
Regional and local adaptation to climate change

Gaps, challenges
and opportunities



IN-DEPTH ANALYSIS

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Climate change adaptation has been gathering momentum. At COP26 in 2021, the parties to the UNFCCC agreed to develop a work programme to deliver on the global goal on adaptation; at COP28, in December 2023, they adopted the framework for achieving that goal. Adaptation efforts should be led locally, by those most at risk, those who know the territory. The EU has been introducing tools, initiatives and strategies to enhance all aspects of climate change adaptation. While there are still barriers to the proper up-take of practical adaptation actions at the local level, in many cases solutions for overcoming them are already available.

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Executive summary

Climate change is a reality. As early as the mid-19th century, it was recognised that what are now called greenhouse gases have the potential to warm the Earth. From the Industrial Revolution to the present day, the rise in global average temperature has been the highest on record, and science has shown that human activity is unequivocally responsible for the current rate of change observed. Agreements have been made to limit global warming. One example is the Paris Agreement, which seeks to keep global warming well below 2°C, but makes efforts to keep it below 1.5°C. Mitigation of greenhouse gas emissions has the potential to help achieve these goals, while adaptation has the potential to address the impacts of a changing climate.

The European Union (EU) has been working for a number of years to develop tools, initiatives and policies to adapt to climate change. Recently, artificial intelligence has emerged as a promising technology. At the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change in Glasgow in 2021, a work programme for achieving the Global Goal on Adaptation was presented. Two years later, at COP28, the parties adopted a framework for achieving that goal.

Local and regional authorities and players have a crucial role to play in the success of adaptation actions, as they are most vulnerable to the impact of climate change, know their territories best and can champion the necessary actions and projects. Key areas where improvement is needed include increasing the uptake of nature-based solutions, filling knowledge gaps, increasing financing for adaptation, and rethinking the relationship between the insurance sector and climate change. In each of these areas, local actors face barriers which make it difficult for them to address climate change adaptation adequately. In most cases, however, opportunities to overcome these barriers have also been identified. Barriers such as a lack of knowledge, insufficient human resources, poor citizen engagement, and an inability to find funding for adaptation projects are common. This paper presents case studies of projects that have been able to overcome such constraints.

Nature-based solutions are attracting increasing interest from project proponents as a valuable means of implementing adaptation measures. They come in many forms, and can be tailored to specific projects. While still an issue, the knowledge gap has been being addressed for more than a decade, with the introduction of tools and initiatives such as Climate-ADAPT and the Covenant of Mayors for Climate and Energy, both with the intention of sharing the best available knowledge in an open source format.

Funding opportunities for adaptation to climate change exist and are widely available. However, at local level, there are a number of obstacles to accessing them, such as a lack of knowledge of their existence, insufficient human resources to devote to finding adequate funding, and a lack of expertise in applying for these funds. Nevertheless, there are cases where innovative adaptation measures have been implemented with the financial involvement of the community. The insurance sector is changing and now has the capacity to deal with risks in a way that it did not in the past. However, there is still a need for accurate data collection to underpin proper risk assessment and the development of products that are attractive to both the insurer and the insured.

There are currently many climate adaptation strategies and plans in place at different levels across Europe. It is essential to address possible maladaptation practices, and establish effective and efficient monitoring and evaluation processes. Experts recommend involving local and regional authorities at those levels where their expertise can make a difference, and developing and implementing tools and initiatives that enable these key players in the climate change adaptation process to go further.

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1. Climate change

The climate is warming. Since the Industrial Revolution began, average global temperatures have risen significantly – by around 1.13 to 1.17 degrees Celsius (°C) – and the last decade was the warmest on record.¹ In Europe, the rise is even greater with average temperatures having risen between 2.04 and 2.10°C.

In the 2015 Paris Agreement, parties to the United Nations Framework Convention on Climate Change (UNFCCC) committed to limit the global average temperature rise to well below 2°C above pre-industrial levels while focusing their efforts on achieving the limit of 1.5°C.² Nevertheless, projections show that the temperature rise will continue, even if all national pledges are implemented, and that north-eastern Europe, northern Scandinavia and inland areas of the Mediterranean Member States will be the regions with the highest levels of warming.

Global average temperature rise is expected to overshoot the 1.5°C target for a while, even under the most optimistic scenarios, before falling back below 1.5°C with the assistance of large-scale carbon removals. While action to reduce greenhouse gas (GHG) emissions and scale up carbon dioxide removal remains crucial, there is an urgent need to upscale efforts to adapt to climate change, in order to avoid losses and build resilience. Adaptation strategies, actions plans and actions need to be deployed widely and developed at, and with, the level where the impacts of the changing climate are felt most intensely: the regional and local levels.

1.1. Understanding the implications of climate change

It is important to understand the difference between weather and climate. Weather refers to different daily events occurring worldwide in our atmosphere. This varies from one place to another and can change in minutes, hours, days and weeks, therefore reflecting short-term changes in the atmosphere. Weather occurs mainly in the lower part of the atmosphere – the troposphere – and is determined, for instance, by air pressure, temperature, humidity, and wind speed and direction.

Climate, meanwhile, reflects changes in weather over a long period of time and in a specific area. This description looks at factors such as averages of temperature, precipitation, humidity, sunshine, and wind, among others, in a given place. Climate can therefore provide an indication of the weather expected in a given area, but cannot predict weather for a specific day.

Even if different regions have different climates, it is possible to analyse climate on a global scale, by averaging all regional data. The global climate is a system that depends on the amount of energy provided by the sun and the amount of energy that stays –trapped – in the system.

Already in the mid-19th century, scientists knew that carbon dioxide (CO₂) and other gases had the potential to trap heat in the Earth's atmosphere. They demonstrated that Earth, given its position in relation to the sun, would be much colder were it not for CO₂ and other gases acting as insulation.

Climate impacts linked with changes in the climate system, such as rising average global temperatures, warmer oceans, shrinking ice sheets, retreating glaciers, sea level rise, decline in Arctic sea ice, extreme weather events and ocean acidification, are increasing in frequency and severity throughout the European Union (EU) and the world. Extreme weather events are described by the

¹ European Environment Agency (EEA), [Global and European temperatures](#), June 2023.

² UNFCCC, [Paris Agreement](#).

Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) as events that occur in a particular place and time, and that are rare.³ The IPCC states that the changes in world climate are directly responsible for the increase in extreme weather events.

The IPCC AR6 report goes further, to say that greenhouse gas emissions linked to human activities have 'led to an increased frequency and/or intensity of some weather and climate extremes since pre-industrial times'. One study notes that within peer-reviewed scientific literature there is over 99 % consensus that there is a definite link between human activities and current climate change.⁴ According to the World Meteorological Organization⁵ (WMO), over the past 50 years, the number of climate-driven disasters has increased by a factor of five. It mentions that in the same period, a disaster related to a weather, climate or water hazard, has occurred every day on average, with a daily death toll of 115 people and losses of US\$202 million. It also states that between 1970 and 2019, 50 % of global disasters were in some way linked with weather, climate and water hazards. The report states that in Europe, between 1970 and 2019, 1 672 disasters were responsible for the death of 159 438 people, with extreme heat events being the deadliest, but flooding and storms the most prevalent.

In Europe, it is expected that average temperatures will continue to rise, even if all national pledges are implemented, with an even faster rise in extreme heat. Events linked with extreme heat and heavy/extreme precipitation will be increasingly common in the future.⁶ Different areas of Europe will experience different impacts. Southern Europe is predicted to have even hotter summers, which will come with a higher frequency of droughts and increased fire hazard. Northern Europe will see a rise in annual precipitation and more frequent heavy rainfall episodes. Central Europe will be subjected to stronger and more frequent weather extremes, with heavy rainfall, flooding, droughts and fire hazards, accompanied by lower summer rainfall. Furthermore, it is expected that all European regional seas will see rising sea surface temperature and water acidity. Sea levels will also rise in all these seas, with the exception of the northern Baltic Sea.

1.2. Risk, vulnerability and impacts

Adaptation to climate change is usually framed in terms of vulnerability, risk and impacts. The IPCC defines vulnerability as the 'propensity or predisposition to be adversely affected because of sensitivity or susceptibility to harm and lack of capacity to cope and adapt', and highlights that human-driven degradation and destruction of ecosystems increases people's vulnerability. The IPCC also mentions that locations experiencing high levels of poverty, governance challenges, limited access to basic services and resources, violent conflict and high levels of climate sensitive livelihoods (small scale farmers or fishing communities, for example) are more vulnerable than others. Vulnerability can also be aggravated by inequity and marginalisation stemming from gender, ethnicity, low income or their combination.

Risk is the potential for negative consequences when something of value is at stake, while uncertainty exists in terms of the occurrence and degree of outcome. Therefore, risk is the product of vulnerability, exposure over time, the hazard itself and the likelihood of its occurrence.

³ IPCC, [Sixth Assessment Report](#), 2023.

⁴ M. Lynas et al, '[Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature](#)', *Environmental Research Letters*, Vol. 16 (11), 2021.

⁵ WMO, [Weather-related disasters increase over past 50 years, causing more damage but fewer deaths](#), 2021.

⁶ EEA, [What will the future bring when it comes to climate hazards? – Overview](#), January 2023.

Impacts reflect the consequences of risks on the system – either natural or human – that can be either adverse or beneficial. In its latest report, the IPCC distinguishes between near-term and long-term risks, from 2021 to 2040, and from 2041 to 2100 respectively, while highlighting that vulnerability and exposure have a greater impact in the near term, when it comes to climate-associated risks to natural and human systems. Furthermore, near-term actions seeking to limit global warming to close to 1.5°C can help to reduce expected loss and damage, but cannot eliminate them, making adaptation crucial. The IPCC also predicts that with further global warming, there will be a rapid rise in climate change risks to cities, especially those in locations that are already exposed to high temperatures, along coastlines, or with high vulnerabilities.

The IPCC states that risks, as well as impacts, are becoming more complex, as climate hazards will happen concurrently, and risks – both climatic and non-climatic – will interact with each other. Such interactions will compound overall risk, as risk cascades throughout sectors and regions. Examples include the increased compound flood risks originating from the combination of future sea level rise with storm surge and heavy rainfall. Another example is the combination of abrupt losses in food production resulting from heat and drought, compounded by reduced labour productivity owing to extreme heat.

The development of both risk and vulnerability assessments are vital to develop strong adaptation plans and measures, to identify the people, infrastructure and systems that are particularly at risk or highly vulnerable, and to prioritise actions.

1.3. Adaptation

Actions to tackle climate change have evolved through time, from a mitigation perspective to one where both mitigation and adaptation measures are vital. Climate change mitigation includes the reduction or prevention of greenhouse gas emissions, through the use of new technologies or renewable energies, energy efficiency improvements, changes in management practices and consumer behaviours, and improvements to carbon sink capacities.

Adaptation in **human systems** is defined by the glossary to the IPCC's Sixth Assessment Report as 'the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities'. The glossary defines adaptation in **natural systems** as 'the process of adjustment to actual climate and its effects', with human intervention sometimes able to 'facilitate adjustment to expected climate and its effects'. The IPCC defines differences in climate change adaptation in terms of its effects. **Incremental adaptation** 'maintains the essence and integrity of a system or process at a given scale' while **transformational adaptation** 'changes the fundamental attributes of a socio-ecological system in anticipation of climate change and its impacts'. In addition, adaptation limits relate to the point where adaptation actions to fulfil a system's needs no longer are effective against an intolerable risk. There are two kinds of adaptation limit. With **hard adaptation limits**, 'no adaptive actions are possible to avoid intolerable risks' while with **soft adaptation limits**, 'options are currently not available to avoid intolerable risks through adaptive action'.

There are several opinions on the categorisation of adaptation options, measures and actions. The IPCC has grouped adaptation options into three main categories: structural or physical, social, and institutional, but they can also be categorised as follows.

- Grey actions are measures to enhance territorial, infrastructural and social adaptation by means of technological and engineering solutions;

- Green actions rely on the services provided by natural ecosystems, through an ecosystem-based (or nature-based) approach to increase resilience and adaptation capacity;
- Soft actions address human behaviour and governance styles, through policy, social, management and financial measures, thus helping to increase awareness about climate change and enhance adaptation capacity.

Adaptation can also be either planned or autonomous. Planned adaptation, as the name suggests, is driven by clearly defined plans, whereas autonomous adaptation is linked with people's organic responses, as is the case of farmers switching between crops as a direct response to drier weather conditions. Overall, adaptation options can be directed towards: accepting the impacts, and bearing the losses that result from risks; off-setting losses by sharing or spreading risks; minimising or avoiding exposure to climate risks; and exploiting new opportunities.

1.4. Different roles for different levels

A Eurobarometer survey on climate change, published in July 2023, revealed that four out of 10 EU citizens believe they are personally exposed to environmental and climate-related risks and threats, and 77 % of respondents consider climate change to be a very serious immediate problem. Furthermore, citizens consider that the EU and national governments hold the main responsibility for tackling climate change, while regional and local authorities occupy fourth place behind the business and industry sectors. Finally, 67 % of respondents are of the opinion that national governments are not doing enough to tackle climate change, while six in ten EU citizens mentioned that in the previous 6 months they had taken action to fight climate change.

There is a need to identify clearly who the different groups of people or tiers of government responsible are and what their roles in climate change adaptation might be. The Sixth IPCC Assessment Report highlights that in order to, rapidly and with enough scale, achieve the Paris Agreement targets, the UN Sustainable Development Goals and other policy goals it is necessary to identify 'who needs to take what action and when'.

A 2023 study that analysed available case studies, identified individuals and/or households as the actor type most frequently reported as being linked with implementation of adaptation actions.⁷ The roles attributed to civil society organisations are those of coordination of the interaction between various actors, awareness raising and financing of adaptation. As identified by the study, government actors play an important role in planning and financing adaptation. Academics play a key role in raising awareness, assessing climate impacts and monitoring adaptation efforts. Finally, the study highlights the scarce references to the private sector but attributes to it a role in both financing and implementation of adaptation responses.

Climate resilience

Resilience is the ability of social, economic, and ecosystems to handle a hazardous event, trend, or disturbance effectively. This involves responding or reorganising in a manner that preserves their essential function, identity, structure, and – in the case of ecosystems – biodiversity. Additionally, resilience encompasses the capacity for adaptation, learning, and transformation.

Climate resilience development pathways

Processes that strengthen sustainable development and efforts to eradicate poverty and reduce inequalities while promoting fair and cross-scalar adaptation and mitigation.

Source: [IPCC AR6](#).

⁷ Petzold J., Hawxwell T., Jantke, K. et al., '[A global assessment of actors and their roles in climate change adaptation](#)', *Nature Climate Change*, Vol. 13, pp. 1250–1257, 2023.

Municipalities play a very important role in incorporating climate change adaptation into their management actions and planning options. However, several barriers prevent municipalities from doing so, such as a lack of knowledge, a short-term political vision derived from political mandates, a lack of human resources, and a perceived lack of financing and/or actual lack of financing. Nevertheless, in Europe, at the time of writing, already over 11 800 municipalities, representing just under 230 million EU citizens, have expressed their concern over climate change by becoming signatories to the Covenant of Mayors for Climate & Energy. In doing so, municipalities commit to develop a sustainable energy and climate action plan with a view to cutting CO₂ emissions at least by 40 % by 2030, and to increase resilience towards climate change (see box).

2. Climate change adaptation strategies and plans

2.1. European Union level

Under the European Climate Law, EU Member States are required to adopt and implement national adaptation strategies and plans. These need to be regularly updated and communicated every 2 years in reports dedicated to national adaptation actions.⁸ Furthermore, starting in 2023 and every 5 years thereafter, the Commission will assess collective progress by Member States. However, there are no provisions for Member States to set binding and/or measurable adaptation targets.

Over the years, the European Parliament has adopted several resolutions addressing climate change adaptation. Ahead of the adoption of the revision of the EU strategy for adaptation to climate change, the Parliament adopted a resolution advising that the upcoming strategy should set binding and quantifiable goals for all – EU-wide and at Member State level – while allowing further developments in EU science, services, technologies and practices directed at adaptation.⁹ Ahead of COP27, Parliament adopted a resolution in which it called on the EU to increase the amount of adaptation finance in the Global Europe instrument, highlighting the need to prioritise grants over loans in all climate finance, and to align all types of financial flows to the 1.5°C target.¹⁰ Recently, and ahead of COP28, Parliament adopted a resolution specifically highlighting the need to step up adaptation action. It called for a 'credible, robust and implementable global adaptation framework', it also called on the parties to scale up their financial commitments in respect to climate adaptation, and on the Commission to 'propose a comprehensive, ambitious and legally binding European Climate Adaptation framework'.¹¹

The European Committee of the Regions (CoR) published its contribution to inform the subsidiary body for scientific and technological advice on the first global stocktake.¹² This contribution is made through the Local Governments and Municipal Authorities Constituency. The CoR recommends, not least, that in order to achieve two specific Paris Agreement goals (Article 2.1(b) and 7.1), local and

⁸ [Regulation \(EU\) 2021/1119](#) of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law').

⁹ European Parliament, [Resolution on the EU strategy on adaptation to climate change \(2020/2532\(RSP\)\)](#), 17 December 2020.

¹⁰ European Parliament, [Resolution on the 2022 UN Climate Change Conference in Sharm El-Sheikh, Egypt \(COP27\) \(2022/2673\(RSP\)\)](#), 20 October 2022.

¹¹ European Parliament, [Resolution of 21 November 2023 on the UN Climate Change Conference 2023 in Dubai, United Arab Emirates \(COP28\) \(2023/2636\(RSP\)\)](#), 21 November 2023.

¹² European Committee of the Regions, [Inputs to Inform the Subsidiary Body for Scientific and Technological Advice First Global Stocktake](#), September 2022.

regional governments should be included in the shaping of the adaptation goal and 'be represented in multilevel coordination mechanisms at international and national level ...'. The CoR also recommends that national governments should develop targets and plans directed at making sure that the available funding reaches the local and regional authorities. It also recommends that local and regional governments be included in the Glasgow–Sharm el-Sheikh work programme through formal recognition of their key player status in addressing climate change. Finally, the CoR recommends that the adaptation goal should 'allow for a common framework of analysis to determine whether adaptation policies have been effective, as well as research, methods and good practices that can be applied at both national and decentralised levels of governments', since measuring progress on adaptation is still a challenge for all concerned.

The objectives of the 2013 EU strategy on adaptation to climate change were to promote action by Member States, better informed decision-making, and adaptation in key vulnerable sectors. On 12 November 2018, the Commission published an evaluation of the strategy, looking at its implementation and performance. Although the evaluation recognised that the strategy was still highly relevant, it identified the need to further develop actions geared towards closing the existing knowledge gaps, to implement and monitor national strategies, to enhance local action, to mainstream climate adaptation in EU policy and to step up the use of both insurance and financial instruments in adaptation. The evaluation also highlighted that adoption of local adaptation strategies had been 'slower than expected' pointing out that a proper downscaling of adaptation knowledge was possibly required.

On 24 February 2021, the Commission adopted a new EU strategy on climate change adaptation that seeks to enhance EU and global capacity to adapt to and minimise the impacts of climate change, while also further developing and accelerating actions across the economy and society.¹³ To widen the international scope of the strategy, the Commission plans to intensify and broaden support to partner countries and local authorities.

The strategy addresses the need to improve existing knowledge and management of the uncertainties associated with climate change. In addition, it envisages the development of policy at all levels and sectors. The strategy focuses mostly on the interaction with other strategies within the European Green Deal – the circular economy action plan, the biodiversity strategy for 2030, renovation wave, the farm-to-fork strategy – so as to increase the EU's preparedness for the impacts of climate change. Adaptation is also being addressed in the revision of many existing directives and regulations (the INSPIRE Directive, the Urban Waste Water Treatment Directive, the Energy Performance of Buildings Directive, the Construction Products Regulation, the directives on the marketing of forest reproductive material, and the directives on the marketing of seed and other propagating material). As with the previous strategy, the Member States will remain the central implementation partners. To assist local and regional authorities, the Commission will further develop the EU and Global Covenant of Mayors, to assist in the process of going from the planning phase to action with respect to adaptation to climate change.

Key elements of the strategy are the **development of nature-based solutions**, action to **close knowledge gaps** and the **financing of climate adaptation**. The Commission highlights the importance of the **insurance sector**, both in gathering knowledge – through the possible further development of the European Insurance and Occupational Pensions Authority – and through the expansion of insurance coverage to alleviate the costs of climate impacts.

¹³ European Commission, [Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change](#), COM/2021/82 final, 24 February 2021.

2.2. Member State level

Since 2021, throughout Europe several Member States have established integrated ministries to deal with climate-related subjects, sending a strong message of political commitment to address the challenges posed by climate change. Nevertheless, not all EU Member States have national climate laws relating to adaptation in place.¹⁴ Only eight Member States have such a law, and all of those have included climate change adaptation considerations from the onset. In 2023, nearly all EU Member States have adopted national adaptation strategies (NAS), with Finland and Spain the first to do so back in 2005. Only Latvia has yet to adopt an NAS. Denmark has already updated its NAS twice, and 13 other Member States have also revised their strategies once.

In 2023, 16 Member States have national adaptation plans in place. Countries such as Romania, Hungary and Estonia used to have such documents in place but no longer do. The numbers are even thinner when looking at which countries have sectoral adaptation plans in place. At the time of writing, only Bulgaria, Ireland, Spain, Italy, Portugal, Finland and Sweden had adopted such plans.

The Regulation on the Governance of the Energy Union and Climate Action mandates that Member States must report every second year. The reporting must, under Article 19, include national adaptation actions. The first reporting exercise was in 2021, and the second in 2023.

2.3. Regional and local levels

At a regional level, only Belgium, Ireland, Greece, Spain, Hungary, Portugal and Sweden reported having one or more adaptation plans adopted that were designed specifically for the sub-national level. As the European Environmental Agency (EEA) highlights, the increase and advance of regional and local strategies and plans could derive naturally from national climate laws or other specific pieces of central legislation, but this is not the case, as top-down regulatory frameworks and legal obligations for the sub-national level remain a minority model.

In Europe, climate change adaptation at the regional and local level is still a non-binding policy field, driven by bottom-up, voluntary and soft initiatives. Currently, all Member States are represented in the Covenant of Mayors for Climate and Energy (see Table 3) through the municipalities that choose to take part. In order to adhere to the Covenant, local authorities must develop a sustainable energy and climate action plan (SECAP). At the time of writing, there are over 11 800 signatories representing over 30 % of the EU's total population. 8 076 SECAPs have been submitted, and 38 % of signatories with SECAPs have already submitted monitoring reports. The SECAPs include 19 701 climate change directed actions, and around 25 % of those include adaptation plans, either dedicated to or in conjunction with mitigation and/or energy poverty actions.

¹⁴ EEA, [Is Europe on track towards climate resilience? Status of reported national adaptation actions in 2023](#), 23 October 2023.

3. Improving climate change adaptation

3.1. Nature-based solutions for local actions

The European Commission has been looking at nature-based solutions (NbS) since 2015, defining them as 'solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience'. It argues that these solutions 'bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions'.¹⁵ Prior to the Commission's mention of NbS, both the World Bank, in 2008, and the International Union for Conservation of Nature (IUCN) in its 2013-2016 programme, made references to them and offered definitions.

The IUCN defined nature-based solutions as '... actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g., climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits'.¹⁶

The EU strategy on adaptation to climate change points to implementing NbS as a means to increase climate resilience and at the same time contributing to several Green Deal objectives. Nevertheless it mentions that better quantification of benefits and better communication of those to decision-makers is key to enhance the take-up of NbS. Furthermore, the Commission identifies the benefits of NbS in areas such as soil restoration, water quality, reduced flood risk, coastal defence, and biodiversity conservation and restoration. Finally, the Commission points out that investment directed towards NbS must be sustainable on a long-term basis, as climate change is magnifying stresses in ecosystems.

In 2020, the IUCN presented a global standard for nature-based solutions, to clearly define the concept and ensure that such measures are successfully implemented and managed.¹⁷ The standard comprises eight sustainable development criteria for nature-based solutions, which must:

- address the societal challenges that have been identified as a priority by those who are/will be affected;
- take uncertainty and complexity in the landscape into account in their design;
- generate net gains to biodiversity and ecosystem integrity;
- be economically feasible;
- take into account the concerns of relevant stakeholders and foster a transparent governance process;
- balance the trade-off between the primary objective and additional benefits;
- involve an adaptive approach to management;;
- be designed and managed with a long-term perspective in mind.

Table 1 illustrates the way the IUCN categorises ecosystem-based approaches.

¹⁵ European Commission, [Nature-based Solutions](#)

¹⁶ IUCN, [Nature-based Solutions](#)

¹⁷ [IUCN Global Standard for Nature-based Solutions](#), 2020.

Table 1 – Categories and examples of nature-based solutions

Categories of NbS	Examples
Ecosystem restoration	Ecological restoration Ecological engineering Forest landscape restoration
Issue-specific ecosystem-related approaches	Ecosystem-based adaptation Ecosystem-based mitigation Climate adaptation services Ecosystem-based disaster risk reduction
Infrastructure-related approaches	Natural infrastructure Green infrastructure
Ecosystem-based management	Integrated coastal zone management Integrated water resources management
Ecosystem protection	Area-based conservation approaches including protected area management

Data source: [IUCN](#), 2016.

Climate change adaptation in urban areas can make use of nature-based solutions to deal with increased temperatures and heat waves, and changes in river hydrological conditions. Some of the solutions include the development of parks, the introduction of new trees and vegetation, and the construction of green roofs and walls, as well as rain gardens and bioswales – channels that gather and conduct storm water runoff. The benefits of all these solutions, other than those tied directly to the specific issues they address, are to bring improvements in quality of life, better mental and physical health, and reinforced cultural identity.

The different actors involved in nature-based solutions have been categorised in groups that reflect their proximity to the issues that such solutions target.¹⁸ The four groups are as follows: (i) micro-level actors, such as citizens, business owners, land owners and non-governmental organisations; (ii) mid-level actors – those working in municipalities and other local authorities; (iii) macro-level actors, including those working at regional, national and international levels; and (iv) trans-boundary actors – those whose work goes beyond geographical and organisational boundaries. Micro and mid-level actors are key actors in driving and implementing nature-based solutions. Nevertheless, the remaining two groups, macro and transboundary, also have a role, as they are the ones driving knowledge sharing, establishing stakeholders networks and providing an institutional context for the NbS.

There are several organisational, political, behavioural and financial barriers to the implementation and full roll-out of nature-based solutions. Examples of such barriers include: the perception that traditional alternatives are less costly than NbS; the short-term planning associated with work done at a municipal level when NbS require long-term vision and efforts; a lack of skilled professionals in all necessary stages of NbS (planning, design, implementation, maintenance and monitoring); lack of cooperation between the departments or institutions that should lead the NbS implementation projects; and also a general fear of the unknown. Municipalities have dealt with such barriers as shown in Table 2.

¹⁸ Ershad Sarabi S., Han Q., Romme G., de Vries B. and Wendling L., '[Key Enablers of and Barriers to the Uptake and Implementation of Nature-Based Solutions in Urban Settings: A Review](#)', *Resources*, Vol. 8(3), 2019, p. 121.

Table 2 – Overcoming barriers

Arranging for targeted stakeholder collaboration
This might involve the private sector, academia and other local authorities: here municipalities rely on external partners to develop expert assessments or provide advice.
Engaging in strategic citizen involvement
This occurs during the conception phase of projects and/ or plans, in order to increase public awareness and reduce conflict.
Altering internal cooperation structures
This involves shifting from a silo department work method to horizontal integration of both NbS and climate change adaptation throughout internal structures.
Outsourcing
Outsourcing means transferring the implementation of NbS and climate change adaptation to other stakeholders, mainly citizens but also the private sector, focusing the role of the municipality in offering information and providing advisory services.
Concealing science-policy integration
Here the idea is that through systemic science-policy integration it is possible to make NbS and climate change adaptation common practice in planning regulations and tools. This can help address a lack of top-down guidance.

Data source: C. Wamsler et al., '[Environmental and climate policy integration: Targeted strategies for overcoming barriers to nature-based solutions and climate change adaptation](#)', *Journal of Cleaner Production*, Vol. 247, 2020.

The chances of overcoming the existing NbS implementation barriers can also be enhanced by correctly assessing the benefits of NbS, developing platforms that allow for technology sharing, applying efficient economic instruments, offering education and training for key stakeholders, encouraging experimentation, and ensuring location suitability.

On 22 June 2022, the European Commission presented a proposal to 'restore ecosystems for people, the climate and the planet' – a nature restoration law. It is one of the key elements of the EU biodiversity strategy, and should help not least with 'achieving the EU's climate mitigation and climate adaptation objectives'. The proposal would set binding restoration targets, including for urban ecosystems. In this setting, Member States would be obliged to ensure that there is no net loss of urban green spaces or of tree canopy cover by 2030, as compared to 2021; this would apply to cities, towns and suburbs. Furthermore, by 2040, Member States would need to increase their total national area of urban green space by 3 %, compared with 2021, and at least 5 % by 2050. In addition, there would be a minimum of 10 % urban canopy cover in cities, towns and suburbs by 2050 and a net gain in urban green space, integrating both existing and new buildings and infrastructure in all cities, towns and suburbs. The co-legislators reached a provisional agreement on the proposal on 9 November 2023.

3.2. Closing the adaptation knowledge gap

In its strategy on adaptation to climate change, the Commission highlights that wide gaps exist in terms of adaptation knowledge. Possession of such knowledge is vital if actors are to choose effective courses of action. There is also a need to gather more and better climate-related data, especially on economic losses. All the data needs to be integrated in customised and user-friendly

tools. In an EPRS survey targeting local and regional authorities, when asked how clearly the Commission communicates its policies on climate adaptation directly with the regional and local levels, only 8 % of respondents gave a score of four or above, on a scale ranging from zero to five.

Under the strategy, the Commission committed to 'support the local uptake of data, digital and smart solutions relating to climate adaptation tailored to local and regional specificities', through the European climate pact initiative and the Education for Climate Coalition, among other tools. It identified the local level as the foundation for climate change adaptation.

In addition to the initiatives already mentioned, others have existed for some time. These focus on the importance of knowledge sharing and on creating networks where local stakeholders can find project partners, minimise their internal knowledge gaps, and actively seek help with their own initiatives through dedicated expert support. Table 3 offers a non-exhaustive list of such initiatives.

Table 3 – Climate change adaptation knowledge-sharing platforms

<p>European Climate Adaptation Platform Climate-ADAPT</p>	<p>Launched in 2012, this is a partnership between the European Commission and the European Environment Agency. The latter manages the platform, with support from the European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation.</p>
<p>An open access platform, Climate ADAPT shares data and information with a view to supporting Europe's adaptation efforts. The data shared covers: expected climate change in Europe; current and future vulnerabilities of regions and sectors; adaptation strategies and actions at EU, national, transnational, regional and local levels; adaptation case studies and actions; and tools to support adaptation planning at all levels. The above is reiterated in the 2022-2024 climate-adapt strategy, where it is highlighted that the initiative's objectives are to: provide trusted data and information; promote solutions for action; empower people for action at multiple levels; drive regional and community resilience; and support international adaptation action and exchanges.¹⁹</p>	
<p>Covenant of Mayors for Climate and Energy</p>	<p>Launched in 2008, this is an EU initiative, led by the Commission's DG CLIMA.</p>
<p>At the time of its launch the initiative had the goal of bringing together local authorities, on a voluntary basis, to aid in achieving and going beyond the EU climate and energy targets. Signatories to the Covenant pledge action towards implementing the 55 % net greenhouse gas emissions reduction target by 2030 and also to take action with respect to climate change adaptation. The Covenant has a substantive knowledge platform, which is open access, meaning that not only signatories can browse, and contains information on funding, adaptation resources, energy poverty, and all the necessary information to become a signatory. One fundamental resource is the 'urban adaptation support tool', designed to aid signatories meet their commitments towards increasing climate change resilience and preparing for the impacts of climate change.²⁰</p>	

¹⁹ European Commission, EEA, [Climate-ADAPT strategy 2022-2024](#).

²⁰ European Commission, EEA, [Urban Adaptation Support Tool](#).

<p>Adaptation to climate change mission</p>	<p>One of the EU missions within the Horizon Europe research and innovation programme for the years 2021 to 2027</p>
<p>The mission aims to support at least 150 European regions and communities towards climate resilience by 2030, by nurturing the development of innovative climate change adaptation solutions and encouraging stakeholders at a local level to lead societal transformation. The areas covered by the mission are: land use, food systems, critical infrastructure, water management, health and wellbeing, and also the enhancement of knowledge, governance and behavioural changes. Furthermore, the mission offers support, through tools and methods, to develop planning, monitoring, reporting and evaluation of adaptation to climate change, mostly at the level of local adaptation strategies. Between 2021 and 2023, the mission was expected to work with 60 to 100 regions, but at the time of writing, 308 regions and local authorities have already joined. The mission's implementation platform assists participating regions and provides the mission with support and coordination. For the 2021-2023 period, the mission was allotted €368.3 million in seed funding, divided over six open calls.</p>	
<p>Copernicus Climate Change Service (C3S)</p>	<p>Part of Copernicus, the EU's Earth observation programme established in 2014, C3S is managed by the Commission, and implemented in partnership with Member States, the European Space Agency, the European Organisation for the Exploitation of Meteorological Satellites, the European Centre for Medium-Range Weather Forecasts, EU agencies and Mercator Océan.</p>
<p>The service provides consistent and authoritative data on climate change with the aim of supporting EU adaptation and mitigation policies. All of the service's data and tools are open access and free. Furthermore, the service offers technical support and training through its 'climate data store' to anyone interested, across Europe.</p>	
<p>Climate Adaptation Investment Advisory Platform (ADAPT)</p>	<p>A European Investment Bank (EIB) initiative under the EIB climate adaptation plan</p>
<p>Directed at public authorities, corporate and public sector entities, and financial institutions, this platform does not provide funding directly for projects but can assist in the search for adequate project funding from other sources. The platform can provide support in the preparation, development and implementation of adaptation projects. It can also assist in capacity building and awareness raising, and through upstream support, e.g. adaptation investment strategies and programmes development, help to identify adaptation project pipelines. ADAPT will also provide advisory support for innovation in climate resilient solutions, including in nature-based solutions. In order to make use of the platform, a project promoter, public authority or private company must submit a request through a national promotional institution or through the EIB group, which would then screen the application and provide technical assistance and coordination.</p>	

Source: Compiled by the author.

3.3. Financing adaptation

The IPCC highlights that available funding is key to successful adaptation, nevertheless, in Europe, only 14 countries have communicated that such budget allocations are present in their adaptation strategies and plans. Furthermore, the latest IPCC report highlights that in Europe, despite an increase in spending on climate action, most of this spending goes into mitigation, not adaptation.

In its the strategy on adaptation to climate change, the European Commission highlights the need to ramp up the international public and private financing directed towards climate change adaptation, which needs to target the most effective actions in the countries and communities that are most vulnerable and least able to act. Furthermore, the Commission highlights that support from the EU needs to be directed at stakeholders at a local level. The EU's long-term budget for 2021 to 2027 provides for 30 % of the total to be allocated to climate action and, within that dimension, adaptation is seen as a key element, according to the Commission strategy. This responds to the need to speed up climate adaptation actions throughout Europe. Nevertheless, globally, there is currently still a gap – of US\$194 billion to US\$366 billion per year – between the existing funding and that necessary to fully address all the climate adaptation actions needed.²¹ In line with the EU's long-term budget requirement, the Commission points out several instruments that can finance climate change adaptation actions and programmes, the most important of which are described in Table 4.

Table 4 - Financing climate change adaptation

Recovery and Resilience Facility (RRF)	The RRF is the main pillar of the Next Generation EU financing instrument. To benefit, EU Member States needed to develop their own national recovery and resilience plans to tackle the challenges identified in the European Semester framework.	
LIFE programme	The LIFE programme for 2021 to 2027 includes four new sub-programmes, one of which is 'Climate Change Mitigation and Adaptation'. This will co-finance projects in the following climate adaptation areas: urban adaptation and land-use planning; resilience of infrastructure; sustainable management of water in drought-prone areas; flood and coastal management; resilience of the agricultural, forestry and tourism sectors; and/or support for the EU's outermost regions (preparedness for extreme weather events, notably in coastal areas).	
Horizon Europe	This funding programme is directed towards research and innovation and encompasses climate change, in part helping the EU to achieve the UN's Sustainable Development Goals.	
European Regional Development Fund	The fund's objective is to strengthen the European Union's economic, social and territorial cohesion. For the 2021-2027 period it will fund projects directed at making Europe smarter, greener, more connected and more social.	
Cohesion Fund	This fund seeks to reduce disparities in the economic and social spheres through investment in environmental and transport infrastructure.	
	Trans-European networks for energy (TEN-E)	Trans-European transport network (TEN-T)
	The objective is to improve the energy security and interconnectivity of all Member States and regions. In order to ensure that the clean energy transition is at the same time climate resilient, supported projects should allow for a climate adaptation dimension from the start of the investment cycle.	These structures need to be climate resilient. Therefore, TEN-T has specific requirements for addressing infrastructure vulnerability in light of climate change and both natural and man-made disasters.

²¹ United Nations Environment Programme, [Adaptation Gap Report 2023](#).

Just Transition Fund	The objective of this fund is to support those regions that are worst affected by the transition towards climate neutrality and to prevent these regions from being left behind in comparison with others. The financing focus is centred on digital connectivity, clean energy technologies, reduction of emissions, regeneration of industrial sites, the reskilling of workers and the provision of technical assistance.
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Source: Compiled by the author.

Seeking to encourage the flow of private finance towards climate resilience, the EU has adopted a common classification system for sustainable economic activities, which is referred to as the 'taxonomy'. The EU's Taxonomy Regulation, which includes references to climate adaptation, entered into force in 12 July 2020.²² A delegated act on sustainable activities for climate change mitigation and adaptation objectives of the EU taxonomy was subsequently published in the Official Journal on 9 December 2021 (applicable from 1 January 2022), as part of the sustainable finance package.²³ The delegated act provides a first set of criteria to define which activities contribute significantly to climate change mitigation and adaptation, thus aiming to provide incentives and encourage the launch of new projects or updates and/or upgrades of existing ones, measured against these criteria.

In 2021, the UNFCCC identified that 72 % of countries across the world already had national-level adaptation planning instruments. It also noted, however, that the funding was still not at the levels needed in order to act fully on climate adaptation. In 2023, the UNEP highlighted that the gap, for developing countries, between financing needs and costs (US\$215 billion to US\$387 billion per year) and financial flows (US\$21.3 billion dollars) has grown, and that even if the goal of achieving the doubling of adaptation financing by 2025 is met, it would only reduce the gap by between 5 % and 10 %. For scale purposes, the International Monetary Fund estimates that, in 2022 alone, fossil fuel subsidies amounted to US\$7 trillion globally.²⁴

Back in 2001, the United Nations established the Adaptation Fund. This fund provides financial assistance for adaptation projects and programmes in developing countries that are parties to the Kyoto Protocol. The fund is financed through proceeds from the clean development mechanism (CDM), amounting to 2 % of certified emissions reductions that are issued for a specific CDM project activity. With effect from 1 January 2019, the Adaptation Fund began serving the objectives of the Paris Agreement, but it was to continue to receive funding from activities²⁵ under the Kyoto Protocol. At COP26, the parties welcomed new pledges to the fund, in total over US\$350 million. Developed countries also pledged US\$100 billion annually to developing countries,²⁶ although the aim is to achieve a 50:50 balance between funding for mitigation and adaptation, the first still receives greater support.

In November 2020, the European Investment Bank Group (EIB Group) published its 'Climate Bank Roadmap' for 2021 to 2025.²⁷ The document sets out how the EIB aims to go from 'an EU bank supporting climate' to 'the EU climate bank', reflecting an increased commitment on both climate and environment levels. The EIB mentions the need to increase climate adaptation financing as the

²² European Commission website on the [EU taxonomy for sustainable activities](#).

²³ European Commission website on the [sustainable finance package](#).

²⁴ IMF, [Fossil Fuel Subsidies Data: 2023 Update](#), 24 August 2023.

²⁵ Activities include those mentioned in Articles 6, 12 and 17 of the Kyoto Protocol.

²⁶ UNFCCC, [COP26 Outcomes: Finance for Climate Adaptation](#).

²⁷ European Investment Bank, [The EIB Group Climate Bank Roadmap 2021-2025](#), November 2020.

core of the EIB Group's actions, and that it will support the EU strategy on adaptation to climate change. Since 2012, annual lending of funding towards adaptation has remained constant at 1 % to 2 % of total lending, which does not reflect the increasingly urgent need for investment in adaptation to climate change.

In October 2021, the EIB Group approved a climate adaptation plan, as envisaged by the 2021-2025 climate bank roadmap. The plan's objectives are support for smarter and more systemic adaptation; faster adaptation financing; and the acceleration of international action on adaptation and resilience. The EIB Group clearly defines the focus areas and types of investments that are in line with the EIB Group's requirements for financing under the plan. The plan highlights the usual support ceiling of 50 % of total project cost, but notes that until 2025, given the need for faster action on climate change adaptation, the ceiling will be increased to 75 % for projects whose main purpose is adaptation. Financing at 100 % will be possible in cases of post-disaster recovery projects and in cases where the projects, when justified, are in small island developing states (SIDS) and least developed countries (LDCs).

Established in 2010 by 194 countries parties to the UNFCCC, the Green Climate Fund (GCF) is an operating entity of the Convention's financial mechanism.²⁸ The GCF is governed by the Conference of the Parties. The fund seeks to change the status quo of the global response towards climate change, by directing its resources to low-emission and climate resilient projects and programmes in developing countries. The Green Climate Fund aims to expand collective human action to respond to climate change. As with the EIB Group's plan, the targets are SIDS and LDCs, also adding the African nations. Currently, the fund has a portfolio of nearly 250 projects, totalling US\$13.5 billion in GCF resources, and US\$51.8 billion including co-financing.

The 11th report on the GCF offers guidance on the approach to and scope for supporting adaptation activities.²⁹ It reinforces the GCF commitment to dedicate half of its programming to adaptation, focusing mainly on those particularly vulnerable to the negative effects of climate change. The report also underlines the fund's vision to deploy adaptation support in an inclusive and stimulating manner to achieve quicker systemic adaptation responses. The GCF strategic approach uses four main drivers: transformational planning; innovation in climate adaptation through investment in new and innovative technologies and business models; commercial viability for new adaptation solutions through de-risking of high-impact adaptation projects; alignment of finance with sustainable development.

The International Climate Initiative led by the German government was established in 2008.³⁰ The focus of the initiative is on mitigation and adaptation projects that address the causes of climate change and its impact on biodiversity protection. The initiative finances projects in countries that are either newly industrialised or in transition, as well as developing countries. The fund has available a yearly sum of €120 million from the government budget. From 2008 to 2021 the initiative funded over 800 projects in 150 countries, representing a funding volume of €5 billion.

The Global Environment Facility (GEF), established in 1992, was the earliest source of climate change adaptation funding, receiving funds from 40 donor countries.³¹ It is an international partnership of 18 agencies, including the UN agencies, multilateral development banks, national entities and non-

²⁸ [Green Climate Fund](#)

²⁹ Green Climate Fund, [11th report on of the Green Climate Fund to the Conference of the Parties to the United Nations Framework Convention on Climate Change](#), July 2022

³⁰ [International Climate Initiative](#)

³¹ [Global Environment Facility](#)

governmental organisations. It is the financial mechanism underpinning five international environmental conventions: the Minamata Convention on Mercury; the Stockholm Convention on Persistent Organic Pollutants; the United Nations Convention on Biological Diversity; the United Nations Convention to Combat Desertification; and the United Nations Framework Convention on Climate Change. The GEF supports climate adaptation through the Least Developed Countries Fund and the Special Climate Change Fund. Since 2001, GEF has provided more than US\$2 billion in grants and mobilised almost US\$13 billion from other sources, for roughly 440 adaptation-focused projects in 120 countries.

In the EU strategy on adaptation to climate change, the Commission highlighted its commitment to increase support, including direct funding, for local authorities. This intention is in line with the Urban Agenda for the EU (see box). Factors such as the financial crisis and the economic and social restrictions imposed by the COVID pandemic have all restricted municipal budgets. Adaptation measures are therefore difficult to build into budgets that are already stretched. Nevertheless, introducing adaptation measures into long-term investments can bring economic savings in the long term.

As presented above, there are funding opportunities available to municipalities, but there are many barriers preventing access to those funds. Only just over 15 % of respondents to the above-mentioned EPRS survey reported having full in-house capacity to apply for EU funds, and 20 % of respondents were not aware of any EU funds available to address climate change adaptation projects. Municipalities need the capability to identify, apply and negotiate through the broad range of financing streams. For this to happen there is the need for dedicated human resources, as currently, although this is changing, climate change adaptation is still a subtask of few employees. As explored in the 'Closing the knowledge gap' chapter, there are already instruments and platforms in place that can help municipalities to overcome these shortcomings.

Nevertheless, these barriers have not stopped all climate adaptation actions, as municipalities have looked into more innovative ways to access the necessary funding, especially in smaller-scale projects (see Section 3.7 on best practice at local level).

3.4. Link between adaptation and the insurance sector

When it comes to shielding individuals, organisations and governments from the financial effects of climate-related disasters, insurance coverage is crucial. According to the Commission, only between 5 % (some parts of the EU do not even reach this level) and 35 % of climate-related economic losses are insured in the EU, and these losses are sometimes under-estimated, and therefore not fully representative of the trends.

New Urban Agenda for the EU

The Urban Agenda for the EU was established in 2016 by the Pact of Amsterdam.

It is founded on the principles of subsidiarity and proportionality, and the three pillars of EU policy-making and implementation: better regulation, funding and knowledge. It focuses on priority themes defined within partnerships, of which climate adaptation is one, seeking to integrate and coordinate approaches to dealing with the urban dimension of the EU and national policies and legislation. The main objective of the agenda is to 'improve the quality of life in urban areas'.

Through the collective and integrated work of multiple stakeholders – cities, Member States, the Commission and non-governmental organisations – the Urban Agenda contributes to the green and digital transitions by implementing practical action geared towards cities' challenges.

Source: [European Commission](#).

The share of non-insured economic losses associated with extreme weather events constitutes a 'climate protection gap'. This gap is growing because of slow adaptation action and the events' increased frequency, without a high climate insurance penetration rate.³² To increase this rate, the Commission highlights that the development of a natural catastrophe dashboard by the European Insurance and Occupational Pensions Authority (EIOPA) could play a crucial role and 'lead to national-level assessments of insurance penetration rates and recommendations to improve them'.

The Commission states that after an extreme weather event, insurance can create incentives to reduce risk in addition to the financial compensation. Insurance shifts the risk away from an insured person, object or organisation to the insurer. In extreme weather event scenarios, this plays an important role, as the related financial damage does not translate into long term economic damage in cases where a house or business can be rebuilt or receive compensation.

The rapid changes in the climate are also accompanied by an increase in risk, a factor that needs to be identified and quantified before insurance can be put in place. Therefore the insurance sector needs good characterisation of historical events. Examples of this are the Operational Windstorm Service for the Insurance Sector³³ and the now retired Windstorm Information Service demonstrator project. These resources provide new datasets and tools to enhance knowledge on the nature of windstorms in Europe and the associated economic loss.

Insurers can play a crucial role in making society more resilient towards climate change by providing financial compensation allowing for faster recoveries, by assessing, communicating and signalling risks, and by setting out incentives or requirements for risk management thus limiting the potential impacts of extreme weather events.

Climate risk insurance offers enhanced financial resilience against the negative impacts of climate change. In the short term, it has the potential to reduce the impacts of extreme weather events and, in the longer term, it can play a role in disaster risk reduction. Climate risk insurance must go hand-in-hand with preventive risk-management strategies, thus making sure that loss and damage linked with extreme weather events are minimised. By establishing innovative measures and smart support, through government subsidies or regional risk pools, insurance has the potential to become more affordable to vulnerable communities. In addition, if insurers establish links with local associations, cooperatives, mutuals and savings and credit groups they can gain access to pre-established delivery mechanisms, making pay outs quicker and minimising the social and financial burden caused by the impacts of extreme weather events. Good quality climate risk insurance should be both transparent and inclusive, involving the community in its design and implementation.

The Commission recommends increasing the role of cities and regions in the development of insurance for climate-related risks.³⁴ Municipalities should assess their vulnerability with respect to insurance coverage rates (including the infrastructure and extreme weather events covered). These authorities should also report on how they use insurance mechanisms to manage risk. In addition, municipalities should use insurance disaster data, and should set premiums through the use of community rating systems. Furthermore, there should be an increase in capacity-building with respect to insurance and climate resilience, and further promotion of risk-spreading by allowing cities to pool their insurance. Finally, stakeholders should actively share data on risks, hazards and

³² European Commission, [Closing the climate protection gap - Scoping policy and data gaps](#), SWD(2021) 123 final, 27 May 2021

³³ Operational Wind Storm Service for the Insurance Sector, [website](#).

³⁴ European Commission, [Using insurance in adaptation to climate change](#), 2018.

impacts through standardised metadata. The EPRS survey, when questioning regional and local authorities on the importance of the involvement of the insurance sector as key players in addressing climate change-related issues, identified that over 70 % of total respondents either do not have an opinion (10 %) or do not regard the sector's involvement as of great importance (60 %).

In its adaptation strategy, the Commission highlights its plan to 'facilitate cooperation and discussion on best practices between the insurance sector's stakeholders' and to 'strengthen the dialogue between insurers, reinsurers, public authorities, and other stakeholders, such as real-estate developers and infrastructure operators in the case of the built environment'. Furthermore, new climate-relevant insurance products will be explored. This is the case of a Horizon Europe-funded project, on 'Best practices on and piloting insurance solutions for climate adaptation in EU regions and communities'.

According to Swiss RE, climate change is a manageable risk for insurers and reinsurers.³⁵ Nevertheless, Swiss RE mentions that the insurance industry should enhance its modelling and benchmarking capabilities in relation to increasingly frequent extreme weather events such as wildfires, heavy rainfall, heat waves and droughts, especially in areas with dense urbanisation or high population growth. Furthermore, insurability is dependent on adaptation to a deeply changed risk landscape, and insurers and reinsurers should, on top of a transition to portfolios that are environmentally sustainable, also align their company policies in order to minimise incentives that support carbon-intensive energy production and consumption.

A recent OECD report identifies three possible approaches to enhancing the insurance sector's contribution to climate change adaptation: incentives and enablement of the development of climate risk analytics; encouragement for insurers to communicate with policy-holders regarding long-term climate risks, potential adaptation options, and potential benefits in terms of premium reductions or discounts; and support for resilient reestablishment in the aftermath of climate-related disasters.³⁶

3.5. Maladaptation

The IPCC report (AR6) states that since its previous report (AR5), evidence of maladaptation (see box) has increased across many sectors and regions. This has impacts on vulnerability, exposure and risk, leading to necessary changes that are both difficult and expensive to tackle, while at the same time raising, reinforcing and entrenching inequalities, which, more often than not, affect marginalised and vulnerable groups adversely first. Therefore, maladaptation happens when actions enable conditions that are worse than those that the strategic plan considered in the first place.

Maladaptation

According to the IPCC, maladaptation refers to 'actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas emissions, increased or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future'.

Source: [IPCC](#).

Maladaptation often shifts one community's climate problems to another community, as is the case when part of the city/region deploys dykes and flood walls, solving the issue locally but shifting the problem elsewhere to a community that might not have the resources to deal with the increased

³⁵ Swiss RE Institute, [Insurance in a world of climate extremes: what latest science tells us](#), 2019.

³⁶ OECD, [Enhancing the insurance sector's contribution to climate adaptation](#), 28 March 2023.

vulnerability and risk. The same is valid for local solutions dealing with coastal erosion, where the protective constructions simply shift coastal erosion from one place to another, potentially leading to the relocation or retreat of communities without the means to deploy similar actions. Furthermore, ecosystem services can be severely impacted by maladaptation, as in the example of hard defences against flooding or in cases where fire suppression actions are taken in ecosystems that are already naturally adapted to fire. In these cases, the natural processes are limited by the actions taken, therefore reducing their resilience to climate change and their own ability to provide ecosystem services for adaptation. It is then crucial to shift focus from actions that address sectors and risks in isolation, and focus on long-term impacts and commitments.

It is recognised that a fundamental cause of maladaptation in planned strategies is the fact that they are often developed by actors having access to funding opportunities and project management expertise, but not much knowledge of the local context, both social and ecological.³⁷ There is no one strategy or action plan that is valid for every given location, as what might work for some will most likely not work elsewhere. Maladaptation can be minimised through the integration of cultural values, indigenous knowledge, local knowledge, and scientific knowledge in strategic plans. Also, planning for climate change adaptation should be multi-sectoral, include multiple actors and be inclusive, so as to reduce the chances of maladaptation, while at the same time making sure that the benefits from a given action cover multiple sectors and systems. Furthermore, it should be kept in mind in the planning stages that adaptation takes time, and that there will always be a degree of uncertainty about the rate and magnitude of climate risk, as well as a diverse range of potential adverse consequences of the chosen adaptation actions. In sum, maladaptation can be avoided through long-term planning that is inclusive, multi-sectoral and flexible, and that provides for adaptation actions that have benefits for a multitude of sectors and systems.

There are many resources to assist regional and local authorities in developing their own strategic plans to address climate change adaptation, but not that many provide assistance with identifying possible maladaptation practices. One example of the latter is REGILIENCE, a self-assessment tool to identify maladaptation risks.³⁸ The project focuses on identifying potential risk factors for maladaptation at an early stage, with the aim of avoiding or reducing the possibility of unintentionally integrating maladaptation in the planning phase of adaptation actions. It is a tool designed to be used by people or institutions in charge of adaptation actions, in both the planning and implementing phases, at different levels (national, local, individual, public and private). It comprises a checklist that users can utilise to check their planned adaptation actions against maladaptation potential, thus allowing the identification of factors where further action is needed in order to avoid maladaptation.

Another example of a tool designed to help adaptation planners identify, anticipate and potentially reduce maladaptive outcomes is the multi-dimensional framework 'Navigating the Adaptation-Maladaptation continuum'.³⁹ According to the authors, there are also benefits in applying the framework after the deployment of adaptive actions, as this can enable actors to identify measures that are not having the intended outcome, and therefore shift efforts towards more successful adaptation solutions.

³⁷ L. Schipper, '[Maladaptation: When Adaptation to Climate Change Goes Very Wrong](#)', *One Earth*, Vol. 3(4), 2020.

³⁸ [REGILIENCE](#)

³⁹ Reckien D., Magnan A.K., Singh C. et al., '[Navigating the continuum between adaptation and maladaptation](#)', *Nature Climate Change*, Vol. 13, 2023, pp. 907-918.

3.6. Effectiveness of strategies, plans and actions

With the number of climate strategies, plans and adaptation actions rising steadily throughout Europe, it is crucial that authorities at a regional/local level assess the effectiveness, and sustainability over time, of the choices taken. The Climate-Adapt platform identifies this step as one that enables outcomes to be checked against the desired objectives.

However, unlike with mitigation, the link between the cost of adaptation measures and its benefits are not as apparent, or might only be possible to identify in the future. As such, decision-makers more often than not choose to focus on more pressing agenda items and choose actions or proposals that bring short-term returns. Knowing the effectiveness of adaptation actions could mean that decision-makers would have the information they need to invest in such actions, and to win public support, as communication would be made much easier.

The effectiveness of an adaptation process should be assessed through periodic monitoring and evaluation (M&E) of choices made. In order to achieve the best results it is necessary to implement a strong M&E framework, supported by suitable indicators. These indicators would then feed a process where the information gathered would be used to improve the regional or local approach to climate change adaptation at the strategic or action plan levels. Ideally, the evaluation process should be conducted in a manner that would allow an assessment of both the effectiveness of individual measures against a particular climate risk, and also the combinations and effects of all measures on hazards, quality of life and the broader environment.

The Climate-Adapt platform suggests a three step methodology to assist in M&E processes. These are summarised in Table 5.

Table 5 – Monitoring and evaluation

Developing the approach	A dedicated M&E plan or strategy should be developed, including clear and specific objectives, robust indicators, knowledge management and sustained engagement of stakeholders (public, private and civil society). It should also consider acknowledging trade-offs, defining the baselines that will serve as the reference for M&E, consider the unintended and unexpected, and also agree on the purpose for M&E and communicate to all involved.
Defining monitoring indicators	While choosing the indicators, special attention should be taken in respect to data availability and how they reflect the adaptation objectives. The baseline for indicators should include the effects of future climate change, and existing indicators should be taken into consideration, and adjusted if necessary to reflect adaptation objectives. Given the possible lengthy process of adaptation, indicators that allow for M&E of both processes and outcomes are key. Lastly, all indicators should have a clear purpose and be relevant, while allowing for the data collection process to be both efficient and effective.
Using monitoring results	The results should allow for better insight into the effectiveness of the adaptation strategy and/or action plans, with a view to their revision and readjustment. In order to involve all relevant stakeholders, the results should be communicated in a manner that is easy to understand and tailored to each specific audience. This in turn can incentivise further action.

Source: [Climate-Adapt](#).

Highlighting that knowledge on the effectiveness of adaptation measures is still in its infancy, but developing at a steady pace, the EEA highlights three lessons that can already be learned.⁴⁰ First, an assessment of the effectiveness and cost-efficiency of adaptation measures has shown that, both planning and construction of cities needs to change to include more nature-based solutions, i.e. shaping cities in a way that is more in line with nature. Second, substantial benefits can be derived from actions such as awareness raising and education, which usually require little investment. Third, the role of disaster risk reduction through dedicated early warning systems can also be of great importance in preventing the impacts of climate change in cities, as these can have the potential to reduce damage while being both effective and cost-efficient.

3.7. Best practice at local level

The regional and local levels have been and will continue to be the optimal scale to roll-out climate adaptation actions. There are many good examples of cases where adaptation actions have been taken to overcome existing barriers. Sharing these best practices is fundamental to closing the knowledge gap and assisting regional and local authorities in their pursuit of climate change adaptation strategies and action plans. The projects described in the four case studies set out below illustrate aspects highlighted by the EU strategy on adaptation to climate change that still need further attention.⁴¹

3.7.1. Case studies

Project name	Location	Link with EU adaptation strategy
Improving biodiversity protection and climate resilience through nature-based solutions	Catalonia (Spain)	Nature-based solutions

From 2009 to 2018, the Ebro Delta was the focus of two LIFE projects, DELTA-LAGOON and EBRO-ADMICLIM. Combined, both projects had a total budget of just over €5.3 million with an EU contribution of nearly 50 %. Both projects addressed the ecological status of the delta's lagoons. Seeking to increase resilience against sea level rise by restoring the hydrological connectivity between the lagoons and the sea, the main actions under the DELTA-LAGOON project were: the development of nesting habitats in the form of small islands for sea birds; limiting access to the area; reintroducing wildlife species; the naturalisation of both rice fields and aquaculture facility to coastal lagoon and salt marsh habitat, respectively; cleaning the existing canals and creating a new one allowing for one of the lagoons to be connected directly to the river, thus making it possible for fluvial sediments to reach the delta.

The EBRO-ADMICLIM project meanwhile developed a climate action plan for the Ebro Delta. It included several other adaptation and mitigation measures that could be applied in the area, and would serve as the guiding document for interventions. The plan is recognised and operationalised by the Catalan Office on Climate Change, but several competences highlighted in the plan fall under the competence of the Government of Spain. This barrier to action – the regional authority dependent on the national one for action to be taken – is seen throughout Europe. The development of the plan included a wide range of stakeholders, such as representatives from the rice sector, irrigation communities and non-governmental organisations. The plan highlights that the guidelines and measures identified were achieved by finding consensus among the participants.

⁴⁰ EEA, [Urban adaptation in Europe: how cities and towns respond to climate change](#), 9 October 2020.

⁴¹ The details of the four case studies are taken from the

Project name	Location	Link with EU adaptation strategy
ClimAdaPT.Local	Portugal	Closing the knowledge gap

ClimAdaPT.Local is a nationwide project in Portugal, financed at 85 % (for a total cost of €1.5 million) through the EEA and Norway grants⁴² which had a starting goal of enhancing municipal responses towards climate change adaptation. The project began in 2016 and is still running. The objectives of the project are to: embed climate change adaptation at local level; engage a local community of actors, that would be trained in decision support tools on adaptation; promote and provide local adaptation knowledge on the development of strategic planning at local level; reduce barriers to local actors' participation in the adaptation process; and build adaptation into local decision-making and planning. The project's specific goals are the development of 26 municipal strategies for climate change adaptation, the training of 52 municipal technical staff in climate change adaptation, the creation of a municipal climate change adaptation platform, and the creation of a municipal network for climate change adaptation.

The development of the strategies was supported by adjusting the UKCIP Adaptation Wizard.⁴³ It required municipalities to identify current and future local vulnerabilities, identify adaptation options, and communicate integration, monitoring and revision processes. The municipalities were also required to establish a local network for climate change adaptation, in which all relevant local stakeholders were present and had the opportunity to be involved in the entire process.

The project has resulted in the creation of a national network for local adaptation to climate change, Adapt.local. The network's mission is to enhance the municipalities' capacity to integrate climate change adaptation into decision-making, planning instruments and interventions. To date, the network has 30 effective members (municipalities) and 14 auxiliary members (private and public sector, e.g. universities, consultants and non-governmental organisations).

Project name	Location	Link with EU adaptation strategy
The Ghent crowdfunding platform	Ghent (Belgium)	Financing adaptation

Impacted by excessive rainfall and rising temperatures, the city of Ghent has developed a range of policies to increase the number of green areas, namely green roofs and urban trees. The municipality was lacking financial means and know-how, but was nevertheless dedicated to developing initiatives using a bottom-up approach, thus involving its citizens.

The municipality aimed for the co-creation of partnerships that would be supported by the community. The aim was a solution where small-scale projects could be financed and would remain accessible, with the possibility to include multiple stakeholders. In March 2015, the municipality established a crowdfunding platform, standing apart from other crowdfunding platforms on account of its societal benefit. There, ideas can be shared and funding can be raised. Anyone can submit a project, thereby becoming a project initiator, providing a short description and funding goal. Minimum donations are set at €5, and only projects that receive broad community support, i.e. funding, become viable.

⁴² [European Economic Area and Norway grants](#) funded by Iceland, Liechtenstein and Norway.

⁴³ Explanation of the [UKCIP Adaptation Wizard](#) on the Climate Adapt website.

For a project to become available to receive community support, it is first approved by the manager of the platform appointed by the municipality. The approval rests on checking the project against pre-defined requirements, e.g.: *'the project makes a positive contribution to the city or one of its neighbourhoods'* or *'the project must transcend individual interests'*. After approval, the project is available to receive community support for a certain period. The projects receive funding even if expected goals are not met.

In order to support the funding process, Ghent municipality allows project initiators to apply for municipal subsidies, from a yearly fund of €55 000 allocated to the platform alone, where they need to indicate if they require 25, 50 or 75 % municipal funding, up to a limit of €5 000. In order to be eligible for subsidies, the project must already have received community support equivalent to the co-financed amount.

Among the crowdfunding project successes are the possibility to identify projects that are not suitable to be financed through subsidies, the potential for funded projects to lead to other projects, i.e. a ripple effect, and the opportunity to drive innovation, cooperation and solidarity within a community. The financial and human resources needed to build and maintain such a platform, and the fact that the municipality cannot control the policy topics submitted, were identified as being limiting factors of the crowdfunding project.

Project name	Location	Link with EU adaptation strategy
Oasis Innovation Hub for Catastrophe and Climate Extremes Risk Assessment	International partners	Adaptation and the insurance sector

This international project, with 22 participants from both inside and outside the EU was coordinated by the Potsdam Institute for Climate Impact Research and had a total cost of just under €5.5 million, with the EU contributing with just over 88 % of the total. It ran from 1 May 2017 to 31 October 2020.

One of the main objectives of the project was to operationalise the Oasis Loss Modelling Framework. This framework combines loss and damage information with climate services, with the output being a standardised risk assessment process able to assess potential losses, identify areas at most risk and quantify financial losses. Under this project, the Oasis Loss Modelling Framework also developed a new interface for non-insurance entities. It is an open source loss model and is available to cities, governmental users, and academics.

The project allowed all relevant stakeholders – insurance and business sectors, policymakers, scientists and academics – to take an active role in achieving the proposed objectives. This approach allowed for rapid development and delivery of tools and services for different situations, such as floods in the Danube region and climate risks to forest resources. The project enhanced modelling processes and tackled gaps in risk assessment for both regions and hazards.

4. Paris Agreement and the global goal on adaptation

A key aspect of the Paris Agreement is the definition of a global goal on adaptation (GGA), which aimed at 'enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response', in order to keep global temperature increase well below 2°C and pursue efforts to hold it below 1.5°C.

The GGA should be driven locally as adaptation happens primarily on a local scale.⁴⁴ In addition, locally led adaptation (LLA) has been identified as an emergent priority by governments, funders and communities. According to the World Resources Institute 'if LLA is successfully mainstreamed early in the work programme, it follows that GGA may be incorporated as an objective measure of LLA progress, including quality and quantity of finance for LLA', with the global stocktake (GST)⁴⁵ as the mechanism through which countries would report on this progress. The GST highlights that both mitigation and adaptation actions are urgently needed, and mentions that current adaptation efforts are 'fragmented, incremental, sector-specific and unequally distributed across regions'. Furthermore, it puts the spotlight on local contexts and populations, as this level can inform and drive more adequate and effective adaptation actions. The GST also mentions that adaptation-related funding needs to be adequate with respect to current and future needs.

Agreed at the 26th Conference of the Parties (COP26) to the UNFCCC, the Glasgow Climate Pact highlighted the urgent need to take up climate adaptation and knowledge and technology sharing to enhance the adaptive capacity, to strengthen resilience and decrease vulnerability to climate change. COP26 established and launched the Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation.⁴⁶ This programme is assisting understanding of the global goal on adaptation and progress made towards it. It provides knowledge and tools for communities and countries to make sure that the adaptation actions being taken are indeed contributing towards a more climate-resilient future. Since May 2022, eight workshops have been held on the work programme, and in September 2023, the participants reiterated that the framework for guiding the achievement of the GGA should 'operationalize the GGA, enhance action and support, guide implementation, help measure progress, enable transformational adaptation while recognizing incremental adaptation, help avoid maladaptation, and create a balance between mitigation and adaptation'.

COP28 took place from 30 November to 13 December 2023, hosted by the United Arab Emirates. Ahead of the conference, Sultan Al Jaber – President of COP28 – stated that the conference 'must leverage an adequate response to the global stocktake and set out a pathway to fill the financing gaps and address shortcomings in the global climate finance architecture'.⁴⁷ Ralph Regenvanu – Vanuatu's Minister of Climate Change Adaptation, Energy, Environment, Meteorology, Geohazards and Disasters Management – has identified adaptation and resilience initiatives as the 'last line of defence', as they have the potential to minimise the impacts of the worsening climate crisis. Dr Michael Usi – Malawi's Minister for Natural Resources and Climate Change – has stated that climate finance needs to be improved, both in terms of access and delivery, especially at local level.

⁴⁴ Climate Analytics, [Global Goal for Adaptation must be locally driven](#), 15 December 2021.

⁴⁵ [Global Stocktake](#) is the 'process for taking stock of the implementation of the Paris Agreement with the aim to assess the world's collective progress towards achieving the purpose of the agreement and its long-term goals'.

⁴⁶ UNFCCC, [Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation](#), 14 November 2021.

⁴⁷ UNFCCC, [COP28 President calls for improved adaptation finance for vulnerable nations at Climate and Development Ministerial](#), October 2023.

Furthermore, the Presidency of COP28 stated that it actively supported new adaptation finance pledges with a view to doubling adaptation finance by 2025, and the successful replenishment of the Adaptation Fund and the Green Climate Fund, with a focus on striking a balance between mitigation and adaptation.

Many key issues were discussed and agreed upon during the conference. As to those directly relating to climate adaptation, the parties adopted the framework for the global goal on adaptation, highlighting that it would be the framework's purpose to steer, and review, overall progress towards achieving the global goal on adaptation.⁴⁸ The parties launched a new 2-year work programme, which will develop indicators to measure progress towards achieving the global goal on adaptation, as well as to increase ambition and enhance adaptation action and support. In respect to the Adaptation Fund,⁴⁹ the parties recognised the urgent need to scale-up the existing financial resources, and highlighted the importance of contributing to the Fund, agreeing that developed countries should double their collective provision from 2019 levels by 2025.⁵⁰

5. The road ahead

Regional and local authorities, as they bear most of the burden of climate change impacts, are increasing their efforts and displaying interest and availability to adapt. However, there is still a long road ahead, in order to fully increase climate resilience everywhere.

Despite a wide array of tools, initiatives and financial options directed towards climate change adaptation already being available to regions and municipalities throughout Europe, the barriers that exist today are not new and are known. Nonetheless, significant efforts are being made to overcome these barriers.

As has been explored in this paper, financial streams are still falling short with respect to what is actually needed to adapt to the impacts of a changing climate. Knowledge sources exist, are maintained and updated, but regional and local authorities throughout the EU still struggle to navigate the knowledge platforms and apply the information gathered. Furthermore, the understanding and uptake of NbS has been increasing, and the insurance sector is slowly but steadily changing its approach and exploring its potential as a key player in climate change adaptation.

As all scenarios currently point towards climate overshooting, the impacts of such an occurrence will be felt for years to come. Adaptation is therefore vital. As many weak links in climate change adaptation processes have been identified, it should now be possible to ramp up efforts to ensure that regions and cities can reach their full potential to become healthy, prosperous, environmentally-friendly and resilient.

⁴⁸ UNFCCC, [Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation referred to in decision 7/CMA.3](#), December 2023.

⁴⁹ [Adaptation Fund](#).

⁵⁰ UNFCCC, [Matters relating to the Adaptation Fund](#), December 2023.

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Climate change adaptation has been gathering momentum. At COP26 in 2021, the parties to the UNFCCC agreed to develop a work programme to deliver on the global goal on adaptation; at COP28, two years later, they adopted the framework for achieving that goal. Adaptation efforts should be led locally, by those most at risk, those who know the territory. The EU has been introducing tools, initiatives and strategies to enhance all aspects of climate change adaptation. While there are still barriers to the proper up-take of practical adaptation actions at a local level, in many cases solutions for overcoming them are already available.

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