



Climate change adaptation of major infrastructure projects

Country report for the Netherlands

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Note for the readers of the printed version: the present country report links to a large number of resources via hyperlinks, which by nature are only active in the electronic version. In order to find the identified resources, an online search will usually deliver the right result; but otherwise it is also possible to make use of Annex II of the main report where all the identified resources and their hyperlinks are presented.

Disclaimer: The identified resources are non-exhaustive and present a snapshot of the readily available and accessible material during 2017. This information was collected through finite web-based desk research, and through questionnaires and interviews aimed at the relevant national competent authorities (ESIF managing authorities, research institutes, ministry officials, etc.). Further resources might be available but not accessible due to privacy restrictions, or a lack of mandate to share related material. Following the publication of the present report, more resources will continue to reach the public domain, including through Climate-ADAPT and the identified national websites.

1. INTRODUCTION

The [EU Strategy on Adaptation to Climate Change](#) of 2013 includes actions to enhance the resilience of infrastructure and mainstream climate adaptation into the European regional and cohesion policy. The [Common Provisions Regulation](#) (CPR) of 2013 states under article 8 that climate change mitigation and adaptation, and risk prevention shall be taken into consideration for investments made with the support of the European Structural and Investment Funds (ESI Funds). The regulation integrates climate change adaptation considerations into the preparation and approval of major projects¹ or other projects funded by the ESI Funds through the requirement to conduct climate change vulnerability and risk assessments. In coordination with the ESI Funds, and complimentary to them, the LIFE fund in addition assists in the realisation of the climate change adaptation objectives. Climate change analyses (such as vulnerability and risk assessments) are also sporadically found to be undertaken for infrastructure projects that are financed outside the framework of EU funds.

This report for the Netherlands focuses on the adaptation to climate change of infrastructure projects supporting the requirement to undertake climate change vulnerability and risk assessments by presenting:

- **Legal, policy and institutional framework:** A schematic outline of national and regional policy and legal framework, and organisational structure to deal with adaptation;
- **Resources:** Offering the most important resources supporting the realisation of climate change vulnerability and risk assessments for infrastructure projects. The available resources for data, methodologies, tools, guidance, design standards, system framework and institutional capacity are contextualised and listed in this section;
- **Sector overview:** Identifying the approach, main strengths and weaknesses for each of these sectors: Transport, Broadband, Urban development, Energy, Water and Waste; and
- **Case studies:** Current practice in adaptation and resilience of infrastructure projects.

Country Overview

The key legislative documents regarding climate adaptation in the Netherlands are the '[National Climate Strategy](#)' 2016 (NAS), [Make Space for Climate](#), and the [Waterplan 2016-2021](#). On the national level, responsibility for climate adaptation lies with the [Ministry of Infrastructure and Environment](#), which oversees several other governmental bodies that address climate adaptation infrastructure projects, including the [Royal Netherlands Meteorological Institute](#) (KNMI), the Rijkswaterstaat, the [Planbureau van de Leefomgeving](#). On the local level, some cities already have long-running climate adaptation programs in place, such as the [Rotterdam Climate initiative](#) (RCI) of the city of Rotterdam.

The main source for information on climate adaptation in the Netherlands is the website www.ruimtelijkeadaptatie.nl, and the main source for [climate scenarios](#) are provided by the Royal Netherlands Meteorological Institute (KNMI). Methodologies addressing climate adaptation are offered as part of a more elaborate methodology to assess sustainability (i.e. the [Environment Compass](#)). There are Dutch climate adaptation tools for the urban

¹ major project: an operation comprising a series of works, activities or services intended in itself to accomplish an indivisible task of a precise economic or technical nature which has clearly identified goals and for which the total eligible cost exceeds EUR 50 000 000 and in the case of operations contributing to the thematic objective under point (7) of the first paragraph of Article 9 of Regulation 1303/2013 where the total eligible cost exceeds EUR 75 000 000

development and water sector. Both the [Rotterdam Climate Game](#) and [TEEB.stad](#) are tools focused on the incorporation of climate adaptation into urban development projects. The [Climate Adaptation Toolbox](#) offers a methodology that allows for an evaluation of adaptation strategies or measures targeting area development projects. Design standards that directly address climate adaptation are provided for dikes and dunes in the [Water Law](#). There are also a number of design standards that indirectly address climate impacts for the design of landfills and waste collection systems (not publicly available). The Dutch policy goals concerning climate adaptation are closely monitored and adapted if necessary (e.g. in the case of the [NAS](#), the [Energy Agreement](#) (SER), the [impact of SER](#) (NEV), the [Deltaprogramma](#) and the [Delta decision on spatial adaptation](#) (DBRA). EU resources are in use, such as the [Guide to Cost-Benefit Analysis of Investment Projects](#), the publication on [Climate Change and Major Projects](#) and the non-paper [Guidelines for Project Managers](#).

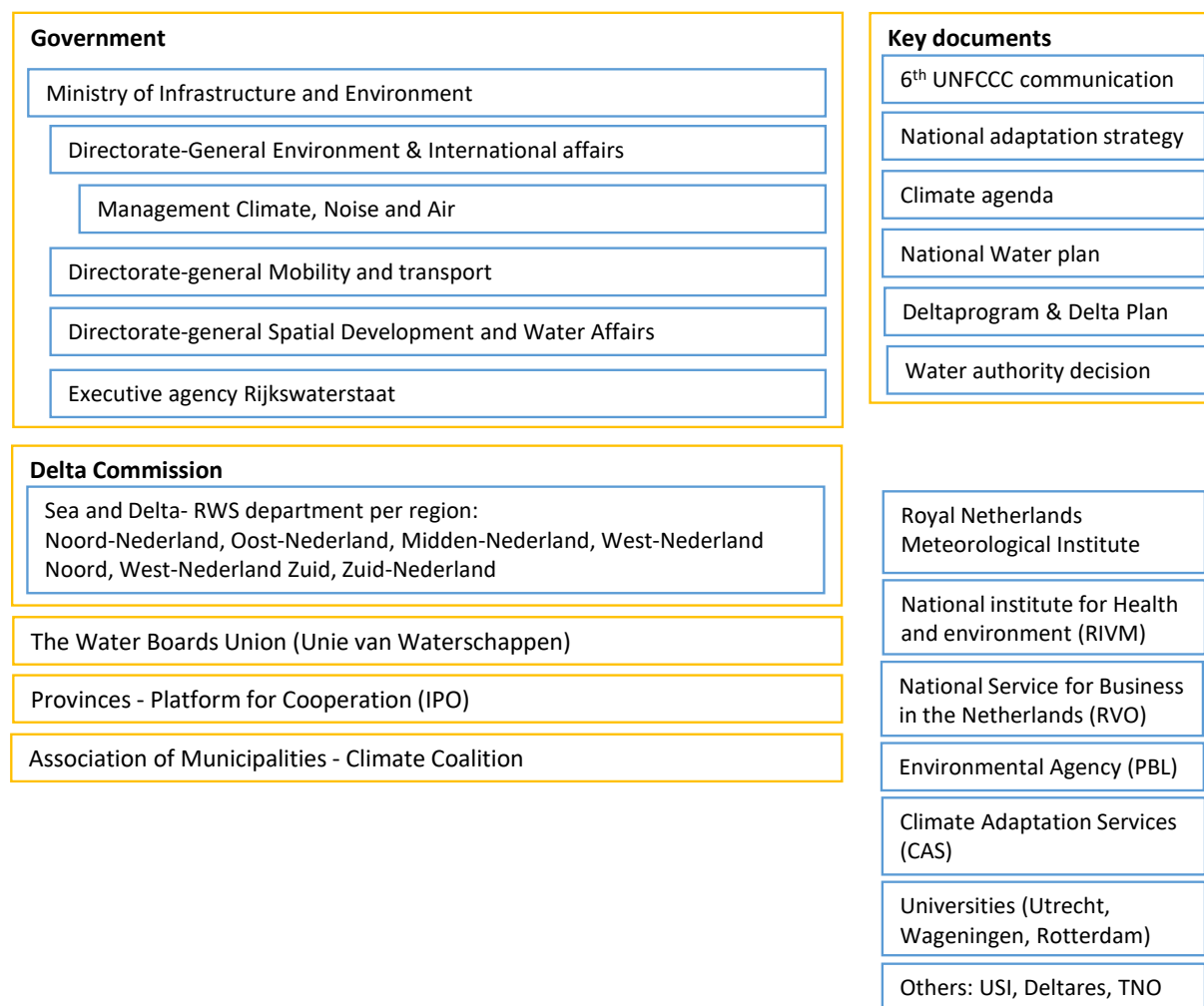
The Executive Agency of the Ministry for Infrastructure and Environment, (Rijkswaterstaat), has been involved in several pilot projects which have integrated adaptation, such as: The Rotterdam-Ruhr corridor, developed within the [RoadApt](#) project, the [New Ringway Utrecht](#), and the [Innova 58](#) road design and research project. For road infrastructure the [Investigation of the Blue Spots](#) (2012) has identified areas that are susceptible to flooding, while for airport infrastructure there are reports on how to increase resilience for [inland navigation](#) and the [Schiphol airport](#) (2013). The Dutch Broadband sector is characterised by short term investments and flexibility according to the [National Adaptation Strategy](#) which provides an overview of the main impacts on the ICT and Broadband sector. The knowledge portal "[Ruimtelijke Adaptatie](#)" has a search function that allows users to find examples of urban climate change adaptation projects. An online [climate atlas](#) is providing insight on climate impacts at a local level, i.e. for [Rotterdam](#), [Schiedam](#), [Rijnland](#) and [Meerdijk](#). The [National adaptation Strategy](#) (2016) has included the energy sector and provides an overview of the most important potential impacts on the energy sector, as does the report [Evaluation of the impact of the Energy Agreement](#). The main issue identified in the Dutch water sector concerning climate adaptation is water safety (both sea level rise and overflowing rivers). The [National Water Model](#) addresses all water subsectors; the [Multi-Layer Safety Scout](#) offers insight into the potential flood risk of new urban developments; the [Deltaprogramma](#) is one of the main programs in the Netherlands focused on water safety; and [Space for the river](#) is a plan to allow the river to overflow without causing much damage. The waste sector in the Netherlands expects to experience a minimal effect of climate change both in waste collection and processing.

Case studies have been provided in the present report for three projects: the [New Ringway Utrecht](#) has implemented a method for choosing the exact location of the new road that can be replicated; the [Landfill park development Nauerna](#) is turned into a future public nature and recreation area that has taken measures on flooding; and the [Aardwarmte Combinatie Luttelgeest BV](#) is a ERDF-funded project with high replicability that took into account scenarios with changing weather circumstances.

2. LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK

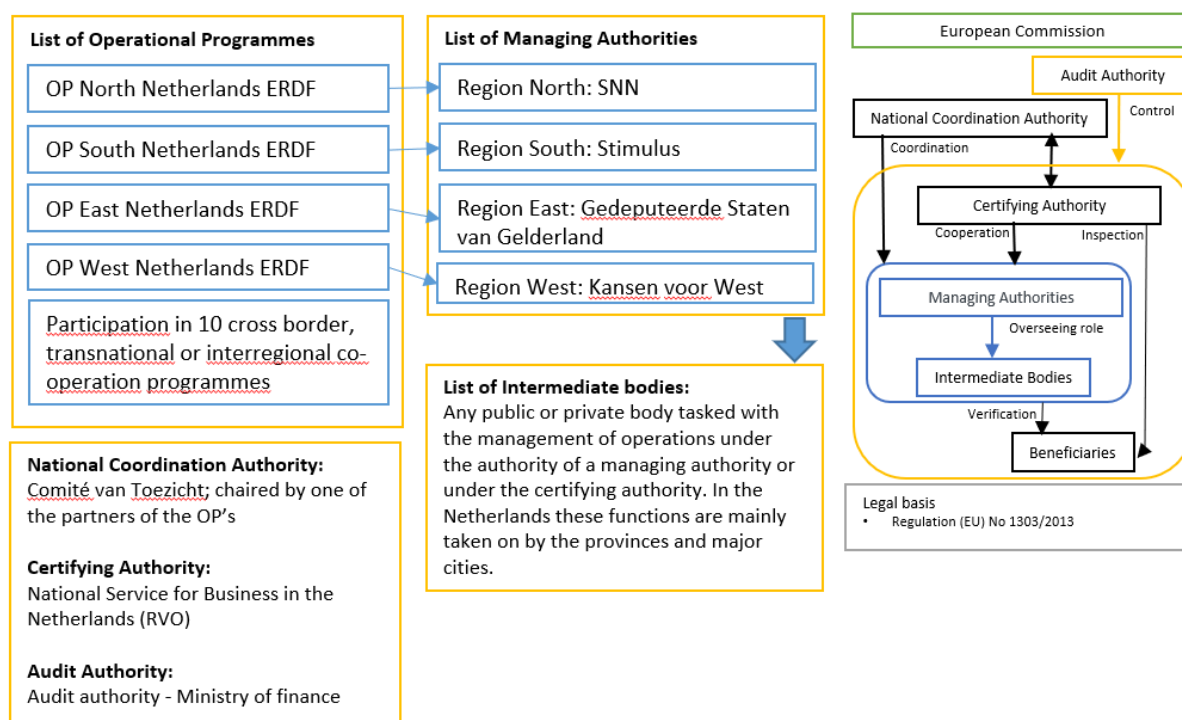
In the Netherlands, the national, regional and local levels play a role in climate adaptation policy. At the national level, the responsibility lies with the [Ministry of Infrastructure and Environment](#) (I&M). The Ministry oversees several other governmental bodies that address climate adaptation infrastructure projects: the National Weather Authority [Royal Netherlands Meteorological Institute](#) (KNMI), the Executive Agency for Infrastructure Management [Rijkswaterstaat](#) (RWS), the National Institute for Strategic Policy Analysis [Planbureau van de Leefomgeving](#) (PBL) and the Ministry's policy department [Directorate General Environment & International](#) (DGMI).

Other governmental bodies that play a key role in climate adaptation goals are the cities, municipalities and Water Boards. Each have an independent governance structure and are represented on the national level by unions: The Interprovincial Consultation (IPO), the Union of Dutch Municipalities (VNG) and the Union of Dutch Water Boards (UvW). Each union has entered a climate agreement with the Ministry including goals on climate adaptation. Some cities already have long-running climate adaptation programmes in place, such as the [Rotterdam Climate initiative](#) (RCI) of the city of Rotterdam.



The Dutch national government uses 'Green Deals' to stimulate public and private stakeholder engagement in the delivery of policy goals by supporting their sustainable initiatives. The [Rotterdam Climate initiative](#) (RCI) is an example of a green deal focused on climate change. The green deals are supervised by Rijksdienst voor Ondernemend Nederland (RVO) and Green Deal Board which includes an ambassador for energy and climate.

The four managing authorities mainly support EFRD-applications and INTERREG projects. They have regional representations and contact points. The four authorities each represent a part of the territory of the Netherlands: North ([SNN](#)), South ([Stimulus](#)), West ([Kansen voor West](#)) and East ([GO](#)). They receive their authority from the provinces. They work closely together and have a [webportal](#) where EFRD-project applications can be entered and managed. Where relevant, they work together with the adaptation experts from the administration, for instance, by referring beneficiaries to the [Rotterdam Climate initiative](#)² or other administrations and expert organizations. In some projects, administrations, such as '[Rijkswaterstaat](#)', are beneficiaries.³



3. RESOURCES

This country report has reviewed the currently available resources in the Netherlands for adapting to the impacts of climate change across six key infrastructure sectors. Adaptation to climate change is integrated in the legal basis⁴ for ESIF-funded projects, through the processes of vulnerability and risk assessments which are, broadly:

1. Vulnerability – evaluating the sensitivity and exposure of infrastructure to climate change
2. Risk – estimating the likelihood and impact of relevant climate hazards
3. Adaptation - consideration of adaptation options and integration into the project planning

The legal requirements for major projects also foresee climate change mitigation. This study however is focused on climate change adaptation and does not cover mitigation aspects.

Information on the requirements for climate change adaptation is available in the 2016 publication [Climate Change and Major Projects](#), and details on the methodology of climate resilience analysis is provided in the 2017 JASPERS publication [The Basics of Climate Change Adaptation, Vulnerability and Risk Assessment](#). Further resources are being identified in the present publication and its references. Effective vulnerability and risk assessments for the adaptation of major projects to climate change require the resources explained in the following table:

Resources	Explanation
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² Interview with the Managing Authority 'Opportunities for West'

³ Example lists of projects: <http://www.kansenvoorwest2.nl/nl/projecten/>

⁴ Regulation (EU) No 1303/2013, Commission Delegated Regulation (EU) No 480/2014, Commission Implementing Regulation (EU) No 1011/2014, No 215/2014, 2015/207; and the Directives 2001/42/EC, 2011/92/EU and 2014/52/EU

Data Availability	The availability, accessibility and applicability of data on climate projections and impacts, on past and historic events, on geophysical parameters, on long-term scenarios, on economic, environmental and social impacts, etc.
Methodologies	The existence of quantitative or qualitative methodologies (a system of processes, a set of principles and rules) for integrating climate change adaptation in the development of infrastructure projects.
Tools	The availability of tools for planning, evaluation, impact estimation (i.e. software, maps, computer simulations, long term climate forecasts etc.) to assist with the adaptation of infrastructure to climate impacts
Guidance	The provision of guidance on how to use methodologies (i.e. for conducting climate change vulnerability and risk assessments) or develop the required infrastructure project documentation relating to climate adaptation.
Design Standards	The availability of published engineering design standards (i.e. by BSI, DIN, ISO) for infrastructure projects that include sections or appropriate provisions to ensure resilience to climate change impacts
System	The institutional and legal framework that the formal authorities work with to deliver their primary responsibilities for climate adaptation, infrastructure, and management of European Structural and Investment Funds
Institutional Capacity	The human and technical capacity of institutions to carry out their functions. It depends on being adequately resourced, on having the appropriate expertise, and on collaborating effectively and enforcing laws and regulations

3.1. Data Availability

Quantitative data are essential to understand the relevant risks and the requirements for any corresponding climate change adaptation in key sectors.

The main source for climate data are the [climate scenarios](#) developed by the Royal Netherlands Meteorological Institute (KNMI). Scenarios are provided for 2030, 2050 and 2085, these also include key figures, graphs and maps. The future climate maps are based on the key figures of the KNMI'14 climate scenarios that have been applied to the standards of the climate class for the climate of the Netherlands (1981-2010). The website provides a calculation example to demonstrate how the table data can be applied. These climate scenarios have been applied in several projects, such as an analysis of the water system for the [pilot Ring road Utrecht](#) and the structural design (proportioning) of [storm surge barriers](#).

The Dutch [Central Bureau of Statistics](#) (CBS) is the national statistics authority and maintains a database of statistics relating to the economy, society and environment. The [Dutch National Data Portal](#) provides an overview of all available datasets provided by government organizations in the Netherlands, including include data on long-term temperature averages.

The website www.ruimtelijkeadaptatie.nl is the main source for qualitative information on climate adaptation in the Netherlands. It offers direction on 'how to start' addressing climate adaptation for different target groups and sectors and provides guidance on which instruments and example projects are available.

The [National Adaptation Strategy](#) (2016) provides information on processed data and potential impacts, including interdependencies.

The Environmental Agency (PBL) published a report on impacts of climate change other than flooding in 2015 "[Adaptation to climate change in the Netherlands - Studying related risks and opportunities](#)", in which the vulnerability of the Netherlands has been assessed, and effects have been prioritized.

Several instruments provide insight in climate change adaptation through processed data. Three examples are:

- The [Climate Effect Atlas](#) is an interactive tool that provides a quick insight into the effects of (future) threats of flooding, water pollution, drought and heat stress at a municipal level. It is based on the KNMI climate scenarios of 2006 and currently updated based on the 2014 scenarios. Atlases are available for several cities, including [Rotterdam](#), [Schiedam](#), [Rijland](#) and [Meerdijk](#);
- The [Story Maps](#) combine multiple spatial datasets (maps and text) to allow for an easy comparison; and
- The [Multi-Layer Safety Scout](#) provides insight into flood risks of new spatial developments. Its data are provided by the project '[Veiligheid Nederland in Kaart](#)' and the '[Deltaprogramma Veiligheid](#)'.

On a local level, data are provided by several Dutch municipalities (e.g. Rotterdam, Schiedam, Rijland and Meerdijk) through an online climate atlas for their territory including heat stress, drought and flood risk maps.

The Netherlands' Seventh [National Communication](#) to the United Nations Framework Convention on Climate Change (UNFCCC) also provides long-term climate change assessments across a range of sectors, with scenarios on risk and vulnerability assessments by sector.

[Knowledge for Climate](#) was a Dutch research programme in the field of climate change and adaptation, co-financed by the [Ministry of Infrastructure and the Environment](#). The programme ran from 2007 till end December 2014. Partners in the foundation, that ran the programme, were Wageningen UR, Utrecht University, the VU University Amsterdam, KNMI, TNO and Deltares. Research was carried out on [eight themes](#), including among others flood risk management, climate proof cities, governance and policy tools. Also scientists studied together with stakeholders various subjects in so called [hotspots](#), such as Rotterdam, Schiphol airport, the big rivers, and shallow lakes and peat meadow areas. The knowledge gained from this programme was widely disseminated and has since been applied in practice, as set out in the [final report](#) of the Knowledge for Climate Programme 2008-2014.

The [Climate Adaptation Services foundation](#) (CAS) is a non-profit organization that was founded within the context of the Dutch national research program "[Knowledge for Climate](#)" (2008-2014) and builds on the knowledge and experiences gained in the program. Together with various knowledge institutes and consultancies, CAS works on the update of the [Climate Impact Atlas](#) and the [Knowledge Portal for Spatial Adaptation](#): the platform for climate adaptation in the Netherlands.

There are a number of research institutions in the Netherlands that make available information and data relating to climate adaptation. This includes the seven research institutes that came together to form the [Netherlands Consortium on Climate Change Adaptation](#).

Updates for a wide range of national adaptation actions, can be found in the [National adaptation actions deliveries database on EIONET](#), and on the [Climate-ADAPT](#) website.

3.2. Methodologies

Methodologies for integrating climate change adaptation into the development of infrastructure projects rely on the basic rules of risk assessment. Some methodologies will be relevant to only part of the risk and vulnerability analysis process, e.g. a cost-benefit analysis methodology.

In the Netherlands, methodologies addressing climate adaptation in the strategy and feasibility phase are either offered as part of a more general methodology to assess sustainability or focused on subsectors.

The [Climate Adaptation Toolbox](#) offers a methodology that allows for an evaluation of adaptation strategies or measures targeting area development projects. The methodology is based on a social cost-benefit analysis and the Overview Effects Infrastructure Systematic (OEI), which is used in cost-benefit analyses for integral area exploration. The methodology has been applied to [cost-benefit analyses](#) of pilot climate adaptation projects in Feyenoord and Bergpolder in Rotterdam (2014).

The [Environment Compass](#) is an example of a methodology focused on overall sustainability. The Environment Compass is a self-assessment used to facilitate a discussion among stakeholders involved in urban development projects by providing insight into the sustainability aspects at play in an area. Climate adaptation is referred to in a selection of the questions of the self-assessment. The tool is continuously monitored and evaluated by a team of Rijkswaterstaat (RWS).

A [BREEAM assessment](#) for urban development provides a similar approach to integrating climate change adaptation in projects. The focus on adaptation is however limited.

Methodologies are available for a number of sub-sectors that help assess the scope of the issues caused by climate change. Two examples are:

- The [Tipping point analysis](#) methodology (2011) offers a methodology to work with tipping points. The methodology has been used for the [Wielwijk](#), a Dutch neighborhood in Dordrecht, to assess adaptation options for the sewage systems; and
- The [Manual on Foundation problems](#) (2016) offers insight in problems with the construction and maintenance of foundations.

Both methodologies provide steps for problem assessment and acknowledge the impact of local climate policies.

3.3. Tools

Tools are highly valuable for facilitating climate adaptation studies and planning for infrastructure. They can be public or private, numerical or descriptive, and be provided in many mediums, such as software, text documents, maps, and so on. Some tools are generic (such as in risk assessments) whilst others are specific to a certain set of circumstances. There are several Dutch climate adaptation tools for the urban development and water sector.

A [dedicated page](#) at the webportal 'Knowledge for Climate' (Kennis voor klimaat in Dutch) has collected a series of tools and instruments on Climate change. For some tools the information provided does not allow an in depth analysis. Some relevant examples of tools are listed below.

The [Rotterdam Climate Game](#) allows multiple stakeholders to adapt a digital model of the area, while confronting them with real-life challenges when increasing climate resiliency.

The stakeholders are encouraged to start discussions and search for solutions in case confrontations occur. The Rotterdam Climate Game has been applied to [a pilot case study](#) in the Rotterdam Feijenoord district. This tool is, however, not publicly available.

The [TEEB.stad](#) tool is freely available and offers a quick insight into the impact and value of green and water in a city through adaptation measure assessment, such as the impact of a green roof on water storage and the reduction of energy use. Its output is expressed in euros. The tool has been initiated by the Ministry of Economic Affairs.

The [National Water Model](#) is a computer model for the water sector that provides insight into the movement of water. It addresses water safety, distribution and quality as well as the salinity and temperature of the water. The tool can be used to assess for example whether there will be a sufficient amount of drinking water in the future or flood risk. It was developed by a consortium of governance and research institutes. Its predecessor is the [Deltamodel](#). In order to use the tool, contact has to be made with the managing governance bodies.

The [Climate impact atlas](#) is a freely available, interactive map viewer showing (future) threats of flooding, water pollution, drought and heat stress on the map. By filling in a city name it is possible to see what is happening in the city. It offers the possibility to zoom directly in to a municipality and to see the possible effects of climate change by 2050.

The [3Di tools](#) concerns interactive and integral modelling tools for high resolution water calculations. It intends to support decision making on flooding, water safety, crisis management and spatial planning. The calculated water images can be combined via Lizard with all sorts of additional information, such as heat stress maps, land subsidence, the location of vulnerable objects. The tool is not freely available.

EIONET provides [Flood Maps](#) which are publically available, mapping areas of potential significant flood risk. EIONET also contains Flood Risk Management Plans.

For a continual update of available tools, the reader is referred to the European Climate Adaptation Platform [Climate-ADAPT](#), which has a dedicated tools section.

3.4. Guidance

Guidance is an essential requirement to ensure consistency in applying methodologies and tools.

The main source for guidance on climate adaptation in the Netherlands is the website www.ruimtelijkeadaptatie.nl. The website offers direction on 'how to start' addressing climate adaptation for different target groups and which instruments and example projects are available. It presents and further elaborates on the results of two research programs on climate adaptation that were initiated by the government: Knowledge for Climate and Climate for Space. The platform is managed by Climate Adaptation Services (CAS), a foundation that was set-up especially for this task.

The handbook [Working with climate scenarios](#) (2013) was set up by the Environmental Agency (PBL) and provides guidance on how to work with climate scenarios. The document and some background information is also provided at the [KNMI website](#) (the Royal Netherlands Meteorological Institute).

The NEN (Dutch Standardization organization) is following the developments in guidance documents, such as the new version of [ISO31000](#) (risk analysis/management), [LCA](#) (life cycle analysis) and [ISO 55000](#) (asset management), which are expected to provide guidance on how to deal with the uncertainties that are characteristic to climate change.

The Dutch managing authorities have extensive [guidance](#) for ERDF project applications, including a specific [template](#) document that describes the required information. Climate change adaptation is part of the information on sustainable development. However, the required information is not very detailed and climate change is viewed as one of a few sub criteria of sustainability. The information on sustainability is judged by an expert commission and given a score (a total of 5 points can be gained, standing for 30% of the total score in 'low carbon' projects and 15% in 'innovation' projects).

In June 2017, the Executive Agency for Infrastructure Management (Rijkswaterstaat) published [guidelines](#) regarding energy and climate (mitigation and adaptation) which should be used by project developers dealing with infrastructure projects and other development plans in the region.

Other guidance is offered mainly within the urban development and water sectors.

The [flood risk management plans](#) (2015) and [maps](#) take climate change scenarios into account and link with 'adaptive water management' as developed by in the Delta Commission.

Sector organization CROW (Water and Road infrastructure, public space) provides a [platform](#) where several guidelines and presentation on climate change adaptation in the urban environment are gathered, including information on the implications of climate change (adaptation) on the development of public domain, including a guideline on [Adapting public space to climate change](#). The target audience are mainly local authorities and consultancies.

The "[Deltafacts](#)" offer guidance through various factsheets focused on the knowledge that was gathered throughout the execution of the Delta program. The factsheets include information on water safety (e.g. innovative approaches for dikes, calculation methods, information on risk management, etc.), fresh water and urban climate change adaptation.

Some websites provide guidance through listing a set of examples:

- [Climate Scan](#) is an open source website for international knowledge exchange on sustainable urban drainage and spatial transformation in urban areas; and
- The 'guiding models' webpage ([Gidsmodellen](#)) provides insight and inspiration on how to deal with climate change adaptation in the different landscape types in the Netherlands.

Information on potential measures and solutions is provided by the [Climate-app](#), [Greenblue networks for sustainable and climate resilient cities](#) and the [Water Window](#).

3.5. Design Standards

Design standards are critically important for all infrastructure projects to ensure stability and optimal functioning under the strain of natural phenomena. For civil works (including bridges, buildings, masts and towers for the mobile access networks), EN standards are available to address natural forces such as wind and snowfall, e.g. EN1991-1-4 (Eurocode 1) and EN1993 (Eurocode 3) for structures in steel. However, these standards might be outdated and not account for the impacts of climate change.

The [Netherlands Institute for Normalisation](#) (NEN), the national standards authority, is collaborating with the [European Standardization Organizations](#) in the context of the EU Regulation No 1025/2012 on European standardisation. The European Committee for Standardisation (CEN) and Electrotechnical Standardisation (CENELEC) established the [Adaptation to Climate Change Coordination Group \(ACC-CG\)](#) to coordinate

standardisation work in the field of adaptation to climate change in support of the implementation of the EU Strategy on Adaptation to Climate Change. More information is available in the section on *Available resources at the EU level* in the Final Report of the present study (European Commission, 2018).

Most of the coordinated efforts in the Netherlands concerning standards are focused on this project. There are however, specific design standards within the different infrastructure organizations (e.g. Rijkswaterstaat), which are not covered by NEN.

The [Water Law](#) was adapted on January 1st, 2017 and provides design standards for dikes and dunes. The standards address climate adaptation.

There are also a number of design standards that indirectly address climate impacts for the design of landfills and waste collection systems (not publicly available). For the design of landfills, it concerns excessive water drainage within and around the site. For the design of waste collection systems, it concerns the proportions of the design. While the standard does address extreme weather events, it does not yet take climate projections into account.

NEN is currently looking to answer the question which data standardization bodies need to integrate climate change into standards for Copernicus Climate Change Services (C3S).

3.6. System

The institutional system for adapting to climate change requires a legal framework (laws and implementing regulations) and strategies and policies (with implementing action plans). The system is usually conflated with disaster management (and its various components, preparedness, reduction etc.) and more generally with resilience.

Institutional and legal framework

The key legislative documents regarding climate adaptation in the Netherlands are the '[National Climate Strategy](#)' 2016 (NAS) "[Make Space for Climate](#)", and the '[Waterplan 2016-2021](#)'. The Waterplan is focused on infrastructure works that ensure water resilience of the Netherlands. The NAS focuses on detailing the potential climate adaptation effects and implementation through (online) information provision and the connection of different stakeholders. Progress reports on the implementation of the NAS will be available as of 2019.

The [Delta Programme](#) aims to ensure the flood risk management, freshwater supply, and spatial planning will be climate-proof and water-resilient by 2050. The legal framework for the implementation of the Delta Programme in the Netherlands is '[the Delta Act on flood safety and freshwater supply](#)'. The Delta Act anchors the Delta Programme, the Delta Fund and the role of the Delta Commissioner. The climate adaptation approach in the Netherlands is highly dependent on co-creation and voluntary cooperation of private and public stakeholders through green deals and covenants.

The Netherlands has transposed the revised Environmental Impact Assessment Directive. While climate change has to be included, climate change is not yet a fully integrated part of the EIA, but will soon be according to the Dutch Commission on Environmental Impact Assessments (Commission MER). The Commission MER increasingly evaluates plans quantitatively on climate targets set by the municipalities themselves and on climate targets set in national policy plans, which include adaptation.

Responsible authorities

Within the Ministry of Infrastructure & the Environment (I&M), the following departments have responsibilities for climate adaptation:

- [DG Environment and internal affairs](#)
- [DG Mobility and transport](#)
- [DG Spatial Development and Water Affairs](#)
- The Executive Agency of I&M: [Rijkswaterstaat](#) (RWS)

Additionally, significant authority is held by the [Delta Commission](#), the [Water Boards](#), platform for cooperation of the Provinces (IPO), and the [Climate coalition](#) for municipalities.

Management of the ESI Funds

The Netherlands has set up four Operational Programmes (North, South, East, West), whose Managing Authorities are respectively, SNN, OP ZUID, OP Oost, and Kansen voor West. The country is also participating in 10 cross border, transnational or interregional co-operation programmes. Regarding the control system, the National Coordination Authority is the Comité van Toezicht; the Certifying Authority is the National Service for Business in the Netherlands (RVO), and the Audit Authority is the Ministry of finance. The four managing authorities mainly support EFRD-applications and INTERREG projects. The Managing Authorities provide support for project applications, but refer to the specific authorities (e.g. Rotterdam Climate Initiative or Utrecht sustainability Institute) for support on climate change and adaptation. A specific [webportal](#) allows for easy management of project applications.

3.7. Institutional Capacity

The institutional challenge for climate change adaptation is that climate policy is a cross-cutting issue, and requires co-operation across a large number of institutions. To be effective in delivering climate change adaptation a minimum level of capacity is needed on leadership, technical and human resources, effective collaboration, and financial support.

Technical and human resources

The Dutch policy goals concerning climate adaptation are closely monitored and adapted if necessary as is the case in the case of the [NAS](#), the [Energy Agreement](#) (SER), the [impact of SER](#) (NEV), the [Deltaprogramma](#) and the [Delta decision on spatial adaptation](#) (DBRA). An [intermediate evaluation](#) (2017) of the 'Ruimtelijke Adaptatie' webportal showed that the current progress is not sufficient to reach the set goals. The instruments provided on climate adaptation are suitable for helping parties, though too general to answer more in-depth questions. Based on this, the institutional capacity (human, technical, equipment) relevant to climate change adaptation is currently being developing further.

Workshops on adaptation have been organised by a multitude of organisations (NEN, NAS, Benelux, ...) and for the different sectors (Water, Energy, transport and urban/spatial development). On October 12th 2017, a [workshop on 'Climate adaptation from practice to standard'](#) was organized to strengthen the development of standards, protocols and guidelines to implement adaptation to climate change.

Effective collaboration

The [Delta Programme](#) is a nationwide programme, in which the national authorities, provinces, water boards and local authorities work together in an innovative way, also

with contributions from NGO's, knowledge institutes, companies as well as citizens. The private sector is increasingly involved in the county's adaptation efforts. The Dutch [Green deals](#) offer a way for companies, other stakeholder organizations, local and regional government and interest groups to work with Central Government on green growth and social issues. A well-known green deal on climate change adaptation is the ongoing [Rotterdam Climate Initiative](#).

Financial resources

The Delta Fund holds resources dedicated by the national government for the implementation of measures and research needs. The fund will be highly significant for credible and timely delta-management in the coming decades. As of 2020, the Delta Fund will be fed with a minimum of €1 billion a year in order to ensure the implementation of the Delta Programme. Every year the Delta Commissioner will present an advice on how to target the budget on necessary measures and supporting research in the annual Delta Programme.

Concerning major projects, by early 2018, there have been no funds allocated for major projects in the Netherlands for the 2016 - 2020 programming period according to the datasets of the European Commission.

According to the [ESIF-viewer](#), the Netherlands are planning investments of 1.3 Billion EUR. Projects under the Thematic Objective 5 on promoting climate change adaptation, risk prevention and management will be receiving 10 Million EUR, with an additional 5 Million EUR approved for Network Infrastructures in Transport and Energy (Thematic Objective 7); 50 Million EUR in Environment Protection & Resource Efficiency (Thematic Objective 6); and 163 Million EUR for Information and Communication Technologies (Thematic Objective 2).

4. SECTOR OVERVIEW

4.1. Introduction

Since 2014, the requirements for major projects to obtain ESIF funding⁵ demand that project applications integrate climate change considerations⁶, such as a vulnerability and risk analysis and adaptation option appraisal. At EU-level, material is available to assist in fulfilling these requirements. Key websites and documents are:

- The [Climate-ADAPT](#) website containing many links to data and a [map viewer](#)
- EUROPEAN COMMISSION Directorate-General for Regional and Urban policy: The [Guide to Cost-benefit analysis of Investment projects](#) (also referred to as the 'CBA guide')
- EUROPEAN COMMISSION DIRECTORATE-GENERAL CLIMATE ACTION: [Non-paper of Guidelines for Project Managers: Making vulnerable investments climate resilient](#)
- JASPERS Guidance note: [The Basics of Climate Change Adaptation, Vulnerability and Risk Assessment](#)

⁵ http://ec.europa.eu/regional_policy/archive/projects/major_projects/index_en.cfm

⁶ For a compilation of the climate change requirements for major projects in 2014-2020, see: <http://www.jaspersnetwork.org/plugins/servlet/documentRepository/displayDocumentDetails?documentId=401>

- JASPERS Guidance note: [An overview of the most important sources for integrating climate change in \(major\) projects](#)

Additional relevant material can be found in the Final Report of the present study (European Commission, 2018) in the section *Available resources at the EU level* and in *Annex I*.⁷

4.2. Transport

Investments in the transport sector are very diverse, covering roads (including bridges and tunnels), inland waterways, rail, ports / airports, and public transport infrastructure. Any disruption caused in this sector can affect many other sectors (economic and societal) directly. Potential threats are sea-level rise and extreme weather events, such as extended heatwaves, flooding, heavy rainfall or storm, and landslides amongst others. Extreme weather events are a potential threat to both infrastructure and operation of the transport system.

With regard to the Netherlands transport sector, easily accessible and comprehensive [climate scenarios](#) are provided by the Royal Netherlands Meteorological Institute (KNMI). The manual [Working with climate scenarios](#) was set up by the Environmental Agency (PBL) and provides guidance on how to work with climate scenarios. The document and some background information is also provided at the [KNMI website](#) (the Royal Netherlands Meteorological Institute). The website www.ruimtelijkeadaptatie.nl is the main source for information (qualitative data) on climate adaptation in the Netherlands both sector related and general. This however is not specific to the context of the transport sector.

Road infrastructure

The '[Investigation of the Blue Spots in the Netherlands National Highway Network](#)' (2012) has looked at the spots in the Highway network that are susceptible to flooding, taking climate change projections into account. The study has also provided offline maps that Rijkswaterstaat provides to constructors on a project-basis. Focus is often, if not exclusively, on flooding issues.

The executive agency of the ministry for infrastructure and environment, Rijkswaterstaat, has been involved in several pilot projects which have integrated adaptation, such as:

- The Rotterdam-Ruhr corridor, a project that was developed within the [RoadApt](#) project (accessible at [climate adapt](#), project initiated by sector federation CEDR)
- Innova 58: an innovative road design and research project which has a specific [website](#) where all preparatory documents are gathered.
- [New Ringway Utrecht](#): This project included the application of KNMI climate scenarios and the development of a climate atlas (in Dutch: [Klimaatatlas](#)). This was used in combination with the framework 'Climate in planning processes' (in Dutch: 'Klimaat in de planuitwerking', offline resource, RWS). This approach will be followed more often in new road infrastructure projects.

In these projects, methods are described and adaptation measures taken on board. The pilot projects serve as guidance documents on how to integrate climate change adaptation in large road infrastructure projects. A research programme to further drive knowledge is being established, but not yet available.

⁷ European Commission (2018) Climate change adaptation of major infrastructure projects. A stock-taking of available resources to assist the development of climate resilient infrastructure. Final report.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

Railway infrastructure

Railway manager Prorail (a privatised company) is setting up several protocols to deal with climate change adaptation (e.g. on heat stress) and cooperates with Rijkswaterstaat on the topic of adaptation. Prorail has participated in the [ARISCC](#) project (available also on [Climate Adapt](#)) and [research](#) has been done to know more about the potential impacts of climate change, including the economic costs. A so-called 'green deal' was signed in order to integrate sustainability (and climate change objectives) into all policy and projects.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

Airport infrastructure

Reports have been written to describe impacts, methods of working and strategies to increase resilience for [inland navigation](#) and the [Schiphol airport \(2013\)](#). [Monthly weather overviews](#) for Schiphol are also available.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.3. Broadband

The International Telecommunication Union has issued the recommendation L.1502 "[Adapting information and communication technology infrastructure to the effects of climate change](#)" (2016) for the purpose of identifying climate threats and their impact. L.1502 supports Resilience by design in identified risky areas, and proposes changes to equipment installation standards to ensure protection from more frequent extreme weather phenomena and their impacts. The European broadband sector standardisation bodies have not prepared vulnerability assessment and risk management framework for dealing with climate change in broadband projects.

With regard to the Netherlands broadband sector, easily accessible and comprehensive [climate scenarios](#) are provided by the Royal Netherlands Meteorological Institute (KNMI). The manual [Working with climate scenarios](#) (2013) was set up by the Environmental Agency (PBL) and provides guidance on how to work with climate scenarios. The document and some background information is also provided at the [KNMI website](#) (the Royal Netherlands Meteorological Institute). The website www.ruimtelijkeadaptatie.nl is the main source for information (qualitative data) on climate adaptation in the Netherlands both sector related and general. This however is not specific to the context of the broadband sector.

The [National Adaptation Strategy](#) provides an overview of the main impacts on the ICT and Broadband sector. The Dutch Broadband sector is characterized by short term investments and flexibility, which makes it easier for the sector to adapt to climate change impacts. The highest risks in this sector are a dependency on other sectors (e.g. energy disruptions that could cause network failure) and (long-term) maintenance of fixed ICT infrastructure (e.g. air conditioning, emergency power, power panels, antenna, transmission and reception masts).

The National Institute for Strategic Policy Analysis published in 2014 a [Report on Climate adaptation in the ICT sector](#).

The research organisation TNO has a database on critical infrastructure incidents [offline], including ICT infrastructure incidents.

It is a general best practice for operators to use flood mapping information from environmental agencies to safeguard new planned data centres from flooding. For civil works (e.g. masts and towers for the mobile access networks), EN standards are available to address wind and snowfall, e.g. EN1991-1-4 (Eurocode 1) and EN1993 (Eurocode 3) for structures in steel. But these standards don't take climate change into account. CEN-CENELEC is currently working on adapting a number of EN standards to climate change. See Final Report of the present study (European Commission, 2018) for more information in the section on *Available resources at the EU level*.⁸

There are no ESIF investments planned in the broadband sector in the Netherlands for the period 2014-2020.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.4. Urban Development

Investments in the urban development sector include site developments (industrial and other), urban planning, local infrastructure, building projects (such as hospitals, schools), and much more diverse projects. Cities have a unique position to analyse and respond to local impacts and vulnerabilities, such as heat island effects, which depend on the specific layout of a city, its green spaces, and numerous other factors. Cities can actively support the uptake of climate change adaptation in infrastructure projects through, for instance pilot projects, and can initiate dedicated infrastructure projects to improve their resilience to climate change.

With regard to the Netherlands urban sector, easily accessible and comprehensive [climate scenarios](#) are provided by the Royal Netherlands Meteorological Institute (KNMI). The manual [Working with climate scenarios](#) (2013) was set up by the Environmental Agency (PBL) and provides guidance on how to work with climate scenarios. The document and some background information is also provided at the [KNMI website](#) (the Royal Netherlands Meteorological Institute). The website www.ruimtelijkeadaptatie.nl is the main source for information (qualitative data) on climate adaptation in the Netherlands, both sector related and general. This however is not specific to the context of the urban sector.

Data are provided by several Dutch municipalities in an online [climate atlas](#) providing insight on climate impacts at a local level including heat stress, drought and flood risk maps. The atlas exists for example for the territory of [Rotterdam](#), [Schiedam](#), [Rijnland](#) and [Meerdijk](#).

Several instruments provide insight in climate change adaptation through processed data. Three examples are:

- The [Climate Effect Atlas](#) is an interactive tool that provides a quick insight into the effects of (future) threats of flooding, water pollution, drought and heat stress at a municipal level. It is based on the KNMI climate scenarios of 2006 and currently updated based on the 2014 scenarios.
- The [Story Maps](#) combine multiple spatial datasets (maps and text) to allow for an easy comparison.

⁸ European Commission (2018) Climate change adaptation of major infrastructure projects. A stock-taking of available resources to assist the development of climate resilient infrastructure. Final report.

- The [Multi-Layer Safety Scout](#) provides insight into floodrisks of new spatial developments. Its data are provided by the project '[Veiligheid Nederland in Kaart](#)' and the '[Deltaprogramma Veiligheid](#)'.

The [Climate Adaptation Toolbox](#) offers a methodology that allows for an evaluation of adaptation strategies or measures targeting area development projects. The methodology is based on a social cost-benefit analysis and the Overview Effects Infrastructure Systematic (OEI) which is used in cost-benefit analyses for integral area exploration. The methodology has been applied in two pilot cases: a [cost-benefit analysis](#) of a climate adaptive alternative for parts of the districts Feyenoord and Bergpolder in Rotterdam.

The [TEEB.stad](#) tool is freely available and offers a quick insight into the impact and value of green and water in a city through adaptation measure assessment, such as the impact of a green roof on water storage and the reduction of energy use. Its output is expressed in euros. The tool has been initiated by the Ministry of Economic Affairs.

Sector organization CROW (Water and Road infrastructure, public space) provides a [platform](#) where several guidelines and presentation on climate change adaptation in the urban environment are gathered, including information on the implications of climate change (adaptation) on the development of public domain. The target audience are mainly local authorities and consultancies.

The Dutch cities and municipalities are represented on a National level through the [Union of Dutch Cities and Municipalities](#) (VNG), they developed their stance on climate adaptation in a [position paper](#). Their common climate policy goals are part of a climate agreement that was made between the national government and the VNG. Green deals are used in the Netherlands to support stakeholder partnerships. A well-known partnership on climate adaptation on the city level is the [Rotterdam Climate Initiative](#) (RCI).

There are quite some adaptation projects realized in an urban setting. Two databases with examples are:

- knowledge portal '[ruimtelijke adaptatie](#)' has an easy search function that allows to find examples of urban climate change adaptation projects.
- The [Climate Scan](#) is an open source website for international knowledge exchange on sustainable urban drainage and spatial transformation in urban areas.

Recent adaptation projects include:

- [Amsterdam Rainproof](#)
- [City Deal Klimaatadaptatie](#)
- [Climate resilient city](#): Book Hogeschool van Amsterdam (2017); Het klimaat past ook in uw straatje. Hogeschool van Amsterdam, Amsterdam.
- [City Blueprint Scan](#)

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.5. Energy

Project investments in the energy sector are related to power generation infrastructure, energy distribution networks and energy storage (e.g. through hydropower). Potential impacts of climate change on energy infrastructure may include increased damage to power generation plants or problems with energy provision, leading to black-outs or

other disruptions. Disruptions in the energy sector can have large impacts on different sectors due to the increasing dependency on (electric) power provision for all kind of operational systems such as water supply (pumping installations, ...), the food system (transport, cooling, ...) and transport (electrified vehicles, dynamic traffic information, ...).

With regard to the Netherlands energy sector easily accessible and comprehensive [climate scenarios](#) are provided by the Royal Netherlands Meteorological Institute (KNMI). The manual [Working with climate scenarios](#) (2013) was set up by the Environmental Agency (PBL) and provides guidance on how to work with climate scenarios. The document and some background information is also provided at the [KNMI website](#) (the Royal Netherlands Meteorological Institute). The website www.ruimtelijkeadaptatie.nl is the main source for information (qualitative data) on climate adaptation in the Netherlands, both sector related and general. This however is not specific to the context of the energy sector.

The National adaptation Strategy (2016) has included the energy sector and provides an overview of the most important potential impacts on the energy sector.

A key document regarding climate change and the Dutch energy sector is the [Energy Agreement](#) (SER), but the document has a strong focus on climate mitigation (through energy savings and renewable energy targets). Energy reliability is a topic that is discussed in the document, but it does not seem to be directly linked to climate adaptation. The report [Evaluation of the impact of the Energy Agreement](#) provides further information in its impact.

The Benelux has organized a series of workshops (2015-2016), among other topics on adaptation in the energy sector, which has resulted in a short [report](#) with an overview of main impacts. Energy network administrators, such as the Gasunie and TenneT are working on initiatives through which the energy distribution network should be made more resilient (offline).

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

4.6. Water

Investments in the water sector are linked to efficient water supply (including reduction of leakage), wastewater treatment and water reuse as well as the implementation of [River Basin Management Plans \(RBMP\)](#) to ensure integrated water management at the river basin scale. Important threats are linked to water quantity (droughts and floods) as well as quality (water pollution). Climate change can have an impact on both water quantity and quality. Following the EU Floods Directive 2007/60/EC, Member States are obligated to perform flood risk assessment and to elaborate flood hazard and risk maps and flood risk management plans. Flood risk maps include the history of floods and climate scenarios. Member States also need to take climate change into consideration when developing RBMP. A [Guidance document on adaptation to climate change in water management](#) is available to ensure that the RBMP are climate-proofed. [Evaluations of the RBMP and FRMP](#) are also available on the EC website.

With regard to the Dutch water sector easily accessible and comprehensive [climate scenarios](#) are provided by the Royal Netherlands Meteorological Institute (KNMI). The manual [Working with climate scenarios](#) (2013) was set up by the Environmental Agency (PBL) and provides guidance on how to work with climate scenarios. The document and some background information is also provided at the [KNMI website](#) (the Royal Netherlands Meteorological Institute). The website www.ruimtelijkeadaptatie.nl is the main source for information (qualitative data) on climate adaptation in the Netherlands,

both sector related and general. This however is not specific to the context of the water sector.

In 2014 the Environmental Agency (PBL) published a report "[Small chances, big consequences' on the consequences of flooding in The Netherlands](#)" to guide investments in new water infrastructure, taking account of the increased risk posed by flooding.

The main issue in the Dutch water sector concerning climate adaptation is water safety (both sea level rise and overflowing rivers).

The [National Water Model](#) addresses all water subsectors; water safety, quality and fresh water supply. Historical data on precipitation and evaporation data can be found in the [Meteobase](#)⁹.

The [Multi-Layer Safety Scout](#) offers insight into the potential flood risk of new urban developments at local level.

Additional concerns for the water sector are overflowing sewage systems. The [tipping point analysis](#) is a methodology that provides insight into potential tipping points, such as the capacity of a sewage system. The analysis integrates climate change scenarios in the research.

Rioned¹⁰, the Dutch Federation for urban water management and sewer systems, has published several tools and articles to integrate climate change considerations in design solutions. To access some of the content they distribute through the [Rioned knowledge platform](#), including climate change adaptation measures and design considerations, one has to log in.

The '[Water Window](#)' is a website with measures to mitigate a wide range of "water problems" (quantity, quality, safety, etc.).

The following framework documents and programs provide information and guidance on (among other aspects) climate change adaptation in the water sector:

- The [flood risk management plans](#) ('overstromingsrisicobeheerplannen' in Dutch, 2015) and [maps](#) take climate change scenarios into account and link with 'adaptive water management' as developed by in the Delta Commission.
- [Deltaprogramma](#) is one of the main programs in the Netherlands focused on water safety (dealing with both the rising sea level and the elevation of the water level of rivers). The program includes the Hoogwaterbeschermingsprogramma (*in English: The High Water Protection Program*) and the 2e Hoogwaterbeschermingsprogramma (*in English: the second high-water protection program*) HWBP-2, which are Rijkswaterstaat's major rural improvement programs.
- [Ruimte voor de Rivier](#) (*in English: Space for the river*) is a plan by the Dutch government for the design of the Netherlands, which focuses on giving space to the river to overflow without causing much damage.

See section 4.1 for more information on other documents that can help in taking climate considerations into account.

⁹ The data in this database have been corrected for climate change based on the KNMI climate scenarios: http://www.stowa.nl/publicaties/publicaties/nieuwe_neerslagstatistieken_voor_het_waterbeheer_extreme_neerslaggebeurtenissen_nemen_toe_en_komen_vaker_voor

¹⁰ The main task of [Rioned](#) is knowledge management

4.7. Waste

Project investments in the waste sector are related to separate collection infrastructure, re-use and recycling infrastructure, energy recovery facilities and closure of landfills. Potential impacts of climate change on waste infrastructure may include increased rates of waste decomposition, odour and dust due to increased temperatures, flooding of landfills and waste treatment facilities, and reduced water availability for wet processes in waste treatment facilities. Also the impact on transport infrastructure should be considered, as transport is a critical component of waste management (collection, transport to and from waste treatment facilities). The impact on transportation is discussed in the section on transport above.

With regard to the Dutch waste sector, easily accessible and comprehensive [climate scenarios](#) are provided by the Royal Netherlands Meteorological Institute (KNMI). The manual [Working with climate scenarios](#) was set up by the Environmental Agency (PBL) and provides guidance on how to work with climate scenarios. The document and some background information is also provided at the [KNMI website](#) (the Royal Netherlands Meteorological Institute). The website www.ruimtelijkeadaptatie.nl is the main source for information (qualitative data) on climate adaptation in the Netherlands, both sector related and general. This however is not specific to the context of the waste sector.

The waste sector in the Netherlands expects to experience a minimal effect of climate change both in waste collection and processing¹¹. The main potential risks are posed by flooding and extreme heat. Waste is collected mostly in underground containers for which the soil functions as an insulating layer. The waste is therefore only minimally impacted by weather or temperature changes.

Most of the Dutch residual waste is incinerated for energy recovery, which takes place indoors and is therefore minimally impacted. In case of peak energy usage, the generators function as their own back-up power generator. Landfills, of which the Netherlands has only 18 still left in operation, are subject to climate impacts. However, these impacts are already accounted for in the strict [environmental regulation](#) with regard to landfilling (implementing [Directive 1999/31/EC on the landfill of waste](#)). For [example](#), a strict distance needs to be kept between the 'groundwater' and the waste layer within the bottom liner of a landfill and water buffers are mandatory in landfill designs to accommodate excess water. Odor issues in landfills are rare as biodegradable waste is not landfilled. A risk of increase in Volatile Organic Compounds (VOC) is also not an issue as all the stored waste is pre-treated.

A 2015 project on [Adaptive Circular Cities](#) offers experience and advice on strategies to implement interdisciplinary solutions on climate change adaptation, circular economy, but also energy and climate change mitigation. One example is to treat demolition waste in order to use it as [building material](#) that at the same time will lower heat stress, compared to traditional materials. The guidance '[Climate Resilience and Circularity in Construction materials](#)' offers insight in how to address these aspects in an integrated manner, provides a set of examples and guidelines to work with the project outcomes.

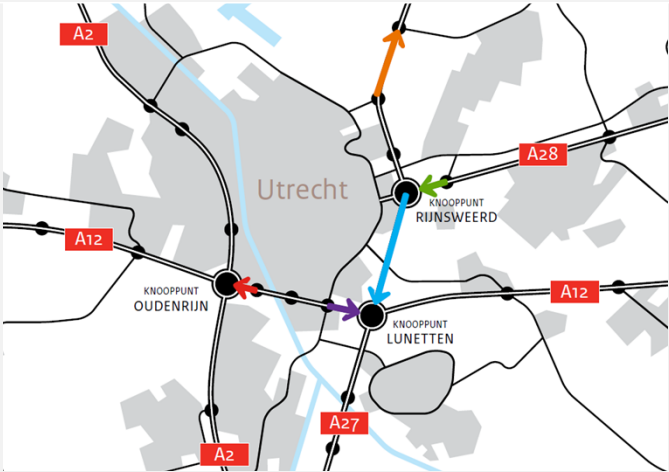
Large waste treatment plant are subject to [Directive 2010/75/EU on industrial emissions](#) (IED), which requires as a general principle that necessary measures should be taken to prevent accidents which may have environmental consequences, and to limit those consequences. This requires that a structured management plan should be available that includes and mitigates hazards such as extreme weather conditions (e.g. flooding, very high winds). In the [BAT reference document \(BREF\) on Waste Treatments Industries](#), some information is provided on the impact of certain climatic conditions (e.g. the impact of higher temperature on biofilter performance, aerobic decomposition, etc.). Although climate change is not specifically addressed.

¹¹

See section 4.1 for more information on other documents that can help in taking climate considerations into account.


5. CASESTUDIES

5.1. Casestudies van infrastructuurprojecten die klimaatadaptatie hebben geïntegreerd in hun aanpak

New Ringway Utrecht	
Project description	During the feasibility studies for the new ringway Utrecht, the project team looked whether climate change impacts were a differentiating factor for choosing the exact location of the new road. The research showed that, while this was not the case, several observations were relevant for the ensuing phases. During the planning process, these observations were further investigated, including an exposure analysis that integrated the climate scenarios. This resulted in the integration of adaptation measures, namely increased water buffering, in the project proposal (MMA or 'most environment-friendly alternative').
Photograph	
Budget	1. 153 Million EUR
Climate Change Vulnerability and Risks	Exposure to flood, taking the climate scenarios (KNMI) into account.
Climate change adaptation measures	Increased water buffering
Good practice	The approach followed in this pilot project will be used in other road development projects by Rijkswaterstaat. The method has been documented and can be replicated.
Further information	https://www.rijkswaterstaat.nl/zakelijk/innovatie-en-duurzame-leefomgeving/duurzame-leefomgeving/energie-en-klimaat/ring-utrecht-aanpassen-aan-klimaatverandering.aspx

<https://www.rijkswaterstaat.nl/wegen/projectenoverzicht/A27-A12-aanpassing-ring-utrecht/>

Landfill park development Nauerna

Project description	Redevelopment of the current landfill Nauerna in Assendelft into a future public nature and recreation area.
Photograph	
Budget	N/A
Climate Change Vulnerability and Risks	Flooding is the main risk. Climate projections have not been included, but extra water drainage capacity has been integrated.
Climate change adaptation measures	The design includes the creation of water buffers to accommodate excess rain water
Good practice	While an update to include climate scenarios has not yet been looked at, there is a systematic approach to address potential risks of flooding.
Further information	https://www.afvalzorg.nl/projecten/park-nauerna/

Aardwarmte Combinatie Luttelgeest BV – ERDF project

Project description	The project is set up by farmers who want to use geothermal energy to heat their greenhouses (depth: ca. 1800m). This will result in a CO ₂ -emission reduction of 18.000 ton and will save 10,6 mln. m ³ of natural gas every year.
Photograph	N/A
Budget	ERDF funding: € 1.200.000,00/ total: € 16.500.000, 00
Climate Change Vulnerability and Risks	A risk-analysis is included in this type of project. Different scenarios with changing weather circumstances are reviewed to check the depth that pipes need to be drilled. Water availability is another parameter that needs to be considered. A scenario with high and low water availability have been studied. This is the case for a series of similar projects that have been funded over the last decade.
Climate change	Potentially change depth of pipes, and review the volume

adaptation measures	of water needed.
Good practice	New geothermal projects need to take these considerations into account to mitigate the risk of not having a performing energy system in place. The fact that this has been done in several similar projects, shows the replicability of the practice
Further information	http://www.kansenvoorwest2.nl/nl/projecten/ - offline

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