European Environment Agency

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

Countries in Europe have made considerable progress in developing and planning policies to adapt to climate change. However, the pace and scale of adaptation actions needs to increase, as Europe is still not adequately prepared to address the risks posed by climate change. This briefing aims to inspire further adaptation actions across Europe. It presents Climate-ADAPT case studies as a pool of practical examples of implemented adaptation measures. These examples are applicable at different governance levels and policy sectors across European countries and can facilitate peer-to-peer learning.

Key messages

The case studies on the European Climate Adaptation Platform (Climate-ADAPT) offer insights from implemented actions and present new governance approaches to enable local and regional adaptation actions.

The European Climate Risk Assessment (EUCRA) emphasises the need for mainstreaming and upscaling adaptation actions across sectors and governance levels to address escalating climate risks, such as from extreme heat, drought, wildfires and flooding. Although Climate-ADAPT case studies cover many risks, gaps remain in the food, and economy and finance risk clusters.

While local examples predominate, there are less sub-national, national and a shortage of cross-border Climate-ADAPT case studies, making it challenging to improve preparedness for extreme transboundary events.

Climate-ADAPT case studies explore the co-benefits and potential trade-offs of adaptation measures, while highlighting the need for enhanced monitoring, evaluation and learning (MEL) to assess the effectiveness of these actions, support learning and prevent maladaptation.

The future development of Climate-ADAPT case studies will focus on addressing specific risks identified by the EUCRA, closing further gaps in terms of regions, sectors and governance levels and on capturing the replication potential of adaptation actions. Collaboration with EEA member countries is key in further upgrading the Climate-ADAPT case studies and to share practical learning experiences across Europe.

Climate-ADAPT case studies show how adaptation measures can be enabled, planned and implemented

Since its launch in 2012, Climate-ADAPT has been supporting and driving EU climate adaptation policies and practices. Guided by strategies (e.g. Climate-ADAPT Strategy 2022-2024) (EEA, 2022a), Climate-ADAPT was evaluated in 2018 (EEA, 2018) and regularly upgraded to match the new knowledge needs and policy requirements, most recently to support the priorities of the EU's

Adaptation Strategy (EC, 2021) and the tasks outlined in the European Climate Law. Another evaluation is currently being conducted and it will provide insights in how to further improve Climate-ADAPT to support new knowledge needs of the upcoming EU policy term.

The EUCRA (EEA, 2024a) has shown that Europe is not adequately prepared to address climate risks in many policy areas. In response to this assessment, the European Commission issued a Communication on climate risks and resilience in which it highlights the need for more and faster actions (EC, 2024).

Climate-ADAPT case studies are a key means to support and boost the implementation of adaptation policies and planning at all governance levels across Europe. It is not yet possible to effectively determine the full impact of the case studies, including how many actions they inspired and in which cases they were upscaled for broader application.

However, feedback from the 2018 Climate-ADAPT evaluation indicates that the Climate-ADAPT case studies were used as illustrative examples for strategic adaptation planning, research-oriented purposes and in stakeholder dialogues (ETC CCA, 2018; EEA, 2018). More recent feedback at EU, national and local level conferences shows continued interest in the case studies. Moreover, the case studies section is the second most visited feature on Climate-ADAPT, averaging 8,100 page views per month in 2023. This is in contrast to the 'Country profiles' section, which received 6,200 page views per month over the same period[1].

The Climate-ADAPT case studies, with their systematic coverage of regions, governance levels, policy sectors and adaptation measures, can serve as a valuable reference and a collective repository of practical solutions across all European countries. They facilitate building on existing experiences in developing adaptation actions and enable peer-to-peer learning, helping societies better prepare for climate change.

Box 1. What are Climate-ADAPT case studies

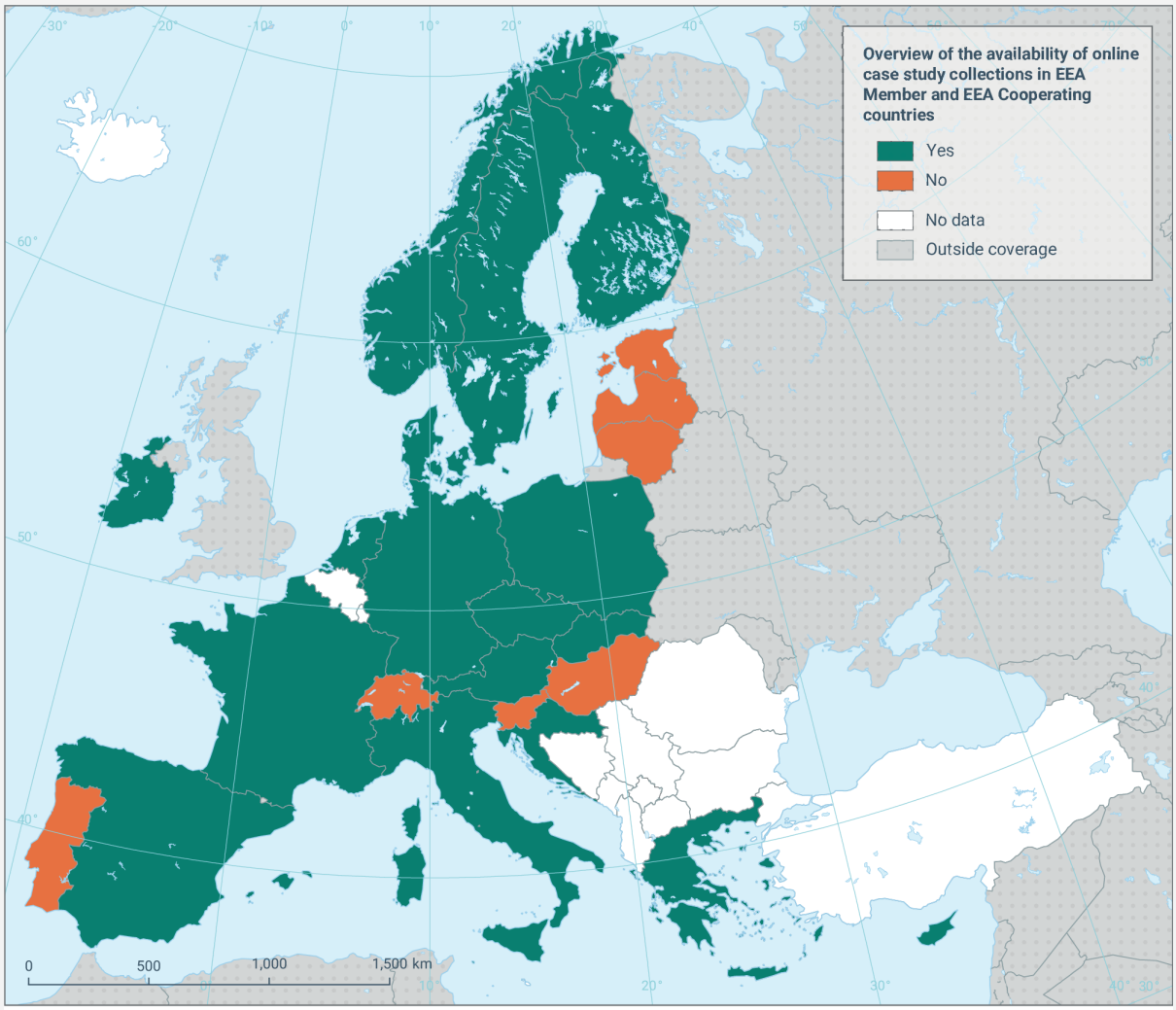
According to their mandate to develop and disseminate knowledge on practical climate adaptation in Europe (EEA, 2022a), Climate-ADAPT case studies showcase implemented adaptation measures and initiatives to create and improve the enabling conditions for adaptation at all governance scales, from local to EU. Since 2012, the European Environment Agency (EEA), supported by the European Topic Centre on Climate change adaptation and LULUCF (ETC CA), has prepared 128 case studies[2]. Climate-ADAPT case study descriptions are designed and updated based on up-to-date knowledge, often developed as a part of thematic EEA assessments, such as in the recent EEA reports Urban adaptation in Europe: What works? (EEA, 2024b) and Responding to climate change impacts on human health in Europe: focus on floods, droughts and water quality (EEA, 2024c). Those case studies often build on outcomes of project-based activities funded by the EU, such as under Horizon2020, Horizon Europe, LIFE, Interreg and funded by other sources, such as EEA and Norway grants. Since 2021, the European Climate and Health Observatory provides case studies of initiatives reducing and preventing health impacts of the changing climate. Most recently, the EU Mission on Adaptation to Climate Change contributes to the Climate-ADAPT case studies.

All case studies are presented on Climate-ADAPT through a common narrative. Each case study illustrates how to apply specific adaptation options.

Climate-ADAPT's case study catalogue is not exhaustive, but it complements other EU case study catalogues that focus on adaptation knowledge within specific governance levels or policy sectors. For example, the OPPLA platform's case studies, aiming to enhance

biodiversity, show examples of implemented Nature-based Solutions (NbS) for climate resilience and the EU Covenant of Mayors for Climate and Energy provides case studies on adaptation at local levels. Climate-ADAPT case studies supplement national case study collections provided by European countries (Figure 1). Many EEA member countries have established national online collections of case studies and adaptation options to inspire action. These collections are mostly available in national languages, with limited content in English and vary in name, format and narrative.

Figure 1. Overview of the availability of online case study collections in EEA Member and EEA Cooperating countries



Reference data: © EuroGeographics, © FAO (UN), © TurkStat Source: European Commission – Eurostat/GISCO

Publications

Note: Assessment of information reported in 2023 under the National Adaptation Action in Governance Regulation Art. 19 (EU, 2018) by EU Member States and by analogy on a voluntary basis by Iceland and Switzerland in 2023 and Türkiye in 2021, and of additional information requested from the Eionet group on Climate Change Impacts, Vulnerability and Adaptation in October 2023 in November 2023. Total number of countries=38 (32 EEA member countries and six cooperating countries (EEA-38_2020).

Click here for different chart formats and data

Climate-ADAPT EU adaptation sector policy pages provide information on EU policies and initiatives, knowledge provision and funding and investment for adaptation across 19 EU policy sectors (Figure 2). Among others, Climate-ADAPT case studies are catalogued on Climate-ADAPT under those EU policy sectors. Moreover, stakeholders are able to search case studies according to their specific backgrounds and interests and to submit case studies by using this guidance here.

Figure 2. Climate-ADAPT policy sector information

Source: Climate-ADAPT, 2024

Climate-ADAPT case studies provide insights on how to enable and implement adaptation actions

Following the framework of the Climate-ADAPT Adaptation Support Tool (AST), the case studies primarily demonstrate how to implement adaptation options, as outlined in step 5 of the AST. However, successful implementation of adaptation actions relies on a thorough understanding of climate challenges and advanced solutions. It also requires effective governance mechanisms and access to funding. Many Climate-ADAPT case studies also present actions to enhance or establish new governance components. They show that different models of collaboration across government levels (local, national and regional) and with non-governmental organisations, private sector actors and communities are crucial for effective adaptation.

The Intergovernmental Panel on Climate Change (IPCC) identifies governance, finance and knowledge capacity as the three key enabling factors for adaptation (IPCC, 2023). Climate-ADAPT increasingly reflects the importance of these factors, introducing new case studies that demonstrate their practical effectiveness.

Examples of Climate-ADAPT case studies demonstrating improved or new governance approaches

Water management

In the case study Landscape and Watershed Recovery Programme, Košice region, Slovakia, a water retention restoration programme prompted a substantial governance overhaul, leading to the creation of six independent Water and Land Restoration Advisory Boards. This new governance setting is expected to achieve the project results with a holistic cross-sectoral approach that favours community engagement.

Urban adaptation

The case study Evolving regions in North-Rhine Westphalia, Germany, adopted a multi-level governance approach to address the adaptation needs and capacities of small, rural municipalities. The approach built on existing cross-sectoral regional networks for sustainable development. With political, financial and scientific support, the Federal State of North-Rhine Westphalia engaged regional administrations and municipalities to develop and adopt regional adaptation roadmaps in accordance with the Federal State Climate Adaptation Act.

Monitoring and evaluation of adaptation action is crucial but still underdeveloped in Climate-ADAPT case studies

Monitoring, evaluation and learning (MEL) is essential to assess the effectiveness of adaptation actions, to prevent maladaptation and to identify areas for improvement, as outlined in step 6 of the AST. Yet only about 15% of Climate-ADAPT case studies showcase MEL approaches and the small number of systematic MEL schemes in Climate-ADAPT case studies means that learning over time may remain limited. In case studies that use monitoring schemes also beyond the start and end of the adaptation measures, over half of them include Nature-based solutions. The use of MEL schemes often depends on the size of the adaptation actions.

Publications

Examples of Climate-ADAPT case studies showcasing various levels of MEL approaches

Buildings

The case study Nature-Based Solutions in schools: a green way to adapt buildings to climate change in Solana de los Barros, Extremadura, Spain, illustrates the added value of monitoring to enhance adaptation actions. Green solutions were tested in a school building to combat rising temperatures and water scarcity. Monitoring revealed that some of the plant species selected were not suited to the local environmental conditions, allowing for swift adjustments, which led to the overall improvement in heat protection and indoor thermal comfort. Monitoring activities are planned for at least four more years to monitor and adjust the measures.

Coastal areas

The case study Sand Motor – building with nature solutions to improve coastal protection along Delfland coast, Netherlands, is a large project with monitoring and evaluation activities which confirm that the measures of this mega-nourishment for mitigating sea-level rise are working well. It is an example of other larger and structured interventions in the Climate-ADAPT case study catalogue which suggest that those have frequently detailed monitoring plans and even dedicated websites that report on the progress and effectiveness of the adaptation actions.

Urban adaptation

The Climate-ADAPT case study catalogue suggests that autonomous and small-scale adaptation actions more rarely include monitoring plans, as in the Climate proof collective garden Vrijburcht, Netherlands case study. It shows that qualitive evidence is available for this local initiative and is sufficient to track its progress, although it is either scattered and not systematically reported on, or not easily accessible.

Urban adaptation

Pilot and small-scale projects are often financed by project funding. Their maintenance and monitoring after the project ends are not always addressed and budgeted. In the Urban adaptation and mitigation Bratislava, Slovakia case study, the city accessed European Economic Area Grants and Norway Grants twice. This allowed the city to implement adaptation and mitigation measures in various areas of Bratislava and to gradually transform the urban layout by creating green spaces. This has been possible although the lack of a comprehensive monitoring scheme means it is difficult to evaluate overall progress.

Climate-ADAPT case studies provide up to date knowledge for learning on effective adaptation approaches

Climate-ADAPT case studies are made available online during implementation or shortly after completion of the projects. However, the outcomes may become measurable only after project completion. Therefore, the case studies are regularly updated to reflect progress and to report if the infrastructure is still in place and maintained, or even if the actions were upscaled or replicated in other areas. Hence, 72 case studies (more than half of the total catalogue at the time of writing) refer to a publication and/or revision date for the 2020-2023 period.

Due to the limited availability of and accessibility to MEL schemes in Climate-ADAPT case studies and the growing number of cases, updating them is challenging. However, the most recent update of a selection of Climate-ADAPT case studies, carried out in 2023 — 6 years after their initial publication — offered new insights into the effectiveness of adaptation measures. For example, the importance of continuity in financing, maintenance and monitoring of adaptation actions was shown to be essential to provide long-term benefits of adaptation governance and measures.

Examples of Climate-ADAPT case studies pointing to continuous funding as a crucial factor for long-term effectiveness of adaptation actions

Financial

The case study Bonds issued by the City of Paris, France raised private finance for public climate change mitigation and adaptation-related projects including establishing green areas, among others for heat protection. The climate bond has evolved into a sustainability bond of the City of Paris, which was launched in 2017 and reissued yearly in the period 2020-2023 with a running time of to 2031 to support a wide range of sustainability projects.

Financial

The case study Crowdfunding platform realising climate change adaptation through urban greening in Ghent, Belgium, shows successful funding of small-scale local adaptation projects. In this case, the continuity of the adaptation actions might be an issue: the priorities of the crowdfunding platform have changed over time towards encouraging socio-cultural initiatives with limited relevance for climate change adaptation. This might lead to a potential risk for long-term success of the actions.

Climate-ADAPT case studies support addressing climate risks across regions, governance levels and policy sectors in Europe

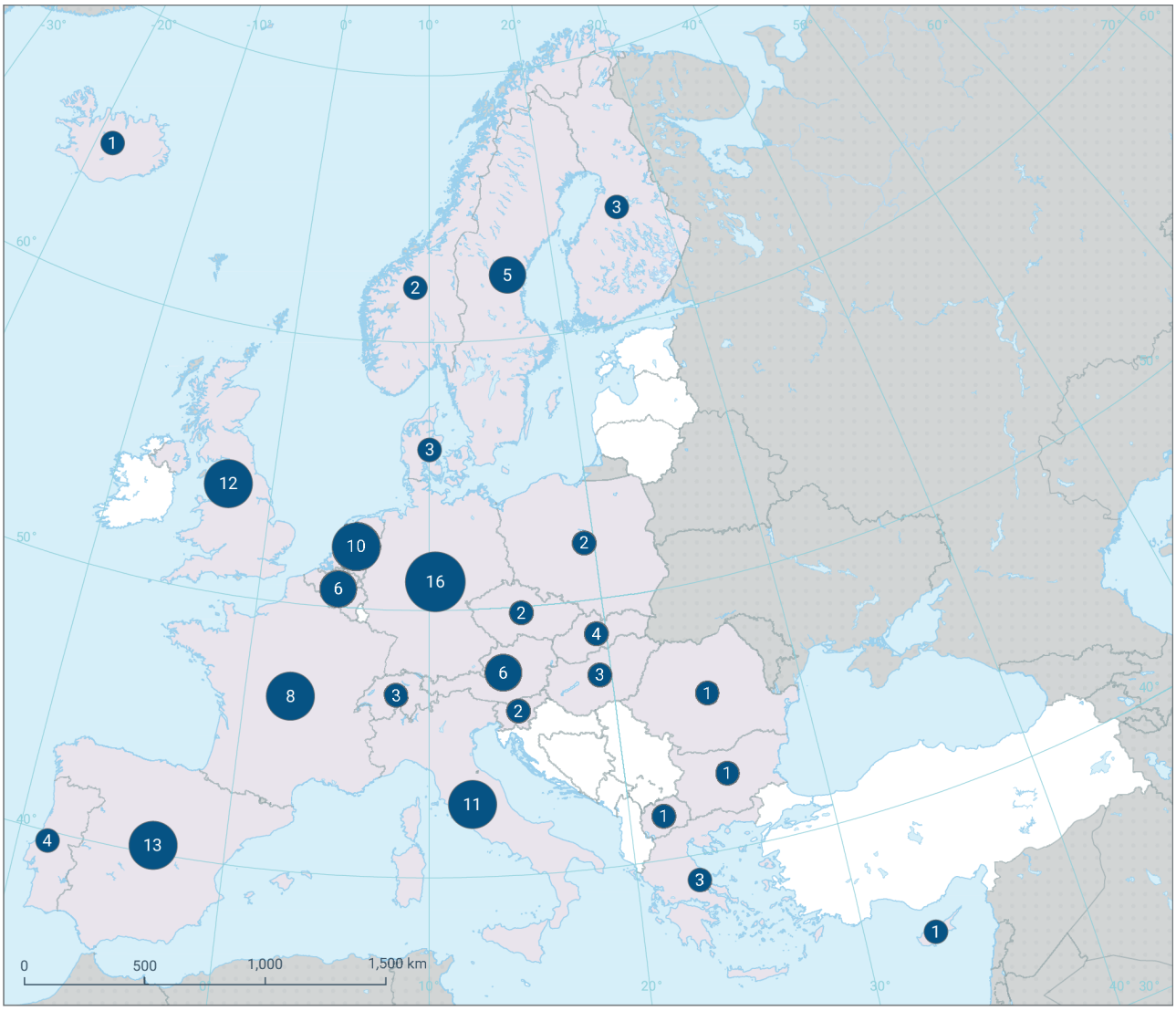
European regions: all covered with Climate-ADAPT case studies but to a varied extent

Climate-ADAPT case studies provide examples of adaptation actions applicable to specific European contexts, though coverage of some regions is limited (Figure 3). However, despite this incomplete geographic coverage, the case studies can serve as a European reference and as a pool of practical solutions for peer-to-peer learning across all European regions. For example, as northern European countries anticipate more frequent and prolonged heatwaves in the future, practitioners need not start from scratch to develop measures, but can draw upon approaches and lessons learnt in central

and southern European countries in managing heat effects to protect people’s health.

Publications

Figure 3. Regional distribution of Climate-ADAPT case studies



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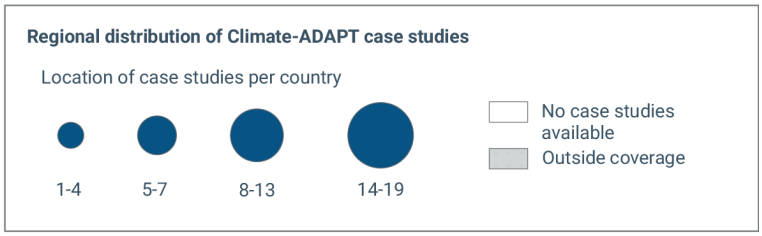


Publications

Note: This map is generated from the Climate-ADAPT case study explorer. It shows the location of case studies from EEA member and EEA cooperating countries including those from UK (EEA_39). Transnational case studies are assigned to one single country (the most relevant one or the one in lead of the adaptation actions).

Source: EEA, 2024

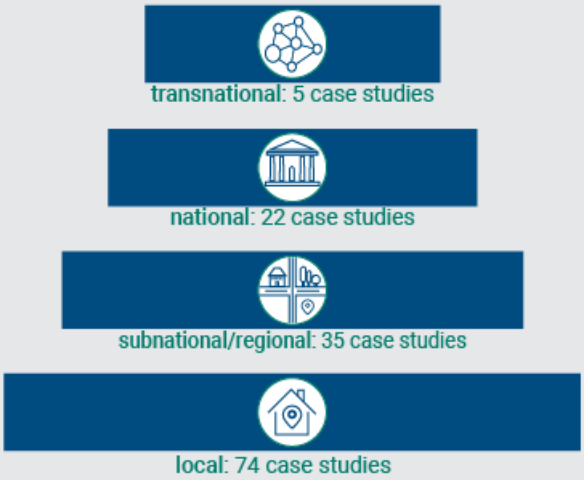
Click here for different chart formats and data

Governance levels: local examples prevail over regional, national and cross-border case studies

Although Climate-ADAPT case studies offer examples of adaptation across all governance levels, local actions are better represented than regional and national ones (Figure 4). This aligns with the EU's Adaptation Strategy (EC, 2021), which puts forward local level actions as one of its key areas of action. Of the local and regional level case studies, 21 were recently referenced as inspiring examples in the 2024 EEA Urban adaptation report (EEA, 2024b).

Effective adaptation requires multi-level governance arrangements supporting and targeting sub-national and local levels (EEA, 2023a). Thus, Climate-ADAPT also includes national-level case studies to show that national frameworks are needed and may support regional and local climate action. Additionally, climate impacts transcend borders. For example, the devastating floods along Germany's Rhine and Belgium's Meuse rivers in July 2021 resulted in some of the most expensive hazards in Europe from 1980 to 2022, with damages amounting to EUR 44 billion in the two countries (EEA, 2023b). However, as of the time of writing, only five case studies address transboundary actions.

Figure 4. Climate-ADAPT case studies per governance level



Notes: Individual case studies can be associated to more than one governance level. Therefore, the sum of case studies shown in the image (n=136) is higher than the total number of case studies (n=128).

Source: Climate-ADAPT, 2024.

Publications

Examples of Climate-ADAPT case studies at different governance levels

Water management

Transnational level

International cooperation frameworks and EU funding can support adaptation at transnational levels. For instance, in the Lower Danube corridor case study, Bulgaria, Moldova, Romania and Ukraine signed an international agreement based on several international conventions and programmes, such as the Ramsar Convention and the EU Phare Multi-beneficiary programme for Environment, with the latter used to restore wetlands and floodplain habitats throughout the entire Danube River Basin. National-level collaboration between public institutions, sector associations and researchers enhanced the credibility of adaptation efforts.

Energy

National level

The case study Hydropower management in Iceland showcases Iceland's 100% renewable electricity and heat system, leveraging the country's abundant hydro- and geothermal resources. With climate change inducing glacier melt, hydropower stands gain from increased water flow. Collaborating with other Nordic governments and research agencies, Iceland's national power company uses hydrological modelling to forecast future water flow, allowing for adjustments in water reservoir management strategies.

Urban adaptation

Regional/ local level

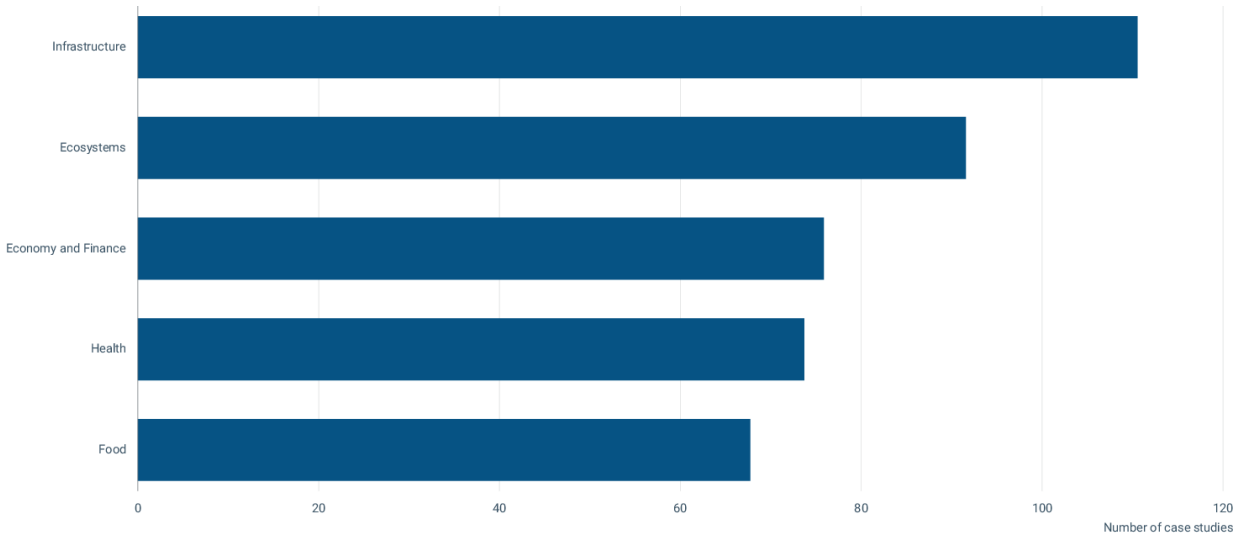
The case study Grey field renovation, in Jena, Germany illustrates how detailed knowledge of local needs ensures that adaptation strategies are realistic and effective. This case study is based on an EU initiative to boost adaptation in cities and is supported by complementary case studies provided by the EU Covenant of Mayors for Climate and Energy, itself guided by Climate-ADAPT's Urban Adaptation Support Tool (UAST).

Climate-ADAPT case studies provide inspiration on how to address key European climate risks

Publications

Case studies address several of the climate risks identified in the five risk clusters (ecosystems, health, food, infrastructure, economy and finance) of the first ever EUCRA (EEA, 2024a). Under those clusters, EUCRA identified 36 major climate risks for Europe and assessed the urgency to act, informed by the severity of climate risks over time and by an indicative policy assessment. Climate-ADAPT case studies can be used to inspire urgent action for the risks grouped under the risk clusters, often addressing several risks simultaneously (Figure 5). The coverage of the 36 specific risks within these clusters will be further analysed. An initial assessment indicates that two risks related to food security in the food cluster and some risks in the economy and finance cluster are not yet covered by Climate-ADAPT case studies.

Figure 5. Climate-ADAPT case studies applying adaptation measures for key European risks



Notes: The assessment of how well Climate-ADAPT case studies cover EUCRA risks was conducted by identifying the relevant Climate-ADAPT adaptation options that address these risks. The selection was supported by expert judgement, provided by the EEA and ETC CA. Further details of the evidence for this analysis are available here. Since case studies usually address several risks, the total number of case studies displayed in the graph (n=421) is higher than the actual number of Climate-ADAPT case studies (n=128).

Source: Climate-ADAPT, 2024.

Click here for different chart formats and data

Publications

Examples of Climate-ADAPT case studies addressing risks under EUCRA risk categories

Ecosystem cluster

The case study Wetland adaptation, in the Attica region, Greece demonstrates the implementation of an action plan aimed at increasing the resilience of wetland ecosystems and reducing biodiversity loss.

Food cluster

Risks to crop and livestock production are addressed in the case study Agro-silvo-pastoral system in Alentejo, Portugal, showing how farm-level agroforestry principles can be used to protect water resources in drought prone areas.

Ecosystem cluster

Health cluster

The case study Water quality protection, in Rimini, Italy presents ways to address the health risk posed by pathogens present in coastal waters experiencing heavy rainfalls. The case study shows how overflow tanks can be used to avoid contamination of bathing waters due to sewage overflow. This approach prevents the need to resort to bathing bans on the city's beaches, thus safeguarding tourism.

Infrastructure cluster

Publications

Infrastructure cluster

The case study Resilient railways, in the Alps, Austria shows how to improve the resilience of land-based transport against flooding and alpine hazards. This is achieved through the establishment of structural protection measures and by using weather monitoring system to ensures passenger safety and service continuity.

Economy and finance cluster

Food cluster

The case study Drought insurance for agriculture, in Austria, describes a subsidised public-private insurance scheme adopted by the Austrian government. This scheme combines indemnity-based insurance with weather index-based products to address risks related to the financial and agriculture sector.

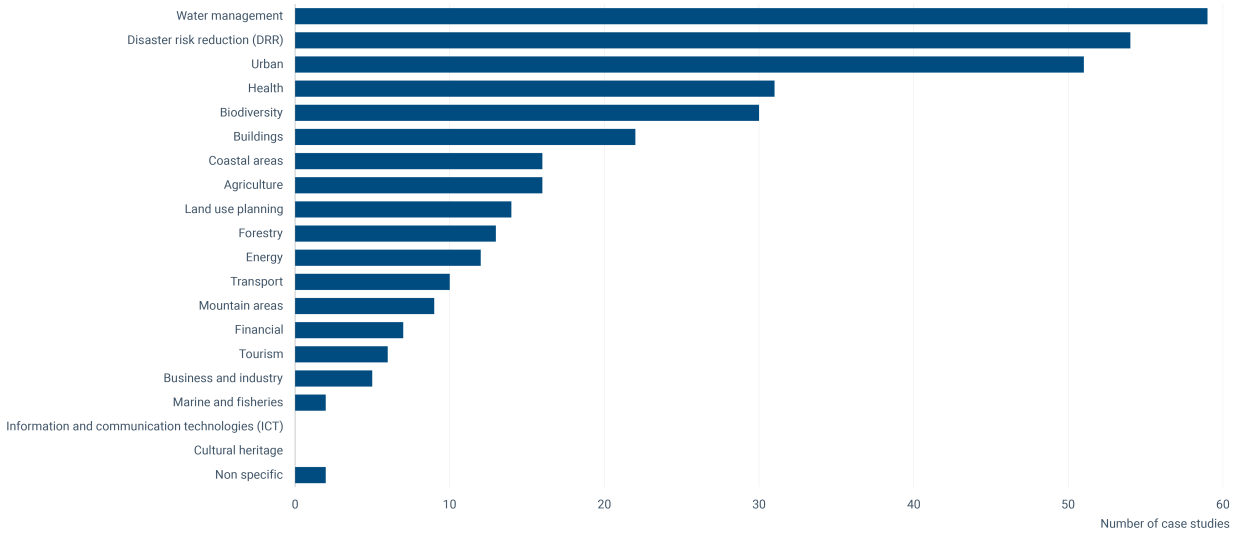
Economy and finance cluster

Climate-ADAPT case studies for key affected policy sectors and sectors addressed under EUCRA

In line with the objectives of the EU's Adaptation Strategy (EC, 2021) to enhance adaptation efforts across the board, Climate-ADAPT case studies provide inspiring examples of adaptation action for policy sectors affected by the impacts and risks of climate change. While not aiming to represent ongoing actions in each sector, Climate-ADAPT case studies are available for most of the policy sectors identified by the strategy. Climate-ADAPT continually strives to capture examples of adaptation from and for sectors that are less represented or not represented at all (Figure 6). Climate-ADAPT provides case studies for sectors that are repeatedly and most often reported by

European countries in 2023 (EEA, 2023a) and 2021 (EEA, 2022b) as ‘key affected sectors’ across all European regions: health, agriculture, forestry and biodiversity.

Figure 6. Climate-ADAPT case studies per policy sector



Note: Policy sectors are structured according to the Climate-ADAPT sector classification (Figure 2). Case studies, not specifically targeting one or more sectors are categorised as ‘Non specific’. Most of the case studies are categorised in Climate-ADAPT with more than one sector; therefore, the sum of all case studies displayed in the graph (n=359) is larger than the total number of Climate-ADAPT case studies (n=128).

Source: Climate-ADAPT, 2024.

Based on increased adaptation actions under EU initiatives and funding, and in line with the priorities of the EU adaptation strategy and national-level actions, the water management, disaster risk reduction and urban sectors show the largest share of Climate-ADAPT case studies. The forestry sector, which requires a long-term perspective and ongoing adjustments, rather than a single-year investment, shows a relatively lower number of case studies.

Since 2021, the number of case studies relevant to the health sector has substantially increased, due to the activities under the European Climate and Health Observatory. These case studies capture adaptation actions to anticipate, prevent and minimise the health threats caused by climate change, such as heat and vector-borne diseases (EEA, 2022c), as well as water-related climate change health impacts (EEA, 2024c).

In line with the EU Adaptation Strategy and other EU policies, EU adaptation initiatives have been extended for the cultural heritage, business and industry, information communication and technology

(ICT), land-use planning, mountain areas and tourism sectors. Complementing those activities with practical evidence through new Climate-ADAPT case studies is ongoing.

Many sectors facing high climate risks, as identified by EUCRA, are also covered by Climate-ADAPT case studies. The marine and fisheries, and financial sectors under the food, and economy and finance clusters only have a few case studies. Delivering climate neutral energy in Europe under changing climate conditions is crucial to achieve the EU climate goals. However, examples of adaptation actions in the energy sector—categorised under the infrastructure cluster by EUCRA — are also underrepresented by Climate-ADAPT case studies.

Most Climate-ADAPT case studies span multiple sectors, highlighting that implementing adaptation measures typically generates synergies among and co-benefits across different sectors.

Publications

Examples of case studies for selected policy sectors

Health

The case study Intercommunal trauma centre, in Schleiden, Germany describes how 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.

Forestry

The case studies Peri-urban Sonian beech forest, Belgium and the Water saving strategy Bosco Limite, Italy show that 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.

Marine and fisheries

Two case studies are available, dealing with invasive species control (Preventing lionfish invasion Cyprus) and fish-born issues for human health (Control ciguatera poisoning Canary Islands, Spain). Both case studies aim to support the fisheries sector coping with risks resulting from higher water temperatures.

Multiple sectors

Forest management activities are examples of adaptation actions supporting multiple sectors. Forest resilience actions contribute to the objectives of the water management sector, as shown in the Silvicultural management in Lavant Valley, Carinthia, Austria case study. Preserving the protective function of forests against natural hazards resulted to be key to avoid transport interruptions, as shown in the Rockfall management in Engadin, Switzerland case study.

Climate-ADAPT case studies showcase using various adaptation measures including NbS

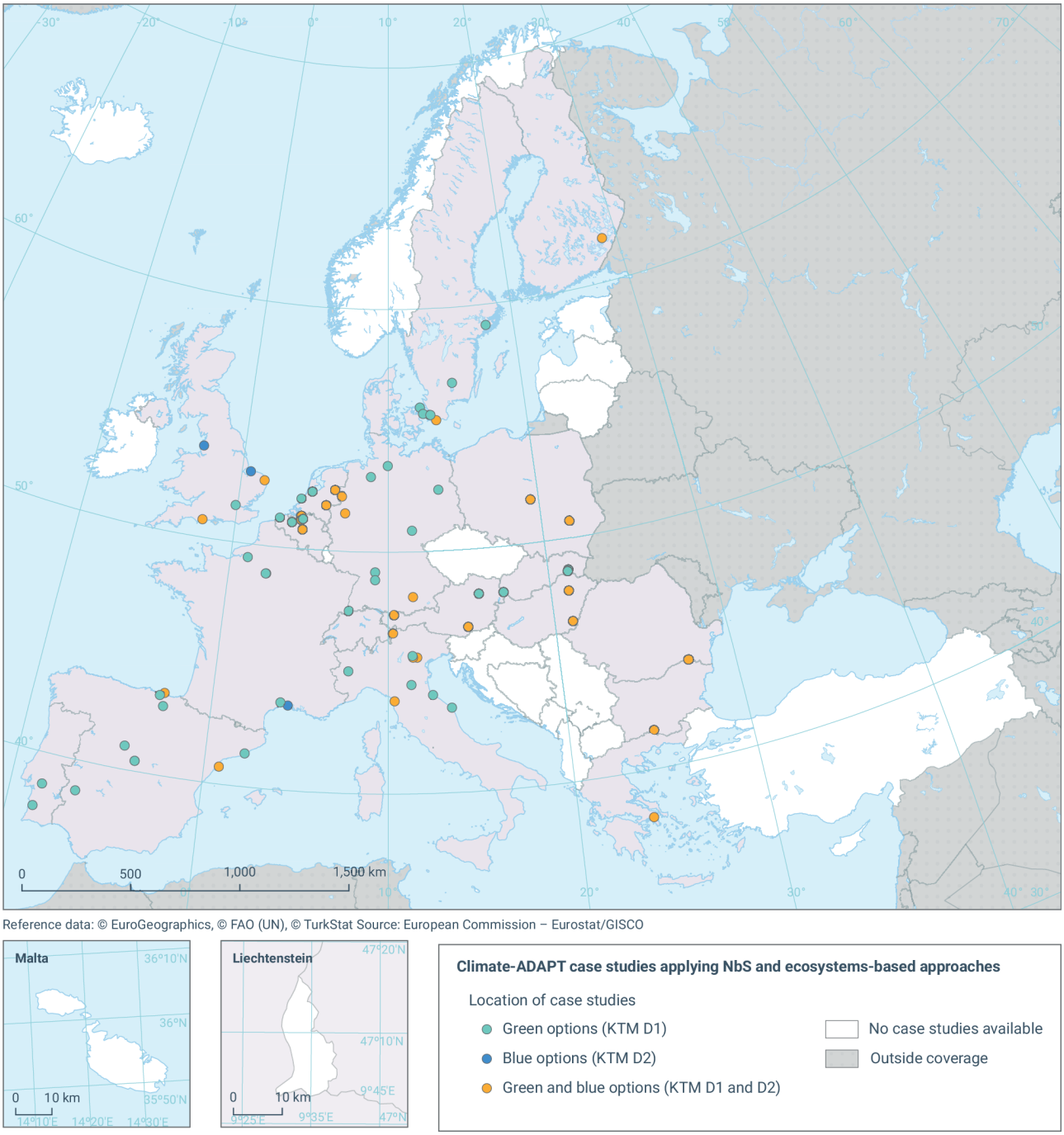
Climate-ADAPT case studies illustrate how applying adaptation options can turn sub-national,

national and EU policies into practical actions. These options are categorised according to the Key Type Measures (KTM), an EEA approach that can be voluntarily used to report adaptation actions under the GovReG (ETC CCA, 2021a)[3]. The Climate-ADAPT case study explorer allows users to find examples where different KTMs have been implemented.

Most Climate-ADAPT case studies, which focus on implemented adaptation actions, apply physical and technological options (KTM C), NbS and Ecosystem-based approaches (KTM D). However, due to the recent extension of the case studies' focus on governance aspects, future case studies will increasingly include examples of how to apply measures related to governance and institutions (KTM A) and to economy and finance (KTM B).

Implementing NbS on a larger scale to increase climate resilience and to contribute to multiple Green Deal objectives is a primary focus of the EU Adaptation Strategy (EC, 2021). NbS used in Climate-ADAPT case studies refer to different sectors and address diverse impacts, demonstrating the versatility and the wide societal and environmental benefits they offer. The widespread distribution of case studies that implemented NbS and ecosystem-based approaches is shown in Figure 7.

Figure 7. Climate-ADAPT case studies applying NbS and ecosystems-based approaches (KTM D)



Reference data: © EuroGeographics, © FAO (UN), © TurkStat Source: European Commission – Eurostat/GISCO

Publications

Note: The coverage of Climate-ADAPT case studies can be accessed from the Climate-ADAPT case study explorer, by using the filter ‘Key Typer Measures’ and the filter option ‘Nature-based solutions and ecosystem-based approaches’. It covers case studies from EEA member and EEA cooperating countries including those from UK (EEA_39).

Source: Climate-ADAPT, 2024.

Click here for different chart formats and data

Examples of Climate-ADAPT case studies highlighting the use of NbS and ecosystem-based approaches (KTM D)

Agriculture

NbS help to deal with drought, water scarcity, increasing temperature and flooding in agriculture. The case studies Soil structure improvement in Heilbronn district, Germany and Crop diversification in Segovia, Spain, demonstrate the applicability of NbS options in agroforestry and conservation agriculture to improve soil conditions and build resilience to climate change.

Water management

NbS are used to manage water of river basins, through the Establishment and restoration of riparian buffers, and the Rehabilitation and restoration of rivers and floodplains. The case study Flood and drought risk management in Serchio River basin, Italy demonstrates how NbS can help transform agriculture and urbanisation land use and address a multitude of challenges highly exacerbated by climate change.

Coastal areas

Climate-ADAPT case studies showcase the application of NbS such as dune construction and strengthening and beach and shoreface nourishment in coastal areas to contrast erosion from sea level rise induced by climate change. For example, the case study Coastal erosion management in the Marche region, Italy, shows how both options were used, while also applying elements of climate change adaptation in the integrated coastal zone management plan.

Climate-ADAPT case studies showcase implementation of adaptation with synergies

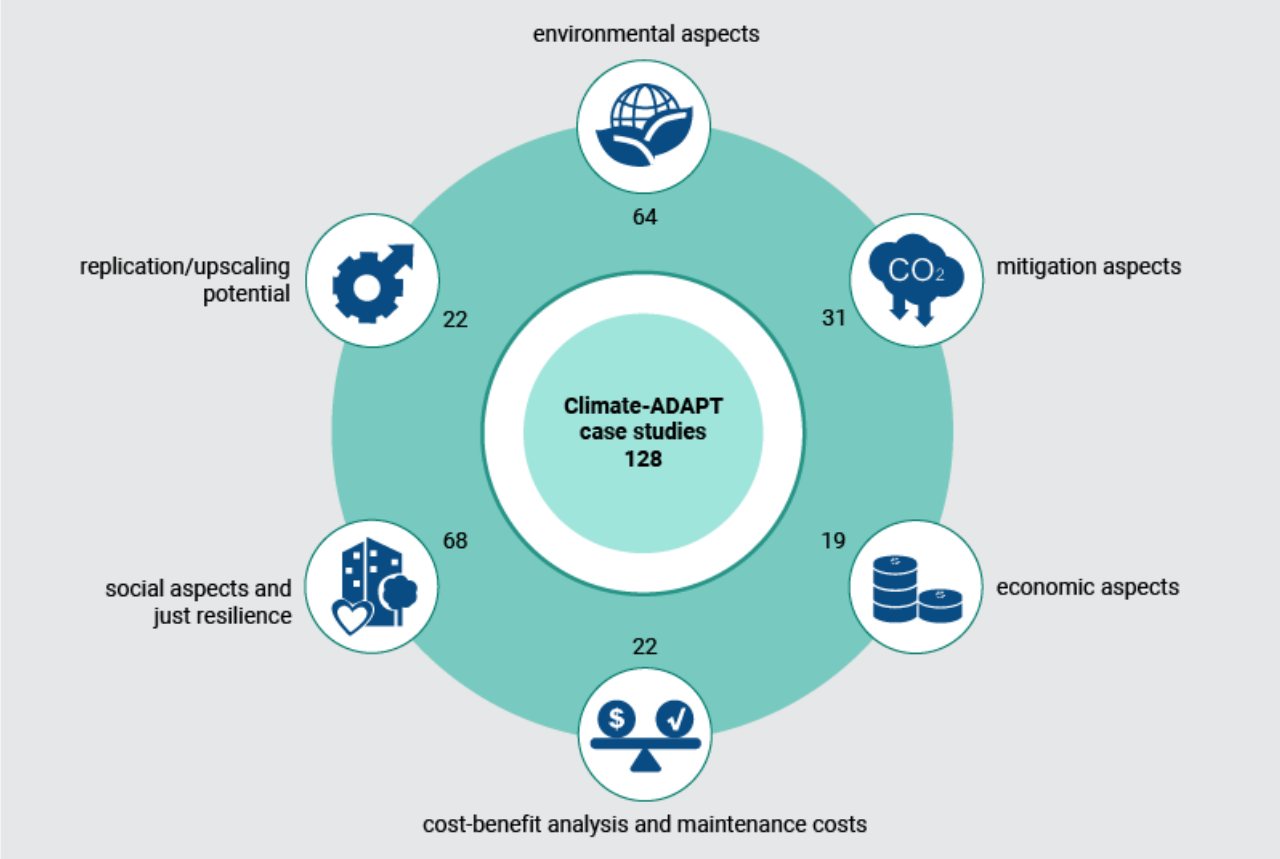
Since adaptation is not the end objective in itself but rather a way to sustainably support other environmental, economic and societal objectives, the co-benefits of adaptation measures are

increasingly important. Adaptation actions should be integrated into broader development policies and planning processes to ensure coherence and avoid unintended consequences of adaptation, as detailed in step 4.1 of the AST. Recently, Climate-ADAPT aims to better capture and explicitly integrate these co-benefits and potential trade-offs in its case study descriptions. Case studies reporting on those aspects can be accessed through the interactive map-based Climate-ADAPT case study explorer via using the 'Adaptation elements' filter.

While most Climate-ADAPT case studies report environmental and/or societal aspects of the adaptation process, cost-benefit analyses and maintenance costs and other economic aspects such as repercussions on the local economy are less frequently described. Similarly, synergies with mitigation actions as a key environmental aspect are underreported, as is the replication and upscaling potential of the adaptation measures (Figure 8).

By detailing all those aspects, the Climate-ADAPT case studies complement the lessons learnt from assessments of national adaptation policies (EEA, 2023a) and contribute to advancing societal preparedness to climate change and addressing the risks identified by EUCRA.

Figure 8. Climate-ADAPT case studies informing about additional aspects for learning on implementing adaptation



Note: Individual case studies can be associated to more than one adaptation aspect. Therefore, the sum of case studies shown in the image (n=290) is higher than the total number of case studies (n=128).

Source: Climate-ADAPT, 2024.

Environmental aspects of adaptation actions presented in several Climate-ADAPT case studies

Considering the co-benefits and trade-offs of adaptation measures for the environment is crucial to maintain ecosystem services. The IPCC's recent Assessment Report highlights that focusing on short-term gains and on sectors and risks in isolation often leads to maladaptation in the long term, creating lock-ins of vulnerability, exposure and risks that are difficult to change (IPCC, 2023). As funding for adaptation increases, there is a growing focus on avoiding potential maladaptive actions. Over half of the Climate-ADAPT case studies describe positive environmental effects of adaptation interventions. However, Climate-ADAPT case studies also indicate that adaptation might result in environmental trade-offs, especially when adaptation is not rooted in an ecosystem-based approach. The case studies also show that these risks are considered during the implementation of adaptation actions.

Publications

Examples of Climate-ADAPT case studies that implement environmental co-benefits and avoid trade-offs

Agriculture

Co-benefits for biodiversity

The most common environmental co-benefit found across the case studies is the creation of new habitats and the preservation or enhancement of biodiversity. These co-benefits are linked to adaptation measures that enhance coastal and river flood safety, increase green spaces in urban areas, or make agriculture more resilient to climate change. For example, the case study Herdade do Freixo do Meio, in Alentejo, Portugal, shows how a farm is implementing sustainable principles of agriculture to protect water resources in a drought prone area, while making efforts to enhance the local biodiversity.

Urban adaptation

Co-benefits for water quality and quantity

Environmental co-benefits reported, often include the improvement of water quality and the conservation of water resources. The case study Fire resilience in Riba-Roja, Spain, proposes a solution to build resilience to wildfire risks in a region exposed to drought by using recycling water from an advanced wastewater treatment plant. The solution decreases the potential impacts of fire risks while also reducing the environmental impact of urban wastewater discharge.

Coastal areas

Avoiding potential trade-offs

Climate-ADAPT adaptation options highlight possible environmental trade-offs of certain grey infrastructure (e.g. groynes, breakwaters and artificial reefs) or even green measures (beach and shoreface nourishment). The case study on coastal protection in the Marche region, Italy shows how actions addressed coastal erosion due to sea level rise, including sand nourishment. The selection of sources for gravel and sand was based on legal and scientific criteria aiming at minimising potential environmental impacts on the affected ecosystems.

Synergies between adaptation and mitigation actions reflected in some Climate-ADAPT case studies

Adaptation is a prerequisite to achieve the objectives of the European Green Deal under changing climate conditions. Some Climate-ADAPT case studies show synergies with climate change mitigation measures through energy savings, usage of renewable energy sources and restoration of ecosystems that enable carbon sequestration and storage. These case studies demonstrate the effectiveness of integrating both adaptation and mitigation strategies.

Examples of Climate-ADAPT case studies presenting synergies with mitigation

Bulidings

Reduce energy consumption

Several Climate-ADAPT case studies show urban green infrastructure to improve living conditions in a warming climate and to address stormwater management. The Hamburg's Green Roof Strategy, Hamburg, Germany; Green Roofs, Basel, Switzerland, White Roofs, Madrid, Spain case studies demonstrate that creating green or white roofs decreases the need for cooling and reduces the associated energy consumption.

Agriculture

In agriculture, greenhouse gas emissions are reduced by optimising crop irrigation. In the Irrigation in Vipava Valley, Slovenia case study, farmers used a Decision Support System for Irrigation that both allows facing the increasing water demand for crops (due to increasing heatwaves and prolonged periods without rain) and reducing energy consumption thus generating lower CO_2 emissions.

Transport

Renewable energy production

In the Albert Canal locks, in Flanders, Belgium case study, hydropower is used in combination with a pump installation that allows the sluicing of ships also in future conditions of more and longer periods of low river discharge.

Coastal areas

Carbon sequestration

The large-scale restoration of Coastal management Ebro delta, Spain case study used an integrated approach for managing water, sediment and habitats to cope with sea level rise. Novel agronomic practices for rice fields were adopted leading to the reduction of Greenhouse gas emissions and the improvement of carbon sequestration.

Addressing economic aspects in adaptation actions

Adaptation is a prerequisite to achieve the objectives of the European Green Deal under changing climate conditions. Some Climate-ADAPT case studies show synergies with climate change mitigation measures through energy savings, usage of renewable energy sources and restoration of ecosystems that enable carbon sequestration and storage. These case studies demonstrate the effectiveness of integrating both adaptation and mitigation strategies.

Examples of Climate-ADAPT case studies presenting synergies with mitigation

Tourism

The case study Winter tourism adaptation in Spessart, Germany shows economic-focused adaptation interventions in the tourism and recreational sectors. Due to climate change reducing skiing opportunities, the local tourism industry in collaboration with other societal actors shifted its focus to year-round tourism, by removing ski lifts and emphasising hiking, biking, wellness and cultural events.

Disaster risk

Case studies, mostly related to disaster prevention and urban adaptation, consider the economic implications on the real estate sector. For instance, in the case study Relocation from flooding in Eferdinger Becken, Austria shows how homeowners were compensated for relocating away from high-risk areas.

Transport

The Adaptation Strategy Grimsel area, Switzerland case study is an example of adaptation interventions in road transport to support the economic viability of the sector. The package of measures of the regional adaptation strategy, implemented in 2016, includes a 20 km-long-long rail tunnel as a ‘climate-proof’ alternative to the hazard-prone cantonal road.

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

According to step 4.1 of the AST, analysing costs and benefits to assess whether the benefits of an adaptation option, such as avoided damage, outweighing its costs is crucial. Such an analysis can also serve to compare alternatives, enhancing the effectiveness of adaptation strategies.

Possibly due to methodological challenges, such as scattered data from heterogenous data sources,

only very few Climate-ADAPT case studies feature an analysis of costs and benefits of adaptation actions. Of these, only 23 case studies provide quantitative information about either costs or benefits or both, with varying degrees of accuracy. Maintenance costs, which are often crucial for the success of adaptation actions, pose a risk of discontinuing the activity if they are too high. To date, only a few case studies consider maintenance costs.

Publications

Examples of Climate-ADAPT case studies showcasing the application of cost-benefit analysis (CBA)

Water management

Among the case studies reporting full application of CBA approaches, the Flood protection Upper Vistula river, Sandomierz area, Hungary and the Natural Water Retention Measures, Altovicentino area, Italy case studies mention explicitly promising cost-benefit ratios (2.05 and 2.3 respectively). Those values significantly above 1 show that the discounted benefits of the planned adaptation actions significantly outweigh the present costs and investments, even accounting for uncertainties. The Flood protection Prague, Czechia case study, which needs to cope with the uncertainties linked to future water-related extreme events presents one of the most comprehensive and detailed CBAs. It applied a range of cost-benefit comparisons under different severity scenarios and return periods.

Energy

Health

Coastal areas

The Hydropower plant flood risk management France case study shows how several alternatives were considered to select the most cost-efficient, using a longer perspective and taking maintenance costs into account. Similar comparisons are provided in a few case studies, such as the Citizen science project mosquito surveillance, Germany, the Camargue former salt work restoration, France and Flood protection Sigma Plan Scheldt Estuary, Belgium case studies.

Energy

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

Protecting people's health is most addressed social and just resilience aspect in Climate-ADAPT case studies

The Sixth IPCC Assessment Report (IPCC, 2023) highlights justice as a core element of climate change adaptation. Justice has also emerged as a key aspect of adaptation policies and planning at EU and national levels (ETC CA, 2023). Ensuring that no one is left behind requires a focus on justice aspects at all stages of the adaptation policy cycle as well as a meaningful engagement of affected and vulnerable groups in decision-making processes (EEA, 2022d; ETC CCA, 2021b).

All case studies include a description of stakeholders' engagement in the adaptation process, from information and communication activities to co-creation and co-design of adaptation measures. However, the case studies typically do not detail the involvement of different social groups. Most case studies that offer social co-benefits involve adaptation actions that ensure water availability, decrease risks from flooding and heatwaves, by creating better access to green areas for recreation, thereby protecting people from heat and improving overall quality of life. Additionally, mapping of vulnerable populations is a common strategy in urban adaptation and land use planning to design just adaptation actions to address the impacts of heatwaves. Only a subset of the case studies focuses on just resilience by placing vulnerable groups at the centre of the implemented measure. A few Climate-ADAPT case studies show that trade-offs between adaptation actions and interests of social groups were analysed and addressed using participatory approaches, mostly in relation to land use for flood or sea level rise management.

Publications

Examples of Climate-ADAPT case studies presenting social aspects and just resilience

Land use plan

Just adaptation measures

The Biotope Area Factor Berlin, Germany case study used a planning instrument to preserve urban green spaces. This was done to lower the temperatures in densely populated areas inhabited by vulnerable populations, and to improve the water run-off management in the city.

Health

Mapping uneven impacts

The Heat stress adaptation Antwerp, Belgium case study used a thermal mapping approach to identify health risks for vulnerable groups. The case study Protecting outdoor agricultural workers in Puglia, Italy focuses on the well-being of outdoor workers. Due to dangerous working conditions under extreme heat, the regional government issued an ordinance to prohibit outdoor agricultural work between 12:30 and 16:00 on high-risk days.

Water management

Adress trade-offs

In the case study Temporary flood water storage in agricultural areas in the Middle Tisza River Basin – Hungary , stakeholder consultations gathered the views of land owners on opening new temporary flood plain areas for river flood management. These consultations allowed the government to plan economic compensation for potential losses incurred, although with unsolved issues.

Urban adaptation

In the case study Just urban greening in Barcelona, Spain, the city rolled out a green strategy to tackle climate impacts via multiple activities, including the Tree Master Plan, the Superblock plan, green space development and the creation of climate shelters. To ensure social justice in adaptation, the city aims to avoid gentrification and supports affordable housing.

Replication and upscaling of Climate-ADAPT case studies has unrealised potential

Climate-ADAPT case studies aim to inspire replication of adaptation across different geographic areas facing similar challenges or to scale up local solutions. Coordinating and upscaling regional and local adaptation efforts, along with aligning adaptation policies across all administrative levels, is considered a key condition of successful adaptation (EEA, 2023a).

However, the potential for scaling and replication of the case studies could be further explored. Certain enabling conditions have been successful in unlocking the replication potential of Climate-ADAPT case studies. On the other hand, transformational local solutions that require broader governmental adjustments might restrict the replication of these approaches. The case studies of the Green Roof in Hamburg, Germany and Tullstorp, Sweden, are highlighted in an EEA briefing for their upscaling potential of NbS (EEA, 2023c).

Publications

Examples of success and limiting factors for the replication of Climate-ADAPT case studies

Water management

Agriculture

The case study Water management in Agriculture in Tullstorp, Sweden illustrates that achieving multiple goals including environmental, economic and social benefits is a key success factor for replicability. This initiative, led by a Business Association, that assisted landowners in adapting agriculture to wetter and drier climates, has also restored a more natural river stream, for example through re-meandering and creating multifunctional wetlands. This successful approach was also applied to the catchment area of the Ståstorp Stream in Sweden.

Water management

In the case study Urban rainwater management in Ober-Grafendorf, Austria, the possibility to avoid investment costs for additional sewage pipes and of regular operational costs for maintaining sewage and operating pumping facilities was a success factor. Due to the innovation potential, the measure won the Austrian Energy Globe Award in the category 'water' and a Climate Star award in 2016. The measure has since been tailored and applied to different contexts in other Austrian municipalities.

Urban adaptation

Complex solutions (that either require advanced technology or complicated administrative and legal procedures) may be hardly replicated as shown in the case study Amphibious housing in Maasbommel, Netherlands. It constructed floating houses to test building in flood-prone zones. Although the pilot was successful, further expansion of the concept was limited to a few locations. Building permission was hard to achieve due to regulations' lack of familiarity with the concept and hesitance to build in areas considered hazardous. Higher construction costs and a limited pool of potential buyers hindered further replication of the solution.

Future Climate-ADAPT case studies will focus on sectors highlighted in the European Climate Risk Assessment

The development of Climate-ADAPT case studies will focus on addressing specific risks identified by EUCRA and that currently lack examples of how to put climate change adaptation policies and planning into practice under the risk clusters (ecosystems, health, food, infrastructure, economy and finance). Additional case studies will also focus on key vulnerable sectors reported by EU Member States (health, agriculture, forestry and biodiversity) and aim to improve the coverage of the marine and fisheries, forestry, financial, transport and energy sectors. Likewise, Climate-ADAPT will also enhance its coverage of case studies for European regions and the outermost regions of Europe, as well as for the transnational level to support cross-border adaptation interventions. An increased emphasis on Monitoring, evaluation and learning is needed to strengthen knowledge on the effectiveness of adaptation actions in Europe. Future case study contributors will be asked to include more information on MEL approaches taken, as well as economic costs and co-benefits of actions to support this. Insights from the ongoing Climate-ADAPT evaluation will inform addressing specific needs of stakeholders for case studies.

The number of case studies collections in EEA member countries is expected to increase. For example, new national information platforms are under construction in Slovakia, Spain and Finland. Collaboration through the European Information and Observation Network (Eionet) will not only improve and close gaps in the catalogue of Climate-ADAPT case studies, but will also serve to further integrate MEL actions into the implementation of adaptation measures. This will facilitate the exchange of knowledge and practices between countries, thereby expanding the accessibility of national expertise across Europe.

Notes

[1] Climate-ADAPT Web statistics 2017-2023, prepared by ETC CA.

[2] Number of Climate-ADAPT case studies by March 2024, Climate-ADAPT case study explorer. This number includes 5 case studies independently developed under the Spanish adaptation platform (AdapteCCa) which were however excluded from all analyses for this briefing. It also includes 12 case studies located in the United Kingdom that is no longer part of EEA member countries and cooperating countries. Their content is no longer updated on Climate-ADAPT and thus not covered in parts of the analysis underlining Figures 6 and 8.

[3] Adaptation options are also structured by IPCC measures to link them to the global level (Noble et al., 2014).

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