Government of the Netherlands

Draft National Climate Adaptation Strategy 2026

(DRAFT NAS'26)

Foreword

The Netherlands is a beautiful country (of water). It is a low-lying delta, through which major European rivers find their way to the sea. By contrast, our Caribbean territories are actually surrounded by water. Nearly four million people in our country now live below sea level. They are perfectly safe because our water defences are among the most advanced in the world and because we continue to adapt to changing conditions through innovations like the 'Sand Motor' peninsula and the 'Room for the River' programme. Although climate change is placing increasing pressure on life in the lowland delta we inhabit and the Caribbean territories, we are adapting our country and our way of life accordingly. This 'battle against water' is, of course, nothing new because we have been fighting it for centuries. What is new, however, is the intensity of that 'battle'. Water now comes at us from four sides, namely from the sea, via the rivers, from the soil and from the sky during sometimes torrential downpours. At other times, it remains extra dry and we have a water shortage. All this calls for a different response, for a forward-looking approach and for fundamental choices.

The torrential downpours in Limburg in 2021 are etched in our memory and the summers of 2018 and 2022 were so dry that inland shipping movements were restricted due to low river levels. On Bonaire, Saba and St. Eustatius, it is becoming noticeably hotter and drier, and the storms are becoming more severe. In addition to rising sea levels, extreme weather events will start occurring more frequently and will be more intense in the (near) future. The increasing heat, drought and pluvial flooding create even greater challenges, such as heat in residential areas, damage caused by severe storms, the degradation of our cultural heritage and more frequent wildfires. Although this new reality is already upon us, we still do not have a crystal ball. That is why we have developed so-called 'adaptation pathway maps' and included them in this new National Climate Adaptation Strategy (NAS). They depict the measures that work best in conjunction with different rates of climate change.

Although the NAS is a central government programme, it is also important that the provincial authorities and the municipalities, the water authorities, civil society organisations and businesses in the Netherlands all become involved in climate adaptation, for example by testing national spatial planning strategies and processes in advance to see how they perform in the face of climate risks and by incorporating their assessments into the business model. Some construction companies are, for instance, already conducting climate stress tests before they start any new projects. Similarly, municipalities and other public authorities are now including 'climate resilience' in their schedules of requirements. When I was a local councillor in Rotterdam, I worked on creating a resilient city which is capable of withstanding more extreme weather events through the use of extensive greenery and water storage facilities and now everyone wants to get involved. Organisations are also working with partners to find solutions for the problems associated with a future in which the European and Caribbean Netherlands have to deal with the increasing impact of extreme weather events. Those partners include, among others, insurance companies and the inland shipping sector.

As Cornelis Lely once said, 'A nation that lives, builds for its future' and that is what we too are now doing. The National Climate Adaptation Strategy provides an insight into possible scenarios and links them to specific courses of action. Climate change affects us all and this strategy belongs to us all. That is why anyone and everyone in the European and Caribbean Netherlands ought to respond to this draft NAS and I very much look forward to those responses.

Vincent Karremans
Minister of Infrastructure and Management

Summary visual

We have a challenge (Chapter 2)

The climate is changing, and that comes with risks

We have an ambition (Chapter 1)

A climate-resilient Netherlands, today and in the future

Across the Netherlands, we are focusing on four government-wide integrated challenges (Chapters 3 and 5.2.2)

1. **Climate-resilient spatial planning and design**
2. **A society which is prepared for climate change**
3. **A government that is equipped for the challenge of adaptation**
4. **Financial backing for climate adaptation**

For the European and Caribbean Netherlands, we are also focusing on the key sector-specific adaptation challenges (Chapters 4 and 5.2.1)

Sector-specific challenges in the European Netherlands

Water
1. High water
2. Pluvial flooding
3. Fresh water
4. Water quality

People and culture
8. Heat-resilient cities, towns and villages
9. Health
10. Cultural heritage

Agriculture, nature and the environment
5. Agriculture
6. Nature
7. Seveso Directive

Living and working
11. New construction
12. Existing structures
13. Workplaces
14. Transport infrastructure
15. Utilities

Sector-specific challenges in the Caribbean Netherlands

Water
1. Water infrastructure
2. Sea water quality
3. Water safety
4. Pluvial flooding

People and culture
5. Health, including heat
6. Cultural heritage

Agriculture, nature and the environment
7. Erosion
8. Nature, incl.coral reefs
9. Food security
10. Fisheries

Living and working
11. Homes and buildings
12. Public space
13. Tourism
14. Infrastructure

What is new since 2016?

Content

- The Caribbean Netherlands
- Feasible and affordable for everyone
- Horizon 2100
- Adaptation pathway maps
- More concrete goals
- Clear strategy per challenge
- More integrated view (improved cohesion between challenges)

Process

- Innovative collaboration with knowledge partners
- Programme under the Environment and Planning Act
- Heavily invested ownership of challenges
- Participation: sounding board groups and research among young people

Content

Chapter 1

Introduction and document structure

1.1 Why is a new National Climate Adaptation Strategy required?

Worldwide, the climate is changing at an ever faster pace, and the consequences are already clear to see. The oceans and atmosphere are warming at an ever increasing rate, and sea levels are rising rapidly. In the Netherlands, we are also feeling the effects of climate change. Extreme weather, for example in the form of heatwaves, heavy downpours, and drought[1], is occurring more frequently than ever before and is already causing casualties and damage. In 2024, for example, so much rain fell in the Pathmos neighbourhood of Enschede that dozens of homes were declared uninhabitable. Some recent weather extremes, such as the extreme heat in 2019, were previously unthinkable.[2] During that exceptional heatwave, there were 400 excess deaths in a single week.

The KNMI's[3] climate scenarios show that these weather conditions will become even more extreme and occur even more frequently in the coming decades, even if there is a significant reduction in carbon dioxide emissions. An unfavourable combination of circumstances can further exacerbate the impact of these extremes, for example a wildfire breaking out on a hot, windy day during a period of prolonged drought.[4] These weather conditions are having serious consequences for our living environment, our health and the economy, and that is why we need a resilient and robust society.

The current National Climate Adaptation Strategy (NAS) dates from 2016 and is no longer adequate. The evaluation of NAS'16 in 2022 revealed that many local and regional authorities and businesses have been addressing climate risks since its publication. However, it also revealed that these efforts have been insufficient given the current pace of climate change. It has also become apparent that the central government is not providing enough of a direction or a focus on the country's climate resilience and that is why the new NAS represents an extra step in the right direction. Having said that, it does build on the successes of the NAS'16, namely by identifying how everyone could deal with climate change.

The new NAS contains a more thorough analysis and broader approach to keeping the country resilient and robust for both the European and Caribbean parts of the Netherlands. In this new NAS, we also look further ahead (to 2100), set out our long-term ambition more clearly, and commit to taking short-term steps in order to prepare for the necessary changes in the medium term. In doing so, we use the very latest climate risk information and other scientific knowledge and establish stronger links between themes. This document is the draft NAS.[5] This is the draft NAS. We expect to be able to publish the definitive version at the end of 2026, which is why it is going to be called the NAS'26.

1 Royal Netherlands Meteorological Institute (KNMI). *Een Extreem Rapport*. De Bilt: KNMI, 2025.
2 Royal Netherlands Meteorological Institute (KNMI). 'Hittegolven zoals vorige week vroeger vrijwel onmogelijk'. *KNMI.nl*, 2 August 2019.
3 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
4 Royal Netherlands Meteorological Institute (KNMI). *Een Extreem Rapport*. De Bilt: KNMI, 2025.
5 The recommendations from the evaluation of the NAS'16 and the priorities outlined in the National Climate Adaptation Implementation Programme (Nationaal Uitvoeringsprogramma Klimaatadaptatie, NUPKA'23) have provided the basis for this new strategy.

1.2 Purpose and status of the NAS'26

The ambition of the NAS'26 is to create a climate-resilient Netherlands, both now and in the future. Climate-resilient does not, however, mean that all risks can be eliminated, but rather that, at any given time, there is a well-considered and optimal mix of: (1) prevention; (2) the ability to manage and accept residual risks, and (3) flexibility for the future. By the latter we mean that we will continue to monitor long-term developments and immediately take these into account where necessary, for example by allocating space right now for dyke reinforcement work in the future.

The NAS'26 provides clarity on the direction, possible routes, and objectives for realising this ambition. We are using so-called adaptation pathway[6] maps to outline the choices we will need to make, and the steps we can take to become climate-resilient in the long term. For all the challenges[7], we clarify what our ambition is, what we mean by that ambition, and what specific objectives are associated with it. We then demonstrate how we, as the government, intend to work in the coming years towards achieving this ambition and these objectives. We are also calling on civil society organisations, businesses, and residents to do their bit as well because we will only be successful in adapting to climate change if we all work together. Water boards and provincial and municipal authorities play a crucial role to climate adaptation due to their direct responsibility for local implementation and the impact on residents and businesses. Other authorities, such as the Safety Regions and Municipal Health Services (GGDs), are also key partners in terms of both prevention and mitigation.

The NAS'26 is to be a voluntary national programme under the Environment and Planning Act. The strategy contains binding measures and initiatives to be taken by central government.

6 We are going to use adaptation pathway maps to visualise adaptation pathways, in other words structured sequences of successive (sets of) adaptation measures that will help to reduce climate risks, while taking account of lead times, sequencing, effectiveness, and feasibility.
7 The fifteen adaptation challenges from the National Climate Adaptation Implementation Programme (NUP KA'23) form the basis of the NAS'26.

1.3 Scope of the NAS'26

The scope of the new NAS has been broadened. The idea is to address no fewer than fifteen adaptation challenges for the European Netherlands and fourteen for the Caribbean Netherlands. This time, we are also going to include the subject matter covered by the Delta Programme. Although the new water policy, including the way in which the challenges resulting from climate change are dealt with, is to be laid down in the National Water Programme (NWP'27), which is to be published in 2027, the current water policy is to be included in this NAS. This is because water is inextricably linked to the other challenges, such as agriculture, cultural heritage, work, and housing.

This NAS also explicitly addresses the relationship between these challenges. This is precisely the strength of the NAS'26, in that it clarifies the interactions, dilemmas, and opportunities that exist between the various adaptation challenges. This will lead to government efforts across four integrated themes, namely spatial, social, administrative, and financial. We are also focusing on overarching NAS themes, such as health, safety, and crisis management.

The NAS'26 includes a chapter on the Caribbean parts of the Netherlands, namely the three public entities of Bonaire, St Eustatius and Saba (BES). Although we are one kingdom, differences still exist and that is why the various challenges we face are also different. For example, the way climate change manifests itself on the islands is as a greater risk of the most severe category of hurricanes, as well as ocean acidification which results in among other things, degradation of coral reefs. Fishing and tourism are also vulnerable sectors on the islands. Socio-economic factors, demographic trends, and limited implementation capacity also influence the number of climate adaptation options.[8] This means that a context-specific approach is needed to determine what is required in the short, medium, and long term in order to create a climate-resilient Caribbean Netherlands.[9] We outline the approach for the fourteen most important adaptation challenges facing the islands in Chapter 5. This approach will enable us to work towards achieving the same goal for the entire Kingdom, namely climate resilience in both the European and Caribbean Netherlands.

Working with adaptation pathway maps means we can effectively manage uncertainties. For example, while we are not opting to use a specific KNMI scenario in the NAS, we do clarify how sustainable a policy option is in conjunction with different rates of climate change and our understanding of those rates will enable us to determine when it is the right moment to switch to other measures.

Even if the Atlantic Meridional Overturning Circulation (AMOC) slows down faster than expected, measures will still be necessary in the coming decades. The AMOC forms part of the Gulf Stream. If the Gulf Stream weakens, Europe will warm up less rapidly than other places, or even become colder, particularly in winter. In addition, if the AMOC weakens or even stops, this will also lead to less rainfall and more drought in Europe, and a faster rise in sea levels in the North Atlantic. At the time of writing, we do not yet have sufficient insight into whether and when this will happen. But even if the AMOC slows down faster than expected, the strongest effects of this will only occur in a century's time. In the coming decades, we can therefore continue to take full account of the climate effects set out in the KNMI'23 climate scenarios. Furthermore, a limited portion of the slowdown has already been incorporated into the KNMI'23 climate scenarios, as a number of climate models already show this weakening in the long term. It is precisely by using adaptation pathway maps in this NAS, which account for different rates of climate change, that we can respond to such unexpected developments. We will continue to monitor this phenomenon through ongoing research.

8 Witteveen+Bos, as commissioned by the Ministry of Infrastructure and Water Management. *Climate change and adaptation efforts BES islands.* Utrecht: Witteveen+Bos, 2024.
9 Nijpels, E. *Advisory Report on Bonaire Climate Table It is never too late.* Climate Table Bonaire, 2023.

1.4 Relationship with other policies

The NAS'26 is closely related to numerous government programmes and other government policies. One example is the National Strategy on Spatial Planning and the Environment (NOVI), in which the government sets out a long-term vision for the future and the development of the living environment in the Netherlands, of which climate resilience is also part. The current NOVI is soon to be replaced by the Spatial Policy Document, which is being developed in parallel with the NAS. Texts in this Draft NAS follow the directions outlined and choices made in the Draft Spatial Policy Document and are, in some respects, a more detailed interpretation of them.

Some programmes and projects have objectives which contribute directly to those of the NAS'26. Figure 1.1 provides an overview of the most important programmes in the European Netherlands. Figure 1.2 provides an overview of the most important programmes in the Caribbean Netherlands.

Figure 1.1
Relationships with other programmes in the European Netherlands

Category	Programme name
Water domain	• National Delta Programme • National Water Programme 2022–2027
Agriculture, nature and the environment domain	• Action Programme for Climate Adaptation in Agriculture • Action Programme for Climate Adaptation in Nature 2025–2030 • National Approach to At-Risk Companies
People and culture domain	• National Action Plan for the Strengthening of the Zoonotic Disease Policy • Heat Action Plan 2025 • Heritage and Living Environment Plan • Health and Active Living Agreement
Living and working domain	• Climate-Resilient Networks • National Approach to Climate Adaptation in the Built Environment • National Approach to Foundation Problems • Implementation Programme for the Critical Entities Resilience Act
Generic, supporting programmes and projects	• Adaptation monitor (in development) • Knowledge Approach to Climate Adaptation • Delta Programme on Spatial Adaptation • National climate risk analysis • Funding approach • Early Warning Centre • LIFE-IP Climate Adaptation • Communication • Security Strategy for the Kingdom of the Netherlands • National Crisis Management Agenda • Soil, Subsurface, and Groundwater Programme

Figure 1.2
Government programmes in the Caribbean Netherlands that contribute to the NAS'26 goals

Category	National policy applicable in the Caribbean Netherlands
Water domain	• Nature and Environmental Policy Plan for the Caribbean Netherlands 2020-2030 • Spatial Development Programme for the Caribbean Netherlands • Crisis Management Handbook for the Caribbean parts of the Kingdom • Drinking Water Policy Document 2021–2026 • Region Deals
Agriculture, nature and the environment domain	• Nature and Environmental Policy Plan for the Caribbean Netherlands 2020-2030 (N.B. This also includes sustainable fisheries, which is of major importance for the BES islands.)
People and culture domain	• Nature and Environmental Policy Plan for the Caribbean Netherlands 2020-2030 • Spatial Development Programme for Bonaire, St Eustatius, and Saba • Policy Agenda for Public Housing and Spatial Planning for the Caribbean Netherlands • National Health Policy Memorandum 2025–2028 • Culture Covenant 2025–2028 OCW-BES
Living and working domain	• Policy Agenda for Public Housing and Spatial Planning for the Caribbean Netherlands • Spatial Development Programme for Bonaire, St Eustatius and Saba • BES Buildings Decree • Policy Agenda for Public Housing and Spatial Planning for the Caribbean Netherlands • Physical domain approach (in development)
Generic, supporting programmes and projects	• Adaptation monitor (in development) • BES Climate effect atlas • Early Warning Centre for the Caribbean Netherlands (currently being formed) • Security Strategy for the Kingdom of the Netherlands

1.4.1 Relationship with European policy

The NAS is also closely linked to European policy. Under the European Climate Law, Member States are obliged to ensure 'continuous progress in enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change'.[10] This European regulation also requires the drafting, updating, and implementation of national adaptation strategies and plans. The European Commission elaborated on this legislation in its 2021 EU Climate Adaptation Strategy[11] and published a guidance document[12] to help Member States draw up plans and strategies. We aligned ourselves with these European documents when drafting the NAS'26.

Wherever possible, we have also incorporated the documents used by the European Commission to draw up a new European Climate Adaptation Plan into this NAS'26. Specifically, these documents are the first European Climate Risk Assessment (EUCRA)[13] and the accompanying communication entitled '*Managing Climate Risks - Protecting People and Prosperity*' (*Klimaatrisico's beheren - De bevolking en de welvaart beschermen*)[14]. The European Commission is using these documents as a basis for the new European Climate Adaptation Plan, which is expected to be presented at the end of 2026. The Commission intends to use this plan to accelerate and intensify work on climate resilience across the EU and its Member States and it is in close consultation with those Member States that the European Climate Adaptation Plan is being drafted.

10 European Parliament, Council of the European Union. 'European Climate Law'.
11 European Commission. *Forging a climate-resilient Europe — the new EU Strategy on Adaptation to Climate Change*. Brussels: European Commission, 2021.
12 European Commission. *Guidelines on MS adaptation strategies and plans*. Brussels: European Commission, 2023.
13 European Environment Agency. *European Climate Risk Assessment*. Copenhagen: European Environment Agency, 2024.
14 European Commission. *Managing climate risks - protecting people and prosperity*. Brussels: European Commission, 2024.

Text box 1.1 **International adaptation policy frameworks**

As a government we have committed to speeding up progress towards achieving the global adaptation goal set out in the Paris Agreement. This sub-goal emphasises the importance of increasing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change.

In addition to the Paris Agreement, the Netherlands has also committed to a number of other international treaties. These refer to (aspects of) an integrated approach to climate adaptation, including the UAE Framework for Global Climate Resilience, the Global Biodiversity Framework (GBF), the Sendai Framework for Disaster Risk Reduction (DRR), and the United Nations Convention to Combat Desertification (UNCCD convention). The UN System-wide Strategy for Water and Sanitation is also relevant in this context. That document focuses on, among other things, freshwater-related issues and flood risks, emergencies and climate-related water and sanitation challenges.

1.5 How this Draft NAS came about

This NAS is based on the very latest know-how. This, of course, includes the latest climate scenarios and insights relating to climate change[15] and climate risks.[16] An extremely large group of scientists, experts, policymakers, and practitioners has also been mobilised in collaboration with the Dutch Climate Research Initiative (*Klimaatonderzoek Initiatief Nederland, KIN*). Together, they have produced adaptation pathway maps[17] for thirteen of the fifteen European-Dutch challenges (see section 4). A social science sounding board group has also kept us on our toes to ensure that technical solutions are sufficiently complemented by social ones. We have also sought advice from the Netherlands Scientific Climate Council (*Wetenschappelijke Klimaatraad, WKR*) on the major choices facing us as a result of climate change. The valuable source is the advisory report entitled 'Changing with the Climate' (*Meeveranderen met het klimaat*) (2025).[18] Lastly, research was conducted into the environmental impacts of various policy options. The strategic environmental impact report (SEIR) is going to be published simultaneously with the draft NAS'26.

We have included as many perspectives as possible when developing the NAS. In doing so, we were partly inspired by the report entitled 'Equity in climate policy' (*Rechtvaardigheid in klimaatbeleid*) by the Netherlands Scientific Council for Government Policy (*Wetenschappelijke Raad voor het Regeringsbeleid, WRR*).[19] For example, we structured the participation process in a more diverse way by, among other things, supplementing broad participation meetings for professionals with a civil society sounding board group and research involving young people. We also used the periodic citizen perspectives surveys conducted by the Netherlands Institute for Social Research (SCP). Finally, this Draft NAS is available for public consultation. We have experimented with a social impact assessment (SIA) of various policy options, once again in collaboration with the KIN. We have incorporated the results of this SIA into Chapters 3 and 4.

The NAS'26 is a joint production by seven ministries:

- Infrastructure and Water Management (coordinating ministry)
- Economic Affairs and Climate Policy
- Agriculture, Fisheries, Food Security and Nature
- Interior and Kingdom Relations
- Education, Culture and Science
- Health, Welfare and Sport
- Justice and Security

We also involved the following (government) bodies when drafting the NAS'26:

- The Ministry of Social Affairs and Employment, the Ministry of Defence and the Ministry of Finance.
- The umbrella organisations for local and regional authorities: the Association of Netherlands Municipalities *(Vereniging van Nederlandse Gemeenten)*, the Association of Provincial Authorities *(Interprovinciaal Overleg)*, and the Dutch Water Authorities *(Unie van Waterschappen)*.

Many other parties are also contributing to the NAS'26. These include other authorities and organisations in both the European and Caribbean Netherlands. More information on this can be found in the background document.

15 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
16 PBL. *Voorbij de Risico's: keuzes voor een klimaatbestendige leefomgeving*. The Hague: Netherlands Environmental Assessment Agency, 2026.
17 Adaptation pathway maps are structured sequences of successive (sets of) adaptation measures that will help to reduce climate risks, while taking account of lead times, sequencing, effectiveness, and feasibility.
18 WKR. *Meeveranderen met het klimaat. Ruimtelijke en maatschappelijke keuzes voor klimaatadaptatie*. The Hague: Netherlands Scientific Climate Council, 2025.
19 WRR. *Rechtvaardigheid in klimaatbeleid. Over de verdeling van klimaatkosten*. WRR report no. 106. The Hague: Netherlands Scientific Council for Government Policy, 2023.

Text box1.2 **Research involving young people in the European Netherlands**

In the future, the young people of today will be directly confronted with the consequences of climate change and the measures needed to tackle it. That is why it is important that our strategy aligns with their experiential world. In order to gain more insight into this, we asked the MarketResponse research agency to carry out an exploratory qualitative and quantitative study. This research shows, among other things, that young people prefer long-term solutions.[20]

The research shows that they think it is important that agriculture is resilient to extreme weather, but opinions differ on how to achieve this. They believe primarily that the government should play a role in achieving this. They prefer measures which are feasible in practice, which are aimed at the longer term, and which contribute to food production, such as the sustainable management of agricultural land and the cultivation of crops that are more resilient to climate change. Conversely, young people see challenges when it comes to farmers becoming self-sufficient in terms of water.

The research also shows that young people prefer the entire surrounding urban and rural system to be taken into account when taking adaptive measures to arrive at the best solution. Making the living environment greener is seen as the easiest way to reduce the level of heat. The research also shows that young people are the least likely to choose active cooling. It would appear to be sensible to focus on behavioural recommendations, given that a majority has indicated that they follow government advice to keep windows and curtains closed during periods of heat. There is also relatively strong support (66%) among young people for the idea of helping residents who cannot afford to adapt their homes to climate change and extreme weather events.

20 MarketResponse. *Opinieonderzoek klimaatadaptatie jongeren*. Utrecht: MarketResponse, 2026.

1.6 Document structure

The government is the author of this NAS. The terms 'the government' and 'we' are used interchangeably in this document.

When reading the NAS'26, there are a number of important points to note:

- There is a difference in maturity between the various challenges and therefore a difference in the level of detail.
- The government's role may vary depending on the challenge. In the various sections relating to the challenges (Chapter 4) we indicate, where necessary, what our legal role is.
- We have not opted for a single specific KNMI scenario.

This NAS is structured as follows:

- Chapter 2 describes observed and projected climate change and the resulting climate risks.
- Chapter 3 addresses the government-wide, integrated topics, namely the spatial, social, administrative, and financial challenges.
- Chapter 4 covers the fifteen challenges themselves and includes the specific objectives and approach for each of them. In this chapter, we also explain how the adaptation pathway maps should be interpreted.
- Chapter 5 describes the approach for the Caribbean Netherlands.

All the measures mentioned in the NAS are, in principle, existing policy or additional measures that are funded from resources already available within the budgets of the relevant ministries.

Chapter 2

Climate change and climate risks

2.1 Our climate is changing

2.1.1. Climate change in the European Netherlands

The climate in the Netherlands is changing at a rapid pace and, on average, it has become more than 2°C warmer here since KNMI records stated in 1906. This is almost twice as much as the average rise in global temperature given that the average temperature in 2022 was 1.2°C higher than in the period before industrialisation (1850-1900).

Over the past 30 years it has become warmer, drier and wetter in the Netherlands. Sea levels have also clearly been rising more quickly. The frequency of extreme weather conditions has increased. For example, the number of days with temperatures above 30°C has almost doubled in recent decades. Extreme heatwaves, such as the one in 2019, when 40°C was measured for the first time, were previously unimaginable.[1] While hot periods are becoming more extreme, cold times of the year have actually become milder with a significant drop in the number of icy days, when the maximum temperature does not get above zero degrees.[2] There are now fewer days on which the temperature dips below freezing. In the period from 1961 to 1990, there were 41 such days. In the period between 1991 and 2020, there were only 35.[3] Climate change is therefore clearly noticeable in the Netherlands.

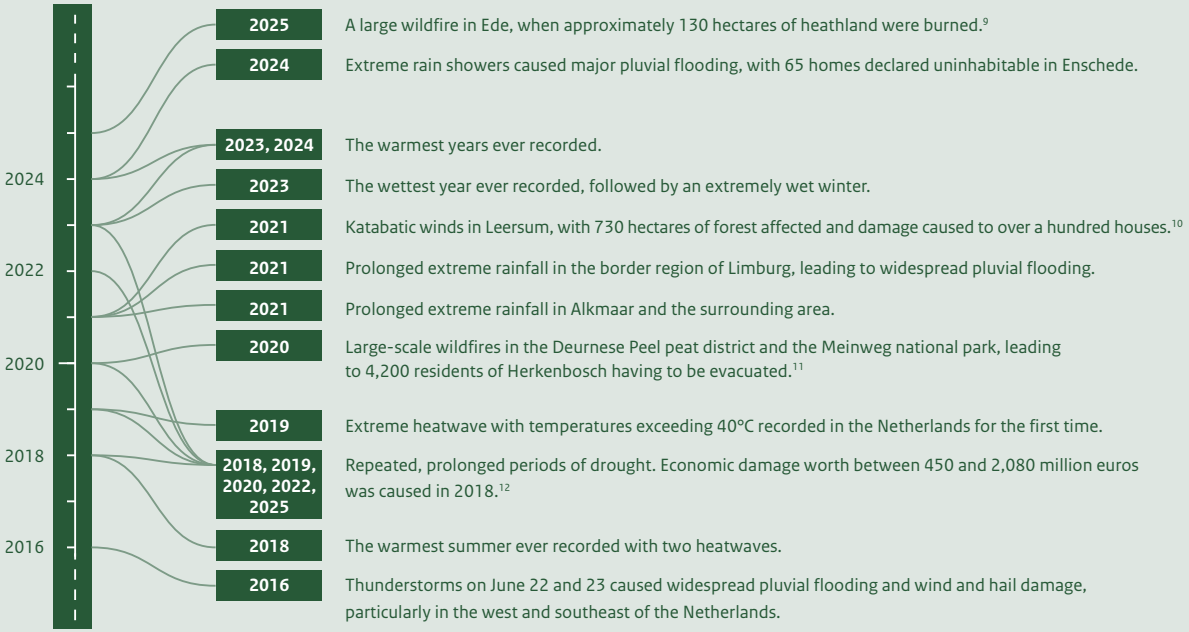
The annual amount of precipitation has also increased by 20% since 1906. Our winters, in particular, have become wetter.[4] Extreme precipitation is also a more frequent occurrence, predominantly in summer. The number of days of heavy precipitation (50 millimetres at a minimum of one location in the Netherlands) has increased by 85% since 1951.[5]

Over the past decade, the Netherlands has repeatedly experienced periods of prolonged drought, for example in 2018, 2019, 2020, and 2022. The likelihood of dry summers in individual years or over a number of years has increased.[6] The substantial year-to-year variations in precipitation and evaporation means we cannot yet claim that there is a national drought trend.[7]

The sea level off the Dutch coast has risen by about 25 centimetres since 1890. The rate at which this is happening has also increased. The sea level rose almost twice as fast in the period from 1993 to 2021, compared to the period from 1890 to 1993.[8] This has been corrected for natural variations in sea level caused by wind speed and direction.

1 PBL. *Klimaatrisico's in Nederland. De huidige stand van zaken*. The Hague: Netherlands Environmental Assessment Agency, 2024.
2 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
3 Royal Netherlands Meteorological Institute (KNMI). *Klimaatsignaal'21. Hoe het klimaat in Nederland snel verandert*. De Bilt: KNMI, 2021.
4 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
5 PBL. *Klimaatrisico's in Nederland. De huidige stand van zaken*. The Hague: Netherlands Environmental Assessment Agency, 2024.
6 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
7 PBL. *Klimaatrisico's in Nederland. De huidige stand van zaken*. The Hague: Netherlands Environmental Assessment Agency, 2024.
8 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.

Figure 2.1 **A number of extreme weather events and their impact in the European Netherlands, 2016-2025**



Source: KNMI; Eden et al. 2018; Copernicus 2023; Otten et al. 2000

Wildfire in Mariapeel
(Photo: Rob Engelaar, Hollandse Hoogte)

9 Brandweervrijwilligers.nl. 'Grootschalige inzet natuurbrand Ede'. *Brandweervrijwilligers.nl*, 20 mei 2025.
10 Scheele, T. 'Hoe een valwind 1 jaar geleden een ravage veroorzaakte in Leersum'. *RTV Utrecht*, 18 juni 2022.
11 Institute of Physical Safety (*Instituut Fysieke Veiligheid*) *Natuurbrand in De Meinweg en de evacuatie van Herkenbosch. Factsheet.* Arnhem: IFV, 2020.
12 PBL. *Toekomstbestendig kiezen, rechtvaardig verdelen. Balans van de leefomgeving 2023*. Den Haag: Planbureau voor de Leefomgeving, 2023.

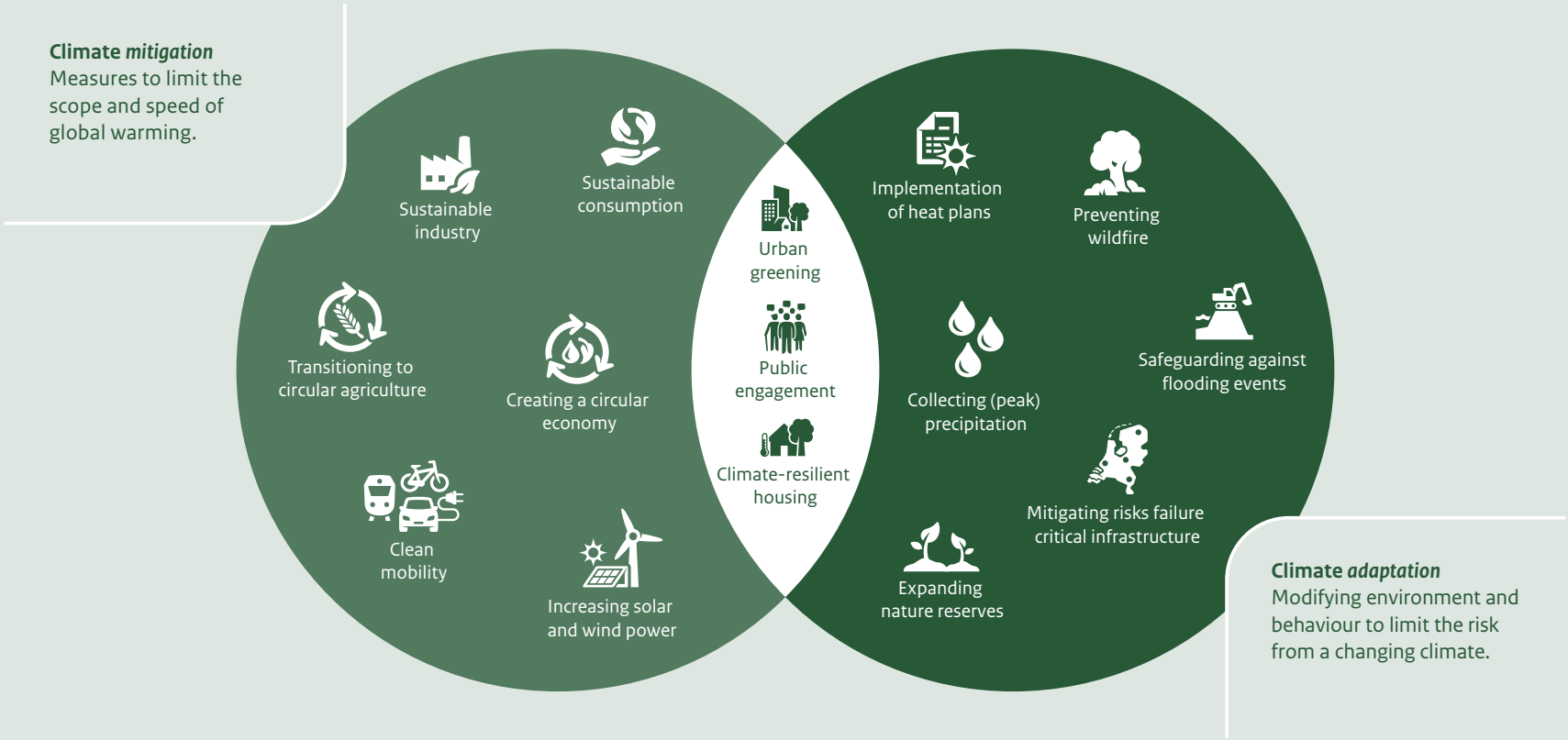


Figure 2.2 **Visualisation of the relationship between climate mitigation and climate adaptation**

Our climate can change due to both natural and human causes. However, since the 20th century, it has been changing primarily due to human activities. The main reason for this is the burning of fossil fuels Which causes more greenhouse gases to enter the atmosphere and obstruct the release of heat into space, thereby causing the Earth to warm up.

The Netherlands is committed to reducing greenhouse gas emissions, and the term used to describe that is 'climate mitigation'. It is also taking measures to limit the negative consequences of climate change on society and the term used to describe that is 'climate adaptation'.[13]

13 Ministry of Infrastructure and Water Management. *National Climate Adaptation Implementation Programme.* The Hague: Government of the Netherlands, 2023.

It is important to have an insight into how the climate is going to continue to change, so that we can prepare for it. To this end, the KNMI has developed KNMI'23 climate scenarios. These translate the knowledge gained from the most recent IPCC report for the Dutch context. The climate scenarios present various possibilities for what the climate in the Netherlands might look like in around 2050, 2100, and 2150 and were developed with low and high greenhouse gas emission futures in mind. The idea was to be as clear as possible about the consequences of international choices in climate policy and enable a proper risk assessment of the potential consequences of climate change.[14]

According to the KNMI'23 climate scenarios, we can expect a number of climate trends. These are illustrated in Figure 2.3. The trends build on the changes that have already been set in motion over the past decades. Put briefly, we can expect to witness the following climate trends in the Netherlands:[15]

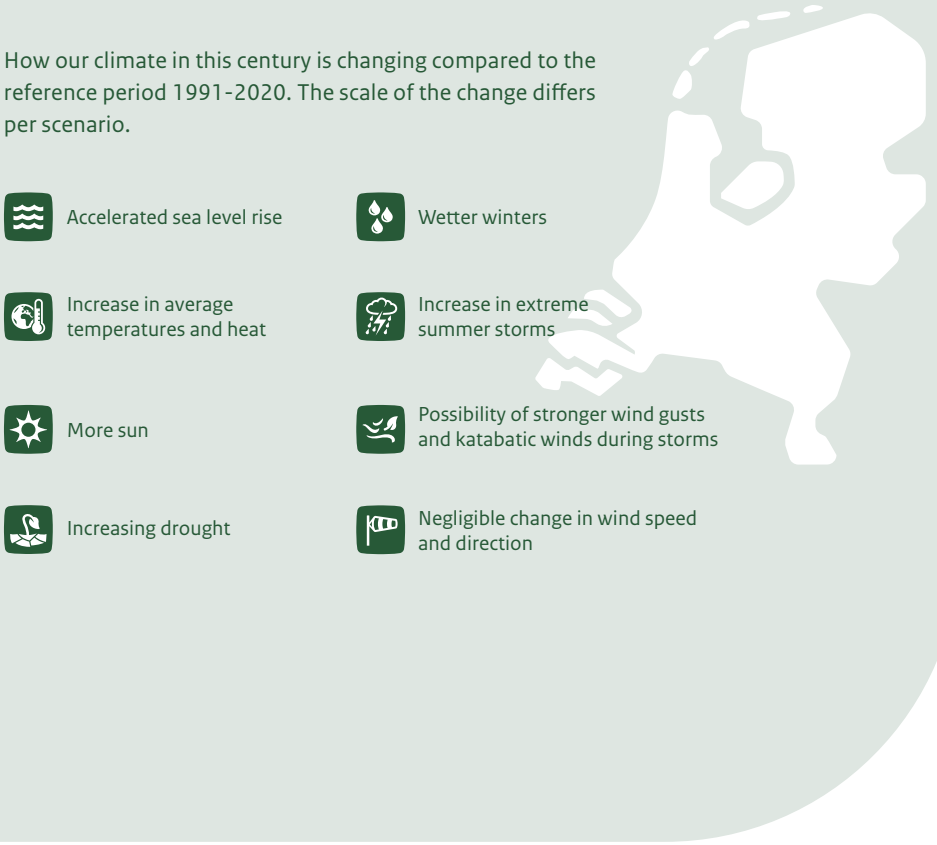
- **Temperatures will continue to rise.** In both 2050 and 2100 the expected temperature increase will be greatest in summer and smallest in winter and spring. There will also be regional differences, with the least warming in the northwest and gradually increasing warming towards the southeast. This warming effect means a further decrease in the number of annual icy days, from six in the current climate to just one in 2100, assuming that global greenhouse gas emissions will be high. The number of summer days with temperatures above 25°C could increase from 28 in the current climate to 40 to approximately 90 in 2100.

- **According to all climate scenarios, precipitation will increase in winter.** Precipitation will actually decrease in summer. However, there will be a shift in the type of precipitation in summer, with light summer showers becoming less prevalent, while the number of heavier and intense showers will increase.

- **The likelihood of extreme drought will increase.** Extreme drought is likely to occur more frequently, particularly if global greenhouse gas emissions remain high. Extremely dry summers, like those in 2018 and 2022, will become a more regular occurrence. In the driest scenario, an average summer in 2100 will be as dry as an extremely dry summer in the current climate.

- **Sea levels will continue to rise.** By 2050, we can expect a rise of between 16 and 38 centimetres above the current level. By 2100, the expected rise will be between 26 and 73 centimetres in the low emissions scenario and between 59 and 124 centimetres in the high emissions scenario. There may even be a 2.5 metre rise in sea levels by 2100. However, this depends on a number of uncertain processes, for example if more of the Antarctic ice sheet is lost than expected.

Figure 2.3 **The KNMI'23 climate scenarios summarised for the European Netherlands**



14 Royal Netherlands Meteorological Institute (KNMI). KNMI'23-klimaatscenario's voor Nederland. De Bilt: KNMI, 2023.
15 Royal Netherlands Meteorological Institute (KNMI). KNMI'23-klimaatscenario's voor Nederland. De Bilt: KNMI, 2023.

Text box 2.1 **Extreme weather in the current climate**

Climate change is not something that is going to take place in the distant future. Not only has our climate already changed, we are experiencing weather extremes like never before. These extremes sometimes occur together (compound event) or follow one another (cascading event), and that increases their impact. What is more, a combination of weather conditions that are not particularly extreme in themselves and non-meteorological factors can still result in an extreme impact.

The Royal Netherlands Meteorological Institute (KNMI) published 'An Extreme Report' (Een extreem rapport)[16] in 2025. Working together with its partners, the KNMI sought to identify several plausible weather extremes in the current climate and the expected impact in a specific sector. One of those extreme weather events was the heatwave in July 2018 which, according to weather models, could have lasted longer, with four extra days above 35°C and additional tropical nights. That could have exacerbated the existing (health) impact on society and put pressure on electricity supplies and the emergency services.

In the Caribbean Netherlands, Hurricanes Irma (2017) and Ivan (2004) could have passed directly over Saba, St. Eustatius, and Bonaire instead of bypassing them. If that had happened, wind damage to buildings on the Windward Islands would have been seven to nine times greater. In the case of Bonaire, the level of damage would have increased from no damage to buildings in the original scenario to 46% damage to buildings in the plausible extreme.

In addition to these examples, the report describes a wildfire, extreme precipitation, a stray hurricane, drought, anticyclonic gloom, extreme cold and a potential outbreak of West Nile virus in the Netherlands. These scenarios, illustrate which new and existing risks are conceivable in the current climate and can be used as a starting point for risk dialogues.

16 Royal Netherlands Meteorological Institute (KNMI). *Een Extreem Rapport*. De Bilt: KNMI, 2025.

2.1.2 Climate Change in the Caribbean Netherlands

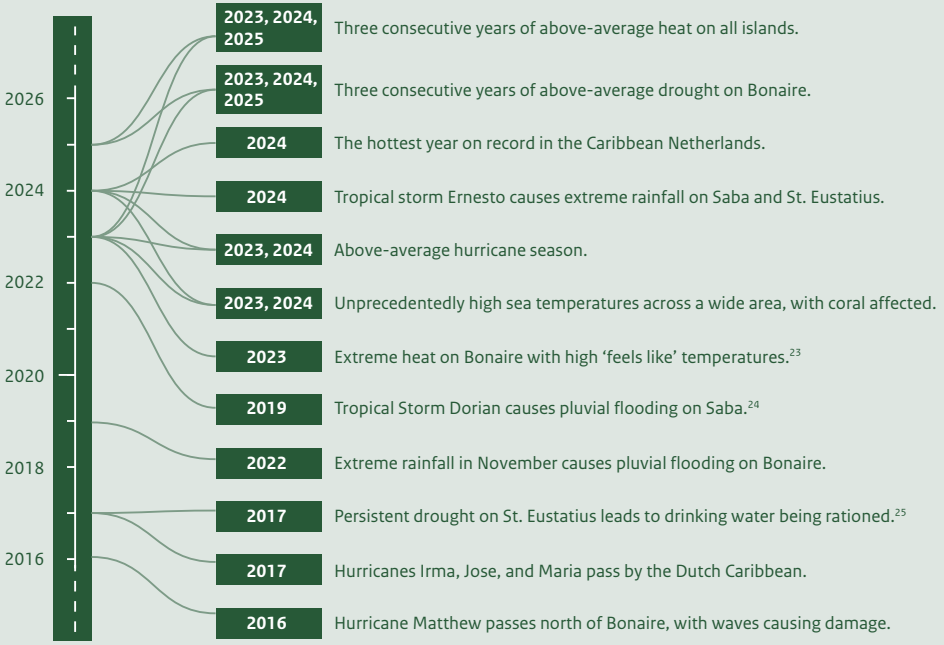
The Caribbean Netherlands is also warming up. On Bonaire 2025 was, in fact, the second warmest year on record, second only to 2024. There was also very little rainfall on Bonaire. What is more, 2025 is the third consecutive year that can be categorised in the top ten driest years. The temperature in the Caribbean Netherlands has risen by 0.8°C since the 1980s.[17]

The KNMI'23 climate scenarios also present the possible changes in climate in the Caribbean Netherlands. According to the scenarios, the temperature and wind speed will increase, while the total amount of precipitation will decrease. The sea level is also rising at an increasing rate and this is particularly a problem for low-lying Bonaire, where it is rising faster than on St. Eustatius and Saba, at a rate of 3.7 millimetres per year. The expectation is that, by 2050, the sea level around Bonaire will have risen by 14-37 centimetres compared to the current level. This could increase to 127 centimetres in 2100, depending on global greenhouse gas emissions.[18]

The likelihood of hurricanes of the highest category occurring is also increasing. It is expected to increase from once every 39 years now (1980-2017) to once every 20 to 34 years in the future (2015-2050).[19] This finding is of particular importance for the islands of St. Eustatius and Saba, because they are more frequently in a hurricane's path. An above-average hurricane season was already observed in the Caribbean Netherlands in 2023 and 2024.[20, 21] Tropical Storm Ernesto caused heavy rainfall and strong winds on Saba and St. Eustatius in August 2024, resulting in flooding, falling rocks, and uprooted trees.[22]

17 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
18 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
19 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
20 Royal Netherlands Meteorological Institute (KNMI). 'Caribisch Nederland,' KNMI Jaaroverzicht (2023).
21 National Office for the Caribbean Netherlands (Rijksdienst Caribisch Nederland) 'De staat van ons klimaat 2024: Een recordwarm jaar.'
22 National Office for the Caribbean Netherlands (Rijksdienst Caribisch Nederland) 'De staat van ons klimaat 2024: Een recordwarm jaar.'

Figure 2.4 **Some extreme weather events and their impact in the Caribbean Netherlands, 2016-2025**



NB: The combination of dry periods on Bonaire alternating with tropical rainfall in November causes pluvial flooding, erosion, and sediment washout almost every year (not just in 2022).

23 Hendriksen, K. 'Extreme hitte op abc-eilanden: 'Hoelang duurt dit nog?' *Caribisch Netwerk*, 29 September 2023,
24 Antilliaans Dagblad. 'Tropical storm Dorian zorgt voor overstromingen op Saba' *Antilliaans Dagblad*, 29 August 2019,
25 Kerkhof, J. van. 'Drinkwater Sint-Eustatius op rantsoen.' *Caribisch Netwerk*, 8 April 2017,

Storm Omar on Bonaire, 2008
(Photo: ABC Online Media)

Figure 2.5 **The KNMI'23 climate scenarios summarised for the Caribbean Netherlands**

2.2 Climate risks of today and tomorrow

The Netherlands Environmental Assessment Agency (PBL) has identified the climate risks for the Netherlands. Climate risks are the potential negative consequences of climate change for human (social, economic, health) and ecological systems. The magnitude of a climate risk is determined by the size of the impact and the probability of occurrence.[26] For example, while the probability of flooding occurring is very small, its impact can be substantial and can result in a large number of casualties and extensive damage. Inundation occurs much more frequently, but usually affects a smaller area and is typically of shorter duration. Consequently, inundation has a smaller impact. Both a large impact and a high probability of occurrence can be reasons for addressing a particular risk. Risks with both a high probability of occurrence and a large impact are usually the most urgent.

The PBL examined climate risks for various sectors, such as agriculture, cultural heritage, nature, and health. Figure 2.6[27] presents the various climate risks for both the current and future situation in the Netherlands and shows that most climate risks are increasing, either in terms of the probability of occurrence and/or in the magnitude of their impact.

As an example, we are now going to examine a number of risks which are linked to expected climate trends. The Netherlands is becoming warmer, drier, and wetter, so what climate risks do these changes imply? This sections on the fifteen challenges in Chapter 4 examine this in more detail. By describing which climate risks already exist, which are likely to occur in the future, and how we as the Netherlands can best prepare for them.

An increased likelihood of heat implies many adverse consequences for society. For example, extreme heat can lead to an increase in mortality, or to reduced accessibility due to movable bridges becoming jammed in the heat. The exceptional heatwave in the summer of 2019 resulted in 400 excess deaths in a single week. Vulnerable groups, such as the elderly, are particularly at risk of overheating.[28] If global greenhouse gas emissions remain at a high level, the expectation is that approximately 3,800 people will die prematurely each year by 2050. Although this will be partly down to climate change, population growth and an aging population also play a role.[29]

Periods of prolonged drought imply significant risks for the Netherlands. This was the case in 2018, 2019, 2020, and 2022, and such periods will become even more likely in the future. They can cause irreversible damage to wetland archaeology and cultural-historical landscapes, as well as large uncontrollable wildfires, damage to nature, and poorer harvests in the agricultural sector. Water can become less available during these periods, and logistics and industry may be disrupted because fewer goods can be transported along waterways. The economic damage caused by extreme drought is huge. For example, the total damage caused by the extremely dry summer of 2018 is estimated to be between 450 and 2,080 million euros.[30] This damage was caused by, among other things, poorly navigable waterways and crop failures.

The risk of flooding increases due to more extreme precipitation. Examples of extreme precipitation include torrential downpours and prolonged showers which overload the water system so that it can no longer drain sufficient amounts of water, thereby leading to flooding. One alarming example of this was the torrential downpour in Enschede on 21 July 2024 when 55 millimetres of rain fell in just one hour.[31] On average, 86 millimetres of rain falls in Enschede during the entire month of July, and in this case, almost the same amount fell within a period of one hour.[32] The consequences were huge, with 60 families losing their homes due to the resulting damage.[33]

26 PBL. *Klimaatrisico's in Nederland. De huidige stand van zaken*. The Hague: Netherlands Environmental Assessment Agency, 2024.
27 PBL. *Voorbij de Risico's: keuzes voor een klimaatbestendige leefomgeving*. The Hague: Netherlands Environmental Assessment Agency, 2026.
28 PBL. *Klimaatrisico's in Nederland. De huidige stand van zaken*. The Hague: Netherlands Environmental Assessment Agency, 2024.
29 PBL. *Voorbij de Risico's: keuzes voor een klimaatbestendige leefomgeving*. The Hague: Netherlands Environmental Assessment Agency, 2026.
30 Royal Netherlands Meteorological Institute (KNMI). 'Attributie van de droogte in 2028 in Nederland'. KNMI.nl, 26 May 2020.
31 NOS and RTV Oost. 'Zestig gezinnen raken huis definitief kwijt na hoosbui Enschede.' NOS, 3 April 2025,
32 Climate-data.org. 'Klimaat Enschede: Klimatogram, Temperatuurgrafiek en Klimaattabel voor Enschede'.
33 NOS and RTV Oost. 'Zestig gezinnen raken huis definitief kwijt na hoosbui Enschede.' NOS, 3 April 2025,

Figure 2.6 **Scale of critical climate risks per sector and topic, now and in 2050, when continuing current policy and with major climate change**

Topic/sector	Risk today	Risk in 2050 with current policy	Risk category (economy, people, nature, culture) and description of outlined risks
Health	Major ■■■■■	Major ■■■■■	**People**: number of additional deaths from higher temperatures; increase in infectious diseases, allergies and sickness from air pollution and UV radiation
Cultural heritage	Major ■■■■	Major ■■■■■	**Culture**: disappearance of wet archaeological heritage due to drought
Water availability	Medium ■■■■	Major ■■■■■	**Economy**: salinisation in low-lying areas of the Netherlands
Nature	Medium ■■■■	Major ■■■■■	**Nature**: irreversible damage to biodiversity and ecosystem functions due to heat and drought
Water quality	Medium ■■■■	Major ■■■■■	**Nature**: irreversible damage to biodiversity and ecosystem functions due to heat and drought
Wildfires	Medium ■■■■	Major ■■■■	**People, economy, nature, culture**: risk of simultaneous or uncontrollable wildfires due to heat and drought
Flooding	Major ■	Major ■	**People, economy, nature, culture**: damage and casualties due to flooding from oceans, major rivers and lakes
Built environment	Major ■■■■■	Major ■■■■■	**People**: number of people affected by heat and pluvial flooding
Drinking water	Minor ■■■■	Medium ■■■■■	**Nature**: increasing damage to natural environment from drinking water extraction
Agriculture	Minor ■■■■	Medium ■■■■	**Economy**: reduced crop yield due to drought
Infrastructure	Major ■■■	Major ■■■	**Economy**: physical damage and societal losses due to extreme weather, with consequences for inland shipping, roads and railways
Energy	Medium ■■■	Medium ■■■	**Economy, people**: damage and disruption from energy supply outages due to drought
Digital infrastructure	Minor ■■■■	Minor ■■■■	**Economy, people**: damage and disruption from data centre outages due to prolonged extreme drought

Legenda

Impact	Economy	People	Nature and water quality	Cultural heritage
Major	More than 1 billion euros	More than 100,000 people affected, more than 100 serious injuries/deaths	National and/or irreversible damage	National and/or irreversible damage
Medium	0.1 - 1 billion euros	10,000 - 100,000 people affected, 10 - 100 serious injuries/deaths	Regional and/or difficult to reverse damage	Regional and/or difficult to reverse damage
Minor	Less than 0.1 billion euros	< 10,000 people affected, 0 - 10 serious injuries/deaths	Local and/or reversible damage	Local and/or reversible damage

Chance of occurrence	
■	< once every 1000 years
■■	1/100 – 1/1000 years
■■■	1/10 – 1/100 years
■■■■	1/1 – 1/10 years
■■■■■	annually

Text box 2.2 **Complex climate risks**

Climate risks do not exist in isolation. They may mutually reinforce each other or accumulate, thereby potentially creating a new risk. These are referred to as complex climate risks or compound effects. It is important that we take this possibility into account. If we only look at individual risks, we may end up underestimating the consequences. An example of a complex climate risk is the simultaneous occurrence of heat and drought, which leads to an increased demand for water while less of it is available. Another example is that soil absorbs water less effectively in times of drought, thereby increasing the risk of flooding in the event of an extreme downpour.[34]

34 PBL. *Klimaatrisico's in Nederland*. De huidige stand van zaken. The Hague: Netherlands Environmental Assessment Agency, 2024.

Figure 2.7
Four area types ir the Netherlands

Source: Scientific Climate Council (WKR)

Text box 2.3
Four area types with specific points to consider

The impact of climate change varies per location and sometimes even per building. Broadly speaking, we can subdivide the European Netherlands into area types. The Netherlands Scientific Climate Council identified the following four area types, each requiring a distinct, area-specific approach.[35]

1. Soil subsidence is a major problem in **peatland areas**. We extract water from these areas for agriculture and housing construction and as a result, the peat comes into contact with oxygen, causing it to oxidise (decompose). This has consequences, such as higher CO2 emissions, the drying up of valuable natural areas, and damage to infrastructure and buildings.

2. In **clay areas**, salinisation is a major threat to maintaining water quality during dry summers. Saline or brackish groundwater mixes with surface water or enters the water system. This poses a threat to current land use that revolves around freshwater and to nature reserves that depend on it. A large amount of flushing water is required to counteract salinisation and this has an adverse effect on freshwater availability. Rising sea levels and increasing drought make the challenge of salinisation even more daunting.

3. **Sandy soils** have been affected by a structural decline in groundwater levels since the 1990s. This is also known as desiccation, with 60% being the result of extracting drinking water from these soils. Desiccation damages nature that depends on groundwater, and it is exacerbated by climate change. The drought in 2018-2020 caused irreversible damage to 4-20% of nature. The exacerbating factors mean that desiccation is now also a threat to agriculture, industry, and drinking water supplies. Finally, flooding is also a major risk in sandy soils, with the regional water system needing more capacity to handle peak precipitation.

4. The greatest risk in **urban areas** is the rise in temperature. Temperatures in our cities are higher on average due to the prevalence of concrete and asphalt and little wind and greenery. The temperature difference between urban and rural areas can be as much as 8°C in some locations during windless nights. High temperatures and heat can have a significant impact on both physical and mental health. They can also negatively affect the quality of the living environment due to poorer air quality and increased exposure to UV radiation.

35 WKR. *Advisory report entitled 'Meeveranderen met het klimaat'. Ruimtelijke en maatschappelijke keuzes voor klimaatadaptatie.* The Hague: Netherlands Scientific Climate Council, 2025.

2.3 The sectoral NAS challenges

Armed with this knowledge of expected climate changes and climate risks, this NAS is going to examine the fifteen most significant sectoral challenges for the European Netherlands.[36] The way these challenges have been defined largely aligns with the sectors identified in the climate risk analysis by the Netherlands Environmental Assessment Agency,[37] although we have also added a number of water-related policy areas.

The islands and the government have prioritised fourteen sectoral adaptation challenges for the Caribbean Netherlands. This prioritisation is based on studies and consultations with various stakeholders, including the BES public bodies.

36 Ministry of Infrastructure and Water Management. *National Climate Adaptation Implementation Programme* The Hague: Government of the Netherlands, 2023.
37 PBL. *Klimaatrisico's in Nederland. De huidige stand van zaken*. The Hague: Netherlands Environmental Assessment Agency, 2024.

Chapter 3

Government-wide, integrated challenges

3.0 Introduction

Failing to do something about climate adaptation now will lead to higher costs in the future.[1] When we organise our living environment in a way which is climate-adaptive now and change our behaviour, we will avoid a situation in which we have to take more expensive measures later on. In Chapter 4, we use adaptation pathway maps to identify, for the fifteen policy sectors most affected by climate change, what is needed to create a climate-resilient Netherlands, now and in the future. The initiatives we have formulated for the short term are therefore a first step towards achieving a long-term goal, with the intention being to prevent, wherever possible, any spillover of costs, nuisance and damage onto future generations. By preparing in good time, we will also be able to contribute to a positive business climate.

The various 'sectoral' challenges are closely interconnected, and that interconnectedness is strongly dependent on context.[2] This concerns both the connection between the adaptation challenges themselves and between the adaptation work and other major challenges, such as that of housebuilding. The assessment of the various challenges in Chapter 4 reveals that some of them, in their combined form, present both strong synergies and substantial dilemmas. For example, the SEIR shows that while additional water supplies and fresh water flushing present opportunities to maintain agricultural production in clay areas which are subject to salinisation, the same measures also increase pressure on drinking water reserves and nature. If this strategy is maintained for too long, a lock-in occurs: dependence on supply and energy, while salinisation inevitably continues.[3] Another example is the building of climate-resilient new buildings. Although this presents clear opportunities for combinations with resilient nature and future-proof work locations, it may also lead to friction with agriculture or nature if they are replaced by new buildings. The relationship between health and water quality is predominantly positive, with fewer obvious negative mutual effects. This suggests that they can function as a connecting element in many instances. It is difficult to make general statements about what can or cannot be combined because whether there is a connection depends very much on the context. A tailored approach, area-specific considerations, and space for local knowledge and cooperation are therefore required.

When we adopt an integrated approach, we can prevent any spillover and save costs. If we consider and implement climate adaptation measures in isolation, spillover may occur from one sector to another, for example due to scarcity of water and space. If, on the other hand, we adopt an integrated approach to climate adaptation, we will be able to seize opportunities. Making the living environment greener will, for example, help to achieve multiple goals, such as cooling and the sponge function. We will also be more effective when we combine social and physical measures. The greatest safety gains can, for example, be achieved with a complete package consisting of a climate-adaptive design for our physical living environment, as well as targeted risk communication. That is why it is important to involve safety partners, such as the Safety Regions, closely in the development of the full set of adaptation measures. Lastly, we will be able to adapt more quickly to the changing climate and to save costs by aligning as much as possible with existing initiatives.

At the heart of this NAS is the idea that everyone in society has and plays a role in order to become climate-adaptive together. Climate change affects everyone. We cannot predict exactly how this will happen or what the consequences will be. We are already seeing clear incidents that will occur ever more frequently in the future. Public authorities, the public, businesses, and other organisations all have an important role to play in order to be properly prepared, both now, by taking proactive measures, and when climate risks arise, by being able to respond appropriately.

As the government we have an important role to play in establishing clear frameworks and making the right information available. In this way, we will ensure better access to information about climate risks and what can be done to address them. We are also sharing information about the measures we are taking at national level regarding, for example, water distribution and how we are preparing for drought and heat.

1 Rebel, as commissioned by the Ministries of the Interior and Kingdom Relations and Infrastructure and Water Management. *Financiële verkenning maatlat klimaatadaptatie. Droge voeten, koele plekken en gezonde steden*. Rotterdam: Rebel, 2024.
2 KIN. *Adaptatiepaden voor de Nationale Klimaatadaptatiestrategie (NAS) '26*: Deel 2. Amsterdam: Dutch Climate Research Initiative, 2026.
3 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Utrecht: Movares, 2026.

In this context, it is our task to prevent spillover of costs, nuisance and damage wherever possible and to take account of people's capacity to act. Among other things this means minimising spillover to other areas, groups, and generations and from the private to the public sector. We are also focusing on people in vulnerable positions who are unable to reduce their climate risks.

In the following paragraphs, we describe the government's strategy for tackling government-wide, integrated challenges. We do this using four components. In section 3.1 we discuss spatial planning and development, in 3.2 we examine a society which is prepared for climate change, in 3.3, we address governance structures equipped to tackle the challenge of adaptation and in 3.4 we examine the financial viability of climate adaptation. We elaborate more on the fifteen sectoral challenges in Chapter 4.

3.1 Climate-resilient spatial planning and design

The changing climate creates additional challenges in the spatial domain of the Netherlands. On the one hand, for example, space is needed to reinforce flood defences and for water itself, in order to withstand torrential downpour and to have sufficient fresh water and navigable depth available during periods of drought. On the other hand, more and more points in the existing organisation are becoming restrictive. In some areas, for example, our agriculture no longer aligns properly with the changing conditions of the water and soil systems, and the space in residential areas is not always organised in a sufficiently climate adaptive way that allows us to deal adequately with the consequences of heavy rain showers or periods of heat. We will also have to start using the soil in a different way. There is also the question of how this aligns with other major and urgent challenges which require space, such as housebuilding, defence, and the energy transition.

We are working together with subnational authorities on a climate-adaptive physical living environment. In doing so, we are focusing on preserving the existing situation where possible (intensification) and on making changes where necessary (transformation). Until now, we have been able to facilitate the majority of current land and function usage through (technical) solutions, for example by arranging water and soil conditions to align with the user's wishes. The SEIR, which has been drafted for the NAS'26, shows that this 'intensification' adaptation strategy is no longer effective in a number of different locations. This finding is also backed up by the reports of the Netherlands Scientific Climate Council (WKR)[4] and the Netherlands Environmental Assessment Agency (PBL).[5] We will have to accept that it is better to focus on 'transformation' sooner rather than later at an increasing number of locations in order to make the system more robust and cope more effectively with the vagaries of climate change.

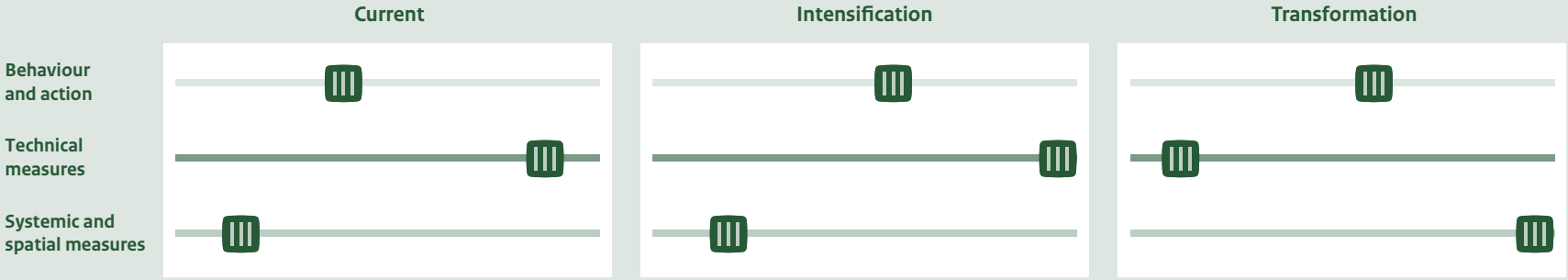
4 WKR. *Meeveranderen met het klimaat*. The Hague: Netherlands Scientific Climate Council, 2025.
5 PBL. *Voorbij de Risico's: keuzes voor een klimaatbestendige leefomgeving*. The Hague: Netherlands Environmental Assessment Agency, 2026.

Text box 3.1.1 **'Intensification' and 'transformation'**

We differentiate between two adaptation strategies: intensification and transformation. 'Intensification' focuses on preserving current functions and land use, despite the changing climate. Examples include housing, agriculture, infrastructure and nature. We can use primarily technical measures to maintain the current way in which space is used. 'Transformation' focuses on adjusting functions and land use, so that they align more effectively with the water and soil system and the changing climate. Decisions on where to transform or intensify require an extensive process of coordination with stakeholders

The two strategies are also part of the study on future climate risks conducted by the Netherlands Environmental Assessment Agency (PBL). The PBL has illustrated the strategies as follows, see Figure 3.1.1.

Figure 3.1.1 **Solution strategies for climate adaptation**



Source: PBL *Voorbij de Risico's: keuzes voor een klimaatbestendige leefomgeving*. The Hague: Netherlands Environmental Assessment Agency, 2026.

Intensification and transformation have far-reaching consequences for an area. The social impact assessment[6] reveals that transformation often yields more positive social effects in the long term than intensification. However, this strategy can cause 'friction' in the short term. We need to pay attention to this and take action. The SEIR concludes, "The Netherlands can achieve rapid, sectoral gains through intensification until approximately 2050, but faces increasing systemic risks in the period to 2100 (including those caused by sea level rise, desiccation, salinisation, and cumulative spatial claims). Transformation requires earlier and more radical choices, such as functional adaptation and taking the water and soil system into account, but delivers a more robust system with integrated solutions in the long term. An adaptive combination is needed, in other words, intensification where possible and necessary right now, and targeted transformation where necessary and feasible. The crucial thing is to prevent lock-ins and shifting (of risks and resource use between areas and generations)."[7]

The Dutch population has a clear preference for transformative solutions over intensification-based solutions.[8] This may be because transformation is viewed as a more structural solution. This is according to a survey conducted by the PBL via the Longitudinal Internet studies for the Social Sciences (LISS) panel among more than 2,000 residents of the Netherlands. This involved the PBL asking for opinions on the two possible solutions and a number of policy choices being presented in four focus groups in line with these solutions.

6 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.
7 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Utrecht: Movares, 2026.
8 PBL. *Voorbij de Risico's: keuzes voor een klimaatbestendige leefomgeving*. The Hague: Netherlands Environmental Assessment Agency, 2026.

As the government we will set out more clearly the extent to which we can continue to support the regions, for example via the main water system. We are doing this via, among other things, the (Draft) Spatial Policy Document (the successor to the National Strategy on Spatial Planning and the Environment) and its further elaboration. The frameworks are provided by the decisions taken as a result of the Spatial Policy Document and national programmes like the National Water Programme. This is how we intend to clarify what others can expect of the government. The result will be that subnational authorities will find it easier to manage their climate adaptation efforts.

The choices included in the Spatial Policy Document therefore influence the organisation of our climate-adaptive physical living environment. To achieve a future-proof main water system, one of the choices, for instance, is to avoid investing, in principle, in technical measures to transport (fresh) water from the main water system to areas where this is not sustainable (in the long term). This means that regions which are not supplied via the main water system must focus more strongly on saving, retaining, and storing water, even more so than regions that are. Water consumers must also take account of periods of extreme drought, water shortages, flooding, and salinisation. They need to take steps themselves to become more resilient. We have elaborated on this in more detail in challenge 4.3 *Resilient to increasing freshwater shortages*. This also features in, for example, challenge 4.5 *Climate-resilient agriculture*, which focuses on more efficient water use at the level of agricultural business and regions. Other choices made in the draft Spatial Policy Document also have implications for climate adaptation policy (see text box 3.1.2).

Text box 3.1.2 **Draft Spatial Policy Document: three building blocks for water and soil**

The Draft Spatial Policy Document contains three building blocks for initiatives relating to water and soil. These are working towards a future-proof main water system, balancing regional systems and ensuring climate-resilient infrastructure at local level.

1. A future-proof main water system
The major challenges relating to flood protection (including coastal protection), fresh water availability and pluvial flooding are increasingly viewed, from the perspective of the main water system, not only in terms of their interconnectedness, but also in relation to other land use. Seen from this perspective, choices are made which will guarantee a future-proof main water system. As far as the NAS'26 is concerned, one relevant choice, for example, is that sufficient space is reserved for the main water system (see challenge 4.1 *Properly protected against flooding*) and for water storage (see challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall*).

2. Regional systems in balance
It is essential that regional water and soil conditions are improved and strengthened. We will then be able to take better account of periods of drought, flooding, and salinisation, as well as for the resulting changes, such as reduced water availability. This is, for example, explored in more detail in challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall* and challenge 4.5 *Climate-resilient agriculture*. Another important aspect is the need to achieve a better balance between fresh water supply and demand at regional level, we explore this in more detail in challenge 4.3 *Resilient to increasing freshwater shortages*. This is how we intend to identify how much water is taken from the main water system, so that it can then develop a policy framework for sustainable groundwater and surface water management.

3. Climate-adaptive design
A strong commitment to climate-adaptive spatial planning and design is crucial. It will help us prepare for the impact of climate change and adapt to changing circumstances where necessary. After all, climate change is having a major impact on the living environment and is, among other things, putting our economy, health, and safety at risk. One of the choices is that we are taking systematic account of the current and future effects of climate change when planning and developing the physical living environment. We explore this in more detail in this section on spatial planning (by seeking to use existing tools more effectively), and in challenge 4.8 *Heat-resilient cities, towns and villages*, challenge 4.11 *Climate-adaptive new developments* and challenge 4.12 *Climate-resilient housing for all*. In those sections we announce that we are, for example, focusing on improving the design of areas to cope with extreme weather events, including by continuing to develop the National Benchmark for a green, climate-adaptive built environment.

We can only achieve a climate-resilient physical living environment through effective collaboration between public authorities and other partners. The role of the provincial authorities is, for example, crucial in terms of control, coordination, and setting priorities. Safety regions are an important partner when it comes to incorporating safety into spatial planning choices. Municipal Health Services and municipalities play a major role as the bridge between the physical and social domains and the creation of a healthier living environment. What is more, as the social impact assessment (SIA) demonstrates, it is very important that residents are properly and punctually on board whenever changes are made to spatial planning.[9] The key decisions regarding intensification and transformation therefore require joint dialogue, and that will sometimes be a challenge. That is why government is involved in area-based approaches. We are doing this, on the one hand, because of the synergy outlined in the Draft National Spatial Strategy. This is why we are collaborating with the provincial and municipal authorities and the water authorities on an integrated description of, and a strategy for, the regional water and soil systems (in relation to the main water system). This will make it possible to establish unambiguous conditions, both now and in the future. On the other hand we are, for example, involved in regional elements of the Delta Programme and existing area-based processes such as the NOVEX areas. In doing so, we are demonstrating how the climate adaptation challenge can be incorporated into regional spatial processes. We are also investigating what kind of additional cooperation, information, and potential support are needed.

As regards new developments in the spatial domain, we are getting off to a good start by taking current and future effects of climate change into account. We are investigating how existing instruments (such as the environmental impact assessment and water interest weighting (*Weging van het Waterbelang*) can be used more effectively, and whether they need to be adjusted. By doing so, we are implementing the recommendations of the Netherlands Scientific Climate Council[10] and the Council for the Environment and Infrastructure (*Raad voor de leefomgeving en infrastructuur*, Rli).[11]. This is also reflected in the challenges, for example in challenge 4.3 *Resilient to increasing freshwater shortages*. Increased management of spatial planning based on water availability requires the provincial and municipal authorities to adapt their environmental visions and plans accordingly. Together with other subnational authorities and sectors, we are also assessing which frameworks and starting points already exist, and which ones are missing. This is also the focus of the various challenges, such as 4.15 *Climate-resilient energy, ICT/telecom and drinking water infrastructure*.

Lastly, management, maintenance and the replacement challenge also offer opportunities for climate adaptation. How we, as the government, look after our own infrastructure networks is outlined in challenge 4.14 *A robust and resilient transport infrastructure* and challenge 4.15 *Climate-resilient energy, ICT/telecom and drinking water infrastructure*. We also have our own property portfolio, within which we ensure that climate adaptation is properly and promptly incorporated into new-build or regeneration projects.

9 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.

10 Recommendation 2 from *Meeveranderen met het klimaat*. The Hague: WKR, 2025: 'Carry out a climate adaptation assessment for spatial plans relating to investments in infrastructure, housing and industry in order to assess the consequences of these plans for the adaptation challenge and supra-regional spillover.'

11 Recommendation 2 from *Ruimtelijke ordening in een veranderend klimaat*. The Hague: Council for the Living Environment and Infrastructure (Rli), 2024: "Assess all spatial visions, plans and decisions of the government for their climate resilience (State, provinces, municipalities, water boards)."

Matrix 3.1.1

Goal/Effort Matrix for climate-resilient spatial planning and design

Ambition

The physical living environment in the Netherlands is climate resilient, both now and in the future
This allows us to ensure that the Netherlands remains safe and liveable for everyone into the future. It is with this ambition that we work towards a resilient Netherlands that can handle climate change and extreme weather.

Improvement goal	**The government is providing clearer information on the extent to which it can still facilitate regions, for example through the main water system.**	**The climate adaptation challenge will be better incorporated in advance into new and replacement challenges, in conjunction with other challenges.**
SMART goal	The government will set the preconditions for regions, upon which the regions will base their adaptation plans.	The climate adaptation challenge will be included in environmental visions, spatial and sector plans that concern new or replacement challenges.
Effort/result	→ The government will make national, integrated spatial choices in the Spatial Policy Document. And the government will work on national programmes like the National Water Programme (NWP). → The government will hold discussions with areas regarding what national choices mean for the climate adaptation plan (intensification and/or transformation) of their area. These talks will take place within the existing area planning processes (such as NOVEX). → The government will work with regions on regional investment agendas (RIA), where climate adaptation is a vital component. As part of this, the government will identify key projects that are incorporated into integrated development perspectives.	→ The government will research how existing tools (like the environmental impact assessment, Social Cost-Benefit Analysis (MKBA), and Weighing the Water Interest) can more effectively contribute to climate resilience (with things like guidelines). → The government will study whether the current tools need to be adjusted, for example around things like ‘forward-looking timeline’ and ‘types of weather extremes’. → The Central Government Real Estate Agency will conduct a climate risk analysis for its real estate portfolio. In 2027, it will be clear which frameworks and guiding principles for climate adaptation are still missing. → The government will work with subnational authorities and sectors which frameworks and guiding principles are still missing. And will take action on those points where necessary.

Climate adaptation in Zwolle in the spotlight

The municipality of Zwolle is taking major steps, together with a wide range of partners such as the local water authority and private stakeholders, to make the city climate-adaptive from the perspective of its connection with the surrounding rural area. Actions are now being taken with an eye on the long term, beyond even the target year of 2100. One example is the construction of the 'Kraanbolwerk' urban island, situated within the water system and has an open connection with the vast IJsselmeer lake. The new development here is capable of coping with high water levels, both now and in the future, for example because the electrical installations are in an elevated position and because of stoplogs and other beams that can be temporarily installed in the car park. Thanks to a clear vision and good cooperation with partners, the project is now successfully being executed by the municipality, and the desired results achieved.

In the Zwolle region the NOVEX urbanisation strategy entitled 'warm hearts in a climate-adaptive delta' (warme harten in een klimaatadaptieve delta) is evidence of a total commitment to climate-resilient development to meet the growth-related challenge. The starting point is to create cohesion between the spatial challenges of housing, mobility, work, energy, and water and soil, with local developments contributing to a more robust and resilient system and region. For example, a new sustainable wooden bridge connects the city centre with the railway zone. The bridge is a raised park, with a water collection system that ensures the trees and plants on the bridge are watered even during dry spells. Zwolle is setting an example in the delta using innovative solutions like this to help build a future-proof city within the context of a changing climate.

3.2 A society which is prepared for climate change

In a resilient society, everyone should be able to cope with, and adapt to, the consequences of climate change. By this, we mean that the public, companies and other social parties should have the opportunity to prepare for current and future climate risks to their homes or businesses. It is also important that all parties in society know what their responsibilities are and can actively assume their roles. As the government we must not forget to help people in vulnerable positions. This will help us realise our ambition of increasing society's resilience, in other words climate adaptation for and by everyone.

After all, the work to create a climate-proof Netherlands is a shared responsibility. The government is collectively tackling the major climate challenges facing our most important social and economic functions.[12] Examples include protecting the dykes and ensuring that sufficient fresh water is available. However, government policy alone will not be able to prevent us as a society from having to deal more frequently with the (increasing) consequences of climate change. Numerous other parties in society will have to play a greater role in climate adaptation. The general public can, for example, make a significant contribution to mitigating and reducing climate risks and improving quality of life, safety, and health by preparing properly. For example by purchasing emergency kits, having sunblinds on homes, and creating more green spaces.

Risk perception is currently still low and there are many differences between groups in society.[13] A lot of young people, for example, have only limited knowledge of climate risks and often act reactively.[14] People have come to expect comprehensive protection because they believe that the government has properly organised to protect them against natural disasters. As a result, people lose sight of risks, which in turn leads to a reduced level of awareness and sense of responsibility.[15] This issue it's going to become increasingly problematic, given that we foresee that it will be impossible to control all current and future risks in all places. When we acknowledge that we have to change and will have to accept risks, we can now reflect on how we want to organise society in the future.

As the government we provide information on the consequences of climate change and on the actions society can take to address them effectively.[16] The intention is to increase awareness and risk perception and recommend a course of action we are doing this using information which is accessible, relevant and understandable for the public, young people, businesses and other organisations, including people who find it difficult to take information on board. We also provide options (course of action), so that people can respond appropriately on the basis of their own insights, expertise, and capabilities, while emphasising the benefits of these actions for, among other things, quality of life, safety, and people's health.

Adaptation measures initiated by the public and businesses are essential for a society to be resilient to increasing climate risks. In connection with this, it is important that initiatives (by the public and businesses) and adaptation measures (by the government) are mutually reinforcing.[17] By sharing and coordinating information properly, we can ensure that initiatives by society will contribute positively to climate resilience.

12 This approach is implemented, among other things, through the National Delta Programme.
13 NIPV. *Lage risicoperceptie, maar wel informatiebehoefte: burgers willen anders geïnformeerd worden over klimaatrisico's*. Arnhem: Netherlands Institute for Public Safety, 2025. ; SCP. Klimaat en samenleving – Burgerperspectieven. The Hague: Netherlands Institute for Social Research, 2025.
14 MarketResponse. *Opinieonderzoek klimaatadaptatie jongeren*. Utrecht: MarketResponse, 2026.
15 WRR. *Mens en klimaat. De kracht van sociale infrastructuur bij adaptatie*. WRR report no. 112. The Hague: Netherlands Scientific Council for Government Policy, 2025.
16 As also recommended in WKR, *Meeveranderen met het klimaat*.
17 WKR. *Meeveranderen met het klimaat*. The Hague: Netherlands Scientific Climate Council, 2025.

The public, civil society organisations, and companies cannot be prepared for every eventuality, and not all climate risks can be insured. Climate resilience is not the same as all-round prevention. It also means managing and accepting residual risks. That is why it is important that, as a society, we know how to minimise the impact of a crisis and prevent social disruption. We are focusing on early and targeted warning systems, for example from the Early Warning Centre.[18] We are also focusing, together with public authorities and insurers, on providing greater clarity on what kind of damage resulting from climate change can be insured and on the sharing of responsibility for costs and compensation[19] (see also section 3.4 *Financial backing for climate adaptation*).

The government is working to increase the resilience of society in the face of crises, including climate risks. Climate change and climate adaptation raise new challenges in terms of crisis management. Extreme weather events increase the risk of large-scale, simultaneous incidents, such as floods and heatwaves. As a result, there is an expectation that crisis management organisations will have to be deployed more frequently. However, their own operational capabilities will also be stretched, for example due to a lack of available staff to operate at different locations. Adaptation measures may also imply new safety risks. For example, the addition of extra greenery to buildings and verges may increase the risk of fire during periods of drought. We are therefore committed to strengthening crisis management. [20]

Climate change affects us all. It is important to pay attention to climate-vulnerable areas and people with less adaptive capacity.[21] This is explored in more detail in the challenges section (see chapter 4), for example in 4.12 *Climate-resilient housing for all*. Some neighbourhoods are struggling to cope with (an accumulation of) severe heat stress, flooding and/or drought and have less capacity to protect themselves from these challenges due to, for example, health disparities and/or due to residents having lower socioeconomic positions. We are investigating the extent to which vulnerable[22] groups and neighbourhoods can be supported to become climate-resilient and capable of taking action themselves, and what role for the government is desirable in this regard.

In the NAS, we focus on the possible consequences of climate adaptation policy. As a government we have taken a first step towards developing a method for a social impact assessment (SIA) to gain a better understanding of the social consequences of climate adaptation policy. This instrument provides policymakers with a picture of the effects of various adaptation measures and can help with decision-making. We have applied the SIA to the NAS to provide an insight into the differences between the transformation and intensification options. Some of the conclusions drawn were that it is possible to limit undesirable effects and that a long-term perspective is important for transformation. The process of formulating policy is also important. That is why we paid significant attention to participation when drafting the NAS. This continues to be an important basis in the context of both the decision-making and implementation of the NAS. The SIA also emphasises the importance of participation for an adaptation policy.

18 Royal Netherlands Meteorological Institute (KNMI). Early Warning Centre (EWC).
19 As also recommended in WKR, *Meeveranderen met het klimaat.*
20 Among other things, in the Security Strategy for the Kingdom of the Netherlands and the National Crisis Management Agenda.
21 RVS. *Te heet onder onze voeten – gezond samenleven kan alleen op een gezonde planeet.* The Hague: Council for Public Health & Society (Raad voor Volksgezondheid & Samenleving, RVS), 2025.
22 In '*De sociale effecten van klimaatadaptatie*', the KIN interprets 'vulnerable groups and neighbourhoods' as being people or places that are exposed more frequently to climate risks, experience most severe negative consequences, or have less capacity to adapt. Examples include children, the elderly, people in lower socioeconomic positions, or residents of risk areas.

Social infrastructure also contributes to society's climate resilience. The WRR argues that, in a society which is prepared for climate change, people look out for one another, trust each other, and have sufficient capacity to act.[23] Social infrastructure is the sum of organisations, facilities, and places in a neighbourhood or district that promote and support mutual contacts and relationships between people.[24] Examples include libraries, community centres and theatres, museums, schools, parks, and public initiatives. All these can play an important role in climate adaptation. This can, for instance, provide an additional channel for the reliable provision of information, identify problems at neighbourhood level, elicit community initiatives, and play a role in collective adaptation measures and recovery operations.[25] Working together to add more greenery to a particular street helps cool the area during hot weather and improve water retention, whilst at the same time providing a space where people can meet. This is explained in more detail in challenge 4.8.8 *Heat-resilient cities, towns and villages*. We want to promote this interplay between physical measures and social cohesion. That is why we are asking local authorities to take social infrastructure into account in their spatial planning wherever possible.

23 WRR. Mens en klimaat. *De kracht van sociale infrastructuur bij adaptatie*. WRR report no. 112. The Hague: Netherlands Scientific Council for Government Policy, 2025.
24 Kolner, C. et al. *De vijf functies van de sociale infrastructuur tijdens een pandemie*. Rotterdam: Erasmus University, 2024.
25 WRR. *Mens en klimaat. De kracht van sociale infrastructuur bij adaptatie.* WRR report no. 112. The Hague: Netherlands Scientific Council for Government Policy, 2025.

Matrix 3.2.1

Goal/Effort Matrix for a society which is prepared for climate change

Ambition

A society which is prepared for climate change
In a climate-resilient society, everyone should be able to cope with, and adapt to, the consequences of climate change.
It is how we can keep the living environment healthy and safe for everyone together.

Improvement goal	**Climate adaptation policy takes greater account of unintended social effects.**	**Society (citizens and companies) is more aware of climate risks, direct and indirect, and is better equipped to handle them.**	**Society will take more climate-adaptive action on their own initiative, both systemically and incidentally.**	**The government is making society and crisis management more resilient and is taking climate risks into account as part of that process.**
SMART goal	The social effects of climate adaptation policy are clear and will be justifiable.	In 2030, the proportion of Dutch citizens who are aware of climate risks and knows how to act accordingly should have increased compared to the baseline assessment[26].	In 2030, the proportion of Dutch citizens who contribute to climate resilience in their own neighbourhoods should have increased compared to the baseline assessment[27].	The government and safety regions are incorporating climate risk into crisis management and their preparations for crisis management.
Effort/result	→ The government is developing a guideline for implementing a social impact analysis in adaptation policy choices. The government will also study options for monitoring social effects for possible unintended negative effects. Where possible, spillover will be prevented in adaptation policy: no passing on problems to other regions or future generations. → The government will use the Future at the Table methodology for various policy choices to clarify whether there is spillover onto future generations, and if this is deemed acceptable. This includes, among other things, a generational test to identify the positive and negative impact on future generations. The government will develop a guideline that encourages subnational authorities to put the future on the table, as well. → The government will study which people and places are vulnerable to extreme weather. (This is explored in greater detail in challenge 4.12 *Climate-resilient housing for all*.)	→ The Netherlands Institute for Social Research (SCP) will monitor the extent to which citizens are aware of the importance of climate adaptation and the extent to which they act accordingly. → The government will implement activities in schools focused on climate adaptation, using tools like the Sustainability in Education Implementation Plan. Part of this will be developing a national information and advice point and focusing on greening schoolyards. → The government will provide information to a range of target audiences regarding climate risk and scope of action: • The government will continue developing existing platforms, such as Milieucentraal.nl, Denkvooruit.nl, overstroomik.nl, Living with Water, the Climate Adaptation Knowledge Portal, the Living Environment Atlas, the External Security Register, and the Climate Effect Atlas. • In 2026, the government will gradually introduce a Water Guide for Buildings, which includes information on flood risk and the accompanying scope of action. Additionally, an exploratory phase into incorporating additional climate risks, like soil subsidence, heat and drought is under way. (This is explored in greater detail in challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall*.) • The Dutch Climate Risk Portal provides businesses in the financial sector with information around climate risk and climate resilience. • In 2026-2027, the government will develop a Water Calendar that provides information about upcoming policy around water safety, pluvial flooding, drought and fresh water supply. • For the NAS, a communications strategy has been developed that will reach a wide range of groups through intermediaries and ambassadors. • The government will hold discussions with municipalities around how they can provide support in communication with residents. → The government will focus on more clear and transparent cost allocation for climate damage and risk responsibility for residents and businesses. (This is explored in greater detail in section 3.4 *Financial backing for climate adaptation*).	→ The government is developing behavioural intervention pilots that municipalities can use to encourage more greenery in gardens and to prepare residents for pluvial and fluvial flooding. This includes special focus on vulnerable groups. → The government is studying how and to what extent support and information can feasibly be provided to residents with multiple problems in climate-vulnerable areas, and what role the subnational or national government should play there. The National Liveability and Security Programme (NPLV) is exploring possibilities in urban focus areas. They are also exploring how to shape those potential possibilities using which accompanying resources and interventions. (Efforts focused on climate-vulnerable areas are also touched on in challenge 4.12 *Climate-resilient housing for all* and in challenge 4.8 *Heat-resilient cities, towns and villages*.) → The government is calling on municipalities to include social infrastructure ambitions in plans for spatial planning or restructuring as a way to work towards greater social cohesion.	→ The government is committed to a resilient society during crises and to strengthening crisis management: • Within the Security Strategy for the Kingdom of the Netherlands and the broad challenge to resilience that accompanies it, the government is committed to a resilient and impact-resistant Kingdom, including in the context of climate change. • The National Crisis Management Agenda specifically takes climate risk into account. • The government and safety regions are developing national and regional crisis plans that are tested and revised as often as necessary. Where necessary, specific crisis plans are. → The government is collaborating with partners on the best possible warnings at all time scales, with accompanying scope of action, and that also includes more vulnerable communities. The government is further developing the Early Warning Centre (EWC) for that purpose. The government is also exploring the possibility of information sharing between the EWC and the government, in particular for situations where time is a crucial factor.

26 This is measured by proxy indicator questions that the SCP will ask for at least the next five years (2025-2030). This includes questions such as: *'I am aware of flood risk from extreme precipitation in my neighbourhood.'* Or *'I have taken steps to prepare for an eventual flood, such as stocking up on an emergency supply of water, non-perishable food and medication.'*
27 This is measured by proxy indicator questions that the SCP will ask for at least the next five years (2025-2030). This includes questions such as: *'I am aware of flood risk from extreme precipitation in my neighbourhood.'* Or *'I have taken steps to prepare for an eventual flood, such as stocking up on an emergency supply of water, non-perishable food and medication.'*

Spotlight:
Behavioural change during heatwaves

The municipality of Heerlen, in collaboration with two housing corporations and the largest home help organisation, conducted a behavioural study into heat stress among the elderly. This study not only asked elderly people about their perceptions and behaviour, but also about the underlying elements of resistance, motives and values behind this behaviour. This led to the development of a strategy that culminated in the behavioural campaign entitled 'Heat: Keep a Cool Head' (*Hitte: houd je hoofd koel*). The campaign materials aligned with the research with water bottles being handed out because elderly people often forget to drink. There was also a focus on changing existing habits and offering more options when it came to making the desired behaviour easier to acquire, for example in the form of informal interactive sessions with coffee and cake. The feedback provided by the residents at the end was positive. In this way the city of Heerlen was able to combine the useful with the pleasant and keep everybody's head cool.

Spotlight:
Flood barrier test in neighbourhoods exposed to a flood risk

A flood barrier test is conducted in Dordrecht every year, which is organised by the Hollandse Delta Water Authority (*Waterschap Hollandse Delta*) and the municipality of Dordrecht. It involves barriers being placed in the doorways of buildings and streets to ensure that the houses behind the dyke and the city centre of Dordrecht remain dry during high water. The event is not only good preparation for the storm season but also attracts large numbers of people who come outside to watch, gather, and reflect on the potential consequences of a flood.

Spotlight:
Assessing buildings for climate adaptability

The Dutch Green Building Council (DGBC) has developed a widely supported Framework for Climate Adaptive Buildings (FCAP). It is a standard methodology that allows owners of real estate (such as housing corporations) to carry out climate risk assessments for their properties based on the environment and the building. The process enables them to ascertain which risks their real estate portfolio is exposed to. The method also helps them identify appropriate measures based on the characteristics of the surroundings and the building.

3.3 An administration equipped for the adaptation challenge

The government is working to improve internal cooperation to speed up the process of creating a climate-resilient country. Together we are stronger! The various ministries, provincial authorities, municipalities, and water authorities, all have a role to play when it comes to protecting the Netherlands against extreme weather. Good cooperation prevents actions and partners from inadvertently getting in each other's way. In all instances, ranging from the construction of dykes, the building of homes, or the replacement of sewage systems, cooperation and integrated working save costs and prevent progress on one subject from leading to delays on another.

That is why we, as the government, are providing greater clarity on the division of responsibilities between the various authorities. Some of the ways we are doing this is through agreements on governance, cooperation, and the consultation and decision-making structure. For example, we are inviting the umbrella organisations of the subnational authorities to work together to develop an intergovernmental approach. After all, a large number of the measures which are designed to make the Netherlands climate-resilient are implemented at regional or local level. The provincial authorities are an important coordinating partner in this context, as are the municipalities and the water authorities. In 2026, the Ministry of Infrastructure and Water Management (IenW) is taking the initiative to work together with others to structure this approach, as well as the associated planning and financial transparency. It is also important that the crisis management structure is in place and that responsibilities are clearly defined, so that the Netherlands is properly prepared for disasters caused by extreme weather events (see section 3.2 *A society which is prepared for climate change*).

As the coordinating ministry for climate adaptation, the Ministry of IenW plays a leading role in ensuring good cooperation between the ministries. Each ministry is responsible for its own policy in relation to climate adaptation, such as health, housing, or cultural heritage. We are also jointly committed to strengthening links with other social challenges. We are doing this via the Interministerial Committee on the National Climate Adaptation Strategy (IO-NAS) and in the NAS Directors Consultation Committee (DO-NAS). The Association of Provincial Authorities (IPO), the Association of Netherlands Municipalities (VNG), and the Dutch Water Authorities (UvW) are also affiliated, as umbrella organisations, with the IO-NAS and DO-NAS and hold regular consultations with the various ministries. Every four years, we draw up a new National Climate Adaptation Implementation Programme (NUP KA) which outlines the measures we are going to implement in the years to come. Every two years, the Minister of Infrastructure and Water Management informs the House of Representatives on behalf of all relevant ministers about the progress which is being made on the climate adaptation dossier.

The NAS is binding for the government but is also important for subnational authorities in the context of their work on a climate-resilient living environment. As a national programme under the Environment and Planning Act, the NAS clarifies which measures the government is taking to make the Netherlands climate resilient. This may help the provincial authorities, municipalities and water authorities with, for example, their own environmental regulations and environmental plans (see section 3.1 *Climate-resilient spatial planning and design*). The funding for the measures formulated in the NAS is already in place, and this means there are not yet any obligations for, or shifting of tasks to, subnational authorities. For the future it is important that every organisation, whether a ministry or a subnational authority, takes care of the follow-up actions for which it is responsible. The government and the umbrella organisations will jointly identify measures that may have potential consequences for subnational authorities in the future. A Feasibility test for Subnational Authorities (Uitvoerbaarheidstoets Decentrale Overheden, UDO) can then be conducted for those measures, which will help shape policy that everyone can implement.

We are using existing networks and ambassadors as much as possible as we work together to achieving climate resilience across the board. This supports the commitment to taking the changing climate into account as a standard practice in every development in the Netherlands. Examples include the network of working regions of the Delta Programme for Spatial Adaptation (*Deltaprogramma Ruimtelijke Adaptatie*, DPRA) and an ambassador such as the Delta Programme Commissioner. The NAS communication strategy is also aimed at reaching people at grassroots level via trade associations and other partners. In addition, connecting with social networks in which citizens and entrepreneurs are represented can help us better incorporate social factors, such as social cohesion[28], and economic factors into adaptation policy.

Subnational authorities are being provided with additional tools to shape their own policy. This will improve the transfer of knowledge and the accessibility of information. The Dutch knowledge landscape for climate adaptation is rich but also fragmented. We are combining know-how from existing knowledge networks and programmes such as the DPRA in the Climate Adaptation Knowledge Portal. This is enabling us to provide a variety of various tools, such as the National Benchmark for a green, climate-adaptive built environment, the Heat Menu, and the guide for supra-regional stress tests. The Climate-Proof Together platform is fulfilling the role of knowledge broker.

We are using monitoring to gain an insight into the country's level of climate resilience. We have asked the Netherlands Environmental Assessment Agency (PBL) to work with other scientific institutes to draw up a plan for a structural national monitoring system.[29] This will track policy progress and allow for adjustments where necessary. In doing so, we are aligning as much as possible with existing systems, such as the monitoring of the Delta Programme. The National Climate Adaptation Monitor (*Landelijke Monitoring Klimaatadaptatie*) will be ready in 2027, at which point we will actually setting it up. We will then report on progress regarding the climate adaptation dossier every two years. Within the framework of the DPRA, we are working on the Regional Climate Adaptation Monitor, which will provide input for the national monitor. To this end, we are incorporating information such as tree canopy cover, shade and the green/grey ratio into the Climate Impact Atlas (*Klimaateffectatlas*). Subnational authorities are gathering other information that might be required.

Given that climate is a cross-border issue, we are collaborating with the European Commission and other European Member States. For example, our changing climate can lead to periods when there is too much or indeed too little water in our rivers. That is why we are collaborating with other countries in river commissions in order to address such problems. Cooperation within the European Union is also beneficial in other areas of our work, for example when defining objectives and monitoring. We can work more effectively and efficiently by aligning research and policy. That is why the European Commission is set to launch a European initiative relating to climate resilience and the management of climate risks at the end of 2026. The aim is for the EU to be better prepared for the consequences of climate change. And that is why the Commission is also proposing EU climate resilience legislation.

International commitment in the field of climate adaptation is also important for the climate resilience of the Netherlands. Together with partners, we are working on creating an effective and coherent international policy framework in the field of climate resilience. We are doing this via the United Nations Framework Convention on Climate Change (UNFCCC) and other international agreements. Bilateral cooperation also presents the Netherlands with certain opportunities. After all, our knowledge and experience can help other countries increase their level of climate resilience. Conversely, we can also learn from other countries, for example when it comes to tackling heat and drought.

28 Recommendation 2 in WRR, *Mens en klimaat*.
29 Recommendation 8 in WKR, *Meeveranderen met het klimaat*.

Matrix 3.3.1

Goal/Effort Matrix for a government that is equipped for the adaptation challenge

Ambition

A government that is equipped for the adaptation challenge
Collaboration, knowledge carry-over and monitoring are essential elements.

Improvement goal	**The government is improving decision-making based on effective implementation of the NAS.**		**The NAS will collaborate better with subnational authorities, where applicable.**
SMART goal	The government has insight into the progress and effectiveness of adaptation policy and the societal consequences of climate change and is making adjustments where necessary.		In 2030, as many subnational authorities as possible will have incorporated NAS goals into their policy, where relevant.
Effort/result	→ The Ministry of Infrastructure and Water Management coordinates the NAS and the National Climate Adaptation Implementation Programme (NUP KA). All departments are responsible for their own policy areas. → Through the Interdepartmental Consultation NAS and the Director Consultation NAS, the departments are committed to strengthened links between climate adaptation and other societal challenges. → The government drafts a new National Climate Adaptation Implementation Programme every four years. → The government regularly discusses (at least annually) the progress of implementation in interdepartmental meetings.	→ In 2027, the government will deliver the National Climate Adaptation Monitor and will supplement it where necessary. → Once the National Climate Adaptation Monitor is published in 2027, the government will systematically conduct monitoring and publish a report every two years.	→ The government is inviting the umbrella organisations of the subnational authorities to work together to determine an intergovernmental approach. → Using best practices and guidelines, the government facilitates knowledge sharing between authorities and other stakeholders in order to contribute to networks and communities of practice. → The government and subnational authorities are developing regional monitoring.

3.4 Financial backing for climate adaptation

The financing of climate resilience is a shared responsibility. Governments, businesses, financial institutions and the public can all help to prevent and mitigate climate damage in their own roles. We want adaptation to become a structural and predictable part of public and private investment decisions, so that climate resilience is no longer dependent on temporary resources or isolated projects.

In the coming years, we are going to strengthen the link between public and private financing methods, increase insight into costs and benefits, and promote a fair distribution of burdens and risks. In the process, we will develop a Climate Adaptation Ladder together with subnational authorities, the financial sector, and other relevant stakeholders. This ladder will help us organise responsibilities, costs, and risks in a way which is transparent for all parties. The ladder will also guide decision-making on who pays for what, where public solidarity is needed, and how the market and government can complement each other. The ladder will serve not only policy objectives but also provide the public, businesses, and governments with greater clarity on how damage and recovery are managed, and what role prevention can play in this context. The result will be a shared frame of reference that will guide policy, instruments, and communication regarding the funding and capacity to finance climate adaptation.

An important part of this development is the revision of the Climate Damage Atlas (*klimaatschadeschatter*). This instrument provides insight into the costs for society of climate damage and the benefits of measures that can limit it. By updating the Climate Damage Atlas and linking it to the Climate Adaptation Ladder, we can demonstrate more clearly which investments are socially profitable, where prevention pays off, and how risks can be fairly distributed. The result is a coherent body of knowledge, instruments, and principles that reinforces financial decision-making in relation to climate adaptation. A clearer picture of the avoided damage and agreements on responsibilities, costs, and risks make it easier for governments and businesses to make clear business cases for relevant topics, such as the built environment and infrastructure.

Together with subnational authorities, we are exploring how we can boost structural public financing. While the government, municipalities, the provincial authorities, and water authorities face a growing challenge when it comes to implementation, they do not always have sufficient structural resources and capacity to achieve adaptation in a sustainable way. We are working together to assess how existing (and potentially new) sources of funding and levies can be used more effectively, and how we can incorporate incentives to make climate-resilient choices more the norm. We are also examining how obstacles can be removed that prevent adaptation measures from being routinely included in area development or other (multi-year) investment programmes. In the process, we are explicitly linking this to the government's multi-year investment programmes and, for example, to the Regional Investment Agendas (RIA). By doing this, we will be able to avoid a situation in which costs spill over to future generations and promote a fair distribution of burdens and benefits.

Text box 3.4.1 **Financial backing for ambitions and follow-up actions**

The finances are in place for all the commitments outlined in this NAS. As stated above, achieving the fifteen sectoral and four nationwide ambitions in this chapter will require an additional commitment on the part of all parties. That is why, when deciding on follow-up actions, give consideration to the costs involved, and how these will be covered. Any follow-up measures that result in additional costs for the government must be covered by the budget of the ministry responsible for the relevant policy. A Feasibility test for Subnational Authorities (Uitvoerbaarheidstoets Decentrale Overheden, UDO) will be conducted in due course for follow-up actions that may require additional capacity and budget from subnational authorities.

We are strengthening cooperation with the financial sector. Banks, insurance companies and pension funds have a direct interest in a climate-resilient economy and strongly influence where and how investments take place. We are working together to create more clarity on the distribution of climate risks and the extent to which they can be insured and we are determining the balance between public and private resources. More effectively by aligning policy, knowledge and information. In doing so, we can also prevent the creation of misguided financial incentives and ensure that funding remains accessible and that insurers can continue to provide cover in vulnerable areas. In that way, we can ensure that climate risks are taken into account promptly in financial decision-making, and that preventive investments become more attractive.

Our strategy is being rolled out in close coordination with other European countries where similar discussions are being held. In this way we can ensure consistency in the way in which investments in climate adaptation are valued and accounted for. It is also a way for us to strengthen the position of the Netherlands within the broader European approach to climate risks.

On the advice of the Delta Commissioner, we are starting to investigate the long-term financial challenge. In the coming decades, significant funding and capacity will be needed to realise all the major challenges facing society, such as dyke reinforcement, infrastructure, housing and energy, in a manner that is future-proof and affordable. Insight into that financial challenge will help to facilitate climate resilience within the framework of the major challenges in the long-term.

Matrix 3.4.1

Goal/Effort Matrix for financial backing for climate adaptation

Ambition

The financing of climate resilience is a shared responsibility
Each partner will, from their own role, take responsibility for preventing, limiting, and mitigating climate risk.

Improvement goal	**There is more clarity for citizens, businesses and the financial sector around how roles, responsibilities and risks are shared in terms of investments, damage and recovery.**	**Incentives are effective so that each partner will actually fill in their own financing specification.**
SMART goal	The government is working with relevant stakeholders to develop a Climate Adaptation Ladder for 2029, which will define cost allocation (investments, damage and recovery) for climate adaptation and risk responsibility.	By 2029, the government will provide clarity around which public-private incentives can be implemented effectively.
Effort/result	*Public-Public en Public-Private*	*Public-Public en Public-Private*
	→ The government is working with water authorities, provinces and municipalities to explore what incentives are needed to gain clarity around costs, and how the parties involved can build coverage for those costs into their cost structures. The government is also clarifying existing roles and responsibilities. → The government is working with subnational authorities to study obstacles to incorporating climate-resilient measures by default into the investment and funding of regular challenges. Decisions will be made on that basis regarding necessary adjustments or other solutions.	→ The government shares data and information in the **Dutch Climate Risk Portal** and handles systemic policy coordination with the sector to prevent or limit deinvestment and over and undervaluation of risks. → The government has joined and aligned with new and existing European frameworks and policy developments that contribute to making climate adaptation financeable. → The government is working with the financial sector and subnational authorities to develop the Climate Adaptation Ladder. In that process, we are taking into account the revision of the Disasters (Compensation) Act and the development of a single information point for handling damage after natural and other disasters.
	→ The government will start an exploratory process, in line with the recommendations of the Delta Commissioner and in partnership with the Delta Programme Steering Committee, into the development of long-term financial challenges and how malleable they are. The government will incorporate into that the major challenges of the Delta Programme, which includes climate adaptation, and other major societal challenges like living and energy. → The government is studying how the costs and benefits of climate adaptation over the full life of a project can be incorporated into the decision-making around investments. → The government is updating information around the cost of climate change and the avoided damage as a result of adaptation measures. The government is working with the private sector to develop the Climate Impact & Damage Tool (KIST) for that purpose, which will replace the Climate Damage Atlas.	→ The government will work with the financial sector and subnational authorities to study how obstacles can be removed or how incentives can be used to facilitate the mix of public and private investments in climate adaptive measures. We will use pilots to clarify where public and private interests lie, and how we handle risk allocation. → The government is priority setting based on national and other identified vulnerabilities, such as neighbourhoods that are susceptible to the consequences of climate change. We are combining this with opportunities to link with other themes, such as sustainability, thereby creating scale and oversight that can be acted upon.

Chapter 4

The fifteen sectoral challenges

Guide on how to interpret the adaptation pathway maps

An adaptation pathway map is a kind of map of the underground with routes to help us adapt to the changing climate. The map shows which different policy options we can take, at what point in time, how long we can continue to implement those policy options, and when we might need to transfer to a different one. Incidentally, the various options may also include measures for other authorities, the public, or businesses, for example in relation to water conservation.

The map shows the structured trajectories of successive (categories) of adaptation measures that help reduce climate risks. They take account of the preparation time, sequence, effectiveness and feasibility of the measures at different rates of climate change and offer the flexibility to adjust decisions to changing circumstances and uncertainties. This makes them ideally suited for use when preparing for and dealing with climate change.

The NAS'26 contains a pathway map for each adaptation challenge. It goes without saying that these pathway maps are also mutually connected. You can read more about the methodology and the mutual relationships between the challenges in the two reports by the Dutch Climate Research Initiative (KIN).[1, 2] Chapter 3 of this NAS contains additional information on how we deal with the mutual relationships between the challenges.

NB:

- The measures referred to on the vertical axis are policy options and explicitly not policy choices.
- The pathway maps may also include policy options that are currently undesirable.
- The pathway maps were created based on literature studies and expert judgments.
- No actual calculation of the measures' effectiveness is included.
- The adaptation pathway maps are 'average' adaptation pathways for the entire European Netherlands. The feasibility and effectiveness of the various measures depend on the context.

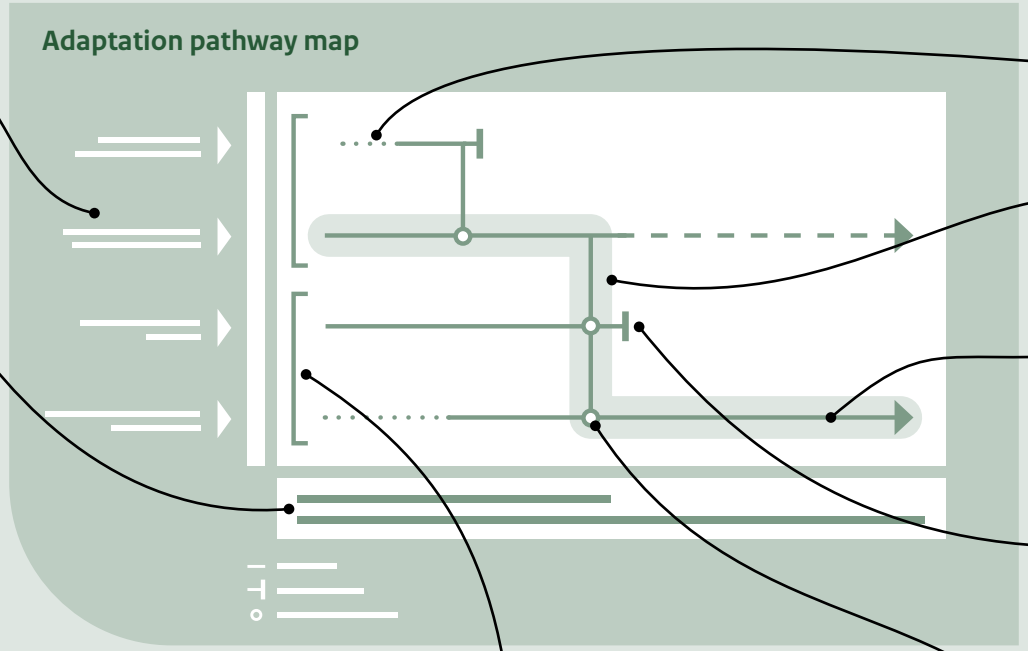
1 KIN. Verkenning van adaptatiepaden voor de Nationale Klimaatadaptatiestrategie 2026: *Ontwikkeling van methoden en een eerste toepassing*. Amsterdam: Dutch Climate Research Initiative, 2024.
2 KIN. *Adaptatiepaden voor de Nationale Klimaatadaptatiestrategie (NAS) '26*: Deel 2. Amsterdam: Dutch Climate Research Initiative, 2026.

What does the graph show?

The vertical axis is a list of the various policy options in different colours. These colours correspond to the lines that depict the possible pathways.

The horizontal axis indicates time.

- The short timeline assumes slow climate change (with low carbon emissions globally). In this scenario, the year 2100 is positioned approximately halfway across the map, meaning that only some of the measures need to be implemented by 2100.
- The long timeline assumes rapid climate change (with high carbon emissions globally). Here, the year 2100 is shown at the far end (far right) of the map. All policy options shown will probably have to be implemented.



Dotted lines indicate a potential preparation time.

The route shaded in grey indicates the preferred strategy where that is possible and logical.

Solid lines indicate when you can start a policy option and until when it will still have an impact.

Kinks in the map indicate the point until which a policy option is effective and therefore mark the end of a line. After that, the policy option will no longer be effective in itself and must be implemented in combination with other policy options.

Dots indicate points of transfer to a different policy option. A transfer may be necessary, for example, if an additional policy option needs to be added to remain resilient to climate change.

Intensification and transformation blocks: roughly two different strategies can be differentiated across all pathways. Intensification focuses on the preservation of current functions and land use.

This often entails technical solutions. Transformation means adapting functions and land use so that they are appropriate for water, soil and climate.

Intermezzo – The interconnectedness of the various water challenges

Climate change is presenting new challenges for our water management. The extreme rainfall which is a consequence of this increases the chance of local pluvial flooding (see challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall*). What is more, the risk of water shortages increases during prolonged dry spells (see 4.3 *Resilient to increasing freshwater shortages*). This can cause damage to agriculture, nature, buildings and their foundations. In addition, rising sea levels and a more erratic river runoff pattern mean that extra effort is needed to continue providing the desired level of flood protection (see 4.1 *Properly protected against flooding*).

Although we discuss these challenges in separate sections, they are closely linked together. In other countries no distinction is therefore made between the concepts of pluvial flooding and flood protection. However, that is the case in the Netherlands:

Flood protection means managing the risk of major river and/or tidal flooding with a potentially high number of casualties and extensive damage. The focus is then on the threat of high water on major bodies of water to a low-lying hinterland protected by a primary flood defence (dyke, dam, or dune flood defence). The Minister of Infrastructure and Water Management is systemically responsible for water safety. This is explored in more detail in Challenge 4.1 *Properly protected against flooding*.

When excessive water accumulates in an undesirable location due to downpours or prolonged rain, we refer to this as **pluvial flooding**. This is the case, for example, when water enters buildings from the street, or makes roads temporarily impassable. However, the term is also used when flooding occurs due to smaller, regional watercourses overflowing their banks. The regional authorities are responsible for managing regional flood defences and for dealing with pluvial flooding caused by rainfall. This is explored in more detail in challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall*.

Protection against too much rain is also closely linked to protection against too little water. For example, dry periods in the summer make it necessary to raise groundwater levels on the high sandy soils around nature reserves and in the low peat areas. However, if this is followed by a period of extreme rainfall, these areas become immediately more vulnerable to the consequences of pluvial flooding. This means we have to manage a new balance between too much and too little water. We discuss this in challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall* and in challenge 4.3 *Resilient to increasing freshwater shortages*.

Since 2008, we have been working in accordance with the principle of multi-layered safety to reduce both the probability of a flood and its consequences. This includes prevention (layer 1), consequence mitigation (layer 2), and crisis management (layer 3). Following the experiences with the floods in Limburg in 2021, water-conscious action (layer 0) and water-robust recovery (layer 4) were also added to the list. The approach involves measures from each layer being used at any given moment with specific goals and responsibilities being assigned to the authorities involved.

Multi-layered safety

Challenge 4.1 Properly protected against flooding

The boulevard of Scheveningen
(Photo: Tineke Dijkstra)

Scheveningen is a weak link when it comes to keeping us safe from water. A new boulevard was built in 2013 to protect the city of The Hague. A roadway and a pedestrian and cycling route were constructed on a new dyke and the beach was raised and widened.

4.1.1 The challenge

The Netherlands is vulnerable to flooding, and climate change increases that vulnerability. This vulnerability is due to our location in a major rivers delta and our proximity to the coast. For centuries, we have protected ourselves against high water by constructing flood defences, such as dunes, dams, dykes, pumping stations, and storm surge barriers. As a result, the risk of flooding is very low. However, climate change means we are constantly having to deal with new circumstances, such as increased river runoff, or an ever faster rise in sea level. As a result, we are continually having to adapt our flood defences to the new conditions. And this requires a constant use of raw materials (sand and clay), as well as people and resources. Another consequence is the continual impact this all has on land use.

It is of national importance that we maintain our flood protection. We do this using primary flood defences that protect us from flooding from the main river system. This includes the North Sea, the Wadden Sea, the waters of the delta, the major rivers and the IJsselmeer and Markermeer lakes. The primary flood defences must prevent (catastrophic) floods which could result in large numbers of casualties and billions of euros of damage. If we did not have these flood defences, more than half of our country would be regularly underwater. The western part of the country is home to nearly 11 million people and it is where approximately 70% of our gross national product is earned.

The ambition

To remain the best-protected delta.

The Netherlands is the best-protected delta in the world, and we want to keep it that way by maintaining our primary flood defences.

The goals for this ambition are laid down in flood protection policy. One initial goal is that a basic level of protection should apply to everyone who is located behind a primary flood defence. The probability of dying from a flood must not exceed 1 in 100,000 per year. In addition, the basic level of protection must be used to determine the requirements each primary flood defence must fulfil. These requirements are laid down in the Environment and Planning Act as environmental standards that the relevant flood defence must meet in order to provide the desired protection.

4.1.2 The options

No options have been defined or elaborated for this chapter. The tasks for flood protection are laid down in the Environment and Planning Act and the Water Act. The flood protection policy is set out in the National Water Programme 2022-2027. It is the ultimate responsibility of the Minister of Infrastructure and Water Management. The government implements this policy together with the water boards. This method and approach are summarised below.

4.1.3 The approach

Dutch flood protection policy is based on a flood risk approach and a multilayered safety approach. The flood risk approach distinguishes between different types of floods. The greater the potential consequences of a flood, the more we want to reduce the chance of it occurring, and the stricter the requirements we impose. Catastrophic floods in the main water system are accompanied by the risk of large numbers of casualties and widespread damage. The respective goals and tasks have been laid down in law in order to prevent this from happening.

The authorities involved use the flood risk approach as a basis for jointly implementing the European Floods Directive. This approach applies to both the main and regional water systems. Every six years, the central government, water authorities and other authorities draw up a flood risk assessment. They use this as a basis to update the flood risk management plans for the river basins of the Rhine, Maas, Ems and Scheldt. Cross-border coordination takes place at the river basin level within the framework of the international river commissions.

We have been working according to the principle of multilayered safety to reduce flood risks since 2008. See for more information the Intermezzo *The interconnectedness of the various water challenges*.

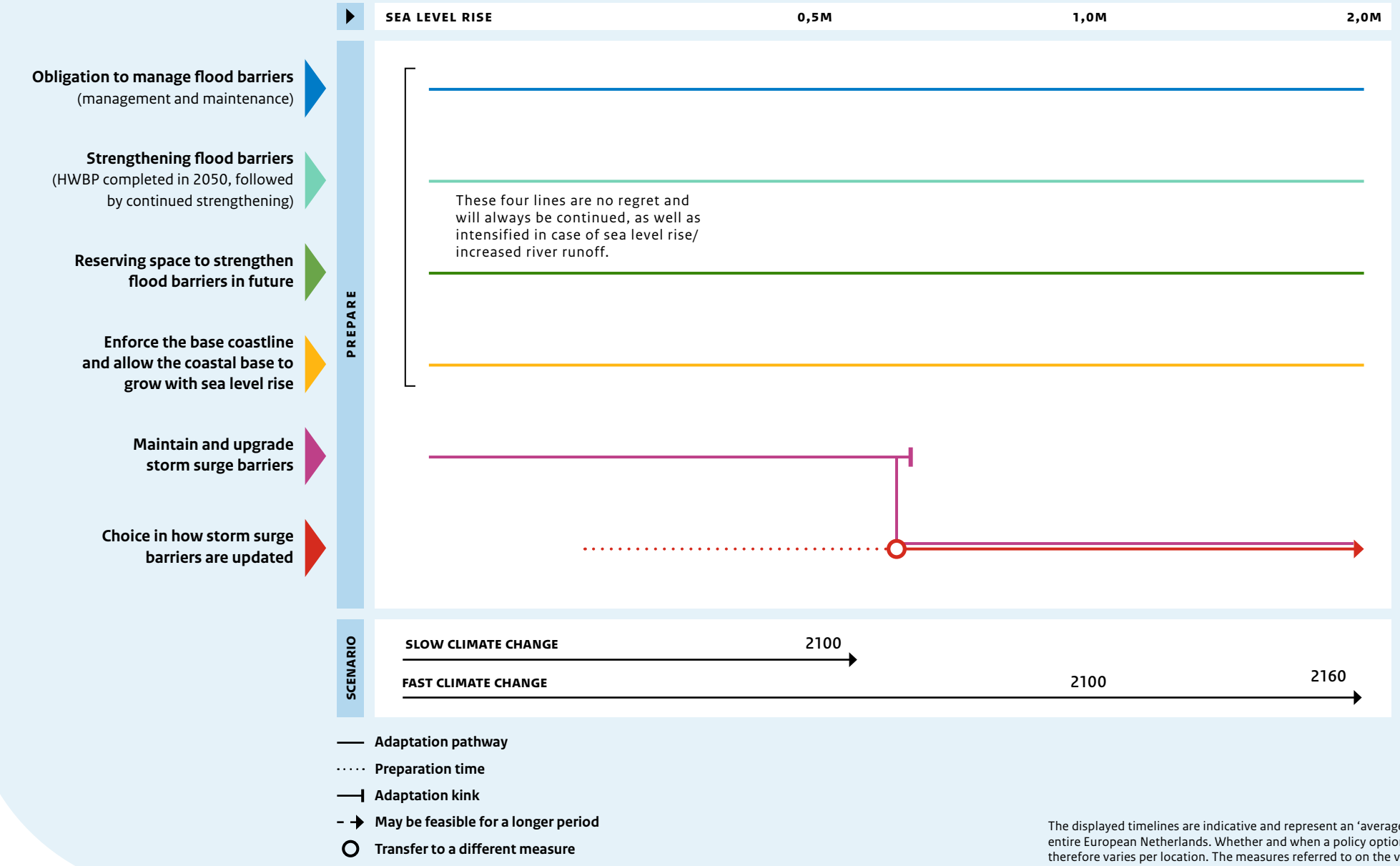
The first layer of multilayered safety, namely prevention (protection against flooding), is key for the challenge of flood protection. In the case of the area of the Netherlands which is protected by primary flood defences, prevention is the most cost-effective way to manage the risk of flooding from the main water system. The primary aim is to prevent catastrophic floods which could result in numerous casualties and extensive damage. That is the reason why we maintain our flood defences.

In our approach, we take changing circumstances into account. If the burden on flood defences increases due to a higher sea level or increased river runoff, we adjust the instruments we use for the periodic assessment of our flood defences accordingly. The same applies to the (hydraulic) preconditions for the design of flood defences.

If we want to maintain levels of safety and our quality of life, our work on the flood defences. The same applies to the rainbowing of sand to maintain the natural coastline (coastal nourishment). The basic level of protection and the standards for flood defences were established in 2017. As a result, many flood defences have to be reinforced to meet the (new) standard. We will be working on this until 2050 with the implementation of the Flood Protection Programme. In the meantime, the regular duty of care and assessments of flood defences will continue. The government is making funds available to finance work on flood protection via the Delta Fund and the government and the water authorities are jointly financing the reinforcement of flood defences through the High Water Protection Programme.

The adaptation pathway map (figure 4.1.1) presents the current flood protection tasks.

Figure 4.1.1 **Adaptation pathway map** for the challenge of properly protected against flooding



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

The continuous management and maintenance and, where necessary, strengthening of flood defences

- **Managing and maintaining flood defences (duty of care) and the periodical assessment of their strength**. These tasks are performed by the authorities that are responsible for flood defences (the water authorities and Rijkswaterstaat).

- **Strengthening flood defences and reserving space for their future reinforcement.** This will involve the flood defence managers updating the 'free space profiles', in other words, the areas around flood defences that must be kept clear for this purpose. Updating the reserved space details and making agreements regarding the use of this space is a shared responsibility of the authorities involved.

- **Creating sufficient space to protect ourselves against water**. We are working towards achieving this goal by taking decisions under the Environment and Planning Act, by establishing policy frameworks and by granting permits. This means, for example, creating space to store water and for river runoff into the riverbed, or for sand replenishment and the expansion of the North Sea coast.

- **Maintaining the baseline along the coast through sand nourishment to combat coastal erosion**. This also helps to maintain the dune flood defences. Rijkswaterstaat adds sufficient sand to allow the coast to keep pace with rising sea levels. Since 1990, the guiding principle for coastal management has been to adopt a dynamic approach to maintaining the coast, which means we work with the natural processes of tides, waves and wind to move sand along the coast. Our coastal interventions are based on the principle of 'soft where possible, hard where necessary'. With soft, sandy measures being preferred.

- **Managing and maintaining storm surge barriers**. The Netherlands operates a 'closable open' system of six storm surge barriers which are only closed to provide extra protection when water levels are excessive. Rijkswaterstaat is responsible for maintaining these barriers until they eventually need to be replaced when they reach the end of their operating life. At that point in time, a choice can be made between continuing the current strategy, or a strategy which involves completely closing them off or permanently opening the estuary or river mouth. The first time such choices will have to be made is when the Maeslant Barrier and Oosterschelde Barrier reach the end of their operating lives in the period after 2070.

Climate change is also exacerbating the challenge of managing regional flood defences. These defences protect us from pluvial flooding and damage resulting from river flooding from within the regional water system (inland waterways), and take the form of, for example, canal dykes and polder embankments. Climate change consequences include, for example, the effects of heavy showers or prolonged rain, or higher water levels in the main water system, which make it impossible to discharge inland water into external waters via pumping stations or pumps (sluicing).

A similar system of maintenance, assessment and reinforcement applies to these regional flood defences. Our regional defences are the responsibility of the provincial authorities, but they are largely managed by the water authorities. Consequently, they fall outside the scope of this NAS. We do, however, provide a more detailed description of the approach to tackling pluvial flooding as a consequence of rainfall in challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall*.

The Goal/Effort Matrix in Matrix 4.1.1 sets out the statutory duties, objectives and requirements.

Matrix 4.1.1

Goal/Effort Matrix for the challenge of properly protected against flooding

Ambition

To remain the best protected delta
Primary flood barriers offer protection against flooding in high water situations from the sea, major rivers and lakes.

	Statutory duty	**Statutory duty**
	Standard for primary flood. (for the provision of a basic protection level behind the primary flood barriers).	**Maintaining the base coastline.**
SMART goal	All flood barriers will comply with the standard by 2050.	
Effort/result	→ Water authorities and the government implement the High Water Protection Programme. → Flood barrier authorities (Rijkswaterstaat and the water authorities) are updating the profiles of free space (reserved space for future strengthening). → Flood barrier authorities have a duty of care (for management and maintenance). → The government ensures that the toolbox for flood barrier assessment and design is in order. → Flood barrier authorities conduct a legally mandated assessment of all primary flood barriers every 12 years.	→ Rijkswaterstaat implements the Coastline Management programme. → Rijkswaterstaat conducts sand nourishment along the coast and sand mining in the North Sea. → The Ministry of Infrastructure and Water Management evaluates the base coastline every six years. → Rijkswaterstaat and water authorities issue permits for onshore activities (including beach construction).

4.1.4 The consequences of the approach

Thanks to this approach, we continue to be the best-protected delta in the world. Changing circumstances, such as a faster rise in sea level, may mean that we need to reinforce flood defences more frequently and more drastically. As our research in the Knowledge Programme on Sea-Level Rise[1] (*Kennisprogramma Zeespiegelstijging*) revealed, our reinforcement work will continue to be effective up to a sea level rise of at least three metres, and possibly even five metres. We have investigated this in the Knowledge Programme on Sea-Level Rise (*Kennisprogramma Zeespiegelstijging*). We are incorporating new insights from this research, so that we can update policy, for example in the form of the new National Water Programme 2028-2033. The draft of this programme will be ready in December 2026. It is important that we realise that it is impossible to protect ourselves from high water levels without a continuous effort and the ongoing deployment of financial resources, equipment and personnel.

Future developments may create a need for new choices or alternative measures. In order to reduce the burden on flood defences, we must, for example, give rivers more space. When it is time to replace the storm surge barriers towards the end of this century, we will have to make a decision as to whether the new barrier will again be an open-closable structure. Whether we have to make that choice at the end of the operating life of the current flood defences or in a subsequent round of replacement work depends on the rate of sea level rise.

In order to be able to anticipate developments on time, we must maintain up-to-date system knowledge and look far enough ahead. We will continue to work on monitoring and research in order to track the development of river runoff and the rise in sea level. If we want to limit the burden of higher water levels on the dykes along our rivers, it is important to have enough capacity for high water discharge in the future. With this in mind, sufficient space on either side of the dykes is being reserved for the main water system. This space is needed, for example, for the purposes of river widening and dyke reinforcements.[2]

Along the coast, we are continuing to work with natural processes in order to leave the morphological processes within the coastal system undisturbed wherever possible. The volume required for sand nourishment will be periodically adjusted in line with rising sea levels. A reservation area has been designated in the North Sea, in which sand extraction, as an activity of national importance (for flood protection and the country's climate-resilient development), takes precedence over other functional uses. This will enable us to continue our management activities in the long term.

1 Knowledge Programme on Sea Level Rise *Tussenbalans van het Kennisprogramma Zeespiegelstijging*. The Hague: Government of the Netherlands, 2023.

2 Ministry of Housing and Spatial Planning. *Draft Spatial Policy Document*. The Hague: Government of the Netherlands, 2025.

Challenge 4.2 Robustness and resilience in the face of pluvial flooding caused by extreme rainfall

Evacuation of elderly couple, Valkenburg 2021
(Photo: Marcel van Dorst/MaRicMedia)

Four years after the 2021 floods in Valkenburg, the consequences are still clear for everyone to see. For example in the Nicolaas en Barbarakerk church. "The damp patches on the wall mean that, four years later, we still haven't been able to restore everything," says Father Herman Janssen. "There is no point in repairing something if the moisture is still in the wall."[1]

Text box 4.2.1 **Legal division of roles**

Subnational authorities are responsible for implementing flood policy, and the Ministry of Infrastructure and Water Management is responsible for the water system on behalf of the government. The increase and amplified impact of extreme rainfall means the central government has a role to play in ensuring that we are properly prepared for pluvial flooding at national level and for guaranteeing uniformity in relation to frameworks and standards, and we are doing so in alignment and close cooperation with subnational authorities, water authorities, safety regions and vital sectors. Part of our role is still being developed and part is already being fulfilled, for example by compiling a national overview which includes the initial results of the supra-regional stress tests. Supra-regional stress tests show us how large-scale extreme rainfall affects the Netherlands and helps us prepare properly for such events.

1 NOS News, in collaboration with L1 News. 'Limburgers bang voor nieuwe overstromingen de komende vijf jaar', NOS, 16 July 2025.

4.2.1 The challenge

The chance of extreme and prolonged rain is steadily increasing due to climate change. When excessive water accumulates in an undesirable location due to downpours or prolonged rain, we refer to this as pluvial flooding and that can result in disruption to society and economic damage for example when water enters buildings from the street (see also challenge 4.11 *Climate-adaptive new developments* and challenge 4.12 *Climate-resilient housing for all*), or makes roads temporarily impassable, or when ditches or streams burst their banks and cause pluvial flooding. The risk of casualties in these cases is small, certainly compared to flooding caused by a breach of a primary water barrier. Nevertheless, extreme rainfall in places like deep polders or sloping areas can also pose safety risks.

Several recent reports have highlighted the urgent need to be better prepared for flooding caused by extreme rainfall. In December 2025, the Royal Netherlands Meteorological Institute (KNMI) published 'An Extreme Report'[2] (*Een extreem rapport*). In it the KNMI emphasised the point that precipitation is becoming more intense due to climate change. At the same time, the Netherlands is becoming increasingly vulnerable due to more and more developments being carried out in areas prone to flooding and to increased economic activity. That is why it is important to take measures that can minimise damage and disruption. The Dutch Safety Board (*Onderzoeksraad voor Veiligheid, OVV*) published a report entitled '*Onveiligheid door extreme regen*' in January 2026[3]. In the report the OVV argues that the Netherlands is insufficiently prepared for the safety risks posed by extreme rainfall. Improvements are necessary at several levels to protect the public against the consequences of such downpours.

We have witnessed the impact pluvial flooding and fluvial flooding can have in the Netherlands on several occasions in recent years. One such event occurred in Limburg in 2021, where extreme rainfall caused major flooding, which also affected Germany, Belgium and Luxembourg. Similar events have caused significant damage and societal disruption elsewhere in the Netherlands.[4] For example, a cloudburst in July 2024 caused significant disruption in Enschede.

2 Royal Netherlands Meteorological Institute (KNMI). *Een Extreem Rapport*. De Bilt: KNMI, 2025.
3 Dutch Safety Board. *Onveiligheid door extreme regen*. The Hague: Dutch Safety Board, 2026.
4 Minister of Infrastructure and Water Management. *Letter to parliament regarding pluvial flooding due to large-scale extreme rainfall*, 30 October 2025.

There 66 homes were deemed ‘too unhealthy to live in’, partly as a result of sewage water ingress. In addition to the physical and mental impact, extreme rainfall can also damage cultural heritage, the landscape, buildings, nature, agriculture and (vital) infrastructure.

In addition to excessive water events, we are also having to deal with water shortages (drought). The extremes of drought and pluvial flooding are directly intertwined because measures designed to drain water quickly to limit flooding can actually reduce availability during dry periods. Furthermore, measures to mitigate drought, such as raising the water level, can increase the likelihood of flooding. Water storage in an area (or the lack thereof) can be affected by housing development, agriculture and the energy transition.

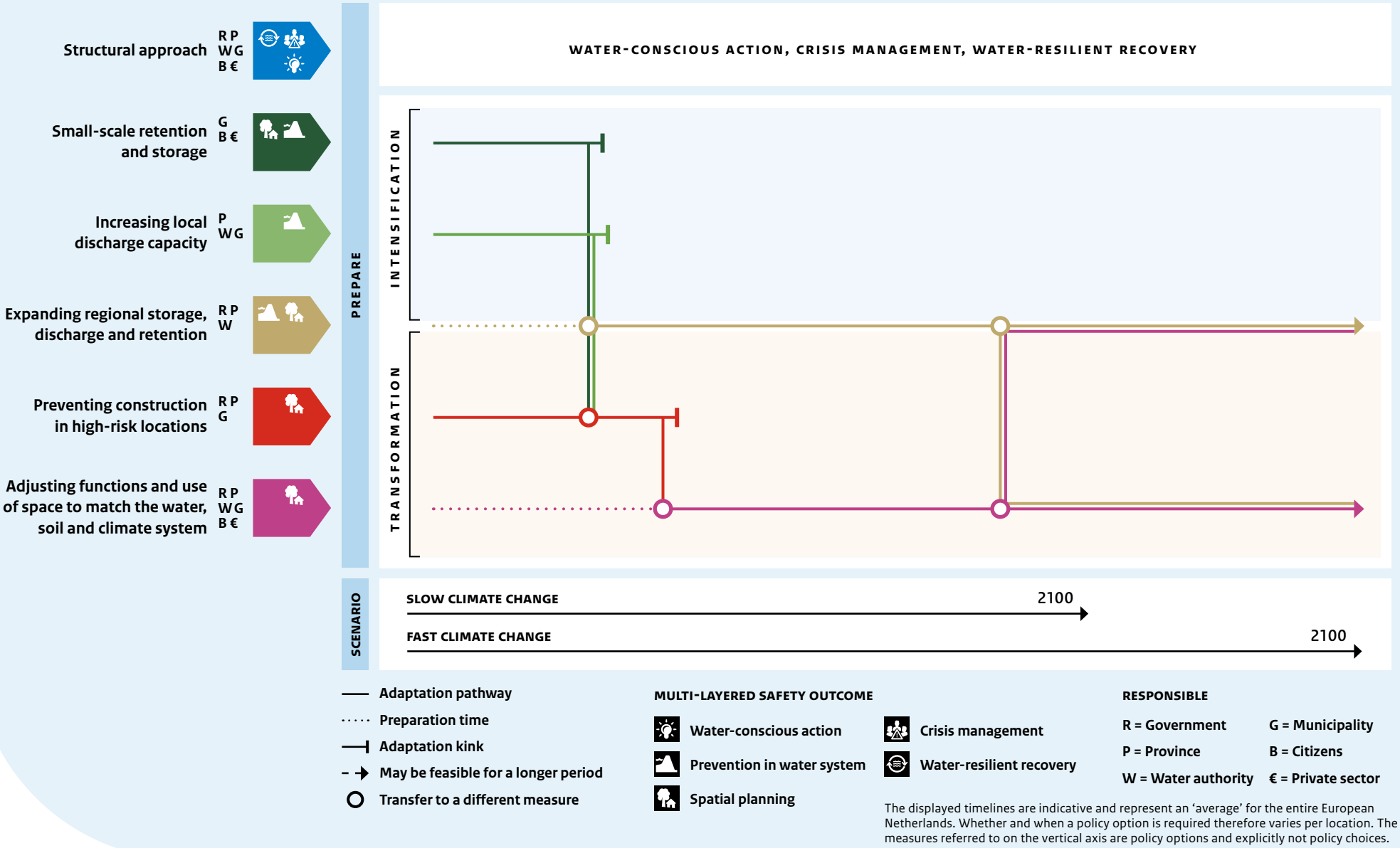
The ambition

The ambition is to make the Netherlands resilient and robust in the face of flooding caused by excessive amounts of rain so that torrential downpours and prolonged extreme rainfall result in only minimal disruption to society and damage.

To achieve this, we are working on the following goals, based on the principle of multi-layered safety:

1. Residents and businesses are **water conscious and act** accordingly during extreme rainfall to minimise material and non-material damage.
2. **Limit pluvial flooding through prevention in the water system**; the water and soil system is then in balance in order to be resilient to drought as well.
3. **Limit the consequences of pluvial flooding through spatial planning**: built-up and rural areas have been designed to minimise the impact on society and damage caused by pluvial flooding.
4. **Crisis management** and early warning are set up to cope with periods of extreme rainfall.
5. Damage after extreme rain is repaired in a **water-resistant manner**.

Figure 4.2.1 **Adaptation pathway map** for the challenge of robustness and resilience in the face of pluvial flooding caused by extreme rainfall



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.2.2 The options

Figure 4.2.1 shows the adaptation pathway map for this challenge, which we can use to clarify the system choices. The pathways show the effectiveness of possible measures in terms of risk reduction, while also taking risk acceptance into account. The categories of measures (y-axis) are plotted against a rapidly changing and less rapidly changing climate (x-axis). The map also depicts two pathways – intensification and transformation – in which logical combinations of measures converge. We explain the possible measures using the five layers of multilayered safety.

Structural commitment (various layers)

The structural commitment is intended to make the Netherlands resilient to events involving extreme rainfall. This can be achieved by continuously focusing on increasing *water-conscious action (layer 0), effective crisis management (layer 3), water-resilient construction (layer 2), and water-resilient recovery (layer 4)* (white bar in the adaptation pathway map). The expression 'water-conscious action' means that residents and businesses are aware of the risks of flooding and act accordingly. Crisis management is necessary when pluvial flooding as a result of extreme rainfall cannot be prevented and people's safety is at risk. We can then limit the consequences of flooding through communication, contingency plans and proper preparation. It is also important that we build and repair in a water-resilient way to prevent (further) damage from occurring during the next downpour. There are opportunities in existing built-up areas and new construction locations to increase the soil's sponge effect (see also challenge 4.11 *Climate-adaptive new developments* and challenge 4.12 *Climate-resilient housing for all and the Spatial Policy Document*). To achieve this, we must limit the number of paved surfaces and plant more greenery. These issues require continuous attention and extra efforts are needed in the time ahead to ensure we are sufficiently prepared for pluvial flooding in the future.

Prevention in the water system (layer 1)

Water authorities are continuing to focus on retaining, storing and potentially removing water in order to reduce pluvial flooding. On a local scale (neighbourhood or fixed drainage level area), they can choose between retaining and storing water or removing it (*increasing local drainage capacity and the small-scale retention and storage of water*). This can be achieved on a small scale by retaining and storing water in green spaces such as green roofs, wadis (green ditches in urban areas), water plazas and parks (focusing on multiple land use). It is also possible to retain and store water by constructing facilities capable of retaining rainwater or slowly releasing it (for example parks and water plazas). It is also possible to widen watercourses or make them shallower, or use other parts of the public space. This approach may cause temporary pluvial flooding, but does prevent any damage. Increasing pumping capacity or potentially expanding sewer systems can, on a local scale, actually cause water to drain more quickly. Although these measures work well on a small scale, they are dependent on the limitation of the drainage and storage capacity of the regional water system. Neither are there any opportunities for combined action for the drought response strategy.

Larger-scale measures are effective on a regional scale. The scale of these measures means that more preparation time is needed before they can be implemented (*in order to increase regional drainage capacity, regional retention and storage*). Examples of these measures include emergency (overflow) polders as a form of storage, the widening of small rivers or reservoirs, or the raising of dykes to increase drainage capacity. Climate buffers are a good example of such a measure.[5] The interaction between the regional and main water systems must be taken into account, Given that excess water cannot always be discharged immediately due to high water levels in the main water system (or vice versa). At regional level, we can then retain water by increasing the sponge effect of landscapes to help meet the challenge of dealing with both water surface flooding and drought, as well as nature restoration. A combination of water retention, storage and discharge will often be necessary on a local and regional scale in order to cope with more extreme rainfall.

5 For more information see .

Spatial planning (layer 2)

We are trying to reduce the consequences of pluvial flooding to a minimum by adapting the layout of the environment (see also 'climate-adaptive planning' in the Draft Spatial Policy Document[6]). Climate-adaptive spatial planning means systematically taking account of the current risks of pluvial flooding and future changes as a consequence of climate change. A first step is to be smart about site selection, which may mean *avoiding construction in high-risk areas*. We can also limit pluvial flooding by *adapting functions in line with the water, soil and climate systems*. Such functions would include, for example, agriculture, housing, business and cultural heritage. On a local scale, the structural use of water-resilient construction methods has a major role to play, for example by constructing a bicycle path or road at a higher level, so that it can act as a flood barrier. This ensures that the functions of the various types of networks (such as the energy network and the transport network) are maintained. Examples on a regional scale include adapting intensive agriculture and horticulture through more extensive cultivation methods that involve only limited intervention in nature (see also challenge 4.5 *Climate-resilient agriculture*), or by implementing climate-adaptive measures for buildings. The changing of functions is, of course, a feature of other adaptation measures that require physical space (for example for living, working and leisure pursuits), such as creating water storage or widening watercourses.

Intensification and transformation strategies

In the case of the intensification strategy (blue block in the adaptation pathway map), the emphasis is on letting the function of land use take precedence (water level follows function). This can be achieved by storing and draining water at both local and regional levels. This then allows us to limit economic damage, prevent societal disruption and enable existing land use in times of extreme rainfall. To achieve this, we must increase water storage and drainage capacity and align it with demand. This strategy not only requires significant resources, but also extra water space.

In the case of the transformation strategy (orange block), we take the water, soil and climate systems into account in the spatial planning and land use functions. We shift from draining water to adapting the land use functions to create more space to retain or store water, and we exclude functions in high-risk areas and ultimately adapt functions to the risk situation. This requires space.

A combination of both strategies is necessary to make the Netherlands robust and resilient to pluvial flooding. The brown and purple lines in the pathway map have been combined at the end to illustrate that both solutions are necessary, but with a different emphasis. If, for instance, water has to be removed from a neighbourhood, it may be necessary to adapt peripheral features so that this water can be stored, and any expansion of the water system will require additional space. Transformation will be essential in all future scenarios, even those based on minimal climate change (timeline below the horizontal axis). As climate change continues to intensify, the extent to which we have to do this will increase and therefore require more space and resources.

Cooperation between the government, subnational authorities and safety regions plays an important role in working to improve robustness and resilience in the context of pluvial flooding. The cooperation is taking place, for example, within the framework of the Delta Plan on Spatial Adaptation (DPRA). We are also gaining knowledge and experience from other countries that have already and more frequently had to deal with extreme rainfall.

6 Ministry of Housing and Spatial Planning. *Draft Spatial Policy Document*. The Hague: Government of the Netherlands, 2025.

Matrix 4.2.1

Goal/Effort Matrix for the challenge of robustness and resilience in the face of pluvial flooding caused by extreme rainfall

Ambition

The ambition is to make the Netherlands resilient and robust in the face of flooding caused by rain; brief torrential downpours and prolonged rainfall result in only minimal disruption to society and damage. In that process, we follow the multi-layered safety principle.

Improvement goals	**Residents and businesses are water conscious and act accordingly during extreme rainfall to limit material and immaterial damage.**	**Limiting flooding by prevention in the water system; the water and soil system is in balance to be resilient against drought, as well.**	**Urban and rural areas are structured to limit societal impact and damage from flooding.**	**Crisis management and early warning are set up to cope with periods of extreme rainfall.**	**Damage resulting from extreme rainfall is repaired in a water-resilient way.**
SMART goals	Residents have clarity about local risks, what they should do before, during and after extreme rainfall.	We are structuring the water system to limit the consequences of extreme rainfall as much as possible. With these measures, we seek to strike a balance that limits both drought and flooding.	Water authorities and municipalities make better considerations early on the process around where urban development should happen, keeping in mind development and management costs and the water and soil systems, among other things.	Communications from the KNMI, the Dutch Water Management Centre and other organisations are focused not only on high water, but also on local extreme precipitation.	Damage from extreme rainfall will be repaired in a water-resilient way, so damage will be limited from the next extreme rainfall situation.
Efforts/ obligations	→ The government will draw up a National approach to water resilience during flooding. The national approach will emphasise behavioural insights for residents and businesses to determine how citizens and businesses can be encouraged to act in a water-conscious way. → The Ministry of Infrastructure and Water Management, the Dutch Water Authorities and the Association of Dutch Water Companies are working on improving water consciousness with the Living with Water programme and website. Part of that includes focus on vulnerable residents with less resilience in these situations. It is also linked to the National Coordinator for Counterterrorism and Security (NCTV) Denk Vooruit campaign, which is focused on preparing Dutch citizens for emergency situations. → The government is collaborating with the coalition 'A greener Netherlands starts in your own garden' to expand on the theme 'reducing flooding' by things like organising Green Garden Week, Plant With Us, and the National Tile Lifting Championship. → Information on local risk is spread by Ministry of Infrastructure and Water Management in an accessible way with the introduction of the Water Guide tool.	→ We conduct cross-regional stress tests to get a sense of the effects of a 'Limburg downpour' on other regions in the Netherlands. The national picture will provide insight into where extreme precipitation leads to bottlenecks in vital sectors, among other places. We also highlight cascading effects, hold risk dialogues and put together packages of measures. → Water authorities, provinces and the government are working on a risk-focused pluvial flooding approach to allow the current flooding standard to better align with the principles of multi-layered safety and take into account both water and soil. → The government is working with water authorities and provinces to draft a sponge effect guideline to accelerate the implementation of natural solutions. The guideline is a resource for water authorities, provinces and municipalities to strike a balance between measures for drought and flooding. → The government is looking into whether provinces can play a role in designating search areas for water storage. → The government is partnering with regional authorities in the Delta Programme for the Central Holland Region on flood policy for the Amsterdam-Rhine Canal and North Sea Canal. The goal is to learn how flooding policy can be drafted for other level-regulated main water systems.	→ The benchmark is used to set a minimum level for climate-adaptive construction when structuring new urban development. → The Spatial Assessment Framework is what will underpin the creation of new provincial environment and planning visions (POVIs) and the subsequent municipal environment and planning visions (GOVIs). → The Ministry of Infrastructure and Water Management sets standards (OKSA) for climate adaptation that are relevant for the flooding approach. → The government will amend the benchmark in line with the Housing Summit Agreements, explore which elements lend themselves to inclusion in existing and new standards, and in which way these agreements can be safeguarded. → The Ministry of Infrastructure and Water Management is working with the Ministry of Education, Culture and Science to explore opportunities for multipurpose uses for space in the World Heritage Site Dutch Water Defence Lines. They are investigating whether there are synergistic opportunities, where the former inundation areas can be used for water storage, strengthening the existing levels. → The Ministry of Infrastructure and Water Management is collaborating, via a NEN committee, with providers of vital infrastructure, such as Rijkswaterstaat, system operators and the KNMI, on a new standard with technical principles relating to climate risks.	→ The Ministry of Infrastructure and Water Management is embedding flooding and roles and responsibilities for communications during extreme rainfall into the National Crisis Plan for High Water and Flooding (LCP HO). → KNMI, the Ministry of Justice and Security, safety regions, and the Dutch Institute for Public Safety are looking into how communications around extreme rainfall can be better embedded into procedures for safety regions and water authorities. The Early Warning Instruments, developed at the Early Warning Centre, can be used here.	→ The Ministry of Infrastructure and Water Management is exploring how water-resilient recovery can be built into insurance policies. → The Ministry of Infrastructure and Water Management is studying how water-resilient recovery can be embedded in policy-making processes.

4.2.3 The approach

With a view to implementing our systemic responsibility for the water system, we are developing a National Approach to Flood Control (*Nationale Aanpak Wateroverlast*), which will be incorporated into the National Water Programme. Of course, we will do this in coordination and close cooperation with other ministries, subnational authorities, water authorities, safety regions and vital sectors.

Matrix 4.2.1 Goal/Effort for the challenge of Robustness and resilience in the face of pluvial flooding caused by extreme rainfall"

0. **Water-conscious action**
   We are increasing the level of insight into the local impact of extreme rainfall. This will allow residents and entrepreneurs to prepare more effectively and take targeted measures. We are implementing a National approach to water resilience to pluvial flooding by residents and businesses (*Landelijke aanpak waterweerbaarheid van inwoners en ondernemers bij wateroverlast*) as part of the 'Living with Water' programme (to be completed in 2027). Part of this approach will involve us focusing on the importance of social cohesion for our resilience to pluvial flooding. In developing this approach, we take into account differences between groups of people in vulnerable positions and how we can reach these groups as effectively as possible.[7] We are also compiling a water guide (*Waterwijzer*) to highlight local risks (to be completed in 2026).

1. **Prevention in the water system**
   We are conducting supra-regional stress tests to identify the supra-regional impact of large-scale extreme rainfall. They will give us an insight into the impacts on other regions in the Netherlands of a downpour like the one that occurred in Limburg (200 millimetres over a large area in 48 hours). Water assessments[8] are being used as a basis for impact assessments which will provide insight into where extreme precipitation would cause problems, including for vital sectors. This, in turn, will provide a basis for the government and regional authorities to identify issues at national and regional level respectively, where disruption to society would be unacceptable. During the follow-up phase, we will determine which **packages of measures are necessary**, and who is responsible for implementing them.

We are taking measures to maintain or restore the balance between water and soil systems. We are, for example, investigating whether current flood control standards can be used more effectively by working towards a more risk-based approach to and standardisation of pluvial flooding, while amending the current standards where necessary. Municipalities are taking measures to store rainwater locally and then slowly release it. Smart Water Management is helping water authorities exchange data on, among other things, water levels and thereby reduce the risk and consequences of pluvial flooding.

More frequent periods of drought make the challenge of flood management more complex. It has become clear, since the drought of 2018, that water shortages are set to become an increasingly extensive and frequent problem. Water authorities and spatial planners face the challenge of developing plans and taking measures which are appropriate for situations in which there is too much and too little water. These measures must be viewed in relation to one another, given that a measure to combat drought can sometimes lead to increased pluvial flooding and vice versa. We are focusing on natural solutions,[9] such as the use of the town or city as a sponge and the restoration of the sponge effect of landscapes and the soil. One of the ways we are doing this is by drawing up a sponge effect guideline (to be completed in 2026) which will clarify the sponge effect measures which we are able to propose for each type of landscape, and how they will help to address the challenges of both water shortages and pluvial flooding. The increasing likelihood of extreme precipitation and drought, combined with pressure on space, means it is necessary to designate areas for water storage and/or to keep local low-lying areas free for inundation purposes. This will generate opportunities to use space in multiple different ways and the relevant choices will align with the principles set out in the Draft Spatial Policy Document. It is essential to focus on a regional, area-based approach.

7 WRR. *Rechtvaardigheid in klimaatbeleid. Over de verdeling van klimaatkosten*. The Hague: Netherlands Scientific Council for Government Policy, 2023.
8 Minister of Infrastructure and Water Management. *Letter to parliament regarding pluvial flooding due to large-scale extreme rainfall*, 30 October 2025.
9 Diersmann, M., et al. *Klimaateffecten in Nederland. Kansen en bedreigingen voor verschillende landschapstypes*. Wageningen: Wageningen Environmental Research, 2024.

2. **Consequence mitigation through spatial planning**
   We are also committed to limiting the consequences of pluvial flooding through spatial planning initiatives. With this in mind, one of the things we are developing, within the framework of the 2024 National Housing Summit (*Woontop*) Agreement on Water and Soil, is a Draft Uniform Framework for Pluvial Flooding, and we are also conducting research into what it is like to live in water-abundant areas. The Dutch Water Authorities (*Unie van Waterschappen, UvW*), the Association of Netherlands Municipalities (*Vereniging van Nederlandse Gemeenten, VNG*), the Association of Provincial Authorities (*Interprovinciaal Overleg, IPO*) and the Ministries of Housing and Spatial Planning and Infrastructure and Water Management are collaborating on national uniform frameworks and newbuild working methods to deal with extreme rainfall and soil subsidence in built-up areas. Previously drafted instruments, such as the spatial assessment framework (where to build)[10] and the National Benchmark (how to build)[11] are being used to formulate these frameworks. This should make it possible to build new homes in the Netherlands in a faster and responsible way, with sufficient water and soil related measures in place. This is also going to be done in conjunction with a study into adjusting existing pluvial flooding standards. Applying the National Benchmark and the Spatial Assessment Framework (locally) when drafting environmental plans will enable municipalities to contribute to climate-resilient spatial design. This will also increase the resilience of urban areas to any extreme pluvial flooding that might occur (see also challenge 4.11 *Climate-adaptive new developments*).

   For a robust approach to pluvial flooding, it is important to bear in mind that water will have to be stored in the deepest parts of the polders. We are also exploring opportunities for multiple land use. After all, water storage can be combined with other functions (extensive agriculture, nature, recreation, housing). We are investigating whether we can restore the cultural-historical values of water defence lines by using them for water storage in emergencies (to be completed in 2026). In addition, we are working on devising climate adaptation standards and norms that are relevant for our approach to tackling pluvial flooding. We are, for example, examining whether we can make adjustments to standard guidelines and design principles for infrastructure whenever these are relevant to pluvial flooding (see challenge 4.14 *A robust and resilient transport infrastructure* and challenge 4.15 *Climate-resilient energy, ICT/telecom and drinking water infrastructure*). We are also collaborating, via a NEN committee, with providers of vital infrastructure, such as Rijkswaterstaat, grid operators and the KNMI, on a new standard for assets/properties with technical principles relating to climate risks.

3. **Crisis Management**
   With regard to crisis management, it is important that there is clear communication between the KNMI and the safety regions and clarity as regards the various roles and tasks. We need to define the roles and tasks of, among others, the KNMI and the safety regions in more detail when it comes to reporting extreme rainfall. This will be laid down in the National High Water and Flooding Crisis Plan (*Landelijk Crisisplan Hoogwater en Overstromingen*) (to be completed in 2026). We are also assessing how reporting on extreme rainfall can be incorporated into the procedures used by the safety regions and water authorities. This will involve using the 'Early Warning' instruments which were developed at the Early Warning Centre (to be completed in 2026).

4. **Water-resilient recovery**
   We are focusing on water-resilient new construction or water-resilient recovery following pluvial flooding, at both neighbourhood and building levels. We are investigating how to embed water-resilient recovery in policy processes and Ministry of Infrastructure and Water Management networks, and how recovery can be incorporated more effectively into insurance conditions (to be completed in 2026). To this end, we are collaborating with the financial sector.

10 Ministry of Infrastructure and Water Management and the Ministry of the Interior and Kingdom Relations. *Ruimtelijk afwegingskader klimaatadaptieve gebouwde omgeving*. The Hague: Government of the Netherlands, 2023.
11 Central government: *National Benchmark for a green, climate-adaptive built environment* The Hague: Government of the Netherlands, 2023.

4.2.4 The consequences of the approach

It is not easy to choose between taking measures or abandoning functions to limit the consequences of pluvial flooding. We have observed that consequence-mitigating measures (technical measures/spatial planning, water awareness, crisis management, faster recovery) are not effective enough to solve 100% of the adaptation challenge. For example, one point of concern relating to water storage and discharge is that, while a great deal is technically possible, wider waterways and drainage capacity simply require a greater surface area and the resulting spatial and financial impact is significant. This spatial issue is complex in the Netherlands because the country has limited space. Based on the 'taking water and soil into account'[12, 13] approach, it is preferable to retain and store water, rather than remove it. However, in specific situations, it may be necessary to remove water in order to minimise or fairly distribute the cost to society. The added value for society lies precisely in combinations of measures, such as natural solutions and increasing the sponge effect, which focus on a combination of improving water quality, increasing supply and reducing flood risks. These measures may also lead to in increased biodiversity and better public health and can contribute to social cohesion in a neighbourhood.

Even if we take preventive and mitigating measures, we cannot completely eradicate the impact of extreme rainfall. It is therefore essential that we raise water awareness and consequently the capacity of residents to take action. Transformative measures are necessary in both rapidly changing and less rapidly changing climate scenarios and the scale at which we will need to adapt our water system and land use depends on the degree of climate change.

12 Minister for the Environment. *Letter to parliament on water and soil as guiding principle*, 25 November 2022.
13 Minister of Infrastructure and Water Management. *Letter to parliament on the vision on water and soil*, 22 October 2024.

Challenge 4.3 Resilient to increasing freshwater shortages

Dried-up stream in the dry summer of 2018.

The year 2018 is memorable for being one of the driest years there has ever been in the Netherlands, there was a very long period without rain. In July, the month in which rain showers are normally a regular occurrence, there was almost no precipitation, and the sun shone incessantly. The other summer months were also extremely dry and sun-drenched. The driest year ever in the Netherlands was 1976. Back then a lack of rain and prolonged heatwaves caused the precipitation deficit to rise to no less than 361 millimetres by the end of August.

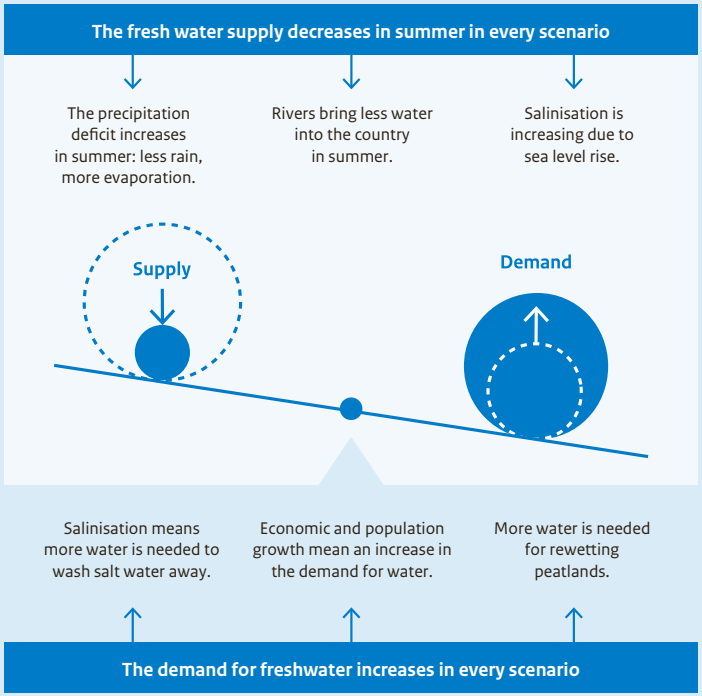
4.3.1 The challenge

The availability of fresh water is going to be subject to increasing pressure between now and 2050 and 2100. The 2024 Delta Scenarios[1] show that the current freshwater strategy will need amending sooner than previously thought. That strategy is laid down in the National Water Programme (NWP) 2022–2027[2]. If we do not change this policy, the balance between water demand and supply during the summer months (the period between the end of March and the end of September) will become increasingly disrupted. The Delta Scenarios 2024 show that water supply decreases in summer, while water demand increases sharply. This is increasingly leading to an insufficient water supply and greater pressure on the groundwater system, resulting in falling groundwater levels and drought.

Various factors are leading to a reduction in water supply and an increase in demand for fresh water. The decreasing water supply in summer is caused by a growing precipitation deficit and lower river runoff during summer. Rising sea levels are also causing an increase in groundwater salinisation and in the accumulation of salt at sea access points. That is having a detrimental effect on the availability of fresh groundwater and surface water. Freshwater demand is actually increasing due to higher temperatures (extra evaporation), population growth, economic developments and more intensive land use. Evaporation also leads to a greater demand for water in order to manage water levels and increases the pressure on groundwater reserves. Larger quantities of fresh water are needed to mitigate increasing salinisation. Those quantities are not always available in all locations due to insufficient river runoff in summer. Lastly, a great deal of water is required for the rewetting of peatlands. That rewetting is needed to combat soil subsidence and carbon emissions. In order to meet the demand for water, more and more is being taken from (fresh) groundwater in a way which exceeds the natural system's capacity. Groundwater levels will continue to decline if we fail to make changes to the water system.

1 Deltares, the Delta Programme Commissioner Staff and the Ministry of Infrastructure and Water Management. *Deltascenario's 2024. Zicht op water in Nederland*. Delft: Deltares, 2024.
2 Ministry of Infrastructure and Water Management, Ministry of Agriculture, Fisheries, Food Security and Nature and Ministry of the Interior and Kingdom Relations. *National Water Programme 2022–2027*. The Hague: Government of the Netherlands, 2022.

Figure 4.3.1 **The challenge of water availability visualised**



The consequence of increasing demand and decreasing supply is that water shortages are occurring more frequently during the summer period. This means it may be necessary to impose bans on extraction from groundwater and surface water and implement the water distribution priority list (*verdringingsreeks*).[3] The water distribution priority list is laid down in law and reflects an order of priority for the distribution of water in times of water scarcity. It is intended to prevent social disruption. The measures may, however, lead to economic damage as it would not be possible to supply all sectors with the required amounts of water. In the Delta Plan for Fresh Water the government and regional authorities are working together to improve resilience to water shortages, for example by ensuring that freshwater reservoirs remain well-stocked and by combating salinisation. It is, however, no longer enough to optimise the current water system to prevent increasing water shortages, and this means the challenge in terms of adaptation outside the water system (in the spatial domain) is becoming more daunting. All sectors must be prepared for more frequent and prolonged periods of water shortages, as well as for conditions which lead to salinisation. This will have consequences for land use and business operations, but may also mean that current area functions cannot always be maintained.

There is a relationship between the availability of fresh water and drought and various themes within the water domain and elsewhere. There is, for example, a relationship pluvial flooding and water quality (see challenge 4.1 Properly protected against flooding and 4.2 Robustness and resilience in the face of pluvial flooding caused by extreme rainfall and 4.4 Safe and healthy water quality. There are also links with other themes such as agriculture, nature, shipping, housebuilding and industry. In the shipping sector, for example, low water levels result in reduced navigable depth. This results in additional waiting times for vessels due to restrictions on the use of locks in order to conserve fresh water.

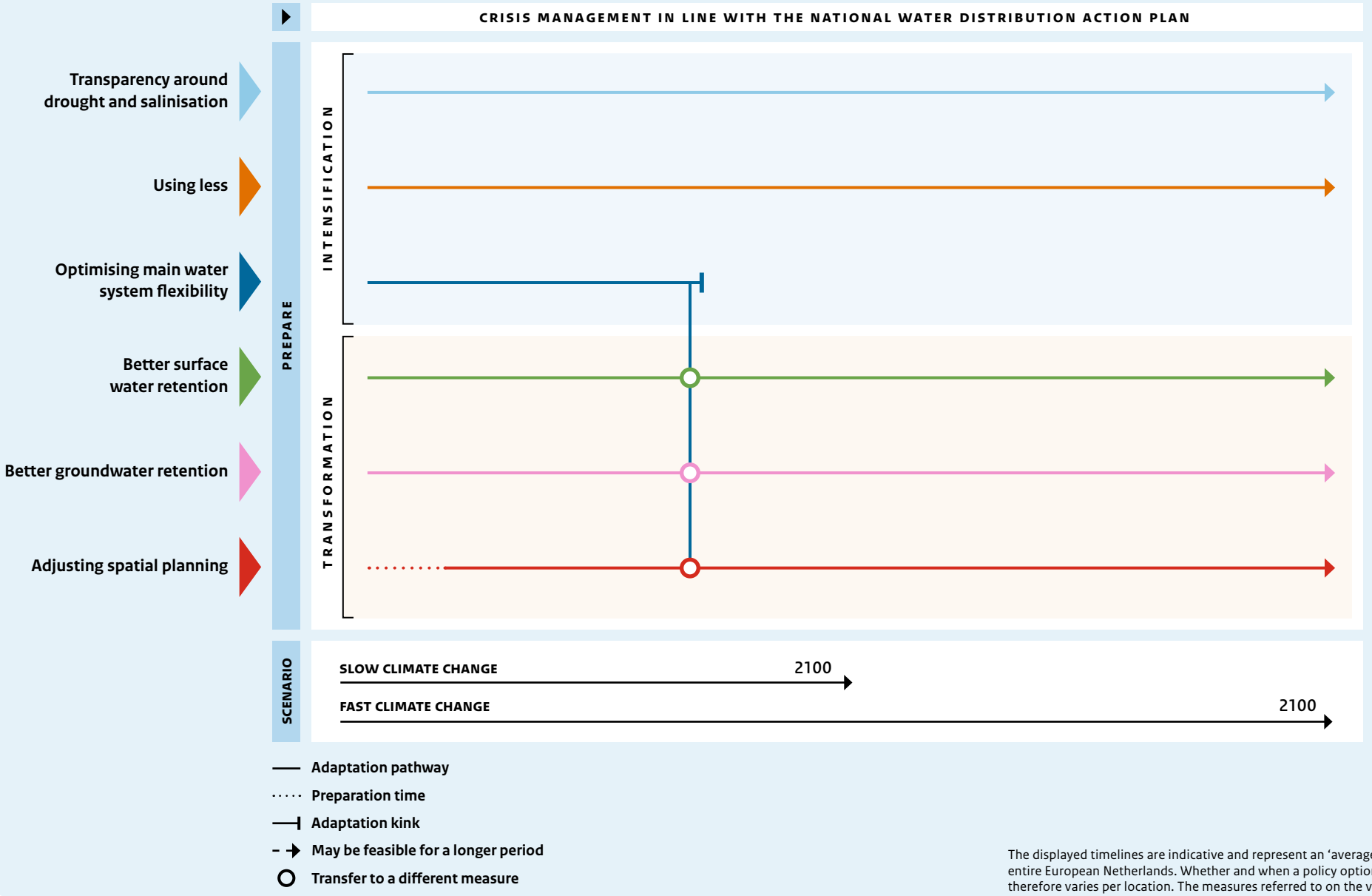
The ambition

The Netherlands will be resilient to fresh water shortages by 2050.

By 'resilient' we mean that there is an optimal balance between water demand and supply, even during periods of drought. This implies a healthy and balanced water system, the protection of crucial land use functions, economical water usage, transparency about the risk of shortages so that users can adapt and adequate crisis management. To this end, we are asking regions to draw up strategies to align water supply and demand in their own region as effectively as possible, whilst taking all spatial interests into account in an integrated manner. They can do this by using appropriate zoning schemes that identify the water and soil systems. The sectors that use water, such as agriculture, industry, drinking water companies and shipping, decide how to interpret the term 'resilient' in consultation with regional authorities. We explain and present this ambition in more detail in the 2027 Delta Programme.

3 Living Environment Information Centre (Informatiepunt Leefomgeving). '*Verdringingsreeks: rangorde bij waterschaarste.*'

Figure 4.3.2 **Adaptation pathway map** for the challenge of resilient to increasing freshwater shortages



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.3.2 The options

Figure 4.3.2 shows a simplified adaptation pathway map for this challenge. It shows the strategies that can be used to make the Netherlands more resilient to freshwater shortages. As the figure shows, all the components of the strategy need to be applied simultaneously in order for us to become more resilient to freshwater shortages. We will briefly outline the various strategies below:

- **Providing transparency (light blue line) about the development and effects of drought and salinisation is important.** That way everyone will be aware of the decline in the supply of fresh water.

- **Between now and 2050, we will be able to optimise those components in order to make the main water system as flexible as possible.** Depending on specific drought conditions, flexible management will enable us to distribute water smartly from the main water system to the regional ones (dark blue line). In principle, however, no investments will be made in technical measures to transport fresh water from the main water system to areas where this is infeasible (in the long term).

- **We can also retain more water in surface water (green line).** The IJsselmeer and the Markermeer will be used more effectively to retain freshwater by gradually increasing the available freshwater supply. In doing so we will take an adaptive approach that takes account of climate change and the time needed to prepare the necessary steps. The available freshwater supply will initially be increased within the current range of the summer water level (-0.10 metres to -0.30 metres NAP). After that the available freshwater supply will be increased by opening an additional 10-centimetre water inlet at the bottom (down to -0.40 metres NAP) in the event of an impending water shortage. At a later stage the freshwater supply may be further increased to a maximum of 50 centimetres. Water can also be retained more effectively in the regional water system.

- **Retaining water in the soil (pink line) is another effective way of becoming more resilient to water shortages.** This will require us to find a balance between combating drought and continuing to prevent flooding. Ultimately, no more will have to be extracted than is replenished. As the government we are therefore working with the provincial authorities on establishing groundwater extraction ceilings. Those ceilings indicate how much groundwater can be extracted in a specific area over a specific period. This will provide a starting point when it comes to the issue of the distribution of available groundwater throughout the country.

- **Water conservation (orange line) is also an important path in all circumstances.** This requires commitment on the part of the public, companies and water authorities. The savings relate to groundwater, surface water and drinking water.

- **Spatial planning and design will also have to be aligned with water availability (red line).** The challenge will not be met if all we do is optimise the water system and technical solutions. Decisions will have to be made regarding the location of activities that require water, and how we should use land to mitigate the consequences of drought. For instance, large-scale new water consumers should not be planned at locations where the availability of fresh water cannot be guaranteed in the long term. This would apply, for example, to large electrolysers (devices to produce hydrogen) whose preferred location is along the coast because that is where saline and brackish water can be desalinated and used. The droughts of recent years have made it clear that we must start the process now. Eventually the demand for water when it comes to spatial planning and design must be aligned more closely with the (declining) availability via the system.

Matrix 4.3.1

Goal/Effort Matrix for the challenge of resilient to increasing freshwater shortages

Ambition

The Netherlands will be resilient to freshwater shortages by 2050
Users and areas will – no later than 2050 – be well prepared for regular periods of freshwater shortages.

Improvement goal	**Provide transparency: water authorities will provide insight into the expected likelihood and possible scope of water shortages, both now and in 2050.**	**Users will be urged to practise water conservation and use of other sources.**	**The ground and surface water systems are designed to be resilient to the consequences of drought and water shortages.**	**Land and water usage are designed to be resilient to the consequences of drought and water shortages in the context of flooding and water quality.**	**Crisis management and communications are designed for drought and water shortages.**
SMART goal	The government and regions will set more concrete national and regional goals for water availability.	Users will endeavour to use water efficiently and effectively.	Goal reached in 2050.	Goal reached in 2050.	The crisis management organisation is well structured.
Effort/result	→ The government will set national goals for crucial functions (barrier stability and drinking water supply). → Freshwater regions will set regional goals for functions and areas. → Provinces will set a desired groundwater scheme.	→ Regions will set savings goals (see also under Transparency). → Users will endeavour to save water.	→ The government and regions will take steps regarding the main water system and regional water systems. → The government will change regulations for ground and surface water extraction and amend regulations for ground water levies. → The government will provide provinces with a framework for creating the best ground water schemes.	→ The government will focus on choice of location, like hydrogen plants on the coast. → Regional authorities will make their own efforts, such as amending strategies on spatial planning and the environment.	→ The crisis management organisation operates according to the National Water Distribution and Drought Action Plan. → The water distribution priority list is applied properly during droughts. → The government will conduct an evaluation after every crisis situation caused by drought.
	Water authorities will set water balances.	There is a wider selection of freshwater sources.	There is a different balance between surface water flooding and drought.		
	→ The government work with the water authorities to map out draws from the main water system (regional water balance). → The government will provide transparency around expected water shortages in the main water system (HWS water balance).	→ Regions will look into opportunities for reusing effluent water from sewage treatment plants. → Users will desalinate brackish/sea water to expand the water supply.	→ Water authorities will increase groundwater levels in low peat areas and high sandy soils. → Water authorities will carefully weigh measures aimed at flooding and drought. → The government will draft a Sponge Effect Guideline. → Policy development around responsible subsurface water infiltration.		

4.3.3 The approach

The government, subnational authorities, and civil society organisations are collaborating intensively within the Freshwater Delta Programme (*Deltaprogramma Zoetwater, DPZW*) to become more resilient to water shortages. In recent years these parties have taken measures to improve water availability, including investments in infrastructure, measures to retain water and improved water distribution. It is essential to make smarter use of fresh water and space. Although gains can be achieved by retaining more water more effectively in winter and using it efficiently.

In the long term, a transition is needed from dependence on technical water measures to land use that aligns with the water and soil system. One way this could be done would be to retain precipitation more effectively in the soil in the agricultural sector. This requires (spatial) system choices, which are made, among other things, in the National Environmental Vision. Many users will have to adapt their water use and possibly also their business model to drier and/or salinising conditions. It is therefore important to provide a greater insight into possible (spatial) consequences, for example into the effects of increasing salinisation on economic sectors and nature, as well as into when and where these effects occur. Drinking water companies and other users of groundwater and surface water are investigating innovations in the field of water storage, alternative sources and circular water use. This will enable them to prepare more effectively for extreme weather conditions.

1. Providing transparency

Authorities must be transparent about expected water shortages. The Netherlands has traditionally focused on water drainage. Now that periods of drought are becoming ever longer and more intense, it is important to be able to manage low water levels and precipitation deficits more effectively. Having insight into expected water shortages will make users aware of the challenge in a particular area. Ultimately, the needs of the various existing and new water consumers will have to be weighed up on a more and more frequent basis.

To this end, the government is first working on specifying the freshwater goals. Consisting of a national goal for crucial functions, the creation of a desirable groundwater regime and the establishment of regional goals for areas and functions which are appropriate for a specific area. The aim is to adopt an integrated approach which takes account of all the spatial challenges. These objectives are currently being developed and are to be laid down in the National Water Programme (NWP) 2028–2033.

We are also working on the drafting of water balances for the main water system and regional water systems. With this in mind, we as the government are identifying incidents of extraction from the main water system and the regions are doing the same for the regional system. We are also working on a policy framework for sustainable groundwater and surface water management. The goal is eventually to be able to weigh up the needs of water consumers, based partly on the availability of groundwater and surface water.

2. Water conservation and the use of other sources

In order to become resilient to water shortages, it is essential to conserve water and broaden the supply of sources. With regard to water conservation, we are offering an insight into expected water shortages, and the regions are setting conservation targets. Particularly in areas where the availability of fresh water is already under pressure, it may be beneficial for various sectors to focus on desalinating brackish water or /seawater and reusing effluent. Effluent is the treated wastewater that leaves a sewage treatment plant (STP) or wastewater treatment plant (WWTP). The use of brackish or salt water requires a significant effort in terms of purification. Effluent from an STP or WWTP presents opportunities in some areas, possibly after an additional purification phase, for agriculture and industry in areas where insufficient fresh water is available.

3. Organisation of the groundwater and surface water system

We are implementing freshwater management measures using funding from the Delta Fund (approximately 42 million euros per year). The implementation of the Freshwater Delta Plan for the second phase (2022-2027) is halfway through. Phase 3 (2028-2033) is being prepared. The Delta Plan contains all the planned measures and investments by Rijkswaterstaat, the provinces and the water boards. The measures focus on improved water retention, smarter distribution of available water, a more (climate) resilient design, combating saline intrusion, water system management and innovations relating to smarter and more efficient water use and the use of alternative sources. These include sources such as effluent and brackish seepage (groundwater that rises under pressure and contains a mixture of fresh and salt water). The relevant work is being carried out in both the main water system and the freshwater regions. By way of illustration, a number of projects were completed in 2025, including the modification of the Pannerling pumping station near Doornenburg and the expansion of the Climate-Resilient Water Supply Facility (*Klimaatbestendige Wateraanvoervoorziening, KWA*) for the Rijnland and Stichtse Rijnlanden water authorities. The KWA can now be used to provide fresh water from the Amsterdam-Rhine Canal and the Lek river during periods of drought combined with extremely low river runoff.

We make a number of strategic choices for the main water system in the National Water Programme 2028-2033. For example, we are assessing the distribution of runoff across the branches of the Rhine and to expanding the freshwater buffer on the IJsselmeer lake. During the lifespan of the NWP we are also formulating a coherent strategy for the Rhine-Maas estuary (among other things for flood protection, nature and the availability of fresh water) and, as the government, we are committed to initiating pilots and experiments in that estuary.

Amending regulations

We are preparing an amendment to the legislation governing discharges and the extraction of groundwater and surface water. The aim is to gain more control over groundwater and surface water extractions and to protect water quality more effectively.

A different balance between pluvial flooding and drought

As the government we are investigating the optimal balance between retaining and discharging rainwater. In the event of extreme precipitation, this water needs to be drained off as quickly as possible to locations where it would cause the least possible damage. During dry spells, it is particularly important to retain this rainwater. In the process, we are assessing the acceptable risks for society and the vital infrastructure that needs to be protected. The infrastructure required to provide sufficient drainage capacity and search areas for water storage form an important part of the investigation. We are also working on a Sponge effect guideline and policy for responsible water infiltration.

As stipulated in the Draft Spatial Policy Document, we are also aiming to establish groundwater levels in peat meadow areas and high sandy soils. In the peat meadow areas, we are moving towards higher (ground) water levels. We are doing this in order to align with European water, nature and climate objectives and to counteract the negative effects of, and the spillover caused by, land subsidence. It is important to continue offering hope for the future to the farmers in the area. We are minimising land subsidence and producing greenhouse gas emissions by taking responsible steps towards achieving a higher water level in an area-specific manner, with a groundwater level of 20 to 40 centimetres below ground level, depending on soil composition and water system conditions. Differentiation is certainly possible, although that depends on soil composition, water system conditions and the needs of the area. This means that a justifiable downward deviation from the starting point of 20 to 40 centimetres below ground level is permitted in exceptional cases. This approach is being implemented by (subnational) authorities, and particularly the water authorities that are responsible for water level decisions, in collaboration with farmers and other parties.

The starting point, wherever possible, is that groundwater levels in the high sandy soils are raised by 10 to 50 centimetres. Among other things, soil composition, water system conditions and area-specific needs are important preconditions in this context. That is the reason why, once again, (subnational) authorities, in collaboration with farmers, are working to raise groundwater levels on an area-specific basis and may justifiably deviate from this in exceptional cases.

4. Organisation of the land and water usage

When it comes to spatial planning and design, the demand for water must be aligned more closely with the (declining) availability via the system. Longer and more intense periods of drought mean that the process of choosing locations is becoming increasingly relevant for activities that require (large amounts of) fresh water, such as certain agricultural crops or industrial production processes. Large-scale new water consumers are not being planned at locations where the availability of fresh water cannot be guaranteed in the long term. This applies, for example, to large electrolysers whose preferred location is along the coast because that is where saline and brackish water can be desalinated and used. Increased management of spatial planning based on water availability requires the provincial and municipal authorities to adapt their environmental visions and plans accordingly.

5. Crisis Management

Water Management Centre Netherlands (*Watermanagementcentrum Nederland*, WMCN) is responsible for coordinating the approach to any (impending) drought. The National Coordination Committee for Water Distribution constantly monitors river discharges and other indicators to identify impending water shortages. In the event of an actual crisis, measures can be taken such as imposing bans on extraction and prioritising water distribution based on the water distribution priority list. Crisis partners are responsible for informing and warning the public and businesses about the situation and the measures to be taken. They are guided when doing so by a national protocol on water distribution in times of drought.

4.3.4 The consequences of the approach

Water supplies will decrease and demand for water will rise. This problem will not be resolved by taking measures within the water system. Due to fresh water no longer being automatically available at all times and in all places, it is important that we focus on conserving and retaining water. Fresh water supply and demand are to be brought more into balance at regional level. Given the limitations which relate to the availability of freshwater, all water users must take account of the possibility of periods of extreme drought, water shortages, flooding and salinisation. They must also take measures themselves to become more resilient, for example, by adapting their land use or operations accordingly. When it comes to spatial layout, the demand for water must be aligned more closely with the (declining) availability via the system.

Challenge 4.4 Safe and healthy water quality

Water lilies in a canal
(Photo: gettyimages)

4.4.1 The challenge

Water quality in the Netherlands is under pressure, and climate change is increasing that pressure. A high level of water quality is hugely important for our health, the economy and nature. It is important for our health because clean drinking water is a basic necessity of life. Good water quality is also a precondition for reducing heat stress in cities and villages to facilitate water recreation and enable people to cool down. Clean water is important for the economy in for example the food sector, industry and agriculture, as well as for nature as a basis for biodiversity.

Various factors affect water quality in the Netherlands, such as emissions of harmful substances and climate change. Emissions of substances into water originate from sources such as agriculture, industry and urban areas. Climate change means we are facing more extreme weather. Extremely wet and dry conditions can both have a negative effect on chemical and biological water quality. It is also getting warmer. This is causing water temperatures to rise, which affects water quality. At the same time, the demand for water of a sufficient quality is actually increasing.

Much less water is discharged by rivers during periods of drought, leading to an increase in concentrations of (harmful) substances in the water. These include various chemicals. The reduced flow of water in rivers, combined with rising sea levels, is also leading to increased salinisation of coastal areas. After all, less river runoff will mean salt water from the sea is able to permeate further up rivers. In addition, the rise in sea levels will lead to increased underground inflow of salt water. Salinisation is not only bad for nature, but also a threat to our drinking water and agriculture. Salinisation and its effects on water availability are discussed in greater detail in challenge 4.3 *Resilient to increasing freshwater shortages*.

During heavy rainfall, contaminants may enter the water. This may happen due to sewer overflows or localised flooding. Other ways this happens is because rainwater washes harmful substances lying on the ground into, for example, ditches or rivers (runoff), or because this rainwater seeps into the ground, thereby carrying substances dissolved in it to deeper soil layers or the groundwater (leaching).

Rising temperatures as a result of climate change also have an impact on water (and soil) ecology. Higher water temperatures lead to lower oxygen concentrations in the water and increase the likelihood of algal blooms. This can, in turn, have an impact on aquatic organisms and increase the risk of issues which could affect people's health (for example due to the presence of blue-green algae). Higher water temperatures combined with lower river runoff can lead to increased stratification (whereby the water separates into distinct layers and no longer mixes properly) and oxygen-poor conditions in deeper layers of lake water. As a result, there is an increased incidence of mortality among aquatic flora and fauna.

Higher temperatures may also lead to a (further) increase in invasive animal and plant species. The arrival of such invasive non-indigenous species can have a negative impact on the ecosystem because, for example, they cause damage to native aquatic flora or fauna. This is the case, for example, with the American crayfish, various species of gudgeon (fish) and the giant water hyacinth (invasive plant species).

Climate change is also increasing the pressure on land use and the possibilities in terms of water quality. Salinisation or excessive concentrations of harmful substances may, for example, may make adjustments in land use necessary. This is because, for example, certain agricultural crops become unprofitable or impossible to grow.

The ambition

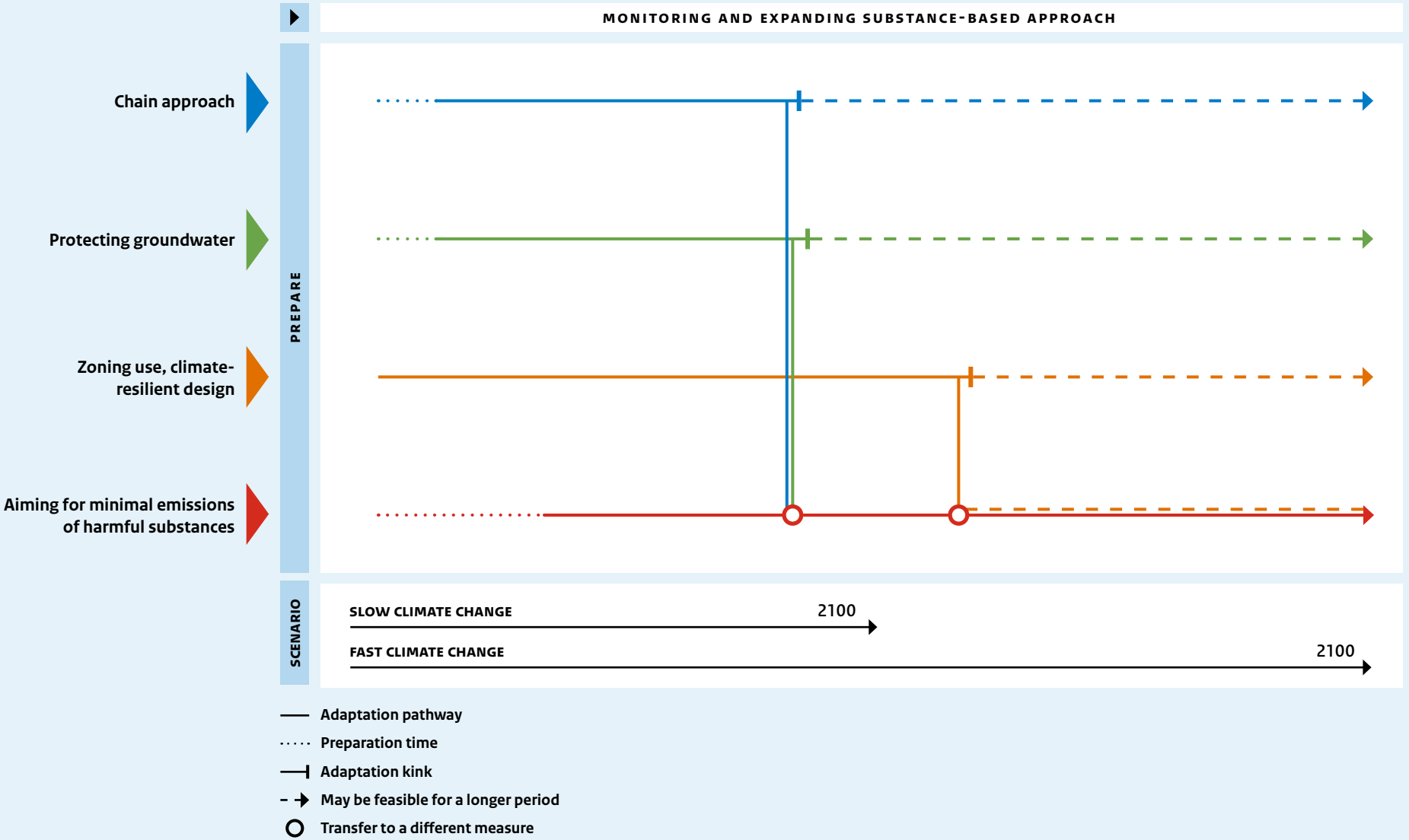
Good water quality: clean and ecologically sound water; aiming for minimal emissions of harmful substances.

If we want to improve water quality in the Netherlands, it is important that we prevent emissions of harmful substances into the water wherever we can. It is also important to create space for natural processes because this contributes to a resilient water system. The aim is also to achieve circular and more sustainable water use. The touchstone for good water quality is the Water Framework Directive (*Kaderrichtlijn Water*).

Text box 4.4.1 **Legal responsibility**

The European Water Framework Directive (*Europese Kaderrichtlijn Water, KRW*) stipulates that river basin management plans must be drawn up every six years. This includes a description of our waters, our goals for good water quality and the measures planned to achieve or maintain these goals. The river basin management plans must also include a section on accountability to Europe for the recently achieved goals. The first river basin management plans for the Rhine, Maas, Scheldt and Ems rivers were published in 2009 and then updated in 2015 and 2021. The third generation of river basin management plans for 2022-2027 is currently being implemented. At the same time, we are preparing for the period after 2027, when the 2028-2033 plan period begins.

Figure 4.4.1 **Adaptation pathway map** for the challenge of safe and healthy water quality



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.4.2. The options

Figure 4.4.1 shows a simplified adaptation pathway map for this challenge. In this we distinguish strategies for maintaining and improving water quality. We need clean and ecologically healthy water for our drinking water and for our economic activities. Pressure on the water system is increasing and there is a growing demand for water. One way in which sufficient water quality could be maintained is therefore by minimising the input of harmful substances into the water to zero in the future (red strategy in figure 4.4.1).

The other three strategies are options which could be used to support the red strategy. One of these other strategies is the zoning of land use (for example preventing emissions to vulnerable nature areas) and the climate-resilient organisation of our waterways (for example restoring stream beds to retain water for longer and to improve ecology). A second is preventing our groundwater from being contaminated with substances that do not belong in it. The third is the chain approach, in which both agriculture, industry, urban wastewater and the water flowing into the Netherlands from abroad all contribute to good surface water and groundwater quality. The monitoring of harmful substances in water is an ongoing activity which applies to every adaptation pathway.

Matrix 4.4.1

Goal/Effort Matrix for the challenge of safe and healthy water quality

Ambition

Excellent water quality
Clean and ecologically healthy water; clean and ecologically healthy water; aiming for minimal emissions of harmful substances

Improvement goal	**Reducing harmful emissions.**	**Explore land use zoning.**	**Improve chain approach.**	**Protect groundwater quality.**	**Monitor and manage substances.**
SMART goal	Bring screening system in line with Water Framework Guideline.	Explore reducing emissions per zone.	Set goals per sector.	Prevent further pollution (greying) of the groundwater.	Further develop monitoring (methods of analysis).
Effort/result	→ Adapt EU regulations to environmental standards. → One substance one assessment; one standard per substance. → Include all harmful substances (not just Water Framework Guideline).	→ Land use zoning in vulnerable areas (N2000 for example). → Natural and resilient design for water systems. → Implement measures from river basin management plans.	→ Agriculture: Explore further reduction in harmful substance emissions. → Industry: from effort to result: put the burden of proof on dischargers. → Urban wastewater: treatment at the source. → River basin: reduce pollution in partnership with other countries.	→ Explore measures for protecting groundwater.	→ Development of combi-tox indicator (all substances). → Improve monitoring for surface and groundwater improvements.

4.4.3 The approach

Reducing harmful emissions

Our approach is focused on minimising harmful emissions. After all, prevention is better than purification. The emphasis is shifting in this even more towards the source-based approach. As the government we are investigating how more rigorous rules can be applied to the authorisation and use of chemical substances in a European context, so that harmful substances do not end up in groundwater and surface water at all. Wherever we are (as yet) unable to prevent emissions into water, our focus is on reducing polluting substances through goal-based regulation and clear result-based obligations. This could involve two possible routes:

1. Zoning

We are investigating whether we can work with area-specific values for maximum emissions or conditions for high-risk activities in an area. This is possible, for example, in the form of zoning to improve water quality in and around Natura 2000 areas, groundwater protection areas, additional strategic stocks and national groundwater reserves. We are incorporating the measures resulting from this study into the forthcoming river basin management plans. Those plans relate to area-specific design measures for a natural and resilient system.

2. The chain approach as system change

A chain approach offers opportunities to differentiate between possible strategies for tackling all sources of pollution. In that way we can work on the ambition of minimising emissions of harmful substances:

- *Agriculture*: in agriculture we are committed to a further reduction of emissions of harmful substances into the water.
- *Industry*: in industry we are committed to a transfer from effort-based targets to result-based obligations. We are placing the burden of proof in this regard more firmly on the companies that discharge waste.
- *Urban environment*: we are committed to ensuring that public authorities and consumers make choices as to where more purification at the source and local reuse of water is possible, and where more advanced purification techniques are needed.
- *Abroad*: we are continuing to focus on the river basin as a whole for both chemical water quality (so that less pollution flows into our country) and ecology (such as fishways which enable fish to reach their spawning grounds and reproduce). This is important even though we also add a lot of substances to the water in our rivers here in the Netherlands.

Protecting groundwater

We must protect our groundwater from harmful substances. Groundwater is water that remains in our substrate for a very long time. Substances that negatively affect quality and pose a risk to drinking water are increasingly being found in our groundwater. Once these substances are present in our groundwater, it is virtually impossible to remove them. That is why we need to take extra care to protect this water and prevent these substances from entering it. One way this can be done, for example, is by preventing the use and storage of harmful pesticides in groundwater protection areas and by developing policies on the responsible infiltration of water to replenish groundwater where necessary.

Broad-based approach to substances and monitoring

More research is needed into the effects that various substances which are present in water at any one time can have. Currently, there is an insufficient focus on the effects of individual substances in surface water and groundwater. In fact, it is precisely the combination of these substances that often causes greater environmental damage. That is why it is important that we work with experts to develop an indicator for the combined toxicity of these substances. Improved monitoring and risk assessment are also needed, so that policy can be amended and so that supervision and enforcement can be adequately carried out.

4.4.4 The consequences of the approach

In order to achieve its water quality targets, the government is dependent on other challenges included in the NAS or elsewhere. Examples of those policies relate to agriculture and industry. European regulations, international cooperation and agreements between countries sharing a river basin are also essential, given that a significant part of the challenge is cross-border in nature and given that countries are dependent on each other for good water quality. Pollution in upstream areas can, for example, lead to standards being exceeded in downstream areas. In addition, obstructions such as dams downstream can prevent fish from reaching upstream spawning grounds.

The effects of climate change are already clearly noticeable in a water management context and are having an impact on water quality and quantity. The measures from the river basin management plans and other programmes (such as the Delta Programme and the Programme-Based Approach to Large Bodies of Water, (*Programmatische Aanpak Grote Wateren*) are aimed at making the Dutch water system future-proof. Water policy is laid down in the National Water Programme.

Challenge 4.5 Climate-resilient agriculture

Weir
(Photo: Harry Kolenbrander)

Entrepreneurs in agriculture and horticulture are already experiencing the consequences of climate change. They are dealing with extreme drought and heat, hail, pluvial flooding caused by heavy downpours or prolonged periods of rain, and the increasing salinisation of agricultural soils and the water they need. These events cause damage to crops and greenhouses and also impact the welfare and health of livestock. This damage and the solutions to manage them more effectively result in additional costs which negatively impact the operating result, especially if the problems persist for several consecutive years. The result is additional pressure on the future of the business, the sector as a whole and food security.

If agriculture and horticulture do not prepare and adapt, vulnerabilities resulting from these climate consequences will continue to increase. This chapter outlines the route and approach to moving from climate-vulnerable to climate-resilient agriculture and horticulture in the Netherlands.

4.5.1 The challenge

Over the past ten years, agriculture and horticulture have faced a succession of various weather extremes and increasing salinisation. These events reflect the fact that climate change is having a significant impact on agriculture and horticulture, and that climate adaptation is an urgent concern for these particular sectors. The **impact** of the consequences of climate change varies per region, agricultural sector and crop.

- Pluvial flooding and river flooding pose a particular risk in the river region and the hilly region of Limburg. In the river region, floodplains can fill up during the growing season and lead to damage. In the hills of Limburg, the Maas and its tributaries can flood. Extreme rainfall (heavy showers) can cause flooding throughout the country.

- Drought is a particular risk on the high sandy soils in the eastern and southern Netherlands, where it affects all agricultural sectors. Sandy soils do not retain water well and water can only be supplied in a few locations. If there is no precipitation and the groundwater level that is too low, soils and crops dry out.

- Salinisation is an issue in the west and north of the country along the coast and in Flevoland. This salinisation is the result of a rising sea level combined with drought and land subsidence. This is already affecting agriculture and horticulture in the Southwestern Delta, as well as capital-intensive salt-sensitive crops such as tree cultivation (in Boskoop) and flower bulbs (in the dune and bulb region and the northern tip of North Holland).

- (Late) night frost, heat and solar radiation pose increasing risks for fruit cultivation.

- More extreme weather conditions also impact livestock farms. Examples include flooding and heat stress which impacts animals in barns, pastures and during transport and in slaughterhouses. Other examples include reduced yields due to poor harvests, less feed from the farm itself and animals being able to go outside less due to extreme (wet or hot) weather conditions. Soil subsidence and salinisation also have consequences for (dairy) livestock farming in the peat meadow areas.

It is hugely important that we preserve and strengthen Dutch agricultural land and use it in a climate-adaptive way. The damage caused to agriculture and horticulture can become very significant if we do not prepare and support these sectors structurally, effectively and before it is too late as they adapt to climate change. Failure to do this will result in the continuity of agricultural businesses being jeopardised, and with that, the security of supply and food production. At the same time, the warmer climate zone shifting towards the Netherlands offers opportunities to implement different or new food production systems in our fertile delta. To achieve this, we must take an adaptive approach to managing our agricultural land.

In addition to adapting their own business operations, farmers can also support surrounding regions and the groundwater system to become more climate-resilient. This can, for example, be done by retaining water to combat drought and capturing excess water. This may result in a social or ecosystem service with corresponding compensation for agricultural entrepreneurs. Rural areas can be boosted by a combination of climate-resilient agriculture and resilient nature. This applies to socio-cultural aspects (the identity of people and areas) and landscape aspects, with respect for animals, as well as economically. Climate-resilient agriculture can also contribute to and learn from solutions in an international context through exchanges with other countries.

The ambition

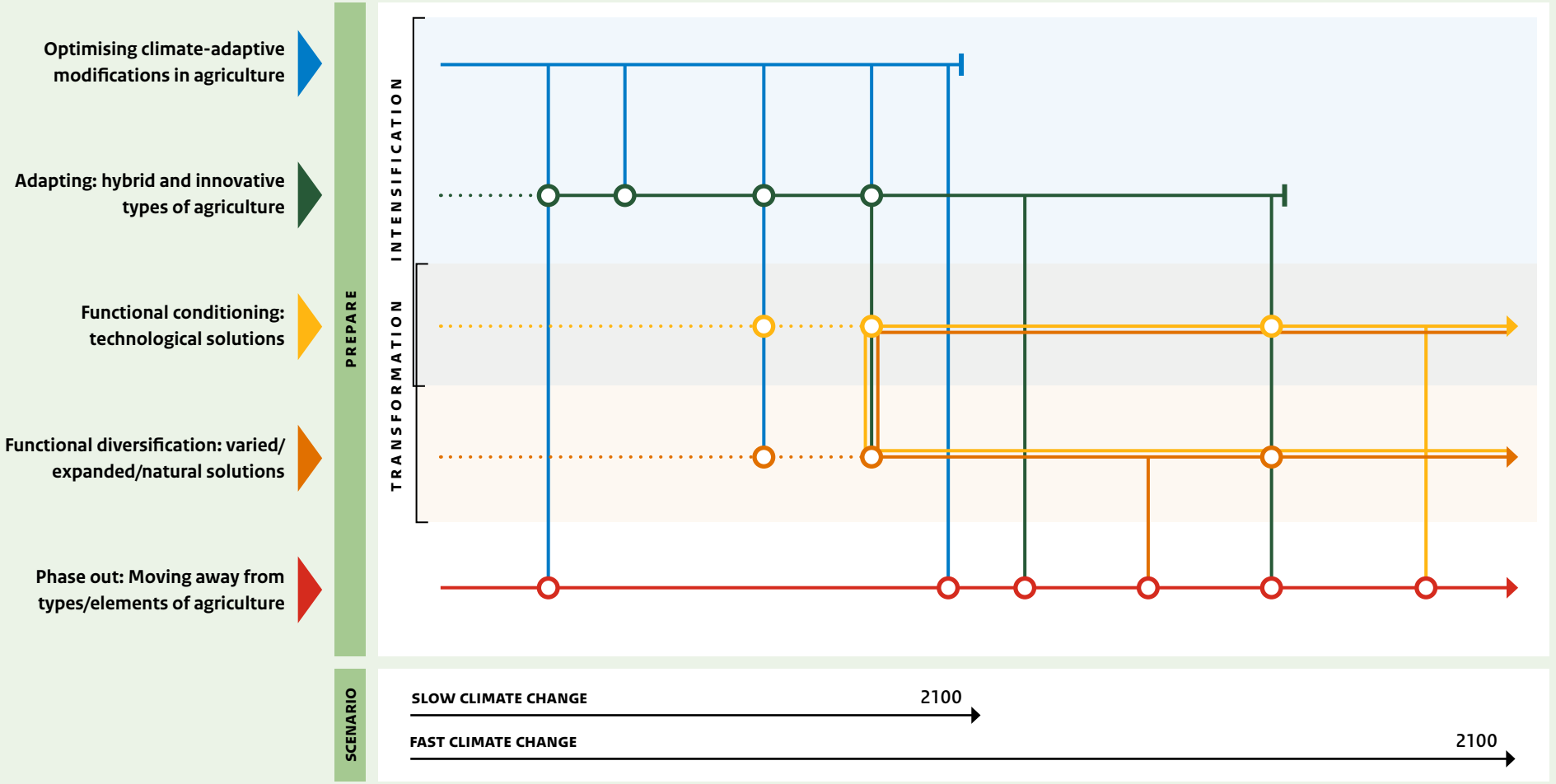
In 2050, the agriculture and horticulture sectors will be resilient to extreme weather events and salinisation, in both the plant-based sectors and livestock farming.

This means that, by 2050 at the latest, all farmers will have adapted their business operations to, and structured them for, the expected increase in extreme weather events (drought, flooding, heat) and salinisation, and that they will be able to cope financially and sustainably with the consequences in the long term. With this ambition to guide us, we can offer hope for the future to agriculture and horticulture, and we will be working towards that longer term goal from 2026 onwards.

Text box 4.5.1 **Legal division of roles**

- The Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN) is responsible for national policy regarding (the climate adaptation of) agriculture and horticulture.
- Agricultural entrepreneurs are responsible for sound, climate-adaptive business operations.
- The Ministry of Infrastructure and Water Management (Rijkswaterstaat), and the water authorities are responsible for water management in the main water system and the regional water system respectively. These responsibilities cover both preventing pluvial flooding caused by precipitation as much as possible, as well as the supply and distribution of water during periods of drought. The agricultural horticultural sector is one of the main consumers of water during such periods and the assessment framework used is the water distribution priority list from the Environment and Planning Act.
- Weather damage to field crops as a consequence of, for example, heavy rain, hail, wind, or prolonged drought can, in principle, be insured under comprehensive weather insurance (with government support). This means that weather damage to crops can never qualify as a disaster within the meaning of the Disasters and Serious Accidents (Compensation) Act (*Wet tegemoetkoming schade bij rampen*, Wts). The Wts applies, for example, in the case of flooding as a result of a dyke being breached, or flooding from the Maas river in Limburg where it is not protected by dykes (as was the case in July 2021). Consequently, financial compensation for weather damage to crops under the Wts cannot, in principle, be granted.
- The provincial authorities, water authorities and municipalities are responsible for implementing national policy in the respective regions. This means imposing regulations and issuing permits that may apply to climate-adaptive adjustments in crop cultivation and for livestock, as well as land and (ground)water use. For example for the installation of crop protection canopies, hail nets, or shelter for livestock.

Figure 4.5.1 **Adaptation pathway map** for the challenge of climate-resilient agriculture



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.5.2 The options

We are using three adaptation strategies to fulfil the 2050 ambition, namely optimisation, adaptation and transformation. This approach is an important part of the implementation and further development of the Action Programme for Climate Adaptation in Agriculture[1] (AP KAL). It is shown in the adaptation pathway map in Figure 4.5.1.

This conceptual framework helps administrators, policymakers and entrepreneurs in the agricultural and horticultural sector to connect the short and long term. It provides entrepreneurs with an insight into when and how they can optimise their business operations, adapt to climate change in the medium term and work towards transforming their business and cultivation as 2050 approaches. It also supports administrators and policymakers at national and regional levels to put in place the right preconditions and make (spatial) choices on time. In this way, clearer future prospects can be created for entrepreneurs, and that will allow them to grow more specifically towards achieving the 2050 ambition. In the process, public and private disinvestments and maladaptation are prevented wherever possible. By taking this approach, we also intend to minimise residual risk and damage.

Each of these strategies focuses on future-oriented developments, actions and moments of decision at four levels of scale. These levels of scale are crop and animal, plot and barn, farm, and lastly chain and region.

- The **Optimisation** phase concerns the first (basic) steps in adapting agricultural business operations to changing climate conditions, such as drought, flooding and salinisation. This means adaptive soil, water and cultivation measures that can already be applied.
- The **Adaptation** phase involves more hybrid and innovative adaptation-related solutions than optimisation.
- The **Transformation** phase can be split into Conditioning and Diversifying. These are two ways of adapting, namely in a more technological way, or in a more varied/broadened way, together with natural solutions, with combinations also being possible, of course.

In the long term, the question of phasing out non-climate-adaptive measures or practices will also play a role in every strategy. This phasing out process may be applied to outdated or undesirable techniques, crops and/or business practices in the agriculture and horticulture sector. Instead, we need to develop climate-resilient alternatives in a timely manner so that farmers can choose to adopt them.

1 See Rijksoverheid.nl

Text box 4.5.2 **Examples of climate-adaptive measures and innovations in agriculture and horticulture**

- The **optimisation** of farm operations may include climate-adaptive and innovative water and soil management (such as water farming and reduced tillage), risk diversification in terms of cultivation (plan) and time, and the application of drought and/or heat-resistant varieties and crops. A number of these types of adaptation measures are already more widely known, and farmers can already start using them. Any adaptive measures that agricultural entrepreneurs are currently taking apply mainly to soil and water, and they are less likely to opt for (larger) crop adjustments.

- **Adaptation** to climate change can be achieved through combination cropping (mixed cropping, strip cropping), convertible canopies in fruit cultivation (innovative coverings that close in the event of precipitation), agroforestry (combining arable farming, livestock farming and/or vegetable cultivation with trees and shrubs on the same plot), saline cultivation, circular water management in open field cultivation, cultivation from the ground, vertically and in buildings, and by taking preventive measures to protect animals against emerging animal diseases (for example through vaccination). Research into these adaptive measures is largely still in its early stages.

- When it comes to **transformation**, which is the greatest long-term challenge, our assumption is that the consequences of climate change can no longer be compensated for using current agricultural systems and strategies. Instead, we must develop and implement completely different (food) production systems. This means the cultivation of crops that would normally not be found in the Netherlands (southern crops, such as soybeans, grapes, or peaches shifting northwards), the further development of salt-tolerant crops and crops which are highly resistant to drought and/or waterlogging, as well as intercropping systems such as aquaponics (a combination of fish farming and crop cultivation). Other examples are the wet cultivation of crops like rice, cattail, bulrush and cranberry, or combinations of agriculture, nature, large bodies of water and urban environments.

Matrix 4.5.1

Goal/Effort Matrix for the challenge of climate-resilient agriculture

Ambition

In 2050, agriculture and horticulture will be resilient to extreme weather events and salinisation, in both the plant-based sectors and livestock farming. This means that, by 2050 at the latest, all farmers will have adapted their business operations to, and structured them for, the expected increase in extreme weather events (drought, flooding, heat) and salinisation, and that they will be able to cope financially and sustainably with the consequences in the long term.

Improvement goal	**1. Water system goal** *More efficient water use, water reuse, water retention (water buffering, above-ground and/or underground), and water discharge with buffering options.* The goal is to become as self-sufficient as possible around water for agricultural businesses and areas. That will make them less dependent on water supply. To this end, farmers and water authorities are taking adaptive water measures and making sound mutual agreements. Retaining water more effectively in agricultural soils, both individually and with groups of farmers and growers, will potentially mean that irrigation bans or water shortages can be postponed. One side effect will be a healthier regional soil water system. If water farmer concept is used, a greater insight will be gained into sufficient water availability during the growing season and in the longer term. This may also result in the provision of rewarded water system services to the surrounding area.	**2. Soil system goal** *More sustainable management of agricultural soils by retaining organic matter (carbon sequestration), counteracting soil compaction and improving soil quality, including soil biology.* The goal is to improve soil quality and water availability at farm level. This will also help create a healthier regional soil-water system and improve crop resilience to drought, extreme rainfall and diseases.	**3. Adaptive crops and cultivation systems goal** *Choosing more consciously and actively for more adaptive varieties, crops, and/or cultivation systems that align with the soil-water system and are more resilient to the consequences of climate change, such as excessively dry, saline and wet conditions, and (new) diseases and pests. In addition, the use of other preventive measures that ensure protection and risk diversification of crops over time and/or place.* The goal is to contribute to soil and water quality and water availability at the farm and regional levels. This should ensure a healthier soil-water system.	**4. Adaptive livestock farming goal** *Choosing more consciously and actively for livestock farming systems and management measures that will mitigate the consequences of climate change in such a way that animal welfare and animal health continue to be optimally safeguarded.* The goal is to reduce heat and cold stress for animals in pastures and stables, during transport and in slaughterhouses, and to protect animals as much as possible against animal diseases or other health problems and in the event of natural disasters, such as floods and wildfires.
SMART goal	With a view to promoting water availability for and by agriculture and horticulture, cooperation is taking place with, among others, the **Freshwater Delta programme.** (improvement goal 1)	The National Agricultural Soils Programme (*Nationaal Programma Landbouwbodems, NPL*) is collaborating with other parties to make agricultural soils more resilient to the effects of climate change and to protect farms and the region to surface water flooding and drought. In **2030**, all agricultural soil in the Netherlands will be sustainably managed. From 2030 onwards, an extra 0.5 megatonnes of CO_2 equivalent (carbon dioxide) will be stored in mineral soils annually. Examples of cooperation are knowledge projects and joint communication. (improvement goal 2)	With a view to encouraging and supporting the use of more adaptive varieties, crops and/or cultivation systems, alignment is being sought with, among others, the Implementation Programme for the Vision for the Future of Plant Protection 2030 (*Uitvoeringsprogramma Toekomstvisie gewasbescherming*). (improvement goal 3)	Actions based on the **Action Plan for Heat Stress in Livestock** (*Plan van aanpak hittestress bij landbouwhuisdieren*) and the National Action Plan to boost Zoonoses Policy (Nationaal actieplan versterken zoönosenbeleid) are being developed and implemented. (improvement goal 4). **Basic monitoring of animal diseases** by Royal GD to ensure continuous monitoring of (emerging) diseases in livestock farming. (improvement goal 4).
Effort/result	In **2030**, all entrepreneurs in the agriculture and horticulture industries will be prepared to deal with climate change in a way which is sustainable and effective. This is at the heart of the Action Programme for **Climate Adaptation in Agriculture.** (improvement goal 1, 2, 3 and 4)			
	→ Promote rewards for measures taken by entrepreneurs on their farmland, for example with regard to the water balance at regional level, as an ecosystem service.	→ Make climate adaptation an **integral** part of the agricultural policy of the Ministry of Agriculture, Fisheries, Food Security and Nature.	→ Draw attention to the consequences of climate change for agriculture and horticulture (**urgency**), provide insight, collaborate and connect with relevant programmes and organisations.	→ **Stimulate and support** agricultural entrepreneurs and parties involved based on the Action Programme for Climate Adaptation in Agriculture and the new NAS'26.
	Organise and sustain financial coverage: → Structural **financing** for climate adaptation in agriculture and horticulture. → Use and, where possible, connect or combine financial flows from public authorities, financial institutions, programmes and topics. This means, for example, resources under the Common Agricultural Policy (CAP), the Delta Programme (Freshwater and Spatial Adaptation), provincial authorities, water authorities, plus European and private funds, products and arrangements. Part of this involves collaborating with financial institutions and supply chain partners.			
	→ Make sure **comprehensive weather insurance** remains available to cover the residual risks of extreme weather within sound climate-adaptive agricultural practices. Examine how this insurance instrument can be further developed as adequate long-term insurance for these residual risks in agriculture and horticulture.		→ Develop and open up an **Investment Scheme** for agricultural business owners to facilitate and accelerate the actual implementation of climate-adaptive measures and green-blue solutions in the farming sector. Emphasis on measures focused on adaptive soil and water management, resilient crops and adaptive livestock farming.	
	→ Fill in the gaps in terms of **knowledge development** and continue and intensify the dissemination of that knowledge. This means enhanced knowledge dissemination on climate adaptation and sustainable soil management via the Delta Plan for Agricultural Water Management (*Deltaplan Agrarisch Waterbeheer, DAW*), measure-related fact sheets and tools for agricultural entrepreneurs. With a view to improving the scope of action for farmers and growers, (practical) knowledge is being made more accessible and applicable to specific farms. This also involves looking at the longer term, costs and benefits, and opportunities that arise as a result of climate change. The focus of the knowledge and innovation lies on dealing with drought, surface water flooding, salinisation and heat stress.			

4.5.3 The approach

The focus of LVVN and the government

Since 2020, the Action Programme for Climate Adaptation in Agriculture (*Actieprogramma klimaatadaptatie landbouw*) has provided a framework for identifying the risks, bottlenecks, opportunities and courses of action for agriculture and horticulture in relation to increasing weather extremes and salinisation. This new NAS'26 represents a step to the next phase, meaning the actual structural and systematic adaptation by farmers and growers of agricultural business operations to climate consequences. The 2050 ambition therefore goes further than the action programme goal for 2030, which states that by 2030, all entrepreneurs in agriculture and horticulture will be prepared to deal with climate change in a way which is sustainable and effective. We expect entrepreneurs to have adapted their business operations to, and organised them for, the climate by 2050.

We will continue working on the course set by the action programme until 2030. We will be doing this on the basis of the five pillars structure. The focus of the four sector-specific pillars is on the water and soil system and adaptive crop and livestock farming systems. The fifth pillar consists of supporting instruments in the areas of knowledge and innovation, regional approach and risk management. With this in mind, we are developing new actions and expanding action lines that have already started. At the same time, we are preparing for the initiatives we want to start taking in 2030 and then continue until 2050.

As regards the period from 2030 to 2050, we will evaluate the approach taken in the action programme by no later than 2029. We will then determine whether a second action programme is needed, or whether we will perpetuate the structure, direction and cooperation on the basis of the current programme with the parties involved and the NAS'26.

Improvement goals per pillar

In addition to the ambition for 2050, we have developed improvement goals for each of the four sector-specific pillars of the action programme. We have done so by taking as a starting point the results we have achieved with the parties involved since 2020 in the adaptation approach for agriculture and horticulture. All goals, together with the policy commitment, are included in the goal/effort matrix (DIN, see matrix 4.5.1).

1. Water system goal
More efficient water use, water reuse, water retention (water buffering, above-ground and/or underground), and water discharge with buffering options.

The goal is to become as water self-sufficient as possible on agricultural farms and in areas To make them less dependent on water supply. To this end, farmers and water authorities are taking adaptive water measures and making sound mutual agreements. Retaining water more effectively in agricultural soils, both individually and with groups of farmers and growers, will potentially mean that irrigation bans or water shortages can be postponed. One side effect will be a healthier regional soil water system. If this water farming concept is used, a greater insight will be gained into sufficient water availability during the growing season and in the longer term. This may also result in the provision of rewarded water system services to the surrounding area.

2. Soil system goal
More sustainable management of agricultural soils by retaining organic matter (carbon sequestration), counteracting soil compaction and improving soil quality, including soil biology.

The goal is to improve soil quality and water availability at farm level. This will also help create a healthier regional soil-water system and improve crop resilience to drought, extreme rainfall and diseases.

3. Adaptive crops and cultivation systems goal
Choosing more consciously and actively for more adaptive varieties, crops, and/or cultivation systems that align with the soil-water system and are more resilient to the consequences of climate change, such as excessively dry, saline and wet conditions, and (new) diseases and pests. In addition, the use of other preventive measures that ensure protection and risk diversification of crops over time and/or place.

The goal is to contribute to soil and water quality and water availability at the farm and regional levels to ensure a healthier soil-water system.

4. Adaptive livestock farming goal

Choosing more consciously and actively for livestock farming systems and management measures that will mitigate the consequences of climate change in such a way that animal welfare and animal health continue to be optimally safeguarded.

The goal is to reduce heat and cold stress for animals in pastures and stables, during transport and in slaughterhouses, and to protect animals as much as possible against animal diseases or other health problems and in the event of natural disasters, such as floods and wildfires.

The focus

To achieve these four goals for climate-resilient agriculture by 2050, we will focus on the following areas of activity in the coming years, together with all the parties involved.

Urgency, integration and financing

- Stimulate and support agricultural entrepreneurs and parties involved based on the Action Programme for Climate Adaptation in Agriculture and the new NAS'26.
- Draw attention to the consequences of climate change for agriculture and horticulture (urgency), provide insight, collaborate and connect with relevant programmes and organisations.
- Make climate adaptation an integral part of the agricultural policy of the Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN).
- Organise and sustain financial coverage:
  - Structural financing for climate adaptation in agriculture and horticulture.
  - Use and, where possible, connect or combine financial flows from public authorities, financial institutions, programmes and topics. This means, for example, resources under the Common Agricultural Policy (CAP), the Delta Programme for Freshwater, provincial authorities, water authorities, plus European and private funds, products and arrangements. Part of this involves collaborating with financial institutions and supply chain partners.

Tools

- Fill in the gaps in terms of knowledge development and continue and intensify the dissemination of that knowledge. This means enhanced knowledge dissemination on climate adaptation and sustainable soil management via the Delta Plan for Agricultural Water Management (*Deltaplan Agrarisch Waterbeheer, DAW*), measure-related fact sheets and tools for agricultural entrepreneurs. With a view to improving the scope of action for farmers and growers, (practical) knowledge is being made more accessible and applicable to specific farms. This also involves looking at the longer term, costs and benefits, and opportunities that arise as a result of climate change. The focus of the knowledge and innovation lies on dealing with drought, pluvial flooding, salinisation and heat stress.
- Develop and open an investment scheme for agricultural entrepreneurs to promote and accelerate the actual application of climate-adaptive measures and green-blue (natural) solutions in farming practice, with an emphasis on measures in the areas of soil and water management, resilient crops and livestock farming.
- Make sure comprehensive weather insurance remains available to cover the residual risks of extreme weather within sound climate-adaptive agricultural practices. We are examining how this insurance instrument can be further developed as adequate long-term insurance for these residual risks in agriculture and horticulture.

Focus on improvement goals

- With a view to promoting water availability for and by agriculture and horticulture, cooperation is taking place with, among others, the Freshwater Delta programme (improvement goal 1).
- Promote rewards for measures taken by entrepreneurs on their farmland, for example with regard to the water balance at regional level, as an ecosystem service (improvement goal 1).
- The National Agricultural Soils Programme (*Nationaal Programma Landbouwbodems, NPL*) is collaborating with other parties to make agricultural soils more resilient to the effects of climate change and to protect farms and the region to pluvial flooding and drought. Examples of cooperation include knowledge projects and joint communication (improvement goal 2).
- To encourage and support the use of more adaptive varieties, crops and/or cultivation systems, we are linking up with, among others, the Implementation Programme for the Future Vision for Crop Protection 2030 (improvement goal 3).
- Actions based on the Action plan for heat stress in commercially held livestock (*Plan van aanpak voor hittestress bij bedrijfsmatig gehouden landbouwhuisdieren*) and the National Action Plan to boost Zoonoses Policy (*Nationaal actieplan versterken zoönosenbeleid*) are being developed and implemented (improvement goal 4).
- Basic monitoring of animal diseases by Royal GD, as commissioned by the livestock sectors and LVVN, to insure continuous monitoring of (emerging) diseases in livestock farming (improvement goal 4).

What is expected of parties involved?

In the food system and our broader society, numerous parties have a direct or indirect relationship with entrepreneurs, companies and sectors in the agriculture and horticulture sector.

Examples include:

- public authorities like the provincial authorities, water authorities and municipalities;
- financial institutions such as banks, insurers and (land) investors;
- market and supply chain parties such as suppliers, buyers, and supermarkets; and
- knowledge institutions such as universities and consultancies.

Each of these parties has an interest in, and influence on, an agricultural and horticultural sector which is capable of coping with climate change. In other words, a sector which can continue to supply food products and thereby ensure food security. It is also important for all these parties that the sectors and businesses can continue their operations in the long term, even in challenging climate and weather conditions. For example, buyers want to be able to rely on a secure supply of vegetables and fruit and banks or insurers want to incur as few financial risks or losses as possible.

We expect these stakeholders to stimulate and support agricultural sectors and businesses over the coming ten years as well. This can be done by focusing on individual organisations or by collaborating with one another. There are already good examples of this, such as cooperation with financial institutions aimed at a multi-year action agenda, knowledge projects with market and supply chain parties, and the exchange of information regarding new or adapted forms of financing to promote climate adaptation. Learning from each other should also be part of this process.

Climate adaptation in agriculture and horticulture often extends beyond the farmyard. Agricultural entrepreneurs want to take the necessary adaptive measures but usually cannot do so alone. The parties around the farmer therefore have a crucial role to play, alongside LVVN and other ministries such as IenW and programmes such as the Delta Programme. They are needed to provide the preconditions and support required for Dutch agriculture and horticulture to continue developing towards 2050 into a climate-resilient sector that can take a few knocks. Along the way, there will be challenges and bottlenecks to be resolved, as well as opportunities and possibilities for agriculture and horticulture to continue using the fertile delta of the Netherlands in a climate-adaptive and sustainable manner, for Europe and elsewhere. This will involve food production, as well as knowledge, innovation and adaptive investments, plus green-blue (natural) solutions and combinations thereof with technological innovations.

This climate adaptation strategy serves as a guide as we journey along the shared pathway to 2050.

4.5.4 The consequences of the approach

Climate adaptation will help to create broader prospects for the future for agriculture and horticulture, as well as for the crucial element of food security. The approach referred to here, which involves public and private commitment and investments, will ensure that agricultural businesses can absorb the climatic consequences for their crop cultivation and livestock farming over many years, and that the most can be made of new opportunities. These investments will ensure that these businesses, sectors and consequently the entire agriculture and horticulture sectors, are prepared for the future, even in the face of extreme weather events and further salinisation.

In addition to investing, it will also be necessary to collaborate with adjacent domains, such as nature. The same applies to those 'crossroads' where sectors, issues and solutions meet. One example is the need to secure sufficient and clean fresh water and space for water buffering.

The crossroads between water availability and agriculture

Agriculture requires sufficient and clean fresh water, particularly in spring and subsequently during the growing season, for the production of food, animal feed, or other plant-based products. This water availability is under pressure due to climate change. Water scarcity will become a more and more frequent occurrence, and salinisation will increase. Water authorities are no longer always able to deliver water to all locations, or sufficiently flush saline ditches with fresh water. This presents dilemmas for the parties responsible for water and agriculture, as well as for water consumers such as agricultural and horticultural businesses.

In the long term, it is likely that we will have to make difficult choices regarding water availability and distribution. It is important that we prepare for this now through research (exploratory studies, scenarios, potential solutions), consultation and collaboration. Moreover, when making policy choices, we will also have to consider the potential spillovers to other sectors, regions, or generations. If spillover cannot be avoided, consideration can be given to supporting policies (compensation/investment support). These will mitigate negative consequences for affected parties and support potentially unavoidable adjustments.

As we head towards 2050, we are working together with public authorities and water consumers, like the agricultural and horticultural sector, on the following mission: 'From taking water to sharing water'. Based on this mission and strategy, the goal is to keep water available for agriculture and horticulture now and in the future, even during times of water scarcity. In this regard, it is important to:

- Provide the agricultural and horticultural sector with a timely insight into the potential consequences of administrative and political choices regarding adjustments to the water system and water management and where, when, and to what extent those consequences will play a role. It is important to develop a range of possible scenarios from which to choose.
- Engage in dialogue with LVVN and agricultural entrepreneurs and organisations on this matter with a view to developing alternatives and potential solutions and to investing in them (both publicly and privately).
- In doing so, make all potential solutions and options (explicitly) visible, including costs, benefits, potential undesirable spillover to other sectors or areas, as well as financial and/or administrative compensation and/or arrangements for affected stakeholders. The aim is to prevent spillover and to develop solutions with due regard for supporting instruments.
- Make sound agreements between (groups of) entrepreneurs, (agricultural) sectors and public authorities regarding water use in order to make the available water in an area last longer. This may constitute a method for potentially postponing or preventing an irrigation ban or restriction.

The crossroads between nature and agriculture

Nature and agriculture together constitute a large part of the rural area. As a consequence, they can play an important role in climate adaptation in the Netherlands, alongside adaptive efforts in urban areas and the transition zones between them. In more specific terms, agriculture can benefit from the green-blue solutions provided by nature and biodiversity, such as sufficient and clean water, pollination, pest control, shelter against extreme weather events (sun, heat, precipitation, wind), and subsurface soil biodiversity.

Conversely, agriculture also influences nature and biodiversity. One example is how it affects the ability to continue providing these green-blue services to agriculture in the long term. The extraction of (ground)water and the artificial maintenance of low water levels in agricultural plots, for example, lead to further desiccation of surrounding nature. In addition, the spread of animal diseases and zoonoses, such as avian influenza or African swine fever, between wild and domesticated animals, can occur more easily wherever agriculture and nature meet. The shared challenge posed by climate change primarily concerns water availability. Agriculture and nature can support each other in this regard as important domains in rural areas, for example by individually or jointly retaining water more effectively in agricultural and natural soils within the region, and by imposing a higher water level.

- Agricultural entrepreneurs, conservationists, drinking water companies and public authorities will engage in dialogue so that they can work towards a joint water strategy in specific areas. This strategy will involve them establishing agreements and instruments so that they can achieve a more balanced soil-water system. One way they will do this is by retaining water more effectively on farms, nature reserves, estates and/or state-owned land.
- The aim behind this collaboration will be to build resilient agricultural businesses that can withstand a climate shock, are therefore future-proof, and can contribute to more climate-resilient nature, cleaner water and healthier soils. Conversely, nature will be able to continue making its green-blue solutions available to agriculture and horticulture.

The crossroads between spatial planning and agriculture

The climate-adaptive organisation of agriculture and horticulture must take account of the natural water and soil system with its area-specific characteristics. This means the high sandy soils, the hilly and river landscapes, the low-lying (peat meadow) areas and the saline coast. Adapting to extreme weather events and salinisation is achieved through water conservation, water reuse and the local retention and storage of a maximum amount of fresh water. In the long term, the way land is used will also have to adapt to changing water and soil conditions.

Every consumer of water will have to become expert at anticipating periods of reduced fresh water availability and increasing drought and/or salinisation. At the same time, farmers, like public authorities, will have to find ways of effectively managing pluvial flooding caused by heavy downpours. Sectors and agricultural entrepreneurs are also preparing for this and implementing the necessary adaptive changes in their business operations. Although the government does not prescribe how they should do this, this national climate adaptation strategy encourages and supports them and the public authorities in this endeavour.

While numerous challenges require space, the space available in the Netherlands is already under enormous pressure. The Spatial Policy Document (*Nota Ruimte*) provides vision and guidance on this issue. The Spatial and Governance building blocks section in the General chapter clarifies in more detail what specific spatial needs exist in the Netherlands with regard to climate adaptation, and how these are addressed in line with the Spatial Policy Document. Examples include:

- Identifying where and for which challenges, such as agriculture and horticulture, space and adaptations are needed in order to meet climate adaptation goals, with the aim being to enable the right choices to be made in this context at national and regional levels.
- Promoting area processes and cross-area administrative agreements so that the necessary decisions are taken on time. It is also important that it is clear who fulfils which role in this respect and that the financing of climate-adaptive solutions is included.

Consequences for people and the living environment

The strategic environmental impact report (SEIR)[2] and the social impact assessment (SIA)[3] on this strategy indicate what climate change and adaptation to it - including in agriculture and horticulture - mean for the (living) environment, and also socially, specifically for young people.

The SEIR describes the extent to which there is a well-considered mix of prevention, control and acceptance of residual risks. To this end, the focus was primarily on strengthening the current adaptation policy through intensification/optimisation and on more system-oriented transformation as the two main options for climate adaptation. Policy options for improving existing functions and land use are less drastic and pose limited risks for the living environment. They are more focused on the short and medium term. Transformative policy options require a greater adaptation of functions, land use and spatial planning so that they align more effectively with natural systems. These (system) changes offer the largest number of opportunities for effective adaptation to climate change in the longer term.

Not all transformative policy options inherently entail major risks. One example of this is the functional diversification of agriculture, which involves using varied and broadened forms of agriculture and horticulture, such as combinations with natural solutions. This structural change in land use scores positively on *People*, *Planet* and *Prosperity* (from the Wheel of the Living Environment as an assessment framework) and has only limited risks.

The conclusion of the SEIR is that the choice between intensifying/optimising or transformative climate adaptation policy will differ depending on the situation and timeline. Both approaches have their own strengths and limitations. Attention must be paid to area-specific characteristics (such as water availability), tensions between options, lock-ins, trade-offs, and timely preparation by and for the parties involved.

The SIA shows that a long-term perspective is important to prevent temporary benefits or improvements from leading to, for example, structural vulnerability in the longer term. The SIA also recommends that policy take account of social and socio-economic aspects, such as affordability, fairness or (in)equality, social cohesion, identity, uncertainty and trust. Support for change is important when it comes to encouraging people and communities to adapt actively to, or take the initiative for, adjustments to their living environment. The SIA recommends that communication should take place in the language of the target groups, using examples that resonate with them, while also paying attention to public support and the financial aspects of adapting to climate change. The SIA also identifies collaboration and knowledge exchange as important actions, both within the agricultural and horticultural sector and with related parties.

These insights are confirmation that it is crucial to keep taking steps towards making agricultural and horticulture resilient to climate change between now and 2030 and 2050. These valuable indications and recommendations will be incorporated into the further development of this strategy. We have already explained how we intend to focus on these insights on a large number of aspects.

2 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Utrecht: Movares, 2026.
3 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.

Challenge 4.6 Resilient nature

Heather turns purple at The Mandeveld nature reserve *(Photo: Camjo Media (2024)*

The Mandeveld nature reserve turns purple ever earlier in the year. Even the forest rangers are surprised by early bloom on the heath: "I thought: gosh, that's early."[1] More and more people are noticing and commenting on the effects of climate change on nature. Experts say that, if we do nothing, things will only get worse. That is why the challenge of climate adaptation in nature is urgent and there is no time to lose. However, that same nature is equally part of the solution, for example because trees can provide cooling and wetlands can retain water. If we manage nature smartly, we will be able to make the Netherlands more resilient to the consequences of climate change.

1 NOS. 2024: 'Even the forest rangers are surprised by early bloom on the heath: "I thought: gosh, that's early."' NOS, 3 August 2024.

4.6.1 The challenge

The various effects of climate change are bringing pressure to bear on nature and on opportunities for nature restoration. The increasing climate effects result, among other things, in drier and more saline natural areas, poorer water quality and quantity, and more wildfires.[2, 3, 4] In addition, climate zones (areas on Earth with a similar climate) are shifting worldwide. This makes habitats less suitable for plants and animals and affects special habitats in the Netherlands.[5] The result will be that some of our native species will migrate to more northerly areas, and invasive exotic species will be able to establish themselves here more easily. In addition, the various effects of climate change have negative consequences for the ecosystem services on which we as humans depend.6 We are continuing to work on nature restoration to prevent a (further) decline in biodiversity and to retain ecosystem services.[7]

Flourishing nature and healthy ecosystems are essential for our existence. The nature around us offers opportunities for us to relax and engage in recreational pursuits, provides us with food, raw materials, clean water, and clean air, and is an inexhaustible source of inspiration.[8, 9] Nature also has intrinsic value in that it is valuable for what it is, independent of its usefulness for humans. That is why we must cherish Earth's biodiversity. Healthy ecosystems are essential for both climate mitigation and adaptation. We can increase the capacity to store carbon by restoring ecosystems such as forests and by creating landscape elements such as hedges and wooded banks.[10] In peatlands and wetlands, we are attempting to reduce carbon emissions through rewetting. This is helping us to achieve EU climate goals. In addition, the restoration of these ecosystems is helping to mitigate the consequences of climate change, such as floods and droughts.

2 Intergovernmental Panel on Climate Change (IPCC). Climate Change 2022: *Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, 2022.
3 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
4 Eertwegh, Gé van den, et al. *Eindrapport project "Droogte Zandgronden Nederland" (Fase 3): Droogte in zandgebieden van Zuid-, Midden- en Oost-Nederland: het verhaal – analyse van droogte 2018 en 2019 en bevindingen*, 2021.
5 STOWA. *Effecten van klimaatverandering op terrestrische natuur*. Wageningen: Wageningen Environmental Research en KWR Watercycle Research Institute, 2021.
6 Vonk, Marije, et al. *Achtergronden bij wereldwijde klimaateffecten: risico's en kansen voor Nederland*. The Hague: Netherlands Environmental Assessment Agency, 2015.
7 The National Biodiversity Dashboard. 'Kerngegevens biodiversiteit, op één plek samengebracht'.
8 Omgevingsweb. 'Natuur Inzetten Voor Een Sterke En Vitale Samenleving'. *PONT Omgeving*, 22 April 2021.
9 Wageningen University & Research. 'De Positieve Effecten Van Natuur Op Gezondheid'.
10 Kruit, Jeroen, et al. *De bijdrage van agroforestry en landschapselementen aan water-, klimaat- en natuurdoelen: een verkenning met behulp van het Natuurlijk Kapitaal Model en de Natuurlijk Kapitaal Rekening*. Wageningen: Wageningen Environmental Research, 2025.

For this reason, a strong commitment is needed to protect and restore nature and to achieve a robust natural environment. This is in line with the goals of the European Nature Restoration Regulation.

The quality and quantity of nature must be improved, while we must also take the changing climate into account. Biodiversity in the Netherlands is currently not resilient, partly due to intensive land use and other pressures such as nitrogen deposition and groundwater extraction. If we want to create a resilient natural environment and unlock the Netherlands, it is important to look beyond just reducing the level of nitrogen emissions. We are focusing on a broad approach to all pressure factors caused by human activity. We are, for example, committed to combat desiccation, improve water quality and limit global warming. The quality and quantity of nature can be improved by optimising environmental factors, by creating sufficient space and connections for nature, and by providing space in society for the transformation of the natural system. This applies to nature in protected nature reserves, cultural landscapes, agricultural areas and parks, verges, and ditches in both rural and built-up areas.

Nature can also serve as a climate resilience solution. Nature can, for example, be used to store water during rain showers or to provide shade when it is hot.[11] These Nature-based Solutions (natural solutions) offer an opportunity to address multiple challenges simultaneously, alongside the nature challenge, and to combine land use, in line with the Draft Spatial Policy Document and the Nature Inclusive Agenda. The use of green/blue, climate-resilient solutions has been incorporated into other challenges in the physical living environment, such as challenges 4.2 *Robustness and resilience against flooding caused by extreme rainfall*, 4.5 *Climate-resilient agriculture*, 4.8 *Heat-resilient cities, towns and villages*, and 4.10 *Properly protected cultural heritage*.

Resilient nature adapts to changing conditions and can take a few knocks. We want to make nature, both inside and outside Natura 2000 areas, more robust so that characteristic landscapes are preserved, as well as the services that nature provides us.

11 Examples can be found at: www.klimaatbuffers.nl

The ambition

Nature is thriving in the Netherlands, even as the climate changes.

Thriving nature includes future-proof ecosystems whose physical conditions (including water, soil and air) meet at least the legal targets, both inside and outside protected nature areas. A thriving natural environment is also characterised by a high level of biodiversity (flora and fauna), which then enables us to meet our statutory nature conservation targets. Social and economic activities are intertwined with the natural environment in such a way that these activities consciously take account of nature and the quality of life in the Netherlands.

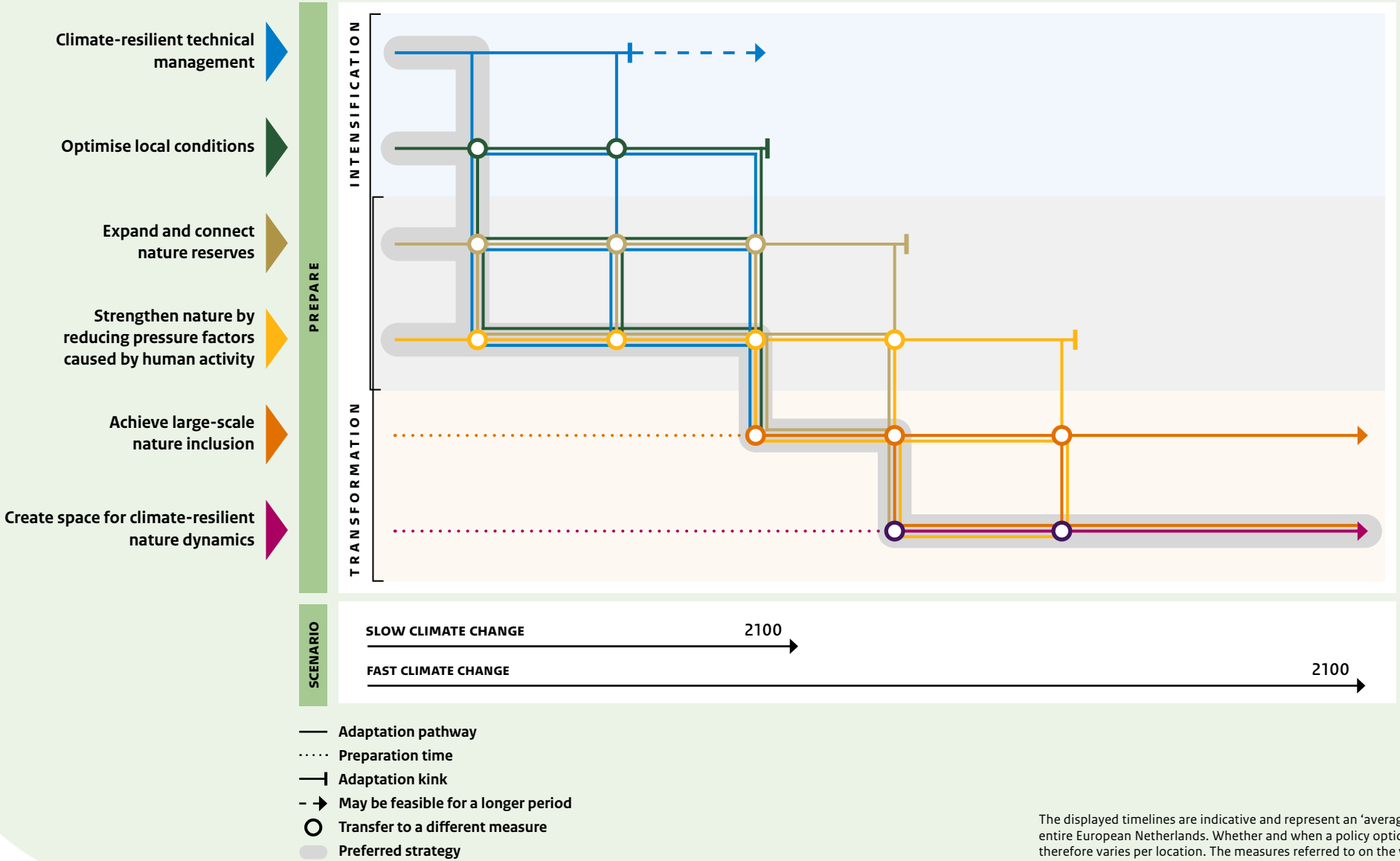
Text box 4.6.1 **Legal division of roles**

Municipalities, developers and provincial authorities are primarily responsible for implementing climate adaptation measures that utilise nature. This means, for example, creating green spaces in the city or green-blue corridors as a network of landscape features in rural areas.

Landowners and land managers are responsible for implementing climate adaptation measures in the natural environment.

The government is supporting these initiatives in order to fulfil statutory obligations for water, climate and nature.

Figure 4.6.1 **Adaptation pathway map** for the challenge of resilient nature



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.6.2 The options

Figure 4.6.1 shows the adaptation pathway map for this challenge. We can use this pathway map to work flexibly towards achieving a resilient natural environment. The first steps towards achieving a climate-proof natural environment focus on policy options from the first four categories in the figure. These policy options are necessary to meet the current statutory nature targets and thus achieve the ambition.[12] It is most effective to combine these policy options.

Technical management measures (blue) and optimising local conditions (dark green) best fit the intensification category.[13] Technical management measures primarily involve continuing the current way of working and further optimising nature (development), for example in line with the Nature Plan and the Nature Programme and promoting agricultural nature management. Land managers can implement these types of measures relatively easily on a small scale, for example by allowing streams to meander locally again, by constructing wadis, through more flexible water level management and by creating firebreaks to prevent wildfires.

We ensure a basic quality of nature by optimising the conditions (dark green) that common species need in order to remain or to become common.[14] This includes measures such as promoting water quality, working on soil health and improving the hydrological system. These measures can have a positive effect on the climate resilience of nature in the short term and on a small scale. However, their effectiveness is limited if we do not implement changes on a larger scale.

Expanding and connecting nature (brown) and strengthening nature by reducing human pressure factors (yellow) fit with intensification on a small scale. However, when applied on a larger scale, they are the first steps towards transformation.[13] We can offer species the opportunity to relocate if we expand nature reserves and link them together robustly. This takes place, for example, within the framework of the policy already implemented for the Netherlands Nature Network and by creating (high-quality) landscape elements.[15] Smart connections prevent each nature reserve from having to expand on its own because species can migrate between areas and therefore use each other's foraging areas and places to shelter. This is crucial for nature's adaptability. Increasing the area, as requested in the context of the NHV and the forest strategy, among other things, also offers opportunities for recreation, water retention, space for sports, exercise and socialising, CO2 storage, and the greening of our living environment and thus public health.

Reducing external pressure factors (yellow) is necessary to get the (physiological) basic conditions in order. These pressure factors include, for example, desiccation, fragmentation and pollution of nature by human activity. We can only achieve this if various sectors collaborate. This approach aligns with the leading principle of 'preventing spillover' in the Draft Spatial Policy Document. If we fail to reduce these pressure factors, it will become increasingly difficult to achieve our nature goals.

System transformation is an option in the longer term. This can be done by achieving nature inclusiveness on a larger scale (orange), which is the aim of the Nature-inclusive Collective (*Natuurinclusief Collectief*) and the NL2120 knowledge programme, and by making room for climate-resilient nature dynamics (purple). By nature inclusivity we mean the extent to which social and economic activities are interwoven with nature, and the extent to which space for biodiversity is consciously created. Another goal of nature inclusivity is to connect protected nature reserves in urban and rural areas. This also strengthens nature outside the protected areas, such as verges, ditches and banks, parks, gardens and field margins.

12 Netherlands Environmental Assessment Agency, in cooperation with Wageningen University & Research (WUR) and Deltares. *Agriculture and Nature Outlook: Seeking a new balance between agriculture and nature in 2050*. The Hague: Netherlands Environmental Assessment Agency, 2025.
13 WKR. *Meeveranderen met het klimaat: ruimtelijke en maatschappelijke keuzes voor klimaatadaptatie*. The Hague: Netherlands Scientific Climate Council, 2025.
14 Dekker, Merijn. *Handreiking Basiskwaliteit Natuur Stappenplan*. Van Hall Larenstein, 2025.
15 Deltaplan Biodiversiteit Foundation. *Landscape action plan Realisation of 10% green-blue permeation*. Wageningen: Samen voor Biodiversiteit, 2022.

Space for natural dynamics (purple) is about the societal side of changes in nature due to climate change. Habitats are shifting, and this is causing some species to disappear and new species to appear in other locations. These changes and the choices made require public understanding and support to yield optimal results. Preparations for these orange and purple measures will start in the short term to facilitate the transition (the dot in the adaptation pathway map) between types of measures. It is important that we start taking these measures into account now in spatial development plans and apply them (on a small scale) where possible.

The preferred strategy (indicated in grey) is to combine the various measures as much as possible for optimal effectiveness. It is also preferable to switch to the next set of measures before the previous measure has reached its end. We have the freedom to make adjustments based on new insights (into effects, resources, support). This will ensure that there is sufficient room for flexibility and preparation.

Matrix 4.6.1

Goal/Effort Matrix for the challenge of resilient nature

Ambition	 **Nature is thriving in the Netherlands, even as the climate changes**					
Improvement goal	**More effort focused on reaching the legally mandated nature conservation objectives (Birds and Habitats Directive, Water Framework Directive (2027), Nature Restoration Regulation (2030, 2040, 2050), where more consideration must be given to the changing climate (= climate adaptation in nature).**			**Use more green-blue (nature-inclusive) solutions within climate adaptation challenges in the physical living environment (= climate adaptation with nature).**		
SMART goal	The government will focus on facilitating climate-resilient technical management.	The government will commit to planning choices that connect and expand nature reserves (Netherlands Nature Network, the Forest Strategy, Green-Blue Veining).	The government will focus on reducing pressure factors caused by human activity within and outside nature reserves (nitrogen and carbon reduction, combating fragmentation).	The government will work to create societal understanding for climate-resilient nature dynamics.	The government will focus on optimising local conditions, in partnership with managers (Basic Nature Quality).	The government will focus on achieving Nature Inclusion in ten areas (Nature Inclusive Collective).
Effort/result	→ The government will have knowledge products and prospects for action developed.	→ The government will do that by setting up a Practice Network (CoP).	→ The government will run pilots in collaboration with Green-Blue Veining, Basic Nature Quality, Green in and Around the City Guide and Nature Inclusive Collective.	→ The government will partner with subnational authorities and site managers to organise target group meetings for this purpose, which will cover evaluation and progress.	→ The government will partner with subnational authorities and site managers to develop and share communications products.	→ The government will draft a policy guideline (2028). → The government will seek out financial resources for climate adaptation in and with nature.

4.6.3 The approach

We have drawn up various initiatives efforts that align with the adaptation pathway map in order to achieve the ambition behind this challenge. Aspiring to a resilient, future-proof natural environment is something that needs to be done in conjunction with other challenges and sectors. Preparing for and dealing with the effects of climate change is not an end in itself but is a precondition for achieving statutory targets. That is why we are implementing the aforementioned policy options (see Table 4.6.1), with the aim being to achieve the existing statutory biodiversity targets (Birds and Habitats Directives, European Nature Restoration Regulation), water targets (Water Framework Directive), and soil targets (EU Soil Strategy for 2030), even in the face of increasing drought, moisture, heat and sea level rise caused by climate change (= climate adaptation of nature). It is important to take measures for nature restoration for both existing nature and nature which is yet to be created. Although we are on the right track, an extra effort is needed in the long term to cope with the changing climate. We are also working on the deployment of green-blue natural solutions in other challenges within the climate adaptation policy, such as 4.5 *Climate-resilient agriculture*, 4.13 *Future-proof work locations* and 4.8 *Heat-resistant cities, towns and villages* (= climate adaptation with nature). We will be able to achieve these objectives at national level if we continue to focus on the six different policy options from the adaptation roadmap.

In practice, this means preparing and equipping land managers and (subnational) authorities as effectively as possible in the coming years so that they are able to cope with future climate effects and risks. Our aim is to create and preserve a thriving natural environment. To this end, the Ministry of Agriculture, Fisheries, Food Security and Nature (LVVN) has drawn up the Action Programme for Climate Adaptation in Nature (AP KAN 2025-2030). This programme describes the actions that are important for pragmatically accelerating and intensifying climate adaptation of, and with, nature. We will offer various tools via this programme to (subnational) authorities and land managers to get started with climate adaptation of, and with, nature:

- **Knowledge products and perspectives for action.** We are developing and circulating knowledge products and are sharing perspectives for action so that land managers can take appropriate adaptation measures. This will, for example, facilitate the further development of climate-resilient technical management and enable policymakers to make smarter spatial choices. We are identifying vulnerabilities per area and are examining how and where we can reduce pressure factors. After all, climate change affects regions differently, from salinisation in coastal areas, drought primarily on sandy soils in the eastern and southern Netherlands, and pluvial flooding and land subsidence in low-lying areas. An area-specific approach is therefore important to bring local conditions up to scratch.
- **Practice networks (communities of practice or CoPs) and pilot projects.** We are using these to continue developing and testing the integrated approach to adaptation of, and with, nature, along with associated adaptive measures in practice. We aim to scale up good examples in conjunction with the approach relating to Basic Nature Quality, the Nature-Inclusive Collective, Green-Blue Networks, climate-smart (forest) management and wildfire control. CoPs and pilots contribute to the improvement of physiological conditions, the implementation of natural solutions and the testing of climate-resilient management.
- **Target group meetings and communication products.** We are organising meetings such as conferences and workshops and create communication products such as websites and brochures to share information on climate adaptation of, and with, nature between the government, subnational authorities land managers. Exchanging ideas is important for public understanding and joint implementation.
- **Policy line.** We are establishing a policy line to integrate climate adaptation of, and with, nature into policy. The policy line contains preconditions, principles and more specific goals for the government, subnational authorities and implementing organisations. We are developing this policy line in cooperation with these parties and it will reflect the policy options. In doing so, we are exploring the option of joining existing initiatives, such as the *Groen in en om de Stad*, *Basiskwaliteit Natuur* and *Groenblauwe dooradering* guides.
- **Financial resources.** We are looking for financial resources for climate-adaptive measures, such as climate-resilient technical management, reducing pressure factors, optimising conditions, and for the use of green-blue solutions for climate resilience. In addition to the climate-adaptive function, these natural solutions also offer opportunities to increase, among other things, the recreational and cultural-historical value of an area. They also help to achieve the Water Framework Directive and the Natura 2000 conservation goals. These types of measures also help us achieve objectives from other challenges for which funding options may be available. We are looking for connections with and involvement by the various sectors associated with these challenges. This includes looking for opportunities for public-private financing.

This is how the government is supporting the parties implementing the described policy options (see Figure 4.6.1). The path to be followed (when to switch between policy option types) depends heavily on the circumstances in a particular area. This means the location, nature types, or nature values. The term of the policy options and the specific kinks in the adaptation pathway map are therefore no more than an indication. The choice of measures to be taken and the level of effort is area-specific and is made in the region, in line with the leading principle of 'area characteristics are key' in the Draft Spatial Policy Document. The idea behind developing policy options is for us to create balanced ecosystems based on safety, health protection and damage prevention.

4.6.4 The consequences of the approach

The point of departure is that we take the changing climate into account in our policy, and in the design and management of nature. The resilient nature approach therefore affects many other spatial and social challenges. Climate adaptation of, and with, nature requires space but also offers opportunities. If we want to create a future-proof and robust natural system, we must integrate nature more effectively into both urban and rural areas. We are creating a climate-adaptive living environment by combining spatial functions, for example by integrating nature with agriculture, defence, housing, or work, in line with the leading principle of 'mixed land use' in the Draft Spatial Policy Document. One of the ways this can be achieved is by creating more greenery in the built environment and constructing landscape elements for water retention, shade and connectivity between areas. It is important to keep an eye on the social impact: climate-adaptive measures must also reach vulnerable neighbourhoods and groups.[16]

Nature benefits from good water quality and quantity and can itself play a major role in improving the water system. Water is an important resource for nature in the Netherlands, both on land (terrestrial) and in and around the water (aquatic). Water quality, pluvial flooding, water shortages and water safety are challenges which are related to water management, and they have a direct effect on nature's resilience. Nature can suffer a negative impact if the focus for water management challenges is primarily on technical measures, such as dykes, river closures and pumps. On the other hand, natural solutions provide more space for aquatic and vulnerable wet nature. Sustainable soil management in agriculture can improve the soil's sponge effect, allowing it to store water more effectively and be resistant to drought and flooding. This prevents large-scale water extractions in rural areas.

16 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.

Of course, the use and development of future-proof nature generates opportunities for ecosystem restoration. Nature exists not only to maintain biodiversity or to create connecting zones for species. It also provides various ecosystem services to humans. Among other things, nature has a positive impact on health, water quality, (water) safety, soil health, crop pollination and heat resilience in the built environment. Conversely, nature and the ecosystem services it provides are sometimes adversely affected by the impact of other sectors, such as intensive land and water use and the leaching of harmful (plant protection) products. Other examples are the extraction of (ground)water and the artificial maintenance of low water levels in agricultural plots, which can lead to the desiccation of surrounding nature. It is important that we bring the ecosystem into balance and maintain that balance. Among other things, this can actually strengthen the farmer's earning capacity. One of the ways balanced ecosystems reduce safety and health risks is through natural predation (where animals serve as each other's food sources). This limits the number of diseases and pests.

We can create synergies if we implement climate-adaptive measures for and with nature in collaboration with various sectors. In this regard, it is essential that we preserve and strengthen existing nature and make sustainable use of it. By collaborating within the government and with subnational authorities and land managers in the field, we can link the nature challenge to, among other things, the energy transition, housing, accessibility, water and climate challenges. It is important that we actively involve local communities and farmers in this endeavour, that we protect vulnerable groups, and that our policy ensures a fair distribution of burdens and benefits. In this way, our approach will contribute not only to ecological but also to long-term social resilience.[17]

17 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.

Challenge 4.7 Seveso establishments properly prepared for climate risks

Petrochemical industry, 2007
(Photo: Rob Poelenjee)

The flooding caused by the 2021 torrential downpour in Limburg is etched in many people's memories. The consequences for the residents of the Geuldal were significant. Chemelot also noticed the effects. This nearby industrial estate consists of a number of Seveso establishments, in other words companies that handle or store significant quantities of hazardous substances. These effects were far less severe than those on the residents in the affected area, but there was damage nonetheless. One of the supply pipes was damaged, resulting in fewer raw materials being supplied. This resulted in a decrease in the production capacity of several factories. Once the flooding had ended, the supply pipe was repaired and normal production could resume.

4.7.1 The challenge

Seveso establishments are increasingly facing extreme weather due to climate change.[1] This can have various direct and indirect effects. For example, floods, torrential downpours and lightning strikes can lead to power outages, potentially causing critical processes or safety systems to malfunction. Drought can result in a shortage of cooling and firefighting water and increase the risk of fire and heat stress can affect the health and concentration of staff at Seveso companies. Heat can also cause hazardous substances to reach excessive temperatures during a process or while in storage.[2, 3] An indirect effect of climate change is, for instance, the risk of faster wear and tear of protective mechanisms due to higher UV radiation. Another example is the risk of tensions on cables and pipes due to drying out. Lower water levels in major rivers can also lead to reduced supply and drainage options.

1 Ricci, F., V. Casson Moreno and V. Cozzani. 'A comprehensive analysis of the occurrence of Natech events in the process industry.' *Process Safety and Environmental Protection* 147 (2021): 703-713.
2 LEC IV. *Klimaatverandering en Seveso-bedrijven. Kennisdocument Natech-incidenten*. Spijkenisse: National expertise center for industrial safety (Landelijk Expertisecentrum Industriële Veiligheid), 2025.
3 National Institute for Public Health and the Environment (RIVM). *Voorbereiding van Brzo bedrijven op klimaatverandering*, Bilthoven: National Institute for Public Health and the Environment, 2021.

Text box 4.7.1 **What is Seveso and what is the legal division of roles?**

The Seveso III Directive is officially known as Directive 2012/18/EU. This European directive contains provisions for environmental safety, occupational safety and disaster and incident response at Seveso companies. The aim of the directive is to prevent major accidents at these companies. Seveso companies are companies that work with, or store, significant quantities of hazardous substances. These include chemical companies, as well as large storage and transport businesses. The directive covers numerous substances, including those relevant to the energy transition. In the Netherlands, there are over 400 Seveso sites spread throughout the country.

In the area of climate adaptation, the Seveso Directive focuses primarily on upper-tier companies.[4] These are companies that work with and/or store such large quantities of hazardous substances that they exceed the high threshold value. More and more attention is being paid to climate adaptation at international level. In the event of a potential revision of the Seveso Directive, further development on this issue is not ruled out.

The Minister for the Environment is responsible for coordinating Seveso matters. Her duties include coordination with other departments and policy-relevant organisations. She is also responsible for allocating powers and the establishment of frameworks for environmental safety and implementation. Lastly, she is responsible for the system of licensing, supervision and enforcement in the environmental domain.

The Minister of Social Affairs and Employment is responsible for the system of health and safety at work (occupational health and safety legislation). Employers are responsible for guaranteeing the health and safety of their employees.

The Minister of Justice and Security is responsible for the system of crisis management. This concerns (preparations in relation to) fire services, disaster relief and crisis management (including the designation of company fire departments). The minister is also responsible for the investigation and prosecution of criminal offences and the system of criminal enforcement.

The Provincial Executives are competent environmental authorities for Seveso establishments.

The parties responsible for carrying out licensing, supervision and enforcement at Seveso establishments work together. These are the six Seveso Environmental Services, the Netherlands Labour Authority (*Nederlandse Arbeidsinspectie*), the Safety Regions and, where applicable, the State Supervision of Mines (*Staatstoezicht op de Mijnen*), Rijkswaterstaat, or a water authority. This collaboration takes place via the SEVESO+ programme.

4 The Seveso Directive distinguishes between two types of establishments: upper-tier establishments and lower-tier establishments. The difference between these companies lies in the volume of materials they store. Upper-tier establishments are required to draw up a safety report setting out scenarios and measures to prevent major accidents. Those scenarios must take natural causes into account.

Prepared for incidents

Incidents at Seveso sites which are the consequence of climate change require specific preparations on the part of industry and regulatory authorities. This is because their scale and scope set them apart from 'ordinary' industrial accidents. Extreme weather conditions are, in fact, external factors that influence both the likelihood of an incident and its consequences and these incidents often have their own dynamics. The effects originate from outside and can therefore impact several businesses at the same time, as well as the surrounding residential area. Storms or floods can affect large areas and have an impact on multiple businesses or even entire industrial clusters. This means that hazardous substances may be released on a very large scale and (in the event of flooding) spread over vast areas. This can have a negative impact on people and nature which, in turn, may also hamper measures to tackle other NAS challenges.

In the case of incidents which are the consequence of climate change, we must also take into account what are known as cascade effects. A single incident can trigger a series of other incidents. For example, if a power supply is cut off, this will affect many other processes. The existing safety features and security systems may become damaged, preventing them from functioning properly. Certain locations may also become difficult to reach, for example due to access roads being flooded.[5]

It is impossible to implement the same technical measures for all Seveso establishments. This is because each Seveso establishment is in a unique location and no two have the same technical operations. The way they are impacted by climate change is therefore also unique. Each company therefore has to assess for itself which principles and considerations that were previously deemed safe in safety studies are no longer adequate. The same applies to regulators because they too must assess, on a site-by-site basis, whether businesses have taken sufficient measures to address the existing risks.

Climate risks and Seveso establishments

With the exception of torrential downpours, the potential impacts of climate risks vary from region to region in the Netherlands. Matrix 4.7.1 shows an overview of the most important chemical clusters and the expected climate risks. Many Seveso establishments are located in energy-intensive industrial clusters that are crucial to our economy, strategic autonomy and energy supply. Climate risks affect specific businesses within these clusters but also the development opportunities within them.

Matrix 4.7.1

Overview of the most important chemical clusters and corresponding expected climate risks

Cluster	Description	The expected climate risks
Northern Netherlands	The seaports of Delfzijl/ Eemshaven, Den Helder, and Harlingen	Increasing risk of flooding near Harlingen
North Sea Canal area	The seaports of Amsterdam, Zaanstad, Beverwijk, Velsen, IJmuiden incl. Tata Steel	Increasing risk of drought due to precipitation deficit and decreased river runoff
Rotterdam-Moerdijk	The seaports of Rotterdam, Vlaardingen, Schiedam, Dordrecht, and Moerdijk	Increasing risk of drought due to precipitation deficit and decreased river runoff; Increasing risk of flooding from rivers during periods of peak runoff
Chemelot	The Chemelot site in Sittard-Geleen, incl. the inland port of Stein	Increasing risk of drought due to precipitation deficit and decreased river runoff; Increasing risk of heat compared to other clusters
Zeeland/Bergen op zoom	The North Sea Port seaport in the municipalities of Vlissingen, Borsele, and Terneuzen	Increasing risk of drought due to precipitation deficit and decreased river runoff

5 Misuri, A., G. Landucci and V. Cozzani. 'Assessment of safety barrier performance in Natech scenarios.' *Reliability Engineering & System Safety* 193 (2020): 106597.

The ambition

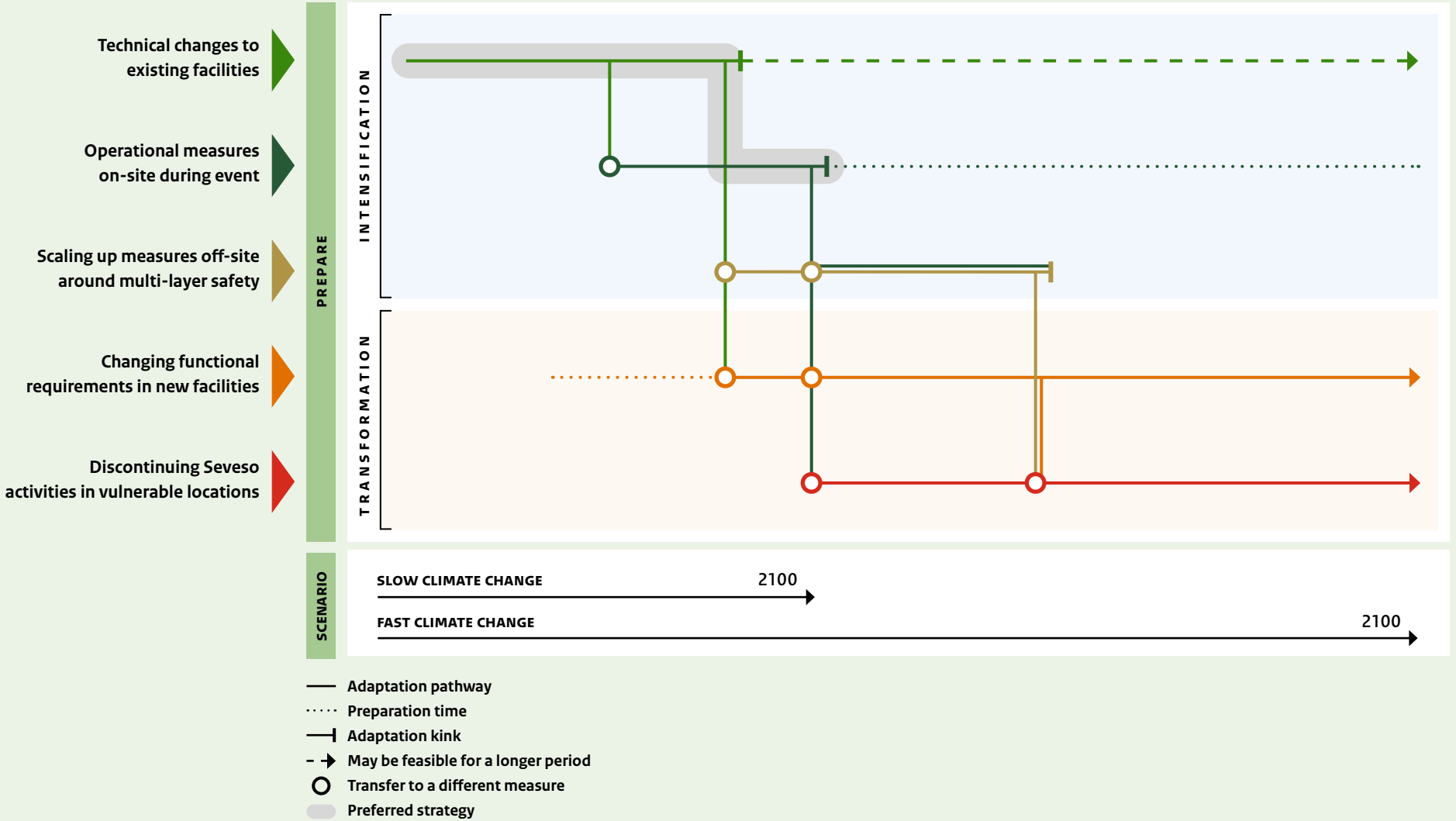
Climate change is not resulting in additional unusual events at Seveso companies, now or in the future.

In order to fulfil this ambition, Seveso establishments must be aware of additional risks and act accordingly, and this must be monitored by the subnational authorities. We use the term 'additional unusual events'[6] because risks continue to exist even without climate change, and such events may well occur at Seveso establishments. What is more, we cannot eliminate every risk. The focus therefore has to be on management, control and recovery in the event of incidents.

This challenge overlaps with challenge 4.13 *Futureproof work locations* in this NAS. However, whereas that challenge relates to the entire work location, in this challenge, we focus primarily on the location-specific points of concern relating to Seveso companies. Where relevant, we will collaborate on this challenge in order to achieve synergy benefits.

6 Unusual events or activities which deviate from normal business operations with (possibly) detrimental significant consequences for the physical living environment. The term 'unusual event' also applies to serious incidents, such as a major accident, disaster or crisis.

Figure 4.7.1 **Adaptation pathway map** for the challenge of Seveso establishments properly prepared for climate risks



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.7.2 The options

Figure 4.7.1. shows the adaptation pathway map to be followed in order to achieve the ambition for the Seveso challenge. The possible measures are listed on the vertical axis. The pace and manner in which we must adapt are dependent on the degree of climate change (x-axis). The speed of climate change determines whether specific measures will be needed sooner or later in time.

The five possible measures can be combined in adaptation pathways in various ways. The starting point is to focus first on 'intensification' (green, dark green, brown) and to choose options which fall under a more transformative approach (orange and red) at the latest possible moment. Measures often run in parallel. For example, increasing climate change will make it necessary not only to changes to the Seveso establishment itself but also to start making changes in the surrounding area, either on the site of the Seveso establishment (on-site) or elsewhere (off-site), depending on the pathway. At a certain point in time, it will also be necessary to adjust the functional requirements of new establishments. In parallel to this, we must continue to take measures at existing establishments and their surroundings.

The idea behind the environmental safety policy[7] is firstly to eliminate the source of problems as much as possible (by implementing at-source measures). Only then does this policy focus on limiting impacts. That is why technical changes to existing installations (green) are preferred over operational measures on-site during incidents (dark green). Making cooling capacity more resilient during heatwaves is, for example, a 'green' adjustment. A 'dark green' measure is, for example, arranging extra storage capacity in the event of an unwanted outflow of a hazardous substance because the process installation has become too hot. Scaling up off-site measures with regard to multi-layer safety (brown) ensures that existing installations can remain operational. This is a first step towards a more transformative approach.

In the longer term, we may need to switch to system transformation by imposing stricter functional requirements on new installations (orange). In extreme situations, it may be necessary to discontinue Seveso sites (red). When relocating a vulnerable site, we must not only reflect on what this means for the circumstances in the area from which the relocation is taking place, but also whether the new site has suitable infrastructure and whether sufficient employees are available.

Two possible routes

The five measures can ultimately be reduced to two routes. In the first route, responsibility lies primarily with Seveso operators. If the operators do not make adequate changes, the government will also take measures via route two.

The first route only covers on-site measures. These include technical changes to existing installations, operational measures on site, changes in functional requirements and finally discontinuation at vulnerable sites. The primary responsibility in this context lies with the operator of the Seveso establishment. One example of a measure which could be taken along this route is that the operator modifies safety provisions or that a company translates experiences into knowledge for other companies.

The second route involves on-site measures being combined with off-site measures. This pathway also begins with technical changes to existing establishments, followed by the scaling up of off-site multi-layered safety measures, changes to functional requirements for new establishments, and ends with the possible termination of Seveso activities at vulnerable sites. In addition to the primary responsibility of the operator of Seveso establishments, this pathway also involves additional steps being taken with regard to preparing emergency services. The involvement of landowners is important in this pathway to implement off-site measures. The measures required of landowners in this context may coincide with, but are primarily supplementary to, what is stated in challenge 4.13 *Future-proof work locations*.

7 See Rijksfinanciën.nl. 'Memorie van toelichting 2023, hoofdstuk XII and National Institute for Public Health and the Environment (RIVM). '*Juridisch kader.' Handboek Omgevingsveiligheid*

Matrix 4.7.2

Goal/Effort Matrix for the challenge of Seveso establishments properly prepared for climate risks

Ambition	**Climate change is not resulting in additional unusual events at Seveso companies, now or in the future**			
Improvement goal	The business community and subnational authorities **are more aware** of the climate risks that exist at Seveso establishments.	The business community and subnational authorities **are better positioned in terms of information and knowledge** around climate risks at Seveso establishments.	Seveso establishments will have **more thoroughly and periodically integrated climate risks into their safety policies** and subnational authorities will be better able to monitor this more effectively.	In 2070, the business community and subnational authorities will be able to **assess whether locations are still sufficiently climate resilient.**
SMART goal	In 2030, all upper-tier companies and the most relevant trade associations will be aware of the increased climate risks and the need to possibly implement additional safety measures.	In 2040, the business community will have created a knowledge ecosystem in which learnings from (near) accidents and exchanging knowledge on climate risks will be utilised by 80% of upper-tier companies.	In 2050, upper-tier companies will have taken more measures to ensure that the basic safety level remains the same compared to 2026, despite the increased climate risks. They will periodically evaluate whether these measures are still adequate.	In mid-2065, the government will draft an assessment framework for subnational authorities to determine whether areas or locations need to be scaled down. The government will create this assessment framework together with the challenges 4.13 *Future-proof workplaces* and 4.15 *Climate-resilient energy, IT/telecom and drinking water infrastructure.*
Effort/result	→ The government will hold regular discussions with trade associations regarding climate risk.			
	→ Starting in 2026, the government will explicitly mention climate risks in policy development communication that touches on Seveso establishments.		→ In 2030, the government will explore how progress can be reported on the basic safety level. The government is studying whether there are other indicators that could provide insight, alongside the number of unusual occurrences.	
	In 2035, all lower-tier companies will be aware that increased climate risks may imply different safety measures.	In 2040, the business community and subnational authorities will have clear information regarding climate risks that are applicable for both lower- and upper-tier companies.	In 2050, lower-tier companies will have a knowledge ecosystem available that allows them to translate experiences of upper-tier companies into their own business operations.	
	→ The government will hold regular discussions with trade associations regarding climate risk.			
	Provincial authorities and Seveso regulators will have insight into their role and duty to incorporate climate risks into the Seveso implementation in 2030.	→ In 2035, the government will explore options for using public digital systems to disseminate climate information in a targeted way. This includes information for safety studies at companies and licencing, supervision and enforcement tasks at subnational authorities. → In 2040, the government will disseminate available climate information on climate risks for Seveso establishments in a straightforward way.	→ In 2040, the government will work with the business community and subnational authorities to facilitate a survey into measures at upper-tier companies. The goal is to translate this to relevant knowledge for lower-tier companies. In 2040, regulators will have a robust regulatory methodology in place to incorporate climate risk into Seveso implementation.	
	→ The government will hold regular discussions with Seveso partners around incorporating climate risks into Seveso implementation.			
	→ The government will participate in international bodies on Seveso implementation and climate risks and will share knowledge with Seveso partners. → At a European level, the government will actively promote the idea that further development around climate adaptation is advisable for future revisions to the Seveso Directive.		→ The government will facilitate supervision through the responsibility mechanisms within the licensing, supervision and enforcement system.	

4.7.3 The approach

In order to achieve the ambition with all stakeholders involved in the Seveso implementation, we have formulated four improvement goals which lead to eleven measures. The proposed measures do not introduce any new or different risk standards for safety. This is because, despite increasing weather extremes, the risk of incidents does not increase due to us taking at-source measures. After all, risk is a combination of probability and effect.

We want to fulfil the ambition within the framework of the current roles and policy instruments of the current government environmental safety policy. This policy already stipulates that climate effects must be included in the assessment of the risks of upper- and lower-tier companies. The emphasis on climate risks lies primarily with upper-tier companies. Our role as the national government varies between facilitating, stimulating and directing. In the case of lower-tier companies, we will primarily adopt a stimulating approach.

1. **The business community and subnational authorities are more aware of the climate risks that exist at Seveso establishments**

The goal is for upper-tier companies and trade associations to be aware of the increased climate risks by 2030 and to know which additional measures they need to take. The same must also apply to lower-tier companies by 2035. This awareness is also important for the provincial authorities, given that they are the ones that grant permits for Seveso establishments and for Seveso regulators.

The primary responsibility for this lies with the business community. As the government, we have a facilitating role. This role entails holding periodic discussions on climate risks with the business community, trade associations and subnational authorities. It is also our job to highlight climate risks in policy developments that affect Seveso establishments (for example cybersecurity) in order to emphasise their importance. We also participate in international bodies and provide know-how to the various Seveso partners. These measures will help us facilitate the intensification route outlined in the adaptation map.

At the moment, the focus of the Seveso Directive is primarily on upper-tier companies. Both lower- and upper-tier companies are required to implement a major accident prevention policy. They also have to have a safety management system to help them continuously identify and assess risks and take the necessary measures to control those risks, regardless of their origin. The changing climate can also create additional risks for lower-tier companies. In the event of a potential revision of the directive, we are therefore also committed to the explicit establishment of climate-adaptive measures for lower-tier companies.

2. **The business community and subnational authorities have a better information and knowledge position with regard to climate risks at Seveso establishments**

The goal is for the business community to have a knowledge ecosystem by 2040 which will enable them to learn from (near) accidents and exchange knowledge on climate risks effectively. The aim is for at least 80% of companies to use such an ecosystem which will cover, among other things, knowledge of technical modifications to existing installations, operational measures on-site, and changes in functional requirements. As the government, we are playing a stimulating role in this regard, in line with the division of tasks within the Seveso Directive.

Something else we want to do as the government by 2040 is to share the information available to us on climate risks for Seveso establishments in a way which is clear to all stakeholders. To this end, we have been assessing whether we can effectively share such climate information via public digital systems. After all, it is important that companies and subnational authorities have access to clear information on climate risks. Companies need this information for risk assessments, and it helps subnational authorities perform their licensing, supervision and enforcement duties properly. The information in question may, for example, concern the average and maximum outdoor temperatures that might apply to a Seveso establishment.

3. Seveso establishments have integrated climate risks more thoroughly and periodically into their safety policy, and subnational authorities are able to monitor this more effectively

In order to fulfil this improvement goal, strengthening measures are necessary along three lines:

a) Upper-tier companies will have taken more measures by 2050 to ensure that the basic safety level remains the same compared to 2026, despite the increased climate risks. They will periodically evaluate whether these measures are still adequate.

b) In 2050, lower-tier companies will be able to use a knowledge ecosystem to translate the experiences of upper-tier companies into their own business operations.

c) In 2040, regulators will have a robust methodology to incorporate climate risks into their supervision of Seveso implementation.

In 2030, we are going to explore how companies can report progress in relation to the basic safety level. In doing so, we will investigate whether, in addition to the number of unusual incidents, other indicators exist which could provide insight. This assessment will not detract from the statutory obligation for upper-tier companies to take measures. As a government, therefore, we are also holding periodic discussions with trade associations regarding climate risks.

In 2040, we are going to facilitate, together with the business community and subnational authorities, a survey of the experiences and lessons learned from upper-tier companies. Lower-tier companies are likely to benefit hugely from this knowledge. We will share the ensuing recommendations in the periodic discussions we hold with the industry associations and Seveso regulators.

We also intend to take steps to ensure that Seveso regulators effectively monitor the new measures taken by companies. As the government, we will engage in periodic dialogue on this issue with the Seveso partners and facilitate supervision through the responsibility mechanisms within the licensing, supervision and enforcement system.

4. By 2070 the business community and subnational authorities will be able to assess whether locations are still sufficiently climate-robust

The fourth improvement goal is to establish an assessment framework for subnational authorities by mid-2065, which they can use to determine whether Seveso areas or sites need to be scaled down. Increasing climate risks mean it may be necessary to use the more transformative approach outlined in the adaptation pathway map. We are developing this assessment framework together with challenge 4.13 *Future-proof work locations* and challenge 4.15 *Climate-resilient energy, ICT/telecom and drinking water infrastructure*. We are also incorporating policy development into this assessment framework which affects Seveso companies, but which falls outside the scope of this NAS, such as the Critical Entities Resilience Act (*Wet weerbaarheid kritieke entiteiten*). The actual application of the assessment framework is the responsibility of subnational authorities and does not fall under the government's activities.

4.7.4 The consequences of the approach

This proposed approach will enable us to continue focusing on the current objective of Dutch environmental safety policy. That objective means creating a clean, healthy and safe living environment that is also perceived as such by the Dutch public. The strategic environmental impact report (SEIR) that has been compiled for this NAS states that there are sufficient intensifying measures that can be taken to limit the increase in risks in this challenge.[8] These measures have no, or limited, effect on *people, planet, and prosperity*.

In the context of the transformative approach, there is a high risk of a significant decline in prosperity. It may lead to a reduction in employment opportunities and a significant decrease in the economic attractiveness of vulnerable regions. What is more, the social impact analysis (SIA), which was carried out within the framework of this NAS, states that companies benefit from lower systemic risks under a transformative approach.[9] That is because they 'grow along' with the risks and are therefore unlikely to have to make major changes to their business operations.

Changing circumstances and/or developments must not lead to any deterioration in safety. Taking measures to make risk sources climate-adaptive must always take precedence over measures to mitigate effects. Strengthening an installation so that summer hail has no effect therefore takes precedence over creating storage space for the removal of hazardous substances.

Climate risks are dynamic in terms of time and location. We must therefore design policy to be sufficiently adaptive. In this way, we will inspire and encourage Seveso establishments and subnational regulators to improve safety on a continuous basis.

8 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Utrecht: Movares, 2026.
9 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.

Challenge 4.8 Heat-resilient cities, towns and villages

Shade in Reigerstraatje in Middelburg
(Photo: Aart Van Belzen)

"Heat has a major impact on people's health and can even lead to increased mortality. That is why the Municipality of Middelburg believes it is important to address this issue and putting the Heat Menu into practice was a great way to start. We also took part in the European "Cool Towns" project, which has now been completed and is being followed up by the "Cool Neighbourhoods" and "Cool Cities" projects. The latter project involves us looking at a cooling network within the city. Cool Neighbourhoods, on the other hand, focuses on tackling neighbourhoods that are particularly susceptible to heat-related problems."

Carolyn Jonkers
Environmental Policy Officer, Municipality of Middelburg

4.8.1 The challenge

Cities, towns and villages in the Netherlands are becoming ever warmer. Although this is often regarded as something positive, because it means we can spend more time outdoors for relaxation, exercise and getting some vitamin D, hot weather also implies certain risks, particularly when pleasantly warm weather turns into prolonged heat. On hot days, there are serious consequences for both society and individuals. These include poor sleep, reduced health and declining labour productivity. Heat causes machines to break down, and movable bridges may no longer be able to open or close due to expansion. Heat also has an effect on water consumption and water quality, as well as the functioning of utilities. If a malfunction caused by heat leads to a power outage, for example, cumulative consequences (chain effects) can hugely exacerbate the impact.

This challenge focuses on the consequences of heat for people (and their health) in cities, towns and villages. Heat is becoming an increasingly common issue. Temperatures in Europe are rising faster than in other parts of the world. The number of tropical days on which temperatures exceed 30°C in the Netherlands has already more than doubled over the past 30 years. A record temperature of 40.7°C was recorded in Gilze-Rijen, in the province of North Brabant, in 2019. Temperatures and the duration and intensity of heatwaves will continue to increase in the future. The consequences of heat for networks are addressed in challenge 4.14 *A robust and resilient transport infrastructure* and challenge 4.15 *Climate-resilient energy, ICT/telecom and drinking water infrastructure*. Challenge 4.3 *Resilient to increasing freshwater shortages* and challenge 4.4 *Safe and healthy water quality* are also relevant when it comes to dealing with the consequences for water use and quality.

Heat can cause damage to people's health. The elderly are the most vulnerable group in this regard, and they also experience the highest excess mortality due to heat. At temperatures above 27°C, excess mortality due to heat can exceed 10% per day. However, those who work outdoors, homeless people, the chronically ill, pregnant women and very young children are also at increased risk of heat stress. Ultimately, however, anyone can become ill during times of more frequent and lengthier periods of heat. Poor sleep due to warm nights can exacerbate all these effects during the day. Summer smog caused by air pollution, combined with elevated pollen concentrations, increases the risks for healthy people.

Effects range from respiratory complaints to dehydration and heatstroke. Heat also increases people's risk of exposure to UV radiation due to spending more time outdoors. This is addressed in challenge 4.9 *Staying healthy in times of climate change*. All these effects can also lead to, for example, reduced learning performance and labour productivity (which in turn has economic consequences). The consequences of heat at workplaces are discussed in challenge 4.13 *Future-proof workplaces.*

Heat can have a greater impact at certain specific locations. The urban heat island effect causes paved areas to heat up even more. The temperature difference with the surrounding area can then be as much as 7 or 8°C in some cities, particularly during windless nights. Surface water can also radiate heat into the environment at night and a warmer built environment limits the possibility for natural cooling in buildings. In particular, neighbourhoods with a low socioeconomic status often have more paved areas and less greenery. What is more, people in a financially vulnerable position have fewer opportunities to take measures against heat themselves.[1] This issue is also addressed in challenge 4.12 *Climate-resilient housing for all* and Chapter 3 *Government-wide, integrated challenges*.

The challenge of heat in cities, towns and villages is evident at various scale levels. The physical and social domains have a strong mutual effect on each other. The layout of an area and the characteristics of a building, as well as people's behaviour, health status, and social structures, all play a role. A course of action also has to be devised for people. What can individuals do during times of heat, for themselves and for others? On top of this, the likelihood of extremely high unprecedented temperatures occurring in the Netherlands is increasing, with a 'code red' scenario being predicted, with the effects possibly causing disruption to society. We will then have to rely on the emergency services and crisis organisations to mitigate the consequences as much as possible.

Aging, urbanisation and sustainability all have consequences for this challenge. The vulnerable group of elderly people is growing as a result of ageing. Urbanisation can exacerbate the urban heat island effect if satisfactory measures are not taken. Heat in new urban developments is part of challenge 4.11 *Climate-adaptive new developments*. The sustainability challenge of the built environment is also having an effect on the consequences of heat. Sustainability helps to slow down climate change. However, if insufficient attention is paid to heat during the process, properly insulated homes cannot effectively dissipate the heat they absorb during warm periods. Overheating then becomes a risk. Solutions for both challenges can be mutually reinforcing if, in addition to insulation and ventilation, sufficient attention is also paid to sunblinds and energy-efficient cooling.

Making towns and cities greener helps to reduce the urban heat island effect and cool the surrounding area. Green spaces are a means to achieve other goals as well, thereby providing a framework for multi-purpose land use. For instance, more greenery not only offers major benefits such as shade and cooling but also rainwater harvesting, promoting biodiversity and mental health, encouraging physical activity and recreation, and strengthening social cohesion. Green corridors which connect separate green areas within the city can help cool the substrate. This can limit the temperature rise in drinking water pipes and thereby reduce the risk of Legionella. In addition, the greenery itself must be climate-adaptive and, for example, be able to cope with drought. It is also important to pay attention to, and seek smart solutions for, potentially less positive effects. More greenery can, for example, lead to increased demand for water, fire hazards and health risks due to potential pathogens and the risk of pollen allergies.

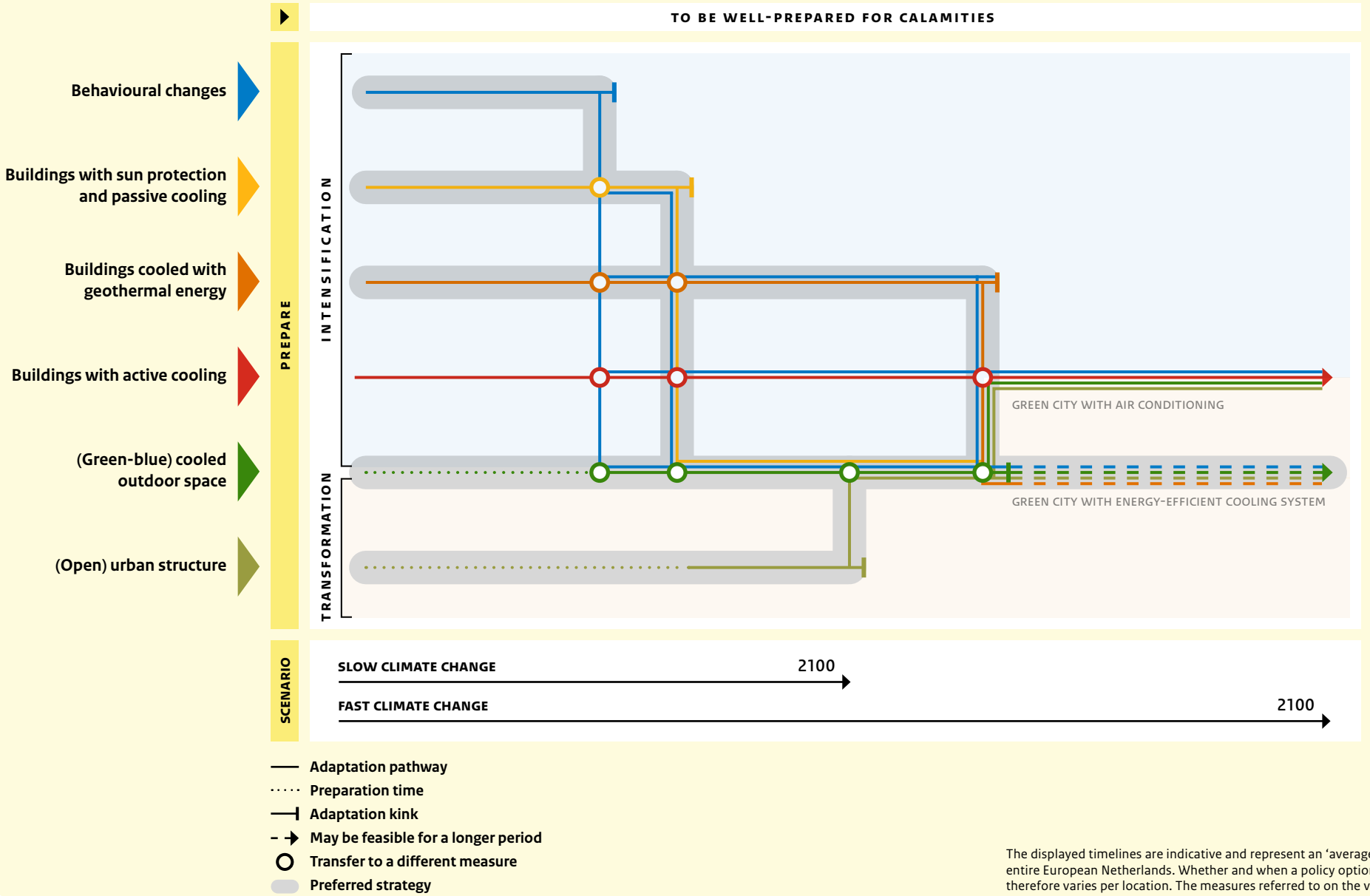
The ambition

During periods of heat, the living environment in cities, towns and villages remains healthy and attractive, both in buildings and in public and private outdoor spaces. During prolonged heat, society adapts and can therefore continue to function optimally.

Physical design and human behaviour both play a role in this ambition. The physical design of outdoor spaces and buildings must limit the effects of heat. Human behaviour, social structures and crisis management help to limit the consequences of heat. Social structures in districts and neighbourhoods can support residents who are less self-reliant.

1 National Institute for Public Health and the Environment (RIVM). *Hoofdrapport VTV-2024*. Bilthoven: National Institute for Public Health and the Environment, 2024.

Figure 4.8.1 **Adaptation pathway map** for the challenge of heat-resilient cities, towns and villages



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.8.2 The options

Figure 4.8.1 shows this challenge's adaptation pathway map. The themes depicted from top to bottom are health (behavioural changes), building (passive and active cooling) and area (green-blue cool outdoor space and open urban structure). Being well prepared for emergencies runs parallel to these themes and is always an essential element (white bar).

People can adjust their own behaviour to cope with the consequences of heat (blue line). This means drinking enough fluids but also lowering sunblinds or closing curtains in the home during the day and ventilating when the outside temperature is lower than the inside temperature. Whenever the temperature continues to rise and the building and surroundings heat up, behavioural changes alone will no longer be sufficient. Changes to the building and/or the area will then be necessary.

Greening measures can be taken (green line) to cool down the area. Residents can also take these measures themselves by making their gardens greener. Planting trees in public spaces can provide shade and encourage evaporation. At a higher scale level, one possible measure is to facilitate a green-blue network (both greening and additional water as a network through the area) of cities, towns and villages. As regards water-related measures, it is important to ensure that they genuinely contribute to cooling and do not unintentionally heat up the area at night. Non-green-blue cooling measures are also possible, such as shade provided by buildings, shade sails, or the use of other materials.

An open urban structure with optimal ventilation (moss green line) can also provide natural air conditioning for the living environment. This is enhanced by green-blue structures. An open urban structure and green-blue networks may require adjustments to current building structures and are therefore more transformative. Consequently, these measures have a longer preparation time. Time is also needed to prepare for the greening of public spaces. After all, greenery needs to grow before it can provide sufficient shade and facilitate evaporation. This process is often dependent on other challenges as well, such as large-scale maintenance, the energy transition, and/or the mobility transition and there is frequently a link to greening operations.

Measures can also be taken at the building level. Passive cooling measures are likely to be successful (yellow line) if combined with a relatively green and cool environment and appropriate behaviour. Examples include sunblinds, sunlight-reflective glass, good insulation and effective purge ventilation (ventilating by opening opposing windows and doors). The approach being taken to the energy transition also presents opportunities, for example by focusing on heat alternatives that can cool efficiently in combination with a form of thermal or cold storage (orange line) such as ground source heat pumps or very low-temperature heat networks. These measures are energy-efficient and do not heat up the outdoor space. Consequently, they do not contribute to the urban heat island effect. Measures like installing air conditioners can be postponed if we commit sooner rather than later to passive and energy-efficient cooling. This will also limit the strain on the electricity grid. It is possible to postpone active cooling (red line) and still have only limited warming. The use of energy-efficient cooling can ensure that this step can be postponed for even longer. The effectiveness of the measures is enhanced by prioritising those which are aimed at risk groups and areas as defined on the basis of the social domain.

An ideal approach to heat is an integrated approach involving the physical and social domains, with a focus on behavioural, area and building measures. Area measures that create a cool environment are important because they will help behavioural and passive building measures to remain effective for as long as possible. Measures that utilise space in a multifunctional way are essential because of the limited space that is available in the built environment. It is therefore preferable to take green measures. It is also advisable to start the process immediately because of the amount of time it takes to prepare for these area measures. If measures are combined, the scenario of a 'green city with passively cooled buildings' becomes more believable. It is important also to implement measures for energy-efficient cooling during the heat transition. If the measures turn out to be in sufficient or if the warming process continues, it is still possible to switch to the scenario of a 'green city with actively cooled buildings'. The fact that air conditioners release heat into the environment raises the question of what effects this scenario might have on outdoor temperatures and the energy grid.

Matrix 4.8.1

Goal/Effort Matrix for the challenge of heat-resilient cities, towns and villages

Ambition

During periods of heat, the living environment in cities, towns and villages remains healthy and attractive, both in buildings and in public and private outdoor spaces. During prolonged heat, society adapts and can therefore continue to function optimally.

Work area	Integrated policy	Priority areas	Area	Building	Health	Emergencies
Improvement goal	**Heat policy will be addressed in a more integrated way. This will primarily entail linking the social and physical domains.**	**When tackling the issue of heat, it is important that greater attention is paid to people and areas that are more adversely affected.**	**The living environment in cities, towns and villages will be cooled by green spatial design at different scale levels with space for shade, water and ventilation.**	**Homes and other buildings will be more resilient to heat thanks to proper insulation, ventilation, sunblinds and sustainable cooling. Residents will know how to optimally keep their homes cool with passive measures.**	**People's health will be protected more effectively during periods of heat.**	**The Netherlands will be better prepared for scenarios in which society could be disrupted during an acute crisis.**
SMART goal	• In 2030, 25% of municipalities will have insight into what is needed for an integrated heat policy. • In 2035, 50% of municipalities will have heat as an integral element of policy. • Practical experience and knowledge will be shared between the government, subnational authorities and other stakeholders. A network approach will be taken to help partners.	• Tackling the issue of heat means that priority is given to taking measures in urbanised neighbourhoods with a low socioeconomic status.	• Plans for new developments and the redesigning of areas will incorporate as much space as possible for a green and cool design. • Outdoor space is designed in a more biodiverse and climate-resilient way, in line with the European Nature Restoration Regulation (NRR, article 8) and the National Benchmark. Through 2030, there will be no decline in urban green space (including water) and tree canopy cover. Beyond 2030, there will be a rising trend until a satisfactory level is reached.	• There is a clear scope of action for owners of different types of buildings to take measures against heat. • When property owners undertake sustainability renovations, they will include (external) sunblinds alongside proper ventilation. • Cooling will be included in the considerations made during the heat transition. • For existing buildings, it will be clear how heat can be determined, and there will be regulations for new construction.	• In 2027, all municipalities will include a focus on heat in their local health policy documents. • In 2028, the number of municipalities with local heat plans will have doubled from 90 to 180. • There will be extra focus on protecting people in vulnerable positions. • In 2030, awareness among Dutch citizens around the potential risks of heat will be greater. The same applies to groups that do not view themselves as high-risk.	→ In 2026, there will be greater insight into a possible 'code red' scenario.
Effort/result	→ The government will facilitate this for municipalities with the Heat Menu. → The government will facilitate the Climate-Proof Together Platform.	→ The government will explore how priority areas can be supported in conjunction with existing initiatives. One way of doing this is through the area-based learning approach taken by the National Approach to Foundation Issues. Six areas have been selected across the country for this purpose. A number of these coincide with the National Programme for Liveability and Security (*Nationaal Programma Leefbaarheid en Veiligheid, NPLV*).	→ The government will facilitate municipalities, developers and builders through the National Guideline for Green Climate Adaptive Urban Environments (*Landelijke Maatlat voor een Groene Klimaatadaptieve Gebouwde Omgeving*) and the Green in and Around the City (*Groen in en om de Stad*) Guide. → The government will decide by the end of 2030 at the latest on a satisfactory level for urban green space and tree canopy cover for article 8 (NRR).	→ The government will share knowledge about effective measures. → The government will investigate the possibilities of integrating heat-reducing measures into the sustainability approach for buildings. → The government will assess the demand for cooling in the future. → The government will partner with NEN and other stakeholders to develop a method to determine the level of heat in existing buildings. → When modernising the method for determining for energy performance, the government will look at including the risk of overheating as a successor to the current Temperature Overshoot July (TOjuli).	→ The government will encourage municipalities to do this with the National Heath Policy Memorandum. → The government will encourage municipalities, Municipal Health Services (GGDs) and health insurers to do this with the National Health Policy Memorandum. → The government will work with social partners in the Heat Approach around clear communication about the subject of heat.	→ The government will explore what a code red scenario might look like in the Netherlands.

4.8.3 The approach

We are focusing on six themes as we work towards achieving this ambition. We have supplemented the themes of area, building, health and emergencies from the pathway with the umbrella themes of integrated policy and priority areas. The overview of goals and initiatives is summarised in Figure 4.8.1.

Integrated policy

An integrated approach to the heat challenge is important for effective cooperation between the physical and social domains. This implies that attention must be paid at the level of the street, neighbourhood and district, as well as the city, town and village. At municipal level, heat is included in the climate adaptation approach, which focuses on the physical domain. We can make improvements when it comes to drawing attention to an integrated heat policy. As the government, we are supporting this with the Heat Menu. This is a tool which municipalities can use to develop an integrated heat plan. In doing so, we hope to make it possible for 25% of municipalities to have an insight into what is needed for integrated heat policy by 2030, and for 50% of municipalities to have incorporated heat into their policies by 2035. It is also important to share practical experiences and knowledge with one another. We are encouraging this through the Climate-Proof Together Platform (*Platform Samen Klimaatbestendig*). This network approach is enabling subnational authorities and other stakeholders to share information so that we do not have to keep reinventing the wheel.

Priority areas

When tackling the issue of heat, it is important that greater attention is paid to people and areas that are more adversely affected. For that reason, more priority must be given to taking measures in urbanised neighbourhoods with a low socioeconomic status. This will prevent people in a financially vulnerable position from continuing to live in areas that are too hot. This aligns with the advice of the Netherlands Scientific Climate Council that transformation is necessary in, among other places, urban areas with a high heat risk. We are exploring how we can support priority areas, in conjunction with existing initiatives. One way of doing this is through the area-based learning approach taken by the National Approach to Foundation Issues (*Nationale Aanpak Funderingsproblematiek*). Six areas have been selected across the country for this purpose. A number of these coincide with the National Programme for Liveability and Security (*Nationaal Programma Leefbaarheid en Veiligheid, NPLV*).

Area

It is important that the living environment in cities, towns and villages becomes cooler by giving them a green-blue, cool design. This design approach must be implemented at various scale levels and must include space for shade, water and ventilation. With this in mind, plans for new developments and the redesigning of areas and public space are incorporating as much space as possible for these features. We are helping municipalities, developers and builders in this regard through the National Guideline for Green Climate Adaptive Urban Environments (Landelijke Maatlat voor een Groene Klimaatadaptieve Gebouwde Omgeving) and the Green in and Around the City (Groen in en om de Stad) guide. This goal also aligns with the spatial planning and climate-adaptive redesign goals in challenge 4.11 Climate-adaptive new developments and challenge 4.12 Climate-resilient housing for all. In addition, the European Nature Restoration Regulation (NHR, Article 8) serves as the legal framework to prevent urban green space from declining between now and 2030 and to ensure it increases to a satisfactory level after 2030. Each Member State determines this level itself. We are going to set the satisfactory level for urban green surface area and tree canopy cover for this section of the Nature Restoration Regulation by no later than the end of 2030.

Building

Homes and other buildings must also be more resilient to heat. This can be achieved through good insulation, ventilation and sunblinds, as well as by using opportunities for sustainable cooling. A clear course of action will be provided for owners and residents of various types of buildings to take measures against heat. In order to do this, we will share knowledge on effective measures. Residents will then know how to keep their homes as cool as possible using passive measures. Whenever homeowners decide to make their properties more sustainable, we will try to encourage them to use (external) sunblinds alongside good ventilation. To this end, we are investigating the possibilities of integrating heat-reducing measures into the sustainability approach for buildings.

Cooling must also be included in the considerations made during the heat transition. This will ensure that the most is made of opportunities for sustainable cooling within the energy transition. With this in mind, we are assessing the demand for cooling in the future. It is also becoming clear how heat can be determined for existing buildings, and regulations are in place for new construction. With regard to existing buildings, we are now developing a method to determine the level of heat in existing buildings together with the Royal Netherlands Standardisation Institute (*Nederlands Normalisatie-instituut, NEN*) and other relevant stakeholders. When it comes to new developments, we are modernising the method for determining energy performance so that it also includes the risk of overheating as an extra condition for the modified Temperature Overshoot July (TOjuli) requirement.

Health

We must protect people's health more effectively during periods of heat. The goal is for all municipalities to focus on heat in their local health policy documents by 2027. By 2028, the number of municipalities with a local heat plan must also have doubled from 90 to 180. We are encouraging municipalities to do this via the National Health Policy Memorandum (*Landelijke nota gezondheidsbeleid*). There is also an additional focus on protecting people in vulnerable positions. Once again, we are using the National Health Policy Memorandum to encourage action on the part of municipalities, Municipal Health Services (GGDs) and health insurers in this area. The intended result is for the Dutch population to be more aware of the potential risks of heat by 2030. The same applies to groups that do not view themselves as high-risk. With this in mind, we are working together with social partners within the framework of the Heat Approach (*Hitte Aanpak*) to ensure that our communication on the subject of heat is clear.

Emergencies

The Netherlands is becoming better prepared for scenarios in which society could be disrupted during an acute crisis. One of the ways this is being done is by creating greater insight into a possible 'code red' scenario by 2026 and we are exploring what a scenario like this might look like in the Netherlands.

4.8.4 The consequences of the approach

The chosen approach has consequences for various other challenges. One of the affected challenges is challenge 4.9 *Staying healthy in times of climate change*. Choosing green-blue measures can have an impact, for example, on pollen and infectious diseases. The social impact analysis (SIA) conducted for this NAS recommends that the types and locations of greenery are carefully selected to eliminate these consequences wherever possible.[2] Conversely, more shade results in less exposure to UV radiation. The taking of more green-blue measures can be included in challenge 4.4 *Safe and healthy water quality* and would also help us to meet challenge 4.6 *Resilient nature*. Reducing heat in a particular area will also help reduce heat in the context of challenge 4.13 *Future-proof work locations*. A focus on priority areas is important for challenge 4.12 *Climate-resilient housing for all* and aligns with the recommendations of the SIA to prioritise poorer neighbourhoods and explicitly address inequality. The choice for green-blue measures and an open urban structure also has implications for new urban developments in challenge 4.11 *Climate-adaptive new developments and for the design of existing infrastructure and the construction of new infrastructure* in challenge 4.14 *A robust and resilient transport infrastructure*.

The strategic environmental impact report drafted for this NAS shows that the measures generally have positive effects on planet and people and that liveability in cities, towns and villages improves.[3] Improved liveability also has a positive effect on the economic value of assets and therefore *prosperity*, and innovations also generate economic opportunities. The claim on space for greenery and water may limit the space available for economic functions, but improved liveability does create additional value.

2 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.
3 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Movares: Utrecht, 2026.

Challenge 4.9 Staying healthy in times of climate change

Climate adaptation can improve and protect people's health *(Photo: Shutterstock)*

'At the Municipal Health Service in Amsterdam (GGD Amsterdam), part of our job is to prevent health issues and diseases that climate change can cause. One of the ways we do this is by trying to help people avoid developing skin cancer due to excessive exposure to UV radiation from the sun. We also focus on communication by advising people to "stay out of the sun, wear protective clothing and apply sunscreen". The availability of shade is very important when it comes to protecting yourself from UV radiation. We are also particularly concerned about protecting vulnerable groups, such as children, for example by drawing attention to the need for sufficient shade in school playgrounds and other play areas. We are able to use the contacts we make during this process to provide input about health effects in other places in the public space, such as squares and shopping streets. We also draw attention to other health risks, such as the risk of infection posed by stagnant water or the irritating and allergic effects of certain plants and trees. We prefer to become involved in developments in the living environment at the earliest opportunity, so that we can maximise the ensuing health benefit.'

Jantine Röttgering
Doctor and environmental and health advisor at GGD Amsterdam

Text box 4.9.1 **Legal division of roles**

The Environment and Planning Act and the Public Health Act are relevant to this challenge. One of the social goals of the Environment and Planning Act is to achieve and maintain a safe and healthy physical living environment and a high level of environmental quality. The Environment and Planning Act allows authorities to define and elaborate their own health ambitions in their environmental visions and plans.

The Municipal Health Services (GGDs) protect, monitor and promote the health of the Dutch public. The Public Health Act lays down the GGD's statutory duties. These include, for example, promoting public health, implementing medical environmental science measures and controlling infectious diseases.

4.9.1 The challenge

Climate change is causing our weather to become gradually more extreme. If we do nothing, the health risks of climate change will continue to increase. We are becoming more exposed to allergens and irritants, UV radiation and pathogens. This is partly because we spend more time outdoors due to the warmer weather. Climate change can also affect our mental health. These consequences of climate change are central to this particular chapter. However, climate change also creates other health risks. For example, longer and more intense periods of drought, flooding and heat cause heat stress and mould to grow in homes. The theme of heat stress falls under challenge 4.8 *Heat-resilient cities, towns and villages*. The problem of mould falls outside the scope of this NAS. The health of workers is covered by challenge 4.13 *Future-proof workplaces*. Although food safety is also influenced by the climate, that issue also falls outside the scope of this NAS.[1]

1 NVWA. *Verkenning van de potentiële effecten van klimaatverandering op de voedselveiligheid in Nederland: Mogelijke kennisleemtes in de borging van de voedselveiligheid*. Utrecht: Netherlands Food and Consumer Product Safety Authority, 2025.

Allergens and irritants

Climate change is resulting in more allergies and irritation because we are exposed to more pollen, insects and arachnids, such as the house dust mite. Higher temperatures and higher concentrations of CO2 in the air are not only causing the pollen season to start earlier and last for longer but also an increase in plant pollen production. In addition to this, larger numbers of new allergenic pollen-spreading plants are moving northwards towards us. The extent to which people are allergic to pollen may also be increasing. This is because heat often causes summer smog and a deterioration in air quality. Our sensitivity to pollen then increases as a result. All this is taking place against the backdrop of pollen concentrations rising significantly during these dry periods. Climate change is making (seasons with) weather conditions which increase the health effects of house dust mites, oak processionary caterpillars and wasps a more frequent occurrence.

UV radiation

The dose of UV radiation to which people in the Netherlands are exposed annually has increased in recent decades. Climate change has played a significant role in this. For instance, climate change affects the amount and type of cloud cover, and that may have resulted in above-average sunshine in recent years.[2] In addition, climate change causes warmer weather, leading us to cover up less. UV radiation damages our skin and eyes and is the leading cause of skin cancer. The Netherlands has the highest incidence of skin cancer in all of Europe, and nearly 1,000 people died of skin cancer in the Netherlands in 2023.[3] Skin cancer is the fastest-growing form of cancer and it already accounts for more than half of all cancer diagnoses.[4]

Infectious diseases

Climate change has an effect on infectious diseases, particularly those from our living environment, such as zoonoses and vector-borne diseases[5] Zoonoses are diseases transmitted between vertebrates and humans. Vector-borne diseases are primarily transmitted to humans and vertebrates by ticks and mosquitoes (vectors). Examples include Lyme disease and West Nile fever. In the province of Utrecht, for instance, there was an outbreak of West Nile virus among common whitethroats in 2020 which was spread via mosquitoes. Climate change also influences the population, activity and distribution of animals such as ticks and mosquitoes, and that increases the risk of infection for humans.

Infections can also be transmitted directly via contaminated water. Higher temperatures can cause water quality to deteriorate rapidly, leading to an increase in the concentration of, for example, blue-green algae, E. coli from faeces, or Vibrio bacteria in seawater. Pneumonia caused by Legionella bacteria from aerosolised water also appears to be becoming more frequent due to climate change.

Mental health

Extreme weather can also affect our mental health. Mental effects can arise as a result of incidents or disasters caused by climate change, such as floods. One specific example is the extreme pluvial flooding which occurred in Enschede in 2024, or the floods which impacted the province of Limburg in 2021. These events also caused significant stress at a later stage, for example because of their financial and legal impact and the fear of recurrence. Climate-related diseases such as skin cancer, hay fever and infectious diseases can also have an effect on our mental state, for example in the form of stress and related issues. Finally, extreme weather can also make existing mental problems worse. A scientific study carried out in the Netherlands revealed, for example, that the number of involuntary admissions due to psychiatric issues increases during heatwaves.[6]

2 Compendium voor de Leefomgeving. '*UV-straling in Nederland, 1980-2022*'. (2023).
3 Netherlands Comprehensive Cancer Organisation (Integraal kankercentrum Nederland). 'NKR Cijfers'. Consulted on 24 November 2025, via
4 Netherlands Comprehensive Cancer Organisation (Integraal kankercentrum Nederland). *Kanker in Nederland. Trends & prognoses tot en met 2032*. Utrecht: IKNL, 2022.
5 Although food safety is also influenced by the climate, that issue also falls outside the scope of this NAS. See NVWA. *Verkenning van de potentiële effecten van klimaatverandering op de voedselveiligheid in Nederland: Mogelijke kennisleemtes in de borging van de voedselveiligheid*. Utrecht: Netherlands Food and Consumer Product Safety Authority, 2025.
6 Joore, N.L., et al. 'Positive associations between mean ambient temperature and involuntary admissions to psychiatric facilities.' *European Psychiatry* 68 (1): Article e2.

Health effects of climate adaptation measures such as greening and more water

Climate adaptation measures, such as more greenery and more water, can have both positive and manageable negative effects on public health. This is because nature and health are strongly interconnected. Nature has a positive effect on mental health; it encourages physical activity and relaxation and appears to ensure better sleep and immune system functioning. However, more greenery can also increase health risks, for example, if it creates more favourable conditions for pathogens, such as more water for mosquitoes and more plants that produce allergenic pollen.

It is therefore important that we take health into account when designing and managing green spaces and water. That will keep the risks manageable and make it easier to make the most of the benefits of more greenery. One way this can be achieved is by designing green spaces for sports and social interaction, which take account of allergies caused by certain plants. This should preferably be done in collaboration with parties that can motivate people in the neighbourhood to use such spaces. Various resources are available to support this initiative.[7, 8, 9] Figure 1 in the 'Green and Health Compendium' (Kennisbundeling Groen en Gezondheid) illustrates the relationships between greenery and health in more detail.[10]

Link to livelihood security and other non-climatic trends

The health risk of climate change and the potential health benefits of climate adaptation differ between population groups and between different regions. For instance, factors such as income, home address and health status influence the health impact of climate change. Significant health disparities already exist between population groups because certain groups live in situations of financial insecurity, for example because they have insecure or low incomes. More often than not, they live in more built-up neighbourhoods and are more dependent on their immediate living environment than others. Those are often locations where there is an accumulation of adverse aspects, such as increased air pollution, traffic noise and a lack of greenery.[11] They also offer the fewest opportunities to residents to do something about the issues themselves. This may be because they live in social housing and are dependent on a housing corporation.

There are also specific groups that are more sensitive to the health risks of climate change. These include very young children, elderly people with weakened immune systems, and pregnant women or chronically ill people. Climate change also affects the availability of healthcare, for example in terms of infrastructure because extreme weather can influence the production, transport and storage of medicines. It also affects care institutions, for example because hot buildings can affect both those in need of care and care staff. Floods can also impact the accessibility and functioning of these institutions.

7 The Ministry of the Interior and Kingdom Relations (BZK), and the Ministry of Agriculture Fisheries, Food Security and Nature (LNV). *Green in and around the City Guide*. The Hague: Government of the Netherlands, 2024.
8 Ministry of the Interior and Kingdom Relations, MooiNL programme. *Groen en gezond leven in de stad: netwerken met meer ruimte voor natuur, bewegen en ontmoeten*. The Hague: Government of the Netherlands, 2024.
9 LEIDEN UNIVERSITY MEDICAL CENTRE (LUMC). *Bomenkompas. Leiden*: Leids University Medical Center, 2023.
10 National Institute for Public Health and the Environment (RIVM). *Kennisbundeling Groen en Gezondheid*. *Bilthoven*: National Institute for Public Health and the Environment, 2022.
11 National Institute for Public Health and the Environment (RIVM). *Hoofdrapport VTV-2024*. *Bilthoven*: National Institute for Public Health and the Environment, 2024.

Knowledge institutions such as RIVM are devoting more and more time to identifying the additional health risks of climate change. Unfortunately, the large number of interactions means that there is still little very specific information regarding the precise impact on mortality and disease burden, the economic impact and specific risk areas and risk groups. Although more research into these factors should be encouraged, the risk groups and areas have often already been identified at local level. The Neighbourhood Dashboard of the Climate Impact Atlas[12], for example, provides a greater insight into climate effects at neighbourhood level. It shows, for example, the perceived temperature on a hot summer day in relation to other surrounding neighbourhoods, as well as the level of social vulnerability to heat.[13] This presents an opportunity to address problems effectively in a coordinated and highly efficient manner. In short, the additional risks caused by climate change should galvanise us to improve existing policy and minimise health losses. However, they also represent an opportunity to strive for a healthier living environment and thereby make more health gains. The result will be a robust and resilient society that is more able to withstand challenges like climate change.

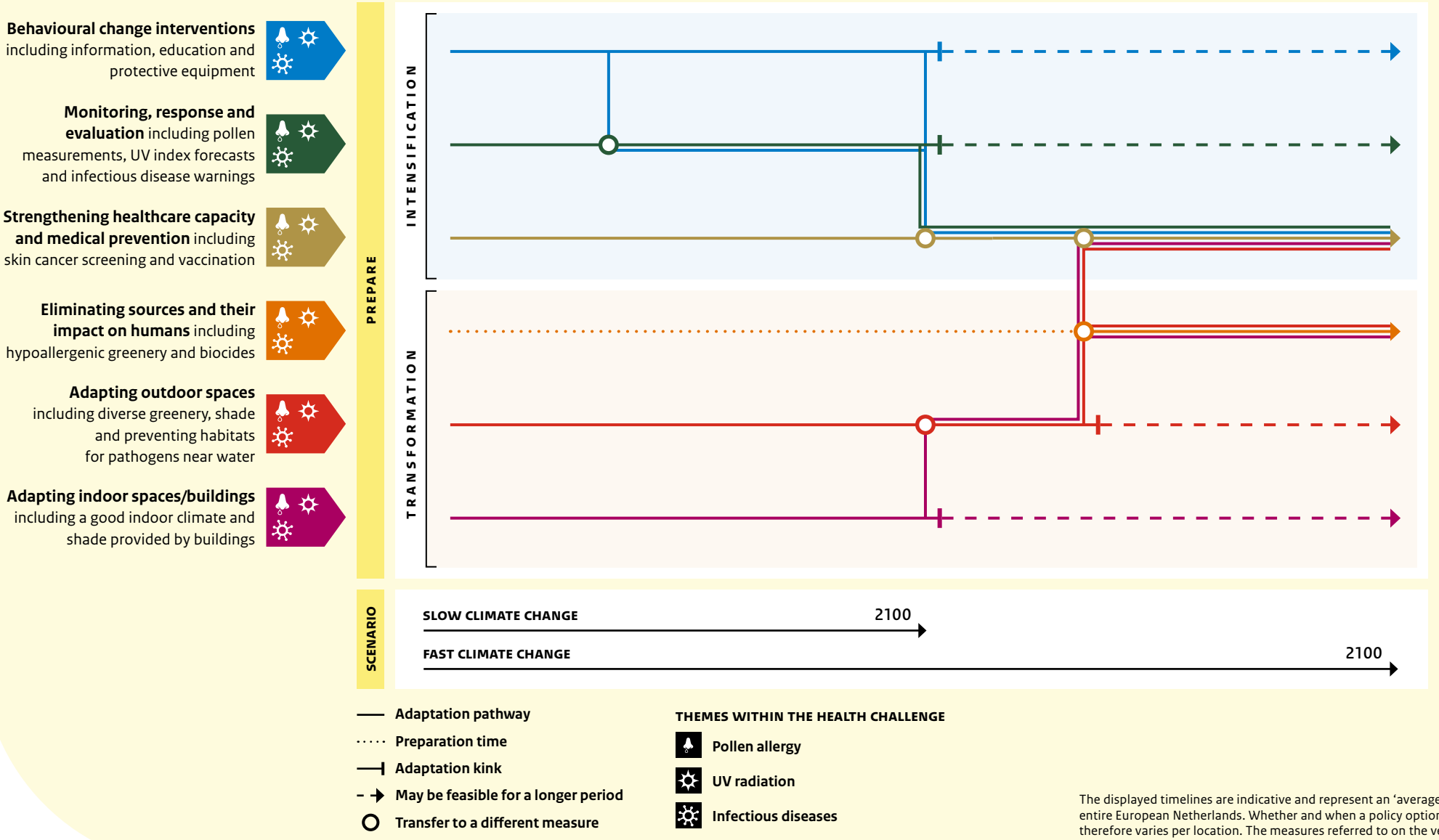
The ambition

Climate adaptation prevents, limits and remedies the negative health effects of climate change for everyone, now and in the future.

Current healthcare and prevention policies are already reducing the described health risks. Our ambition with the NAS is to minimise the additional health risks caused by climate change. We also aim to use as many synergistic opportunities as possible to promote health.

12 Stichting Climate Adaptation Services. '*Klimaateffectatlas*'. (2025).
13 Stichting Climate Adaptation Services. '*Sociale kwetsbaarheid hitte*'.

Figure 4.9.1 **Adaptation pathway map** for the challenge of staying healthy in times of climate change; health risks posed by pollen, UV radiation and infectious diseases



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.9.2 The options

Merely intensifying the measures currently being taken by Municipal Health Services (GGDs), municipalities and knowledge centres to address the health risks of climate change will only have a limited effect. These stakeholders are monitoring the effects and communicating about them in order to raise awareness of the health impact of climate change. This is having a positive effect on public support for adaptation measures and is increasing resilience by offering a course of action to provide behavioural advice. Support is increasingly being provided to vulnerable target groups in collaboration with local partners from the care, welfare and housing sectors. However, this approach alone does not completely eliminate the health risks of climate change.

The need for transformation is therefore increasing. We must take additional steps, such as adapting the living environment, and these will take more time to complete. If we do not start this process in good time, a so-called *lock-in* may occur, leading to an increase in health risks. This adjustment aligns with a broader system transition, for example increased 'active mobility' when it comes to transport and more plant-based food in our food supply. After all, a healthy living environment should be made up of nature that encourages physical activity and is combined with social initiatives such as urban farming.

Allergies, UV radiation and infectious diseases

We have combined the possible measures for addressing the additional health risks of pollen, UV radiation and infectious diseases into a single adaptation pathway map (Figure 4.9.1). This is because corresponding sets of measures can be used to combat these risks. The first group of measures (blue line) focuses on behaviour. This includes, for example, wearing sun-protective clothing to limit exposure to UV radiation. The final sets of measures focus more on the physical living environment, with solutions in the outdoor space (purple line), such as shade provided by large tree canopies and the installation of insect screens in buildings (red line). The monitoring, response and evaluation measures (green line) focus on collecting information on exposure to pollen, UV radiation and pathogens, and the related health effects. They also facilitate the development of more specific measures and the evaluation of their effectiveness. If measures aimed at preventing adverse health effects fall short, the focus can switch to the early detection of diseases and care (brown line). By concentrating on new treatments, we can further reduce the long-term risks of infectious diseases (orange line).

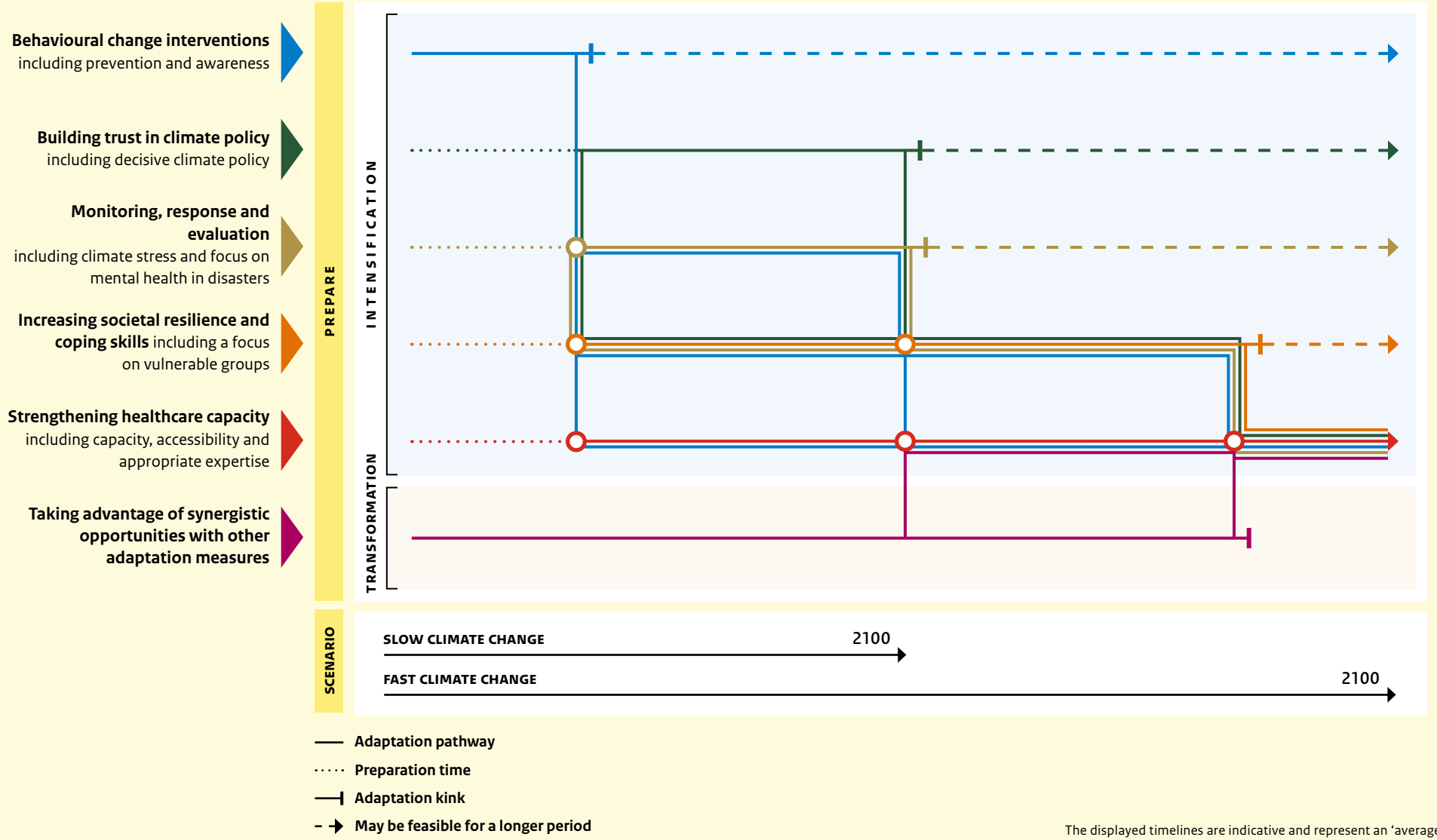
Mental health

Figure 4.9.2 describes the possible measures for addressing health risks for mental health associated with climate change. Three groups of measures are comparable to Figure 4.9.1, namely measures aimed at behavioural change (blue line), monitoring, response and evaluation measures (brown line), and measures in healthcare (red line). The remaining measures differ. There are, for instance, measures that focus on trust in climate policy (green line). In this respect it is important that the government has a clear vision on climate policy and that it involves the Dutch public, especially the younger generation, when taking measures. Clear communication on this, via existing programmes aimed at mental health, can reduce stress levels.

Increasing the level of resilience (orange line) is also a good idea if we want to reduce the impact of incidents and disasters. This can involve more general measures that, for example, focus on increasing social cohesion outside of crisis times or providing advice on how to act during a crisis. Lastly, another option is to use synergistic opportunities of other climate adaptation measures (purple line) in order to limit the adverse mental effects of climate change. This would include the aforementioned communication on climate policy. However, adaptation measures such as making the living environment greener also have a positive effect on mental health. People's mental well-being improves if they can see some greenery when they look out the window.

Figure 4.9.2

Adaptation pathway map for the challenge of staying healthy in times of climate change; mental health



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

Matrix 4.9.1

Goal/Effort Matrix for the challenge of staying healthy in times of climate change

Ambition

Now and in the future, the negative health effects of climate change will be prevented, limited and remedied as much as possible for everyone through climate adaptation

	Effectiveness	**Communication**	**Spatial planning**	**Monitoring**
Improvement goal	The government is devoting more attention to the negative health effects of climate change affecting people in vulnerable positions.	The Government is raising awareness of the risks posed by allergens, exposure to UV radiation, infectious diseases and the impact on mental health in relation to climate change.	Stakeholders in the physical space will have more consideration for the risks of allergens, exposure to UV radiation and infectious diseases, as well as the impact on mental health, when designing the living environment.	Researchers, policymakers and residents are better informed about the risks of allergens, exposure to UV radiation and infectious diseases, and the consequences for mental health in relation to climate change.
SMART goal	By 2030, municipalities will have taken into account the health risks of climate change and the groups vulnerable to them in their health policy documents.	The Climate-Proof Together Platform will work until 2030 to establish a network for sharing knowledge on climate and health.	By 2030, the impact on health will be considered as standard in spatial development, for example by involving the Municipal Health Services.	By 2030, the risks of allergens, exposure to UV radiation and infectious diseases, and the consequences for mental health in relation to climate change will be monitored.
Effort/result	→ The government will include the health risks of climate change in the Public Health Policy Document.	→ The Climate-Proof Together Platform will establish a community of practice entitled ‘Staying healthy in times of climate change’.	→ Health in relation to the living environment is reflected in the National Strategy on Spatial Planning and the Environment and the Spatial Policy Document. → In 2026, the government will launch an exploratory study into how it can improve the capacity for local advice on health in relation to the living environment.	→ In 2027, RIVM will submit a proposal for a climate, care and health monitoring system.

4.9.3 The approach

Communication

The government is committed to providing clearer information, for example through the NAS communication strategy. The government can use clear communication to increase awareness, involve people in climate adaptation and provide clear behavioural advice. The Ministries of the Interior and Kingdom Relations (BZK), Health, Welfare and Sport (VWS), and Infrastructure and Water Management (IenW)) are also encouraging knowledge to be exchanged between climate adaptation professionals from both the physical and social domains. This is taking place via the Climate-Proof Together (*Samen Klimaatbestendig*) platform.

Information on climate adaptation and health is also available from RIVM and the national GGD working group on climate and health. Via the LIFE-IP Climate Adaptation programme, the GGD and RIVM are carrying out various projects to make information readily available in, for example, a number of guides.[14] LIFE-IP is a Dutch programme, which is co-funded by the European Union and which focuses on accelerating climate adaptation in the Netherlands. Information specifically for infectious diseases is also available via the Vectors and Vector-Associated Infectious Diseases Knowledge Platform (*Kennisplatform Vectoren en vectorgebonden Infectieziekten*).

Monitoring

We are going to focus on improved monitoring in the coming years. This will involve monitoring the health effects associated with the living environment as well as sources that help to cause diseases to emerge. Knowledge institutes such as RIVM will play an important role in this monitoring. They will, for example, provide insight into the strength of UV radiation at any given moment using the Sun Strength Indicator tool (*Zonkrachtwijzer*).[15] In 2027, RIVM is going to produce recommendations on how to identify the health effects related to climate change over time. In the same year, we expect additional insights to become available from studies into the health effects of climate change by RIVM and other organisations.

Spatial planning

Spatial (planning) policy that takes health into account is the most effective measure that can be taken to reduce the health effects of climate change. However, the transformation to a healthy living environment only takes effect after approximately ten to fifteen years. Moreover, the effectiveness of these adjustments is linked to behavioural measures and the extent to which monitoring has been developed. Better monitoring and research results will enable us, for example, to implement more location-specific and target-group-oriented measures as well, in addition to adopting a generic approach. This means, for example, adding greenery to predominantly paved neighbourhoods inhabited by people with lower incomes.

When making spatial choices, it is important to address and improve both people's health and the living environment simultaneously from the very beginning of the planning process. This often requires a tailor-made approach at local level. It is therefore essential that the cooperation between the physical and social domains involves residents in the design and layout of an area. This not only improves the efficiency of the interventions but can also increase the level of collective self-reliance. It will also make it possible to identify problems and people in vulnerable positions at local level more quickly.

As the government, we will create links between a healthy living environment and climate adaptation in various national initiatives. The focus on health in relation to the living environment is reflected in the National Strategy on Spatial Planning and the Environment (NOVI) and the Spatial Policy Document. The Health and Active Living Agreement, drafted by municipalities, Municipal Health Services, health insurers and the Ministry of Health, Welfare and Sport, is an example of agreements and partnerships aimed at a healthy living environment in conjunction with a strong social network. The Ministry of Health, Welfare and Sport and the municipalities are going to continue this approach in the coming years by implementing the National Health Policy Memorandum. Specific measures to encourage more greenery include the forest strategy and the Nature-Inclusive

14 Academic Collaborative Centre for Healthy Living Environment (Academische Werkplaats Gezonde Leefomgeving). 'Klimaatadaptatie en gezondheid'. (2023).
15 National Institute for Public Health and the Environment. 'Zonkrachtwijzer'.

Collective movement. The Ministry of Health, Welfare and Sport is going to start a dialogue with the Ministry of Agriculture, Fisheries, Food Security and Nature to investigate how health can be adequately represented and is also exploring how advice provided by the Municipal Health Services can be used more effectively when working towards creating a healthy living environment.

There are also examples of climate adaptation in health policy. The Coherent Prevention Strategy (*Samenhangende preventiestrategie*) of the Ministry of Health, Welfare and Sport stipulates that structural attention should be paid to sun protection in environments in which vulnerable groups are present, such as education, childcare, sports clubs and the workplace. An explicit aspect of this is the promotion of sun-safe behaviour and the availability of, for example, shaded areas or sun protection facilities. The aim of the National Action Plan for the Strengthening of the Zoonotic Disease Policy (*Nationaal actieplan versterken zoönosenbeleid*) is to continue reducing the risks of zoonoses and vector-borne diseases from the living environment in the future.

Tackling health risks is a joint challenge for the physical and social domains

The tackling of health risks is a joint challenge for the physical and social domains. When people think of health and disease they generally think of doctors and hospitals. In the context of climate adaptation, physical interventions, such as flood defences and wadis, may also come to mind. The theme of health is therefore primarily associated with the social and medical domains, while the theme of climate adaptation is primarily associated with the physical domain. However, the adaptation pathway maps clearly show that the challenge is a joint one and that corresponding measures need to be taken. In this regard, the social and physical domains are dependent on each other for a successful outcome of the measures. For instance, physical adaptations, such as ensuring proper water flow, are important for the prevention of infectious diseases as a result of contaminated surface water. However, for an optimal effect, we must combine these with effective advice aimed at encouraging hygienic behaviour, for example in the form of clearing up waste and rinsing oneself off after swimming. Those measures then fall under the social domain.

Parties active in both domains, such as the Municipal Health Services, fulfil a bridging role. The social domain also has a clear role to play in terms of identifying the impact of climate change on the health of vulnerable groups and supporting the regional and local climate adaptation approach. In this context, the Municipal Health Services can adopt the role of process facilitator when it comes to organising and implementing the local approach.

By formulating a joint National Adaptation Strategy (NAS), the government is committing to a joint approach involving the physical and social domains in order to keep people healthy in times of climate change. Both the implementation of climate adaptation and the impact of climate change take place within a social context. After all, these matters also involve human behaviour, interactions and consequences. This not only involves physical and mental health, but also trust in the government, a willingness to act and resilient communities. These are all factors which are relevant to the increasingly common broader definition of health known as 'positive health'[16], in which aspects such as meaning and participation also play a significant role. First and foremost, this joint approach guarantees the optimal implementation of climate adaptation aimed at the health risks posed by climate change. It also increases the opportunity of using the social infrastructure in the Netherlands to tackle other challenges in this NAS, as recommended by the Netherlands Scientific Council for Government Policy.[17]

4.9.4 The consequences of the approach

An effective approach to the health risks of climate change improves public health. If we end up in a lock-in and a high demand for care arises, the impact would be a (limited) risk to the healthcare sector (prosperity). A number of the policy options, specifically the transformative options, reinforce each other and also contribute positively to other challenges, for example by encouraging more greenery, water and shade. Such adjustments to the outdoor space increase biodiversity (*planet*) and enhance the social quality of the space. This, in turn, can lead to more social interaction and movement in public spaces (*people and prosperity*).

16 Institute for Positive Health. '*Een bredere kijk op gezondheid, die meer oplevert*'.
17 WRR. Mens en klimaat. *De kracht van sociale infrastructuur bij adaptatie*. WRR report no. 112. The Hague: Netherlands Scientific Council for Government Policy, 2025.

Challenge 4.10 Properly protected cultural heritage

Dam in the river Dommel to protect the Van Abbemuseum in Eindhoven during high water
(Photo: Van den Noort Innovations)

A flood barrier was installed to protect the Van Abbemuseum against water in early March 2016. The museum's location on the river Dommel means it is at risk of water damage during high water. A flood was narrowly averted in 2012 when sandbags had to be placed at the building's entrance. In the future, we will have to take the consequences of climate change for our cultural heritage more into account in order to protect our collections, traditions, monuments and more besides. Cultural heritage is conceived and shaped within the living environment. It is a permanent part of that living environment and therefore part of the solution. If we view heritage as an opportunity, we will be able to make the Netherlands more resilient to the consequences of climate change.

Text box 4.10.1 **Tangible and intangible heritage**

Cultural heritage consists of tangible and intangible heritage

- Tangible heritage can be divided into built heritage, archaeological heritage, movable heritage, cultural landscape and green heritage.
- Intangible heritage is 'living heritage'. It encompasses social customs, traditions, expressions, special knowledge, or skills which communities and groups (and sometimes even individuals) recognise as a form of cultural heritage, and which are passed down from one generation to another.

4.10.1 The challenge

Our heritage is threatened by the effects of climate change: (more and) more cultural heritage will be lost if we do not take sufficient measures. This loss must be prevented because cultural heritage is what makes the Netherlands the country it is with our historic city centres, typical cultural landscapes, rich archaeological sites, our world-famous paintings and collections and, of course, our traditions and customs. These are not only valuable elements that make our living environment recognisable and attractive, but also things we want to pass on to future generations. The story of the past and its physical remains make up an area's identity.

Climate change threatens cultural heritage in all its forms. The threat occurs as both gradual changes (such as sea level rise) and disasters and crises. Changes in temperature, precipitation and rising sea levels are a threat to collections and archival materials (in museums), monuments, cultural landscapes, archives, repositories and archaeological sites. Extreme weather conditions, such as floods, storms and heatwaves, can cause accelerated wear and tear, fire and structural damage to vulnerable heritage objects. Changes in humidity, salinity and groundwater levels can also affect underground archaeological artifacts and the foundations of monuments. Warmer periods also make staging events more challenging, such as the Elfstedentocht skating race or the Nijmegen 4Days Marches walking event (intangible heritage).

Cultural heritage is a relatively new field for climate adaptation policy. Consequently, the risks and effects are still only partially understood, and further research is needed. The Netherlands Environmental Assessment Agency commissioned the Cultural Heritage Agency to conduct research into various climate risks for cultural heritage. This research[1] has revealed that cultural heritage is already under threat. This is reflected in, for example, the drying out of (wet) archaeology and (often invisible) damage to monument foundations caused by fluctuating groundwater levels.

Increasing attention is being paid to the use of cultural heritage for climate adaptation purposes. This is also referred to as learning from the past, and that approach aligns with what the Intergovernmental Panel on Climate Change (IPCC) calls indigenous and local knowledge.[2] Cultural-historical knowledge and applications therefore also present an opportunity for climate adaptation, both through the application of knowledge from the past and the use of physical heritage for climate adaptation. For example, archaeological and geological knowledge is being used for the new Rijnenburg neighbourhood in Utrecht to design it in such a way that residents are protected from flooding and the Woudagemaal pumping station (UNESCO World Heritage Site) has been used since 1920 during times of extreme rainfall or excessively high water levels.

Our cultural heritage is the result of us adapting and using our land and is therefore dynamic. It can play an important role in spatial transitions because it forms an indispensable part of (new) spatial quality. Spatial challenges[3] have major implications for existing built-up areas, the design of protected landscapes, and the preservation of archaeological remains. The focus of national policy on heritage and the living environment is on involving cultural heritage in developments and challenges at an early stage. In this way, we can take cultural-historical values into account right from the start of the planning process, integrate heritage as much as possible, and ensure that implementation is not unnecessarily delayed.

1 Cultural Heritage Agency. *Cultureel Erfgoed – Huidige risico's. Nationale Adaptatiestrategie 2022-2026*. Amersfoort: The Cultural Heritage Agency, 2023.
2 IPCC. 'Glossary.' *In Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group* II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, 2897-2930. Cambridge: Cambridge University Press, 2023.
3 What we mean here are the spatial challenges set out in the four themes of the Spatial Policy Document: Residential, work and accessibility, Economics and energy, Agriculture and nature, and Water and soil.

Text box 4.10.2 **Legal division of roles**

The government, municipalities, provincial authorities and owners are jointly responsible for caring for our cultural heritage.[4]

- As the government, we encourage research and advice which helps to ensure that our cultural heritage is properly looked after. With this in mind, we support owners with grants and loans. The Cultural Heritage Agency also has the power to designate objects as being part of our cultural heritage and thereby grant them protected status.
- Municipalities are responsible for, among other things, granting permits, supervision and enforcement in relation to listed buildings.
- The provincial authorities are responsible for, among other things, restoration subsidies and supervising municipal listed building duties.
- The government, provincial authorities and municipalities are also owners of cultural heritage themselves.

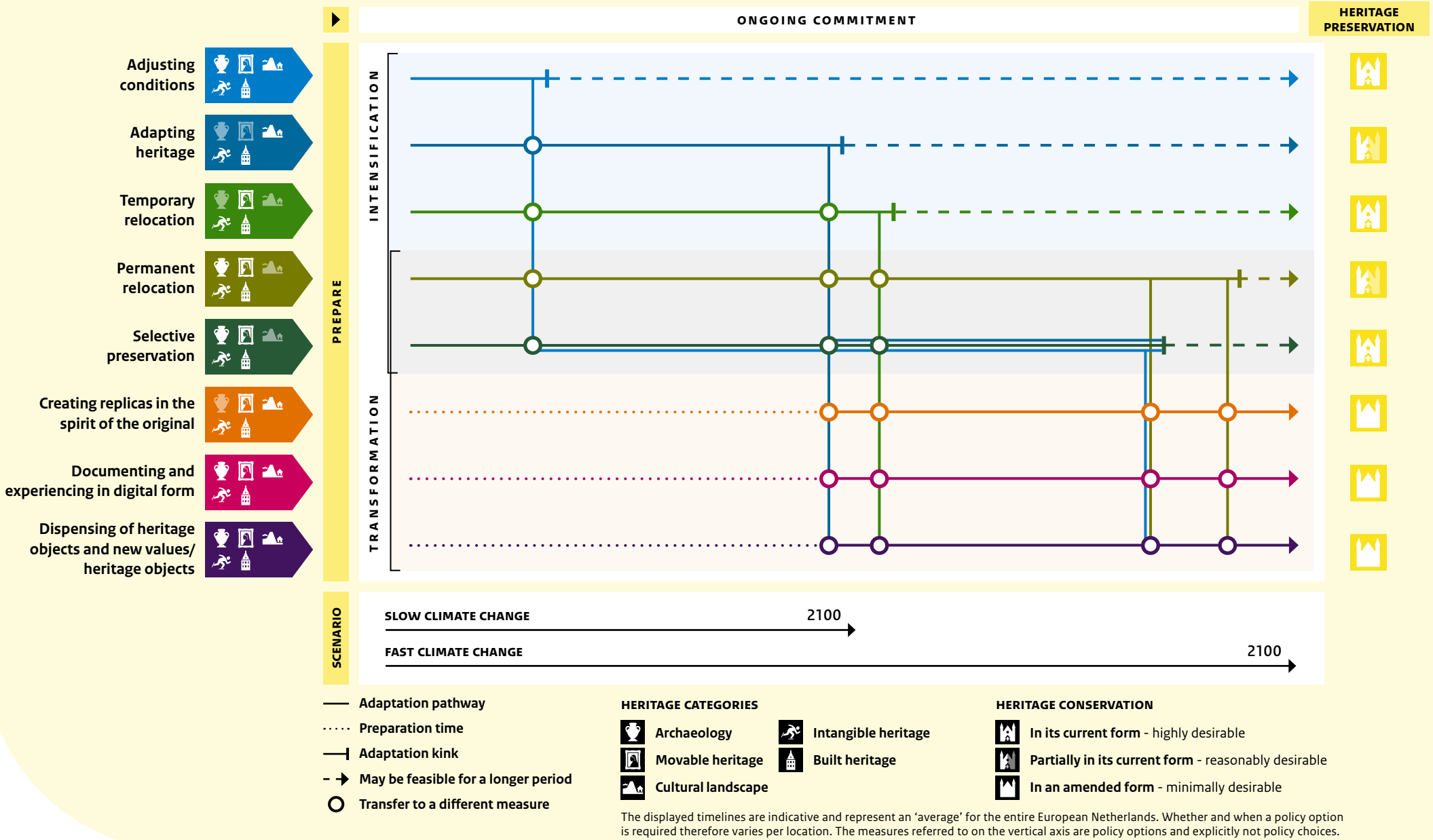
The ambition

Cultural heritage is future-proof and climate-adaptive in such a way that:
- **the Dutch living environment remains recognisable and attractive to everyone in the future;**
- **cultural heritage is not lost and can be passed on to future generations;**
- **this knowledge, just like physical heritage, is used for climate adaptation and other challenges facing society.**

This requires a well-thought-out mix of prevention, management and acceptance of residual risks (safety plans) and flexibility (long-term investments, futureproofing and timely adjustments). We discuss the approach and the options for this below.

4 This is laid down in, among other things, the Heritage Act (Erfgoedwet) and the Environment and Planning Act. The Heritage Act clearly stipulates what makes up our cultural heritage, who is responsible for it, and what kind of regulatory arrangements are in place.

Figure 4.10.1 **Adaptation pathway map** for the challenge of properly protected cultural heritage



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.10.2 The options

We developed an adaptation pathway map for this challenge on the basis of a literature review and expert judgment from the heritage sector. The adaptation pathway distinguishes between preparatory steps and adaptation possibilities, or in other words adaptation measures. The adaptation pathway is not a blueprint for policy but provides insight into various possibilities.

There are a number of essential preparatory steps that must be taken to enable choices to be made between the various adaptation options:

- The government will identify and monitor climate risks more effectively for the various forms of cultural heritage. This will provide more insight into what is needed and when.[5]
- The government and the field must engage in more active dialogue within society regarding heritage values, based on development principles from the Faro Implementation Agenda[6]. On the one hand, this may help to increase awareness of the effects of climate change on heritage and, on the other hand, build support for choices to be made in the context of climate adaptation[7].
- The government is responsible for including cultural heritage in assessment frameworks and emergency policy, as well as in long-term choices regarding climate adaptation.[8] Among other things, this means how heritage is included in crisis management or in the water distribution priority list (fresh water distribution ranking) during periods of drought. This requires more knowledge to be acquired at local (municipal), regional (provincial) and national levels, so that more policies can be developed.
- The government and the field are going to document heritage in an appropriate manner, so that it can be used as a basis for decision-making and as a reference for the future. In this regard, it is important that the documentation is widely accessible and usable.

We have identified seven categories of adaptation options, within which specific options may exist. Not all options are possible for all types[9] of heritage. The effectiveness of the measures is difficult to assess because they have only been applied to a limited extent in practice so far. We consider the blue options to be intensification measures, given that they are additional measures which are designed to preserve existing heritage functions. The orange options are transformative, which means that we can use them to change function and use so that they align more effectively with water, soil and climate.

1. **Adjusting conditions.** This involves adjustments to the conditions relating to heritage in order to reduce the risk. Examples include adjustments to water management, such as changing the water level or including heritage in the water distribution priority list.[10] That water distribution priority list determines where freshwater goes first during periods of drought.

2. **Adapting heritage.** This means assessing ways in which we can reduce the climate risk for heritage through adaptations (while preserving heritage values). One example of how we could do this is by replacing avenues of beech trees with avenues of lime trees at country houses, because beech trees are vulnerable to drought. Another way would be to take specific measures to protect buildings, such as installing flood barriers.[11]

3. **Relocating heritage.** A relocation can be temporary or permanent.
   a) **Temporary relocation.** This means storing the most vulnerable and valuable objects on the upper floors of the building to protect them from flooding or moving certain cultural events to a different location or time in the event of extreme circumstances. Permanent relocation.
   b) **Permanent relocation.** This would involve, for example, the permanent relocation of (part of) a building as in the case of the '*De Roos*' windmill during the redevelopment of the railway zone in Delft. It is rarely possible or desirable to relocate immovable heritage on a permanent basis because the value of the heritage involved is often strongly linked to its surroundings. In the case of archaeological heritage, this means, for example, the preventive excavation of archaeological sites.

5 Fatoric, S. and R. Biesbroek. 'Adapting cultural heritage to climate change impacts in the Netherlands: barriers, interdependencies, and strategies for overcoming them'. *In Climatic change.*
6 Cultural Heritage Agency. *Onderweg naar Faro. Uitvoeringsagenda Faro (deel I).* Amersfoort: The Cultural Heritage Agency, 2022.
7 ICOMOS. *The Future of Our Pasts: Engaging cultural heritage in climate action. Outline of Climate Change and Cultural Heritage.* Charenton-le-pont: ICOMOS, 2019.
8 Zwegers, B. and K. van Knippenberg. '*Erfgoedensembles en klimaatadaptatie: grenzen aan de maakbaarheid wat planologen en hydrologen kunnen leren van erfgoed en de geschiedenis van ons cultuurlandschap*'. *Jaarboek van het Sociaal Historisch Centrum voor Limburg.* Red. N. Randeraad and J. Roosen. Maastricht: Sociaal Historisch Centrum voor Limburg, 2024: 266-284.
9 The five heritage categories are intangible heritage, built heritage, archaeology, cultural landscapes and movable heritage.
10 The Information and Heritage Inspectorate (Inspectie Overheidsinformatie en erfgoed). *Aanhoudend droog, een inventariserend onderzoek naar de gevolgen van droogte op groene rijksmonumenten.* The Hague: The Information and Heritage Inspectorate, 2020.
11 Blavier, C.L.S. et al. '*Adaptive measures for preserving heritage buildings in the face of climate change:* A review.' Building and Environment, 245: 110832.

4. **Selective preservation**. This means making decisions about what we do and do not actively preserve. This approach can be combined with other adaptation options, for example the digitisation of heritage objects.
5. **Rebuilding in the spirit of, or creating a replica**. In some cases, a decision may be taken to rebuild heritage in the spirit of the original, or to create a replica of the original.
6. **Documenting and experiencing in digital form**. Another way to preserve heritage is by capturing it digitally and creating ways to experience it in digital form. One example of this is the digital reconstructions by Heritage on the Edge.[12]
7. **Dispensing of heritage objects and possible new values/heritage objects:** In extreme cases, a decision may be taken to dispose of certain heritage objects. In such instances, special attention is paid to the manner in which this is done, in order to allow new heritage values to emerge.[13]

12 See .
13 Desilvey, C. *Curated decay: heritage beyond saving*. Minneapolis/Londen: University of Minnesota Press, 2017.

Matrix 4.10.1

Goal/Effort Matrix for the challenge of properly protected cultural heritage

Ambition

Cultural heritage is future-proof and climate-adaptive
This will help keep the Dutch living environment recognisable and appealing to everyone in the future; cultural heritage will not be lost and can be passed on to future generations.
This knowledge, just like the physical heritage itself, can be used for climate adaptation and other challenges facing society.

	Improvement goal	**Better identifying the risks and effects of climate change on heritage, including in relation to other challenges.**	**Greater scope for action regarding protection and adaptation measures for heritage.**	**Increasing awareness within the heritage sector and in society of the risks and effects of climate change.**	**Solution-oriented collaboration between cultural heritage and other sectors**
	SMART goal	Continuing research into the risks and effects of climate change.	Further safeguarding of cultural heritage within the safety regions in collaboration with the Safe Heritage Task Force.	Continue to encourage knowledge sharing and discussions about heritage values using a variety of instruments.	OCW is partnering with the Ministry of Infrastructure and Water Management to explore opportunities for multipurpose land use along the World Heritage site of the Dutch Water Defence Lines by investigating whether there are synergistic opportunities for water storage and the enhancement of existing values of the Dutch Water Defence Lines.
Effort/result		→ The Netherlands Environmental Assessment Agency (PBL) coordinates research into the effects of climate change. The Cultural Heritage Agency (RCE) conducts research into this for the five categories of heritage. → From 2026 to 2036, the Ministry of Education, Culture and Science (OCW) will focus on the anticipated Partnership Resilient Cultural Heritage. Through this partnership, 25 countries and the EU are investing heavily in European research into climate change and heritage. One theme is the contribution that heritage and historical knowledge can make to adaptation.	→ Acting as a discussion partner in meetings on weighing up risks and threats which affect cultural heritage during a regional risk analysis and assessment of safety risks and the associated policy development. → Encouraging the practising of crisis scenarios by the heritage sector. → Further focusing on networking to support each another, such as in prevention networks or safety regions. → Providing information to the safety regions.	→ Encourage information and networking meetings such as those organised by the Heritage and Climate Platform. In 2026–2027, the RCE will visit water authorities for workshops on the Water Timeline Map and its application. In the current search for a new relationship with water and soil, this knowledge offers historical insights and opportunities for current challenges. → Further development and strategic deployment of the Serious Game in the region in 2026. → Organising the Flowing Through Time III Symposium in 2026 by the RCE.	→ Results of the supra-regional stress tests will be compared with the boundaries of the Water Defence Lines. Results of this assessment are expected in 2026.
		The RCE encourages municipalities to incorporate cultural heritage into stress tests through the organisation of webinars and workshops.	Exploring the potential application of climate adaptation within the current heritage system.		OCW is committed to interministerial heritage-inclusive spatial area developments.
		→ The RCE encourages municipalities to incorporate cultural heritage into stress tests through the organisation of webinars and workshops.	→ In 2026, OCW, in collaboration with various stakeholders, will explore the extent to which the valuation and selection framework for archaeological sites can be recalibrated. For example, with parties such as the Network of Municipal Archaeologists (CGA), umbrella organisations of archaeological bodies and initiating partners. In particular, they will investigate how climate can become a consideration within the valuation and selection framework for archaeological sites, and what courses of action are appropriate. → In 2026, OCW will explore the possibilities for financing preventive climate adaptation measures. → We are committed to the preservation of monumental values and the archaeological soil archive as part of the National Approach to Foundation Issues.		→ OCW continues to provide financial support for the development of area biographies.
		In 2026, OCW will explore a structured form of monitoring the effects of climate change on cultural heritage.			

4.10.3 The approach

The adaptation pathway provides an insight into which measures are possible when it comes to protecting cultural heritage against climate change. However, things can be difficult to manage in practice, and the effectiveness of measures varies per heritage site, category and climate impact. It is therefore important to focus initially on the preparatory steps (see section 4.10.2) and to explore how we can apply the measures within the current heritage system.

We are also committed to including cultural heritage in developments and challenges at an early stage. In this way, we can take cultural-historical values into account right from the start of the planning process, integrate heritage as much as possible, and ensure that implementation is not unnecessarily delayed.

In the case of the majority of heritage categories, the responsibility for making cultural heritage climate-adaptive lies with the owners of the objects of cultural heritage. These include, for example, owners of monuments, museums, and heritage practitioners. However, the same does not apply to the categories of archaeology and cultural landscapes. As the government, we believe our role is to facilitate knowledge about climate change and heritage, support the funding of preservation through existing instruments and be the driving force behind the process. We are therefore focusing on large-scale pilot projects that demonstrate that cultural-historical knowledge and physical heritage are invaluable for today's climate adaptation challenges.

The Goal/Effort Matrix in Figure 4.10.1 shows that we are working towards the ambition by focusing on four pillars:

1. **We are identifying the risks and effects of climate change on heritage more effectively, including in relation to other challenges.**
   - We are continuing research into the risks and effects of climate change.[14,15]
   - We are providing insight into the effects of climate change at local level by supporting the region with location-specific or region-specific research into climate adaptation. The Cultural Heritage Agency is encouraging municipalities to incorporate cultural heritage into stress tests through the organisation of webinars and workshops. We have also identified mapping material which is specifically relevant to the conducting of stress tests.
   - We are continuously focusing on European cooperation and research in order to boost cooperation between the heritage field and the climate field in an international context. From 2026 to 2036, we are going to focus on the anticipated Partnership Resilient Cultural Heritage. This partnership involves more than 25 countries and the European Union investing heavily in European research into climate change and heritage over the next ten years. One of the key themes is the contribution that heritage and historical knowledge can make to (social) adaptation.
   - From 2026 onwards, we intend to incorporate the systematic monitoring of climate adaptation indicators in the heritage sector into the Heritage Monitor.

2. **We are offering the heritage sector greater scope for action regarding protection and adaptation measures for heritage.**
   - We are continuing to safeguard heritage within the safety regions (risk and crisis management). The Cultural Heritage Agency is working on, among other things, the following:[16]
     - Providing information to the safety regions.
     - Acting as a discussion partner in meetings on weighing up risks and threats which affect cultural heritage during a regional risk analysis and assessment of safety risks and the associated policy development.
     - Focusing on networking to support each other, such as prevention

14 Cultural Heritage Agency. 'Klimaatrisico's voor het Nederlandse erfgoed'. (2024).
15 PBL. *Voorbij de Risico's: keuzes voor een klimaatbestendige leefomgeving.* The Hague: Netherlands Environmental Assessment Agency, 2026
16 Cultural Heritage Agency. 'Verhogen weerbaarheid van de erfgoedsector'.

networks and contacts between the heritage sector and the safety regions.
  - Encouraging the practising of crisis scenarios by the heritage sector.
- We are exploring the potential application of climate adaptation within the current heritage system.
  - We are currently exploring the extent to which the valuation and selection framework for archaeological sites can be recalibrated. We are doing this in collaboration with various parties, such as the network of municipal archaeologists known as the *Convent van Gemeentelijke Archeologen*, umbrella organisations of archaeological companies and other initiating parties. We are investigating how climate can become a consideration within the valuation and selection framework for archaeological sites, and what courses of action are appropriate.
  - We are also currently exploring the possibilities for financing preventive climate adaptation measures.

3. **We are focusing on increasing awareness within the heritage sector and in society of the risks and effects of climate change.**
   - We are continuing to encourage knowledge sharing and discussions about heritage values using a variety of instruments:
     - We are encouraging information and networking meetings, such as those of the Heritage and Climate Platform (*Platform Erfgoed en Klimaat*).[17]
     - In 2026 and 2027, the Cultural Heritage Agency is going to visit the water authorities for workshops on the 'Water Timeline Map' (*Watertijdreis*)[18] and its application. After all, the past, present and future of the Netherlands are closely intertwined with water. The 'Living with Water' (*Leven met Water*) theme map shows how decisive the management of water has been and continues to be for our country.
     - We are going to continue to develop and deploy the serious game tool Heritage and Climate (*Erfgoed en Klimaat*) to raise awareness of the potential consequences of climate change for heritage.[19]
     - The RCE is organising the Symposium *Stromend door de Tijd III* in 2026. To broadly share knowledge from the past in order to address current climate adaptation issues.

4. **We are committed to solution-oriented collaboration between cultural heritage and other sectors.**
   - The Ministry of Education, Culture and Science (OCW), together with the Ministry of Infrastructure and Water Management (IenW), is exploring opportunities for multiple land use along the Dutch Water Defence Lines (UNESCO World Heritage Site). We are doing this by investigating whether there are synergistic opportunities, so that the former inundation areas can be used to store water in emergencies, while simultaneously strengthening existing cultural-historical values. To this end, we are comparing the results of the supra-regional climate stress tests with the Water Line boundaries (see also challenge 4.2 *Robustness and resilience against flooding caused by extreme rainfall*). We expect the results to be available by the end of 2026.
   - At interministerial level we are committed to heritage-inclusive spatial area developments. It is important that heritage and heritage values are part of environmental visions and design. Knowledge about the area's past will then help us in our current search for solutions. One way we are doing this is by continuing to provide financial support for the development of area biographies.
   - We are committed to the preservation of monumental values and the archaeological soil archive as part of the National Approach to Foundation Issues.

17 See klimaatenerfgoed.nl
18 See cultureelerfgoed.nl
19 This tool was created by E. Stegmeijer (RCE), see

4.10.4 The consequences of the approach

The loss of cultural heritage is irreversible. Once heritage has been lost, it will be gone forever. It is therefore important to make timely, well-considered choices to make heritage future-proof and climate-adaptive.

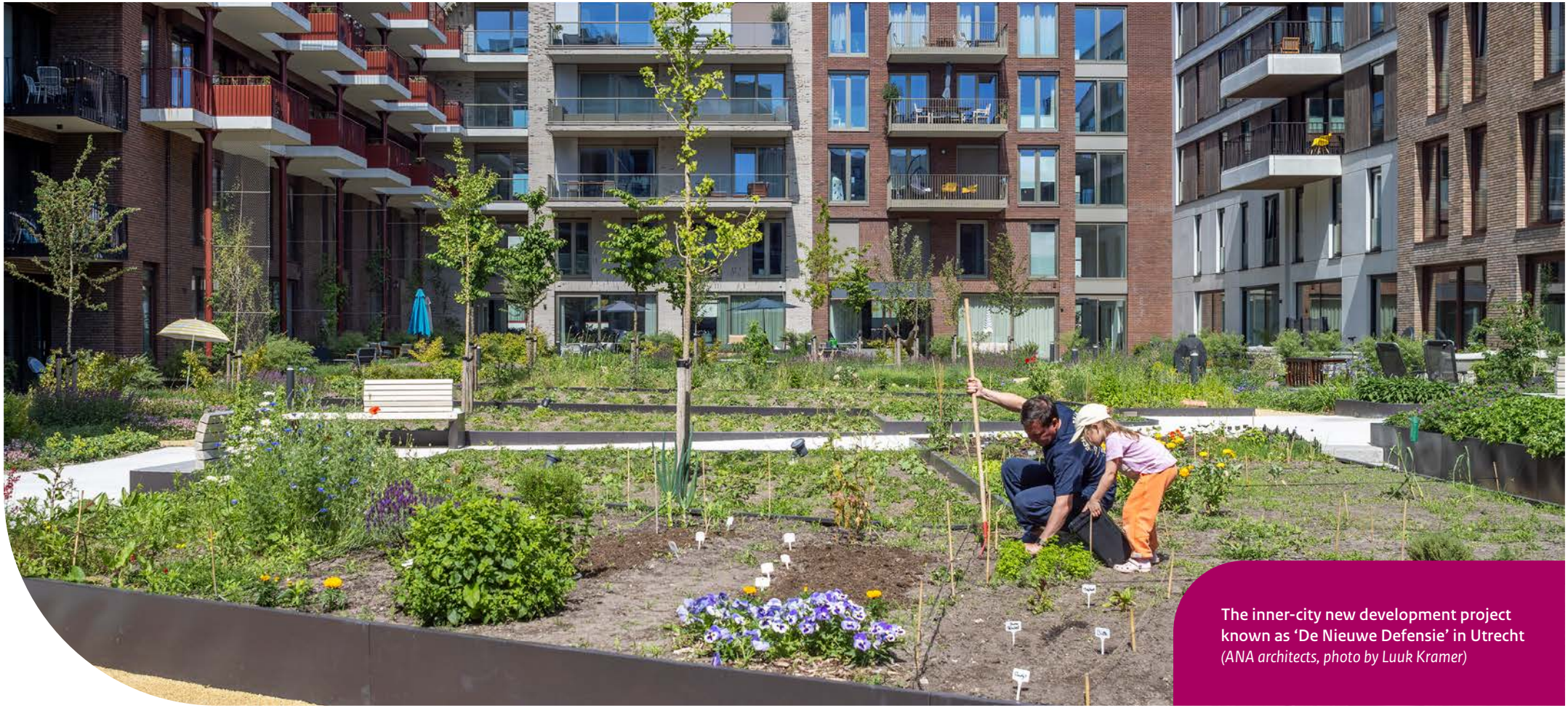
The SEIR shows that most heritage can be properly protected until 2050.[20] We can limit the impact of extreme situations with measures such as contingency plans, relocating events and establishing emergency depots. After 2050, worsening climate change will make it increasingly difficult to preserve cultural heritage, both directly (due to the impact of drought, heat, precipitation, and sea level rise) and indirectly (as a result of measures for other functions). The costs of measures to preserve cultural heritage are becoming increasingly higher.

The measures we can take to protect cultural heritage against climate change also have various social effects. It is important for policy to take account of the (negative) social effects caused by damage to cultural heritage. Whenever cultural heritage is damaged or relocated, this may have consequences for the living environment, the sense of community and the mental health of residents. Moreover, cultural heritage in a neighbourhood, district, or city can serve as a landmark from which people derive their identity. Preserving or relocating heritage objects can also impact land use and the availability of nature, which in turn contributes to healthy ecosystems and indirect health benefits.

Space in the Netherlands is scarce, and the pressure on space is increasing. In addition to climate adaptation, various other issues require space, such as the housing challenge, the energy transition and the economy. That is why we, as the government, are working on the new Spatial Policy Document. Fundamentally, cultural heritage does not require extra space, as it has always been there. Protecting heritage through adaptation measures may, however, require additional space.

20 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Movares: Utrecht, 2026.

Challenge 4.11 Climate-adaptive new developments



The inner-city new development project known as 'De Nieuwe Defensie' in Utrecht
(ANA architects, photo by Luuk Kramer)

"The new housing development 'De Nieuwe Defensie' in Utrecht is a demonstration of how climate-adaptive infill works: smart water collection using greenery and infiltration, integrated into the design from day one. By collaborating early with all partners, the benefits – such as reduced pluvial flooding, heat stress and improved quality of life – far outweigh the costs. The integrated approach connects private (rooftop) gardens and public space, utilises inner courtyards, roofs and the park in a multifunctional way, and encourages social interaction and biodiversity. Adopting this approach enables us to enhance the spatial quality of the existing city."

Martijn van Gelderen
Strategic Advisor Environmental Quality,
BPD Ontwikkeling B.V.

4.11.1 The challenge

The effect of extreme weather events caused by climate change is becoming increasingly noticeable in our built environment. Extreme climate events and the long-term consequences of climate change can both cause physical and mental health problems. Prolonged periods of drought, heat, and pluvial flooding caused by extreme precipitation have consequences for the futureproofing and liveability of our cities, towns and villages, as well as our prosperity.

Our focus in the context of this challenge is on investing in and incorporating climate adaptation into new urban developments. By this, we mean all new developments, in other words residential construction, non-residential construction (buildings that have not been designated for residential use such as offices or schools), large-scale area development, infill development (building within the existing built environment) and adding a street.

The following climate themes, in particular, pose the greatest risks of damage to buildings and public spaces, as well as health problems:

- **Heat and drought:** Persistent extreme temperatures during heatwaves lead to increased excess deaths, premature births, heat stress, health complaints, and higher energy consumption in the built environment due to a growing demand for cooling (see challenge 4.8 *Heat-resilient cities, towns and villages*). Water quality, urban greenery and biodiversity also decline (see challenge 4.6 *Resilient nature*). Other consequences are water shortages and an increase in prolonged droughts due to drier summers and higher temperatures. All this takes place at the same time as increasing water demand due to new developments and higher (peak) consumption (both domestic and commercial). Another problem is increased pressure on the supply of drinking water (see challenge 4.4 *Safe and healthy water quality*). Drought also causes damage to urban infrastructure, with lower groundwater levels causing road subsidence and breaks in underground cables and pipes (see challenge 4.14 *A robust and resilient transport infrastructure*).
- **Pluvial flooding:** The increase in more extreme downpours heightens the risk of pluvial flooding and rain-induced flooding. This regularly leads to flooded basements, crawl spaces and cellars, as well as material damage to the ground floor. Buildings all over the Netherlands are susceptible to damage due to pluvial flooding. In the west of the country, pluvial flooding can occur quickly because there is little space to collect water. In South Limburg, differences in elevation

make buildings vulnerable to a rapid rise in water levels in rivers and streams. Drought exacerbates the problem because water then drains away less effectively into the soil and flows more quickly to lower areas.

The ambition

New urban developments are resilient to the consequences of climate change and extreme weather events, now and in the future, enabling us to create a future-proof living environment and limit damage and costs.

By 'damage', we mean nuisance, inconvenience, impaired liveability and potential damage to the economy and public health.

We are working on this ambition and are making our cities, towns and villages resilient and robust enough to survive extreme weather conditions by incorporating climate adaptation properly from the start into the planning and development of new urban developments. A climate-adaptive design with more space for greenery and water offers many other benefits as well, such as an environment that improves social cohesion and physical and mental health. A climate-adaptive design at the local level of scale is therefore one of the building blocks of the Spatial Policy Document.

Text box 4.11.1 **Legal division of roles**

Climate-adaptive new developments are a joint responsibility of the central government, subnational authorities, the construction sector and private parties such as building owners, housing corporations and the financial sector. Everyone is expected to take measures within the scope of their own capabilities.

- **Central government:** The coordinating responsibility for climate adaptation in general lies with the Minister of Infrastructure and Water Management. The Minister of Housing and Spatial Planning is responsible for climate adaptation in the built environment and spatial planning.
- **Subnational authorities:** Subnational authorities are responsible for the regional and local implementation of climate adaptation. This is achieved through spatial policy, environmental plans, and the use of instruments such as stress tests.

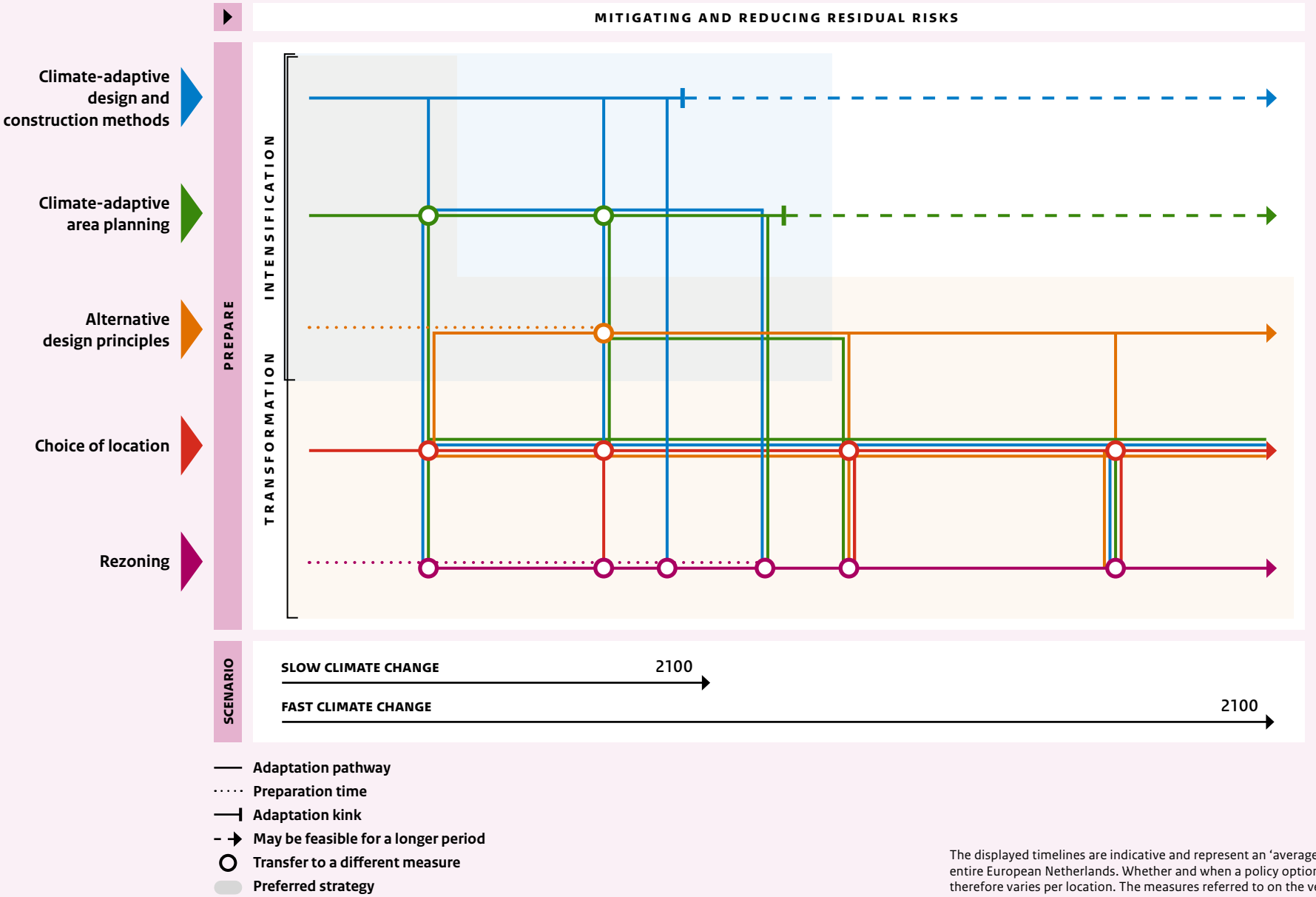
Relationship with other challenges facing society

There is a strong relationship between this challenge and the housebuilding challenge and the restoration of biodiversity. Accelerating the construction of sufficient and affordable housing continues to be a challenge, certainly in combination with other challenges facing society such as climate adaptation. Large-scale area development may take place at the expense of nature, but it also offers opportunities to restore biodiversity by creating space for green, climate-adaptive measures. In the case of new developments within the existing built environment through infill development or the addition of a small street, there is often less room for such measures, depending on the design. As a result, multi-purpose land use, where functions are combined and scarce space is used as efficiently as possible, is becoming increasingly important. Competition for space, both above and below ground, complicates the realisation of green climate-adaptive solutions. However, these measures do contribute to a pleasant and healthy living environment. Climate-adaptive new developments can increase the level of resilience to heat, pluvial flooding and drought in the existing environment. Furthermore, new developments must fulfil preconditions relating to nitrogen emissions, the Nature Restoration Regulation, water quality requirements in relation to the goals of the Water Framework Directive and drinking water supply, and a future-proof water and soil system.

This challenge is also affected by the energy and heat transition. In the context of the energy and heat transition, more attention must be paid to cooling buildings down in an environmentally friendly and energy-efficient manner (sustainable cooling). This will create synergy between achieving energy transition goals on the one hand and realising climate-adaptive new developments that address heat and drought issues on the other. In addition, new developments must fulfil preconditions relating to energy connections.

We must ensure that adapting to climate change is feasible (and affordable) for everyone. Climate change affects us all. Everyone wants an affordable, safe, pleasant and healthy living environment in which to live, work and interact. However, not everyone has the same opportunities to protect themselves against extreme weather. We must ensure that we develop new climate-adaptive residential areas with affordable and accessible housing and are therefore inclusive (see also challenge 4.12 *Climate-resilient housing for all*).

Figure 4.11.1 **Adaptation pathway map** for the challenge of climate-adaptive new developments



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

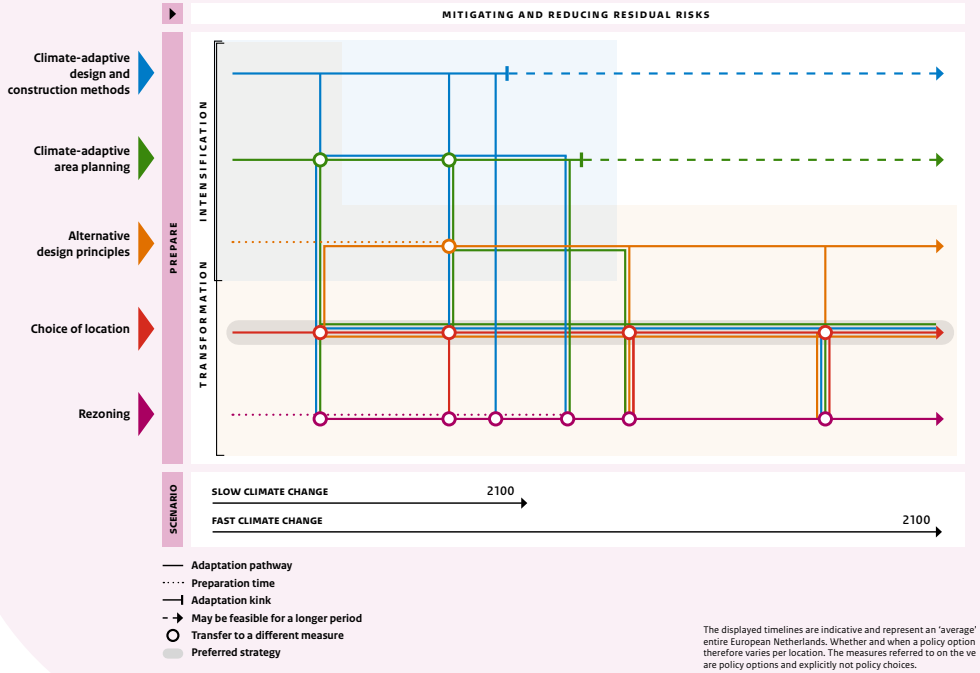
4.11.2 The options

The adaptation pathway map (Figure 4.11.1) shows pathways which are based on the intensification and transformation scenarios. These scenarios were devised by the Netherlands Environmental Assessment Agency, and they partially overlap. Each pathway consists of a combination of categories of adaptation measures (y-axis) plotted against a rapidly and less rapidly changing climate scenario (x-axis).

The grey bars in Figures 4.11.2 and 4.11.3 show two preferred strategies. Figure 4.11.2 shows the preferred strategy for large-scale area development. The choice of location is then the starting point. Area planning will help to make difficult locations available. Figure 4.11.3 shows the preferred strategy for infill development/adding a street. Area planning is the starting point here. The location is the guiding factor for the measures to be taken. We have provided a brief explanation of the categories of adaptation measures below. This explanation is followed by a discussion of the two scenarios, namely intensification and transformation.

Figure 4.11.2

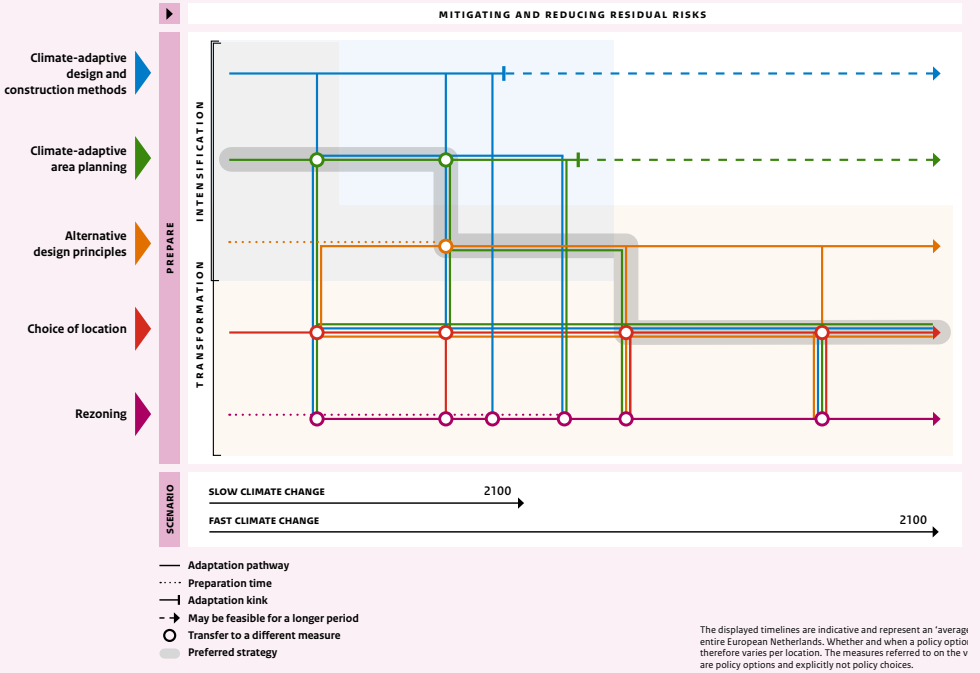
Adaptation pathway map Preferred strategy for large-scale area development



The displayed timelines are indicative and represent an 'average' entire European Netherlands. Whether and when a policy option therefore varies per location. The measures referred to on the ve are policy options and explicitly not policy choices.

Figure 4.11.3

Adaptation pathway map Preferred strategy for infill/an additional street



The displayed timelines are indicative and represent an 'averag entire European Netherlands. Whether and when a policy optio therefore varies per location. The measures referred to on the v are policy options and explicitly not policy choices.

Categories of adaptation measures:

1. **Climate-adaptive design and construction methods (blue line)**
   This category covers the integration of climate-adaptive measures into the design and the construction methods. These measures are intended to provide a solution for excess and insufficient water, heat, and soil subsidence. For example, they take account of the orientation and size of glass surfaces, or the use of water-resistant construction and finishing materials.

2. **Climate-adaptive area planning (green line)**
   This includes climate-adaptive measures for the (re)designing of existing or new street profiles or new neighbourhood layouts. This means that, based on the National Benchmark for the Green Climate-Adaptive Built Environment[1] (*Landelijke maatlat voor de groene klimaatadaptieve gebouwde omgeving*), an assessment is made of how a location can be designed to be climate-adaptive, for example, through the use of green, blue and grey measures[2] that better retain and infiltrate water, thereby increasing the soil's sponge effect. When it comes to heat, the focus is on cool spots and routes, plus sustainable cooling with green-blue structures, such as water and vegetation, combined with energy-efficient thermal energy storage.

3. **Alternative design principles (orange line)**
   This includes innovative solutions for climate-adaptive new developments. Alternative design principles offer, for example, the possibility of building now in areas designated as buffer or risk areas, which may need to be cleared after 2050. Building floating constructions on water is also a promising idea in many locations, for example in old harbour basins near urban areas. However, riverbeds are not suitable for this purpose.

4. **Choice of location (red line)**
   By choice of location, we mean determining where it is or is not sensible to build, based on the water and soil system. The characteristics of a location and the multifaceted challenges facing the location are key. This means that an assessment is made at an early stage using the Spatial Assessment Framework for the Climate-Adaptive Built Environment[3] to determine how to create connections to the water and soil system.

5. **Rezoning (purple line)**
   By rezoning we mean that, in some cases, an original decision to build a new development somewhere may need to be revised. This relates to areas where future-proofing cannot be guaranteed, despite a climate-adaptive approach to design, construction, or area planning. We cannot guarantee acceptable risk levels or costs in those areas. Rezoning may also be considered if the area is needed as a buffer location for large-scale climate-adaptive measures (for example, for *nature-based solutions*, such as a nature reserve for water storage capacity and a natural buffer against flooding, or for dyke reinforcement). It is therefore important to take account of the choice of location for new developments in plenty of time.

In order to fulfil the challenge of climate-adaptive new developments, a combination of choice of location and area planning is always the starting point. Aligning well with the natural water and soil system will mean less drastic measures are required, and long-term problems remain few and far between.

In the intensification scenario (blue area), the focus is on a climate-adaptive design and construction method and the area's layout, possibly supplemented by alternative design principles. The adaptation measures within this area would allow us to realise climate-adaptive new developments, as long as climate change remains within limits. The location is relevant, in addition to the 'how'. Further increasing climate change will increase the chance of this scenario proving to be inadequate. By focusing solely on a climate-adaptive area planning and design and construction method, we may then be unable to realise a future-proof living environment, or housing costs may rise to an unacceptable level.

1 Central government: *Landelijke maatlat – factsheets en overzichtstabel.* The Hague: Government of the Netherlands, 2023.
2 Green measures include adding vegetation (trees, parks, green roofs) to promote cooling and biodiversity. Blue measures focus on water management (water features, drainage and storage). Grey measures are the traditional, urban infrastructure (roads, buildings, sewage system).
3 Ministry of Infrastructure and Water Management and the Ministry of the Interior and Kingdom Relations. *Ruimtelijk afwegingskader klimaatadaptieve gebouwde omgeving.* The Hague: Government of the Netherlands, 2023.

In the case of the transformation scenario (orange area), the focus is on choice of location. This scenario is adequate even if the threat of climate change increases. Taking water and soil into account when designating areas for new developments makes it possible to build in the most suitable areas. The costs involved in climate-adaptive construction are lower as a result. This approach also increases the robustness of the living environment and prepares us more effectively for a future with far-reaching climate change (rapidly changing climate scenario).

The combination of a lack of space, an increasing number of construction plans, and other spatial challenges such as energy and nature requires innovative solutions that take water and soil into account. By using alternative design principles, such as demountable or relocatable construction, it is possible to build temporarily in areas that may later become hazardous or may be needed as buffer locations. Additionally, floating and amphibious construction forms (structures that can stand on the ground as well as float during high water) offer opportunities to build on or near water, and even in places where there is an increased risk of higher water levels.

If climate change continues to accelerate, there will be places where building becomes too risky or too expensive. Even after implementing climate-adaptive measures. In such cases, it is wiser to give the area a different function or not to build there at all.

Although both scenarios focus on limiting potential damage, we cannot completely rule out the possibility that a climate incident will affect new urban developments. It is therefore necessary, in the case of both intensification and transformation, to accommodate and reduce residual risks, in other words, the risks that continue to exist after implementing preventive and mitigating measures. This requires a coherent approach to risk education, contingency plans, communication on climate insurance and financial support for the most vulnerable households.

Matrix 4.11.1

Goal/Effort Matrix for the challenge of climate-adaptive new developments

Ambition

New urban developments are resilient to the consequences of climate change and extreme weather events, now and in the future, enabling us to create a future-proof living environment and limit damage and costs.

Measure	Climate-adaptive design and construction methods (building and private garden)	Climate-adaptive area planning	Alternative design principles	Choice of location
Improvement goal	New buildings and their plots are more resilient to the consequences of climate change and extreme weather events.	Areas are being designed to better cope with extreme weather events and limit damage.	Innovation is being used more frequently for complex issues or when existing solutions fall short.	Better considerations will be incorporated early on in the process regarding the careful selection of locations for urban developments, keeping in mind development and management costs and the water and soil systems, among other things.
SMART goal	Architects, developers, contractors and property owners know how to design and construct climate resilient buildings.	Subnational authorities and the construction sector know how to design areas to be climate resilient.	Climate-resilient measures are part of conceptual and industrial construction.	The Spatial Assessment Framework is a resource for the creation of new environment and planning visions (Spatial Policy Document (NOVI), provincial environment and planning visions (POVIs) and the subsequent municipal environment and planning visions (GOVIs).
Effort/result	→ The government is exploring what constitutes a minimum level of climate resilience (heat, flooding and water conservation) for buildings, which elements are suitable for inclusion in existing and new standards, and what measures are required to achieve it.	→ The government will facilitate municipalities and the construction sector with the National Benchmark and the Green in and around the City Guideline.	→ The government is exploring possibilities for making climate adaptation part of conceptual and industrial construction.	→ The government will facilitate provinces, municipalities and water authorities with the Spatial Assessment Framework.
	In line with the European Nature Restoration Regulation (Article 8), gardens are being designed to be more biodiverse and climate-resilient.	The National Benchmark is used to set national standards for climate-adaptive construction when structuring new urban development.	Subnational authorities and the construction sector are aware of developments in the field of alternative design principles and apply them.	In some cases, previous decisions to build new developments in certain locations will need to be reviewed. This applies to areas where futureproofing cannot be guaranteed, despite climate-adaptive design, construction or area planning. Or if the area is required as a buffer location for large-scale climate-adaptive measures (such as water storage or dyke reinforcement). In these cases, it will be necessary to rezone areas.
	→ The government will share knowledge about climate-resilient gardens and look into options for completing homes with (peat-free) garden soil as the default.	→ The government will amend the National Benchmark in line with the Housing Summit Agreements, explore which elements lend themselves to inclusion in existing and new standards, and in which way these agreements can be safeguarded.	→ The government will encourage innovation so that it becomes common practice and shares knowledge about alternative design principles (for buildings and areas).	→ The government will support subnational authorities with expertise in the process of rezoning a location.
		In line with the European Nature Restoration Regulation (Article 8) and the National Benchmark, outdoor space will be designed to be more biodiverse and climate resilient. Through 2030, there will be no reductions in urban green space and tree canopy coverage. Beyond 2030 there will be a rising trend.		
		→ The government will decide by the end of 2030 at the latest on a satisfactory level for urban green space and tree canopy coverage for Article 8 of the Nature Restoration Regulation.		

Matrix 4.11.2

Goal/Effort Matrix for the challenge of climate-adaptive new developments

Ambition	**New urban developments are resilient to the consequences of climate change and extreme weather events, now and in the future, enabling us to create a future-proof living environment and limit damage and costs.**			
Measure	**Integrated policy**			
Improvement goal	Climate adaptation policy will be addressed in a more integrated way. This involves collaboration between different policy fields and taking each other's interests into account (spatial planning, housing, water management, nature, health, liveability, spatial quality and the economy).			
SMART goal	Subnational authorities and the construction sector will understand what is required to achieve an integrated adaptation policy and are implementing it.	Subnational authorities, the construction sector, property owners, the financial sector and citizens will have a clear understanding of their own roles, responsibilities and options for taking measures. They will also have an awareness of potential risk scenarios.	The distribution of costs and benefits for taking climate-adaptive measures has improved, and stakeholders have more options for financing these measures.	Subnational authorities, the construction sector, property owners, the financial sector and citizens understand the importance of climate-adaptive new developments, know what the benefits are, and how they can work together.
Effort/result	→ Through the Spatial Policy Document, the government is committed to climate-resilient development across the Netherlands. → The government is supporting subnational authorities and the construction sector with a guide to ensure that new urban development is based on the area's multiple challenges, using an area-based and integrated approach. → The government will actively promote land use policy that enables control over land allocation conditions. This includes things like integrated adaptive climate policy.	→ The government will communicate with the involved parties regarding their own roles, responsibilities and options for taking measures. → The government will support stakeholders with information on potential risk scenarios. → The government is exploring opportunities and barriers to implementing climate-resilient recovery (building back better) following a climate incident.	→ The government will support stakeholders with information on costs, benefits and financing options.	→ The government is drawing up a communication plan focused on a narrative that resonates with stakeholder experiences. This plan clarifies the government's commitment and what parties and citizens can do themselves.

We first focus on a number of preconditions necessary for the challenge to succeed:

- *Provide clarity about the roles, tasks, and responsibilities* (for public authorities, the construction sector, property owners, financial institutions and the public). This creates a solid foundation for a joint effort and prevents inefficiency.
- *Increase insight into the challenge and approach.* Collecting and sharing information about the challenge and updating and sharing required data helps to raise awareness, provides a course of action and facilitates benchmarking.
- *Continue to develop existing framework-setting instruments.* The continued development of instruments such as the Spatial Assessment Framework for choice of location and the National Benchmark for area planning ensures that parties can make good use of them.
- *Expand financial arrangements.* Providing clarity on the distribution of costs and benefits and the expansion of financing options encourage the use of climate-adaptive solutions.
- *Pursue an active land policy.* Municipalities can manage the realisation of climate-resilient area development through active land policy, subject to the allocation conditions.
- *Make system choices at Delta level.* The space that will eventually be needed for interventions must already be taken into account when redesigning the Netherlands and selecting future housing locations. Climate adaptation is therefore included in the Spatial Policy Document.

We will also start implementing a number of extra actions within the five themes that align with the categories of measures from the adaptation pathway map:

1. **Climate-adaptive design and construction methods (building and private garden)**
   New buildings and their gardens will become more resilient to the consequences of climate change. To this end, we are investigating what the minimum level of climate resilience for buildings should be, for example in the form of a review of the risk of overheating and ways to deal with both a water surplus and shortage. We are also sharing knowledge about climate-resilient gardens, and we are exploring the possibilities of delivering homes with (peat-free) garden soil.

2. **Climate-adaptive area planning**
   Areas are being better designed to cope with extreme weather events and limit damage. We are supporting subnational authorities and the construction sector with the National Benchmark for the Green Climate-Adaptive Built Environment and the Green in and Around the City guideline. We are adjusting the benchmark in line with the Housing Summit Agreements. By the end of 2030 at the latest, we will determine the satisfactory level for urban green surface area and tree canopy cover in accordance with the European Nature Restoration Regulation.

3. **Alternative design principles**
   Innovation is being used more frequently for complex issues or when existing solutions fall short. We are encouraging innovation, and we are making sure that this becomes normalised, among other things by collaborating with public and private parties, sharing knowledge, and investing in research projects.

4. **Choice of location**
   A careful selection of locations for urban developments can be made. We are facilitating this using the Spatial Assessment Framework for a Climate-Adaptive Built Environment. When doing so, we are taking account of development and management costs, as well as the water and soil systems. The (temporary) rezoning of a location is sometimes unavoidable. This can have a significant impact and must therefore be done on the basis of careful consideration. We are supporting subnational authorities with knowledge they need to substantiate the necessity and suitability of rezoning.

5. **Integrated policy**
   Climate adaptation policy is being addressed in a more integrated manner through collaboration between policy fields. Examples include policy fields such as spatial planning, housing, water management, nature, health, liveability, spatial quality and the economy. The idea is to promote an area-based approach in which climate adaptation is part of new urban developments. We are supporting subnational authorities and the construction sector in this regard by providing them with a guideline. We are also strengthening communication with a view to involving the public and businesses and informing them about potential risks. Finally, we are exploring opportunities for climate-resilient recovery following climate incidents, where new urban developments must be robust.

6. **Given that not all the risks of climate change and extreme weather can be completely eradicated, attention must always be paid to mitigating and reducing residual risks.** Once again, it is important to increase insight and provide a scope of action. To this end, we are offering targeted communication and support by sharing knowledge and developing useful products.

We regard climate-adaptive new developments as a joint undertaking in which everyone has a responsibility to take measures within the scope of their own capabilities. When elaborating the themes, we therefore involve the Central Government Real Estate Agency, the subnational authorities, the construction sector, housing corporations, the financial sector, knowledge institutions and civil society organisations, among others. We describe how we are going to perform the necessary work in the NAS Built Environment Implementation Programme (*Uitvoeringsprogramma NAS gebouwde omgeving*).

4.11.4 The consequences of the approach

The intensifying measures for design and construction method and area planning are less drastic and help reduce the consequences of limited climate change on the built environment. Measures aimed at the design of buildings effectively reduce the effects of climate change. The same applies to measures that help improve water retention in the built environment and to solutions for drought, soil subsidence and heat. These measures take up little space and are easy to integrate. According to the strategic environmental impact report, they therefore have no or a limited effect on *people, planet* and *prosperity*.[4] Intensification is enough in case of a limited degree of climate change but does not guarantee a living environment that is also future-proof in the long term. According to the social impact assessment, a living environment that is not future-proof can lead to increased stress, health risks, inequality and financial pressure.[5]

The transformative measures of choice of location and rezoning offer greater certainty for a climate-adaptive built environment in the long term. However, these measures, particularly rezoning, are drastic and therefore require careful consideration. The speed of climate change determines the importance of these measures for a future-oriented approach. According to the strategic environmental impact report, these choices have major consequences for *people* and *prosperity*, and also indirectly for *planet*. Choosing new development locations based on the water and soil system is beneficial for natural ecosystems but can also mean that there is less space for other functions. Rezoning building locations can lead to fewer homes in the short term and increased pressure on housing elsewhere. Despite the housing shortage, young people are often reluctant to support rezoning and prefer not to see construction take place in areas which are at risk of flooding.

As the government, it is our job to focus our policy for climate-adaptive new developments on integrating climate adaptation into new urban developments at an early stage. Doing so will mean that potential climate risks are taken into account from the very beginning of the planning process, and that unnecessary delays and additional costs will be avoided.

4 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Movares: Utrecht, 2026.
5 KIN. *De sociale effecten van klimaatadaptatie.* Amsterdam: Dutch Climate Research Initiative, 2026.

The preference is for a strategic approach at the neighbourhood or area level, with multiple land use enabling us to address several challenges simultaneously. The limited available space in the Netherlands makes climate-adaptive new developments complex and also requires innovative, integrated solutions. Climate-adaptive new developments are closely linked to other challenges facing society, such as housing, the energy transition and the restoration of biodiversity. Limited budgets, time, capacity and space may make it necessary to prioritise the implementation of measures. In addition, the design and construction of new developments must also take account of the value and preservation of any existing cultural heritage.

This challenge overlaps with other NAS challenges. There is a clear connection, for example, between this challenge and challenge 4.12 *Climate-resilient housing for all.* If we approach the challenge of climate-adaptive new developments correctly, we will avoid the situation in which current new developments lead to a larger challenge of making the existing housing stock and immediate surroundings climate-resilient. This could encourage us to take up the challenge and also improve the quality of life in the surrounding existing area. The layout, design, and construction method of new urban developments also has a bearing on the fulfilment of other challenges, such as challenge 4.2 *Robustness and resilience against flooding caused by extreme rainfall and the national approach to water resilience to pluvial flooding*, challenge 4.8 *Heat-resilient cities, towns and villages*, challenge 4.9 *Staying healthy in times of climate change*, challenge 4.10 *Properly protected cultural heritage*, and 4.13 *Future-proof workplaces*. The choice of location for new urban developments is strongly related to challenges 4.1 *Properly protected against flooding*, 4.4 *Safe and healthy water quality*, 4.5 *Climate-resilient agriculture*, 4.6 *Resilient nature* and 4.10 *Properly-protected cultural heritage*.

Challenge 4.12 Climate-resilient housing for all

Homes in Pathmos after extreme rainstorm
(Photo by Reinier van Willigen)

"In Enschede, on 21 July 2024, we were caught off guard by an extreme rainstorm that had major consequences for our residents and for our homes. As a housing corporation, this demonstrated to us that climate change is not an issue of the distant future, but something we need to tackle today. It calls for proactive and integrated cooperation with the municipality. Together, we are looking at how we can reduce the risk for our residents in the future. It will take years before people can live in the affected area again."

Gabriël Kaplan
Managing Director of housing corporation *De Woonplaats*

4.12.1 The challenge

Climate change and extreme weather events can have a major social and economic impact on the existing housing stock. This impact is expected to increase. It could mean real estate declining in value, (potential) homeowners losing creditworthiness, decreasing and more expensive home insurance, and high repair costs following climate-related damage. The impact could even lead to people losing their homes, as we witnessed in the Pathmos neighbourhood in Enschede following the extreme rainstorm of July 2024. On top of that come the social and health related costs.

Our focus in respect to this challenge is on the consequences of climate change and extreme weather events for homes and the immediate surroundings. This chapter does not include any elaboration of the challenge for buildings which have not been designated as residential. That aspect of the challenge will be addressed in a subsequent phase when the NAS for the built environment is developed in more detail. The impact of climate change on our homes is already noticeable. Pluvial flooding, heat and drought, in particular, cause damage to homes and the immediate surroundings:

- **Pluvial flooding**: Pluvial flooding is caused by an increase in extreme downpours and rain-induced floods. This can lead to damage to homes and household contents (see challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall*). In combination with high groundwater levels, this can also lead to (an increase in) water in crawl spaces and mould in buildings. That, in turn, can have consequences for residents' health.

- **Heat**: The increase in extreme temperatures and prolonged heatwaves can lead to higher temperatures in and around homes, resulting in increased heat stress, health issues and excess mortality (see challenge 4.8 *Heat-resilient cities, towns and villages*).

- **Drought:** Drought causes soil and groundwater levels to fall, and that exacerbates foundation problems. It also affects the way listed buildings are cared for (see challenge 4.11 *Properly protected cultural heritage*). Drought also affects urban infrastructure, as various elements suffer disproportionate subsidence (uneven settlement). That can lead to breaks in underground cables, (drinking water) pipes, and the sewage system (see challenge 4.15 *Climate-resilient energy, telecom and drinking water infrastructure*).

Some groups in society are more vulnerable to the effects of climate change than others. Their scopes of action also differ. This is due to inequality in factors such as socioeconomic position, age, health, language and knowledge gaps, access to resources, and housing quality and ownership. People in vulnerable positions with limited skills and limited resources find it difficult to respond to climate change and extreme weather events, and to recover after a climate event. This is despite the fact that people in a vulnerable socioeconomic position live relatively frequently in neighbourhoods and homes that are poorly adapted to the changing climate. Furthermore, they do not always have control over their situations, for example if they live in rented accommodation. Although the risks of climate damage vary per neighbourhood, people in vulnerable positions can be found all over the Netherlands.[1]

A climate event also has a completely different impact on people who are insured and those who are less well insured. Some types of damage cannot be insured at all (such as foundation damage or water damage following the breaching of a primary flood defence). There is little that the most vulnerable and unresourced groups of people can do in such instances. They are less well informed about the steps they can take or do not have the means to do so.

The ambition

Existing homes and the immediate surroundings are resilient to the consequences of climate change and extreme weather events. If we can achieve this, we will be able to limit the damage to a level which is acceptable for everyone.

By 'immediate surroundings', we mean private space (garden, yard, plot) and public space in a residential area. 'Damage' includes nuisance, inconvenience, impairment of liveability and potential economic and health damage. We are still working out what constitutes an 'acceptable' level. This also requires public debate and political consideration to determine how great a cost (to society) we are able and willing to incur in order to mitigate which risks, based on the understanding that it is impossible to prevent damage completely. In this cost-benefit analysis, it is important to take the long-term impact into account. After all, the costs of future investments will increase if we postpone them now. By 'for everyone' we mean that, when elaborating on this challenge, we have paid explicit attention to people in vulnerable areas and situations.

1 Stichting CAS. *Klimaateffecten, gender en inequality*. Bussum: Stichting CAS, 2026.

Interfaces with other challenges

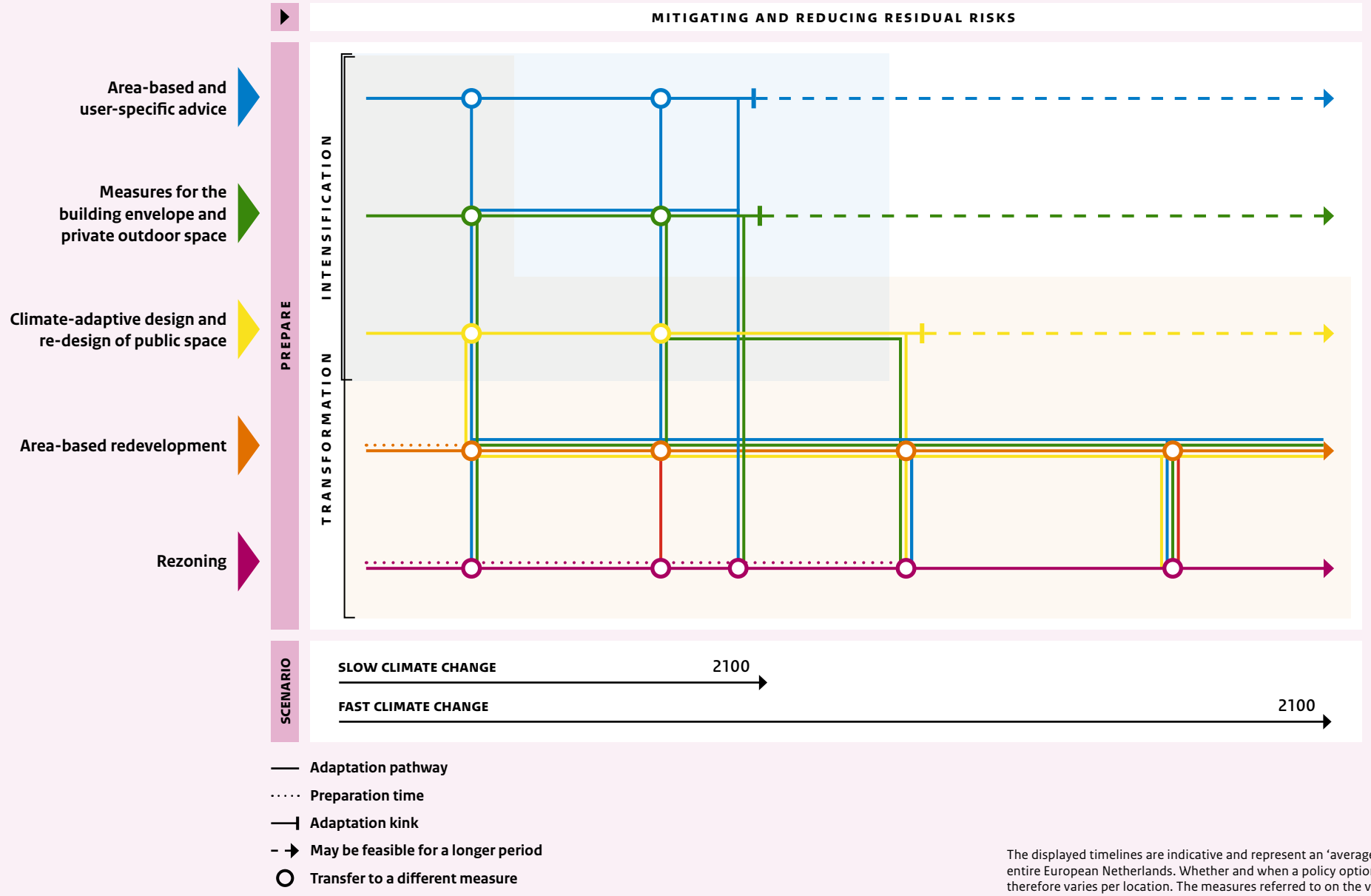
The approach to foundations is strongly related to this challenge. This challenge does not include any elaboration of the approach to tackle damage to foundations. That is addressed in the National Foundations Action Plan (*Nationale Aanpak Funderingen*)[2] which is aimed at tackling foundation issues over the long term, and thereby at improving the quality of the existing housing stock and making better use of it. The focus on climate adaptation and tackling foundation issues reinforce each other, both in scope and intensity. You cannot solve the first problem without also dealing with the other. For example, the risk of subsidence affecting land and the homes built on it is increasing due to drought. During heavy rain fall, these homes are subsequently hit particularly hard by pluvial flooding caused by incoming rainwater and elevated groundwater levels.

This challenge is also affected by the housebuilding challenge. *The Climate-adaptive new developments challenge* is detailed in 4.11. In addition, the housebuilding challenge is largely, though not entirely, realised within the existing built environment by making better use of the available space in towns and cities, for example by building more homes on existing locations (inner-city densification). This often goes hand in hand with urban transformation, meaning that existing buildings and/or areas are given a new function.

In the case of transformation, the multiple challenges are viewed in an integrated and area-oriented manner. Tackling foundation issues and the heat transition are important challenges to keep in mind in this context. They also require large-scale interventions in the areas concerned. On the one hand, this competition for space within the existing built environment makes it more difficult to find the necessary space above and below ground to add climate-adaptive elements (such as water storage or planting extra trees and vegetation). At the same time, transformation also offers opportunities, for example to add more greenery to public spaces, roofs and facades. As well as providing shade, cooling the environment and collecting rainwater, green spaces also offer other significant benefits, such as promoting biodiversity and mental health, encouraging physical activity and recreation, and strengthening social cohesion. One point of concern is that transformation and urban renewal in existing neighbourhoods can lead to increases in real estate prices and housing costs. This, in turn, can result in the displacement of current residents to less liveable and climate-resilient parts of the city, with the consequence being a weakening in neighbourhood social cohesion.

2 Central government: 'Kabinet start met meerjarenaanpak voor funderingsproblematiek'. *Rijksoverheid.nl*, 10 July 2025.

Figure 4.12.1 **Adaptation pathway map** for the challenge of climate-resilient housing for all



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.12.2 The options

This adaptation pathway map (Figure 4.12.1) shows pathways aimed at 'intensification' and 'transformation'. Each pathway consists of a combination of categories of adaptation measures (y-axis) which we plot against a rapidly and a less rapidly changing climate scenario (x-axis).

The focus under 'intensification' (blue block) lies on further developing and optimising current land use. The adaptation measures within this block enable us largely to realise the *Climate-resilient housing for all challenge*, provided that climate change remains limited.

1. **Area-based and user-specific advice (blue line)**
   This means making residents and homeowners in specific areas aware of the potential effects of extreme weather on their homes and immediate surroundings and advising them on possible measures they can take to reduce potential damage, and on how they can act when confronted with a climate event.

2. **Measures for the building envelope and private outdoor space (green line)**
   Residents and homeowners carry out small-scale climate adaptation measures on the floors, walls, windows, doors and roof of their home (building envelope) and the private outdoor space (garden, yard, or plot).

3. **Climate-adaptive (re)design of public space (yellow line)**
   This means taking climate-adaptive measures when streets are (re)designed or when new neighbourhood layouts are devised in cities, towns or villages. This involves green (preferably), blue, and grey measures[3] in public space that allow (rain)water to be retained and infiltrated more effectively. These measures increase the soil's sponge effect. It also involves measures that provide shade and allow evaporation in order to limit the effects of heat.

It is also necessary to focus on the measures under 'transformation' (orange block), starting right now and even more so as climate change intensifies. These measures need to be taken if the individual climate adaptation measures mentioned under 'intensification' are no longer proportionate for the multifaceted challenge that an area faces, for example when housing costs rise to an unacceptable level. Such costs include, among others, water authority tax, sewage charges, drinking water charges, insurance premiums and utility costs like energy and water bills. Another such situation would be when insurance cover is no longer available. The way we manage the land will need to be adapted to changing circumstances. This sometimes also requires adjustments to existing land-use practices or business operations. The adaptation pathway map distinguishes two categories of adaptation measures in this regard:

4. **Area-based redevelopment (orange line)**
   This area process identifies which other challenges exist in an area, alongside climate resilience. This means both physical and social challenges (such as foundations, energy transition, cultural heritage, socioeconomic challenges and health). The aim of the area process is to reach agreement with all stakeholders on the challenge to be resolved, the shared ambition and the process to be followed. The potential of the water and soil system must be taken into account when assessing the opportunities and obstacles presented in a particular area. This is how we can best integrate climate adaptation into the process.

5. **Rezoning (purple line):**
   Rezoning means that an area with a residential function is designated for a different form of land use. This may be necessary when an area's residential function can no longer be guaranteed with acceptable risk levels. In that case, rezoning is the only future-proof, feasible and profitable approach for the multifaceted challenge in that area. We only resort to this drastic measure in extreme cases, when all other options have failed. This situation may arise as part of a plan and therefore as the outcome of a carefully conducted area process. However, rezoning can also be an unforeseen and undesirable consequence of a climate event. In both cases, rezoning is a measure with a high impact and one which represents a huge financial challenge. It requires a careful process with sufficient attention being paid to all parties involved.

3 Green measures include adding vegetation (trees, parks, green roofs) to promote cooling and biodiversity. Blue measures focus on water management (water features, drainage and storage). Grey measures are the traditional, urban infrastructure (roads, buildings, sewage system).

The categories of adaptation measures referred to reduce the likelihood of damage and nuisance as a result of climate change and extreme weather events. However, it is impossible to eliminate all risks completely. We refer to the remaining risk as the 'residual risk' and it is and continues to be relevant to try and mitigate or reduce this residual risk for private individuals wherever possible. This is shown in the adaptation pathway map by the 'Mitigating and reducing residual risks' bar at the top. Associated measures consist of a combination of risk education, contingency plans, insurance against climate risks, and financial support/subsidies for the most vulnerable households.

4.12.3 The approach

In the approach to resolving the challenge of *Climate-resilient housing for all* we have specified the ambition as three main goals:

- Existing homes and the immediate surroundings (private/public space) suffer less damage from climate change and extreme weather events.
- Climate damage to existing homes and the immediate surroundings (private/public space) is repaired more effectively, or redevelopment is undertaken.
- Additional attention is paid to people in vulnerable positions and areas when it comes to preventing and repairing climate damage to their homes.

We have translated these main goals into subgoals and corresponding efforts per category of adaptation measures. In line with the adaptation pathway map, we distinguish between measures aimed at 'intensification ' and 'transformation'. We are also paying attention to 'mitigating and reducing residual risks'. All the goals and efforts referred to complement one another, and the government is responsible for ensuring that this is the case. Where relevant, we involve, among others, subnational authorities, housing corporations, property owners, the financial sector, knowledge institutions and civil society organisations. After all, climate-resilient housing for all is a joint undertaking, and all the parties involved have the duty to commit to this within the scope of their own capabilities.

Before we explain the approach in more detail, it is important to reflect on the five preconditions necessary for the successful fulfilment of the challenge. These are:

1. Clearly formulated and assigned roles, tasks and responsibilities. This provides a solid basis for joint initiatives by, for example, authorities, financial institutions, homeowners and residents.
2. Insight into the challenge and the required approach. Our focus is on collecting additional data and information and making it accessible. This increases awareness and helps define a scope of action and enables benchmarking.
3. Existing instruments which can be easily used by subnational authorities and which support them with helping people in different socioeconomic situations.
4. Good financial arrangements and safety nets. This encourages solutions for climate adaptation in area processes.
5. An inclusive approach when it comes to designing measures, area development processes and decision-making.

Intensification

Matrix 4.12.1 shows the goals and efforts for 'area-based and user-specific advice', 'measures relating to the building envelope and private outdoor space', and the 'climate-adaptive (re)organisation of public space'. In the case of all three, we start by increasing the level of insight into the challenge. For example, we investigate which groups of residents and areas are (particularly) vulnerable to climate change and extreme weather events, how we can determine whether a home is climate-resilient, and what we consider to be an acceptable level of damage. We also strive to increase awareness and scopes of action among residents and homeowners regarding the potential impact of climate change and extreme weather on their housing(stock). We also explore financing options to make homes climate-resilient in collaboration with the financial sector. Finally, we support subnational authorities with the climate- and water-resilient design of public space. In the process, we align with the efforts from challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall,* the National approach to water-conscious action in the event of pluvial water flooding (*Landelijke aanpak waterbewust handelen bij wateroverlast*), challenge 4.8 *Heat-Resilient cities, towns and villages*, and the long-term National Foundations Action Plan.

Matrix 4.12.1

Goal/Effort Matrix for the 'intensification' category of the challenge climate-resilient housing for all

Ambition

Existing homes and the immediate surroundings are better able to withstand the effects of climate change and extreme weather events. In this way, we limit damage to an acceptable level for everyone.

Improvement goal

- Existing homes and the immediate surroundings (private/public space) will suffer less damage from climate change and extreme weather events.
- Climate damage to existing homes and the immediate surroundings (private/public space) is repaired more effectively or redevelopment takes place.
- Special attention is being paid to people in vulnerable positions and areas when it comes to preventing and repairing climate-related damage to their homes.

	Area-based and user-specific advice.	**Measures for the building envelope and private outdoor space.**	**Climate-adaptive design and re-design of public space.**
SMART goal	We have an understanding of which people and categories of people are vulnerable to climate change and extreme weather events and where (which neighbourhood/district/area) they live.	We have an understanding of what constitutes an acceptable level of climate resilience for a home and of the vulnerability of homes.	We have an understanding of the baseline requirements for climate resilient residential areas.
Effort/result	→ The government will study which people and places are vulnerable to extreme weather.	→ The government is investigating how to determine what constitutes an acceptable level of climate resilience for a home and its associated outdoor space (including an acceptable degree of nuisance). → The government is exploring what data is required to determine the vulnerability of homes and their associated outdoor spaces.	→ The government is making the National Benchmark for a green, climate-adaptive built environment applicable to the existing built environment through the revision of the 'Green in and around the City' (GIOS) Guideline. The principles of the Benchmark for the 'neighbourhood' scale are already included in the current guideline (new construction and existing buildings). The update of the 'Green in and around the City Guideline' will also incorporate the principles of the Benchmark for the other scale levels. The main focus is on 'building/plot'.
	Residents and other stakeholders know what climate-resilient living means locally and for themselves, understand their own role and responsibilities, and have a clear scope of action, both before, during and after a climate-related incident.	Property owners have an understanding of the climate resilience of their homes (or housing stock), and how they can better prevent damage caused by climate change and extreme weather events.	By 2050, the Netherlands will be designed to be climate-resilient and water-robust, based on the four climate risks: waterlogging, drought, heat stress, and mitigating the consequences of floods (DPRA).
	→ The government supports subnational authorities with knowledge to inform residents about local risks and their own roles and responsibilities, and to provide a clear scope of action, with particular attention to residents in vulnerable areas and situations.	→ The government has developed a tool based on the Framework for Climate Adaptive Buildings (FCAP building score) to provide housing corporations with insight into the climate resilience of their housing stock. The first 50 housing corporations have started using it. The government is also facilitating the use of the FCAP by other property owners (including other housing corporations and the financial sector) to assess climate risk.	→ Municipalities, provinces, water authorities and government are working together within the Delta Programme for Spatial Adaptation (DPRA) to achieve a climate- and water-resilient design of public space.
		There is clarity regarding the financing options for making homes climate resilient.	There is clarity regarding the financing options for designing public space in a climate and water resilient way.
		→ The government and the financial sector: • are exploring the costs and benefits, as well as public-private financing options, for making homes climate-resilient; • are exploring new financial and legal solutions to address gaps (alongside other challenges such as foundations and sustainability); • are focusing on clarifying roles, tasks and responsibilities.	→ Parties collaborating within the DPRA are investigating opportunities for public-private financing to make public space climate resilient, including the ideal distribution between measures in public space versus on private land and exploring new financial solutions where gaps exist.
		Property owners will improve the climate resilience of their homes (or housing stock) while still taking residents' interests into account.	Public space is being greened in line with the European Nature Restoration Regulation (Article 8) and thus designed to be more climate-resilient.
		→ The government is committed to embedding climate adaptation in the National Performance Agreements. → The government is exploring how residents and property owners can be encouraged to improve the climate resilience of their homes (housing stock) and outdoor spaces.	→ In the 'Green in and around the City' (GIOS) Guideline, government has set out standards with scope for local adaptation to support subnational authorities in managing green and green-blue structures qualitatively and quantitatively at various scale levels.
		In line with the European Nature Restoration Regulation (Article 8), gardens and plots are being designed to be more biodiverse and climate resilient.	The interests of residents and property owners are taken into account in the design and decision-making processes regarding making public space in residential areas climate resilient.
		→ The government is contributing to the development of initiatives to help residents design their gardens to be climate resilient and biodiverse (Green Coalition 'A greener Netherlands starts in your own garden'). → The government provides guidance on greening private land owned by homeowners' associations, housing corporations and private parties via the 'Green in and around the City' (GIOS) guideline, which is due to be updated.	→ The Environment and Planning Act stipulates that subnational authorities must adopt a participatory approach to involve residents and owners in planning and decision-making. We are exploring whether, in the interests of fairness, extra attention should be paid to vulnerable residents in this context.

Transformation

Matrix 4.12.2 shows the goals and measures for the categories of adaptation measures aimed at transformation ('area-based redevelopment' and 'rezoning'). We explore how climate adaptation can become an integral part of the transformation of existing residential areas with multiple challenges on both physical and social levels. This is done via an area-based approach, usually by the municipality, together with other relevant stakeholders. The composition varies per area and challenge. An area-based approach roughly looks like the following: It starts with an analysis of the challenges and opportunities in the area. This not only means climate adaptation but also, for example, the foundation challenge, the energy transition, cultural heritage, socioeconomic challenges and health. Stress tests are used to provide an insight into the area's vulnerability to climate change and extreme weather events. This vulnerability, in other words to what extent is this picture recognisable or visible in the area, is discussed with stakeholders during the area process. This dialogue helps identify the challenges present in the area. The ambition for the area can be jointly determined as soon as agreement is reached on the overall challenge. It is important that all stakeholders feel seen and heard and contribute to the chosen solution. That solution may be aimed at improving the current situation (intensification). Alternatively, a decision may be taken to transform the area. The question then arises of how we should navigate between a socially desirable solution and the financial bottlenecks that are now becoming clearer. An intermediate step could be to work towards the redevelopment of the entire area in phases, taking each block of houses in turn.

An area-based process like this represents a very complex puzzle with regard to which we all still have much to learn. That is why our aim with this process is to align with the area-based learning approach being developed within the framework of the National Foundations Action Plan. Six areas have been selected across the country for this purpose. A number of these coincide with those from the National Programme for Liveability and Security. This learning approach is intended to lead to a better understanding of what does and does not work, process supervision (how to involve people, how to motivate parties), the identification of obstacles and opportunities (technical, legal, and financial), and the development of new financial arrangements.

In extreme cases, the conclusion may be that we need to rezone areas. The area would then acquire a different form of land use instead of a residential function. This conclusion may be the result of a carefully conducted area-based process, but it may also be the unforeseen and undesirable consequence of a climate event. In both cases, this would involve a very far-reaching decision which goes hand-in-hand with a huge financial challenge and may lead to social inequality and resistance from residents. We therefore only resort to this if all other measures have failed. Such situations can already occur as demonstrated when approximately 60 homes in Enschede were declared uninhabitable following an extreme rainstorm in July 2024. The likelihood of such events is expected to increase with further climate change.

It is therefore important that we prepare for this possibility thoroughly and in good time. We are therefore learning from experiences in areas that are highly vulnerable to extreme weather events (such as Enschede). We are jointly exploring what practical lessons we can learn about the futureproofing of functions (housing) and what the possible options might be (including rezoning as a last resort). Based on these practical examples, we are developing guidelines or a guide on how to deal with similar situations or tasks. We are identifying where this might be necessary and are carrying out an impact assessment with the stakeholders.

Matrix 4.12.2

Goal/Effort Matrix for the 'transformation' category of the challenge climate-resilient housing for all

Ambition

Existing homes and the immediate surroundings are better able to withstand the effects of climate change and extreme weather events. In this way, we limit damage to an acceptable level for everyone.

Improvement goal

- Existing homes and the immediate surroundings (private/public space) will suffer less damage from climate change and extreme weather events.
- Climate damage to existing homes and the immediate surroundings (private/public space) is repaired more effectively or redevelopment takes place.
- Special attention is being paid to people in vulnerable positions and areas when it comes to preventing and repairing climate-related damage to their homes.

	Area-based redevelopment	Rezoning
SMART goal	When redeveloping a location, an area-based approach is adopted, in which climate adaptation forms part of the location's multiple challenges. The interests of residents and property owners are taken into account in the design and decision-making process.	An area with a residential function will be designated for a different form of land use if this is the only future-proof, feasible and cost-effective approach for the multifaceted challenge in that area. We will prepare for this possibility in a timely and thorough manner.
Effort/result	→ The government supports an area-based learning approach from the National Foundations Action Plan. In this learning approach, we work in practice and together with all stakeholders to identify ways of effectively resolving multiple challenges (including foundations, climate adaptation and social challenges) within an area. The lessons learnt will be collected and shared.	→ The government is collaborating with areas that are highly vulnerable to climate change and extreme weather events (such as Enschede) to explore what practical lessons we can learn about the futureproofing of functions (housing) and what the possible options might be (including rezoning as a last resort). → Based on practical examples, the government is developing guidelines or a guide on how to deal with similar locations or similar challenges. We are identifying where this might be necessary and are carrying out an impact assessment with the stakeholders.

Residual risk

Finally, it is important to maintain a constant focus on mitigating and reducing the residual risk of damage due to climate change and extreme weather events. Matrix 4.12.3 shows the corresponding goals and efforts. This focus on residual risks will take place in parallel to all other adaptation pathways. In cooperation with the financial sector and subnational authorities, we are committed to conducting feasibility studies and product development, establishing procedural agreements on recovery, and to providing targeted communication and information tailored to specific needs. In doing so, we align with challenge 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall*, the National approach to water-conscious action in the event of pluvial flooding and the National Foundations Action Plan.

Matrix 4.12.3

Goal/Effort Matrix for the 'mitigating and reducing residual risk' category of the challenge climate-resilient housing for all

Ambition	**Existing homes and the immediate surroundings are better able to withstand the effects of climate change and extreme weather events. In this way, we limit damage to an acceptable level for everyone.**
Improvement goal	• Existing homes and the immediate surroundings (private/public space) will suffer less damage from climate change and extreme weather events. • Climate damage to existing homes and the immediate surroundings (private/public space) is repaired more effectively or redevelopment takes place. • Special attention is being paid to people in vulnerable positions and areas when it comes to preventing and repairing climate-related damage to their homes.
SMART goal	We have an understanding of the residual risks to homes and the immediate surroundings following a climate incident.
	→ The government is assessing whether, in collaboration with the financial sector, a residual risk assessment can be carried out for homes and the immediate surroundings.
Effort/result	We have an understanding of the insurability of damage to homes and the immediate surroundings due to climate risk.
	→ The government is partnering with the financial sector to look into the insurability of damage to homes and the immediate surroundings due to climate risk.
	Residents and property owners in vulnerable positions and areas have been informed about the possibilities and limitations of insuring their homes against damage caused by climate incidents and residual risks and have a clear scope of action.
	→ The government, in collaboration with the financial sector and subnational authorities, is exploring how residents and property owners can be informed about the possibilities and limitations of insuring their homes against damage caused by climate-related incidents and residual risks, and how a practical scope of action can be provided.
	We have an understanding of the insurability of damage to homes and the immediate surroundings due to climate risk.
	→ The government is partnering with the financial sector to explore: • financing options for better repair of damage to homes and their immediate surroundings (private and public) following a climate-related incident (excluding surface water flooding); • new financial solutions (to address gaps); • options for financial support for the most vulnerable households.
	We have procedural agreements in place for dealing with the repair of damage to homes and the immediate surroundings following a climate incident, including residual risks and follow up.
	→ The government is exploring how to procedurally handle damage repair to homes and their immediate surroundings following a climate incident, with a focus on residual risks and follow up, and clarifying roles, tasks and responsibilities.
	We are exploring options for ensuring climate-resilient recovery following a climate incident.
	→ The government is investigating opportunities and barriers to the application of climate-resilient recovery.

4.12.4 The consequences of The approach

The strategic environmental impact report[4] and the social-impact assessment[5] conducted within the framework of the NAS shows that making homes climate-resilient and designing streets and neighbourhoods to be climate-resilient is important and has a positive impact on residential areas. This is an approach that involves working directly with residents and stakeholders leads to greater engagement, support and social cohesion. More social cohesion also contributes to a faster recovery following a climate-related event.

In the case of existing residential areas that are facing multiple challenges on both a physical and social level, an area-focused and inclusive approach offers opportunities to improve the living environment. However, in extreme cases, it may transpire that the residential function of an area can no longer be guaranteed at acceptable risk levels. In such instances, rezoning the residential use to another form of land use is the only future-proof, feasible and cost-effective approach to tackle the multifaceted challenge in that area. This would involve a very far-reaching decision which goes hand in hand with a huge financial challenge. In the longer term, area-based redevelopment results in a flexible, robust and resilient system in which our living environment is better designed and able to withstand climate change and extreme weather events.

4 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Movares: Utrecht, 2026.
5 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.

Challenge 4.13 Future-proof workplaces

Industrial estate Chemelot in Geleen-Sittard
(Photo: Flying Holland, John Grundlach)

"Cooling water from the Maas is indispensable for cooling numerous production processes at the Chemelot industrial park. Climate change is causing prolonged droughts and warmer water in the river Maas. The occasional result is insufficient (cooling) water, with businesses not always being allowed to discharge used water because otherwise the river water would become too warm. Water quality is also deteriorating due to algae growth, which causes malfunctions and extra costs. Chemelot is therefore working on innovative measures in the Circular Water project, which involves us investigating, among other things, the reuse of waste water"

Tjaart Molenkamp
Director Technology & Sustainability
at USG Industrial Utilities.

Text box 4.13.1 **Legal division of roles**

Ensuring that workplaces are fit for the future is a joint responsibility of central government, the provincial and local authorities, water authorities, individual businesses, workplace clusters and other private parties such as building owners, park managers and the financial sector. Everyone must contribute within the scope of their own capabilities, and this requires cooperation and organisation.

- **Central government:** The Minister of Housing and Spatial Planning is responsible for climate adaptation in the built environment and spatial planning. The Minister of Economic Affairs and Climate is responsible for the economy and, consequently, for the business environment, entrepreneurship and innovation across various workplaces.
- **Subnational authorities:** Subnational authorities are responsible for the regional and local implementation via spatial policy, environmental plans, and the use of instruments. They are also responsible for the local economy and related business conditions, such as water availability.

4.13.1 The challenge

Workplaces in the Netherlands are already exposed to various extreme weather events and these events, are set to increase in both frequency and intensity in the future. A large proportion of the country's gross domestic product is generated at workplaces in the Netherlands. Many of these workplaces are currently located in areas at risk of flooding.[1] We are also having to deal with rising average temperatures and more frequent and longer-lasting heatwaves. These forms of climate change have a direct effect on companies' business operations. Indirectly, this can also affect supply chain partners and impact (international) production functions and the value chain, for example due to reduced labour productivity and machine breakdowns. Extreme precipitation can also cause a variety of problems, such as power outages and water damage to buildings or their contents. These climate effects also influence the movement of goods and personnel. This latter problem is explained in more detail in challenge 4.14 *A robust and resilient transport infrastructure* and falls outside the scope of this workplaces challenge.

1 CBS. *Klimaatimpact op de economie.* The Hague: Statistics Netherlands, 2025.

Climate-adaptive measures at workplaces can yield long-term economic benefits and reduce business economic risks. To achieve these goals, it is important to collaborate on other topics that require action from workplaces and companies. Combining the various elements will prevent duplication of effort and overburdening of the target group. This means, for example, working together to increase the level of organisation of organisations/companies at workplaces, or combining the spatial demands for climate adaptation and the energy transition. This also requires cooperation between various challenges within central government.

This challenge concerns existing areas consisting exclusively of non-residential buildings (buildings not designated as residential) in various buildings, where there is no mixing with residential functions. These locations are where businesses and private and shared land come together and we refer to them as workplaces. They are primarily locations at which economic activities take place. The focus of this challenge lies on workplaces as a whole, and to a lesser extent on the individual companies within an area. Workplaces can take many different forms, depending on the requirements that the companies at a location impose on the surrounding environment. Examples include industrial estates, campuses, logistics parks and office areas. Mixed-use forms also occur. Non-residential buildings in mixed-use areas that also contain residential functions fall outside the scope of this challenge. The task of making these non-residential buildings climate-resilient is being developed in more detail in an implementation programme for the built environment, as a more concrete goal within the framework of the National Adaptation Strategy (NAS) And will be dealt with in due course as the NAS for the built environment is developed in more detail by the Ministry of the Interior and Kingdom Relations. In terms of ensuring that new workplaces have future-proof designs, we are adhering to the same line as that of challenge 4.11 *Climate-adaptive new developments*. When it comes to the additional commitment on the part of companies that process hazardous substances at workplaces, we refer to challenge 4.7 *Seveso establishments properly prepared for climate risks*.

Text box 4.13.2 **Work landscapes**

In the 'intensification' and ' transformation' scenarios (see section 4.13.2), workplaces can take climate-adaptive measures to become future-proof. The more far-reaching measures fall under the 'transformation' scenario. This involves assessing the situation from a broader perspective than just the workplace itself, in what we call a work landscape. In a work landscape, work is an integral part of the environment, with the landscape aligning with the workplace's function. A work landscape is a green, climate-resilient, pleasant and multifunctional location that interacts with its surroundings, while the development of (sustainable) economic activities remains the primary goal. The appearance of a work landscape depends on the opportunities, functions, and area characteristics of a workplace.

The ambition

All workplaces are prepared for the consequences of climate change and extreme weather events so that they can continue to perform economically from 2050 onwards. To this end, workplaces are gradually becoming climate-resilient work landscapes.

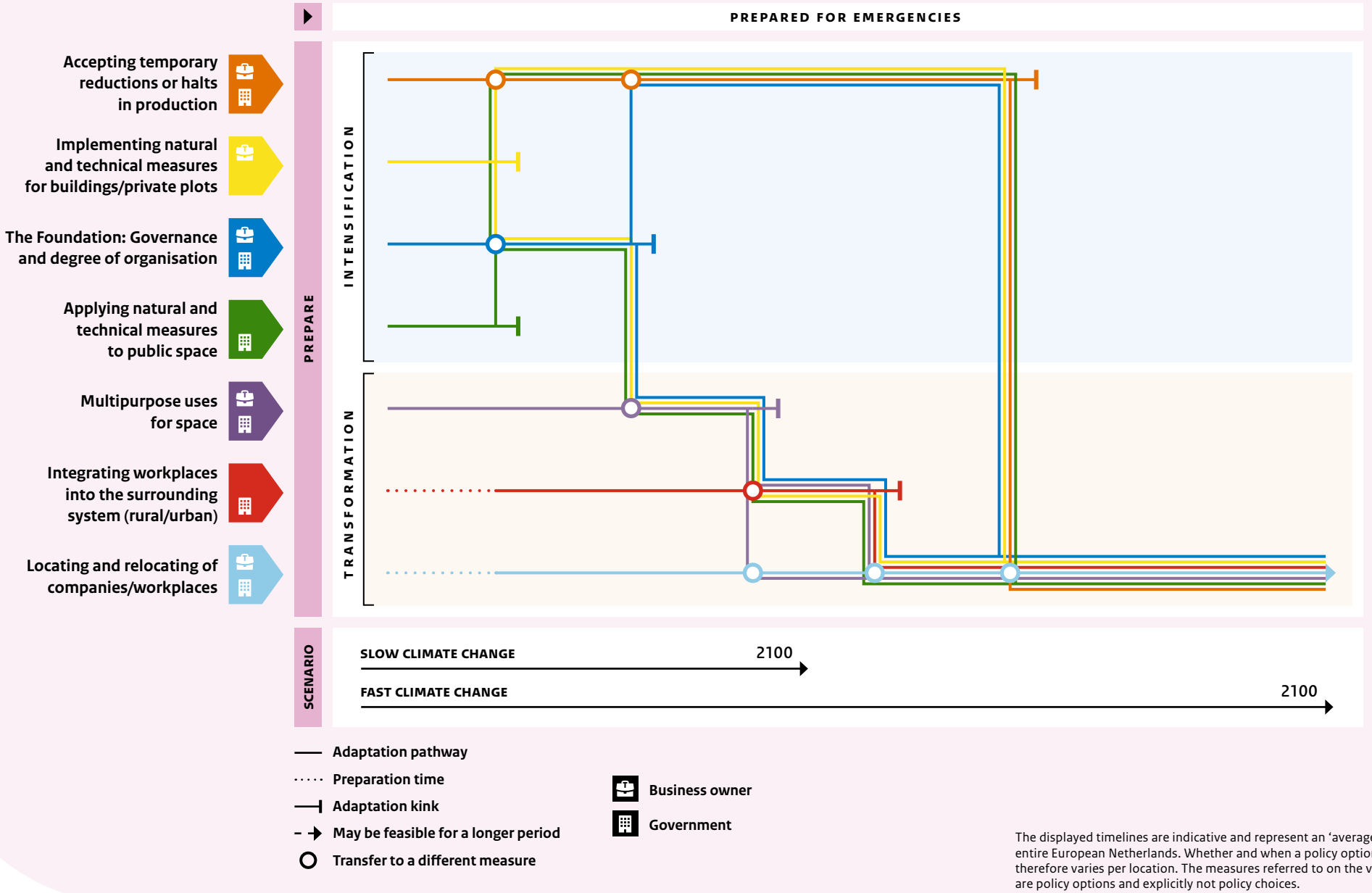
It is essential for workplaces to be designed as work landscapes in order to ensure that economic activities can continue to take place at these locations in the future. This will lead to the creation of climate-adaptive work landscapes where business operations can continue as much as possible, and where clear scopes of action are available should this not be possible. In line with the Spatial Policy Document and the Spatial Economic Vision (*Ruimtelijk Economische Visie, REV*), we, as the government, are committed to protecting existing areas where companies are active. We apply the principle of compensation whenever transformation might be necessary after all.[2, 3, 4]

2 Ministry of Housing and Spatial Planning. *Draft Spatial Policy Document.* The Hague: Government of the Netherlands, 2025.
3 Ministry of Economic Affairs and Climate. *Spatial Economic Vision. Ruimte voor een dynamische economie in tijden van verandering.*
4 D66, VVD en CDA. *Aan de slag: Bouwen aan een beter Nederland* (2026-2030). The Hague: Government of the Netherlands, 2026.

As stated above, there are many different types of companies and workplaces. The degree to which these are designed to be climate-adaptive and/or the number of steps required for them to become a future-proof work landscape varies.

The goal that all workplaces in the Netherlands are designed to be future-proof by 2050 provides space to combine the implementation of measures with natural opportunities wherever possible. In this way, we can also avoid having to tackle all the issues at once. It is important that workplaces remain adaptive even after 2050. That is why we will need to take measures and make choices now and in the future so that we can do all we can to minimise disinvestment.

Figure 4.13.1 **Adaptation pathway map** for the challenge of future-proof workplaces



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.13.2 The options

The adaptation pathway map (Figure 4.13.1) distinguishes between seven adaptation measures. Quite apart from the various measures referred to, it is also essential for workplaces[5] to be prepared for emergencies. After all, not all risks can be prevented. It is therefore important that building owners, business owners and employees at these locations are well prepared and know what to do in the event of a (predictable) extreme weather event or climate-related disaster. For each measure an indication is given as to which parties (government body and/or entrepreneur) this applies to.

In the case of the 'intensification' scenario (blue area), the focus is on implementing climate-adaptive measures at workplaces and on enhancing cooperation. In short, the focus is on continuing along the path already taken. The pathway map shows that this only to be adequate in a less rapidly changing climate scenario and if we accept lower production or production downtime more frequently or for longer periods than is currently the case. If we wish to maintain the same level of risk of production loss as currently exists, we must apply one or more minor measures from the 'transformation' scenario (orange) at specific workplaces in the less rapidly changing climate scenario.

1. **Acceptance of temporarily reduced or no production.** In certain situations, a decision may be taken not to implement specific measures, even if they could (partially) mitigate the risks of climate change. This would be the case, for example, when the costs of the measures outweigh the risks. We then have to accept that business operations may come to a standstill, for what may be a short or long period of time. Preparations must be made for such situations to make the (temporary and predictable) downtime as safe as possible. This might involve, for example, drawing up a water and heat protocol which outlines how a production process can be scaled down and in which situations. Consideration must also be given to how employees can safely leave the location in certain situations, or receive assistance in the event of, for example, pluvial or fluvial flooding.

   If situations become unsafe for people, climate-adaptive measures must, of course, always be taken. These measures will focus on both unforeseen events, such as a sudden cloudburst, and predictable situations, such as persistent heat. Attention then has to be paid to both damage mitigation and recovery.

2. **Applying natural and technical measures to buildings/private plots.** The majority of workplaces are privately owned. This includes the business premises but also, for example, parking spaces, greenery, and in some cases, roads. If we want to prevent climate change having an impact, it is crucial to take measures in private workplace areas. Such measures could include adding greenery to cool people down and protect them from the sun, or both. Taking (or not taking) measures on private property affects other people's property, the public space on which all companies on the site depend, or both. In the case of new workplaces, the National Benchmark is an important instrument for climate-resilient construction and design. Article 8 of the EU Nature Restoration Regulation is also an incentive to preserve greenery on private land and on and around buildings (up to and including 2030) and to enhance it (after 2030). In this way, we can increase climate resilience and biodiversity.

3. **The basis: governance and organisational capacity.** A high level of organisation among companies at workplaces and properly functioning governance which involves all the various stakeholders are crucial for the successful and collective implementation of adaptation measures. Collective measures can be more effective and sometimes even cheaper than individual measures. Collaboration is therefore a key prerequisite for achieving a future-proof work landscape.

4. **Applying natural and technical measures in public space.** Measures are also needed in public space to make the environment future-proof and, consequently, climate adaptive. This applies despite the fact that the public space surface area at many workplaces is smaller than the private space surface area. These measures, in turn, impact private properties, the surrounding area, or both. Article 8 of the European Nature Restoration Regulation serves as an incentive to preserve greenery in these areas (up to and including 2030) and to enhance it (after 2030), thereby increasing climate resilience and biodiversity.

5 For the sake of readability, we are going to refer in the rest of the text to workplaces. By this we mean both workplaces and future work landscapes.

The transformation scenario (orange area in the adaptation pathway map) involves combining, intensifying and, in extreme cases, (re)positioning certain (new) types of business activity.

5. **Mixed land use.** It is important to consider combining measures and smart land use when multiple climate-adaptive measures are required. Doing so will allow us to make optimal use of the limited amount of space in the Netherlands. This may involve combinations of climate-adaptive solutions or other functions at workplaces, such as greenery to combat heat stress and increasing the level of rainwater infiltration or combining a blue-green roof with solar panels or natural water storage[6] at a logistics business park.

6. **Integrating workplaces into the surrounding system (rural/urban).** In some cases, it will be necessary to view the workplace within a larger system that interacts with the surrounding natural and urban areas, for example when there is not enough space at the workplace to accommodate the desired number of climate effects, or when certain climate adaptive measures are not suitable for a workplace due to safety requirements, environmental standards, or physical and spatial conditions. In such cases, a choice can be made to implement these measures in the surrounding rural or urban area. Conversely, measures can also be taken at the workplace when this is the best place for them to be taken for surrounding areas. Examples would include the construction of controlled flood sites outside the workplace to prevent flooding, or the addition of greenery or green structures at a workplace, with this greenery being connected to the existing surrounding green structures. This is done in line with the Green in and around the City approach and serves as a climate-adaptive measure to limit pluvial flooding and heat.[7]

7. **(Re)locating companies/workplaces.** Not all types of business activity will remain possible everywhere in the Netherlands. This is because climate change is bringing pressure to bear on the availability of physical and spatial conditions for establishing businesses, for example in the form of sufficient access to cooling water or logistical access. This represents a risk to the continuity of economic processes for certain companies, vital functions and specialised clusters. In those cases, (re)locating is sometimes a necessity for both new and existing locations and it takes place in line with the principles and choices of the Spatial Policy Document.

6 DistriPark Dordrecht. 'Vier natuurlijke waterbergingen.' Distriparkdordrecht.nl, 6 July 2023.
7 The Ministry of the Interior and Kingdom Relations (BZK), and the Ministry of Agriculture Fisheries, Food Security and Nature (LNV). *Green in and around the City Guide.* The Hague: Government of the Netherlands, 2024.

Matrix 4.13.1

Goal/Effort Matrix for the challenge future-proof workplaces

Ambition	**All workplaces are prepared for the consequences of climate change and extreme weather events so that they can continue to succeed economically from 2050 onwards. Workplaces will gradually become climate-resilient work environments to make that a reality.**			
Improvement goal	**Better organisation** of work environments/workplaces between businesses, contractors, municipalities, provinces and other stakeholders active in work environments.	To **reduce the effects** of climate change and extreme weather events on human health and on labour in work environments/workplaces.	To **reduce the impact** of and/or safely manage disruptions and stoppages in production and work processes caused by climate change and extreme weather events.	**Improve the design of the area** to better cope with the effects of climate change and extreme weather events, in both public and private space.
Sector	**Organisation**	**Labour**	**Production/work process**	**Area**
SMART goal	• From 2030, all municipalities will fully incorporate work environments/ workplaces into the new environment and planning strategies and visions. • From 2026, climate adaptation will become part of existing processes to encourage and/or require workplaces/ work environments to organise themselves. • By 2028, there will be a narrative that best encourages businesses and workplaces to take climate adaptation measures.	• From 2030, every company will have a heat and water protocol, which will be regularly updated. Work environments/ workplaces can play a coordinating role here. • From 2030, awareness must increase among work environments/workplaces regarding the risks of working outdoors and how they can protect employees from heat and UV radiation. • From 2030, water and drinking water consumption in work environments/ workplaces must decrease, and the reuse of rainwater and other water sources will increase. • By 2035, it will be clear under what conditions and when businesses must temporarily close in the event of predictable extreme weather events (such as periods of heat and pluvial flooding) for health and safety reasons, and which businesses must continue to operate at all times.	• From 2030, every company will have a heat and water protocol, which will be regularly updated. Work environments/workplaces can play a coordinating role here. (Same as labour) • By 2040, all work environments/workplaces will have implemented heat-reducing measures wherever possible to protect the production/work process as much as possible. (linked to labour goal for 2030 regarding UV radiation) • From 2030, water and drinking water consumption in work environments/ workplaces must decrease, and the reuse of rainwater and other water sources will increase. (Same as labour) • By 2035, it will be clear under what conditions and when businesses must temporarily close in the event of predictable extreme weather events (such as periods of heat and pluvial flooding) for health and safety reasons, and which businesses must continue to operate at all times. (Same as labour)	• By 2030 at the latest, all spatial requirements for work environments/workplaces will be set to enable proper consideration in area planning. These spatial requirements relate to water availability, pluvial flooding, the energy transition and residential construction. • From 2030, the amount of shade will increase, and the urban heat island effect on work environments/workplaces will decrease, to improve health and the quality of travel and outdoor work. • From 2030, the water infiltration potential and the amount of greenery in work environments/workplaces will increase. The amount of paved space will also decrease. • By 2030 at the latest, it will be clear which activities in which parts of the Netherlands can no longer take place without measures being taken, and from when. From then on, the consequences will be considered, taking into account the physical and spatial conditions for business, safety, economic and other costs and regional employment.
Effort/result	→ For all of the aforementioned goals, the government is exploring where links can be made to existing initiatives, what studies are required, and which partners are needed for implementation.			

4.13.3 The approach

The approach being adopted to achieve the ambition for climate-resilient workplaces from 2050 onwards focuses on four components, namely organisation, employment, production and work processes, and area. We have established an objective to aim at for each of these components. In order to achieve these targets, we are combining measures wherever possible with other challenges, such as the energy transition. We also prefer to implement the measures during planned maintenance, a planned renovation, or expansion (in other words, at opportune moments). In line with the Spatial Policy Document, we are focusing on the multifunctional use of space. Nevertheless, it is not always possible (or desirable) to prevent exposure to climate change, and the impact varies from one business function and occupational group to another. We can reduce climate effects by taking measures early on in the process, by preparing properly, or by adjusting behaviour. For this reason, it is important for companies to gain an insight into climate risks so that they can prepare themselves. The diversity of companies and occupational groups must be taken into account in this regard.

We do not specifically highlight buildings in the Goal/Effort Matrix (Matrix 4.13.1). Requirements for buildings to become climate-adaptive can vary significantly depending on the type of business activity and the associated real estate. The specific requirements for this fall under the responsibility of the various ministries and are therefore not generically incorporated into these challenges. However, we are going to investigate which generic building adaptations are necessary to mitigate the consequences of climate change and extreme weather events. This will also be the focus of the NAS implementation programme for the built environment.

Cooperation with subnational authorities and (representatives of) companies at workplaces is crucial for us achieving this ambition and these goals and steps. After all, a large proportion of the sites are privately owned. Over the coming years, we (the government) and the other parties involved are therefore going to investigate and explore which steps are necessary to achieve these goals, and how we should take them. At that point, a decision will be taken as to who is best suited to take the lead and by means of which measures the goal can best be determined. A more detailed elaboration of the actions will follow in the implementation programme for the built environment.

Organisation

In order to realise climate-resilient workplaces, the various parties involved must take measures, both on private sites and in public space. Companies and owners will need to implement climate-adaptive measures at privately owned sites as well because that is where the majority of workplaces are located. We are going to investigate which framework would best motivate them to take these climate-adaptive measures, and how we can make the added value of these measures clear to them. The taking (or not taking) of measures has an impact on other parties present at a workplace.

Increasing the level of organisation at workplaces is a precondition for taking effective collective measures. Companies on a business park must cooperate with one another so that they can take collective measures. To this end, we are aligning with the Programme for Sustainable Business Parks (*Programma Verduurzaming Bedrijventerreinen Nederland*, PVB)[8] and the Space for the Economy Programme[9] (*Programma Ruimte voor Economie*), and are applying successful examples from the parks which are functioning as ambassador sites and living labs within the Work Landscapes of the Future[10] (*Werklandschappen van de Toekomst*) programme. We therefore wish to continue supporting projects that focus on good organisation, given that this is an important means of achieving the goals. It is also necessary to improve governance between workplaces and external parties (including government organisations) and to view workplaces as fully-fledged areas that make a valuable contribution to society within municipalities.

Employment

We are collaborating with subnational authorities and other parties on measures to limit the negative health effects of climate change and extreme weather events on employees. We are raising awareness and helping companies take appropriate actions (such as establishing a heat and water protocol) and reducing water consumption. In doing so, we are exploring how best to align with the National Drinking Water Action Plan (*Nationaal Plan van Aanpak Drinkwater*).[11]

8 PVB. '*Programma Verduurzaming Bedrijventerreinen Nederland*'.
9 Ministry of Economic Affairs and Climate. Spatial Economic Vision. *Ruimte voor een dynamische economie in tijden van verandering.*
10 Working Landscapes of the Future.
11 Ministry of Infrastructure and Water Management. *Nationaal Plan van Aanpak Drinkwaterbesparing.* The Hague: Government of the Netherlands, 2024.

It is important that companies are aware of the potential negative consequences of inaction. They will then be able to take steps to protect employees where necessary, thereby improving workers' comfort at work and health situation. Green measures, in particular, also help to achieve a more pleasant working environment and higher productivity. The temporary closure of a company is sometimes unavoidable when it comes to safeguarding the well-being or safety of employees.

Production and work processes

We are focusing on climate-resilient workplaces where companies take account of the effects of climate change on their production and work processes. This means preventing climate effects where possible and financially feasible, while simultaneously being prepared for unavoidable nuisance and damage, in other words the residual risk. This is the risk that remains after certain measures have been taken to prevent a climate incident or limit its consequences. Although climate adaptation can reduce the likelihood of damage and nuisance caused by extreme weather events, it is impossible to eliminate all the risks entirely. Our specific focus is on identifying risks, adapting production and work processes and the associated locations, as well as on the capacity to deal with, for example, temporary water shortages, water reuse and the temporary shutdown of processes when this proves to be necessary in extreme cases.

Area

We are taking measures to make the physical layout of the workplace climate-resilient. This includes creating shade, retaining water and increasing greenery to mitigate the negative effects of climate change. The 'Green in and around the City' Guide plays a role in this context.[12] The measures involve implementing a combination of measures in public space and on private property. According to the adaptation pyramid, it is preferable to take green measures rather than grey/technical measures because green measures offer multiple benefits. After all, they contribute not only to climate adaptation but also to healthier and happier employees and higher labour productivity.[13]

Finally, the theme of area also concerns spatial choices: the choice of location and the combination with other functions. We are identifying the long-term climate risks. In doing so, our aim is to protect existing workplaces as much as possible, in line with the Spatial Policy Document, and we are assessing what is needed to preserve them, with special attention being paid to vital business operations.[14] When this is not possible, we focus instead on compensation. When planning and allocating new workplaces, we have to take account of the preconditions that companies require and whether the location can provide these within the frameworks of the NAS and other programmes. We also have to consider the strengths of different regions as identified in the Spatial Economic Vision.[15]

12 The Ministry of the Interior and Kingdom Relations (BZK), and the Ministry of Agriculture Fisheries, Food Security and Nature (LNV). *Green in and around the City Guide.* The Hague: Government of the Netherlands, 2024.
13 He, C., et al. 'The inequality labor loss risk from future urban warming and adaptation strategies'. Nature communications, 13, nr. 1 (6 July 2022), 3847.; Kondo, M.C., et al. 'Urban green space and its impact on human health'. *International journal of environmental research and public health*, 15, no. 3 (2018), 445.
14 Ministry of Housing and Spatial Planning. *Draft Spatial Policy Document*. The Hague: Government of the Netherlands, 2025.
15 Ministry of Housing and Spatial Planning. *Draft Spatial Policy Document*. The Hague: Government of the Netherlands, 2025. ; Ministry of Economic Affairs and Climate. Spatial Economic Vision. *Ruimte voor een dynamische economie in tijden van verandering*.

4.13.4 The consequences of the approach

Generally speaking, we have only just started developing a climate adaptation policy within the framework this challenge. Nevertheless, measures are already being taken at various workplaces in the Netherlands, and a great deal of knowledge is being gathered through the Work Landscapes of the Future programme, including knowledge on the climate-adaptive design of workplaces. Because this challenge relates to a newer issue, a number of surveys and studies are first going to take place via the various pathway map measures, in line with the Goal/Effort Matrix (see Matrix 4.13.1). We will select an adaptation approach after that. According to the strategic environmental impact report[16] and the social impact assessment[17], the most important issues to take into account in this regard are the limited availability of space, the declining flexibility of the business climate, and the dependence of workplaces on energy supply and available infrastructure. The implementation of, and investments in, climate-adaptive measures are also leading to an increase in employment opportunities in the Netherlands.[18]

Effective coordination with other NAS challenges and the business community is crucial to address the negative effects of limited space and the business climate. Of course, this must be done in conjunction with other spatial issues addressed in the Spatial Policy Document. It is also important to adopt an integrated approach to climate adaptation along with other challenges, such as the housing challenge, the climate transition and energy projects. Although multifunctional land use can help in this respect, conflicts are bound to arise. In short, involving the necessary parties and clearly communicating information and decisions form a key cornerstone for mitigating these effects. It is also important to consider inequality between sectors and functions at and between different workplaces. We must ask ourselves which occupational groups are particularly vulnerable and should be kept in mind when developing policy.

16 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Movares: Utrecht, 2026.
17 KIN. *De sociale effecten van klimaatadaptatie*. Amsterdam: Dutch Climate Research Initiative, 2026.
18 Arcadis, as commissioned by the Ministries of the Interior and Kingdom Relations and Infrastructure and Water Management. *Financiële en ruimtelijke impact klimaatadaptatie Nederland*. Arnhem: Arcadis, 2024.

Intermezzo – The interconnectedness of critical infrastructure

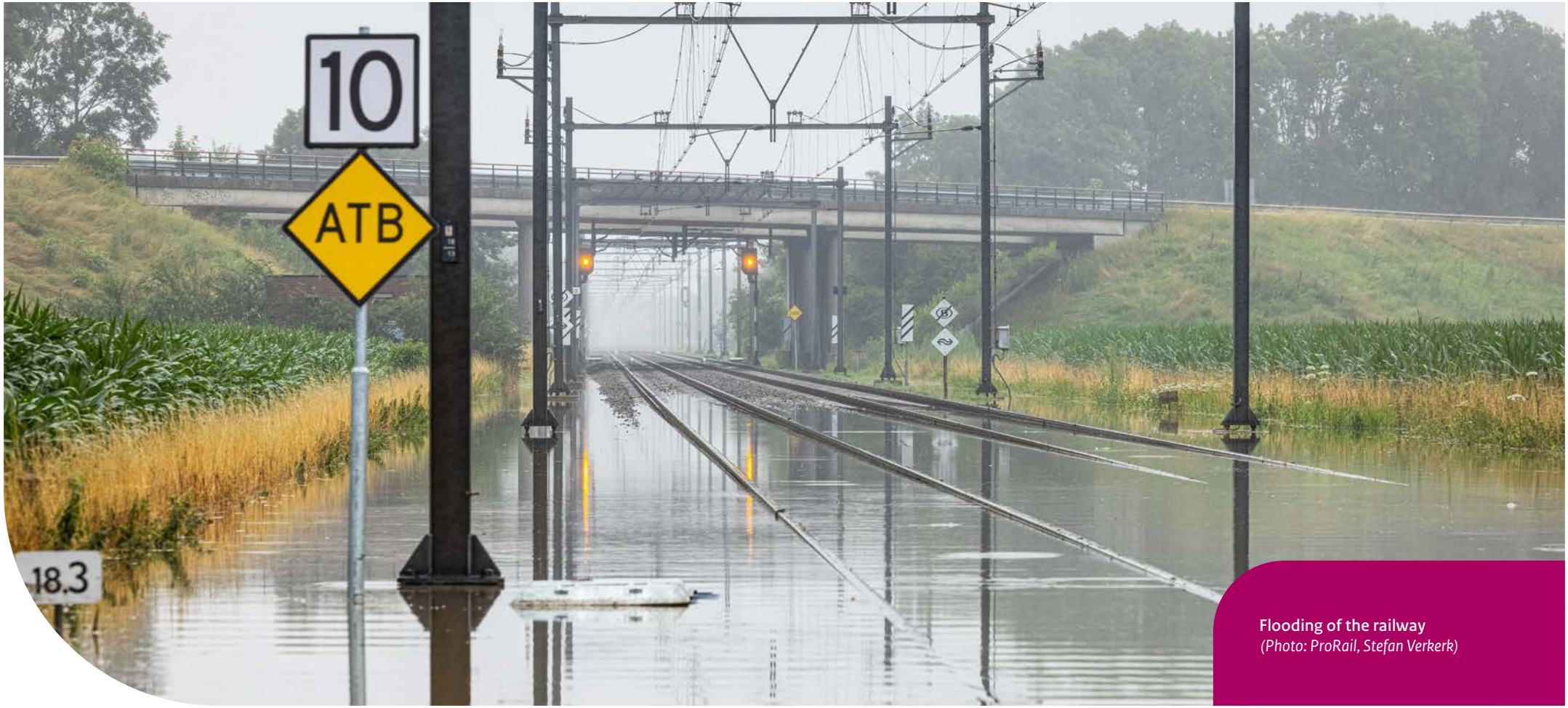
Climate change increases the chance of extreme precipitation, drought, heat and sea level rise, and consequently of disruptions to our critical infrastructure. That critical infrastructure consists of networks that together form the basis of our society, such as energy, drinking water, telecom & ICT (see challenge 4.15 *Climate-resilient energy, ICT/ telecom and drinking water infrastructure*) and rail, roads and waterways (see challenge 4.14 *A robust and resilient transport infrastructure*). Although we discuss these networks in separate sections, they are closely linked together. Without electricity, pumping stations and data centres would come to a standstill, without digital systems, locks or railways would not function and without transport, supplies and healthcare would stagnate. Moreover, a disruption in one network can cause chain reactions in other networks.

We should not view critical networks in isolation but must always consider them against the backdrop of their mutual interconnectedness. Our dependence on critical networks is increasing due to digitalisation, the energy transition, population growth and economic developments. At the same time, certain elements of the infrastructure are becoming outdated, and operational and financial resources are scarce. This means that damage at a local level can rapidly spread between systems and sectors.

The need to protect critical infrastructure is the subject of increasing attention in European and national regulations. The Critical Entities Resilience Directive (CER Directive) is being implemented in the Critical Entities Resilience Act (*Wet weerbaarheid kritieke entiteiten*, Wwke). This directive obliges organisations covered by this new law to identify risks and take measures, including for climate-related threats. In addition, the Network and Information Security Directive (NIS2 Directive) is intended to increase the digital resilience of critical processes and requires not only digital systems but also the physical environment in which they are situated to become more resilient. Developments are also taking place specifically in the field of transport networks. The EU Trans-European Transport Network Regulation (TEN-T Regulation) stipulates that climate risks must be explicitly taken into account during the construction and maintenance of transport networks (by carrying out a climate assessment). These frameworks ensure that flood and climate risks are analysed more effectively and that adequate, future-proof measures are sought more actively.

The characteristics of each network differ, but what they have in common is that they are indispensable. As a consequence, they must be resilient to extremes, disruptions must be detected and repaired quickly, and society must be able to continue to rely on their functioning. This applies in particular in the face of extreme weather conditions and unexpected events. We explore what this means for each network in more detail in the following chapters (4.14 *A robust and resilient transport infrastructure* and 4.15 *Climate-resilient energy, IT/telecom and drinking water infrastructure*).

Challenge 4.14 A robust and resilient transport infrastructure (rail, roads and waterways)



Flooding of the railway
(Photo: ProRail, Stefan Verkerk)

Extreme weather events, such as heavy precipitation or even heat, regularly cause problems on our railways, roads and waterways. Extreme downpours and the resulting pluvial flooding can lead to damage to, and the disruption of, these infrastructure networks. Such extreme weather events then cause travel disruption and have a detrimental effect on freight transport. Similar problems are experienced on the waterway network in the event of a long period of drought.

4.14.1 The challenge

Climate change means that more and more effort is required to maintain the reliability, accessibility and safety of our rail, road and waterway infrastructure. This is despite the fact that the mobility system fulfils an essential function for Dutch society and the Dutch economy. Millions of travellers, carriers and shipping companies use these networks on a daily basis. People travel to work or visit family, and companies and organisations transport their goods around the country and abroad or use the transport infrastructure to provide (emergency) services. Our transport infrastructure is also very important when it comes to transporting military units and equipment.

Demographic and economic developments are also putting more pressure on our infrastructure. The Netherlands is becoming an increasingly busy place, we are becoming more mobile and we are transporting more goods. At the same time, a lot of our infrastructure will soon need to be updated, and the increasing weight and size of vehicles are causing problems. It is therefore all the more important to pay attention to the climate adaptation challenge of the networks when maintaining, operating and building infrastructure.

Climate threats per network

Our transport networks are already exposed to a variety of climate risks. There are already significant challenges, and the risk will increase even more due to a changing climate.

Rail network

The main climate risks for the rail network are extreme precipitation, prolonged drought, heat, thunderstorms and gales. Extreme precipitation and prolonged drought can affect, among other things, the stability of embankments, which can lead to train services being restricted. Torrential downpours can cause stations to become flooded. Increasing heat can lead to passengers and staff becoming overheated (heat stress). Extreme temperatures can also cause the rails to expand (track buckling) and disruptions in electronic systems. In addition, an increase in gales and thunderstorms can cause more damage to the overhead lines and electronics of the rail system, thereby leading to train cancellations and delays.

Road network

The major threats facing our road network are surface ponding in the event of extreme precipitation and roadside fires and wildfires. These events can result in lanes or even sections of road having to be closed. Extreme rainfall can also cause embankments to crumble and become unstable. If no additional measures are taken during periods of hot weather, movable bridges (that open for shipping) may become jammed and that can cause all kinds of additional problems.

Waterway network

Prolonged drought (in combination with soil erosion) has by far the greatest impact on our network of waterways. This is because drought causes a reduction in river runoff and therefore a decline in water levels. The available navigable depth decreases as a consequence, and this is accompanied by riverbed erosion. All of this means that ships can carry less cargo, and more journeys or vessels are required to continue transporting goods, resulting in increased transport costs. Companies may then not receive the supplies they need, and this may potentially force them to halt production. The impact of drought on waterways can last for several months. Even after the drought period has ended, the logistics sector sometimes needs months to clear backlogs.

Heavy precipitation can also have significant negative consequences for inland shipping and the logistics chain. Indeed, heavy rain can actually cause water levels to rise, creating bottlenecks at bridges and locks. Unlike drought, intense precipitation has only a temporary impact, lasting a maximum of a couple of weeks. As far as seaports and fixed bridges over waterways are concerned, rising sea levels are also a climate-related threat that we must not ignore because they can affect the accessibility of the ports in question. Rising sea levels combined with lower water discharges also cause salinisation and measures to combat that affect the navigability of waterways, for example when lock restrictions (restrictions on the use of (sea) locks) are imposed.

Interconnectedness of the networks

The networks are interconnected, and it is therefore important to bring together the national adaptation strategies of these three networks. One example of this interconnectedness is the fact that passengers have to be transported by road whenever there is a disruption on the railways. Another is goods having to be transhipped from waterways to rail if a waterway is blocked. The expansion (lengthening) of movable bascules during extreme heat can also lead to disruptions on all transport networks. A climate threat is therefore not always limited to a single network. Consequently, the level of disruption may even increase because the networks are no longer able to accommodate each other.

The ambition

The current level of accessibility and security of supply in the Netherlands is maintained in the face of a changing climate.

As the government, we have set out this ambition in the 2050 Mobility Vision (*Mobiliteitsvisie 2050*).[1] The focus is, first and foremost, on maintaining the accessibility of things that are important for society, such as healthcare, education, food and work. The secondary focus is on the security of supply of essential goods such as medicines, food and fuel. As the government, we also need to keep an eye on challenges at area level. After all, accessibility in one area may come under pressure more quickly due to, for example, pluvial flooding than in another area.

To achieve this ambition, the Ministry of Infrastructure and Water Management is working towards creating infrastructure networks that are resilient to climate change by 2050.[2] ust like other critical infrastructures, these networks face three central goals, namely to identify risks more effectively, create clear frameworks and principles and produce a more robust system that can withstand shocks.

1 Minister of Infrastructure and Water Management and Minister for the Environment. Letter to parliament on the framework memorandum on the mobility vision 2050, 17 March 2023. ; Minister of Infrastructure and Water Management and Minister for the Environment and Public Transport. Letter to parliament on the government's position on levelling up accessibility, 14 March 2025.

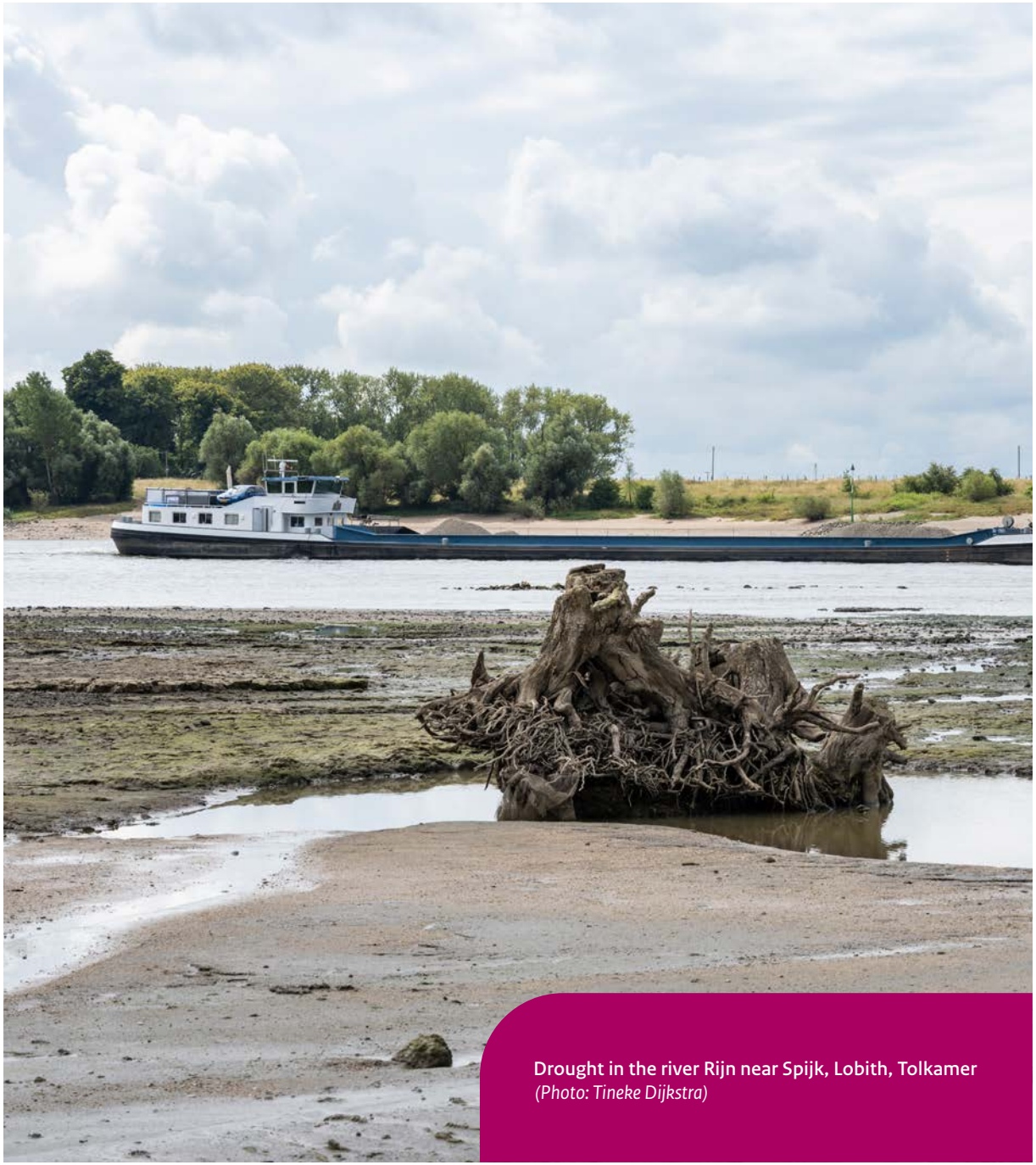
2 Further implementation of the goals in the Delta Programme for Spatial Adaptation: In 2050, the Netherlands will be water and climate resilient.

Text box 4.14 **Legal division of roles**

This chapter focuses on our main road and waterway networks, and on our main railway infrastructure. These networks and the railway infrastructure are government-owned. For the sake of readability, we do not use the prefix 'main' on all occasions.

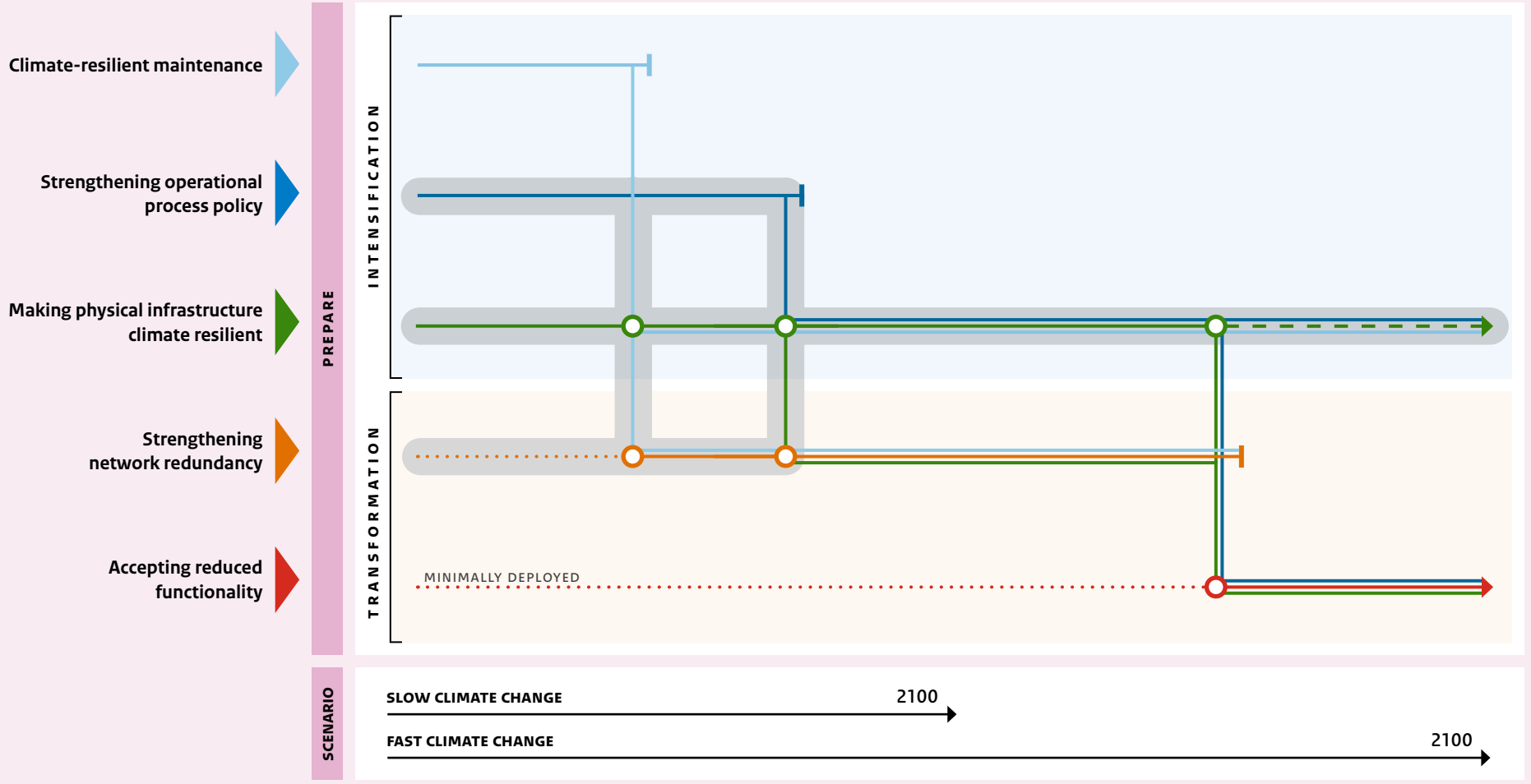
- The government is responsible for these infrastructure networks and has assigned this responsibility to the Ministry of Infrastructure and Water Management. The main road network comprises national motorways (A roads) and several main roads (N roads).[3] The main waterway network includes all waterways that are (partly) government-owned. Rijkswaterstaat manages, among other things, the main road network and the main waterway network.
- The main railway infrastructure comprises all railways (including materials and equipment) intended for public passenger or freight transport. ProRail manages the main railway infrastructure based on what is known as the 'management concession'. Stations are often jointly managed and owned by ProRail and NS. Subnational authorities are responsible for the area around stations.
- Underlying rail, road and waterway infrastructure (such as provincial roads and waterways, metro networks and bus infrastructure) and (inland) ports are the property and responsibility of regional parties. These include, for example, provincial authorities, municipalities and transport regions.

3 Rijkswaterstaat '*Wegenoverzicht*'.



Drought in the river Rijn near Spijk, Lobith, Tolkamer
(Photo: Tineke Dijkstra)

Figure 4.14.1 **Adaptation pathway map** for the challenge of a robust and resilient transport infrastructure



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.14.2 The options

We have identified five categories of measures (the adaptation options) for a resilient transport network:

1. **Climate-resilient maintenance**
   Preventive maintenance to increase the resilience of our infrastructure. Examples include managing vegetation (such as mowing plant growth) to stabilise slopes and combat soil erosion, and regularly cleaning culverts (water conduits) and drainage channels to prevent blockages and, consequently, pluvial flooding.

2. **Strengthening operational processes**
   This means improving operational and traffic management measures to enable a faster response (shortly) before, during and immediately after extreme weather conditions. This should ensure less damage, nuisance and disruptions, and the rapid recovery of assets and network functionality. Assets are all physical components that contribute to the functioning of the network, such as roads, rails, bridges, locks, points and pipelines. Examples include training staff for emergency situations and developing strategies for temporary diversions.

3. **Making the physical infrastructure climate resilient**
   This means making small and large structural adjustments to (specific parts of) the physical infrastructure. Examples include increasing the capacity of water discharge systems and pumping systems at tunnels and locks, reinforcing railway embankments, and improving drainage systems in station areas.

4. **Enhancing network redundancy**
   This means adding alternative routes and transshipment points to make the transport network more flexible and less susceptible to disruptions. Examples include creating multiple access roads to critical facilities or ports and improving the ability to switch (temporarily) between different modes of transport, such as from water to rail, road or pipelines for specific goods. This will increase system robustness.

5. **Accepting reduced functionality**
   This means accepting temporarily reduced functionality when it is not possible to maintain accessibility and functionality during extreme situations For which no appropriate preventive measures exist. This implies a controlled reduction in functionality that depends on the situation and the area. In the future, this could sometimes mean, for example, fewer trains running, stations being inaccessible, or certain roads being closed more frequently in the event of pluvial flooding. It could also mean production flows sometimes relying more on stocks due to limited supply via water. In fact, this occasionally already happens during periods of extreme weather events (for example during severe storms or heavy snowfall).

We have combined these categories of measures into a generic adaptation pathway map which is applicable to all climate risks and infrastructure systems. The measures are the result of various projects and studies into the climate risks of the road, waterway and rail networks, as well as the solutions for these offered by Rijkswaterstaat and ProRail. These pathways are ‘average’ adaptation pathways for the entire Netherlands (because climate threats to the networks differ by region) and outline the options up to 2100. The feasibility and effectiveness of the various measures depend on the segment or corridor (transport artery) within the transport network being focused on, and on the trade-off between costs, performance and risks.

The adaptation pathway map visualises the five categories of measures over time. The first three categories (climate-resilient maintenance, strengthening operational processes, and making physical infrastructure climate resilient) have already been implemented and focus primarily on intensifying the current system. The final two categories (enhancing network redundancy and accepting reduced functionality) are in the preparatory or ‘minimal deployment’ phase. These are the more transformative strategies, which demand a different configuration or use of the mobility system.

Continuing and strengthening climate-resilient maintenance is expected to have limited problem-solving capacity if we do not adapt the assets to the changing climate. The most cost-effective approach is to renew these assets. If we do not adapt the assets, we will be forced to take the second and third categories of measures, namely those of strengthening operational processes and continuing to make the physical infrastructure climate resilient.

We can also already consider taking steps towards enhancing network redundancy by aligning different modes of transport more effectively and allowing them to act as each other's backup (multimodality). This measure requires a longer preparation time Due to the potentially high investment costs and the cross-system cooperation that would be required. There must also be a willingness to invest in a different modality if that is more effective for the system as a whole. This strategy can yield significant results. In practice, the market is already willing to switch to another mode of transport in the event of disruptions. As a government, it is therefore important to cooperate with the market in order to facilitate switching between modes of transport on a national scale. However, the strategy also has its limitations because it places significant demands on financial resources and technical capabilities and has limited applicability (only during disruptions). Focusing on network redundancy is therefore a less effective approach.

At that point, the only option remaining is that of accepting reduced functionality during extreme weather events. In that case, we must adjust current ambitions and abandon the focus on maintaining current network performance. We are currently implementing this strategy on a very minimal basis and only for short periods. It also requires coordination with emergency services and safety regions. Planned outages or repair work are almost always accompanied by alternatives (network redundancy).

The necessary measures depend on the climate scenario. We base the related choices on potentially changed performance as a result of climate change. This has to be measurable. In a less rapidly changing climate scenario (climate change is slow and remains relatively limited), the expectation is that we will succeed in maintaining current network performance with the first four categories of measures. However, if we face a rapidly changing climate scenario (rapid climate change), it is possible that we will have to accept reduced functionality more frequently at some point. In that case, we must adjust our ambitions and goals, despite the focus on making current and new infrastructure climate-resilient.

Matrix 4.14.1

Goal/Effort Matrix for the challenge of a robust and resilient transport infrastructure

Ambition

Keeping the current accessibility and security of supply in the Netherlands in a changing climate
Key services (such as healthcare, education, food and employment) remain accessible, and the supply of essential goods (such as medicines, food, fuel and military equipment) remains possible despite a changing climate. To achieve this, the infrastructure (rail, roads and waterways) must be resilient to more extreme weather events. This means that network performance, even with future growth, will not deteriorate as a result of extreme weather events.

Improvement goal	By 2050, the mobility networks will be resilient to extreme weather events.	The mobility system will become more resilient to extreme weather events. We will strengthen the redundancy of the system as a whole to mitigate vulnerabilities.
SMART goal	By 2026, we will have gained new insights into hotspots on the networks.	By 2030, the vulnerabilities in the mobility system during extreme weather events will be clear, and we will have a better understanding of potential solutions (including costs, performance and risks).
Effort/result	→ Rijkswaterstaat and ProRail are conducting stress tests. → Rijkswaterstaat and ProRail will update the Climate Impact Atlases and draft an implementation agenda.	→ The Ministry of Infrastructure and Water Management is conducting research to gain insight into the system and the interfaces between the networks by building a system dynamics model.
	By 2028, there will be an understanding of the societal and other costs of extreme weather events and potential investment costs to prevent damage.	The Ministry of Infrastructure and Water Management and subnational authorities are investigating vulnerabilities at network level through stress tests.
	→ Rijkswaterstaat and ProRail are conducting research into the cost of societal and other damage. → The Ministry of Infrastructure and Water Management, Rijkswaterstaat and ProRail will discuss case studies with one another.	→ The Ministry of Infrastructure and Water Management and subnational authorities will regularly conduct regional and supra-regional stress tests.
	By 2030, climate-adaptive work will be embedded in policy and implementation.	
	→ ProRail and Rijkswaterstaat will implement a Top Framework detailing the application of the KNMI'23 climate scenarios. → Where necessary, we will adapt work processes, design specifications or operational frameworks.	

4.14.3 The approach for resilient transport networks

Matrix 4.14.1 outlines the planned actions up to and including 2030 within the two main streams from the adaptation pathway map: making infrastructure resilient and a redundant mobility system. Making the infrastructure resilient is an interpretation of the first three categories of measures, Namely, climate-resilient maintenance, improvement of operational processes, and making physical infrastructure climate resilient. To achieve this, it is first necessary to acquire knowledge and insights and to anchor these in asset management.

First of all, we want to gain an insight into hotspots. They are locations that are sensitive to extreme weather events and also have a major effect on network availability. After all, climate change does not have the same impact on all networks in all locations. One area is more sensitive to drought, while another is more sensitive to pluvial flooding. This makes it important to take the most appropriate measures regionally. We collect information about these hotspots by, among other things, updating stress tests, conducting the Integrated Mobility Analysis (IMA) as well as through research and monitoring. This allows us to determine more precisely which areas and assets are at greatest risk.

When we do so, our focus is first and foremost on developing a course of action for the most urgent hotspots (making the physical infrastructure climate resilient). A key area of concern specifically for rail is the deterioration of track stability (the firmness of the track's subsoil) caused by factors such as heavy or prolonged precipitation. The attention in the case of roads is on locations susceptible to pluvial flooding. Reduced water supply due to drought combined with riverbed erosion is the main concern as regards waterways.

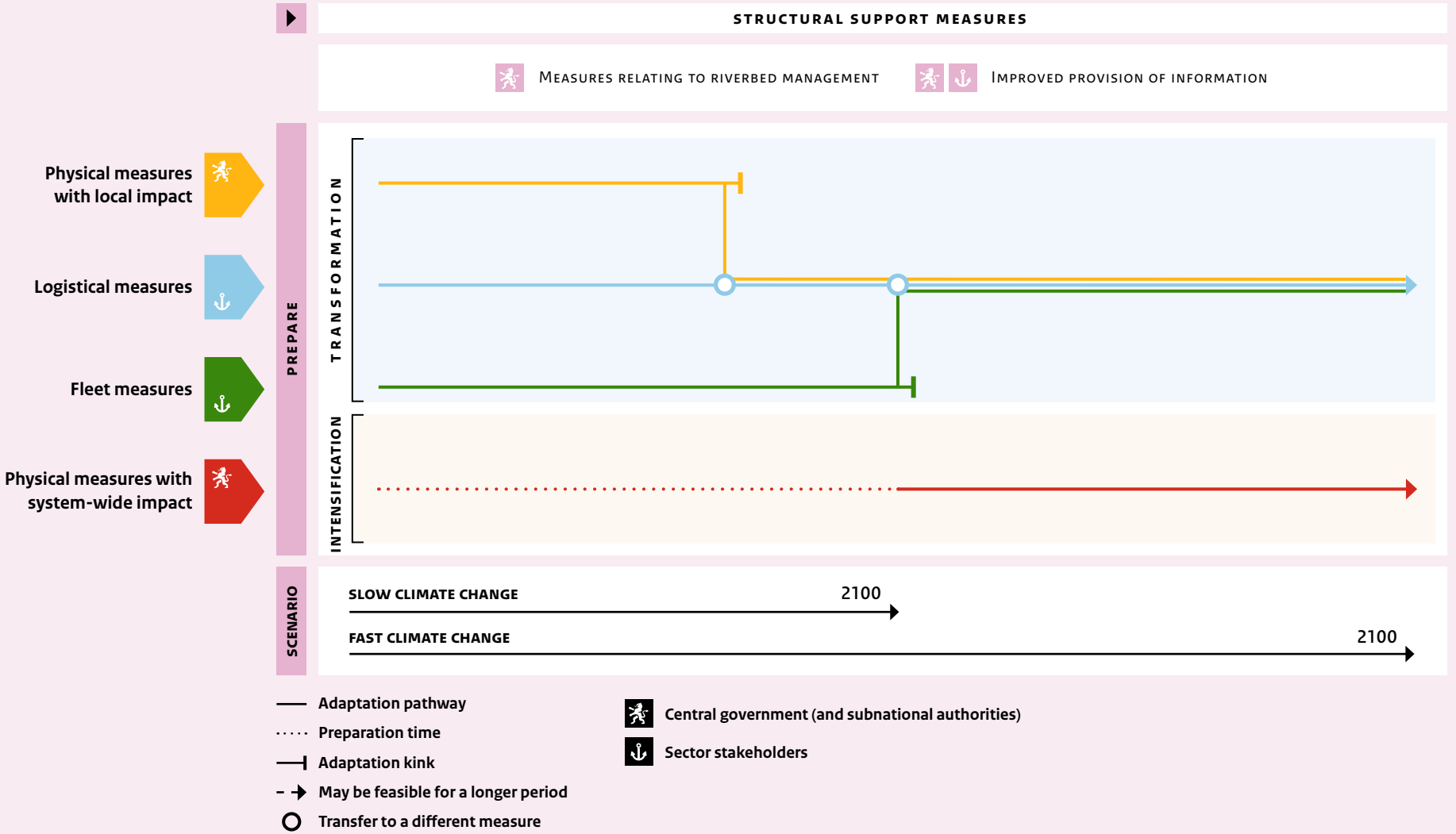
Further research will also provide insight into, for example, the extent to which disruptions at civil engineering structures, traffic jams, or train travel disruptions are the result of extreme weather. Civil engineering structures include all constructions that are part of a transport or water network but are not roads or railway tracks, such as bridges and tunnels. If we can gain a better insight into these effects, we will be able to select measures more effectively. Following the update of the stress tests, Rijkswaterstaat and ProRail are drawing up new implementation agendas which will specify the choices in more detail. These must be integrated within the policy, legal and financial constraints applicable to the policy field of the Ministry of Infrastructure and Water Management. In order to achieve this, the ministry must weigh up the costs, performance and risks against each other, in consultation with both implementing organisations. Ultimately, assessing and mitigating climate risks on the networks must become part of the regular asset and traffic management of ProRail and Rijkswaterstaat.

New or revised frameworks and guidelines help with (the decision-making on) incorporating climate change into the replacement, renovation and construction of (new) infrastructure. These activities fall within the categories of climate-resilient maintenance and making the physical infrastructure climate resilient. The standards we currently use for the design of (new) infrastructure are often based on standards that have not yet been adapted to climate change, even though we are constructing infrastructure for the long term. It goes without saying that, together with the implementing organisations, the Ministry of Infrastructure and Water Management must weigh up the costs, performance and risks against each other. In addition, the new frameworks and guidelines must be used to tighten up the protocols of the operational processes. To achieve this, Rijkswaterstaat and ProRail are implementing a framework for the application of KNMI'23 climate scenarios, which is known in Dutch as the *Topkader toepassing klimaatscenario's KNMI-'23*.

Finally, we are investigating in various ways how to make the mobility system (road, rail, and waterways) more resilient for the long term (network redundancy). This implies examining the best solutions to maintain accessibility and security of supply based on the interconnectedness of the different modalities (road, rail, water). In that context, the transport networks act as each other's backup. During periods of extreme drought, it may, for example, be the case that goods cannot be transported by inland shipping along all routes, meaning that diverting to rail or road must be regarded as a serious option. This systems approach will enable us to make even better choices with regard to investments in order to maintain the system. In this way, the Netherlands will retain its leading position as a logistics and accessible country. Freight[4] and passenger transport policies[5] are already focusing on increased network redundancy through the principle of the right mobility at the right place, at the right time. The aim is to make optimal use of modalities, strengthen them and link them together more effectively.

4 Minister of Infrastructure and Water Management and Minister for the Environment. Letter to parliament on the main points of the review of the freight transport agenda, 20 March 2024.
5 Ministry of Infrastructure and Water Management. *Mobiliteitsvisie 2025. Hoofdlijnennotitie*, 17 March 2023.

Figure 4.14.2 **Adaptation pathway map** waterways resilient to low water levels during periods of extreme drought



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.14.3 In the spotlight: extreme drought and our waterways

The options in the event of extreme drought and its effects on our waterways

Extreme drought has by far the greatest impact on our waterways. This, in turn, has major consequences for the security of supply in the Netherlands. We have therefore drawn up a separate adaptation pathway map for this climate risk.

The government (together with external parties) can follow two leading strategies for a future-proof waterway network, with one involving the intensification of current efforts and the other the transformation of the system. Certain measures are also necessary on a structural basis, regardless of the chosen strategy. These are shown at the top of the adaptation map. If we do not start to make choices and take measures, the reliability and navigability of the waterways will decrease. The figure also shows the actual implementation of the measures over time.

It is important that the categories of measures are broader and cover more than the government's direct responsibilities. The measures also include those for which other parties are responsible, such as provincial authorities, water authorities, municipalities, companies, or sector organisations. In the adaptation pathway map, these are, for example, the measures which relate to the fleet or logistics. Cooperation and joint management are therefore required in order to implement these measures. Finally, it is important to note that some measures apply specifically to a particular location or corridor.

Structural supporting measures are measures that we must take regardless of the chosen adaptation strategy.'Supporting' also implies that they are insufficient as standalone measures to make and keep waterways climate resilient.

- **Measures relating to riverbed management**
  Navigability can be improved by tackling sedimentation (the accumulation of materials such as sand and clay), shallow areas and local erosion. The options include resolving bottlenecks at 'non-dredging locations', where dredging is prohibited due to cables and pipelines crossing the route. Sediment replenishment (the artificial and targeted addition of, for example, sand) and the optimisation of dredging strategies can also help.
  The responsibility for this lies with the government (Rijkswaterstaat), in coordination with grid operators (for pipelines/cables) and water authorities.

- **Improved provision of information**
  It is essential to improve information on water depth, which shipping companies, shippers and charterers need in order to prepare for trips. This can be achieved through more accurate measurements of the minimum surveyed depth and water level forecasts several days to weeks in advance. This will help to optimise transport and inventory management, especially when water levels are extremely low. The government (Rijkswaterstaat) is primarily responsible for the measurements and forecasts, in collaboration with sector parties that use this information.

A system change is necessary in order to guarantee the future sustainability of the waterways. This is a transformative strategy. Transforming waterways means that the waterway network and its users will be confronted with a combination of various measures that together lead to system change. Some measures are standalone intensification measures, while combining measures is what makes the strategy transformative. The measures could include, for example, logistical measures, fleet adjustments, or physical interventions at local level. It goes beyond mere maintenance or expansion. Not all measures within this strategy are measures that we, as the government, can take independently.

- **Physical measures with local impact**
  Small interventions can improve navigability without any major infrastructural impact. Examples include lowering lock sills, constructing a 'multi-channel system' (longitudinal dams), pumps at locks to reduce loss of water when a ship is guided through a lock, innovations which involve flexible structures and adapting inland port infrastructure to improve the way cargo is processed during prolonged periods of drought. Taken individually, these are intensifying measures. The responsibility for this lies with the government (for main waterways and locks), subnational authorities (for inland ports and regional waterways), and market parties (for innovative applications).

- **Logistical measures**
  Refining and improving the logistics chain within the technical space of the system can increase flexibility. Examples include a less strict 'just-in-time' principle (having exactly enough stock) in inventory management and maintaining larger stocks to cope with peaks in demand or transport. We can also use multimodal transport options, such as synchromodal transport, by which goods are temporarily transported via an alternative modality where possible, such as by rail or road. However, there are limits to this option. Taken individually, these are intensifying measures. For which the sector (shippers, logistics service providers) is primarily responsible. The government and subnational authorities have a role to play in encouraging the development of multimodal networks and policy coordination.

- **Fleet measures**
  Modifications to vessels can increase the resilience of the inland shipping sector. This would include using lighter vessels with shallower drafts, more push-barge combinations to increase buoyancy and flexibility, and new combinations of smaller or lighter barges. This is a transformation measure, for which the sector and market parties (shipping companies, shipbuilding industry) are responsible. As the government, we may have a facilitating role to play.

Measures aimed at intensification essentially revolve around optimising the existing situation. This means strengthening or improving existing processes or structures And focusing on optimisation and efficiency, without fundamentally changing the system, for example by building large-scale hydraulic structures. The focus of this strategy is therefore on operational aspects and expansion.

- **Physical measures with system impact**
  This means raising water levels during periods of drought by making structural investments such as new weir structures (for example on the Waal or IJssel rivers), expanding lock capacity at strategic system bottlenecks (for example in Grave and Weurt), and creating upstream water buffers (for example at Lake Constance). Such initiatives would require significant investments and take a long time to implement. Such large-scale physical adjustments to waterways depend to a large extent on future river runoffs as well as any physical adjustments to waterways upstream by our neighbouring countries.

Het Rijk is verantwoordelijk voor de investeringen in het hoofdvaarwegennet. In close cooperation with international partners (such as Germany and Switzerland), and in coordination with subnational authorities if there are regional implications.

Matrix 4.14.2

Goal/Effort Matrix for the approach for extreme drought on waterways

Ambition

Reliable and safe waterways
A reliable, accessible and safe main waterway network that is resilient to climate change and continues to meet international requirements and user needs.

Improvement goal	Take into account natural, geographical and technical boundaries and possibilities on the main waterway network in order to facilitate navigability.	Reserving and setting aside space for current and future water-based activities, expanding multimodal terminals and integrating energy infrastructure, in conjunction with climate-adaptive modifications to waterways.	Managing water scarcity in a sustainable and flexible way by comprehensively weighing up all water functions, including waterways (and therefore shipping use), when making decisions.
SMART goal	When making decisions regarding the operation or renewal of bridges, locks and waterways, the Ministry of Infrastructure and Water Management will consider how these will continue to function in the future under changing climatic conditions. To this end, the Ministry will develop and apply clear policy agreements, working methods and tools.	By 2030, water-based activities and multimodal transhipment locations will be better utilised and strategically expanded, and energy infrastructure will be spatially integrated. This will be done in conjunction with climate-adaptive adjustments to waterways, in line with freight transport policy, the new Spatial Policy Document and the Mobility Vision 2050.	By 2030, the Ministry of Infrastructure and Water Management will present a proposal for a future-proof operational balance at sea and inland locks and other structures where water distribution and the functionality of the waterway converge, including measures for periods of drought.
		Limiting the undesirable shift of high-risk transport, such as hazardous substances, to other modes near built-up areas during droughts. This requires timely coordination between waterway management, safety partners and transport operators.	By 2030, a consensus decision will have been reached within Room for the River Programme 2.0 regarding the Meuse system and the desired riverbed elevation and runoff distribution in the Rhine system. This decision will take into account safety, water availability, nature and navigability.
			By 2050, the new riverbed elevation for the Meuse system and the riverbed elevation and runoff distribution for the Rhine system will be in place, with the necessary interventions implemented and coordination with neighbouring countries.
Effort/result	→ The efforts outlined above form part of a broader initiative in this area. See the Goal/Effort Matrix for road, rail and waterway.		→ The government will outline this in the National Water Programme (2028–2033).

The approach for extreme drought on waterways

It is crucially important to invest in infrastructure to maintain the strong position of Dutch ports and logistics. In that way, we will be able to continue guaranteeing reliable, accessible and safe waterways with associated engineering structures. This infrastructure is essential for the Dutch and European freight transport system because it ensures that goods and raw materials are available at the right place and at the right time for the economy and society, such as the energy grid, construction industry and utilities. The waterway network plays a crucial role in this respect, because a great deal of freight and bulk transport can be transported over long distances via Dutch waterways without burdening the main road or rail networks.

The main waterway network is physically connected to the water system and strengthens, and connects to, the transport system. That is why, in the context of waterways, we are reasoning from an integrated network perspective and looking for solutions that transcend regional boundaries. All the stakeholders involved face a common challenge when it comes to creating a properly functioning logistics system. In this context, climate resilience is not only a technical issue, but also one of governance and society.

In order to become climate resilient, we must make choices and invest strategically in infrastructure bottlenecks. This means: smart combinations of adaptive measures, risk-driven maintenance, and area-based cooperation. We know that we cannot eliminate every risk, so climate resilience therefore means being prepared for extremes, and ensuring that inconvenience stays at an acceptable level. By 'acceptable', we mean inconvenience that is predictable and manageable, and that causes the shortest possible disruption to logistical chains, economic processes, or vital functions.

Various programmes are underway to prepare the main waterway network for current and future challenges. The aim of the Rijkswaterstaat programme to make the national main waterway network climate resilient which is referred to in Dutch as '*Het programma Klimaatbestendige Netwerken-Hoofdvaarwegennetwerk* (KBN-HVWN)' is to identify vulnerabilities, perform stress tests and organise risk dialogues to adapt the networks to changing climate conditions. In addition, the Room for the River 2.0 (RvdR 2.0) programme focuses on future-proofing the Maas and Rhine system and ensuring an optimal balance between flood safety, nature, water quality, freshwater availability and navigability.

Due to scarcity of space, financial resources and capacity in terms of personnel and materials, we will not always be able to absorb all the effects of extreme weather events or implement adjustments to our networks in time. As a result, our networks may not always offer the same level of availability as before. It is therefore important to clarify which performance levels are still possible (due to climate impact), and what choices we need to make in this regard. That will provide clarity to waterway users and help make timely adjustments.

The logistics sector is also looking for innovative solutions. Examples include the development of vessels capable of navigating waterways when water levels are low and revising transport planning during extreme weather events. These measures are essential if we want to adapt the logistics sector to the consequences of climate change and to safeguard the reliability of the waterway network. As the government, we can play an important role in this by encouraging research and development and setting clear frameworks for climate-adaptive solutions. We can also develop policy measures that support innovation within the sector. By doing so, we can ensure that the necessary adjustments are implemented on a large scale, and that both public and private parties contribute to the robustness of the waterway network.

4.14.4 The consequences of The approach (road, rail, and waterway)

The focus of our efforts as a government

As the government, we are choosing to focus primarily on intensifying the current system and exploring possible network redundancy. This will enable us to remain committed to maintaining the accessibility and security of supply of the Netherlands, as described in the 'Levelling up Accessibility' (*Bereikbaarheid op peil*) approach. The travelling public can count on a reliable mobility system, and companies and organisations can continue to deliver or receive goods or (emergency) services.

The alternative, in other words actively focusing on the acceptance of reduced functionality, could lead to too many (unintended) negative effects. This would result in restrictions on infrastructure availability. A consequence of that could be that certain groups of people have to put up with lower levels of accessibility. For instance, large groups of people – particularly in rural areas – depend on cars and road infrastructure to reach facilities.[6] In addition, certain regions lack a viable alternative for the secure supply of goods via, for example, roads or waterways. There is also a specific group of people who cannot afford[7] a car, or who are too young to drive (such as schoolchildren). They are dependent on public transport. Opting for full acceptance could also lead to higher repair costs. This would make the infrastructure maintenance task more expensive and require additional efforts on the part of incident response teams operated by infrastructure management organisations.

However, this does not mean that all the effects of climate change can be fully prevented or mitigated. Some extreme weather events are so disruptive that we can, at best, limit the damage they cause. Furthermore, adaptation costs are not always proportionate to the potential damage (to society). In this regard, the Ministry of Infrastructure and Water Management, together with its implementing organisations, must weigh up the risks, costs and performance. Similarly, we must also weigh up how reconstruction takes place after damage has been caused (as soon as possible versus building back better).

Specifically, this means that extreme weather events can cause damage or outages at locations where the decision was taken not to take measures. The result would be a temporary limitation in terms of functionality, and therefore accessibility as well. Consequently, we cannot completely rule out taking the path of accepting reduced functionality. In order to make well-considered choices in this context, we must take damage to society into account in order to prevent an unintended negative social impact.

System responsibility for main networks

The Ministry of Infrastructure and Water Management is responsible for the mobility system but does not manage all of the transport infrastructure in the Netherlands. The ministry is responsible for major roads, the main rail network and major waterways, including all facilities for storing and transshipment, stations, lay-bys, etc. However, the underlying and adjacent infrastructure is also crucially important when it comes to keeping facilities accessible and maintaining a resilient freight transport sector. This includes, for example, provincial roads, metro and bus stations, ports and infrastructure for slow traffic, as well as local public transport infrastructure. The resilience of this infrastructure partly determines the extent to which extreme weather events put pressure on accessibility and security of supply.

In order to assume system responsibility as a government, we are following the methodology outlined in the government's position paper entitled 'Levelling up Accessibility'. Together with subnational authorities, we are, for example, using the accessibility check (*bereikbaarheidspeil*) or (supra-regional) stress tests to identify which infrastructure is affected by climate change in such a way that it limits accessibility or restricts security of supply. We then address the identified risks in integrated accessibility analyses, such as the Integrated Mobility Analysis. We share risks and potential consequences in the Multi-Year Programme for Infrastructure, Space and Transport Administrative Consultation Committees (*Bestuurlijke Overleggen Meerjarenprogramma Infrastructuur, Ruimte en Transport*, BO MIRT). After that, we can make a targeted choice between accepting the risks or intervention by the responsible authorities.

6 Netherlands Institute for Transport Policy Analysis (Ministry of Infrastructure and Water Management). '*Het wijdverbreide autobezit in Nederland*'. (2022).
7 Netherlands Institute for Transport Policy Analysis (Ministry of Infrastructure and Water Management). *Financieel autoloos*'. (2025).

Relationship with other challenges

We intend our approach to transport networks to help with other major challenges, both as part of the NAS and elsewhere. By making stations and their immediate surroundings heat resilient, for example, we can alleviate heat pressure for the travelling public and local residents. In doing so, we can contribute to challenges 4.8 *Heat-resilient cities, towns and villages*, 4.12 *Climate-resilient housing for all*, and 4.10 *Properly protected cultural heritage* (for example listed station buildings). There is also a relationship with challenge 4.13 *Future-proof workplaces*. Companies depend on the supply of goods and services for their production, and if there is no accessibility, employees will be unable to reach their locations.

Challenge 4.15 *Climate-resilient energy, ICT/telecom and drinking water infrastructure* is crucial for the functioning of road, waterway, and rail infrastructure. For example, the technology used in infrastructure is (almost) entirely dependent on energy, and almost all trains in the Netherlands run on electricity. In the event of any incidents, ICT and telecommunications are also indispensable for traffic control and incident response and to contractors who need to resolve disruptions as quickly as possible and inform or assist travellers, carriers, and shippers.

The correlation with challenges 4.1 *Properly protected against flooding* and 4.2 *Robustness and resilience in the face of pluvial flooding caused by extreme rainfall* are crucial for the functioning of the rail and road system. If these challenges are not addressed adequately, and flooding or pluvial flooding occur more frequently as a result, it will become more difficult to configure the networks accordingly. The adaptation challenge for these networks is therefore set to become more demanding. Finally, challenge 4.3 *Resilient to increasing freshwater shortages* is crucial for water distribution issues during periods of drought and low water which then have a direct effect on the performance of the waterways.

Challenge 4.15 Climate-resilient energy, ICT/telecom and drinking water infrastructure

A tangle of underground cables, pipes, and tubes, Leiden
(Photo: Hollandse Hoogte, Peter Hilz)

4.15.1 The challenge

Climate change is bringing pressure to bear on our energy, ICT/telecom and drinking water infrastructure. We are facing more extreme rainfall, more frequent heatwaves, prolonged droughts, storms and rising sea levels. These extreme weather conditions can cause damage to infrastructure and faster wear and tear on components, such as cables and transmission towers, as well as signal disruptions. Increasing drought puts pressure on freshwater supplies, and that has consequences for our drinking water supply, as well as for cooling water for power plants and data centres. All these effects increase the risk of critical network breakdowns,

And the consequences for society can be huge. After all, these networks form the backbone of our society and economy. They connect people, goods, facilities and systems And provide every Dutch citizen with 24/7 access to energy, drinking water and the Internet. If these networks were to fail, for example, due to disruption or manipulation, this would have serious consequences for the functioning of our society. According to the National Coordinator for Security and Counterterrorism, in the worst-case scenario, this could even pose a threat to national security.[1]

Critical networks are also becoming increasingly interwoven. This interdependence makes them both critical and vulnerable, given that failure in one system almost always affects another. Without electricity, there is no Internet, without ICT, there is no control of locks or pumping stations, and without stable telecommunications, it is impossible to coordinate crisis situations efficiently. In addition, different elements of critical infrastructure can also influence each other. For example, a district heating network can unintentionally heat drinking water and excavation work for the laying of fibre optics can delay other projects. The likelihood of failures or disruptions is increasing, with the potential for the consequences to spread rapidly within and between chains.

What is more, society's dependence on these infrastructures is growing due to digitalisation, the energy transition, population growth, and economic development. There is an increasing demand for energy, drinking water and ICT and telecommunications, while supply has almost reached its limits. As a result, the availability of sufficient drinking water, energy and ICT and telecommunications is no longer a given and this is already causing damage to our society and economy, for instance when the commissioning of homes, schools and workplaces is delayed or comes to a standstill due to grid congestion, or when companies have insufficient water for their processes. Furthermore, obsolescence, spatial pressure, a growing implementation challenge and limited implementation capacity make the system physically and organisationally more vulnerable.

The ambition

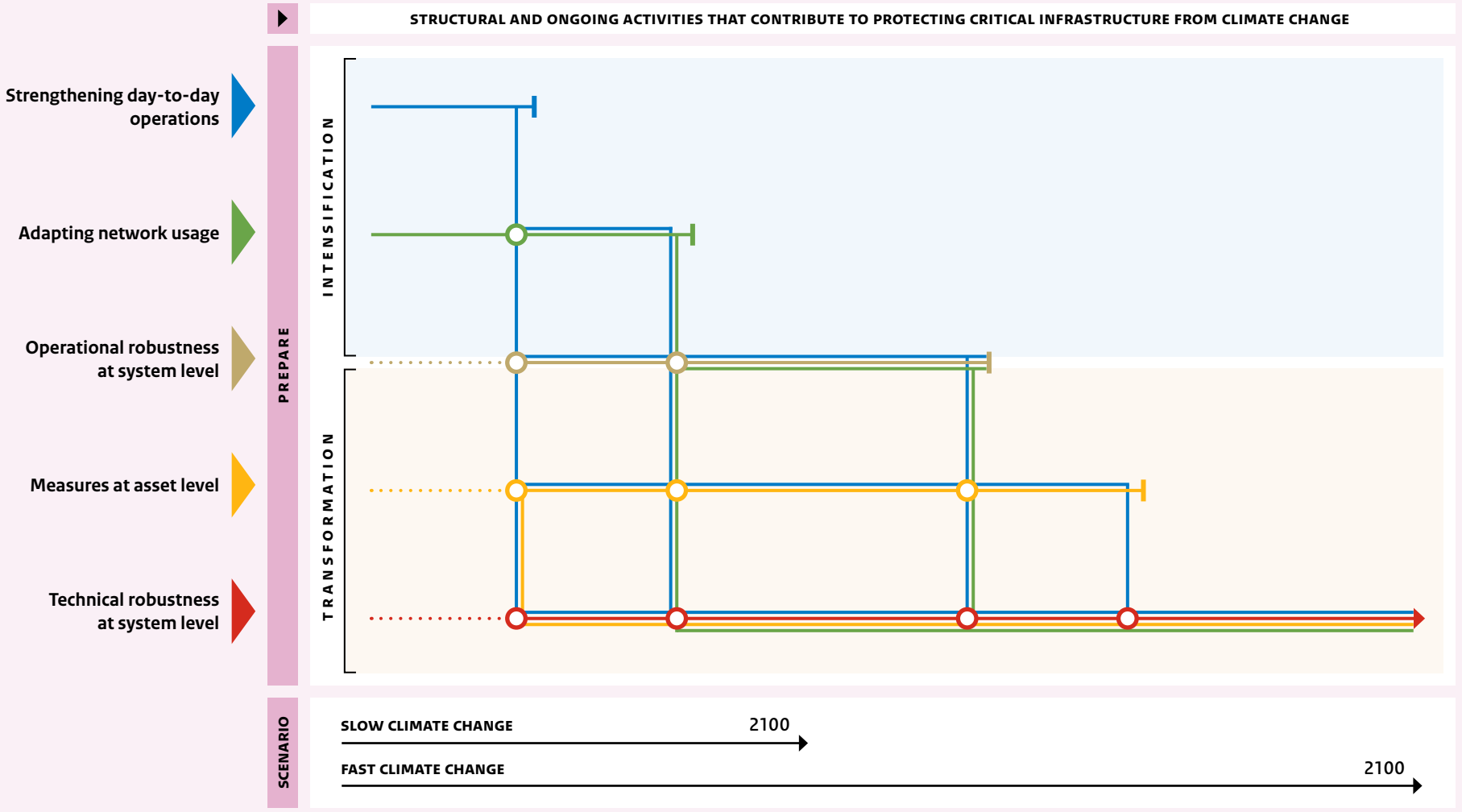
A climate-resilient and reliably designed critical infrastructure by 2050.

This ambition applies to all critical networks. As the government, we are focusing on three interconnected areas, namely better insight into risks, clear frameworks and principles, and a more robust system that can withstand shocks. We will explain this in more detail in relation to energy, drinking water and ICT/telecom in the following sections.

It is crucially important for society that our critical infrastructures remain reliable. Currently, these infrastructures are of high quality and offer a high degree of security of supply. This must remain the case, and therefore they must be resilient to disruptions and built to withstand climate change. This requires a coherent, future-oriented approach. Within the framework of the NAS, we therefore apply a conceptual framework that provides a cross-sectoral trajectory for energy, ICT/telecom, and drinking water. To guarantee security of supply, we must take long-term measures. In other words, we must rapidly expand the infrastructure, make careful spatial choices and ensure better protection against extreme weather conditions. In doing so, we need to take account of sector-specific challenges and the regional effects of climate risks. By adopting a coherent approach to these infrastructure sectors, we are able to invest more efficiently, manage risks better, and make timely adjustments in response to changing circumstances.

1 National Coordinator for Security and Counterterrorism (*Nationaal Coördinator Terrorismebestrijding en Veiligheid (NCTV)*. 'Vitale infrastructuur.' *NCTV.nl*.

Figure 4.15.1 **Adaptation pathway map** for the challenge of climate-resilient energy, IT/telecom and drinking water infrastructure



The displayed timelines are indicative and represent an 'average' for the entire European Netherlands. Whether and when a policy option is required therefore varies per location. The measures referred to on the vertical axis are policy options and explicitly not policy choices.

4.15.2 The options

As shown by the adaptation pathway map, we are working towards a robust and climate-resilient system in the Netherlands. The map displays different types of adaptation options. These are different for the drinking water network compared to a telecom network, but we can apply the same grouping of measures in both cases. The pace at which we will need to switch between types of measures depends on the degree of climate change (x-axis).

We distinguish between intensification measures and transformation measures. The term 'intensification' is most appropriate in conjunction with measures to enhance day-to-day operations (dark blue) and measures to adapt network usage (green). These measures are aimed at continuing within the current scenarios and further optimising the country's critical infrastructure.

- One example of a measure to enhance day-to-day operations is investing in robust maintenance procedures. We can avoid malfunctions through frequent inspections and preventive maintenance.

- When adjusting network usage, the focus is on the more efficient use of, for example, energy and data networks. An energy saving obligation already applies under the Environment and Planning Act, with companies and institutions being required to implement energy-saving measures. This relieves the pressure on the energy system.

The remaining measures can best be described as 'transformation'. In these scenarios, we choose future-proof locations and work on, or transform, critical infrastructure on a large scale. This category includes measures to enhance operational robustness at system level (brown), measures at asset level (yellow) and technical robustness at system level (red).

- Measures to boost robustness at system level focus on operational and administrative processes. We can, for example, reduce the risk of failure by optimising control systems and ICT components.

- The focus of measures at asset level are on physically protecting and strengthening specific infrastructure components. One example is the elevation of vulnerable components (such as control equipment) during the construction of new infrastructure, or the erection of an additional dyke around it. This can help prevent damage caused by pluvial flooding.

- Measures within the technical robustness cluster at system level focus on increasing the resilience of the entire system by investing in new physical infrastructure. In this context, it is important that climate adaptation is taken into account early on when choosing where to locate critical infrastructure. Redundancy is also essential and means we have to ensure reserve capacity and alternative routes so that critical functions can continue to operate even in the event of disruptions or failures. This latter category of measures requires a longer preparation time.

The adaptation options are positioned relative to one another in the adaptation pathway map, based on a qualitative approach. The feasibility and effectiveness of the different measures depend on the specific location and infrastructure asset. Furthermore, the measures not only benefit climate adaptation but also improve the resilience of the infrastructure in a broad sense. However, the adaptation pathway generally shows that, partly due to climate change, merely continuing and enhancing the daily functioning of the system (blue path) is only sustainable for a limited period of time. We therefore need to start working on future-proof measures, both operational and technical, even before this path reaches its end.

Text box 4.15.1 **Legal division of roles**

Providers of critical services (energy, ICT/telecom and drinking water) have the statutory task of guaranteeing security of supply. rid operators manage the daily functioning of the system and operational robustness and measures at asset level. This statutory responsibility also includes the responsibility of identifying climate risks and, where necessary, devising and implementing smart solutions.

The protection of critical services is enshrined in a number of overarching European and national frameworks. The Critical Entities Resilience Directive (CER Directive) is being implemented in the Critical Entities Resilience Act. This legislation obliges providers designated as critical entities to conduct periodic risk assessments and take appropriate measures. This explicitly also relates to threats arising from climate change, such as pluvial flooding, drought, or heat.

The Network and Information Security Directive (NIS2 Directive) increases the digital resilience of critical processes and networks. In the Netherlands, this directive has been transposed into the Cybersecurity Act (*Cyberbeveiligingswet, Cbw*). The fact that digital systems and physical infrastructure are becoming increasingly interlinked makes this connection crucial for the continuity of critical services.

These frameworks therefore ensure that operators structurally take climate risks into account, and that critical infrastructure is resilient from both a physical and digital perspective. They create a level playing field within the European Union and provide the government with direction and powers to exercise oversight and monitor the coherence between sectors.

Matrix 4.15.1

Goal/Effort Matrix for the challenge of climate-resilient energy, IT/telecom and drinking water infrastructure

Ambition

Climate-resilient and reliably designed critical infrastructure

SMART goal	**Better understanding of risks**	**Clearer frameworks and guidelines**	**More resilient system**
Effort/result	→ The government is improving data and information on climate risks to better determine exposure to them and their impact. We are making up-to-date and comprehensible climate data, stress tests and policy measures available for critical sectors. → The government addresses climate risks through the Critical Entities Resilience Act (Wwke) and the Cybersecurity Act (Cbw), and we monitor risk analyses and action programmes. → The government facilitates risk dialogues based on stress tests and risk analyses (this action is to be completed by 2028).	→ The government is exploring whether and how it can standardise climate risks for critical infrastructure (this action will be completed by 2028 at the latest). → The government supports sectors in establishing clear principles for data and scenarios for design and management, including EU developments (this action will be completed by 2028 at the latest). → The government will reduce administrative burdens by better aligning cycles arising from European and other legislation and regulations and ensuring they can be used for multiple purposes (the ambition is to complete this by 2030).	→ The government is strengthening resilience through contingency plans, asset accessibility and the deployment of equipment. → The government is exploring ways to ensure that safety regions and critical service providers are considered in spatial planning decisions and design tasks (this action is to be completed by 2028 at the latest). → The government will stipulate that the competent authority must incorporate climate resilience as standard in the construction and replacement of critical infrastructure (ongoing action). → The government will foster greater collaboration between critical sectors and the public sector when implementing climate adaptation measures. The aim is to strike the ideal balance between resilience and societal costs.

4.15.3 The approach

Providers of critical services have a statutory duty of care to guarantee security of supply, and therefore also to protect the infrastructure against climate risks. The government sets frameworks and plays a facilitating role so that these responsible parties can take measures. It is important that it is clear to providers what they must comply with in relation to physical risks to critical services resulting from flooding and climate risks, and which data and information they must use for this purpose. Clarity will also guide regulators, who play a role within these sectors in ensuring sound decision-making regarding investments and accountability. As the government, we are collaborating with subnational authorities, grid operators, market parties and knowledge institutions on integrated implementation agendas. We are investing in better data, stress tests and risk analyses, including better insight into cascade effects (chain reactions where a disruption in one system leads to problems in other systems). We are developing and harmonising standards and frameworks to provide clarity on what constitutes 'adequate' or 'acceptable'.

The government, provincial authorities and municipalities also have to consider in their spatial policy how and where we should construct our critical infrastructure. These parties must also determine the conditions under which this infrastructure will be constructed, taking account of the long-term costs (to society). The advisory role of water authorities and safety regions is becoming more important in this regard. In addition, we must take account of the choices made within the framework of the Spatial Policy Document. In this way, we can anchor climate adaptation in spatial procedures, area development and management strategies and by doing so align our policy with European directives. We are also using the impact of the Spatial Policy Document[2] and existing programmes, such as the Delta Programme, the Multi-Year Programme for Infrastructure, Space and Transport, and the Main Energy Structure Programme (*Programma Energiehoofdstructuur*, PEH). Climate adaptation is taken comprehensively into account in these programmes.

Public authorities, safety regions and critical service providers can together make optimal location choices based on critical service providers' risk analyses and clear spatial policy. The focus must be on identifying bottlenecks that pose significant risks of failure or lead to unacceptably high costs, both initially and throughout the applicable operating life. Our aim is to lower costs for society and prevent the spillover of costs between public authorities and society as a whole wherever possible. To achieve this it is important that it is clear which principles provide a basis for determining whether risks are socially acceptable or not, and which parties are involved in those choices.

We have translated the ambition of a climate-resilient and reliably designed critical infrastructure by 2050 into three cross-sectoral goals. We intend to supplement these goals with more specific objectives per sector or challenge.

1. **Better insight into risks**

Our focus is on improving the available data and information regarding climate risks. This is enabling us to determine exposure to these risks and their impact more effectively. That information is essential to make and keep critical infrastructure climate resilient. In more specific terms, this requires the following actions:

- We are using the Policy Approach to Critical Infrastructure (*Aanpak Vitaal*), existing and new legal frameworks, such as the Critical Entities Resilience Act and the Cybersecurity Act, to help protect critical providers against flood and climate risks. We are providing critical sectors with the clear and up-to-date data and information they need for this purpose. (When this action will take place depends on the legislative process.)
- We are monitoring progress in terms of the execution of risk analyses and action programmes in the context of the applicable agreements. In doing so, we are also linking this to the monitoring tool the government is developing for the theme of climate adaptation. (Continuous process resulting from critical legislation.)
- Together with subnational authorities, we are providing up-to-date and understandable climate data, stress tests and policy measures that can help critical sectors increase their resilience. We are supported in this endeavour by the stress tests which are, for example, being conducted within the framework of the Delta Programme for Spatial Adaptation. Environmental services and safety regions are providing relevant information on risk management, crisis management and recovery.
- Based on the outcomes of the stress tests and risk analyses, we will focus on engaging in a risk dialogue where necessary in order to devise measures on a collaborative basis. In the case of supra-regional and national networks, we will focus on facilitating a (confidential) discussion between critical providers, the government, subnational authorities and other relevant partners. (These actions will take place before 2028.)

2 De Nota Ruimte betreft de (nieuwe) nationale omgevingsvisie in de zin van de Omgevingswet.

2. Clearer frameworks and guidelines

We are committed to clear frameworks and legislation for critical infrastructure providers and operators/developers with regard to climate risks. After all, critical providers play a crucial role in the climate-resilient management and development of their networks. Specifically, we are carrying out the following actions:

- We are exploring whether and how we can establish standards for climate risks for critical infrastructure and how this relates to existing legislation and regulations. (This will take place no later than 2028.)
- We are supporting the sectors in establishing clear principles for the use of data and scenarios to design critical infrastructure in a climate-resilient manner and to adjust it periodically, depending on how climate change develops. We are also taking account of developments within the EU context during the process. (This will take place no later than 2028.)
- We are committed to limiting the administrative burden associated with risk analyses on critical providers. We are doing this by aligning cycles from various (European) legislation and regulations more effectively. The basic principle is that providers periodically carry out one high-quality, comprehensive analysis that can be used in multiple applications. (The ambition is for this action to be completed by 2030.)

3. A more robust system

In the case of infrastructure design and management, we are opting for an approach aimed at improved resilience and robustness. In concrete terms, this means the following:

- In addition to optimising existing systems, we are asking critical providers to reflect explicitly on the accessibility of assets, required implementation capacity and equipment in crisis plans and recovery tasks. Our aim is to limit the consequences of failure and damage and minimise recovery times. After all, the recovery process largely determines the impact of failure and damage. We are developing useful information and tools. (We are carrying out this action on an ongoing basis.)
- We are exploring how we can safeguard the position of safety regions and critical providers in spatial choices and design tasks. This is enabling us to gain a better understanding of safety risks, crisis management, investments and long-term financing when spatial plans start to be put together. The system becomes more robust when we make smarter choices regarding the conditions for constructing new critical infrastructure and where this can be done (more) safely and more affordably. (This action will be completed by 2028 at the latest.)
- We are obliging the competent authority to include climate resilience as a standard requirement for the construction and replacement of critical infrastructure. The competent authority must then incorporate these climate risks into an integrated spatial assessment within strategic spatial visions and critical infrastructure projects. (This action is ongoing.)

We are carrying out the following actions specifically for the energy, drinking water, and ICT/telecom sectors:

Energy: we are focusing on the energy mix and the spatial planning aspects of the energy system.

- Our aim is to achieve a differentiated energy mix involving various sources such as wind, solar, and nuclear energy. This will reduce dependence on specific assets. We are also focusing on energy conservation to reduce dependence on the grid. (We are carrying out this action on an ongoing basis.)
- In the context of recalibrating the Main Energy Structure Programme, we are assessing future space for energy infrastructure in terms of climate resilience. This programme outlines the spatial strategy for the energy system between now and 2050. Where necessary, we are introducing new design principles that will make the system more robust. We are doing this in our role as the competent authority for the spatial planning of national interests. (This action will be completed in 2028).
- Based on the Main Energy Structure Programme, we are assessing whether further research is needed into the specific interfaces between climate adaptation and the energy system. For instance, as part of the implementation of the Main Energy Structure Programme by the Ministry of Climate Policy and Green Growth and the Ministry of Infrastructure and Water Management, research was conducted into the demand for water in the context of hydrogen production in relation to the declining availability of fresh water, and potential solutions were then identified. This provided a basis for future-proof choices in the Spatial Policy Document. (Formulation of potential research questions based on Main Energy Structure Programme 2028).

- We are also incorporating climate change risks, such as flooding, into individual energy projects as part of the comprehensive assessment for new energy infrastructure locations. In doing so, our aim is to build in a climate-adaptive manner. There are multiple options for achieving this, with our preference being to select the option with the lowest impact on the project and the surrounding area. (We are carrying out this action on an ongoing basis.)

Drinking water: we are increasing the robustness of the drinking water supply in a variety of ways.

- Drinking water companies are including the impact of climate change on installations in the supply plans they draw up to prepare for potential disruptions. In addition, the Drinking Water Directive (*Drinkwaterrichtlijn*) also stipulates that drinking water companies must conduct a risk analysis for each water catchment area, and that this must be accompanied by a risk management plan. The relevant protocol includes a requirement that drinking water companies' risk analysis explicitly addressed climate risks at that specific location.
- In line with the letter to parliament on the vision for water and soil,[3] the drinking water companies and provincial authorities are working on connecting the supply networks more effectively.
- We are committed to expanding the production capacity of drinking water via the Action Plan for the Availability of Drinking Water Sources 2023–2030 (*Actieprogramma beschikbaarheid drinkwaterbronnen 2023-2030*)[4]. We are also working to reduce demand for drinking water through the National Action Plan for Drinking Water Conservation (*Nationaal Plan van Aanpak Drinkwaterbesparing*).[5] The objective is for drinking water consumption to reach 100 litres per person per day by 2035.
- We are striving to avoid exceeding the quality requirement of 25°C set out in the Drinking Water Decree.[6] The urban heat island effect (where urban areas are warmer than their rural surroundings) increases the risk of exceeding this temperature. Doing so also increases the risk of microbial activity in the drinking water. The NEN-7171-1 standard provides criteria for the proper organisation of underground networks in public land during new developments and applies to new development situations. The organisation principles may also be useful when work is being carried out on the underground networks for other reasons.

ICT/Telecom: there is a strong focus on resilience within the ICT/Telecom sector, as part of our digital infrastructure.

- Entities are required to comply with the duty of care under the Telecommunications Act (*Telecommunicatiewet*) and/or the Cybersecurity Act (NIS2). This includes the obligation to take technical and organisational measures, which are appropriate for the risks that arise, in order to ensure the continuity of their networks and services. This duty of care is regulated by the Dutch Authority for Digital Infrastructure (*Rijksinspectie Digitale Infrastructuur*).
- As the government, we are collaborating with critical parties in the ICT and telecom sector on additional reinforcement measures to increase resilience to current military and hybrid threats. These measures are intended to improve the general robustness of such networks and thereby also help to limit and prevent any climate change consequences.
- The National Telecom Continuity Forum (*Nationaal Continuïteitsoverleg – Telecom*, NCO-T) is assessing the various risks and threats that may disrupt the continuity of these networks and how to prevent this.

3 Ministry of Infrastructure and Water Management Letter to parliament on the vision for water and soil, 22 October 2024.
4 Minister of Infrastructure and Management Letter to Parliament accompanying the programme of action on the availability of drinking water sources 2023-2030, 13 January 2025.
5 Minister of Infrastructure and Management Letter to parliament on protecting the quality of drinking water, 24 June 2024.
6 TZ202402-063 dated29-01-24.

4.15.4 The consequences of The approach

The robustness and resilience of critical infrastructure enables us as a society to keep functioning on a day-to-day basis and achieve our objectives. A robust and resilient critical infrastructure is expected to result in less damage and lower repair costs, shorter and less extensive periods of downtime.

The NAS's Strategic Environmental Impact Report shows that the robustness of critical facilities can be enhanced if we take water and soil into account when developing infrastructure, and when constructing new assets in a climate-resilient manner.[7] However, this comes at the cost of increasing pressure on space and the burden of implementation. After all, the critical networks in this chapter are already facing a major challenge in terms of expansion and design. Effective spatial policy and improved insight into the consequences of spatial choices can alleviate the pressure placed on critical providers. Moreover, uniform agreements on applicable scenarios and basic principles will ensure that spatial choices become more transparent, and that additional and reduced costs are more clearly visible. Uniformity also offers sectors the opportunity to compare measures and learn from one another as well as simplifying the task of monitoring risks. It also creates a level playing field and prevents or limits unfair competition or disproportionate pressure on rates.

Increasing the climate resilience of critical infrastructure requires effort on the part of society as a whole. Changes to network usage may require every citizen and business to contribute by critically examining their own usage. Critical providers have an ongoing obligation to ensure the continuity of the networks despite increasing climate risks. As the government, we must facilitate this by applying the appropriate frameworks and guidelines.

7 Movares, as commissioned by the Ministry of Infrastructure and Water Management. *PlanMER Nationale klimaatadaptatiestrategie 2026*. Movares: Utrecht, 2026.

Chapter 5

The Caribbean Netherlands

This chapter describes the government's climate adaptation strategy for the three public bodies of Bonaire, St. Eustatius, and Saba (BES), collectively referred to as the Caribbean Netherlands. Where relevant, we briefly discuss its applicability to Curaçao, Aruba, and St. Maarten, where similar climate risks exist.

5.1 The challenge

Climate change can have major physical, social and economic effects in the Caribbean Netherlands. In Chapter 2, we described which weather extremes have already occurred in the Caribbean Netherlands in recent years, and how climate change is expected to manifest itself here. The most important effects are sea level rise, an already noticeable increase in temperatures, a decrease in precipitation, ocean acidification, and an increased likelihood of Category 5 hurricanes.[1]

The effects of climate change can have major consequences for various sectors in the Caribbean Netherlands.[2] In the future, agriculture on Bonaire may, for instance, be disrupted even more because of drought, while infrastructure on St. Eustatius and Saba may be impacted more frequently by Category 5 hurricanes. Low-lying areas around the coasts will be affected by rising sea levels, heat will increasingly affect people's health,[3] and the more intense rainfall will also lead to more pluvial flooding and erosion.[4] The Caribbean Netherlands also has a number of extremely vulnerable ecosystems, such as coral reefs and heritage sites, which are sensitive to the consequences of climate change.[5, 6, 7] Such changes will affect key sectors, such as tourism and fisheries.

1 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
2 Witteveen+Bos, as commissioned by the Ministry of Infrastructure and Water Management. *Climate change and adaptation efforts BES islands*. Utrecht: Witteveen+Bos, 2024.
3 Royal Netherlands Meteorological Institute (KNMI). *KNMI'23-klimaatscenario's voor Nederland*. De Bilt: KNMI, 2023.
4 HKV Lijn in Water, as commissioned by the Ministry of Infrastructure and Water Management. *Risicoprofielen overstromingen BES eilanden*. Lelystad: HKV, 2024.
5 Wageningen Marine en Environmental Research, as commissioned by the Ministry of Economic Affairs and Climate. *Staat van de natuur van Caribisch Nederland 2017*. Wageningen: Wageningen University & Research, 2018.
6 Ministry of Agriculture, Fisheries, Food Security and Nature, Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations *Plan voor land en water. Nature and Environment Policy Plan for the Caribbean Netherlands 2020–2030*. The Hague: Government of the Netherlands, 2020.
7 Cultural Heritage Agency of the Netherlands. 'Landscape biographies Saba and St. Eustatius. 'Landscape biographies Saba and St. Eustatius Landschapsbiografieën Saba en Statia'.

The islands and the government have prioritised various domains and sectoral adaptation challenges for the Caribbean Netherlands. These are presented in Table 5.1. This prioritisation is based on studies and consultations with various stakeholders, including the BES public bodies.

Table 5.1
Prioritised domains and sectoral challenges

Domain	Challenges
Water	Water infrastructure, seawater quality, flood protection and pluvial flooding
Agriculture, nature and the environment	Erosion, nature (including coral reefs), food security and fisheries
People and culture	Health and cultural heritage
Living and working	Homes and buildings, public space, tourism, infrastructure

In addition to these sectoral challenges, we are also including a number of integrated challenges in this adaptation strategy. These are climate-resilient spatial planning and organisation, a society which is prepared for climate change, an administration equipped for the adaptation challenge and financial backing for climate adaptation. We are doing this due to specific circumstances applicable to the islands:

- A significant proportion of islanders face severe socio-economic conditions, which are coming under further pressure due to climate change. The high cost of living is difficult for many to cope with. This is also complicating the adaptation approach.
- Demographic developments are influencing the challenge and the scope for solutions[8]. For example, the number of residents on Bonaire is increasing sharply, while a decline in the population is projected on St. Eustatius. This could lead to increased pressure on facilities and public space in the case of Bonaire, while the capacity to support facilities on St. Eustatius is decreasing.
- Bonaire, St. Eustatius, and Saba have limited capacity to implement measures and limited access to financing sources, such as funds and loans. The islands are not, for example, eligible for development aid because they are they part of the Netherlands. At the same time, they do not always qualify for European funds because they are located outside the EU[9].

The ambition

The Caribbean Netherlands is climate-resilient, now and in the future.

8 National Commission on Demographic Developments in the Caribbean Netherlands by 2050 (Staatscommissie Demografische Ontwikkelingen Caribisch Nederland 2050). *Gerichte groei.* The Hague: National Commission on Demographic Developments in the Caribbean Netherlands by 2050, 2024.
9 Witteveen+Bos, as commissioned by the Ministry of Infrastructure and Water Management. *Climate change and adaptation efforts BES islands.*

Text box 5.1 **Island climate plans**

In 2023, the government decided to support the BES islands with the development of climate plans, as is also customary at subnational level in the European Netherlands. This was done as follow-up to the advisory report entitled 'It is never too late' (*Het is nooit te laat*).[10] The government made resources, knowledge and expertise available for these climate plans. The plans are being developed by and for local residents and cover the breadth of the climate challenge. They will include measures that the islands themselves will take to increase climate resilience. Each island is working towards its own climate plan that is appropriate for local circumstances. A climate working group has been established for this purpose on Bonaire, on behalf of the public body. On St. Eustatius and Saba, the civil service is being supported with the drawing up of a suitable plan. Discussions have taken place with stakeholders and all layers of the population on all three islands.

Climate plans are also being worked on by officials on Curaçao, Aruba and St. Maarten. The Netherlands has supported these processes through the International Panel on Deltas and Coastal Areas (IPDC). The approach was based on respect for local autonomy, while simultaneously developing a shared knowledge base that supports decision-making. Knowledge and partnerships are also regularly shared, for example in the context of crisis management, health and the Four Country Consultation. Where possible, we are making the approach described in section 5.2 available to these islands as well. This will apply in particular to knowledge development.

10 Minister for Kingdom Relations and Effective Government. Letter to parliament setting out the government's response to the advisory report 'It's never too late', 7 November 2023. The Hague: Government of the Netherlands, 2023.

5.2 The approach

The focus of our approach is on the above-mentioned sectoral and integrated challenges. In the process, we will take local circumstances into account.

5.2.1 The approach for the sectoral challenges

The Goal/Effort Matrix in Matrix 5.2 describes our approach to the sectoral challenges. This also includes several existing programmes and initiatives like the Nature and Environment Policy Plan (*Natuur- en milieubeleidsplan*, NMBP) and the Spatial Development Programme for the Caribbean Netherlands (*Ruimtelijk Ontwikkelingsprogramma Caribisch Nederland*, ROCN).[11]. Various ministries are, in fact, already working on climate resilience.

11 Het ROCN (2004) contains an overview of government policy in the Caribbean Netherlands with special implications. Many of the fourteen national interests listed are linked to climate adaptation. Two of those are related very specifically to the issue, namely: 'The protection of critical and sensitive functions from the effects of climate change' and 'Effective water management to mitigate flooding, drought and erosion'.

Matrix 5.2

Goal/Effort Matrix for the sector-specific challenges in the Caribbean Netherlands

Ambition

The Caribbean Netherlands is climate resilient, both now and in the future
Using a sector-specific approach, the government will contribute to increasing the climate resilience of the Caribbean Netherlands through policy, research and measures.

Domains	**Water domain**	**Agriculture, Nature and the Environment Domain (including fisheries and food security)**	**People and Culture Domain**	**Living and Working Domain (including the economy and tourism)**
SMART goal	Resilient water infrastructure.	Less erosion	Negative health effects of climate change are minimised as far as possible	Climate-resilient homes and buildings
Effort/result	→ The government will draft a long-term strategy for drinking water and wastewater infrastructure. → The government is investigating how to contribute to improving rainwater management.	→ The government is exploring how to contribute to erosion control through natural measures and infrastructure projects.	→ The government will support public health through public bodies, with a focus on heat stress. → The government will support monitoring for vector-borne diseases and the introduction of diseases via invasive alien species.	→ The government is exploring what data is available and required for the Caribbean Netherlands to assess the climate resilience of homes and buildings.
	Improved seawater quality	Reduced pressure factors for nature, including coral reefs	Cultural heritage is climate resilient	Climate-resilient public space, including roads
	→ The government is looking into expanding the monitoring network for groundwater and seawater and is investing in modelling.	→ The government is using the Nature and Environment Policy Plan to conserve and protect nature and the environment.	→ The government will support public bodies in the management and conservation of cultural heritage, incorporating protection against the effects of climate change. The government will structure this support by providing insight into the effects of climate change on heritage.	→ The government is committed to improving the physical domain and is doing it in a climate-resilient manner. → The government encourages proper drainage during the road construction or renovation, in part by providing relevant expertise.
	Increasing understanding of water safety and pluvial flooding resilience.	Climate change will not lead to a decline in food security		Sustainable tourism
	→ The government is exploring how to develop knowledge about pluvial flooding within the various layers of multi-layered safety. → The government will support public bodies in drafting frameworks for vulnerable areas through the CN Spatial Development Programme. → The government is exploring the development of a CN Climate Adaptation Knowledge Agenda. → In collaboration with the water authorities, the government will support public bodies with expertise and capacity.	→ The government is exploring ways to boost food availability on the islands. → The government is assessing the vulnerability of supply chains in relation to climate risks.		→ The government is promoting the development of sustainable tourism. This form of tourism is less vulnerable to climate change and exerts less stress on natural systems.
		Sustainable fisheries		Critical infrastructure (airports, ports, energy, telecoms and waste) is resilient to extreme weather events
		→ The government is promoting the development of sustainable fisheries. This form of fishing is less vulnerable to climate change and exerts less stress on natural systems.		→ The government will provide support by giving clear insight into climate risks and ensuring they are taken into account in delivery plans and its own investments.
				Greater regional cooperation
				→ The government is exploring possibilities for regional cooperation to increase local resilience and improve preparedness for disasters.

Water domain

It is important to prepare the BES islands water system for our changing climate. This means responding to, among other things, increasing drought, sea level rise, groundwater that is becoming more and more saline, pluvial flooding caused by intense downpours, vulnerable drinking water inlets on the coast, and the effects of inadequate wastewater facilities on marine ecosystems, which in turn help to protect the coast. The government is therefore carrying out the following actions:

- We are exploring the possibilities of linking water management initiatives to existing programmes such as the Nature and Environment Policy Plan and the Spatial Development Programme for the Caribbean Netherlands. This means future-proof and context-specific drinking water and wastewater infrastructure, improved seawater quality, reduced flooding and increased flood protection. This also entails a long-term investment agenda for water infrastructure that clarifies which investments are needed on the islands for the coming years.
- We are investing in the development of knowledge on pluvial flooding, while focusing on multi-layered safety.[12] Our aim is for our spatial development policy to steer us towards taking water and climate change into account in order to prevent nuisance wherever possible. This partly involves us also exploring the possibilities for drawing up a knowledge agenda for climate adaptation in the Caribbean Netherlands.
- We are expanding the monitoring and modelling of both the quality and quantity of water and soil to track the effects of climate change more effectively.
- We are establishing a partnership between the government, water authorities and the public bodies of the BES islands in order to provide support on water issues. We are investigating how this partnership can complement and enrich existing initiatives, such as the VNG Caribbean Desk and the Caribbean Netherlands Project Office (*Projectenbureau Caribisch Nederland*, PBCN)[13]. These initiatives originated from the various support arrangements offered by the Ministry of the Interior and Kingdom Relations and other ministries to boost the public bodies' implementation capacity.

Agriculture, nature and the environment domain (incl. fisheries and food security)

It is crucial to work on nature's resilience. After all, climate change is a threat to nature in the Caribbean Netherlands.[14] At the same time, if that nature is in a reasonable state, it can make an important contribution to the islands' capacity to adapt. For example, a healthy coral reef fulfils the function of a breakwater, which in turn helps to protect the coast. Agriculture is also suffering from climate change and its effects are already noticeable in the fisheries sector as well. Fishermen have to sail further and further out to sea because fish are moving to deeper and cooler waters. The government is therefore carrying out the following actions:

- We are implementing various measures from the Nature and Environment Policy Plan for the Caribbean Netherlands 2020-2030.[15] We are focusing on, among other things, preventing erosion (incl. reducing free-roaming livestock), reducing pressure factors for important ecosystems such as coral reefs, promoting food security and making the fisheries sector more sustainable. In the coming period, we aim to design the second phase of the Nature and Environment Policy Plan for the Caribbean Netherlands, while explicitly taking account of the risks posed by climate change.[16]
- We are using various initiatives to focus on increasing food security in order to boost the islands' self-reliance.[17]
- As a member of the International Panel on Deltas and Coastal Areas (IPDC), we are conducting an analysis of the vulnerabilities of sea container supply lines.

12 Multi-layered safety comprises water-conscious behaviour (layer 0), prevention (layer 1), mitigation (layer 2), crisis management (layer 3) and water-resilient recovery (layer 4).
13 See overview of support arrangements for implementation capacity:
14 Wageningen Marine Research as commissioned by the Ministry of Agriculture, Fisheries, Food Security and Nature. *State of Nature Report for the Caribbean Netherlands* 2024.
15 Ministry of Agriculture, Fisheries, Food Security and Nature, Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations *Plan voor land en water. Nature and Environment Policy Plan for the Caribbean Netherlands* 2020–2030.
16 Minister for Food Security, Fisheries and Horticulture. Letter to parliament on the response to the interim review of the Nature and Environment Policy Plan for the Caribbean Netherlands, 8 July 2025. The Hague: Government of the Netherlands, 2025.
17 Minister for Kingdom Relations and Effective Government. Letter to parliament regarding the establishment of the CariFoodFund (CFF) foundation, 13 February 2026.The Hague: Government of the Netherlands, 2026.

People and culture domain

We are mindful of the impact of climate change on individuals and society. This includes the economic impact, health consequences and effects on, and consequences for, cultural heritage. As the government, we are committed to limiting the negative effects of climate change on people's physical and mental health as much as possible. We do this by taking the following actions:

- We are supporting public health, while also paying attention to heat stress.
- We are supporting the monitoring of vector-borne diseases (diseases that insects such as mosquitoes and ticks can transmit to humans).
- We are developing an adaptation monitoring system that also allows us to monitor the presence of invasive species. That is because climate change can lead to an increase in invasive species that bring new diseases with them.
- We are supporting the management and preservation of cultural heritage, and this will include incorporating protection against the effects of climate change. Our support mainly revolves around providing insight into the effects of climate change on heritage sites. For instance, the preservation of the coral reef off the south coast of Bonaire is also important for the preservation of the huts where enslaved people once lived. Erosion caused by extreme rainfall poses a major challenge to the preservation of indigenous archaeological sites and heritage locations near the coast on Saba and St. Eustatius. Intangible heritage, such as seasonal festivals, is closely linked to agricultural practices and is therefore related to food security initiatives. Cultural heritage is very important for the BES islands' identity.

Living and working domain (incl. economy and tourism)

It is important to make the physical living environment on the BES islands resilient to the consequences of climate change. This is the aim despite the fact that backlogs already exist in areas such as infrastructure and it is why the government is going to focus heavily on this issue in the coming period[18]. However, little data is currently available on the housing market in general and the climate resilience of the existing housing stock in particular.

- In the coming period, we are going to make every effort to gain a better insight into what data is available and needed to identify the climate resilience of homes and buildings in the Caribbean Netherlands.
- We are emphasising the importance of new infrastructure that takes future climate risks into account and provide any relevant knowledge that might be required. The same applies to the renovation of existing roads, in which context it is important to improve drainage.
- We are committed to increasing the climate resilience of the crucial infrastructure on which the islands depend, and this includes airports, ports, energy systems, telecommunications and waste management facilities. Climate change is already part of our analysis of the security of supply of drinking water and energy. The government is going to continue encouraging this approach as much as possible by making climate risks transparent and by factoring them into its own investments. In doing so, we will take account of the responsibility and obligations of infrastructure and industrial operators when it comes to them also taking measures themselves.
- We are going to encourage the tourism industry to become more sustainable, so that this sector exerts less pressure on nature. A healthy natural environment, such as coral reefs, actually enhances these islands' ability to adapt. On top of this, the islands can reduce their vulnerability to potentially disappointing visitor numbers (for example, due to climate change) by broadening the range they have to offer tourists and in this way work towards economic resilience. Finally, it is important to safeguard ecotourism. The main tourist attraction on almost all the islands is nature (hikers, divers). Nature conservation measures designed to maintain tourism levels are therefore essential for the small-scale economies.

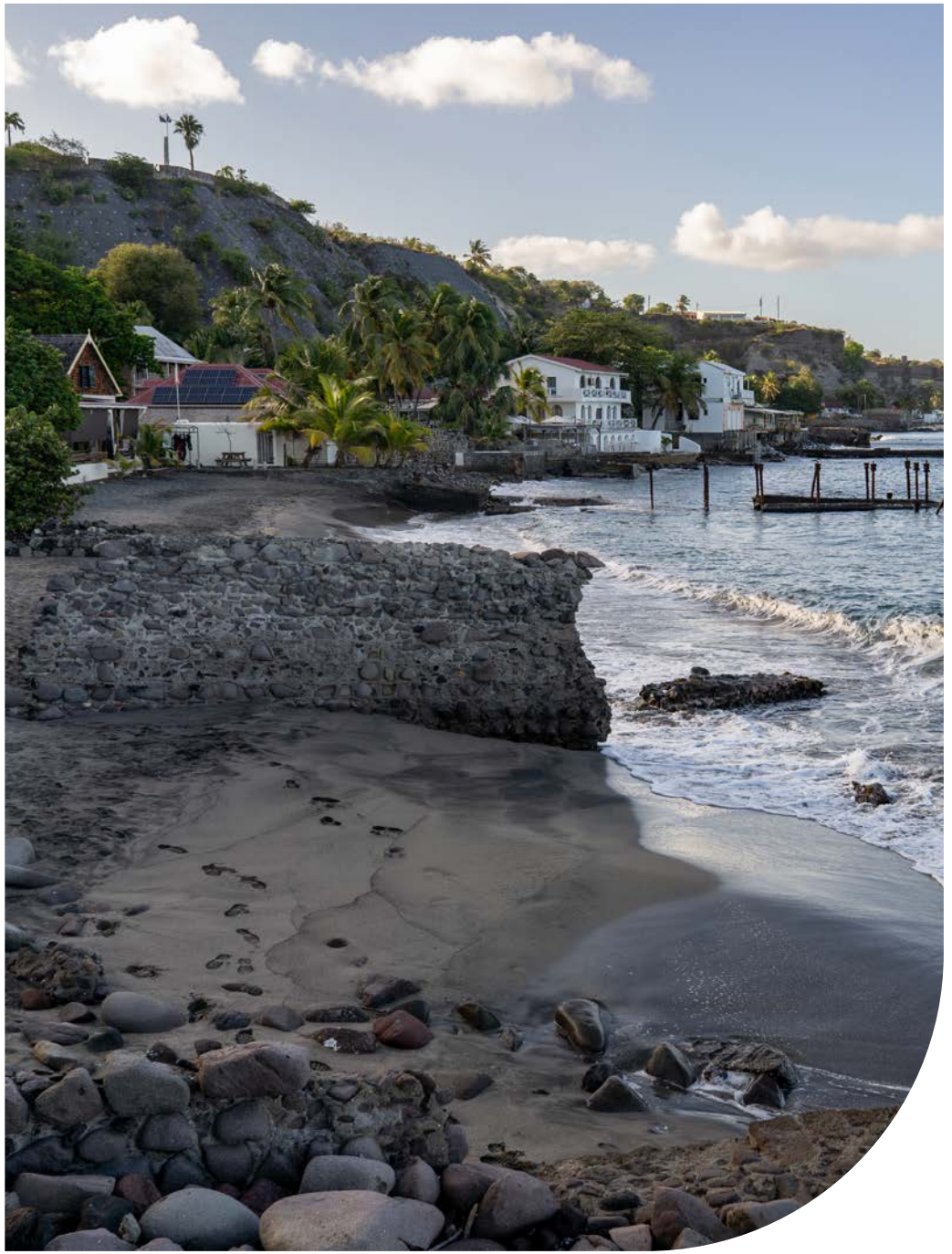
18 Minister for Kingdom Relations and Effective Government. Letter to parliament setting out the government's response to the recommendations of the Council for the Environment and Infrastructure and the Council for Public Administration regarding the physical environment of the Caribbean Netherlands, 7 November 2025. The Hague: Government of the Netherlands, 2025.

5.2.2 The approach to the integrated challenges

The focus on sectoral challenges has consequences for both the islands and the government services that deal with them.

The Caribbean Netherlands is facing considerable issues in several other domains in addition to climate change. The situation is – and remains – challenging, with major issues needing to be resolved with limited implementation capacity. The result is a constant search for the right balance between ambition and realism. In practice, work on climate resilience and the other issues will have to be carried out simultaneously. This requires an integrated approach and an eye for opportunities to link challenges within different policy areas. In the long term, climate adaptation must become part of ongoing national policy for the Caribbean Netherlands.

The Goal/Effort Matrix in Matrix 5.3 describes the goals and efforts for the integrated challenges. These challenges are climate-resilient spatial planning and design, a society which is prepared for climate change and an administration which is equipped to tackle the challenge of adaptation and financial backing for climate adaptation.



Remnants of warehouses
Lower Town, Sint Eustatius
(Photo: Robin Ammerlaan)

Matrix 5.3

Goal/Effort Matrix for the integrated challenges in the Caribbean Netherlands

Ambition

The Caribbean Netherlands is climate resilient, both now and in the future
Using an integrated approach, the government will contribute to increasing the climate resilience of the Caribbean Netherlands through policy, research and measures.

Domains	Spatial planning and design	A society which is prepared for climate change	A government that is equipped for the challenge of adaptation	Financial feasibility
SMART goal	The measures from the island climate plans will be incorporated into the island spatial development plans by 2027 at the latest.	Adaptation policy will not lead to increased costs for those with low incomes.	Climate adaptation will be systematically incorporated into administrative coordination with the islands (ongoing).	An exploratory study will follow to ensure that government investments in the Caribbean Netherlands take climate change into account by 2030 at the latest.
Effort/result	→ Island climate measures will be incorporated into the island spatial development plans. → The government is exploring a methodology for a sustainable financing system for the islands' infrastructure.	→ The government is committed to ensuring a liveable social minimum and reducing the cost of living. → The government will conduct a SIA for climate policy in 2026.	→ The government will regularly discuss progress on sectoral and overarching objectives with the islands and across ministries.	→ The government is exploring what is needed to make all government investments in the Caribbean Netherlands climate adaptive by 2030 at the latest.
	From 2028, climate change will be considered when making relevant policy decisions.	Resilience to extreme weather events in the Caribbean Netherlands will be enhanced.	The government has insight into the progress and effectiveness of adaptation policy and is making adjustments where necessary.	
	→ Avenues for incorporating climate change from the outset will be explored for all relevant new government programmes and policy intensifications in the Caribbean Netherlands.	→ The government will invest in early-warning systems for natural disasters. → The government is investigating the possibility of establishing a bespoke scheme that can offer victims of disasters on the BES islands at least the same level of protection in terms of compensation as that provided by the Wts to disaster victims in the European Netherlands.	→ The government will deliver the National Climate Adaptation Monitoring Report in 2027. → The government is exploring options for systematic monitoring and biennial reporting. → The government drafts a new National Climate Adaptation Implementation Programme every four years, and that will include the Caribbean Netherlands.	
		Data availability will be increased and the knowledge base for climate adaptation will be further developed (ongoing).		
		→ The government will continue to invest in relevant knowledge and in the underlying basic data. → The government is exploring options for establishing a solid geo-data foundation in the Caribbean Netherlands.		

Climate-resilient spatial planning and design

Given that physical space is limited, it is crucially important to find measures that can serve spatial goals, in addition to climate adaptation. This means the goals from the Spatial Development Programme for the Caribbean Netherlands[19] and the spatial development plans of Bonaire, St. Eustatius, and Saba. Nature-based goals such as reforestation and coral restoration can, for example, go hand in hand with adaptation and new infrastructure can also contribute to other goals after relatively minor design adjustments. For example, rainwater collected at a solar panel park on Saba can be made available as drinking water. As the government, we are aiming towards achieving this coherence in the proposed approach for the physical domain in the Caribbean Netherlands.[20] In this regard, ambiguities relating to land ownership are a complicating and potentially delaying factor. We are focusing on the following goals and corresponding commitments:

- The measures contained in the island climate plans will become part of the islands' physical agendas by no later than 2027. The BES islands are drawing up climate plans which contain measures to increase the islands' climate resilience. The government is committed to supporting these measures as much as possible. We are doing this by incorporating the necessary measures wherever possible into ongoing programmes and the physical agendas developed per island and adopted by central-local government steering groups.[21] A crucial part of this is that the government will commit to providing sufficient structural funding. The report entitled '*Small area, major challenge*' *(Klein gebied, grote opgave)* by Andersson Elffers Felix (AEF)[22] and the advice of the Council for Public Administration[23] (*Raad voor het Openbaar Bestuur*, ROB) show that the funding made available for investment, maintenance and replacement tasks in physical infrastructure is still inadequate. The recommendations emphasise the lack of structural funding for a sustainable financing system for island infrastructure. That is why we are investigating how the aforementioned challenges can best be addressed.[24]
- From 2028 onwards, climate change will be taken into account in relevant policy choices. We will do this by exploring how climate change can be incorporated from the outset in all new national programmes and accelerations of measures in the Caribbean Netherlands. This can be done, for example, by conducting an analysis of the potential effects of climate change during the preparatory phase and incorporating these into further policy development.

A society which is prepared for climate change

It is important that climate adaptation measures take account of the socioeconomic conditions and the implementation capacity on the BES islands. Many residents in the Caribbean Netherlands have an income below the social minimum. There is national policy to address this, including through tax relief. It is therefore important that climate adaptation policy does not lead to increased burdens for minimum income households. At the same time, climate adaptation measures can also have a cost-reducing effect. Investing in erosion control can, for example, lead to less flooding. Furthermore, it is important for public bodies that 'work produces work', because implementation capacity is already a major problem on the BES islands. To this end, the government is investing in expanding the Physical Domain Project Office (*Projectenbureau fysiek domein*) of the National Office for the Caribbean Netherlands[25].

The government is focusing on the following goals and associated efforts:

- Prevent adaptation policy from leading to increased burdens for minimum income households. We are commissioning a social impact assessment to gain a better insight into the potential consequences for society of adaptation policy on the BES islands. The expectation is that residents who live on less than a minimum income will be hit hardest by the consequences of extreme weather phenomena, such as hurricanes and drought. In order to prevent climate policy from leading to an increased burden on this group, the government is committed to ensuring that

19 Ministry of the Interior and Kingdom Relations. Spatial Development Programme for the Caribbean Netherlands The Hague: The Hague: Government of the Netherlands, 2024.
20 Minister for Kingdom Relations and Effective Government. Letter to parliament setting out the government's response to the recommendations of the Council for the Environment and Infrastructure and the Council for Public Administration regarding the physical environment of the Caribbean Netherlands, 7 November 2025.
21 Minister for Kingdom Relations and Effective Government. Letter to parliament setting out the government's response to the recommendations of the Council for the Environment and Infrastructure and the Council for Public Administration regarding the physical environment of the Caribbean Netherlands, 7 November 2025.
22 AEF, as commissioned by the Ministry of the Interior and Kingdom Relations. *Klein gebied, grote opgave.* Utrecht: Andersson Elffers Felix, 2024.
23 ROB. *Advies bekostiging infrastructurele opgaven Caribisch Nederland*. The Hague: Council for Public Administration, 2025.
24 Minister for Kingdom Relations and Effective Government. Letter to parliament setting out the government's response to the recommendations of the Council for the Environment and Infrastructure and the Council for Public Administration regarding the physical environment of the Caribbean Netherlands, 7 November 2025.
25 Minister for Kingdom Relations and Effective Government. Letter to parliament setting out the government's response to the recommendations of the Council for the Environment and Infrastructure and the Council for Public Administration regarding the physical environment of the Caribbean Netherlands, 7 November 2025.

people have a minimum income that they can live on. Structural funding has been provided to develop measures to reduce the cost of living, based partly on the recommendations of the Minimum Income Standard Committee of the Caribbean Netherlands (*Commissie Sociaal Minimum Caribisch Nederland*).

- Increase resilience to extreme weather events in the Caribbean Netherlands. We are doing this by continuing to invest in systems such as the KNMI Early Warning Centre. We are also exploring which additional investments are needed to enhance systems that warn on time about heat, drought, wildfires, the consequences of high sea surface temperatures and compound events. We aim to have these systems in place by 2027 at the latest. We are also investigating whether it is possible to establish a tailor-made scheme that can offer victims of disasters on the BES islands at least the same level of protection from a damage perspective as the Disasters and Serious Accidents (Compensation) Act (*Wet tegemoetkoming schade bij rampen*, Wts) offers disaster victims in the European Netherlands.
- Increase data availability and improve the knowledge base. In order to increase resilience to climate change, it will be necessary to continue investing in knowledge and the underlying basic data. We are attempting to do this for all Caribbean parts of the Kingdom while, of course, also taking local autonomy into account. This relates both to knowledge of the physical system and weather and climate change and to the impact of climate change on various sectors. We are also continuously working on the further development of climate scenarios for the Caribbean Netherlands. In association with this, we are investigating how we can actively discuss the acquired knowledge with island communities, including in schools. This is essential for a better understanding of climate risks and sustainable behavioural change. In order to improve the availability of data, it is necessary to have a solid geo-data foundation in place on Bonaire, St. Eustatius and Saba. This involves, for example, a registry of addresses and buildings, topography, a registry of cables and pipelines and a secure coordinate system. We are having the costs and benefits of this worked out in 2026.
- Increase the resilience of the islands by investigating how to stimulate further regional cooperation. The government is also taking account of existing support arrangements for, and partnership initiatives between, the Caribbean parts of the Kingdom. These regional partnerships offer benefits, for example in terms of working together on preparations for, and responses to, natural disasters.

An administration equipped for the adaptation challenge

It is important to incorporate climate adaptation as effectively as possible into all developments and policies. This requires effective administrative cooperation between sectors and levels of government alike. The government will continue to encourage this by itself placing climate adaptation repeatedly on the agenda - and by discussing progress - in interministerial and administrative consultations with the BES islands. In this context, it is desirable to agree on a clear division of responsibilities between the government and the public bodies regarding the climate resilience of standard policy issues. This results in the following efforts:

- Climate adaptation is to be structurally included in the administrative coordination with the islands (ongoing). In order to achieve the substantive and overarching goals, good cooperation and coordination are essential, both with all the government ministries involved and with the islands. Progress on these goals is to be discussed on a recurring basis by the different ministries and with the islands.
- The government has insight into the progress and effectiveness of adaptation policy and makes adjustments where necessary. We are going to do this by delivering a National Climate Adaptation Monitoring System (*Landelijk Monitoringssysteem Klimaatadaptatie*) in 2027 that is suitable for tracking policy progress and making adjustments where needed. We are exploring the costs and funding possibilities for the structural collection of the data which is required to achieve this goal, as well as the analysis, evaluation and biennial reporting. We are also drawing up a new National Climate Adaptation Implementation Programme (NUP KA) every four years which will contain an overview of all government initiatives taking place in the Caribbean Netherlands.

Financial backing for climate adaptation

We are identifying the financial resources required for climate adaptation. As described earlier, work is already underway to address the challenges associated with adequately tackling ongoing tasks in the physical domain, by bringing both implementation capacity and the necessary resources up to scratch[26]. The AEF overviews contain initial estimates of the costs of climate adaptation[27]. Larger investments will also be required in the future. And the types of investments and their size must be determined in more detail and prepared in due course. On the other hand, the costs of doing nothing are significant. The costs resulting from hurricane damage up to 2050 are, for example, estimated at being $48.6 million for Bonaire, $121.2 million for St. Eustatius and $84.3 million for Saba[28]. The government is focusing on the following goal:

- The government knows what is needed to take climate change into account in government investments in the Caribbean Netherlands by 2030 at the latest. We are not only developing policy, but are also investing in, for example, infrastructure and real estate in the Caribbean Netherlands. We are exploring what is needed to make all government investments in the Caribbean Netherlands climate-adaptive by 2030 at the latest, and in some instances, we are also doing the same for Curaçao, Aruba and St. Maarten.

Text box 5.2 **How this chapter came about**

The basis for writing this chapter is the realisation that it is important to provide an insight into how the government contributes to climate resilience for the Caribbean Netherlands as well. Several reports have been published in recent years which show that Bonaire, Saba and St. Eustatius are facing major adaptation challenges. To do as much justice as possible to the local situation in the Caribbean Netherlands, we have involved – in addition to the public bodies – various types of stakeholders in the development of this strategy, such as:

- The participants of the Bonaire Climate Table and the relevant civil servants from St. Eustatius and Saba.
- Civil servants and scientists from Aruba, Curaçao and St. Maarten via the IPDC.
- Young people from the student diaspora.
- Scientific experts.

26 Minister for Kingdom Relations and Effective Government. *Letter to parliament setting out the government's response to the recommendations of the Council for the Environment and Infrastructure and the Council for Public Administration regarding the physical environment of the Caribbean Netherlands*, 7 November 2025. The Hague: Government of the Netherlands, 2025.
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Colophon

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