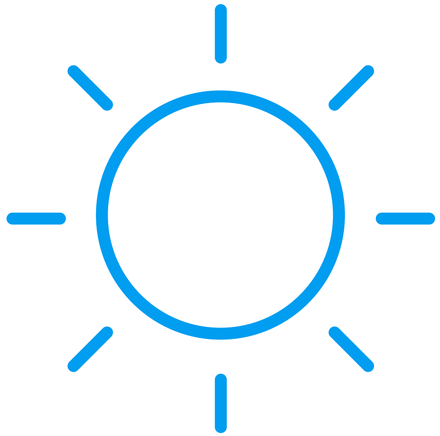
STEP 5: IMPACTS
What are the potential adverse impacts from each hazard, and how significant would these be?

STEP 6: LIKELIHOOD
How likely is the climate impact to occur over the lifespan of the building?

STEP 7: RISK OUTCOME

	HEATWAVES	FLOODING	STORMS
Risk Rating	High	Medium	Low

Matilda needs to adapt her building to heatwaves



How to use the Best Practice Guide to inform climate resilience.

Matilda’s building

Overview of the solutions

1. Heat wave

1.1 Description

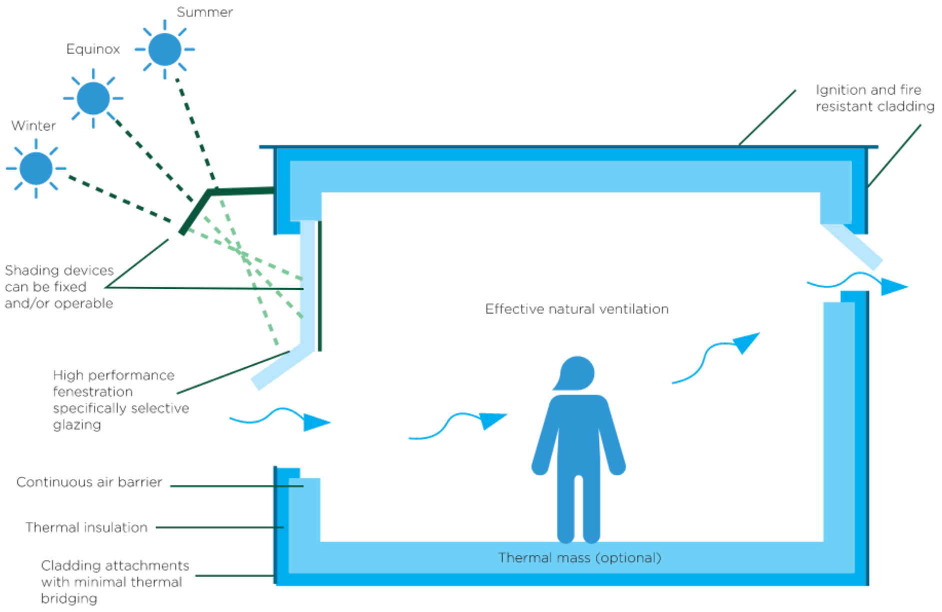
A heat wave is a prolonged period of extremely high temperature for a particular region. Across Europe, periods of high temperatures and heat waves will increase in intensity and duration due to climate change. This is anticipated to be more pronounced in cities, where large volumes of heat-absorbing materials and limited green spaces generate the urban heat island effect. For residents and occupants of buildings in both urban and rural areas, higher indoor temperatures can impact human health, well-being and productivity. Hence, the main objective of the solutions identified for heat waves is the safeguarding of well-being within buildings and ensuring thermal comfort for building users. It is important to note that these solutions also apply to high-temperature conditions in general and are therefore not exclusively for the occurrence of a heat wave event.

1.2 Solutions

Solution	Element	Impact on other hazards	Key considerations
Orientation of main facades away from direct sunlight to minimise solar gains	Building shape	N/A	+ Reduced energy demand and costs ! Potential trade-offs with natural lighting and desired heat gains during winter Not suitable for a retrofit or renovation
Insulation of walls, windows and roofs	Walls, windows, roof	! Flooding ! Heavy precipitation	+ Reduced energy demand and costs ! Possibility of humidity occurring within the walls and roof
Exterior shading for windows	Windows	! Storms	! During instances of high winds, long protrusions are fragile elements of a building
Light-coloured and reflective materials	Walls, roof	N/A	+ Reduced energy demand and costs ! Risk of glaring effects to the surroundings and the visual comfort of people
Photovoltaic (PV) installations on roof	Roof	! Storms	+ Provision of clean energy source + Acts as a shading device + Can be coupled with green roofs ! Should be impact-resistant in storm and hail-prone regions
Green roof	Roof, vegetation	+ Heavy precipitation	! Higher embodied carbon due to additional load for roof structure + Benefits for biodiversity + Improved the efficiency of PV installations
Green facades	Vegetation, walls	+ Heavy precipitation	+ Benefits for biodiversity + Reduced energy demand and costs ! Humidity of wall structure can be harmful for thermal function of the wall Potential for mould growth.
High vegetation on sun-exposed sides of the building to provide shading (exterior)	Vegetation	+ Heavy precipitation + Flooding ! Storms ! Subsidence	+ Benefits for biodiversity + Reduced energy demand and costs ! Risk of vegetation being uprooted during storms ! If roots are too close they expose foundations to higher risk of subsidence
Passive ventilation through thermal chimneys	Space considerations	N/A	+ Reduces energy demand for cooling and ventilation Not suitable for a retrofit or renovation

Solution	Element	Impact on other hazards	Key considerations
Temperature zones (preventing flow of heated air)	Space considerations	N/A	+ Potential trade-offs with natural and desired heat gains during winter
Thermal mass and phase-change materials	Preferred materials	N/A	+ Reduced energy demand and costs ! High embodied carbon from materials with high inertia
Natural ventilation	Space considerations	N/A	+ Reduced energy demand and costs
Movement joints	Structure	+ Subsidence	+ Protect buildings from cracking due to high temperature variability
Active cooling and ventilation	Services	! Storms ! Flooding ! Heaving precipitation	+ Provides immediate cooling in periods of extreme heat ! Standing water from flooding might damage the electrical components ! Driving rain may cause damage
Geocooling and heat pumps	Other	N/A	! Consideration of energy source for the heat pump
Connection to district cooling	Other	N/A	! Requires installation of neighbourhood-scale network

Figure 3: Overview of different adaptation solutions to heat waves.



Building shape

Foundations

Walls

Windows

Roof

Vegetation

Preferred materials

Space consideration

Primary structure

Services

Other

1.2.1. Building shape

The building shape and orientation can help to reduce exposure of the building to solar heat gain by considering the path of the sun (National Building Specification, 2014). Heat gains will be highest in the parts of the building exposed to a southwestern direction. Hence, it is best to avoid letting air flow into the building from southwest facing rooms. This way, buildings can provide certain spaces or zones with lower temperatures that can be used as primary work and living areas, or even respite zones (spaces that provide thermal relief during heat waves) during extreme heat. While such zones offer benefits for temperature regulation, considerations of indoor air quality may require specific ventilation mechanisms to ensure adequate air exchange.

The ideal orientation of a building depends on local sun-paths and temperature profiles for each season. In peak summer, east and west-facing facades can heat up considerably in the morning and evening respectively. North and south-facing facades generally provide a balance of minimising heat gains in summer but allowing lighting and solar heating in winter months. It is recommended that the direction and elevation of the sun are assessed when designing a building. Tools, such as Suncalc, are available online to help determine orientation, altitude and daylight duration specific to an address.

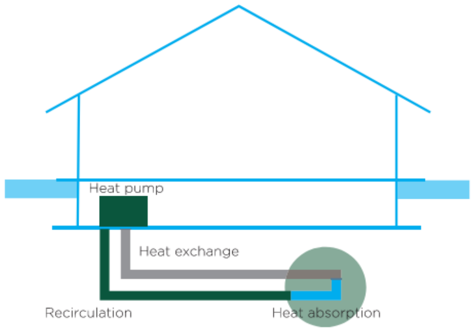
1.2.2. Foundations

Technological systems can be installed to help reduce a building's internal temperature. Geothermal cooling is a type of renewable energy system that moves heat from a building to below the earth's surface, using the ground like a heat sink (Techtarget, 2014).

Geothermal heating and cooling in buildings is done through ground-source heat pumps. (see Figure 4).

A ground-source heat pump draws heat in from the air outside before distributing it around the room in winter, and will absorb heat from the inside air and dissipate it outside during summer, leaving the building cooler.

Figure 4: Geothermal cooling and ground-source heat pumps



1.2.3. Walls

Using a coating of light and white colours on the exterior walls and windows of the building is a simple solution that can be used to reflect incoming sunlight and thereby avoid heating the building. Lighter colours reflect more of the sunlight and reduce the heat gained by building materials (Figure 5). Special surface coatings or materials using nano-technologies to create minuscule mirrors for sunlight can also help to reflect the energy and help maintain lower temperatures in the building.

High-quality insulation of the building envelope is crucial to delay heat gain of the building fabric during heat waves. However it is important to ensure that thermal bridges are avoided. Thermal bridges typically occur where there is either a break in the insulation, less insulation or the insulation is penetrated by an element with a higher thermal conductivity (BREGroup, n.d.). Thermal bridges should be avoided particularly around windows and at the junction between floors and walls. Design elements to tackle this may include cladding attachments. Not only do these reduce thermal bridging but also improve wall assembly thermal performance.

Figure 5: Light colours used on exterior building walls reflects incoming sunlight

1.2.4. Windows

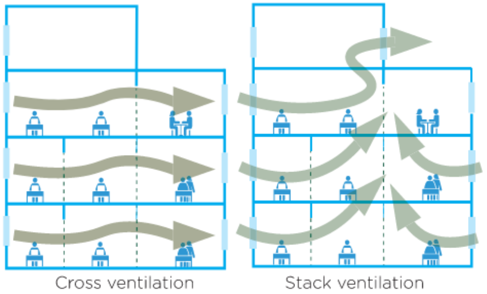
Windows are the main entry point for sunrays and heat energy in the building. The glazing ratio, or the proportion of glazing to opaque surface in a wall (also known as window-to-wall ratio), should therefore be carefully considered to limit solar gain whilst still maintaining appropriate daylighting for well-being (BRE, 2022). The optimal ratio of glazed facade surface to non-glazed surface depends on local climate conditions and regulations. It is also possible to use low solar-gain glazing or smart glass that darkens and brightens automatically, controlling the penetration of the solar radiation. High-performance glazing should be a priority in retrofitting buildings (with the exception of heritage buildings where the windows hold cultural value).

To make designs more energy efficient, it is possible to use glass that is printed with a ceramic frit and fired into a permanent, opaque coating. Fritted glass helps reduce glare, cuts cooling costs, and lowers the danger to birds (Stamp, 2016).

Windows are critical for effective natural ventilation of a building. In particular, the night time removal of hot indoor air through windows is essential (see Section 1.2.7). Ventilating or cooling a building with no energy consumption as part of a design feature is referred to as passive ventilation (See Figure 6). Passive ventilation may be achieved through either cross or stack ventilation (Figure 6). Cross ventilation relies on placing windows or openings on opposite facades of the building, with ventilation being driven by exterior wind or airflow. Stack ventilation relies on openings that are placed at different heights in the facade or roof; air flows between the openings as a result of the thermal difference between the indoors and outdoors temperate allows the air to flow. As the warmed air rises up through a central space, it draws more air in at the bottom in a convection process.

A solar or thermal chimney (generally tall wide structures constructed facing the sun, designed to absorb solar radiation) uses a similar process as stack ventilation. Solar chimneys are particularly effective in climates that are humid and hot (Designing Buildings, 2022). It is important that the chimney is insulated from the building itself so that the heat gains do not transmit into occupied spaces.

Figure 6: Passive ventilation techniques reduces indoor temperatures

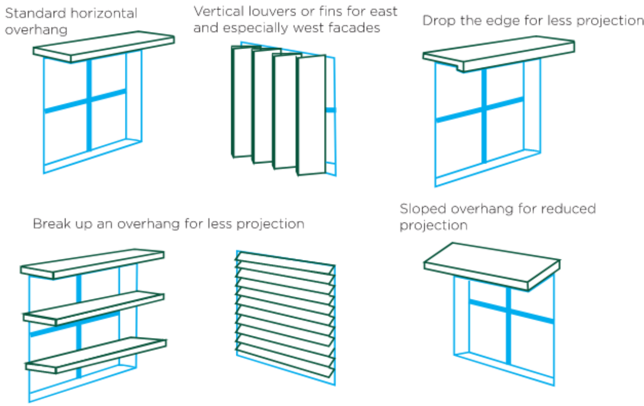


Passive cooling is a measure that uses no energy to cool buildings. It involves solar -shading installations that reduce automatically or manually the amount of heat and light entering the building.

Installations can include external window shutters features and brise-soleil above glazing (Figure 7).

Additionally, window blinds can also be used inside the building but are not as effective in reducing thermal gain as the heat energy has already entered the internal space.

Figure 7: Mechanism of overhang shading and other different shading installations



The overheating solutions presented in this chapter **may not be appropriate for heritage buildings** as external and internal solutions may conflict with historic characteristics. Alterations to the building fabric are likely to also erode historical significance. In some cases, heritage buildings have existing measures that help with adaptation to heat waves and overheating. For example, **sash and case windows** are a common feature of traditional buildings. These should be **maintained** where possible, to ensure that the top and bottom sashes are openable in such a way that effective air circulation and low-level background ventilation is maintained. In traditional windows, **shutters** may be set into the window reveals to prevent overheating by controlling sunlight. If not, these may be re-instated with low levels of intervention to reduce the need for mechanised cooling. Installing roller blinds may also be effective in helping to reduce solar gain and glare (Historic Environment Scotland, 2017).

1.2.5. Roof

Having **light colours** and **reflective materials** (such as **solar-reflective tiles**) on the building's roofing can increase its albedo and reduce the heat island effect.

Green roofs (Figure 8) help lower the indoor temperature of buildings because soil has a high capacity for heat storage and foliage acts as a shading device that absorbs thermal energy through photosynthesis (Marvuglia, Koppelaar and Rugani, 2020). The plants used on green roofs should be carefully selected to respect local species, have a positive impact on biodiversity and lower heat gain as much as possible. Plants like salvia and stachys are found to be particularly effective at lowering buildings' temperature (Vaz Monteiro et al., 2017). Moreover, evapo-transpiration of water from plants and soil can regulate the local microclimate, thus supporting adaptation efforts on a wider scale. Green roofs can also help reduce storm water runoff generated during heavy precipitation events, therefore offering benefits against multiple climate hazards. Refer to Section 2.3 for more information.

The **installation of photovoltaic (PV) panels** on roofs not only generates renewable electricity but also keeps the building shaded and cool. This solution offers important co-benefits for the reduction of greenhouse gas (GHG) emissions (Figure 9).

Photovoltaic panels and green roofs can be combined to improve the performance of solar panels by an average of 4 %. Vegetation surrounding solar panels on roofs can help keep the air clean from dust and pollutants, maintaining the effectiveness of photovoltaic panels (Irga et al., 2021). Vegetation also helps to keep surrounding temperatures low which limits overheating the panels, leading to increased performances (Peacock, 2021).

Green roofs and **solar panels** will **increase** the loading to roofs which may result in additional material required and **higher embodied carbon.** Solutions to reduce the structural material and associated embodied carbon should be explored. This could include: reducing the depth of substrate in a green roof, using suitable planting to reduce water storage requirements at roof level or using a pitched roof to allow light-weight PV panels to be utilized.

Figure 8: Green roofs insulate the building and create cooler microclimates

Figure 9: PV installations on the roof reduce heat gains of the building while supplying renewable energy

1.2.6. Vegetation

Green facades can provide heat reduction benefits similar to green roofs, by blocking and transforming sunlight and cooling the building's microclimate. Green facades can be created on external walls, with either lightweight structures allowing plants to grow directly on the facade, or by plants growing from the bottom of the building, climbing up the wall.

Careful consideration in designing the green facade is required as the humidity of a green wall structure can be harmful to the thermal function or integrity of the wall. This is explored further in Section 3.2.3

As part of the landscape, planting trees on the sides of buildings that are most exposed to sunlight during the day supports adaptation by offering protection from direct sunlight to the facades, and providing shade around the building (shown in Figure 10).

This solution can result in reduced heat absorption and heat radiation of the building's fabric, as well as the potential to reduce the urban heat island effect. This solution also offers co-benefits by supporting adaptation measures to water-related hazards and enhancing biodiversity (C2ES, 2017) (see Figure 11).

Trees planted in eastern, southern and western directions provide the most shading. The choice of deciduous plants (as opposed to coniferous trees) offers higher protection from sunlight in summer while enabling heat gains in winter months when they lose their leaves.

Additionally, planting shrubs and grass provide cooling through evapotranspiration. Evapotranspiration, alone or in combination with shading, can help reduce peak summer temperatures by 1 to 5 °C.

Figure 10: Exterior vegetation provides shading to the building and its users.

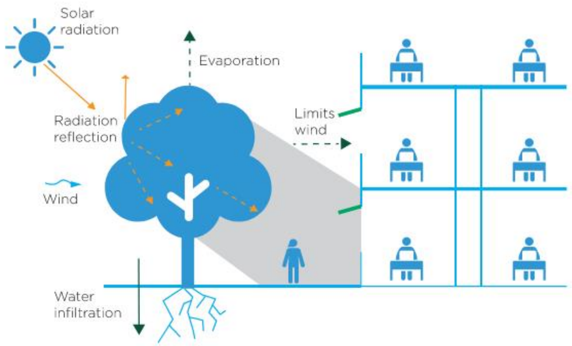
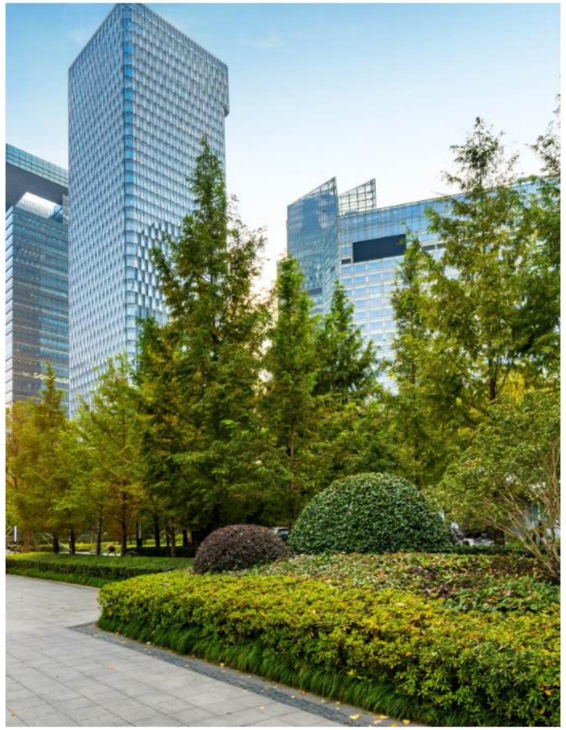


Figure 11: Planting shrubs and grass can provide cooling via evapotranspiration.



Building shape

Foundations

Walls

Windows

Roof

Vegetation

Preferred materials

Space consideration

Primary structure

Services

Other

1.2.7. Preferred materials

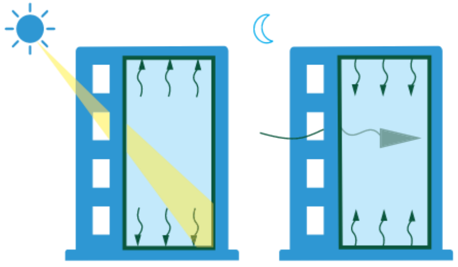
As described under the walls and windows sections, **surface coating and reflective materials** are key adaptation solutions. When selecting materials and their characteristics, additional measures to consider are their thermal mass. Materials with high thermal mass such as concrete slabs, masonry and timber frame walls, and tiles have the ability to absorb and store heat (both sunlight and internal gains) (Reardon and Marlow, 2020).

Different thermal mass materials absorb varying amounts of heat and take longer (or shorter) to absorb and re-radiate it (Smarter Homes, 2017) .

High thermal mass materials will absorb and release the heat slowly, thereby regulating temperatures over time, making the inside of a building cooler during the day and warmer during the night (Figure 12). The release of heat overnight makes the building warmer during this timeframe and hence it is important to have appropriate ventilation during the night.

Adobe walls offer a durable and low-carbon high thermal mass material option (Olukoya Obafemi & Kurt, 2016).

Figure 12: Thermal mass helps regulate indoor temperatures



1.2.8. Space consideration

Trees and vegetation around the building offer protection from direct sunlight and provide shade to a building, when planted in strategic locations. They can also be used to shade pavement in parking lots.

Additional outdoor cooling solutions may be provided by shading mechanisms around the building.

1.2.9. Primary Structure

The use of thermal mass from the primary structure, with active strategies such as **chilled beams** can control overheating. Ventilation strategies could make use of **thermal structures in the basement** to cool external air flowing into the building (Minson, 2019). The **additional load** of any of these **cooling strategies** should be accounted for when designing the primary structure of the building.

When buildings, particularly large ones, are exposed to high temperature variability, attention must be paid to the **frequency** and **position** of **joint movements**. This can be particularly prevalent during the construction of the building, before the building is thermally stable.

Some forms of construction, particularly in traditional buildings, may have a permeable building envelope (as opposed to a fully-sealed envelope). Therefore, adding insulation and vapour barriers to permeable walls to regulate temperatures could significantly increase indoor humidity, leading to moisture and dampness. Professional guidance should be sought when adapting a building for overheating, to avoid maladaptation.

Variations in temperature and atmospheric humidity can also have a significant impact on the deterioration of a building structure. An increase in temperature will accelerate the corrosion and deterioration of concrete, steel and reinforcement (Raposo, et al, 2020). This can affect the limit states of a building design and reduce the building's service life.

Solutions to avoid structure deterioration due to humidity within the building are detailed in Section 3 (Heavy precipitation).

1.2.10. Services

During the operational phase of the building, the use of efficient **active cooling** and **ventilation mechanical systems** may be used to improve thermal comfort during peak heat times. Active cooling solutions could involve air-conditioning systems, geothermal cooling, ground coupling or forced ventilation. When installing air-conditioning, the use of renewable energy should be prioritised to ensure that active cooling does not contribute to increasing GHG emissions and adversely impact climate change mitigation strategies. Additionally, the energy use of active cooling can be reduced through the use of **fans** that provide sufficient ventilation cooling in medium heat.

Some traditional and heritage buildings have the inherent property of **passive cooling** and ventilation. However, these features can get overlooked in refurbishment projects, with mechanical systems being implemented instead. Therefore it is important to ensure that vents, such as heritage cast iron vents, are not blocked, chimney flues are open and chimney balloons removed or deflated during summer months.

1.2.11. Other

District cooling networks have been created in many southern European cities. In these systems, excess cooling capacity from industrial activities is pumped via a network to connected buildings. District cooling systems play a key role in reducing energy consumption, they have the potential to reduce energy consumption by around 5% compared to conventional air-cooled chilled water systems (GlobalABC, 2021). Additionally, **heat exchangers** can then use this cooling potential as an energy efficient cooling source for air-conditioning systems.

During daytime, **cooling from water** can be used to amplify cooling. For example, this could be combined with cross-ventilation by allowing incoming air to flow over a water body or through a curtain of pulverised water , which cools it before entering the internal spaces. To avoid high humidity, a heat exchanger can be used. In that case air exiting the building is cooled down with water and inflowing air can be cooled with the outflowing air.

In heritage buildings it is important that **exposed domestic hot water pipes** are **insulated**. This prevents heat from dissipating and contributing to the build-up of heat inside the building. Additional measures such as lagging hot water storage tanks will also minimise the amount of heat emitted from plumbing systems.

1.3 Technical assessments, guidance & tools

National and international sustainable building certification tools such as BREEAM, LEED, DNGB, HQE include criteria or recommendations for passive cooling.

Technical Guidance for implementing green roofs and green facades (in German).

The Passive House Standard contains criteria for passive cooling and can be adapted to local climate characteristics.

Forecasting tools for future temperatures such as Weathershift are publicly available.

Climate projection models combined with building specifications to assess the resilience to heat (in French).

The Vienna Burgtheater uses an air well cooling strategy dating from the 19th Century

Technical assessments, guidance & tools

1.2.7. Preferred materials

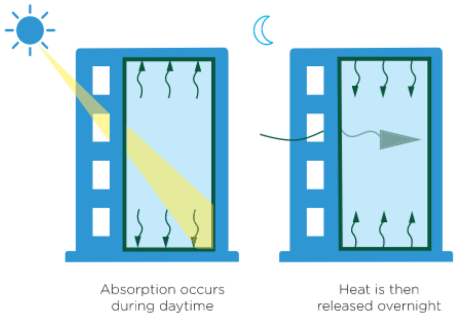
As described under the walls and windows sections, **surface coating and reflective materials** are key adaptation solutions. When selecting materials and their characteristics, additional measures to consider are their thermal mass. Materials with high thermal mass such as concrete slabs, masonry and timber frame walls, and tiles have the ability to absorb and store heat (both sunlight and internal gains) (Reardon and Marlow, 2020).

Different thermal mass materials absorb varying amounts of heat and take longer (or shorter) to absorb and re-radiate it (Smarter Homes, 2017) .

High thermal mass materials will absorb and release the heat slowly, thereby regulating temperatures over time, making the inside of a building cooler during the day and warmer during the night (Figure 12). The release of heat overnight makes the building warmer during this timeframe and hence it is important to have appropriate ventilation during the night.

Adobe walls offer a durable and low-carbon high thermal mass material option (Olukoya Obafemi & Kurt, 2016).

Figure 12: Thermal mass helps regulate indoor temperatures



1.2.8. Space consideration

Trees and vegetation around the building offer protection from direct sunlight and provide shade to a building, when planted in strategic locations. They can also be used to shade pavement in parking lots.

Additional outdoor cooling solutions may be provided by shading mechanisms around the building.

1.2.9. Primary Structure

The use of thermal mass from the primary structure, with active strategies such as **chilled beams** can control overheating. Ventilation strategies could make use of **thermal structures in the basement** to cool external air flowing into the building (Minson, 2019). The **additional load** of any of these **cooling strategies** should be accounted for when designing the primary structure of the building.

When buildings, particularly large ones, are exposed to high temperature variability, attention must be paid to the **frequency** and **position** of **joint movements**. This can be particularly prevalent during the construction of the building, before the building is thermally stable.

Some forms of construction, particularly in traditional buildings, may have a permeable building envelope (as opposed to a fully-sealed envelope). Therefore, adding insulation and vapour barriers to permeable walls to regulate temperatures could significantly increase indoor humidity, leading to moisture and dampness. Professional guidance should be sought when adapting a building for overheating, to avoid maladaptation.

Variations in temperature and atmospheric humidity can also have a significant impact on the deterioration of a building structure. An increase in temperature will accelerate the corrosion and deterioration of concrete, steel and reinforcement (Raposo, et al, 2020). This can affect the limit states of a building design and reduce the building's service life.

Solutions to avoid structure deterioration due to humidity within the building are detailed in Section 3 (Heavy precipitation).

1.2.10. Services

During the operational phase of the building, the use of efficient **active cooling** and **ventilation mechanical systems** may be used to improve thermal comfort during peak heat times. Active cooling solutions could involve air-conditioning systems, geothermal cooling, ground coupling or forced ventilation. When installing air-conditioning, the use of renewable energy should be prioritised to ensure that active cooling does not contribute to increasing GHG emissions and adversely impact climate change mitigation strategies. Additionally, the energy use of active cooling can be reduced through the use of **fans** that provide sufficient ventilation cooling in medium heat.

Some traditional and heritage buildings have the inherent property of **passive cooling** and ventilation. However, these features can get overlooked in refurbishment projects, with mechanical systems being implemented instead. Therefore it is important to ensure that vents, such as heritage cast iron vents, are not blocked, chimney flues are open and chimney balloons removed or deflated during summer months.

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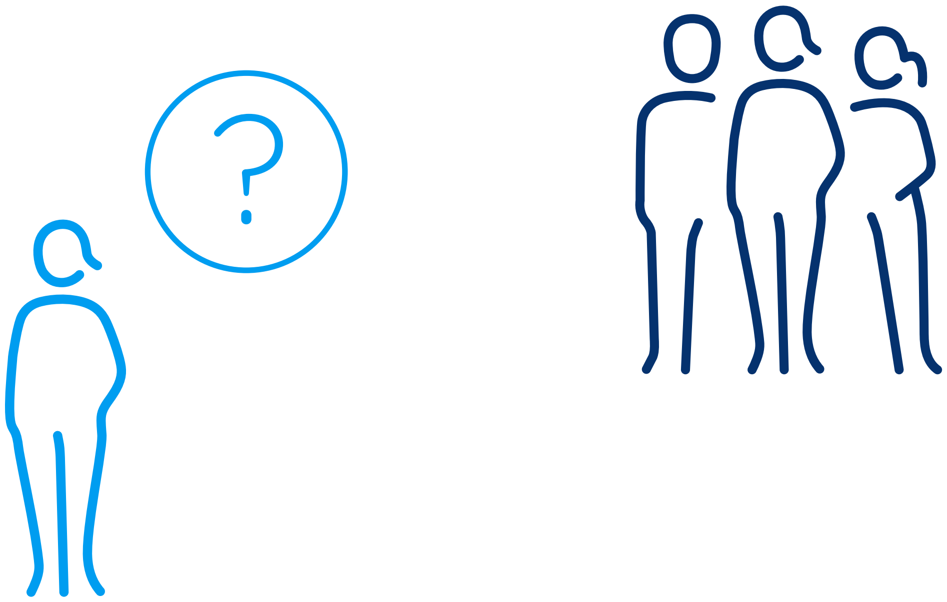
What about stakeholders?



Case studies

Industry actors

1.4 Case studies

Cooling Singapore, a large city-wide project that resulted in a catalogue of 86 measures to mitigate the urban heat island effect and improve thermal comfort.

The Vienna Burgtheater uses an air well cooling strategy dating from the 19th Century

SOLAR XXI, an office building in Portugal that combines facades covered in photovoltaic panels, geo-cooling and night-time cooling.

Library of TU Delft, which features a large green roof that is oriented is orientated in a southwestern.

Yale Environment study of white roofs in New York.

1.5 Industry actors

1.5.1. Government, regulators & local authorities

Policymakers and spatial planners can support the adaptation of buildings to heat by developing an encompassing **intervention framework**. This framework should be based on the establishment of standards to prevent overheating in buildings, good quality easily accessible climatic data and campaigns for raising awareness. Pairing **reliable** and **easily accessible data** on climate change risks and vulnerability with **climate change forecasts** enables industry actors to make informed decisions and minimise the possibility of high costs of adaptation due to delayed action.

Policies that facilitate the inclusion of climate risk considerations in standards can help ensure that climate risk is incorporated early in the planning stages. For example, the requirement for appropriate cooling or ventilation installations early in the construction stage can prevent costly renovations in the future. Therefore, **building codes** and requirements for **risk assessment documentation** can have substantial benefits.

Urban planners have the possibility to anticipate and influence adaptation **solutions** at the **neighbourhood level** to enable individual buildings to make use of larger structures for temperature regulation. Green spaces or networks for airflow and trees along streets for shading of buildings can be implemented at a local level. Similarly, water bodies to cool air can be included in urban development plans and projects.

1.5.2. Investors, developers & insurance providers

Thermal discomfort may reduce the usability of a building and lead to costly refurbishments to implement adaptation solutions at a later stage. It is therefore important for investors, developers and insurance providers to carefully **consider the need for thermal adaptation** from the start of a development project. Requiring a **climate risk assessment process**from design teams is an important first step to understanding these risks. This assessment can inform the development and implementation of adequate adaptation solutions.

Financial institutions offering financial products, such as funds that incorporate real estate, are a key target of regulation at EU level. Certain financial products under the EU Sustainable Finance Disclosure Regulation will be required to disclose on their sustainability implications and have to **assess their assets contribution to climate change adaptation** under the EU Taxonomy. This includes adaptation to heat waves. Therefore, **active adaptation planning**, and the consideration of the adaptation measures explored in this chapter will provide an advance on regulatory requirements for the coming years.

Investors, developers and insurance providers can make use of reporting frameworks such as LEVEL(s).. LEVEL(s) is the EU framework for assessing and reporting on the sustainability performance of buildings and the extent to which climate adaptation is incorporated. In fact, one of the six macro-objectives of LEVEL(s) is a healthy and comfortable space that includes a sub-indicator on the degree of thermal comfort. Utilising these reporting frameworks provide valuable information for industry actors to identify sustainable intervention and future-proof their investments.

1.5.3. Design teams (engineering and architecture)

Most of the solutions for adapting buildings to heat waves must be designed and implemented at the planning and design stage. Designers therefore play a crucial role in ensuring that the risk of overheating is assessed, and that adaptation solutions are included in early design stages.

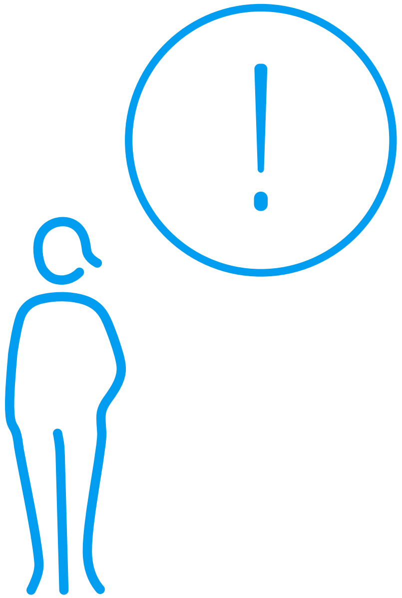
A comprehensive appraisal of adaptation solutions should be conducted by the design team, which is then discussed with the developers to prevent challenges in future heat wave events. This process starts with assessing the risk of overheating (likelihood, extent based on local climate projections and the vulnerability of the planned building), identifying adequate solutions (such as designing in the correct use of thermal mass) and advising clients on these solutions. Furthermore, design strategies should undergo a series of stress tests to demonstrate that they are robust solutions. Design teams can make use of the stress test recommended by Passivhaus. This can be supported by governmental recommendations, public assessment tools and existing case studies.

Dynamic thermal modelling tools should be used to assess the risk of overheating for building designs for new builds or renovations. These tools simulate the internal temperature conditions of a building and can help evaluate whether threshold conditions of discomfort may be reached. Dynamic thermal modelling tools allow for a zonal approach to be taken, examining how different spaces within the building perform. This can allow for a more targeted approach to renovation or remedial works, that minimises disruption to the building (Historic England, 2021).

Emission reduction targets in certain countries have resulted in the building sectors tackling emission reductions by increasing the level of thermal insulation in buildings, as well as increasing the level of airtightness. Buildings that have been insulated and tightly sealed to prevent heat loss during winter, and which lack thermal mass, have little shading and poor natural ventilation, are at risk of overheating during summer. Designers should carefully consider what adaptation solutions can be applied to existing buildings to maintain the building temperature at a moderate level and reduce the need for cooling.

For design teams, heritage buildings may present a complex situation given the sensitivities of the buildings. Heritage buildings should be treated on a case-by-case basis and adaptation solutions carefully considered so they do not compromise the cultural value of the building.

The impact of indirect effects



Appendix A

Building solutions by priority hazard

Possible solutions to adapt buildings to the priority hazards are summarised in the tables on the following pages. They are listed by Hazard, in order of cost (low to high) and ease of implementation (simple to complex). Each adaptation will have a beneficial impact, improving a building's capacity to respond to the target hazard. However, the adaptation may also create an indirect effect, with a potentially negative impact on the building's capacity to respond to other hazards. These interactions are highlighted in the table below.

Legend:

Green	Solution has a beneficial impact in responding to this hazard
Light orange	Solution has an indirect beneficial impact in responding to this hazard
Orange	Solution has a negative impact on this hazard if implemented
Grey	Not relevant / no interaction

Careful consideration is required when identifying appropriate solutions for both new and existing buildings. For detailed strategies, tailored to specific building types or environmental locations, appropriate professional guidance should be sought to ensure adaptations are effective against climate change.

Heat waves

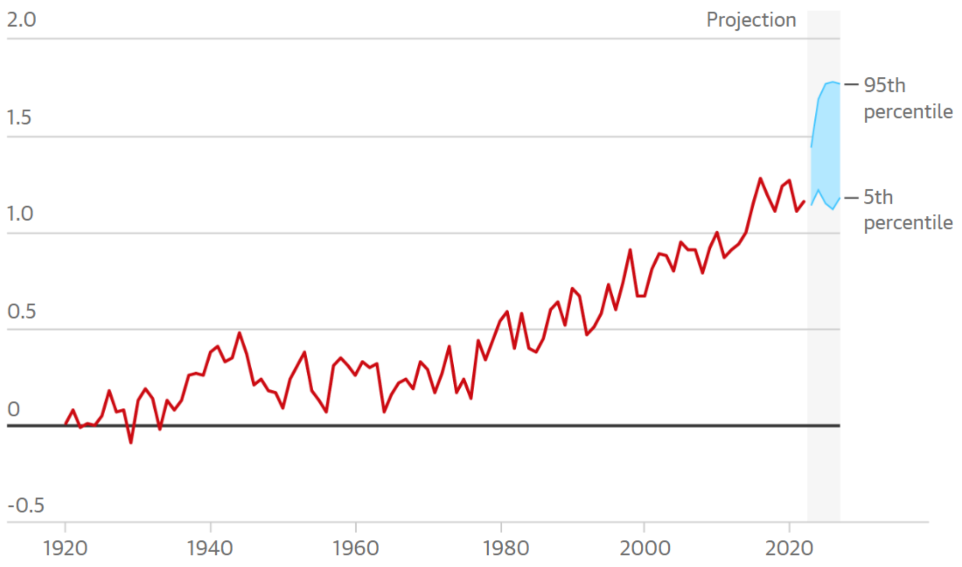
Solution	Category	Cost	Ease of implementation	Heat waves	Storms	Heavy precipt.	Flooding	Subsidence	Drought	Commentary on co-benefits	Commentary on negative impacts
Exterior shading	Building shape	LOW	SIMPLE	Beneficial	Negative	Negative	Not relevant	Not relevant	Indirect beneficial	• Limits solar gains by reducing the entry of sunlight and heat into the building. • Reduces energy demand for cooling.	• Elements that protrude from the building's structure are at risk of uplift from high winds. • Trees used to create shade should be carefully selected to avoid them being uprooted during storms (causing damage).
Green roofs	Roof	LOW	SIMPLE	Beneficial	Indirect beneficial	Beneficial	Indirect beneficial	Not relevant	Indirect beneficial	• Can support biodiversity. • Can provide significant noise reduction. • PVs can be combined with a green roof; vegetation can reduce the surrounding temperature and improve PV efficiency.	• Increases the amount of material required in structural elements, resulting in higher embodied carbon. The depth of substrate can be reduced in conjunction with suitable planting to reduce the load.
High vegetation on sun-exposed sides of the building	Vegetation	LOW	SIMPLE	Beneficial	Negative	Beneficial	Indirect beneficial	Negative	Indirect beneficial	• Reduces energy demand for cooling. • Beneficial for local biodiversity. • Increases water uptake of soil.	• There is a risk of vegetation being uprooted during storms and flooding and causing damage. • If the roots are too close to the building foundations they can increase vulnerability to subsidence.
Night ventilation	Services	LOW	SIMPLE	Beneficial	Not relevant	Not relevant	Negative	Not relevant	Indirect beneficial	• Reduces energy demand for cooling and ventilation	• If applied to parts of the building below flood level, damage can arise in the event of a flood.
Use of energy-efficient appliances in the building	Services	LOW	SIMPLE	Beneficial	Not relevant	Not relevant	Not relevant	Not relevant	Indirect beneficial	• Reduces energy demand for cooling and ventilation.	• No negative climate adaptation impacts have been noted.
Active cooling and ventilation appropriate to the building's needs	Services	LOW	SIMPLE	Beneficial	Negative	Negative	Negative	Not relevant	Indirect beneficial	• Provides immediate cooling in periods of extreme heat • Can provide further relief when passive ventilation measures are no longer efficient.	• Higher energy consumption than passive cooling solutions. • Standing water as an effect of flooding might damage the electrical components of outdoor active cooling units. • Driving rain may cause damage when dirt and debris enter the unit.
Enable passive airflow through the building for ventilation	Space consideration	LOW	SIMPLE	Beneficial	Not relevant	Not relevant	Negative	Not relevant	Indirect beneficial	• Reduces energy needed for cooling and ventilation.	• There may be instances during the year where internal temperatures may become high unless active mechanical cooling is used.
Light-coloured and reflective materials on roofs, walls, windows and blinds	Walls	LOW	SIMPLE	Beneficial	Not relevant	Not relevant	Not relevant	Not relevant	Indirect beneficial	• Limits solar gains by reducing the entry of sunlight and heat into the building.	• Risk of creating a glare effect. High albedo coatings can be dazzling and cause daily discomfort for people on the exterior of the building. • High reflection rates can intensify light pollution and disturb local biodiversity.
Thermal mass	Preferred materials	LOW	MODERATE	Beneficial	Not relevant	Not relevant	Not relevant	Not relevant	Indirect beneficial	• Reduces energy needed for heating and cooling. • High thermal mass materials are an inherent feature of some heritage buildings.	• Exposed thermal mass can leave hard surfaces that negatively impact the acoustic quality of the space.

The building is now more climate resilient

Where are we now in the bigger picture?

“There is a 66% likelihood that the annual average near-surface global temperature between 2023 and 2027 will be more than 1.5°C above pre-industrial levels for at least one year.”

World Meteorological Organization
17 May 2023



“This will have far-reaching repercussions for health, food security, water management and the environment.
We need to be prepared.”

Professor Taalas,

World Meteriological Organization

17 May 2023

Passive

Active

How can Ramboll help navigate these challenges?

- Standalone climate risk assessments
- Climate adaptation planning & building design
- Technical due diligence
- EU Taxonomy alignment
- Taskforce for Climate Related Financial Disclosure

Contact us

Contact us for if you want to know more about the Technical Guidance on adapting buildings to climate change, or how Ramboll can help with enhancing the resilience of buildings.

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Questions?

Bright
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