



Future Cities

urban networks to face climate change

THE FUTURE CITIES GUIDE

Creating Liveable and
Climate-Proof Cities



The [Future Cities](#) partners seek to hand on their experience, the lessons learned and the problems encountered to other cities or regions in North-West Europe. During five years of intense cooperation, the partnership developed and implemented a variety of measures to make their cities and city regions fit to cope with climate change. In this report these experiences are presented – common achievements across borders and results at the local and regional level of each partner area.

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The report is divided into four parts:

- Part A: About the [Future Cities](#) project
- Part B: Transnational Tools for [Future Cities](#)
- Part C: The [Future Cities](#) project guide
- Part D: The way forward

In addition more detailed information is available on each partner project: You can find it listed at the end of the document; reference is made where applicable.

January 2013

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Preface



The effects of our changing climate will considerably affect the quality of life in our city regions. Repeated flash flood events, heat waves or storms – to name just a few – have a strong impact on our cities. Although it is important to do all efforts for mitigation, due to science it is not possible any more to fully avoid climate change. Therefore we, the **Future Cities** partners being water boards, municipalities, council and planning authorities, have decided to proactively adapt: to take care of our densely populated cities.

The key role of cities in the adaptation process is recognised by the EU Commission within the development of the EU Adaptation Strategy. As a major transnational project, exclusively dedicated to making city regions in North-West Europe fit to cope with the predicted climate change impacts, we believe that the results of **Future Cities** provide a useful perspective for other city regions and countries.

The European funding has enabled us to implement concrete adaptation measures based upon the retro-fitting of existing infrastructures in England, the Netherlands, Belgium, France and Germany. But we could do even more: to help foster adaptation the partnership has developed innovative tools such as the Adaptation Compass. This guidance tool for developing climate-proof city regions helps planners and experts at cities and water boards to meet their needs to consider adaptation in planning process. Subject to exchanges with European and national organisations in charge of adaptation, the Adaptation Compass works in all European countries, complementing the range of existing tools.

"Enjoy adaptation" is one leitmotiv chosen by the partnership after five years of cooperation. With this positive way of thinking, politicians and decision-makers are invited to consider the need to face climate change as an opportunity to develop future urban areas which meet environmental demands.

For us, the joint work with eight, fully engaged partners from five countries was always a great pleasure. We invite you to discover the many results of the **Future Cities** Partnership and wish you an inspirational read.

Dr. Jochen Stemplewski
CEO Lippeverband, Lead Partner from **Future Cities**

Part A About the Future Cities project

A.1 Climate change requires a pro-active attitude

Our climate is changing and adaptive action is required.

The heat island effect in summer or wetter winters with increased flood risk are phenomena which greatly influence urban living conditions. Rising temperatures and weather extremes like floods and storms can be detrimental for the quality of life in our towns and cities - challenges we have to face. Our urban city regions must be prepared to cope with the effects of climate change as city structures and the urban living environment are especially vulnerable.

At the same time well-functioning city regions are one of the most important pre-requisites for sustainable economic development. A mere reaction on the impacts of climate change will lead to increased costs for adaptive measures. Anticipatory strategies are needed for adapting the urban structures in a way that the impacts of a changing climate will not endanger the urban living environment.

Read more:

IPCC Climate Change 2007 WG II: Impacts, Adaptation and Vulnerability

Urban adaptation to climate change in Europe – Challenges and opportunities for cities together with supportive national and European policies, European Environment Agency EEA Report 2/2012



Heat stress – flooding – storm damage may threaten the quality of life in our towns and cities.

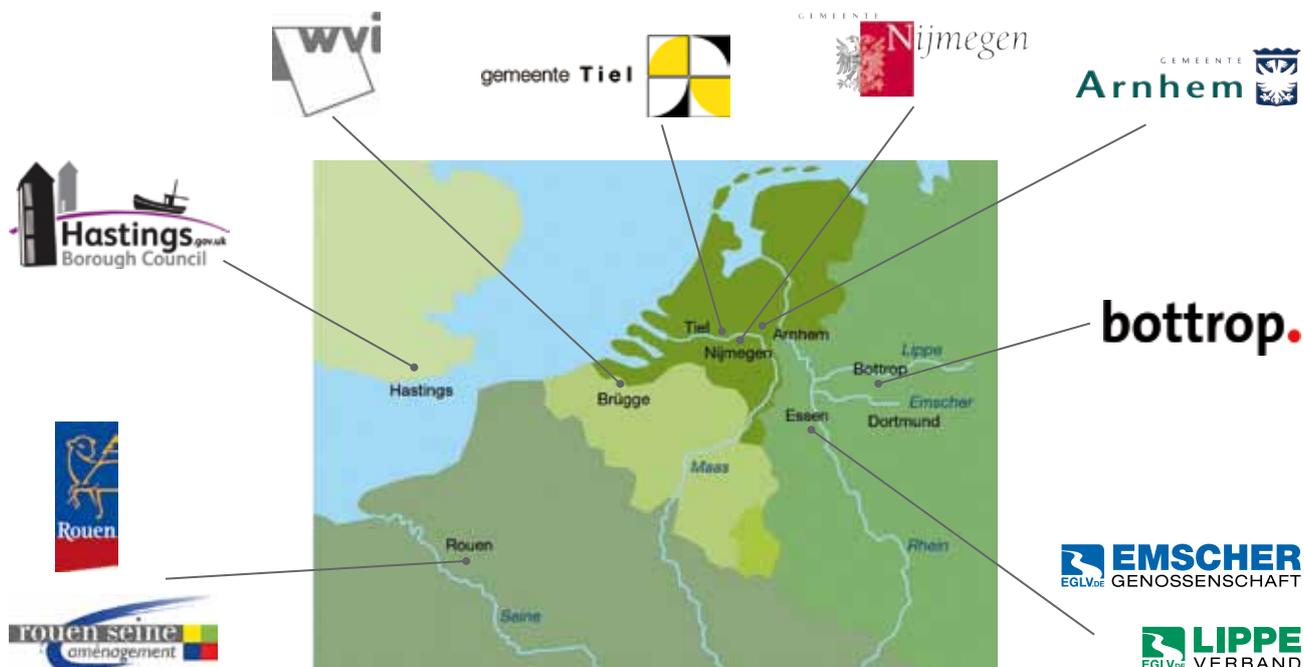
A.2 A network for adaptation

At the European and national level urban networks exist to promote strategies to mitigate greenhouse gas emission. Mitigation is of course important but not sufficient. If mitigation and adaptation measures are combined at the local level, synergies can add value. It is no longer possible to reduce the emissions quickly enough to avoid dangerous or negative impacts on people's life, economy and ecology. It is obvious that in addition to mitigation, adaptation is necessary as well. As there are still practical obstacles to overcome, this calls for coordinated action and transnational cooperation. Acting locally is essential to directly face the challenges of extreme weather. It is not enough, however, because the impacts of climate change do not stop at national borders or city limits. Through international partnership, sectoral and individual know-how can be built upon and

several actors can work together to achieve local and regional improvements.

"Future Cities – urban networks to face climate change", a project in the framework of the INTERREG IV B NWE programme, led by the German water board Lippeverband: the project aims at making city regions in North-West Europe fit to cope with climate change impacts. The Future Cities strategy combines selected strategic key components of the urban environment – green structures, water systems and increasing energy efficiency – for a pro-active transformation of urban structures. As public bodies are frequently responsible for urban water management and green structures in cities, they also have the possibility to design and implement adaptation measures within the existing urban infrastructure.

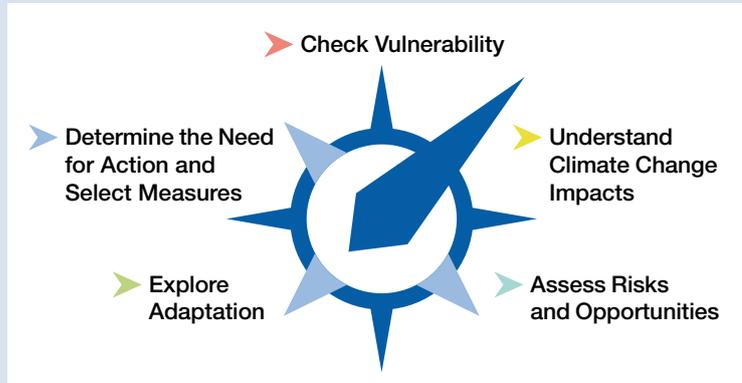
The Future Cities partners are: Lippeverband/DE (Lead Partner), City of Arnhem/NL, Emschergenossenschaft/DE, City of Bottrop/DE, Hastings Borough Council/UK, South East England Partnership Board/UK (formerly), Sea Space (Hastings and Bexhill Renaissance)/UK (formerly), City of Nijmegen/NL, Rouen Seine Aménagement/FR, City of Rouen/FR, City of Tiel/NL and West-Vlaamse Intercommunale/BE.



The Future Cities organisations are located in North-West Europe.

Since the beginning of the project in 2008, the project partners have developed and implemented:

Common evaluation methods for climate-proof city regions – the "Future Cities Adaptation Compass"



Action plans to enable the participating regions to adapt their strategies in a concrete manner



Combined measures: selected construction solutions in pilot projects



Targeted awareness raising methods and campaigns with decision-makers and disseminators



A.3 European and national challenges – local and regional implementation

Climate change is a topic that is recognised at all political and administrative levels. The European Adaptation Strategy is on its way, national adaptation strategies and more concrete actions plans already are at hand or being developed. All these strategies emphasise that the local and regional level is decisive because this is where the impacts are felt and the adaptation measures have to be implemented "on the ground".

Therefore, the starting point of the [Future Cities](#) network is to develop concrete anticipatory strategies for the local and regional level by combining viable and cost-effective adaptation measures. At the same time, national and European adaptation strategies provide an important framework.

Two aspects are particularly acknowledged: In the first place especially densely populated areas are involved. Here the consequences of climate change affect the living environment of people as well as economy and society in a special manner. The vulnerability of metropolitan regions is particularly high. But at the same time city regions play a significant role in the "economic powerhouse of Europe" – as North-West Europe is called.

It is essential that urbanised areas are not harmed by climate change. Secondly, a specific focus is on the existing infrastructure. As far as new developments are concerned a lot of knowledge is available on energy efficiency and climate-proof buildings but for the existing infrastructure, such as old industrial sites or older housing stock, no practical measures are at hand which do not cause immense costs. Here, especially cost-effective measures are required.

Recommendation:

The right strategy – bottom-up meets top-down

It is necessary to trigger and combine the top-down and bottom-up approach: an overall climate strategy and appropriate policies are required on the EU, national, regional and municipal scale to implement concrete and coherent projects. Of course, it is inevitable that everybody has to make his or her individual contribution.



The [Future Cities](#) partners at a meeting in Ieper (BE), September 2011

A.4 The partnership: interdisciplinary and international

The **Future Cities** partnership includes water boards, urban administrations, planning associations and project developers in North-West Europe. The geographical scope of the partnership covers densely populated areas in river catchments or directly at the coast: the Northern Ruhr area with the catchments of the rivers Lippe and Emscher as tributaries of the Rhine, the province of Gelderland in the catchment of the rivers Nederrijn and Waal, the region of Upper Normandy in the catchment of the river Seine, West Flanders with the river catchment of the Schelde and finally South East England on the South coast of Great Britain.

Each partner of the **Future Cities** project has a special expertise for the different fields of action: e.g. the expertise of water boards about the urban water system is combined with the expertise of the municipalities regarding the effects of green structures. The involvement of regional planning authorities secures the expertise in planning guidelines and development agencies provide the know-how needed for planning issues with investors. Together, the **Future Cities** partners developed a practical tool – the **Future Cities** Adaptation Compass – where the experiences across sectors and countries are compiled in a structured and understandable way to support cities in identifying their own adaptation strategy.

Exemplary measures – on town and city quarter level:



Ready to analyse the city climate

The Dutch city of Arnhem focused on the urban vulnerability due to heat and the urban heat island effect. Based on the analysis of the urban climate a "Heat Attention Map" was developed to provide recommendations for urban planners and developers.



The eco-district of Luciline

The French city of Rouen is developing the "quartier Luciline" on the banks of the river Seine into a sustainable business site and living quarter. The first measures taken concern the reconstruction of the water system in order to deal with weather extremes more efficiently.



Ecological improvement and sustainable use of storm water – a no-regret-measure fulfilling multiple aims

The German water board Lippeverband created a green-blue corridor in the city of Kamen to improve the city micro-climate. Additionally, in combination with the ecological enhancement of the stream "Heerener Mühlbach", storm water from private properties was disconnected from the sewer.



Involving decision-makers: study visits helped to convince.

The West-Vlaamse Intercommunale (Belgium) developed a sustainable and climate-proof new district, the city quarter "De Vloei" in the Belgian city of Ieper. The planners placed a particular emphasis on including decision-makers in their considerations: construction techniques leading to sustainable towns are often already known but have to be implemented by the right persons at the right time.



Planners of the municipality are explaining the adaptive measures.

Emschergenossenschaft and the municipality of Bottrop (Germany) cooperated to make an industrial park climate-proof. Flash floods after heavy rainfalls often occurred on the site. This situation is likely to be intensified by the changing climate. Adaptive measures with regard to the water system reduce the potential sewer overflow in case of heavy rainfall.

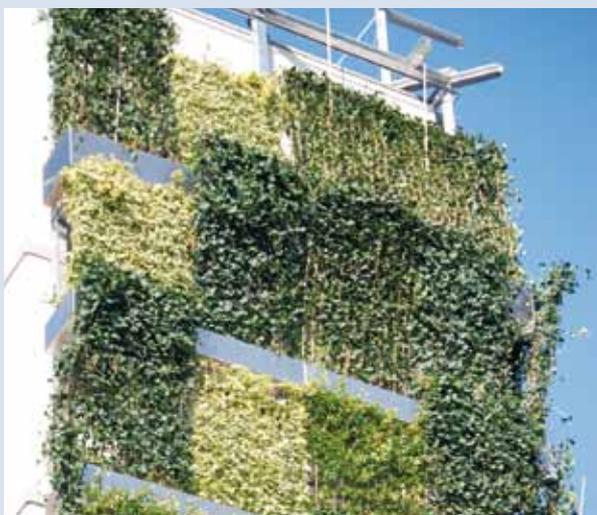


The Cool Nature park was developed as part of the integral water scenario.

Exemplary measures – at the building level:



The Sussex Exchange: a conference centre offering ideal facilities for events dealing with sustainability issues



Outstanding visibility: the vertical green realised in Nijmegen

In the eastern part of the Dutch city of Tiel an integral scenario was developed to deal with water-related problems. As a result, innovative design principles and technical measures combined the requirements of water management, climate resilient building and renewable energy.

A good example of a new climate-conscious construction is the Sussex Exchange exhibition building in the region of Hastings / Bexhill in the South East of England. It combines the right location, an architectural design which favours a healthy climate with natural ventilation, the use of renewable energy, rainwater systems and roof greening.

As part of a climate campaign, the Dutch town of Nijmegen installed green roofs and green facades on existing buildings. They help to cool the buildings, retain rainwater and reduce energy needs. Furthermore, Nijmegen converted a parking lot in the city centre into a park to help to cool the area.

A.5 The bigger picture: a European cluster

Future Cities is part of *SIC adapt!*, the Strategic Initiative Cluster (SIC) of the INTERREG IV B North-West Europe (NWE) Programme dealing with adaptation to the impacts of climate change in seven member states. The Cluster involves eight transnational projects with 100 partner organisations representing all levels of public authorities, academic institutions, non-profit and private sector organisations. The Cluster organisations have brought together their collective experiences of good practice tools and measures for climate change adaptation like no-regret measures. The **Future Cities** partnership actively contributed to the web-based Cluster Knowledge Platform, e.g. with the Adaptation Compass and good-practice measures. The platform provides information in a number of different categories e.g. action fields, types of tools, spatial scope or target group, allowing to share the knowledge and to transfer the results to North-West Europe and other European regions.

The Cluster identified five themes for in-depth discussions within cross-project exchanges: heat and bio-climatic stress in urban areas; vulnerability assessment; flash floods; climate-proofing; and multifunctional land-use. The cross-project event on flash floods was organised by **Future Cities**.



Read more:

www.sic-adapt.eu



Part B Transnational tools for Future Cities

The **Future Cities** partners want to hand on their experience, lessons learned and problems to other cities or regions in North-West Europe. Working internationally and across disciplines, they wished to integrate their single projects in an overall "adaptation structure". In the **Future Cities Adaptation Compass** their experience is presented according to a structured and understandable approach that will help cities to identify their own adaptation strategy. In the following chapters you will find an overview of the **Adaptation Compass** as well as the experiences of the **Future Cities** partners applying the **Adaptation Compass**.

B.1 From being vulnerable to taking action – follow the Adaptation Compass

In a city almost all departments are facing the impacts of climate change. They must adapt their policy and practice. Measures taken by one department might also meet the adaptation needs of another. On the other hand, adaptation activities of one department may conflict with the adaptation aim of another urban structure. This situation is where the **Adaptation Compass** starts from: it aims at interlinking different stakes and checks the vulnerability and adaptation options across sectors.

The **Adaptation Compass** supports planners, climate change policy officers, technical staff and experts at cities and water boards in structuring their adaptation work. It gives examples of good practice, presents the experience of the **Future Cities** partners and highlights possible obstacles.

The main features are:

- Applying a pre-structured assessment and documentation layout, the **Compass** allows the user to plan the stages in order to create climate-proof cities.
- The **Adaptation Compass** can be applied to a region, a city or a project area providing best results for a city or a city quarter.
- The tool provides general information and automated answers. It also gives the user the opportunity to submit local information.

The Adaptation Compass

- is a computer-based tool supporting the user to develop a cross-sectoral, integrated adaptation strategy including options for measures, suitable on quarter, city or regional level.
- consists of an Excel-file and is accompanied by a guidance document.
- can be downloaded free of charge www.future-cities.eu
- is available in English and German language.

The focus is on "guiding through the process" based on a pre-structured assessment: Five modules provide guidance from a vulnerability assessment to adaptation options and their selection.

Determine the current vulnerability of a city region or parts of a city with the VULNERABILITY CHECK.

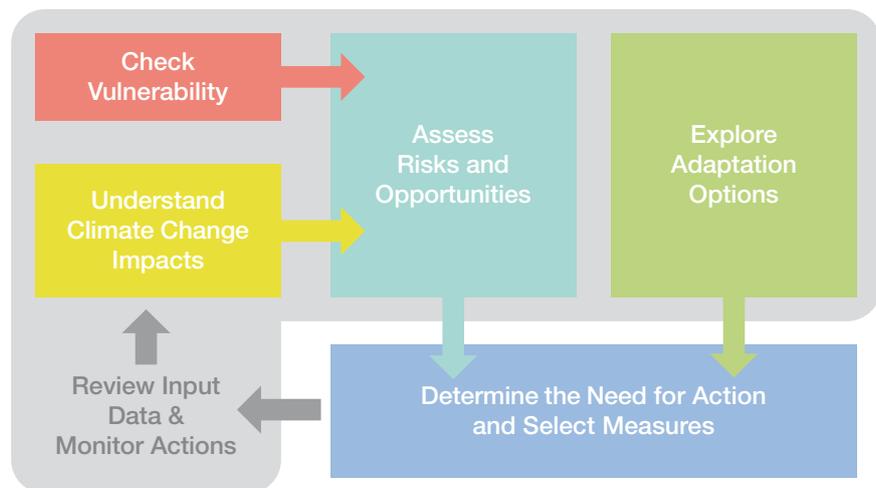
The module UNDERSTAND CLIMATE CHANGE IMPACTS assists in getting the relevant information and helps to cope with uncertainties.

For the ASSESSMENT OF RISKS AND OPPORTUNITIES a method is proposed that uses the results of the vulnerability check and the projected climate change trends.

The module EXPLORE ADAPTATION explores the various adaptation options: especially the combination of different measures based on the practical experiences of the Future Cities partnership.

Last but not least, the NEED FOR ACTION can be determined. The core problems and problem areas can be identified and suitable adaptation measures can be found.

The user can save the results, REVIEW input data later and update, if required. Examples for MONITORING the results of the measures are also provided.



Discuss, interlink, integrate

The Adaptation Compass was developed within a period of five years including several tests performed by the partner organisations. Additionally, members of the scientific and strategic advisory pool – from regional and national authorities and universities – discussed the features so that their practical experiences could be integrated.

Using the first version of the tool, the Future Cities partner organisations considered it extremely convenient for discussions with colleagues from other departments. Different approaches could be detected, e.g. concerning the indicators to weigh the impacts. The discussion improved the development of mutual understanding within the organisations. A coordinator of the process was considered to be very helpful. For

instance, a person in charge of climate issues in the city would be in charge of the coordination and invite different services and organisations to contribute to the gathering of information and to discuss with other services e.g. the choice of receptors. In practice, the Future Cities partners started the Vulnerability Check with an introductory workshop where a facilitator explained the basic features, followed by a phase of collecting data and a workshop to discuss the results of this phase.

In order to take full advantage of the Adaptation Compass it should not be considered to be a single tool but as an instrument to provide links between the working methods used in different departments. As an example, the structuring of the process can be combined with a visualisation-tool like the Heat Attention Map to develop the best adaptation strategies.

Conditions change – be aware

Adaptation is a process that demands monitoring and regular review. When reviewing the adaptation process, the focus is on the investigation of the background conditions and the initial reasons for starting the adaptation process. Input data may change or new aspects may arise. Monitoring aims at checking the implemented adaptation measures with regard to the predefined goals during the planning phase, e.g. are the goals reached and is the measure living up to the expectations? This is not a separate module within the Adaptation Compass but a process to be embedded into regular review and monitoring standards. However, the partnership has integrated some crucial guiding questions to provide ideas about the reviewing and monitoring requirements of keeping adaptation strategies up-to-date and assessing implemented measures.

Synergies with national and regional tools

While developing the Adaptation Compass the partnership monitored similar tools, which already existed or were developed in the partners' countries: Where do

tools complement each other in order to create synergies? E.g. the French tool Impact' Climat provides a detailed database of the vulnerability of French towns. One main added value of the Adaptation Compass is the broad catalogue of adaptation options containing many concrete examples of measures implemented by the Future Cities partners.

Some examples of tools to support adaptation:

Adaptation Wizard, UKCIP, Environmental Change Institute (ECI), University of Oxford, Great Britain

Klimalotse, German Environment Agency; *Stadt-klimalotse*, German Federal Ministry of Transport, Building and Urban Development

Impact'Climat, Agence de l'Environnement et de la Maitrise de l'Energie (ADEME); *Reference framework for sustainable cities*, French Ministry of Ecology, Sustainable Development and Energy

Stages from first ideas to producing a viable tool					
April 2008	2009	2010	2011 – 2012	2012	February 2013
The start: We want to develop a "transnational check to assess the climate-proofness of urban structures and (...) to act in an anticipatory manner"	Basic structure developed and concepts of modules "Check Vulnerability" and "Explore Adaptation Options"	Named "Adaptation Compass", User inquiry, Test run with parts of tool, feedback by advisory pool	Completion of content (e.g. guidance document, definition of terms, fact sheets), technical development	Application of prototype at project partners, review	Final version, available for download



Future Cities partners from different departments test the Adaptation Compass (March 2012, Nijmegen).

B.2 In detail: the modules of the Adaptation Compass



B.2.1 Check Vulnerability

Based on the experience of the project partners, the **Future Cities** vulnerability check was developed: The check starts by determining the current vulnerability. The development of a city is already subject to many uncertainties, e.g. changes in the demographic situation with the climate projections adding even more uncertainties. Therefore, the **Future Cities** partnership decided to consider the consequences of climate projections in a separate step.

The local physical features and socio-economic conditions – called receptors – are the initial point to determine the vulnerability. The list of receptors provides a comprehensive checklist for the urban environment.

For customised use the receptors of individual interest can be selected and further receptors can be added. For the description of the spatial layout of receptors practical indicators are proposed. These indicators can often be based on existing statistical figures, e.g. to determine the areas with a high percentage of elder population (e.g. over 65 years).

Individual information regarding former events provides knowledge, e.g. about heavy precipitation or heat waves and their impact on the different receptors and the action taken, e.g. in the infrastructure system or in organisational procedures. Here, the **Future Cities** Adaptation Compass provides a similar approach based on the good practice experience of the Hastings case study.

As the overall result, the current vulnerability is summarised in basic categories – low, medium, high – for each receptor. Pre-set values are given and can be changed according to the individual situation. The pre-setting values represent a key element of the Adaptation Compass. These values were subject to intense discussions during the test phase. Because of the importance of these selections for the final results, the qualification of the user plays an important role.



The Adaptation Compass can be started with the module "Check Vulnerability".

Receptors and examples of the impact of weather extremes



Population: Public health and vulnerable groups

Storm in England, 2008: pupils at Torfield School in Hastings were evacuated after winds had blown off the roof.

Heat wave in Germany, 2003: during the summer heat wave 7,000 people died of cardiac infarction, cardiovascular disease and renal failure plus problems with respiratory systems and dysfunctions of the metabolism. A regional shortness of potable water led to further health problems.



Infrastructure: Transport, electricity and heating services, water supply and sanitation services, social infrastructure

Storm in Europe, 2007: Kyrill was a severe storm that struck Europe. Traffic was paralysed over most of Europe.

Extreme icy conditions in Germany, 2005: in the Eifel region special weather conditions caused the accumulation of ice on electricity lines. The electricity poles broke down under the weight and the region was without electricity for days.



Built environment: Building stock and materials

Heat can produce damage to buildings, especially in densely built up areas. E.g. plastic parts of roofs, windows etc. can be deformed. Floods can cause water penetration in houses which can cause long-term damp in walls.



Economy: Tourism, industry, retail

Heat wave in Europe, 2003: a large-scale heat wave with a drought led to rising prices at the stock exchanges:

- for electricity due to limited production
- for raw materials due to difficult transport conditions and
- for oil due to a higher demand.



Natural resources: Green spaces, water resources and water quality, air quality, agriculture, forestry, biodiversity

As a consequence of flooding, pollutants or salt water may be enriched in water bodies and soil which can lead to water quality problems.

In the Adaptation Compass more background information is given by a basic catalogue of the direct and indirect impacts of changes in climate variables and their consequences for the different sectors and functions of a city.

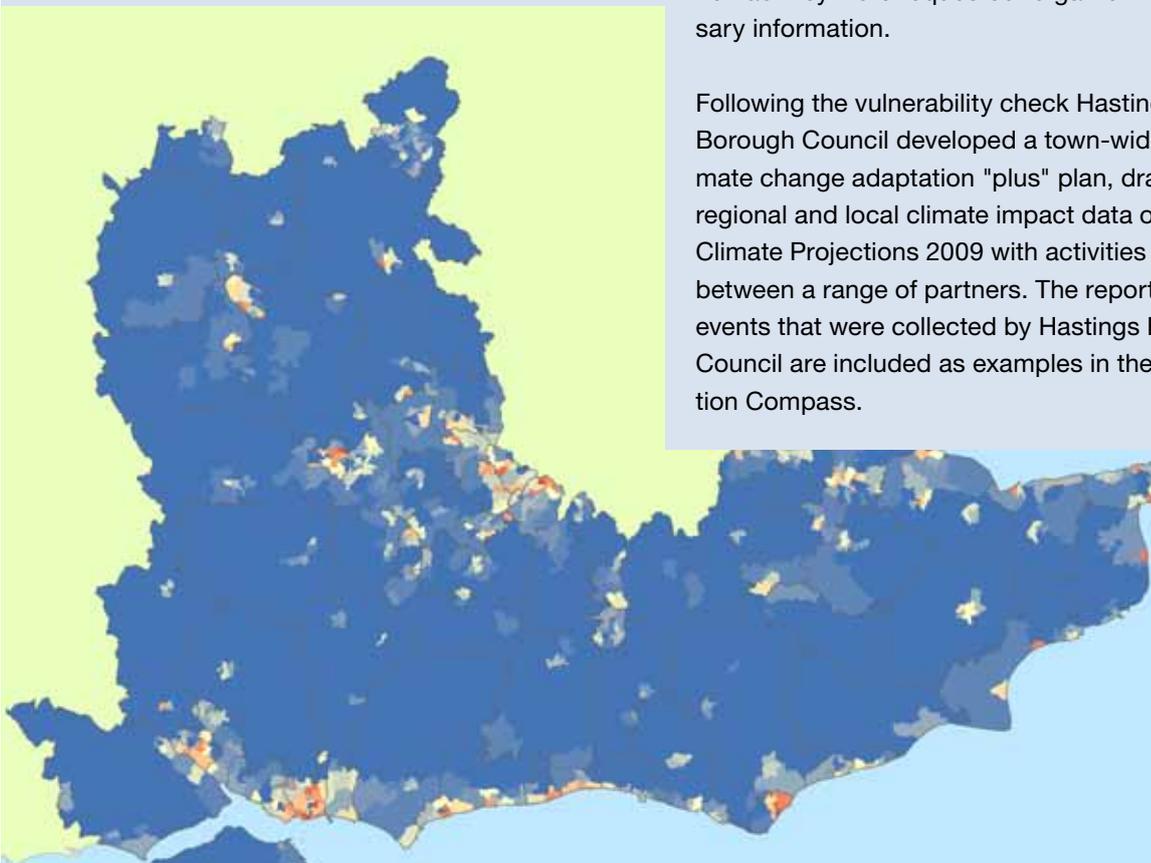
Vulnerability of cities and city regions: examples of Future Cities partners

The [Future Cities](#) network tested their vulnerability by means of different tools.

In the South East of England, the Partnership Board, a partnership between the local authorities and the regional economic development agency, undertook a regional vulnerability assessment. Different sectors were explored, e.g. population and health, water resources and economic development. The Board decided to first look at the current vulnerability: what consequences are currently experienced as a result of flooding and erosion? The regional vulnerability assessment focused on identifying areas at greatest risk or "vulnerability hot spots". These were identified by overlaying maps with the geographical information available at the regional planning association. Starting from the current vulnerability the experience made with the receptors was integrated into the [Future Cities](#) Adaptation Compass.

The [Future Cities](#) partner, Hastings Borough Council, explored its local vulnerability by conducting a Local Climate Impacts Profile. This is a procedure introduced by the UK Climate Impacts Programme to explore the consequences of extreme weather events. In Hastings, a coastal town in South East England, the weather events reported in the news during the past 10 years were connected to the impacts they had on the municipal services and communities. During the past 10 years, twenty events of flooding, fourteen events of drought and seven events of heat waves and the same number of high winds were noted. Heat waves had positive and negative consequences. More tourists came to visit Hastings because the sea and wind lower the temperatures. A negative aspect was the increased number of complaints because of the noise in the streets during warmer nights. The process also raised the awareness among the various departments of the administration as they were requested to gather the necessary information.

Following the vulnerability check Hastings Borough Council developed a town-wide climate change adaptation "plus" plan, drawing on regional and local climate impact data of the UK Climate Projections 2009 with activities shared between a range of partners. The reported former events that were collected by Hastings Borough Council are included as examples in the Adaptation Compass.



Mapping the vulnerability of South East England; here the example of the resulting map of overlaying household density and flood zones (red areas)



B.2.2 Understand Climate Change Impacts

In Europe and all over the world detailed research is being done to determine the impacts of climate change. Models are being developed and refined to concretise the possible effects. Nevertheless, the models involve many assumptions on how the parameters will develop and interact. Almost every country is working on its own regional climate projection model derived from different global climate models. For some regions, different regional climate models are being used providing varying results.

The Adaptation Compass supplies city planners with practical information guiding the user by questions such as: what do I need to know? What kind of information do I need? Where can I get the information from? How can I manage uncertainties?

Uncertainties in climate projections are manifold. Moreover, we have to consider that climate is a complex system, which is difficult to forecast. The amount or value of uncertainty is hard to quantify as it depends on the model input data, the time frame, the resolution and the output parameters. Nevertheless, uncertainty should not be used as an excuse for not taking appropriate action. Lots of decisions, in various fields such as economy, politics, planning and water management, are taken in the face of uncertainty, e.g. most investment decisions. Decisions on adaptation should be approached in a similar way.

The experience of the [Future Cities](#) partners shows that it is advisable to start with the general trends of the climate parameters and the consequences for weather events. Climate parameters in question are air temperature, precipitation, storm and sea level change which may lead to weather events such as heat waves, extreme cold, drought, heavy precipitation and floods or storm waves. The general trends are classified in three categories: increasing, decreasing and no change expected. Many projected trends have a reinforcing effect on the current situation such as more extreme rainfall might lead to increased storm water flooding events. Some are probably indifferent or might even have a balancing effect for the urban environment, e.g. milder winter temperatures mean less energy needed for heating and thus lead to a lower greenhouse gas emission.

The results of climate projections can provide valuable background information for regional and local adaptation decisions. The decisions, though, should always be based on a variety of information, such as vulnerability assessments or general spatial planning needs, development plans etc.

Uncertainties can be classified into four categories according to their origin:

- Uncertainties resulting from scenarios: future emissions, land use and many other influencing factors on climate are projected under assumptions.
- Uncertainties resulting from inaccuracies in global climate models are passed to regional climate models.
- Uncertainties resulting from inaccuracies in regional climate models
- The so-called sampling uncertainties: the modelled climate always has to be estimated based on a limited number of years.



B.2.3 Assess Risks and Opportunities

The changing climate conditions lead to an increasing number of risks but also offer some opportunities. In the Adaptation Compass the assessment is based on the results of the module "Check Vulnerability" and the projected climate change trends, which were described in module "Understand Climate Change Impacts".

The current vulnerabilities are combined with the future climate change trends projected by means of an evaluation matrix answering the following questions:

- What types of future risks and opportunities exist?
- Which receptors of the city will be most affected in future?

At this stage a so-called risk-assessment approach is frequently applied. Based on the experiences within their organisations the **Future Cities** partners decided to take an approach that is different from the classical risk approach. There, the term risk is defined as the combination of the probability of occurrence and the magnitude of the consequence or hazard. For the Adaptation Compass the **Future Cities** partnership decided not to evaluate the probability of occurrence – in this case of a climate change impact – because the uncertainties of climate change projections are, at least for some parameters, significant. A reasonable rating of probabilities seems therefore impossible. Furthermore, in the Adaptation Compass no climate change data is used, only tendencies and qualitative descriptions are given. Therefore, the user is hardly in a position to determine a probability of occurrence without having quantitative data at hand.

	climate change impact		
Current vulnerability	balancing	indifferent	reinforcing
High	medium	high	very high
Medium	low	medium	high
Low	low	low	medium

Evaluation matrix to determine the categories of risks (grey cells): The matrix brings together the results of the Vulnerability Check (Vulnerability classes high, medium, low) and the module "Understand Climate Change Impacts" with the climate change impact (balancing, indifferent, reinforcing).



B.2.4 Explore Adaptation Options

The Adaptation Compass invites the user to learn about the concrete experiences made by the **Future Cities** network. They include structural measures, which require building or modification of infrastructure or houses, and raising awareness measures, informing and supporting the implementation of structural measures.

Structural measures

In the Adaptation Compass structural measures are categorised according to the focus of **Future Cities**: categories are green structures, water systems, energy efficiency and mitigation, and urban structure. The types, which were defined in addition, are described in more detail, there are up to four types in one category. Even more detailed fact sheets inform about the **Future Cities** measures documenting key points of description and lessons learned: e.g. type and spatial characteristics of the measure – such as scale (region, town, quarter etc.) and use (city centre, business, residential), the adaptation problems which can be addressed by the measure and

the synergies and conflicts encountered because of other adaptation and mitigation measures or sustainability aims.

This structure was developed to organise the information within the tool. For the implemented measures in **Future Cities** one major category was determined by its pattern and one or two further categories are additionally given for further positive impacts of the options. Taking the measure "building green roofs" as an example, it is mostly a green structure as vegetation is planted. Water systems and energy efficiency, however, are also involved as the measure is connected with ideas to improve rainwater management and building insulation.

While presenting the adaptation measures, **Future Cities** focuses especially on their synergy effects related to climate protection and effects related to other aims which are on the agenda of cities, such as coping with demographic change or regenerating industrial areas. These additional aspects of an adaptation measure facilitate the actual implementation.

Detail (example) of the category “Green Structures”

Category of structural measure	Type of measure	Description as used in the Future Cities Adaptation Compass	Problems addressed	Possible obstacles (examples)
Green Structures	Green roofs 	Roofs of buildings covered with vegetation	Heat/Extreme cold: thermal insulation layer Heavy precipitation: decentralised water retention	Structural preconditions and existing slope; Monument conservation
	Green walls 	Walls covered with vegetation	Heat: cooling effect	Might not meet the requirements of a historic city centre
	Green open spaces 	Parts of cities not built upon, partly covered with vegetation	Heat: cooling effect Heavy precipitation: increased water retention	Leaves may block gullies and can lead to local flooding; conflicts with other usage of space, especially parking lots

Example of fact sheet on structural measure

Explore Adaptation Options: Structural Fact Sheet

Green roof “De Tweeling”

Status	Implemented in 2010
Location	The Netherlands, Gelderland, Nijmegen, Willemskwartier
Spatial info	Kindergarten “De Tweeling”; residential area
Measure type(s)	Green roofs; Water retention, Increase energy efficiency; Urban texture
Contact	Ton Verhoeven, t.verhoeven@nijmegen.nl



Nijmegen

Description and Aim

On the extension of an existing kindergarten a green roof (400 m²) was constructed combined with all kind of other sustainable building design aspects (heating, ventilation). This green roof is also an extension of the garden. The kindergarten works on an anthroposophic basis and the children play and sleep outside. The green roof which is visible from the ground helps with the feeling of a green surrounding.

Adaptation to climate change

With the green roof storage of a part of the rain water is arranged, the rest of the rainwater flows into the ground (disconnected building). A green roof is a good insulation layer in times of heat.

Problems addressed:
Heat wave, heavy precipitation / flooding

Receptor(s):
Built environment, vulnerable groups

Experiences

Functionality:
The impact of a green roof of 400m² is on the site itself: The green roof together with the insulation layers reduces the impact of the sun on the roof and therefore lowers the cooling demands during hot times. The green roof lowers the impact of heavy rainfall, so less rainwater has to be brought underground via the disconnected system. A green roof also has other positive aspects e.g. increasing the biodiversity (flowers, insects) and lowering fine dust loads in the air. Both are aspects the kindergarten uses in its philosophy.

A green roof lasts longer than a conventional roof, e.g. because the vegetation is more sustainable for heat exposure. A green roof of 400 m² has no reducing effects on a scale of a town or town area.

Further synergies/benefits:
A fine example for the municipality’s green roof strategy and for communicating that strategy. A fine example of a very sustainable building (climate control, energy supply and water retention).

Costs:
Estimated € 50 to € 60 / m² (total € 20.000 - € 24.000). The municipality gave a subsidy of € 10.000,- (€ 25 / m²).

Funding:
International and local. Subsidy of the municipality for the green roofs. Subsidy of Future Cities for the rain water monitoring devices.

Stakeholder involvement:
Building owner of the private kindergarten, constructor, engineering office of the municipality (for the monitoring).

Acceptance:
The city of Nijmegen uses this example in its green roof strategy and will place pictures of the roof in the second version of the Nijmegen green roof booklet.

Obstacles/restrictions:
In exchange for the local green roof subsidy the city of Nijmegen requested to install a rainwater monitoring device (paid by the municipality). Implementing the device within the construction of the building was difficult.



The information is based on the experience of the Future Cities-partnership. It is not necessarily comprehensive, complete, accurate or up to date.



Raising awareness measures

The Future Cities partners have implemented many measures to raise awareness of the topic of adaptation in general, of risks and the need to adapt. At the same time the acceptance of structural measures should grow and structural measures should be developed following a participatory approach. In the Adaptation Compass

the experiences are structured according to the types of target group integration – from being observer or listener ("Inform"), giving advice ("Consult") to being a co-partner in implementing ("Co-produce"). Specific examples of implementation within the Future Cities partnership describe the activities in detail and show the experience and obstacles during the implementation process.

Explore Adaptation Options: Raising Awareness Fact Sheet

Energise Hastings

Measure by	Local Authorities, Hastings Borough Council with other partners
Coverage	Local, Hastings & St Leonards, neighbouring Boroughs
Measure type(s)	Inform / Consult / Co-produce
Contact	Chantal Lass, class@hastings.gov.uk www.energysshare.com/energise-hastings/

Jane Dodson, Hastings

Description and Aim

The forum is called "Energise Hastings" and brings together developers, architects, energy companies, residents, Sussex Coast College Hastings, Hastings Trust, Hastings Borough Council and a school to promote energy efficiency and use of renewables in buildings.

Aim:
Change behaviour:
To increase the uptake of energy efficiency and renewable measures in the town, to reduce carbon emissions and help alleviate fuel poverty locally, through giving advice and developing projects, including training.

Target group(s), Message, Instruments

Target group(s):
Businesses, inhabitants, networks
Local businesses and local community including residents and community groups

Message:
As national government policy changes, to share good practice, communicate grants available and funding mechanisms. Also to co-produce projects and provide advice and training.

Used instruments:
Inform and consult about the changes and co-produce projects and provide advice and training.

Experiences

Combination with other measure:
The eco-retrofit training manual, a technical training manual and video how to renovate a Victorian terraced property in an eco-friendly way with adaptation and mitigation measures such as insulation, is a key resource to assist in the training element. Open days at the property in Cambridge Gardens show the results of the eco-retrofitting. Also links to Enviro 21 project as helps to encourage businesses into the town to take up the eco business units and use the Sussex Exchange.

Follow up:
Projects are underway and in development, so the forum is working! For example, solar panels are to be fitted on a school, and energy advice has been piloted at the local development trust.

Good-practice:
The good practice is bringing together private, voluntary and public sector partners to develop the work, and the sharing of good practice by people who have had renewables and energy efficiency measures installed.

ADAPTATION COMPASS
Future Cities
urban networks to face climate change

The information is based on the experience of the Future Cities-partnership. It is not necessarily comprehensive, complete, accurate or up to date.

Example of fact sheet on raising awareness measure

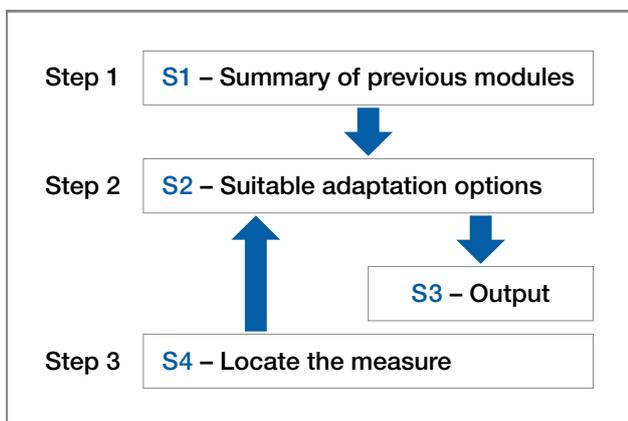


B.2.5 Determine the Need for Action and Select Measures

By this module the previously collected information and assessment steps are summarised and matched with suitable types of adaptation measures. The result is a list of core problems which are to be addressed by adaptation measures, e.g. urban structures which are likely to heat up too much in an area where many older people live. In the list of adaptation measures, suitable actions and combinations of measures are given which will help to mitigate the core problems. The method is based on the multi-criteria analysis approach. Additionally, guidance is provided on how locations for the implementation of the selected adaptation measures can be found.

The searched location can be characterised as follows:

- The potential for effective adaptation is high, e.g. setting up a green space to create a climate oasis in the quarter is most effective if air exchange (i.e. wind channels) is guaranteed.
- Further benefits are covered, e.g. further urban development goals are reached.
- A problem has already occurred there, i.e. it is always easier to achieve the people's and politician's acceptance if you solve an existing and possibly deteriorating problem.



The three steps of the module Determine the Need for Action and Select Measures

B.3 An old but crucial question: how to get the message across

Communication and participation are prerequisites for the successful implementation of adaptation measures. The major aims are to raise the awareness of risks, to raise the acceptance and to foster the adaptation options as well as to change the behaviour. Therefore, it is necessary to communicate in many ways: to keep on raising the public awareness of adaptation to climate change; to keep on raising the political awareness in order to put the topic on the working agenda within the organisations. Moreover, local governments and organisations should be encouraged to assess their vulnerability to climate change in order to enhance their understanding of this challenge on local scale.

B.3.1 Communicate about adaptation – lessons learned in Future Cities

<p>Create a communication strategy to structure your communication approaches before starting the activities.</p>	<p>Examples from Future Cities</p> <p>The Guideline Climate Change by Lippeverband and Emschergenossenschaft provides information on the coherence of climate change, the water cycle and the activities of the water board.</p>
<p>Have a vision where your communication strategy may lead to.</p>	<p>Before the communication was started, the local project partners who developed the sustainable quarter of De Vloei, agreed that they wanted to communicate about the integrated sustainability in the new city quarter and on the target groups they wanted to reach (citizens, politicians, technical staff in cities, the regional level, architects).</p>
<p>Stay flexible: identify aims, target groups and messages but also adapt them during implementation.</p>	<p>The water game which features the eastern part of Tiel is an interactive computer game designed for professionals as well as for inhabitants. The user decides which kind of problem he or she wishes to address and what solutions he or she prefers.</p>
<p>Be organic: the communication strategy should not be static but evolve and grow organically during implementation.</p>	<p>In Arnhem, investigations about the city climate, such as temperature measurement by climate bike and infrared pictures taken out of an air plane, made residents curious of the next steps. Following, the opportunity was seized to use the investigations for awareness raising.</p>
<p>Use networking on all levels: with study visits, information sessions, special events and new media.</p>	<p>Energise Hastings is a forum to promote energy efficiency and the use of renewable buildings. The forum consists of different participants (e.g. developers, residents, energy companies). This mixture of private, voluntary and public sector partners supports the exchange of experiences and best practices.</p>
<p>Communicate information bit by bit: first inform about the basics of e.g. sustainability goals in general, then about the details of your specific problem e.g. about sustainable buildings in your city.</p>	<p>Lippeverband set up a communication strategy to motivate residents for disconnection along the Heerener Mühlbach. Public meetings informing in general were followed by individual assistance: a technician visited the buildings and drafted plans for disconnection suggesting a detailed list of materials for the implementation.</p>

The experiences of **Future Cities** have shown that it is extremely helpful to use a positive message:

"Adaptation is enjoyable"

Adaptation is not only necessary, it is also enjoyable. It is an excellent way to enhance the quality of life, to create attractive public spaces, to benefit from a better local climate and from a richer biodiversity within a greener environment.



The ambassador of the climate campaign of Nijmegen delivers colourful and enjoyable messages.

B.3.2 The Future Cities Twinning Approach – communicate experience across borders

In the **Future Cities** twinning sessions staff of different **Future Cities** partners discussed their measures and continued to develop their plans together. The twinning method turned out to be a valuable communication tool to dig deeper into a concrete topic which is of interest for at least two project partners to exchange their know-how. According to the different topics, the twinning activities are followed up by integrating the advice given.

How to do it

Staff (2-3 persons) of **Future Cities** partners meet in a one-day or two-day workshop to discuss concrete measure and to continue to develop their plans. Practical experience is exchanged and advice is given across borders. This can be enhanced by combining the know-how of the project partners with input from external experts. The aim is to foster the direct and problem-oriented exchange of practical experience and to find solutions generated by local/regional authorities and water boards from different countries. The know-how of different organisations from different countries can contribute effectively to improve a measure or to solve a problem.

In the twinning activities several instruments are used to explain the adaptation measures or plans and procedures to the other project partners, to learn from each other and to develop a measure or make it transferable: printed information, presentations, site visits and moderated co-producing sessions with the "map-table". For the practical development of a twinning topic a "twinning request" is formulated by one partner describing the topic and potential solutions. The interested partners respond to the request. The hosting partner organises the meeting with the adequate instruments. In order to make the results of the meeting easily available to all project partners a "twinning report" is written by all participating partners. This report sums up the results but also the lessons learned by each project partner.

As certain efforts have to be made with regard to the time needed for travelling and meeting, twinning activities can also exceptionally be done by e-mail or via internet. However, personal meetings including site visits proved to be more effective. The network for twinning activities was established during the funded period of the **Future Cities** project. After the end of the funding period, twinning exchange is most likely to continue by e-mail.

Exemplary highlights

The role of green roofs in France and the Netherlands

Administration staff from Rouen Seine Aménagement, Arnhem and Nijmegen exchanged their knowledge and experience regarding green roofs and biodiversity. At the hosting municipality, Nijmegen, examples of green roofs could be visited in different states of development and the monitoring results were discussed. Besides the practical aspects, the twinning especially focused on the implementation of green roofs on public and private buildings and on their early integration in concrete real estate projects. Furthermore, the improved quality of housing, urban landscape and life in general is a social aspect, which often holds a commercial interest for the developers.



Blue-green networks: strategies and cross-sector effects

In Brugge (Belgium) the sustainability aspects of the master plan for the city quarter "De Vloei" in Ieper were discussed within the Blue-green-network and re-viewed with the help of the international experts from the German water board Emschergerossenschaft, the city of Bottrop, and the Dutch city of Tiel. The outcome of this twinning was a valuable consideration of the preparatory studies on water and energy for the site. The blue-

green corridor of Heerener Mühlbach in Kamen was the topic of a twinning hosted by the Lippeverband. The programme included a visit of the construction site of Heerener Mühlbach, of the completed ecological transformation at another water body (Seseke or Körne) and of the art project "walk on water".



Recommendation:

Seize the opportunities of international exchange

The *Future Cities* twinning approach proved to be an excellent instrument to exchange information and opinions between different European partners. As there are always different ways to deal with problems, twinning allows to cope with problems beyond the standard way of each organisation.

Organisations such as municipalities, water boards and planning institutions endorsing responsibilities with regard to climate change should be technically and financially encouraged to network. Their capacity to exchange and spread knowledge and experiences within their own organisations and also externally needs to be enhanced.

Successful transfer of ideas and equipment

What conclusions for spatial planning and urban developments should be drawn from the knowledge about the city climate in Arnhem? Input given by climate experts from the city of Rotterdam, the Regional Health Service and Dutch and German universities and the practical experiences of six *Future Cities* project partners was combined. As a consequence, the city of Arnhem was advised to translate the Heat Map into a Heat Attention Map. The workshop, which brought together climate experts, health services and spatial planners, allowed for views from different angles and interests. It also introduced a tool called "Map Table". The Map Table was considered to be very useful as a consultation, planning and communication tool. It inspired the English partner Hastings to have the Map Table shipped across the channel in order to inform the climate change adaptation plan in Hastings and to demonstrate it to planners, developers, policy makers and residents of Hastings and the wider South East of England. Following a successful demonstration in the UK, Hastings has purchased its own Table and will use it for scenario planning, consultation work and energy projects.



"Health specialists and urban planning experts drew complementary conclusions. Nijmegen transferred the process while setting up a strategy for a city quarter based on maps displaying opportunities and obstacles. The strategy shows the existing opportunities for the construction of a sustainable green-blue structure in an existing city quarter."

Ton Verhoeven, Municipality of Nijmegen

"The Hastings colleagues found that the twinning on the map table enabled us to form plans and work out how the map table can be used locally. It could be demonstrated directly to the stakeholders of the region."

Chantal Lass, Hastings Borough Council

B.3.3 Conferences and workshops to raise local interest

The transnational tools and the results of the regional projects were presented to the local and regional stakeholders in international conferences and workshops in all participating countries. In Dortmund (Germany), Rouen (France), Brugge (Belgium) and Tiel (The Netherlands) a lot of interest was raised among the local stakeholders for the topics of their local project. In Hastings, a regional seminar addressed the local and regional building professionals. Here, the experiences of developing climate-proof city quarters made by Rouen Seine Aménagement (France) and West Vlaamse Intercomuncale (Belgium) were presented and discussed.



In 2010, the German water boards Emscher-Genossenschaft and Lippeverband brought together 120 practitioners and scientists from Europe to attend the mid-term conference of [Future Cities](#) in Essen. International and regional speakers outlined the relations between local solutions and a globally changing climate. Dr. Y. Sokona, co-chair of the Intergovernmental Panel on Climate Change (IPCC) directed the view to a global perspective and gave an insight in the next IPCC Report in 2014. All contributions made clear that adaptation needs integrative and cross-sectoral thinking and local acting. The overall costs and efforts for preventive action are in most cases below the costs of retroactive action.

Finally, in February 2013, the conference in Hastings “The Future of our Cities – Make them attractive and climate-proof” is designed to bring all the work of the project together and to showcase the pilot project, the Enviro 21 Sussex Exchange. A range of national and international speakers discussed about the challenges on European level and the implications with local and regional implementation of adaptive measures, looking out towards the future perspective of funding adaptation.



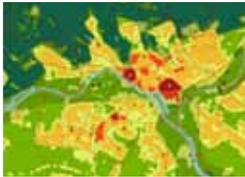
The [Future Cities](#) partnership has become a close cooperation in the light of mutual trust and openness. The individual expertise of all involved partners is used to exchange know-how and discuss occurring problems as well as common solutions.



Impressions of the [Future Cities](#) mid-term conference in Essen, 2010

Part C The Future Cities project guide

In the Future Cities project guide you find a summary of the implemented projects of the partnership. Often, more detailed information is available (see list of additional documents on page 74. If you are interested you are welcome to contact the project partners (see page 79).

	<p>Creating a green-blue corridor in Kamen</p> <p>In Kamen (DE), adaptation measures of the Lippeverband combined the ecological improvement of the stream „Heerener Mühlbach“ with the disconnection of storm water of the nearby paved areas: ready to make a significant contribution to weakening the potential impacts of climate change.</p>	<p>C.1 31</p>
	<p>Arnhem is getting prepared for climate change</p> <p>Within the Future Cities project, the city of Arnhem in the Netherlands focused on two aspects of climate change: Adapting the city to extreme weather conditions like heat waves and reducing the CO₂-emission to make the city energy-neutral by 2050.</p>	<p>C.2 36</p>
	<p>Clean solutions for Bottrop</p> <p>The water board Emschergerossenschaft (DE), responsible for one of the most densely populated catchment area throughout Europe, improves the mass and energy flow at a wastewater treatment plant and cooperated with the municipality of Bottrop to make two industrial parks climate-proof.</p>	<p>C.3 42</p>
	<p>Environment and economy go together in Hastings</p> <p>The Hastings (UK) project is evidence of the fact that environmental measures to adapt to climate change can comply with economic interests. Even historic buildings can be converted in an eco-friendly way. Partners from the social, the ecological and the economic sector join for the town-wide adaptation strategy.</p>	<p>C.4 46</p>
	<p>A wide range of opportunities in Nijmegen</p> <p>Green structures, water management and energy projects: A wide range of activities resulting from a climate campaign will help the city of Nijmegen (NL) to adapt to climate change and to become energy-neutral by 2045.</p>	<p>C.5 50</p>
	<p>Focus on sustainability in Rouen</p> <p>Wasteland left by its industrial past and port activities is being reclaimed and transformed into a new eco-district within the framework of the Rouen (F) Luciline – Banks of the Seine project. Due to the involvement of the citizens, additional environmental aspects were added, such as uncovering the river Luciline.</p>	<p>C.6 57</p>
	<p>Coping with water in the city – the integral approach of Tiel East</p> <p>The adaptation measures taken in Tiel (NL) are at the same time an opportunity to enhance the city in many ways. As water nuisance is a familiar and complex topic here, the approach chosen had to be very comprehensive as well.</p>	<p>C.7 61</p>
	<p>Sustainability from the start for "De Vloei"</p> <p>Sustainability needs to be incorporated as a standard process in the long term. The West-Vlaamse Intercommunale together with the city of Ieper (BE) introduced a far-reaching planning process to develop a new sustainable and climate-proof housing quarter.</p>	<p>C.8 66</p>

C.1 Creating a green-blue corridor in Kamen

In Kamen (DE), adaptation measures of the Lippeverband involve the ecological improvement of the stream „Heerener Mühlbach“ in combination with the disconnection of storm water of the nearby paved areas: ready to make a significant contribution to weakening the potential impacts of climate change.

A historic context causing problems

As a result of the history of the Ruhr region, the Heerener Mühlbach was a canalised water body used as an open wastewater system. Conducting a mixture of waste and storm water in a straight concrete bed, the water body got classified as heavily modified following the EU Water Framework Directive. The Heerener Mühlbach has a length of 6 km, feeds the river Seseke and flows into the Lippe. In Kamen, it leads over a length of 2 km through a densely built area being between 50 and 150 m wide.

At this location a number of problems needed to be resolved. Discharges of wastewater in the stream detrimented the ecosystem tremendously. The concrete bed of the water body and the specific management of the banks prevented biodiversity. In addition, the frequently occurring flood events led to damages to private as well as industrial buildings located nearby the stream. Another problem was the dangerous shape of the canal which prohibited the recreational use of the water body. And finally, bad smell regularly disturbed the neighbourhood.

It is obvious that the expected effects of climate change reinforce the challenges of this area. Extremely heavy rainfall does not stay without consequences and aggravates the problems mentioned above. As the intensity and the frequency of such extreme weather events are most probable to increase in future, the long-term planning of this water infrastructure needed to build on a climate change approach. The uncertainties inherent in climate change call for decentralised adaptation measures rather than technical solutions, e.g. higher dikes or wider sewer, which often lack cost-effectiveness and the acceptance of the public.

Progress with Future Cities

The [Future Cities](#) project allowed to look at the ecological improvement of the Heerener Mühlbach through the lens of climate change. It aimed at creating a green-blue corridor, combining effects of green structures with the water system. In order to work on the source of the problem, an efficient and fair process was necessary to implement adequate decentralised measures. In accordance with the German national as well as North Rhine Westphalian adaptation strategies, the measures chosen in Kamen pursued a no-regret strategy, i.e. measures that unfold their potential not only in (worst) case of climate change.

Most municipalities have many options regarding mitigation measures. However, in the context of adaptation the know-how on dimensioning, design and efficiency is often not sufficient on the local level. The transnational [Future Cities](#) cooperation evaluated the benefits of the investment. Every project was rated with regards to its contribution to an improved city climate and in terms of its adaptation potential.

At the beginning of the project the access to Heerener Mühlbach was dangerous and forbidden.



After the transformation of the Heerener Mühlbach the danger sign can be removed.



Involving citizens

Future Cities in Kamen emphasised the cooperation with the citizens. By the end of the project most of the property owners at the Heerener Mühlbach were aware of the need to adapt to climate change and understood how every individual can make his/her contribution. In doing so, the measures designed and implemented by the water board and the municipality were accepted and – ideally – encourage to take action for a better city climate and against climate change.



- 1), 2) Heerener Mühlbach before transformation
- 3) At the beginning of construction works, August 2011
- 4) During construction works
- 5) The result after transformation, 25 April 2012

Transforming the Heerener Mühlbach

The green-blue corridor at the Heerener Mühlbach was realised in 2011/2012 within a time frame of just over twelve months.

Prior to the Future Cities project, a sewer pipe was placed underground along the river. Then the concrete bed was removed wherever possible, e.g. except under the bridges. The river started to flow on a new sole, which is higher and wider than before and even meandering. The hard banks were converted into nature-like banks. The initial plantation is complemented by wild and natural vegetation: green plants have the chance to flourish along the blue water body.

The partners of Future Cities checked the climate-friendly planning at Heerener Mühlbach within a twinning session. One of the basic questions addressed the benefits and the performance monitoring of the ecological enhancement of the water body.



Disconnection of private property at Heerener Mühlbach

Disconnection

This ecological improvement was combined with the storm water disconnection of the neighbouring paved areas. In total, 72 properties of paved areas nearby, which feed the combined sewer system, were disconnected. Now their storm water drains off into the new nature-like water body.

No-regret measures

In view of the uncertainties of climate change, the decision was made to apply no-regret measures. According to the long-term rainfall measurements of the water board Lippeverband, no significant trend towards climate change can be observed. But it can also not be sure that rainfall will not increase. The ecological improvement of the stream in combination with the disconnection of storm water of the nearby paved areas is ready to make a significant contribution to weakening the impacts of potential climate change, no matter in which dimension this will happen. In case of more intense and frequent heavy rainfall, it reduces the flood risks since the water run-off is slowed down by means of meandering and infiltration through the natural bed and banks. Also, the ecological improvement and the sustainable use of storm water can reduce the floods because the sewer system does no longer have to cope with the same amount of storm water. With rising temperatures in summer the water bodies tend to dry out. Due to the use of rain water for the open water body the water cycle remains sound even in dry periods and evaporation creates a better micro-climate. The ecological functions of the water system are strengthened. While combining water management measures with green corridors in the cities, the climate in the urban surrounding is enhanced.

If the effects of climate change do not come true as expected, these measures will still allow for a number of benefits. First, the local inhabitants, who live on disconnected properties, will enjoy paying lower fees. In Kamen and all other municipalities belonging to the Lippe catchment, the established system is the “divided fee” system (see box). Local inhabitants also enjoy better living conditions, having the possibility to use the river for recreational purposes. The process of getting the inhabitants involved in the storm water disconnection within the green-blue corridor is also a great opportunity to raise their general awareness of the water cycle and their own responsibility for sustainable development. For the water board Lippeverband itself, such a no-regret measure is also a way to attain the EU Water Framework Directive, to reach better flood resilience and to allow for a more cost-effective water treatment. At the level of the municipality, the city has become more attractive due to the ecological enhancement and the discussion on creating water bodies in existing or new urban developments (risks & benefits, responsibilities) has been set off.

Recommendation:

Start now! Don't wait until all answers are clear – they never will be!

Most anticipatory options are not only beneficial for climate change adaptation but also for other sectors such as economic growth. Even if climate change impacts do not occur as expected, the measures will still be beneficial and cost-effective. Such adaptation options are called no-regret measures.

The divided fee system

Most of the municipalities in the Lippe catchment apply a divided fee for the discharge of waste and storm water.

The system distinguishes between:

- a fee for connected paved area to the mixed sewer system €/m² and
- a fee for wastewater discharged into the sewer system €/m³.

In former times, the fee for the discharge of waste and storm water depended on the amount of drinking water a household used. Several court decisions, however, concluded that this kind of calculation was unfair.

The divided fee system was considered to be very interesting by the EU partnership.

“The German instrument of having a fee for the discharge of rain water from the private domain into the public domain is very interesting. I also think it is very interesting that still half of the fee has to be paid if you bring the rain water to the Heerener Mühlbach and that the only way to have no fee is to keep the water on your private terrain. This really is set to reach the aim that also Flanders has: first use the rain water, then infiltrate the remainder on your own parcel and only after that buffer it on public domain to be slowly discharged.”

Nathalie Garré, West-Vlaamse Intercommunale

Communication – a key to motivation

The transformation of the water body was well planned in accordance with the municipality and implemented in 2011 and 2012. However, the storm water disconnection implied some specific challenges so that the communication had to take place on different levels.

A communication strategy to inform on the construction works required for the transformation of the stream and to motivate people for disconnection was set up in combination with an individual assistance. After two public informative meetings and a personal invitation, the citizens had the chance to receive a technician at their homes who drafted plans for disconnection and suggested a detailed list of materials for the implementation. A point of contact at the water board was defined and succeeded in motivating many citizens to act on behalf of climate change. An on-site information point was also set up but the poor number of visits clearly showed that the communication strategy for the neighbourhood's acceptance had been successful.

Due to the involvement of the stakeholders, the entire project received a lot of attention. In other words: their involvement can be considered as an integral part of climate-friendly planning on the long run.

The interaction between ecological transformation and climate change as well as the benefits, monitoring indicators and communication measures were thoroughly discussed with **Future Cities** experts. The way from a historical situation towards adaptive measures to face climate change demonstrated how climate-friendly planning was strategically linked with demographic and economic factors. The combination of communication, public funding, voluntariness, on-site advice by a “disconnection ambassador” and a reduction in fees for disconnected households showed an interesting and transferable process actively involving the stakeholders. The amount of funding should always be considered according to local standards and match with the costs avoided by the adaptation measure.



Public participation at Heerener Mühlbach, first information evening, 1 March 2010

The crux

During the process described, some central questions came up that caused a number of difficulties. One of the first problems the water board had to cope with was an administrative issue: what is the appropriate handling of field data different from the database described in the official documentation? After field acquisition, it was found out that some properties had already been disconnected but not registered accordingly in the official databases. Another issue was the public funding that should be invested in technical measures at private properties. Both issues were thoroughly discussed so that a common approach could be agreed on.

Finance

The property owners willing to disconnect received 10 € per disconnected square meter. The funding should cover a major portion of the costs of disconnection. Based on the results of the feasibility, the costs were highly depending on the local situation, starting from 9 €/m² and reaching 30 €/m², with an average range of 16-21 €/m². Costs of disconnection works realised by owners themselves were also eligible. Indeed, the payment of the subsidy was dependent on the official acknowledgement of the municipality that the site had been disconnected from the mixed sewer system. On top, individual counselling was also financed by the water board within the [Future Cities](#) project, as well as the pipe leading the water from the boundary of the sites to the river. All this has become possible as the disconnection was combined with the ecological enhancement of the stream.

Outlook

Following this approach, it can be expected that the efforts made by the citizens at the local level will continue to be carried out through the neighborhood. The monitoring of the river, the development of the vegetation and the biodiversity at the Heerener Mühlbach are likely to remain a matter of public concern. The municipalities are well-advised to listen carefully to the feedback of the citizens with regard to their changed living conditions.

“Apart from all the other improvements, the ecosystem benefits from the creation of new places for different species. And inhabitants can already be observed enjoying better recreation facilities. The ecological improvment as realised within Future Cities helps citizens to start discussing ecological issues.”

Marie-Edith Ploteau, Lippeverband



The [Future Cities](#) project team of Lippeverband (from left: Daniel Wischniewski, Marie-Edith Ploteau, Cordula Skrabaczewski, Guido Geretshauer; missing on the picture: Anke Althoff, Matthias Weilandt)

C.2 Arnhem is getting prepared for climate change

Within the scope of the **Future Cities** project, the city of Arnhem in the Netherlands focused on two aspects of climate change: Adapting the city to extreme weather conditions like heat waves and reducing the CO₂-emission to make the city energy-neutral by 2050 and thus contributing to the overall aim of reducing global warming.

Adapting Arnhem to extreme weather events

Urban areas are sensitive to extreme weather conditions like heat and drought because of their built-up and stony character. Buildings, especially tall ones, provide multiple surfaces for the reflection and absorption of sunlight, increasing the heating-up of urban areas. Cities lack vegetation and produce additional heat from heating, cooling and traffic. This causes an unbalance in the energy input and output as cities become significantly warmer than their surrounding rural area: a difference of three to four degrees is no exception. This phenomenon is called the Urban Heat Island (UHI) effect. Although the energy balance is basically determined by solar radiation, it is also influenced by local heating, cooling and traffic. Reducing this energy can lead to decreasing temperatures and thus contribute to a better local climate.

Within the scope of the **Future Cities** project the city of Arnhem based its approach on the Urban Heat Island effect and focused particularly on the consequences of extreme heat and drought for the city and its surrounding area. Climate change will result in more extreme weather conditions and will thus also have an impact on the attractiveness of cities. Therefore, Arnhem strives for the best possible quality of life for its citizens and all other people who come to work, visit, do shopping or recreate, now and in future.

At the beginning of the project the following questions needed to be worked on:

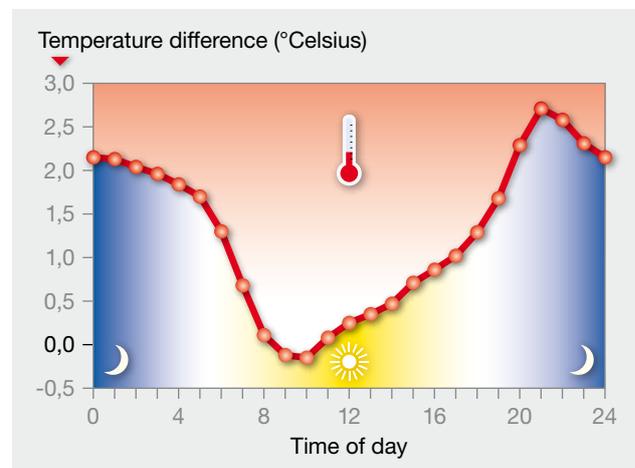
- What does the current city climate look like? Does the city have an urban heat island?
- What impact does the current climatic situation have on the inhabitants? Is it already urgent to act and what are the consequences of climate change?
- What measures are the most (cost-)effective ones to reduce unwanted heating on the regional, city and project level?

Reduce unwanted heating

The first step was to determine the current climate of the city of Arnhem. In the summer of 2009, when the city encountered a series of hot days, the air temperatures were measured. The measurements were repeated in the summer of 2012. The measurements showed a considerable temperature difference of about 7°C in the evening and 3°C in the daytime between the old city centre and the outskirts. The daily pattern of the heating-up of the city is shown by the measurements of a weather station placed on the roof of a building near the city centre.



Measuring the temperature by bike



The daily pattern of the heat island effect in Arnhem: mean difference between measurements in Arnhem (Van Muijwijkstraat) and North of Arnhem (Deelen)

At the same time infrared pictures were taken by a plane in the evening of hot days. These pictures indicated that the temperatures of roads and squares were the highest as shown by red and yellow colours on the pictures. Tree-lined roads showed less radiation due to the shade of the trees. The forests, parks and moist grasslands of the river floodplains were coolest. The pictures documented that in general more heat is stored in roads than in buildings, parks and water. Shaded districts of course store less heat than open stony areas.

Read more:

The detailed results of all measurements are available in separate reports, see list of additional documents.

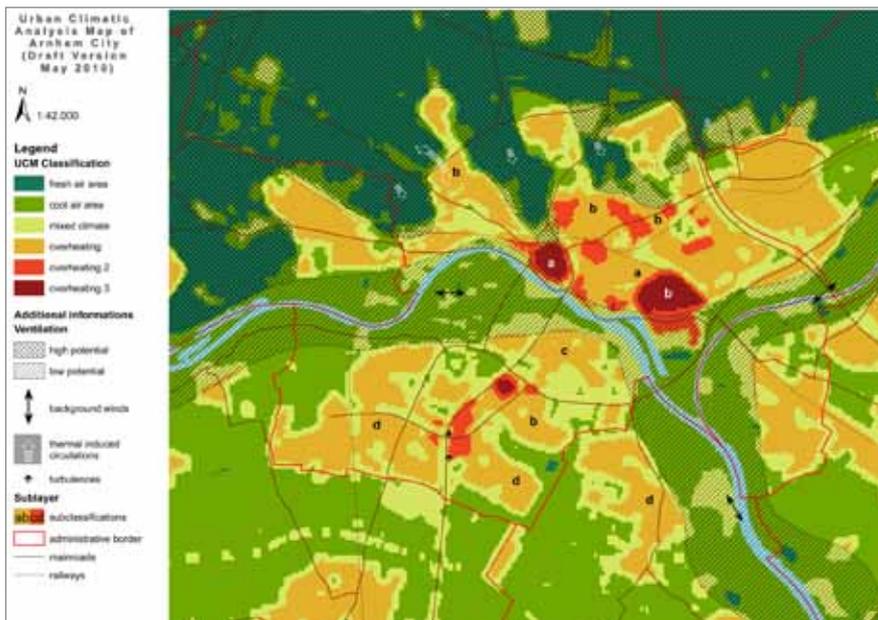


The heat scan of the city of Arnhem shows the warm areas, e.g. the city centre in the top left corner, and cool areas like the river Nederrijn in the middle of the picture.

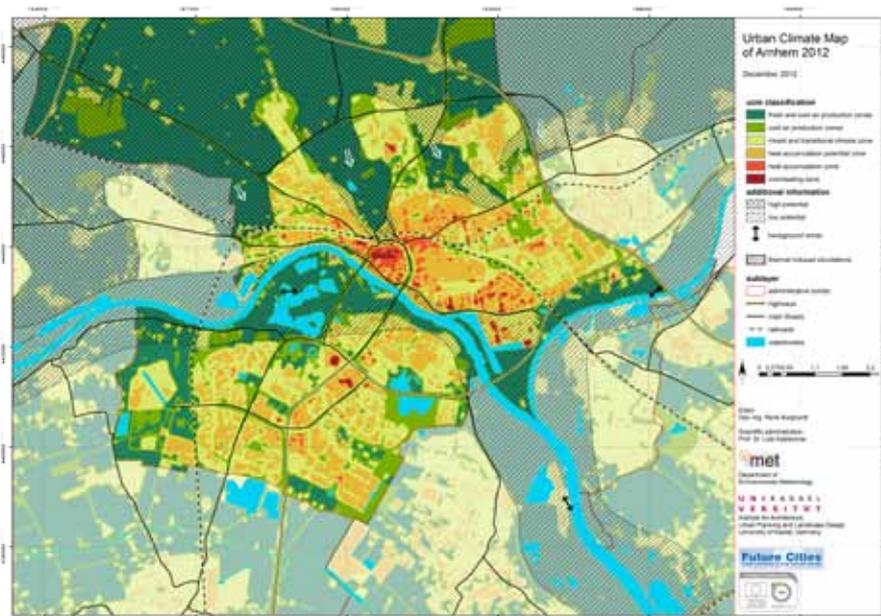
With the aid of the knowledge of the University of Kassel (DE), the Chinese University of Hong Kong and Wageningen University (NL), an “Urban Climate Analysis Map” or short “Heat Map” was set up in 2010 followed by a more detailed one in 2012. The map, which is the first one of its kind in the Netherlands, shows the influence of different types of wind patterns and the typology of the districts on the local climate. To set up the map, existing geo-information and meteorological information was used. It was found that the degree of heating of different parts of the city is determined by the ability to ventilate, i.e. the wind pattern, and also by the build-up structure or morphology, the materials and colours used, the land use and topography. The map was then calibrated with the temperature measurements supplemented by information from the infrared pictures.

The study clearly revealed that Arnhem has got urban heat islands. Several areas in Arnhem, above all the city centre, a major industrial area and a large indoor shopping mall, tend to store heat in the daytime and have considerable difficulties cooling down at night (red areas on the Heat Map). These areas show a stony character, a lack of vegetation and only slight possibilities to ventilate. Other areas, like major parks, the northern hills with forests, the floodplains of the rivers Rhine and IJssel and the rural areas around the city, produce cool and fresh air that has a considerable cooling effect (green areas on the Heat Map).

Once the findings were at hand, the significance of the current thermal situation had to be assessed. The results of the investigations were discussed with the [Future Cities](#) partnership in the course of a twinning session in 2011. Further experts joined the twinning: the Regional Health Service (GGD), the National Institute for Public Health and Environment (RIVM) and the Royal Dutch Meteorological Institute (KNMI), climate experts from the University of Kassel (DE), the Ruhr-University of Bochum (DE) and the University of Wageningen (NL), spatial planners, project managers and environmental experts from the municipality of Arnhem.



The Heat Map of Arnhem (May 2010; grid of 100 metres)



The Heat Map of Arnhem 2012 with more detailed information (grid of 25 metres)

No time to wait

All the experts involved in the twinning agreed that action is urgently required, at least with regard to a stabilisation of the current thermal situation in the areas that heat most, i.e. red and dark-red areas on the Heat Map, and to protect the areas producing cool and fresh air shown as green and dark-green areas. As heat is experienced differently by different persons, the focus needs to be on vulnerable inhabitants such as young children, elderly and sick people, who are most likely to suffer from the heat (c.f. PET, Physical Equivalent Temperature).

Some parts of Arnhem are situated on the hills of the Veluwe and on the banks of two main rivers. The city is rather green due to a lot of parks and trees. Although the thermal conditions are quite good as compared to other cities in the Netherlands, there is a broad agreement that climate change resulting in higher air temperatures and more hot days over 30°C, will lead to an increase in the Urban Heat Island effect and therefore an overall worsening of the city climate. The Heat Map is very likely to show more red areas in the decades to come.

From theory to action

All the information gathered was used and translated the Heat Map into a Heat Attention Map. The map distinguishes between four types of areas which require different measures:

- Red areas: in these areas the heating should urgently be prevented and efforts should be made to improve the current situation.
- Orange areas: further heating should be prevented as both the densification of the building volume and climate change will aggravate the situation, i.e. turn from orange to red.
- Yellow areas: the current situation needs to be protected as these areas show a good climatic balance between green and blue (parks, water, trees) and red (built-up parts sensitive to heating).
- Blue areas: the potential to cool and ventilate the city needs to be used at most. These areas should be kept open and protected. Building is either prohibited or only approved to a limited extent.

The final step of the study was to define effective adaptive measures for each area identified on the Heat Attention Map. The map can be used on the district or project area level or the city level.

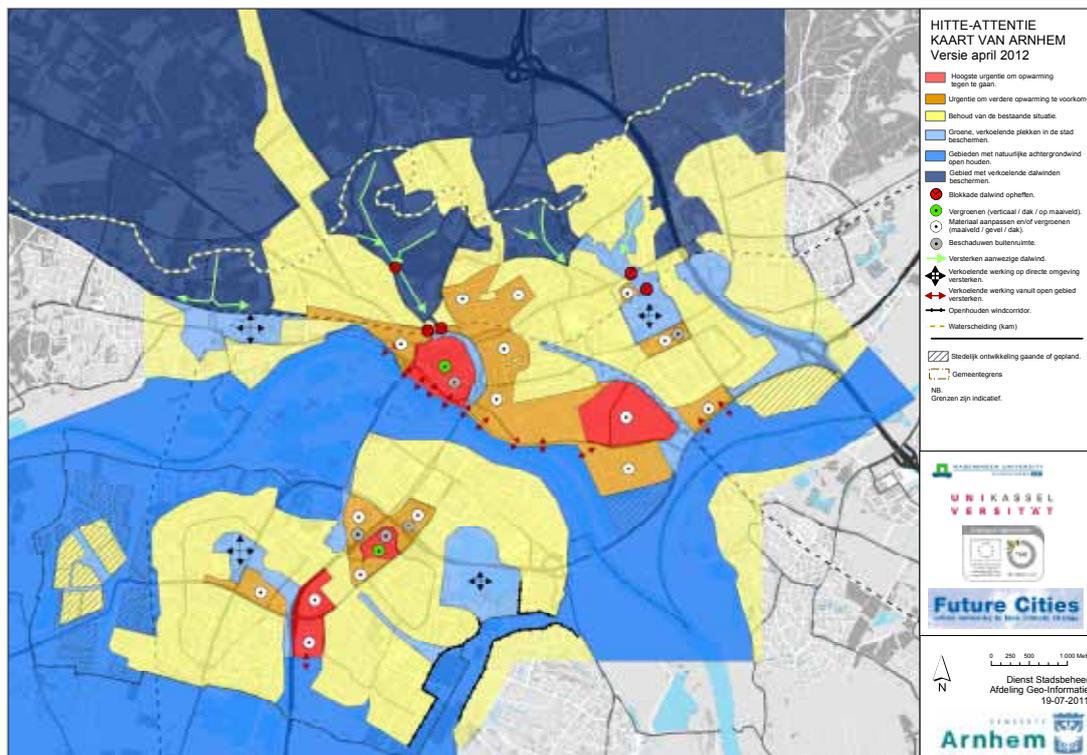
With regard to the district or project area, the Heat Attention Map gives information on

- the current climatic situation,
- the urgency of adaptive measures, either in terms of improvement or protection from planned interventions, and
- the type of measure that is most effective in the respective situation.

Read more:

The maps are available in high resolution, see list of additional documents.

Please visit www.arnhem.nl/energie (left column "klimaatbestaendige stad") for further information on the heat study and the results in Arnhem.



The Heat Attention Map of Arnhem: In the red areas further heating-up should urgently be prevented and efforts should be made to improve the current situation; blue areas should be kept open and protected. Building is either prohibited or restricted here.

This information is of course very useful for the municipality responsible for the public area and the legal obligations regarding spatial planning, for project developers having plans for a specific area or housing corporations, for landscape and urban planners as well as architects and for individual residents. In addition to the exact measures suggested, the emphasis is on the preservation and protection of existing green and blue structures for the benefit of the current climatic situation.

The recommendations comprise green structures like green roofs, vertical green, trees and grass, as well as water structures such as rivers and streams. Reference is also made to appropriate building and pavement materials or specific construction of buildings regarding size, shape and volume. Finally, temporary measures are suggested to lower the so-called Physical Equivalent Temperature PET, e.g. with sun screens.

On the city level, the Heat Attention Map gives strategic information on future city developments. During the [Future Cities](#) project the municipality started setting up a new structure vision for Arnhem with a time frame of 2020 to 2040. The outcome of [Future Cities](#) led to the overall conclusion that the city climate is a vital element for the well-being of the citizens. Therefore, it was decided that the climatic qualities of Arnhem need to be protected:

- The height differences of the city result in thermal induced valley winds late in the evening and at night entering the city, as shown by the dark-blue on the Heat Attention Map.
- The large green-blue open areas in and around the city provide natural background winds capable of cooling it down.
- Further heating of some parts of the city, the orange and red areas on the Heat Attention Map, has to be avoided and the heat stress of vulnerable groups of inhabitants has to be considerably lowered.

Success with Future Cities

The issue of climate adaptation was incorporated in the new structure plan of the city and has thus received an official and legal status. Arnhem is the first city in the Netherlands that implemented the heating issue in its structure vision and is ready to face the consequences of climate change while remaining a city worth living in. The experience and results of the [Future Cities](#) project have paved the way for several Dutch climate adaptation programmes.



The "Climate" house



School children learning about climate change

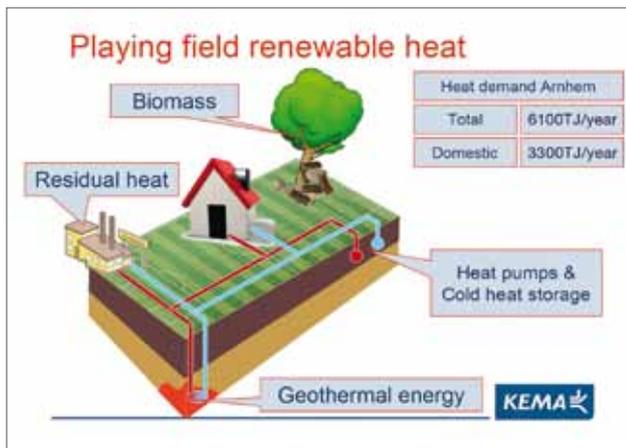
Informing the residents about the city climate

During the [Future Cities](#) project, residents, housing corporations and institutions were regularly informed about the measurements and outcomes. In doing so, all relevant stakeholders were made aware of the consequences of climate change step by step. In October 2012, a large city festival was set up ([Future Cities Festival](#)) focusing on Arnhem in 2050 with regard to energy and climate. For this occasion a "climate house" was built informing the visitors on the current and future climate of the city. A huge Heat Map (6 m²) showed the current outdoor temperature in the neighbourhood which encouraged discussions about the nuisance of hot summer days. The festival was a great success and provided also valuable information on the 'state of awareness' of the residents. It became evident that the communication on the heat studies during the past three years had made the residents more climate-aware.

Arnhem becomes energy-neutral by 2050

Via carbon dioxide, there is a strong connection between climate change and the production and consumption of energy in cities. Therefore, Arnhem focused also on sustainable energy. The aim of the city is to become energy-neutral by 2050.

As there was no strategy in place to enhance the percentage of sustainable energy production and consumption, a study was undertaken. As a first measure, an inventory of the already available and potential sustainable energy sources in and around the city was raised. Furthermore,



Renewable energy is one pillar of Arnhem's energy strategy.



The [Future Cities](#) project team of Arnhem (from left: Hans van Ammers, Albert Anijs, Marion Visser, Jos Verweij)

the energy consumption with regard to traffic, housing, offices and industry was assessed. The success of the whole project has been depending on a common strategic focus of all stakeholders to enhance the production and consumption of the potentially relevant sustainable energy sources. The results were mapped and documented in a Geographic Information System (GIS).

The study shows a number of ways to become an energy-neutral city. About 30% can be achieved short term, taking into account the new technical developments. In order to cope with the remaining 70%, however, further investigations will be required. The next step was to translate the energy study into a strategy. By means of the GIS-data and the information derived from the study, a strategic tool was developed to support the progress in the energy supply of the city. This tool can be used on different levels, from the city level to the street level.

At present the third and last step is being worked on, which is the implementation of an energy strategy. As the municipality can certainly not become energy-neutral by itself, all stakeholders have to participate. The results of the [Future Cities](#) project were implemented in a new city programme called "Energy Made in Arnhem". The contribution of every partner is required under the prerequisite that it needs to meet the aims of the programme and comply with the activities of the other stakeholders. So far it has proved to be successful.

"The Future Cities project enabled us not only to investigate the city climate but also to determine the steps to remain a climate resilient city now and in the future. With the help of the knowledge and experiences of all our partners it was possible to make large steps in a short period of time."

Hans van Ammers, Municipality of Arnhem

Read more:

More details are provided in the Energy study, see list of additional documents.



The wastewater treatment plant of Bottrop

C.3 Clean solutions for Bottrop

The catchment area of the Emscher is one of the most densely populated regions throughout Europe. The Emschergenossenschaft and the municipality of Bottrop (DE) engaged in a cooperation to make two industrial parks climate-proof. To contribute to mitigation, the Emschergenossenschaft improves the mass and energy flow at a wastewater treatment plant.

Saving potentials in wastewater treatment

Municipal wastewater treatment plants in cities consume an average of 15% of the energy demand of public infrastructure. Therefore, the Emschergenossenschaft works hard to reduce its energy demand. Within the scope of the [Future Cities](#) project the focus was laid on the key components water systems and energy efficiency. A multidisciplinary team analyses mass and energy flows at wastewater treatment plants. Specialists from the water board Emschergenossenschaft and external partners worked together aiming at making the plant in Bottrop more energy-efficient.

During the cleaning process of wastewater, sludge is produced which also requires treatment. The final treatment of the sewage sludge of the wastewater treatment plant in Bottrop is standard thermal incineration. In order to allow for the combustion, the sewage sludge has

to be dewatered. In the past, this de-watering process was improved by applying fine black coal to obtain the optimal calorific value.

The coal was substituted by shredder fibres, a particular material emerging from car recycling. After a testing period, the positive results suggested a regular operation for five years. The benefit of this measure was the improvement of the sludge de-watering process that does without fossil energy and thus has become a lot more energy-efficient.



Material from scrapped cars replacing black coal to reduce the use of fossil energy.

According to the tests, no extra-harmful substances have to be added to the process. The exhaust emission is regularly checked by the Environment Agency of North-Rhine Westphalia. However, some technical problems as a result of the new additive had to be solved. The station for dumping the shredder fibres had to be enclosed completely in order to avoid the explosion of the dust. Furthermore, the stirring gear for mixing the fibres with the sludge had to be designed anew to prevent the light fibres from staying on the surface.



The covered station for dumping the shredder fibres

As the test has been successful and all technical difficulties were resolved, the wastewater treatment plant in Bottrop plans to save 12,000 tons of fossil coal due to this modification. In other words: 32,000 tons of CO₂ emissions per year will be saved which is the equivalent of the average emissions of 32,000 persons in Germany.

After having analysed the mass and energy flows of all wastewater treatment plants the water board is in charge of, an energy efficient solution was found, i.e. a solar and waste-heat dryer for the sewage sludge was studied. In the medium term, due to the new system it is possible to avoid the use of coal for the sludge treatment completely. Building a new turbine to produce energy from the incineration heat will help to increase the micro energy generation. The detailed planning of this project will be assigned at a later date so that the implementation of the entire solution should be completed by 2019.

In addition, the use of renewable energy sources at the wastewater treatment plant was studied to increase the micro energy generation. Besides investigating the use of the heat from sewers (funded by the regional programme), especially the use of wind power in the densely populated area of the plant was of interest. Several studies on different aspects, e.g. sound emission and protection of species, were already obtained to check the capabilities of wind power. The main idea of all the measures is to make the wastewater treatment plant self-sufficient by using renewable energy sources.

Choice of measures in industrial park

The Emschergenossenschaft and the municipality of Bottrop agreed on a cooperation to restructure the industrial parks "Scharnhölzstraße" and "Boytal" combining water, green and energy measures to make them climate-proof.

The Scharnhölzstraße is an old business-site whose surface is almost completely sealed. Heavy rains tend to cause problems as well as overheating during drought periods. First of all, a feasibility study was made to develop a rough concept for the whole industrial area. Therefore, it was necessary to take a combined approach for the public space on the one hand and the privately owned premises of the industry on the other hand. Decentralized solutions for rainwater, i.e. rainwater infiltration and rainwater use, solar power usage and green-zone enrichment were envisaged to strengthen the area for upcoming climate events.

The study showed that disconnection was feasible for some of the buildings as well as the implementation of green roofs. Limitations, however, which also were encountered in Tiel East, arise from the existing constructions. Some of the roofs are not strong enough and the facades are partly not suitable because of the arrangement and construction of the windows. Although there is a lot of room for improvement as far as energy and water for sustainable and economic redevelopment are concerned, it was not possible to pursue the project within the framework of [Future Cities](#). The measures taken with regard to private buildings of the different businesses were not eligible under the INTERREG IV B programme. They will most probably be implemented by means of local and regional funding programmes for economic redevelopment at a later date.

Given that the project couldn't be supported by European funding any longer after the feasibility study, the industrial area Boytal was considered to be the showcase within the **Future Cities** project. The industrial park drained the rainwater into an open ditch which ended in a nearby lake. There was no existing overflow from the lake into a natural body but only into the mixed sewer system. The aim was to disconnect the whole industrial park from the system. As this will take place in the context of the ecological transformation of the river Boye, a new blue-green corridor will be realised in this area, too. The storm water will be pumped from a lake and conducted to the river. With this measure also another misleading connection can be solved: a swamp area west of the industrial park drains at present over two open ditches into the mixed sewer system. This swamp area could be drained into the new storm water canal to be connected to the lake, from where both rainwater and drained water will be conducted into the river. In addition, a lot of energy will be saved which used to be needed for the cleaning of the rainwater.



The draining measures will strengthen the area and thus allow for future development. The river Boye is supplied with a great amount of water which will improve the regu-

lated water flow. In neighbouring cities of the Emscher region similar conditions apply so that a transfer of this approach will easily be possible.

Get prepared for climate change

The Emschergenossenschaft wanted to take a closer look at what climate change really means to the region and what can and needs to be done today in spite of the existing uncertainties. The examination of the facilities for collection and treatment of wastewater and storm water allowed for the conclusion that the current and planned technical capacity will be sufficient. Nevertheless, the water board wishes to be splendidly prepared to take its responsibility as a regional public player and consequently takes no-regret measures.

The regional projection reveals an increase in the average temperature of up to 2,0°C, more days with higher temperatures and less frost days. With regard to precipitation, it is predicted that it will rise in winter (monthly) and that there will be less precipitation in summer (monthly) with a higher occurrence probability of storm water events. The survey of existing historical data revealed a slight increase in the total annual precipitation. The effects on the facilities of the water board were estimated. What might take place in the sewer system? Will there be more deposits because of longer dry flow periods and damages in case of technical failure because of more frequent storm water events? The storm water tanks might be menaced by more and longer overflows with higher emissions. The capacity of the pumping stations could be exceeded more often. With regard to flood protection, more intense storm water events might have consequences for the protection facilities. The first investigations show that there is no need for immediate action because significant changes cannot yet be observed as compared to the historical data of the Emschergenossenschaft. However, there are of course uncertainties with regard to the accuracy of the projections. As a consequence, the water board developed a "Guideline Climate Change" as a basis for its long-term no-regret strategy:

- All decisions and measures involving climate change consider the uncertainties, the special needs and solutions of the experts from different divisions.
- The existing infrastructure is sustained and adapted to future requirements.

- The impact of climate change is compensated by strengthening the natural water cycle, e.g. disconnection of paved areas and decentralised retaining and infiltration of rainwater.



The EmscherGenossenschaft is monitoring rainfall data since more than 70 years.

In the Climate Change Guideline information on global and regional climate change is summarised and the consequences for the different types of facilities of the EmscherGenossenschaft are explained. A special focus is on the management of uncertainties which addresses primarily the staff of the water board.



Informing staff members: What can you do within your daily work to deal with climate change?

The Guideline defines the following activities of the water board:

- research projects
- adaptation measures (e.g. decentralised retaining and infiltration of rain water)
- vulnerability checks
- risk assessments to minimise the damage potential in case of failure, e.g. optimisation of facilities and controlled flooding of less vulnerable areas to protect areas with high damage potential

"The development of the guidance climate change was an important step for us to consider climate change adaptation in all kinds of projects for now and in the future."

Matthias Weilandt, Future Cities-project manager of EmscherGenossenschaft

Read more:

More details can be found in the Guideline Climate Change, see list of additional documents.

C.4 Environment and economy go together in Hastings

The Hastings (UK) project is evidence of the fact that environmental measures to adapt to climate change can comply with economic interests. Even historic buildings can be converted in an eco-friendly way. Partners from the social, the environmental and the economic sector join for the town-wide adaptation strategy.

Location

Hastings is a vibrant, coastal town in South East England with a rich history and a strong sense of community among its population of around 90,000 people.

The majority of the town's homes and offices are historic, so do not conform to current environmental standards. Given its geographic location further housing and building development opportunities are fairly limited. Approximately 70% of existing buildings are in designated "conservation areas" in planning terms, facing restrictions on renovation. Some areas also face social and economic deprivation.

Hastings is likely to experience major climatic change over the coming years. Impacts will include warmer, wetter winters, hotter, drier summers, rising sea levels and more extreme weather events, such as heat waves, intense downpours of rain and heavy storms.



During the heat wave of 2003 tourists headed towards Hastings' beaches.

To adapt to these impacts effectively, the service continuity delivery of services needs to be planned, those who are most vulnerable in the community need to be protected, whilst at the same time opportunities for employment and skills development have to be provided to address the economic challenges.



View over Hastings

The framework: a town-wide adaptation strategy

The basic approach was to develop a town-wide climate change adaptation strategy, working with a range of partners, including residents, businesses, the community sector and public agencies. This was informed by a climate vulnerability assessment for the South East of England and a low carbon housing study was commissioned early on in the project.

The climate change strategy was developed with a local strategic partnership, which represents health, emergency services, education and the community sector, as well as businesses. Policy actors include Climate UK, the network of climate change partnerships, the Sussex Sustainability Network and prior to a UK government restructure, the South East England Regional Partnership Board.

The strategy primarily addresses adaptation, but incorporates some mitigation measures. It also recognises the importance of partnership working and encouraging behaviour change across the community, businesses and organisations in the town. It has ten themes ranging from working with low carbon business to health and well-being.

Hastings 2066 – Footsteps into the Future

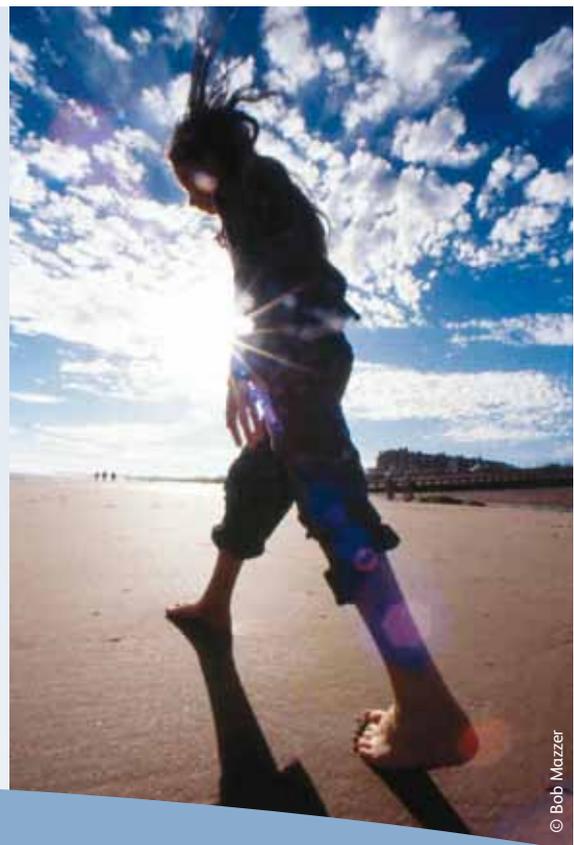
Friday 17 June 2011 - 8.30am for 9am start, finish by 3.30pm
The Stade Community Space, The Stade, Hastings Old Town

Climate change is one of the key challenges facing Hastings over the next 50 years, and will need a joined-up response from the whole community. How brave and braced are we in our public institutions, businesses, local community and voluntary organisations, and our local neighbourhoods, to tackle these challenges, and reap the potential benefits? Join us as we take those first footsteps into the future and ensure our town sustains a vibrant community that's resilient and responsive to change.

Who is this session for?

Members of the Local Strategic Partnership, councillors and key council staff, community sector service providers, business leaders, arts professionals.

To find out more about this event, which is part of the Future Cities: urban networks to face climate change project, and to register, please contact Jane Dodson, Climate Change Project Officer for Hastings Borough Council: jdodson@hastings.gov.uk 01424 451484



© Bob Mazzer

Key aspects of the day will be:

- Consider the joint impacts of climate change, economic and demographic change, on Hastings
- Assess how our buildings, businesses, transport, our health and education, and local economy, need to change to be fit for the future
- Work out how to act now, to make sure that these impacts do not affect those at risk, the most
- Retain our sense of place, and quality of life in the town
- Take advantage of opportunities arising from the green economy, and develop the skills we need
- Support collective well-being, leading to more resilience and ability to engage in enterprising opportunities that make sense for Hastings
- Take stock of and share what we know; taking us from the here and now, to scanning the horizon.

This work will not stop here, but become part of a town-wide commitment and response to climate change.

Invitation to the start of the climate change strategy

To start with, the seminar "Hastings 2066 – Footsteps to the Future" was held. It was the beginning of the development of the climate change strategy and primarily for key partners and elected members. There then followed a period of drafting up the plan before a formal twelve week consultation period for the climate change strategy where all the documents were on the website with an online survey. A range of community groups, public agencies, businesses, and residents were invited to comment on the plans, and over 50 consultation responses were received.

Win-win: eco-retrofit to build capacity

The eco-retrofit project put in environmental measures such as sun pipes and insulation to bring down the carbon footprint of the building, making the homes cheaper and more efficient to heat and light and providing training to participants in installing eco-measures. Local partner

Hastings Trust has produced a technical training manual and video that shows how to renovate a Victorian terraced property in an eco-friendly way. The conversion is now four apartments that are highly energy efficient. A group of trainees worked on the project, some long-term unemployed, who now have new skills to enable them to work in this industry.



Ministerial visit to Cambridge Gardens with John Denham MP, Minister of State for Communities and Michael Foster MP

Innovative contribution to urban development

The **Future Cities** climate change strategy was informed by local and national planning policy, and the international experience of **Future Cities** partners. It links directly to the Local Plan. This gives an overall framework for development in Hastings, which lays out where building can take place up to the year 2028, helping to encourage regeneration whilst protecting the best bits and the things that make it unique.

A network of green infrastructure is to be established in the town, linking the sea front with green spaces such as nature reserves, parks, outdoor sports facilities, allotments and cemeteries.

The Sussex Exchange, a sustainable conference venue on the Enviro 21 green business park, is designed to attract new green industries into the town. The conference centre is designed to enable business to business sharing of innovation. It has high standards of energy efficiency such as natural ventilation systems, green roofs, a biomass boiler and sustainable urban drainage measures. Furthermore, planning permission has been granted for a two Megawatt wind turbine on site.



The Sussex Exchange is covered with green and brown roofs integrating ventilation and infiltration. Within the brown roof parts the environmentally diverse brown field sites were replicated and thus, vegetation associated with such sites can colonise a range of low-fertility substrates.

In taking a set of four homes, and a conference centre as demonstrator projects the key areas in which Hastings will need to take action were illustrated to meet the objectives of regenerating the town in a way that does not excessively increase the carbon footprint. This approach helps to create buildings that are fit for purpose and adapted to the impacts of climate change.

Communication with experts

In September 2009 the conference entitled "Facing up to Climate Change" was held to raise awareness of the **Future Cities** project in Hastings and across the South East of England. Significant expertise from the eco-construction sector and the water industry as well as government advisors were brought together. Two project partners, Rouen-Seine Aménagement and West-Vlaamse Intercommunale, also took part to present their work.

The conference was filmed, and all the slides and supporting information were placed on the website. It was attended by architects, developers, and urban planners and made some specific good practice recommendations. The event was well covered in the local press and attended by approximately 80 delegates.

Social media networks were used to reach out to wider audiences and help organise meetings and events. This has been particularly useful to raise awareness of the low carbon buildings network Energise Hastings. It has a membership of architects, energy companies, residents and developers. The meeting venues chosen have installed renewable energy so that the group could learn by seeing. These included Sussex Coast College Hastings, with a training eco-house, and the White Rock Hotel, with a solar array on its roof.

Read more:

More details are provided in the Eco-retrofit Manual, see list of additional documents.



Discussion at the conference in September 2009



The Hastings project team (from left: Adam Wickersham, Dave Spillet, Chantal Lass, Catherine Jobling, Jane Dodson)

A thermal imaging camera was purchased and training given to staff across departments in housing, surveying and estates. It was used for "before and after" shots of housing and business buildings to identify heat loss and potential problems with the structure and fabric. For a relatively small initial investment the capacity to cope with climate risks has therefore been increased and fuel poverty is being addressed.

Bring the message to the people

To bring the climate change strategy to a different audience, it was linked to an outdoor theatre with acrobatic production of *Pi Leau* by the Dutch company Close Act. This told the story of a fisherman, trying to save the world following the melting of the polar ice caps. A flyer was developed explaining the climate change themes and linking it to the [Future Cities](#) work and it was tied in with a local artist discussing an expedition to the High Arctic – where artists were invited to produce their own cultural responses to climate change. This attracted around 50 participants, and was followed by a film screening.

The final conference allowed us to bring all the work of the project together and to showcase the pilot project, the Enviro 21 Sussex Exchange. A guided tour of the building's sustainability features was provided to all delegates, along with a chance to speak to specific project partners about their work. A range of national and international speakers were invited and there was also space for discussions at the local level.

"During the March 2010 working group we were actually able to 'play' with the Water Game and see how the Map Table, that our colleagues in the Netherlands use regularly, works. We decided to bring the approach and the technology to Hastings to show the clear potential benefits of this sort of responsive decision-making to others in our organisation. The cooperation with the Future Cities colleagues was immensely fruitful. Developing the Adaptation Compass has been a productive collaborative approach, with a useful Task Force set up to focus specifically on this work. It has been interesting to compare the different European policy approaches."

Chantal Lass, Sustainability Officer of Hastings Borough Council

C.5 A wide range of opportunities in Nijmegen

Green structures, water management and energy projects: A wide range of activities resulting from a climate campaign will help the city of Nijmegen (NL) to adapt to climate change and to become energy-neutral by 2045.

Location

Following the [Future Cities](#) strategy, Nijmegen has focused on water, green and energy projects concerning climate adaptation. The green and blue components belong to the adaptation part whereas the energy projects refer to the mitigation part of the municipality's Climate Programme.

The projects described were executed during the past five years. Some of them were executed within the framework of [Future Cities](#), some others were undertaken in a different context but are also good examples for climate adaptation measures in the city centre.

Green over stone – bringing a vision to reality

Since 2007 Nijmegen has worked on a great project entitled "Green Allure Inner City" with the main goal to create more green improving the quality of public space. The green transformation of Nijmegen comprises the systematic greening of roofs, facades, urban squares and streets. The project will be followed up by monitoring studies investigating the effects on the urban climate that can actually be achieved.

From parking lots to green squares

Within the framework of a project of the University of Applied Sciences Larenstein, the potential for green and blue in the lower part of the inner city was assessed. How could stony squares be transformed into green and blue public spaces and what would be the effect on water storage? Twelve squares were analysed and a detailed design was made for two of them. Existing data on the flowing direction of flash floods and the potential for implementing more green were examined. The squares were prioritised with regard to their capacities to store rainwater and their potential for green adaptation. Finally, the two most appropriate squares were selected and a design with blue

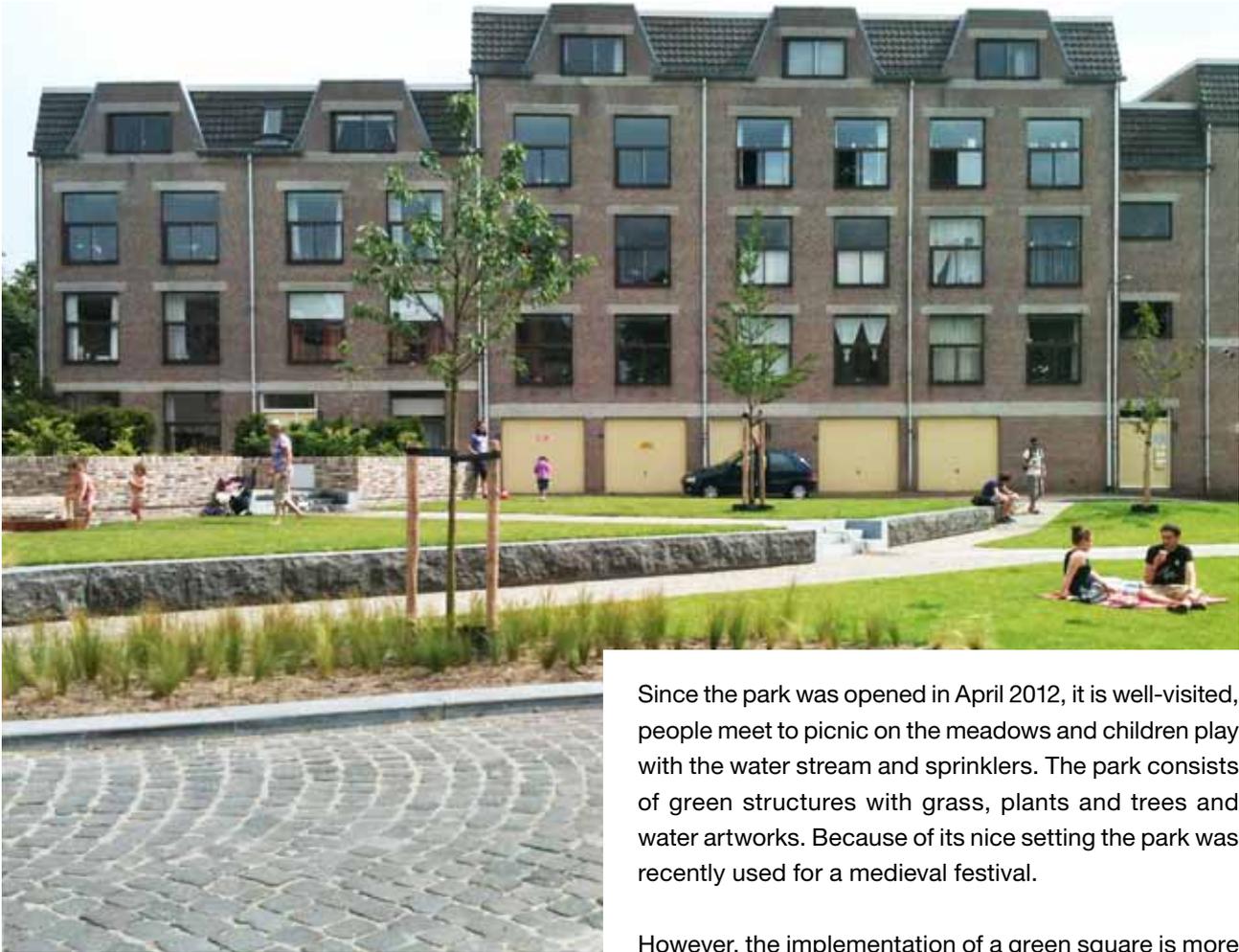
and green structures was generated. These designs will be further detailed within "Green Allure Inner City" so that they can be implemented at a later date.

Another project within "Green Allure Inner City" is the Korenmarkt, which used to be a parking lot but was turned into a green park by the city of Nijmegen between September 2011 and April 2012. The municipality made the designs and discussed them with the citizens. Together, the decision was made not to change parts of the square but to convert the whole square into a park. The same process was applied for the roof of the parking lot Eiermarkt.



The transformed parking lot shortly after opening makes reference to the medieval remains.

During the reconstruction it turned out that the park Korenmarkt is located above medieval remains, i.e. cellars of medieval houses and graves of the St John Knights. The medieval hospital of St John Knights still exists today. It is now a restaurant called the "Commanderie", where the owner recently constructed a green roof above his brewery cellars with subsidy from the municipality.



Residents enjoy the new park.

Since the park was opened in April 2012, it is well-visited, people meet to picnic on the meadows and children play with the water stream and sprinklers. The park consists of green structures with grass, plants and trees and water artworks. Because of its nice setting the park was recently used for a medieval festival.

However, the implementation of a green square is more difficult than expected. It took a lot of time to persuade the citizens that they will benefit more from green than from parking spaces. The construction of the park took longer than expected because of the archaeological investigations. The remains found were made visible by a reconstructed grave underneath a glass plate and the outline of the chapel was restored.

Green roofs – incentives foster implementation

In 2009 an external organisation published a small handbook on "Green Roofs in Nijmegen". In addition, a subsidy regulation was made to encourage private green roofs. The handbook is useful for people who investigate whether their roof is suitable for green. Furthermore, an analysis of possibilities for green roofs in a specific part of Nijmegen was made by a group of students. It showed that there are many flat roofs in Nijmegen which can be changed into sedum roofs. Since most of them are on private buildings, however, the municipality needed to create incentives.

Due to subsidy for green roofs many private projects have been initiated during the past three years. A housing corporation installed green roofs, too, subsidised by the province. The subsidy regulations for green roofs were extended after the first year so that companies and housing corporations can also receive subsidy now. Altogether forty private green roofs were installed (circa 2,350 m²) and more roofs are in the planning or construction phase.

In 2008 the first part of the black roof of the city hall was turned into a green one. A second part was finished in 2009 (in total 1,100 m²). In 2011 another two roofs on the city hall were converted into green ones (400 m²). As three different techniques were used, the different types of construction, maintenance and longevity can be compared. This information will be communicated to the citizens also via the climate shop "The Green Heart".

Vertical green – the third dimension

As there is not much space for green in the city centre, alternative locations were found. One solution is to make green walls. Two places to install such walls were selected. Unfortunately, one of the two was not approved by the municipal committee for building quality. The other one was approved in July 2011 and a green wall was installed on an elevator shaft of a municipal building. The wall has about 200 m² and consists of planter boxes with ivy growing on an iron rack.



Outstanding visibility: the vertical green realised in Nijmegen



View over the green roofs of Nijmegen's town hall

The background: checking the vulnerability of upheating

Nijmegen is also involved in the projects of the City region Arnhem-Nijmegen. For **Future Cities**, Arnhem and a number of other partners started the investigation and modelling of the Urban Heat Island effects. In 2011 the heat map for Nijmegen was accomplished showing the heat stored in different places. It became evident that especially the city centre is relatively hot but also some residential areas further away from the centre.

As the first heat map was not interactive, a second climate map was developed together with Arnhem, the Ruhr Universität Bochum and the company Mapsup. The project started in 2012 and also comprised temperature measurements in the streets in summertime to help validate the information given by the map.



The heat map of Nijmegen

Groundwater nuisance

In the lower parts of Nijmegen the groundwater is relatively high and can cause problems in the houses. A consultancy agency made several investigations on the groundwater nuisance in these specific areas. Additionally, a survey of 13,000 households was conducted. When analysing the results, it was found that there were two types of nuisance. Most houses had problems with wet gardens and therefore often with wet walls. The drainage of the gardens, however, is part of the responsibility of every property owner to make his or her home waterproof. Only a small portion of houses had problems with wet cellars because of too high groundwater levels. Again, it is the responsibility of the owners to make the cellars waterproof, but it belongs to the responsibilities of the municipality and the water board to secure that the groundwater levels are not too high.

Due to the Water Service Desk these results were communicated to about 1000 households (by letters) and to the public (articles in newspapers and magazines). In September 2012 the consultancy agency made a report comprising a detailed investigation of three houses. After a year of monitoring, complete information on the detailed drainage and soil situation around the houses was gathered. It confirmed the rough conclusions mentioned earlier and will help to advise the concerned citizens in future.

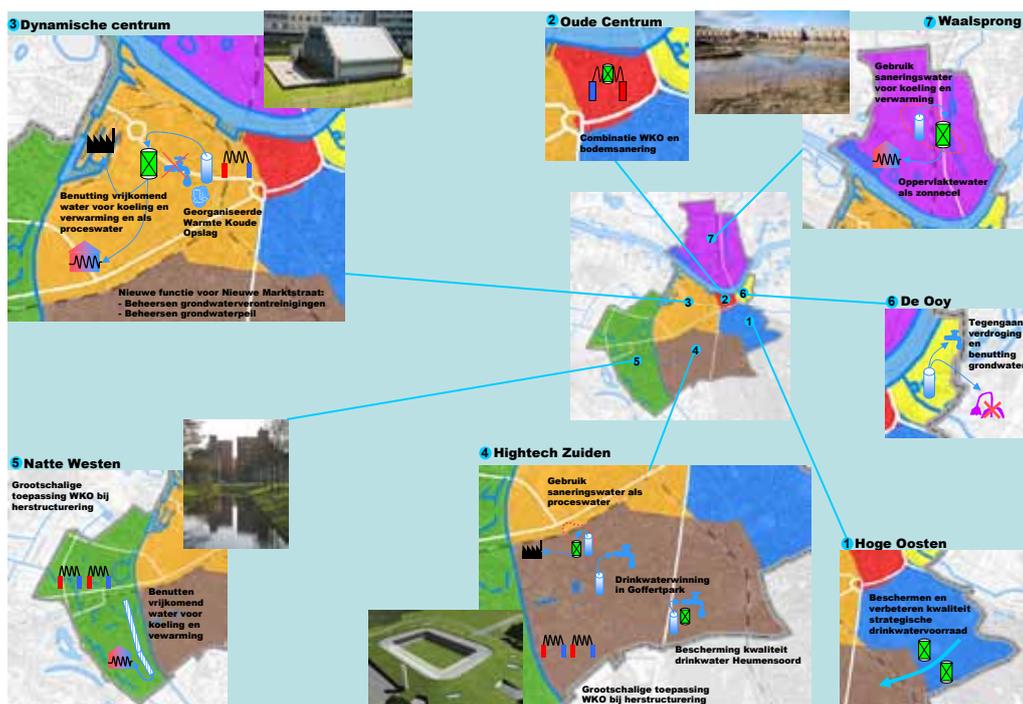
Groundwater and underground policy plans

In order to get a clear view of how to deal with groundwater and underground in the context of climate adaptation and mitigation, policy plans for these subjects were required. In the Groundwater Policy Plan, soil and groundwater quality problems are investigated and a strategy to make the existing city sustainable is developed. Of course, not all problems will be solved. In addition, groundwater quantity problems were investigated: one of the two drinking water pumping stations had to be closed because of quality issues. What this means for the future building plans, is part of the Policy Plan.

Using groundwater for energy and cooling-heating purposes creates many opportunities for both the city centre and the riverfront. The Water Vision combines the technical water themes with the concept of water being an

important structuring factor in future city development. Green and blue structures as climate adaptation measures will be designed with the help of models and maps. This helps to prepare the city as of today for climate change. Using this Water Policy Plan not only for newly built neighbourhoods but also for the existing parts of a city is new for the Netherlands. Both the Underground Vision and the Water Vision were completed in 2010.

These were very successful projects that will be continued. Both plans are key elements on the way to sustainable urban development. The Water Vision of 2010 was used for further policies on the local level within the Structure Plan and on the national level. The Dutch Ministry of Infrastructure & Environment now develops a national policy for sustainable urban development including the subjects of heat and heavy rains and is building on the existing knowledge.



The strategic overview for the underground of Nijmegen

Underground Spatial Planning

Important tools for underground spatial planning are the maps with opportunities lying underground. They deal with the supply of clean groundwater for drinking water, chances for lowering the groundwater nuisance, chances to decrease the pollution or which ensure that the groundwater pollution is no obstacle for spatial planning. In the Water Vision a similar map is produced with the opportunities provided by water, i.e. where to plan cold and heat groundwater storage locations, new locations to abstract drinking water, etc.

Renewable energy – to complement adaptation

Master plan cold-warmth storage underneath the city centre

The opportunities to use groundwater for energy and cooling-heating purposes were investigated for several areas. A major reconstruction is planned around the railway station and a master plan for spatial underground planning was set up in this context. The focus was put on the possibilities to determine the underground so that there will be no wrong interferences between the cold and warmth storage places.

Solar panels on community centres

On the roof of a community centre in Hatert, a residential quarter in the south of Nijmegen, solar panels were installed and a sun boiler construction was placed on a roof of a sports centre. Also, the Sun Tree, an artwork with solar panels, was installed near the university campus. The latest project is the "sustainable" roof on the Thermion Building in the north of Nijmegen. This roof is an exhibition roof with solar panels and all kinds of green roofs.



Sustainable mobility market

The sustainable mobility market was organised twice, in September 2010 and 2011, to present sustainable modes of transportation currently available to the citizens of Nijmegen. Electric bikes, electric cars and electric scooters could be tried out. In addition, sustainable bikes made of old bike parts were exhibited. The citizens were also provided with information on provincial subsidies for sustainable vehicles.

Energy strategy

A consultancy agency prepared a strategic report about Climate and Energy Targets. The "Quick Scan" gives an insight in the measures necessary to meet the long-term climate goals the City Council of Nijmegen defined in

2008. Furthermore, it specifies the cost effectiveness of different types of climate measures. The Quick Scan is in this context a useful tool which supports the choice of the most effective energy and climate measures for the short, medium and long term.

In 2012 all 175 stakeholders were invited to develop ideas on how to reach the goals of the Energy Strategy becoming an energy-neutral city by 2045 in the end. This project, called "Power2Nijmegen", allowed for numerous ideas related to wind and solar energy, biomass and cold-warmth storage.

The "Green Heart" of Nijmegen

The climate campaign "Our Green Heart" was designed to raise the public awareness of sustainable energy and of everybody's contribution to help the municipality to reach the goal of making Nijmegen an energy-neutral city by 2045: 50% decrease in energy consumption and 50% sustainable energy. Since its start in 2010, many PR-activities have been organised. As a follow-up on these activities, a consultancy agency made a business case for a local Climate Shop that offers sustainable products, advice on sustainable subsidies and local businesses and raises the overall awareness of sustainability and climate issues. The shop opened in February 2011, has worked well since then and already arranged a number of market places focusing on topics such as green roofs, insulation and energy saving measures and disconnection possibilities.



The campaign's original Dutch name is "Ons groene hert". "Hert" means "Deer" and it sounds similar to the English word "heart". A green deer became the mascot of the campaign.

Conclusion

What has been the contribution of **Future Cities** to the sustainable projects in Nijmegen and the way the municipality now deals with topics like sustainability, climate adaptation and climate mitigation?

Future Cities has made financial contributions to several projects on climate adaptation. This support allowed for projects which otherwise would not have been possible. In addition to the financial support, the possibility to participate in the **Future Cities** cooperation helped the municipality to gain more knowledge on climate adaptation and to involve several colleagues in the issues. Due to their different backgrounds – they belong to the departments for water, green, urban design and housing – the climate and sustainability topics are now more widely spread among the municipality. All current and future spatial and policy projects in the Netherlands will benefit from this.

"In Nijmegen we have a lot of urban development and retrofitting projects, we try to realise green roofs and other sustainable measures. It is always hard to find arguments to convince the project developers that they need to consider not only cost aspects but also the benefits for social aspects like health and liveability. Through the exchanges with our Future Cities partners we now have better arguments and more knowledge on the benefits of green roofs and green-blue structures for the citizens."

Ton Verhoeven, Municipality of Nijmegen



The Future Cities team of Nijmegen
(from left: Maarten van Ginkel, Henk-Jan Nijland, Veroniek Bezemer, Ton Verhoeven)

Recommendation:

Adaptation to climate change – a great opportunity to improve the urban environment

Adaptation concerns almost all issues related to urban infrastructure involving many services at the local level and beyond: spatial planning, environmental policies, building regulations, communication and economic developments.

Apply climate change adaptation as an opportunity to benefit from multiple land use and reconsider the use of the spaces by allowing them to cover several aspects: water management, public recreation and green structures can be combined in cities reducing climate change impacts such as heat stress and heavy rains.

Read more:

More details are available in separate reports, see list of additional documents.

C.6 Focus on sustainability in Rouen

Within the framework of the Rouen (F) Luciline – Banks of the Seine project wasteland left by its industrial past and port activities will be reclaimed and transformed into a new eco-district. Due to the involvement of the citizens, Rouen managed to realise additional aspects that had not been projected. The river Luciline was uncovered due to the citizens' involvement which shows the commitment of the parties involved.



The redevelopment site of Luciline (in the bottom left corner of the photo) is close to the city centre and to the river Seine.

Location

The project is one of Rouen's most ambitious and largest ones to be accomplished by 2020. The site is located between Docks 76 and Rue Jean-Ango. The district has an exceptional location close to the city centre with excellent public transport links and easy access to major roads. It has views over the Seine to the south and to the hills in the north. This significant project creates a new relationship between the city and its river due to better links and accessibility. The city will come closer to its river and its quiet flow. The district will offer direct access to the Seine and massive waterfront developments will be avoided.

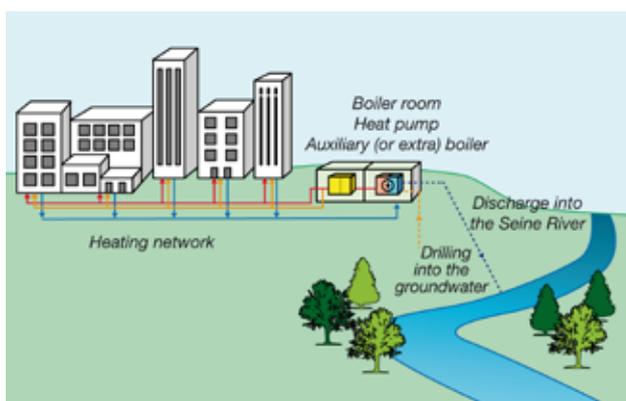
New conception

The Seine West project as a whole refers to the development of an 800 hectares wasteland. The Luciline section is the first to be developed: it comprises 9 hectares and will be a mixed area with shops, offices and housing. A range of accommodations from detached properties to small blocks of flats including 25% of social housing will be offered. At the same time the public areas will be protected from overbuilding. Transforming the Luciline site will reclaim this land for the city and is an opportunity to create a new eco-district just one kilometre from the historic centre. The project is based on a new concept which focuses on the environment. The primary approach is to combat urban sprawl by offering more homes and businesses in a smaller area while still providing airy public areas. The new buildings will comply with the energy efficiency accreditation "Très Haute Performance Énergétique".

The environmental objective of the Luciline – Banks of the Seine project is to design areas that can help reduce CO₂ emissions and implement solutions to face climate change. All aspects of transport, energy and the living environment have been carefully reviewed and planned by means of the French planning approach (AEU) according to the method of the Environment and Energy Management Agency (ADEME). From the initial surveying phase on, a specialist environmental consultant has been part of the planning team.

As part of the INTERREG project, the focus is mainly on energy, water management and ecosystems which will be combined on the site and will rely on:

- A heat network on the Integrated Development Zone (ZAC) supplied by the geothermal sources located near Luciline: shallow groundwater, permanently renewed by the water from the river Seine, as well as by spring waters and rainwater. The network delivers hot water and heat in winter and cold water in summer.
- A natural rainwater management system will serve two purposes: the ground channels and gardens, which will be created in the city centre, will not only serve as areas for the development of ecosystems but also as storage areas for the infiltration of rainwater.



Scheme of the heating network

Rouen Seine Aménagement involves partners

The operations of Rouen Seine Aménagement are based on a contract with the city of Rouen. The developing agency Rouen Seine Aménagement acts on their behalf, within the framework of the goals defined by the city which has a right to inspect the activities performed. Rouen Seine Aménagement works with a team of designers with complementary skills who design and follow up the realisation of public spaces and also define the main guidelines for the buildings realised by private developers.

One of the partners is the local car dealers association, as the city of Rouen decided to support the development of this traditional business in the new Luciline district.

Water management and revegetation

Throughout the last century, the cities tended to neglect the use of rainwater. Their extension and drainage of course contribute to an increased risk of flooding. In the context of environmental protection, the goal of the project is to come as close as possible to the natural water cycle by increasing the vegetation – an approach which is today in many cases very constrained by dense urbanisation.

The management of rainwater presupposes topographic, climatic and geotechnical studies, etc. Thanks to these studies, uncovering the river Luciline, which is presently channeled under the site, has been identified as potentially beneficial as far as adaptation to climate change is concerned. This solution based on a natural method has been integrated in the global water management plan and complies with national policies (Grenelle Laws 1 and 2) in the context of sustainable development. The method is combined with the revegetation of spaces, which allows for both landscape and acoustic advantages and thus helps to improve the existing urban structures by increasing the air and water quality and by decreasing noise.

Water management and revegetation are a natural and efficient way to improve the environment and at the same time to weaken the damaging effects of climate change.

The following measures are planned:

- The minimisation of the sealed surface in relation to 135,000 m² of buildings
- The improvement of the living environment
- The encouragement of biodiversity
- The limitation of waste (e.g. drinking water not to be used for watering).



A view of the planned spaces for surface water and green structures

Sustainability is manifold					
Energy efficiency	Water Management	Traffic control	Urban settings	Ecosystems	Processes
<ul style="list-style-type: none"> - Control of power consumption: all the buildings in the Integrated Development Zone (ZAC) will have to be labelled Very High Energy Efficiency (65 kWh/m²/year and 60% of renewable energy) - Pooling of energy production sources: installation of a heat network - Renewable energy provided by geothermal resources 	<ul style="list-style-type: none"> - Water retention as far upstream as possible - Minimising the level of surface sealing - Rainwater management using natural methods - Minimising the runoff rate on parcels of land 	<ul style="list-style-type: none"> - Fostering "light" modes of transport - Access favouring dedicated-lane public transport (TCSP) - Optimising the collection of domestic waste 	<ul style="list-style-type: none"> - Combining population density and individuality - Social and functional diversity - Greening of public areas - Sustainable public areas - Night lighting - Protecting landscapes and sun lighting - Acoustic comfort of private and public areas 	<ul style="list-style-type: none"> - Landscaping continuity between public and private areas 	<ul style="list-style-type: none"> - Minimising power consumption, from construction to management - Preference of solutions minimising maintenance requirements - Involving car dealers into the conception in order to allow them to stay in the area - Supporting the development of broadband networks

Three types of water

In this area the water present will limit the effects of urban heat islands and contribute to a pleasant living environment.

Three types of water will be in the focus of the project:

- The water of the spring Luciline, at present channelled in a rainwater manifold, will be uncovered via channels.
- Rainwater originating from private plots after retention will be infiltrated.
- Water from public spaces and groundwater (geothermic drainage), flowing out of the heat production locations, which will flow in the channels.

The three types of water converge in a central valley, a place for walking and leisure, ensuring water retention and thus creating a humid habitat in the area. From this point water is evacuated into the Seine. The public spaces will be designed according to the activities in water management. This applies in particular to the selection of plants for the green spaces.



Thierry Verrier, director of Rouen Seine Aménagement, presenting the project

Public participation wanted

The Luciline site is marked by the automobile industry (franchise holders), minor commercial activities and several office buildings. Although there is not a lot of housing on the site, the operation is going to have an impact on the neighbouring population and the city.

The dialogue with the population is a legal obligation in the framework of the "Urban Development Zone" procedure. This dialogue, i.e. public meetings and the organisation of exhibitions, informs the population about the environmental objectives of the project. It is also an opportunity to get to know the opinions of associations involved in the issues. As a result of the communication with the public, the city decided to integrate some additional aspects in the development project, such as the uncovering of the river Luciline as well as the implementation of green roofs.

Although the opinion of the citizens is only consultative, it constitutes an important pillar for the building engineer and the contracting authority as the development operation will be most successful if it meets their expectations. The communication with the citizens will continue during the entire development process of the project.

European cooperation is beneficial in many respects

"The collaborative work with the working groups and twinnings is very fruitful in terms of developing and testing new ideas on climate adaptation and helps to improve the project. Although the partners have quite different goals and projects, the participation in a European network allows for more credibility in the cooperation with the city and financing partners. The experience of operating beyond the national level, i.e. on a European basis, has been very dynamic and productive. The Luciline project has become quite attractive for private partners. This would not have been the same without the appeal of the Future Cities project. In all, it can be said that the original project was substantially changed and enhanced by Future Cities."

Thierry Verrier, Rouen Seine Aménagement

C.7 Coping with water in the city – the integral approach of Tiel East

The adaptation measures taken in Tiel (NL) are at the same time an opportunity to enhance the city in many ways. As water nuisance is a familiar and complex topic here, the approach chosen had to be very comprehensive as well.



Aerial view of Tiel East

Water nuisance – a constant challenge

Located between the rivers Waal and Linge, Tiel has always been involved in water issues. The first inhabitants built their houses on the higher grounds along the Linge but when the city started to grow substantially in the beginning of the 19th century, the higher grounds were soon occupied. Consequently, building development went on in the lower areas around the city centre.

The water allowed for prosperity but has always also been a threat: the traces of many breakthroughs of dikes can still be found today. It was only in 1995 that the city and its surrounding districts had to be evacuated because of flooding. Since then, a number of dikes have been raised to decrease the risks. But is this feeling of safety justified in view of the expected effects of climate change? And what are other consequences of climate change that Tiel will have to overcome in future?

It is in the district of Tiel East where these questions were asked for the first time. This district was built in a former bank area of the river Waal. Today, a strong dike keeps

the river away from its original position. Tiel East offers a mixture of housing and industry and has grown a lot in the past years, gradually compressing the area. As a result, public green is relatively rare.

Due to its location in the corner of the river Waal and the Amsterdam-Rhine Channel and its lower ground level, Tiel East has always been dealing with water nuisance. The specific structure of the underground makes the groundwater fluctuate with the water levels of the river Waal which is caused by a trickle of water that seeps under the dike continuously. The higher the river, the stronger the seepage flow. Especially in spring and autumn the groundwater levels are high. In low sandy parts of the district the groundwater is almost up to street level. This causes considerable nuisance, e.g. in houses where the water is so high that the wallpaper gets damp and wooden floors are bended. If it rains heavily at this time of the year, the risk of flooding is substantial.

Mission impossible?

As Tiel East has a long tradition of water problems, it is obvious that these problems do not solve themselves but require action. Climate change will make the water levels of the rivers rise and consequently the groundwater levels will do so, too. To tackle the problems, drastic measures had to be taken:

- The groundwater levels had to be lowered to a depth of at least 70 cm.
- Extra capacities of thousands of cubic square meters of water storage were needed to store rainwater temporarily.
- The overloading of the sewer system had to be decreased by 50% by disconnecting 6 hectares of hardened surface, mainly roofs.



All these measures had to be taken in Tiel East but in view of the effects of climate change other districts will have to cope with water nuisance as well.

Solving the existing water nuisance was only part of the approach. As the population of Tiel is growing, more houses are needed.

These houses are prefer-

ably built in the existing residential areas so that the surrounding open landscape can remain intact. Additional space was required also in Tiel East to allow for more houses. The plans had already been developed when it was found out in 2006 that they could not be realised without causing even more water problems in the surrounding neighbourhoods.

In 2007, the municipality therefore made the decision to stop new developments until an integral water scenario for Tiel East would be developed which would solve the existing water problems and prevent new ones in future. The water scenario had to consider the expected effects of climate change and still allow for the spatial developments required. In addition, it had to be widely accepted and financially feasible.

Numerous experts and stakeholders were invited to participate in the development of an integral water scenario. The water board Rivierenland, the Province of Gelderland, ministries, housing corporations, inhabitants, external experts from several institutions, consulting agencies and the municipality of Tiel worked closely together and developed four scenarios. Elements of all four scenarios were then identified and combined in one integral water scenario to be realised by 2030. The extensive participative process led to a contract that was signed by the municipality and the water board Rivierenland in 2010. What had seemed to be a mission impossible evolved into a realistic and affordable water scenario: sustainable and innovative, creating new opportunities by combining green, energy and water measures.

Integral approach creates opportunities

The integral water scenario consists of measures for the short, mid and long term that can be classified into four types:

- Retain water longer
- Store water temporarily
- Discharge water to areas in the district that are less vulnerable
- Develop the "Climate dike".

Some of these measures are relatively simple, like creating new waterways and using permeable pavement. Other measures are more innovative and complex as they are based on synergies between water, green and energy.

Green roofs to retain water

The most striking advantage of green roofs is that rainwater is retained and its flow into the sewage system is slowed down. In addition, they serve multiple purposes as they also enhance the biodiversity and air quality and contribute to decreasing the heat island effect. At the building level, green roofs improve the sound and heat insulation and their life span is substantially longer than in case of bitumen roofs. Green roofs thus represent the result of a combination of water, green and energy aspects.

Several companies were informed of the possibilities and benefits of greening their roofs. Eventually, 1.600m² of green roofs in Tiel East and another 1.400m² in other parts of the city were realised. In each case the buildings accommodate vulnerable groups (students, patients) and/or continuously accommodate a large number of people. A surprising side-effect involves aspects of well-being as hospital patients undergoing a dialysis treatment with a view of green roofs confirmed a growing comfort.

A water square to store water temporarily

An example of storing water temporarily is a water square. Such squares are positioned on a lower level than the surrounding grounds in which rainwater during and after heavy rainfall can be stored. If there is water in the square, it resembles a shallow pond. When the square is dry, it offers an attractive green public space where people can meet and play. In Tiel East, two water squares will be realised. These water squares will not only be part of the water scenario but will also add public green to the district.



The water square: combining water retention and green public space

Groundwater-use for energy purposes and to lower precarious levels

The discharge of water to less vulnerable parts of Tiel East is not the most sustainable solution but this measure is able to solve current problems fast. To improve the sustainability of these measures, the combination of water discharge and cold and heat storage, a form of sustainable energy, was investigated. When cold and heat storage water is usually pumped up, the heat or cold is being used for energy purposes and then the water is pumped back into the same ground layer. In

Tiel East, however, calculations were made to distract the cold or heat from the water and then pump it back into the ground in less vulnerable areas. The results were very promising as it is possible to lower the groundwater levels by up to 60 cm and the technique can also be combined with a decontamination of the groundwater.

The Climate dike – a long-term measure

The most drastic long-term measure of the water scenario is the realisation of the climate dike. A climate dike is often defined as a multifunctional dam that is robust enough to guarantee lasting safety. It will reduce the flow of seepage water by 6%, which can also be achieved by other measures. A climate dike, however, is more than just a water measure because it has the potential to create additional space for housing, social meeting points and green as well as to serve economic functions.

In 2011 a master plan was compiled that was based on the development of an area where special forms of housing with magnificent river views, nature development, recreational functions and "dry feet for the district behind the dike" go hand in hand. With this development, new opportunities will be created for an area that is at present hardly accessible and positioned in a remote corner of the city. With the "Cool Nature" park the first part of the climate dike was realised in the beginning of 2013. This former landfill was decontaminated in 2010 and was transformed into a park with a natural character where kids can play and learn about climate change and nature. Here, people find shelter from the sun and the heat on hot summer days. Since Tiel East does not possess much public green, the park makes the district a lot more appealing. In addition, the kids are stimulated to play outdoors, which helps combating obesity.



The Climate Dike offers opportunities for specialised residential development.

Targeted communication is a must

During the **Future Cities** project, several communication methods were applied. Some of them focused on improving the process of the integral water scenario, others were developed to improve the awareness of the need to adapt to climate change. Although some of them have been developed particularly for Tiel, the results and their underlying concepts can be useful everywhere.

Water game

The water game is a multi-player computer game featuring Tiel East with its specific water problems. The aim of the game is to make the players achieve a common goal, e.g. solving the water nuisance by means of a given variety of measures and financial resources. Each player represents one of the stakeholders, such as the project developer, the water board, housing corporations and the municipality. The influence of the inhabitants is considered in the game as well. Several circumstances are simulated, for example heavy rainfall, high river levels, effects of an extra hardened surface due to new developments, the effects of specific measures taken, etc. When the game was played in Tiel every participant had to play the role of another stakeholder. This was a fun way to gain more insight in each other's interests and to experience the benefits of cooperation. At the occasion of a working group meeting in Tiel, the game was presented and played by the **Future Cities** partners, too.

Educational programme

Educating children and raising their awareness of climate change is important and can help to make future generations more knowledgeable and thus more adapted to climate change. Therefore, the educational programme 'Who, what, water' for primary schools was developed. The programme gradually narrows its scope from global to local effects and highlights the green and water measures taken. While raising the awareness of climate change in a fun way, the programme also improves the understanding of the water measures taken in the district. The programme starts with one of the teachers leading a group discussion about climate change. After the introduction the children learn to work with a special 3D map of the Netherlands in which floods can be simulated. They actively experiment with water to get to know the effects of different water levels. The programme is quite popular among schools as the children and their teachers appreciate the playful way the subject is being presented.



Screen shot of the water game: the area of the water square

Students project

As climate change means of course more than just growing water problems, the effects of climate change on the city climate of Tiel were investigated. This study addressed local politicians, housing corporations, project developers, inhabitants and a number of municipal departments. In order to enhance the knowledge of students, a project with 5th year students of Landscape Architecture and Urban Planning of the University of Wageningen was initiated.



Students bring in a fresh and creative view.

In the first part of the project, the students analysed the city climate taking into account the effects of wind, shade and sun and the heat island effect. A city climate map that gives insight in specific areas that need to be adapted was developed. In the second part, several climate-adapted designs were made for specific locations. At the beginning of the project, a lecture about city climate was given to local politicians and other interested parties. During the project, the students cooperated closely with the municipality and at the end of the project the analysis and designs were presented. The city climate map and in particular the designs were received very well although some of the designs were based on a complete makeover of districts. The fresh and creative view of the students on a climate-adapted future, however, was highly appreciated and led to lively discussions.

More than just adaptation measures

The realisation of the green roofs on existing roofs proved to be a difficult task. Most companies having a huge roof span lacked the roof capacity to be able to carry the extra weight of the green roofs. Other com-

panies simply feared leakages and higher maintenance costs. As nothing is more convincing than a company that can present the results and share its experience, pilot projects play a very significant role in this context.

All the measures taken in Tiel contribute to the integral water scenario. But they add more to the district than avoiding water nuisance alone. Aspects like additional public green, more opportunities for kids to play and exercise have a positive impact on sustainability and keep the district attractive. Adapting to climate change is therefore much more than simply taking certain measures as it means an opportunity to enhance the cities in manifold ways.

One of the difficulties in the context of raising the awareness of climate change is that it is a global problem having large scale impacts but huge uncertainties with regard to the exact local effects. Therefore, adaptation measures have to be taken locally so that climate change can be understood and accepted locally as well. Visualising the effects (e.g. water game, city climate study) might be a helpful approach.

The awareness of the necessity to adapt to a changing climate started with the water nuisance in Tiel East. It will, however, not end there.



"During the Future Cities project we learned that climate adaptation is much more than just preparing for the effects of climate change: an integral approach with involvement of all relevant stakeholders and a smart combination of measures enhances the liveability of a city, keeping it attractive in the future."

Annemieke Spit, Municipality of Tiel

Read more:

The full description of measures can be found in the brochure "Tiel East drier and nicer". See list of additional documents.

C.8 Sustainability from the start for "De Vloei"

Sustainability needs to be incorporated as a standard process in the long term. The West-Vlaamse Intercommunale together with the city of Ieper (BE) introduced a far-reaching planning process to develop a new sustainable and climate-proof housing quarter. Inspiring partners and a professional communication mix are keys to success.

Location

The city of Ieper (Ypres) is located in the south-west of the province of West Flanders. With approximately 35,000 inhabitants it is the fifth largest city of the coastal province of Flanders and the biggest city of the Westhoek region. The city offers many facilities to its inhabitants: culture, leisure and recreation, sports, schools, shopping, pubs and restaurants, medical care and hospitals – and all this in a green environment. Adjacent to the city centre, West-Vlaamse Intercommunale (wvi) plans to develop a new sustainable housing quarter in cooperation with three partners, i.e. the city of Ieper, the social housing company Ons Onderdak and the private housing company Imfiro. In this quarter, called "De Vloei" (in English: the flow), sustainability is integrated from the planning phase on to actually sustainable living. Energy, water, viability, use of space, materials, mobility, economy and other aspects are being considered. The project has a size of 10 hectares and will offer room for about 250 dwellings.



The development area in the Northwest of Ieper

Scope of the project

The **Future Cities** project focuses on networks which combine water management, urban greening and sustainable energy systems. Green-blue corridors form the backbone of the quarter and connect it with an adjacent housing quarter and the main roads. The water structures were dimensioned taking into account climate change impacts. The possibilities of collective renewable energy

sources and the rational use of energy were investigated by an energy study (see further).

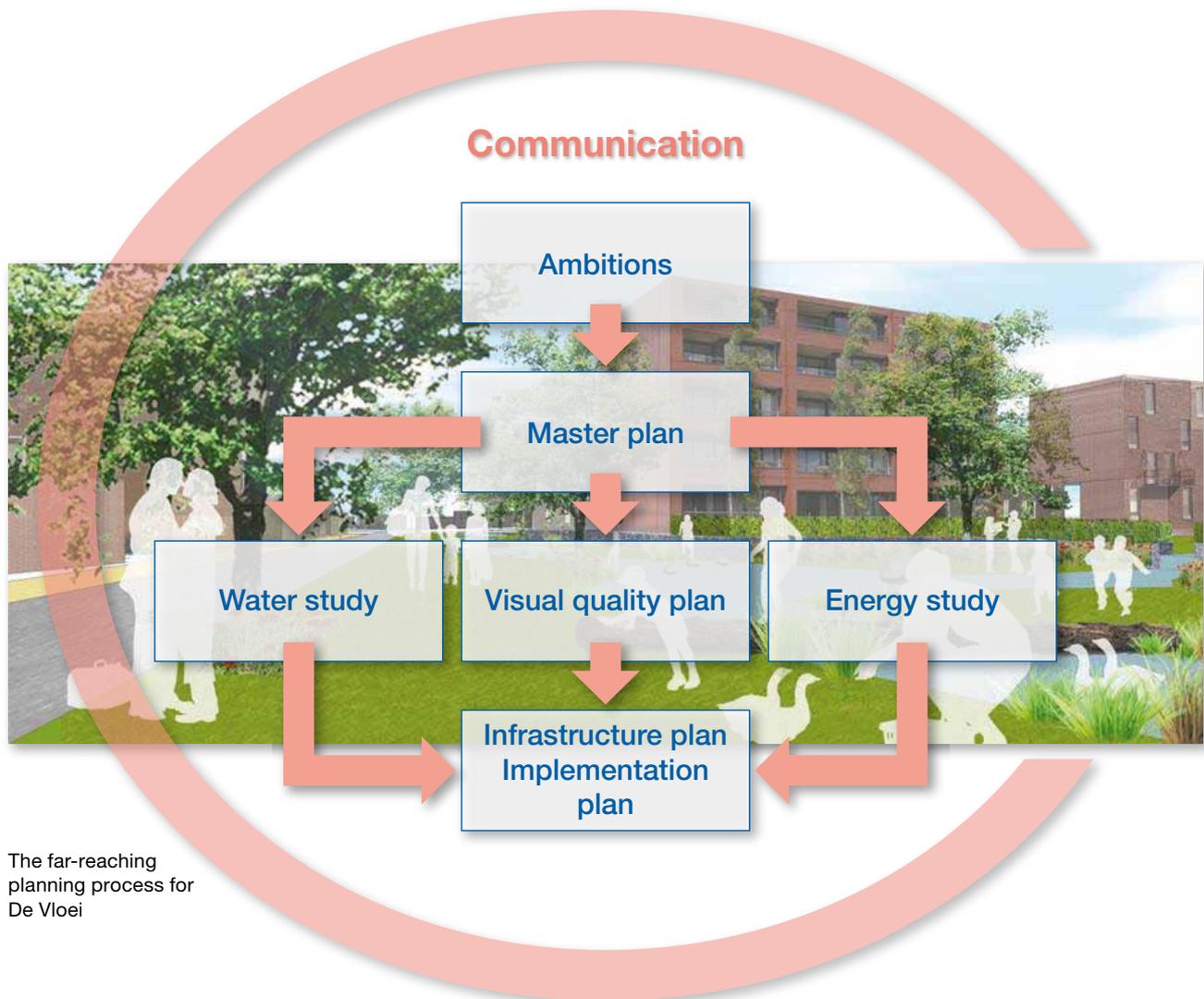
In order to achieve an overall sustainability, it was necessary to pass through several phases. In the first phase, the ambitions within the project were determined and agreed on. Second, a master plan had to be developed to translate these ambitions in spatial planning outputs. The visual quality plan resulted from the master plan whereas the energy and water study provided more detailed information. After these steps, the preparation of the implementation could start: a designer for the infrastructure plan was appointed to convert the master plan into a concrete implementation plan.

The whole process was accompanied by a communication strategy raising the awareness of sustainability among the local stakeholders and inhabitants but also to improve the cooperation between the project partners and within each organisation. The partners were supported by the Flemish Government (Department of Environment, Nature and Energy) and by the province of West Flanders. This national and regional support helped to communicate the results of the **Future Cities** project beyond the local level.

Recommendation:

The right planning process – think and act across all sectors

It is necessary to strongly coordinate sectoral plans and to consider climate adaptation as an improvement for city development. This should be realised at an early stage of spatial planning so that adaptation measures are not just added at the end. Acting across all sectors also means to always keep mitigation of greenhouse gases in mind. It is necessary to involve specialised organisational capacities with multidisciplinary teams from the beginning on. In the long term, sustainability will thus be incorporated as a standard process.



The far-reaching planning process for De Vloei

Everything starts in your mind

The first and greatest challenge was to change the mindset and integrate the idea of sustainability from the very beginning of the project. Another challenge was the internal communication and cooperation between the partners and within their different departments. Through open and clear communication and consultation, however, support for the ambitions and trust between the partners and within each organisation have been built. A third challenge was to find consultants, designers, architects and construction companies who are able and willing to implement the idea of sustainability and – if necessary – to convince the different parties of the goals of the project. The final challenge was the planning and execution of the communication and awareness raising strategy, as wvi is not experienced in elaborate communication and does not have a communication department.

First things first

Wvi tackled the challenges by means of an integrated approach that can be described in four phases, which are also part of the **Future Cities** work packages:

- The ambition note for the project and the regional guideline – as it relates to the development of the **Future Cities** Adaptation Compass
- The master plan – being an action plan for adaptive measures
- The realisation of the ambitions with the infrastructure plan implementing combined measures
- The awareness raising strategy – aiming especially at decision-makers and disseminators.

The ambition note defines the goals of the project. The document was generated in cooperation with the partners and all of them agreed to execute what had been stipulated. The ambition note is based on an integrated approach of sustainability according to the four p's: people, planet, prosperity and process. The ambitions are classified in basic ambitions and plus level ambitions. The basic ambitions are the ones that have to be achieved when realizing the project. The plus level ambitions have to be pursued but their successful implementation cannot be guaranteed in advance because of their higher standard or the fact that other parties such as new residents are involved.

From the positive experience with De Vloei grew the regional guideline. It is an instrument that introduces sustainability to municipalities and focuses on the implementation of the concept in a housing project. After an introductory part, the different measures are explained. The regional guideline contains four chapters based on the four p's of sustainability (people, planet, prosperity and process), in which specific topics are described. The measures can be prioritised by all parties involved according to the specific conditions for and the location of the project, and the goals and abilities of the project partners. By determining the priorities, an ambition note for the project can be developed. The ambitions for every topic are described at the level of the individual house

and at the level of the quarter because every level has specific possibilities and weaknesses. The ambitions are further arranged according to a basic and a plus level. The basic level measures already go beyond what is determined by current legislation but are common use or fairly easy to implement. The plus level measures require greater effort. The goal-oriented approach describes the goals but does not define the measures to achieve them and thus allows for innovative solutions.

More inspiration

In order to be able to achieve the goals set in the ambition note, the partners considered it necessary to gather more information. Different good examples, like Freiburg in Germany, were visited, which helped to broaden the support of the decision-makers with regard to plus level activities. Nevertheless, some design questions remained open, i.e. with regard to the creation of a suitable green-blue network, a smart mobility system and a viable quarter. Therefore, the four partners participated in a workshop where also external experts were invited. The workshop did not only lead to a better understanding as regards the topics but was also productive as the partners got to know and understand each other better so that their confidence in the new concepts could grow.

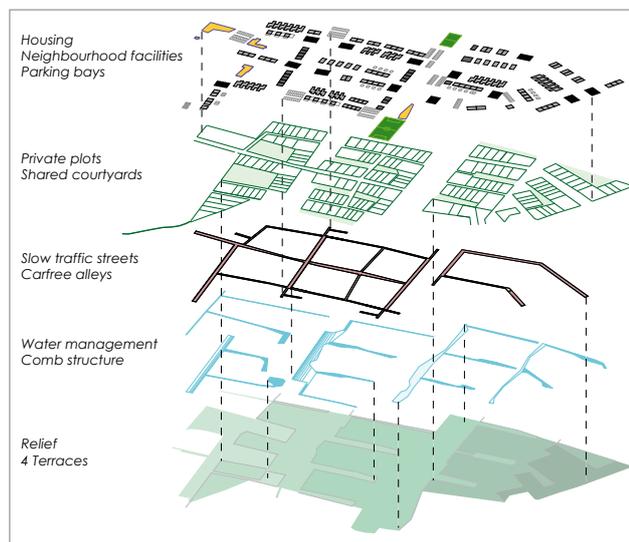


Examples from the ambition note: how to infiltrate rainwater

The master plan

The master plan for De Vloei is based on the ambition note and is the first outline of the project. More detailed plans are developed on the basis of the master plan. It is a rather simple set of planning and design decisions, visualized in a layer-scheme and an elaborate reader, explaining the correlation between the different layers. This plan contains the most essential spatial elements.

Wvi took the initiative to draw the master plan to make sure that the ideas developed during the entire process were integrated. The concepts that resulted from the workshops that initiated the process of master planning, added new spatial ideas to the key issues: terraces and green axes to buffer and slowly drain storm water, collective parking spaces to keep cars out of car-free streets but close enough to the houses and balanced transition spaces between public and private properties. Some of these ideas resulted directly in decisions, like a strong green central axe separating two car accesses to the quarter. Other ideas generated minor components, e.g. the courtyards inside the building blocks with free spaces to drain rainwater or to serve the inhabitants as meeting points.



The master plan contains several layers showing the interconnections.

The main role of the master plan was to anchor basically loose ideas in one scheme and to clarify the coherency of the spatial decisions. This scheme was presented as a layered model, showing the interconnections between green, water, mobility and architecture. In addition to the scheme, the "typical section" of the building block showed the direct link between the positioning of the housing, the limited section of the road, and the section of the garden and the courtyard.

All further design, production of images and calculations seamlessly fit into the basic scheme of the master plan. A lot of the work was done in workshops, using and testing the master plan with the aim to meet the ambitions defined in the ambition note.



Excerpt from the visual quality plan for De Vloei

“Creating a climate-proof city makes people work together in a multi-disciplinary way and encourages to follow a bottom-up strategy, striving towards a greater harmony between sectors and policies, with as final result a better liveability of our cities”.

Eveline Huyghe, West-Vlaamse Intercommunale

Detailed information required

Once the master plan was ready, it was felt that more detailed information was needed. A water study gave more input on how to dimension the water bodies in the quarter taking into account possible climate change impacts. Furthermore, an energy study was required to find out how to adapt buildings to climate change and whether a collective energy system for electricity and heating can be realised. As a consequence of the energy study the decision was made that, as the buildings will be very well insulated, a collective system for heating will not be introduced. Solar panels and individual heat pumps were considered to be the most sustainable solution. Also, the possibility of exploiting a cooperation with Energy Service Companies was investigated for the purchase and maintenance of heat pumps.



The water study: combining the blue and green areas for synergy effects

The master plan served as a basis to derive plans such as the visual quality plan. This plan takes into account the radial structure of the site opposite the city centre, the blue-green axes and the mobility plan. The open space is laid out according to four themes referring to different experiences: the garden, the ballroom, the river and the farmyard. The garden is a flower-rich area, serving as a quiet resting place while the ballroom is of a larger scale to accommodate neighbourhood events. The river is designed as an adventurous area for children and the farmyard connects different smaller functions such as a small horticulture garden and a collective compost area to an already existing farmhouse.

The allotment plan shows what types of individual houses are to be realised where and how in the quarter. The allotment plan and the infrastructure plan were needed to get a building permit for the site. The infrastructure plan, which was set up by an external consultant, shows how the infrastructure is implemented (roads, water parties, green, utilities), the materials used and the costs of the project.

The city of Leper owns 58% of the area whereas the three other partners own 14% each. In order to avoid that every partner owns one large connected area, an owner distribution plan was drafted. According to this plan, the area got divided into small dispersed lots which were distributed among the four partners. This system of granular ownership contributed to the social mix in the project.

Read more:

More details are given in the water study, the energy study and the Master Plan, see list of additional documents.

Confidence through communication

The aim of the awareness raising strategy was to arouse the general level of knowledge about adaptation to climate change and how this can be achieved by means of integrated sustainable development. Another aim was to raise the knowledge of wvi and the other partners. Furthermore, the general goal of course was to make publicity not only for the project but also for the North-West Europe cooperation programme.



Ideas from abroad influenced daily decision-making.

Several excursions to exemplary projects in Belgium and abroad were organised, specifically addressing so-called disseminators who are likely to spread the message and integrate it in their daily work and decisions, e.g. experts and professionals, planners, decision-makers in the administration. As an example local politicians and civil servants visited Eva Lanxmeer (Culemborg, the Netherlands), a showcase of a new sustainable city quarter, to gather ideas for developing "De Vloei" in leper. It could



Students of a professional school present the sustainable building techniques in leper.

be demonstrated that integrated sustainable development is feasible without extra costs if well planned from the beginning. As these excursions were very interesting for the local politicians and planners, they enhanced the implementation of the sustainable quarter in leper tremendously.

Furthermore, information sessions were arranged at the local and regional level and some of them are worth being described in greater detail: wvi used regional forums to distribute information, the project partners invited experts to inform the citizens of leper on different measures concerning water, energy and sustainable building, the project was presented at the occasion of a neighbourhood meeting and the citizens were invited to participate in different workshops. The De Vloei website, www.devloei.be was launched in August 2011. It is not only supposed to inform on the project and its progress but also to allow future inhabitants to interact and exchange their experiences.

Wvi and Green vzw cooperated within the framework of their respective projects [Future Cities](#) and SIEU (Schools for Intelligent Energy Use) to arouse interest for energy efficiency and the use of renewable energy in professional secondary schools. Two professional schools in leper were involved and developed scale models for walls of passive and low-energy houses and a plan for sustainable lighting of the public space. Due to this cooperation, the institutes considered sustainable building and lighting models that had not been given much attention in the training plans.



The project team of wvi (from left to right standing: Ann Tack, Johan Michielssens, David Loeys, Trui Naeyaert, Nick De Craemer, Luong Hung Chau, Björn Denecker, Stijn Saelens; sitting: Stijn Aelter, Eveline Huyghe, Nathalie Garré)

Part D The way forward

by the *Future Cities* partnership

The partners of **Future Cities** have now accomplished five years of fruitful cooperation. During these five years, we implemented projects, gathered experience, exchanged information and learned from each other. We have developed and applied instruments to make our cities fit for climate change while simultaneously improving the quality of life.

This journey has started well but we still have a long way to go. Therefore, we asked ourselves how should this continue? Which ideas and visions do we have for the coming years and decades? Which instruments do we want to use here? Which ones must still be developed?

Each of the project partners – backed up by five years of experience in **Future Cities** – has found answers to these questions for their city and their region.

Lippeverband and Emschergenossenschaft

Integrated water management has an enormous potential to make our cities climate-proof and liveable. And we, Lippeverband and Emschergenossenschaft, perceive ourselves as permanent, trusted players in the region with a key role in the implementation of adaptation to climate change. We are starting now with consequent adaptation measures and behavioural changes in order to avoid taking emergency measures later. Therefore, we, as responsible water boards, work catchment-wise, sustainably, integrated, cross-sectorally; and above all – in cooperation networks.

Important next steps towards a climate-proof region will be to integrate the aims of adaptation and mitigation into the realisation of greater action plans: the RVR plan (The Ruhr Regional Association), the climate protection law of North Rhine-Westphalia and the European Water Framework Directive. Here, we will work together with the local authorities in particular extending single measures that were implemented in the past years to wider areas. With the **Future Cities** Adaptation Compass, a strategic action plan can be elaborated all over the region. Also, the "dynaklim roadmap" can provide support – this is developed in a regional networking and research project together with the State of NRW, and national Research Ministry.

On the European level, we have started close cooperation beyond the **Future Cities** partnership: Since 2010, the Lippeverband is also Lead Partner of the Strategic Cluster "*SIC adapt!*", which includes about 100 organisations and public bodies throughout Northwest Europe. We will foster this collaboration as we truly believe that international exchange is necessary for promoting and achieving effective climate adaptation.

Arnhem

The city of Arnhem wishes to remain attractive for all those who live, work, shop or spend free time in the city; now and in the future. Climate change will place a burden on that ambition. Extreme weather situations will cause more damage and possible even health risks for certain population groups. For the next period, the city will put emphasis on further improving the climate awareness of its partners expecting them to take their responsibility regarding their property, tenants, etc. Exchanging knowledge and experiences at the regional, national and European levels is essential to reach this target.

Hastings Borough Council

In our outlook, we are looking ahead to 2066, and beyond, in our climate change strategy. Whilst focusing on retrofit of existing buildings, using the manual created during the **Future Cities** project, we will also need to protect our nature reserves and green spaces. Other areas such as increasing renewable energy generation and becoming a zero waste town will also be important. As a coastal town, how we adapt to sea level rise is a crucial question for us. We plan to make good use of the tools we have gained during the **Future Cities** project, such as measuring heat loss in buildings and using the Map Table to create scenarios and inform adaptation work. Following a successful testing of the Adaptation Compass at the regional level, we also have an opportunity to use this across East Sussex.

We will continue to seek opportunities at EU level, building on the legacy of strong partnership in **Future Cities** with our pilot project "Answers to the Carbon Economy" (ACE) refurbishing an industrial unit.

Nijmegen

In our Sustainability Vision 2011-2015, one of the main issues is to create a sustainable and climate proof city development. In our spatial development processes we want to integrate the policies on energy, mobility, economy and climate adaptation. In that way we expect to turn over our existing city into a sustainable city, which is energy neutral, easy accessible, economically successful, climate proof and above all liveable. Nijmegen should become a city in which people can live a healthy life and can work pleasantly, a city which supplies its own energy demands and is adapted to future climate changes.

Rouen Seine Aménagement

The collaborative work through [Future Cities](#) European programme is very fruitful in terms of obtaining and testing new ideas on the subject of climate adaptation. Although the partners had quite different goals and projects, our involvement in a European network gives us more energy and credibility to obtain positive decisions from the City and financing partners regarding climate adaptation.

We were already used to networking at the national level; we went a step further, learning to work within a European network. The original Luciline project was substantially changed through [Future Cities](#) and we will take benefit from this experience, disseminating it through other urban projects in Rouen and its region – with a particular emphasis on the water, energy and biodiversity topics.

Tiel

Adapting to climate change is more than just preventing problems, it is a great opportunity to create benefits and improve the liveability of a city. Adaptation should therefore not be seen as something extraordinary, it is mainly a question of integrating urban functions from the start. The municipality of Tiel will, together with local regional partners, use the experiences from the [Future Cities](#) partnership to improve the climate resilience and liveability of existing areas and new development in Tiel. This starts with raising awareness, creating local involvement, followed by guidelines for integral designs. We would like to share our knowledge and experience with other organisations on national and European levels.

West-Vlaamse Intercommunale

The West-Vlaamse Intercommunale wishes to support the municipalities in the development of sustainable housing quarters. The main aim is to create climate-proof areas by working together in a multi-disciplinary way, internally but also externally with project partners. In this process, we strive towards a greater harmony between sectors and policies.

Based on the regional guidelines, we shall produce a working guideline to integrate sustainability and internal cooperation between departments in our own projects based on a similar document for the development of business parks.

We intend to implement the tools we have gained during the [Future Cities](#) project such as the thermal imaging camera, to measure heat loss in buildings, the regional guideline, the adaptation compass for a better understanding of climate change impacts and adaptation to these.



List of additional documents

Further reading – Here you can find more details of the implemented measures. The files are available for download on www.future-cities.eu

Content	File name	File size MB
Lippeverband and Emschergenossenschaft		
Short version of the EGLV Climate Change brochure	EGLV_Leitfaden_Klimawandel_Kurzfassung_web_german.pdf	0.6
Arnhem		
Future Cities: naar klimaatbestendige steden in de Stadsregio Arnhem Nijmegen (boekje, 2009)	01_boekje Future Cities 1 NL.pdf	1.1
Future Cities: analyse van het hitte-eiland effect op Arnhem (boekje, 2010)	02_boekje Future Cities 2 NL.pdf	2.0
Future Cities: naar een klimaatbestendige gemeente (flyer, 2011)	03_Flyer Future Cities 3 NL.pdf	0.5
Hittekaart van Arnhem – grid 100 * 100 meter (University of Kassel, 2010)	04_heat map of Arnhem 2010 ENG.pdf	0.3
Urban Climatic Map of city of Arnhem (University of Kassel, 2010)	05_report Heat Map of Arnhem 2010 ENG.pdf	1.2
Hittekaart van Arnhem – grid 25 * 25 meter (University of Kassel, 2012)	06_heat map of Arnhem 2012 ENG.pdf	1.9
Urban Climatic Map of city of Arnhem (University of Kassel, 2010)	07_updated report Heat Map of Arnhem 2012 ENG.pdf	6.2
Hitte Attentiekaart Arnhem (2012)	08_hitte Attentiekaart Arnhem 2012 NL.pdf	1.6
Legenda Hitte Attentiekaart Arnhem (2011)	09_legenda Hitte Attentiekaart Arnhem NL.pdf	5.0
Heat Attention Map of Arnhem including legend	10_Heat Attention Map of Arnhem including legend ENG.pdf	0,2
Hittescan Arnhem Nijmegen (Dakwacht, 2009)	11_Hittescan Arnhem Nijmegen.jpg	0.4
Hittescan Stadsregio Arnhem Nijmegen – verslag (2010)	12_verslag hittescan Arnhem Nijmegen NL.pdf	2.2
Ruimtelijke analyse van het stadsklimaat in Arnhem – rapport Wageningen Universiteit klimaatfietsmetingen 2009 (2012)	13_rapport klimaatfietsmetingen Arnhem 2009 NL.pdf	2.0
Resultaten klimaatfietsmetingen Arnhem 2009	14_resultaten klimaatfietsmetingen 2009 NL.pdf	0.8
Air temperature map of Arnhem (2012)	15_air temperature map Arnhem 2012 ENG.pdf	1.2
Urban climatic map studies; a review (Chinese University of Hong Kong and University of Kassel; publication in the International Journal of Climatology 2010)	16_publication on heat map Arnhem in international journal of climatology 2010 ENG.pdf	1.1
Future Cities: wonen op een hitte-eiland. Winkelcentrum Kronenburg in het groen – middelbare schoolproject 2010	17_profielwerkstuk middelbare school Arnhem 2010 NL.pdf	3.3
Future Cities – a concept on Arnhem – secondary schoolproject 2010	18_secondary school project Arnhem 2010 ENG.pdf	1.0

List of additional documents (continued)

Content	File name	File size MB
Future Cities – klimaatbestendig bouwen in de binnenstad van Nijmegen – middelbare schoolproject 2011	19_profielwerkstuk middelbare school Nijmegen 2011 NL.pdf	0.9
Microclimatic analysis of Arnhem – Rijnboog-gebied (University of Kassel, 2012)	20_micro climatic analysis Rijnboog area Arnhem 2012 ENG.pdf	4.5
Microklimaat Rijnboog Arnhem – visualisatie (Buro Poelmans Reesink 2013)	21_visualisatie microklimaat Rijnboog gebied Arnhem NL.pdf	5.0
Urban Heat Island Conference – Arnhem May 26th 2010 – minutes	22_minutes Urban Heat Island Conference Arnhem 2010 ENG.pdf	1.9
Kennis- en netwerkdag klimaatbestendige gemeente; Gelredome Arnhem 14 april 2011 – verslag	23_verslag Kennis- en netwerkdag klimaatbestendige gemeente Arnhem 2011 NL.pdf	0.7
Creating a design tool for the city of Arnhem: research report (Saxxion Hogeschool, Alterra 2010)	24_report creating a design tool for Arnhem 2010 ENG.pdf	1.6
Klimaatadaptatie in de stad – verslag proeftuin klimaat Den Haag Arnhem (Bosch Slabbers, 2010)	25_verslag proeftuin klimaatadaptatie in de steden Arnhem en Den Haag NL.pdf	19
Krant voor Future City Festival Arnhem oktober 2012	26_krant Future City Festival Arnhem oktober 2012 NL.pdf	9.5
Energiekaart en –strategie: op weg naar implementatie (KEMA, 2009)	27_energiekaart en –strategie Arnhem 2009 NL.pdf	5.3
Visie op de ondergrond van Arnhem (TTE, 2009)	28_rapport visie de ondergrond van Arnhem 2009 NI.pdf	20.9
Hastings Borough Council		
Climate change strategy HBC Eng	01_CCS HBC_Eng.pdf	0.4
SE England Regional Vulnerability Study	02_SEERVS_Eng.pdf	2.3
Eco-retrofit Training Manual	03_EcoRetrofit_Eng.pdf	8.6
Annexes to SE England Regional Vulnerability Study	04_SEERVS Annexes_Eng.pdf	0.1
UK Climate Change Risk Assessment	05_UKCCRA_Eng.pdf	1.4

List of additional documents (continued)

Content	File name	File size MB
Nijmegen		
Spatial Vision Water Nijmegen (Ruimtelijk Kader Water Nijmegen)	01_RuimtelijkKaderWater_Dutch.pdf	9.4
Local Climate Impact Profile Nijmegen	02_LCLIP Nijmegen_Dutch.pdf	3.8
Spatial Vision Underground (Ruimtelijk Kader Ondergrond Nijmegen)	03_RuimtelijkKaderOndergrond_Dutch.pdf	3.1
Masterplan Energieopslag Spoorzone.pdf	04_MasterplanEnergieopslagSpoorzone_Dutch.pdf	20.1
Photographs Korenmarkt	05-11_Korenmarkt 001-007.JPG	1
Photographs Green Roofs on the City Hall Nijmegen	12-15_Green roof city hall 001-004. JPG	0.5
Photographs Green Wall on a lift shaft in Nijmegen	16-18_Green wall 001, 003, 005.JPG	0.3
Design Reconstruction Korenmarkt from parking lot into a park	19_DesignKorenmarktNijmegen.pdf	0.3
Urban Climate Map Nijmegen (Hittekaart Nijmegen)	20_UrbanClimateMapNijmegen_Dutch.pdf	1.6
De Kracht van Groen en Water in de stad (benedenstad hofjes vegroenen)	21_KrachtGroenWater_Dutch.pdf	3.6
Tiel		
Tiel East drier and nicer	01_Waterscenario Tiel East_English.pdf	1.7
City climate Tiel	02_City Climate Tiel_English.pdf	14.8
West-Vlaamse Intercommunale		
Leidraad duurzaam woonproject	01_Leidraad_NL.pdf	2.4
Waterstudie De Vloei Inventaris	02_Waterstudie_Inv_NL.pdf	33.2
Waterstudie De Vloei duurzaam watersysteem	03_Waterstudie_Sys_NL.pdf	6.4
Waterstudie De Vloei Addendum	04_Waterstudie_Add_NL.pdf	0.1
Energiestudie De Vloei fase 1 & 2	05_Energiestudie_fase1&2_NL.pdf	2.0
Energiestudie De Vloei fase 3	06_Energiestudie_fase3_NL.pdf	2.3
Masterplan De Vloei	07_Masterplan_NL.pdf	4.9

Authors and References

Part A About the Future Cities project

Authors: Marie-Edith Ploteau, Lippeverband;
Birgit Haupter, Infrastruktur & Umwelt

Part B Transnational tools for Future Cities

Authors: Marie-Edith Ploteau, Lippeverband;
Birgit Haupter, Stefanie Greis, Infrastruktur & Umwelt

Part C The Future Cities project guide

C.1 Creating a green-blue corridor in Kamen

Marie-Edith Ploteau, Lippeverband

C.2 Arnhem is getting prepared for climate change

Hans van Ammers, Municipality of Arnhem

C.3 Clean solutions for Bottrop

Matthias Weilandt, Emschergenossenschaft

C.4 Environment and economy go together in Hastings

Chantal Lass, Hastings Borough Council

C.5 A wide range of opportunities in Nijmegen

Ton Verhoeven, Municipality of Nijmegen

C.6 Focus on sustainability in Rouen

Jessie Joseph, Rouen Seine Aménagement

C.7 Coping with water in the city – the integral approach of Tiel East

Annemieke Spit, Municipality of Tiel

C.8 Sustainability from the start for "De Vloei"

Eveline Huyghe, West-Vlaamse Intercommunale

Part D The way forward

Marie-Edith Ploteau, Anke Althoff, Lippeverband
Matthias Weilandt, Emschergenossenschaft
Hans van Ammers, Municipality of Arnhem
Chantal Lass, Hastings Borough Council
Ton Verhoeven, Municipality of Nijmegen
Jessie Joseph, Rouen Seine Aménagement
Annemieke Spit, Municipality of Tiel
Eveline Huyghe, West-Vlaamse Intercommunale

Pictures

(Page: Source)

Title: B. Mazzer, Hastings Borough Council

4: Emscher-genossenschaft/Lippeverband

5: top to bottom: R. Felden; Emscher-genossenschaft; Zuurman, Nijmegen; B. Haupter, Infrastruktur & Umwelt

7: top to bottom: The Future Cities partnership; S. Saelens, West-Vlaamse Intercommunale; A. Zuurman, Nijmegen; J. v. d. Lindt, Nijmegen

8: Lippeverband

9: top to bottom: Arnhem; L. Perreau (Perspective), Devillers et Associés (Landscape Architects)

10: top to bottom: Lippeverband; E. Huyghe, West-Vlaamse Intercommunale; M.-E. Ploteau, Lippeverband

11: top to bottom: Stichting Duurzaam Rivierenland; Sea Space; Nijmegen

12: Lippeverband

14: The Future Cities partnership

15: left: B. Haupter, Infrastruktur & Umwelt; right: M.-E. Ploteau, Lippeverband

16: The Future Cities partnership

17: top to bottom: Emscher-genossenschaft; R. Felden, Emscher-genossenschaft; D. Wischniewski, Lippeverband; R. Felden, Emscher-genossenschaft; Emscher-genossenschaft

18: South East England Partnership Board

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26: Nijmegen

27: Nijmegen

28: left: H. v. Ammers, Arnhem; right: M.-E. Ploteau, Lippeverband

29: Emscher-genossenschaft

30: top to bottom: Lippeverband; Arnhem; Emscher-genossenschaft; Hastings Borough Council; Nijmegen; Rouen Seine Aménagement; J. Bouwhuis, Tiel; West-Vlaamse Intercommunale

31: top to bottom: A. Althoff, Lippeverband; M.-E. Ploteau, Lippeverband

32: 1) Fryczinski, Lippeverband; 2) A. Althoff, Lippeverband; 3) M.-E. Ploteau, Lippeverband; 4) M.-E. Ploteau, Lippeverband; 5) B. Grün, Lippeverband; bottom: M.-E. Ploteau, Lippeverband

34: top to bottom: A. Althoff, Lippeverband; A. Althoff, Lippeverband

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43: Emscher-genossenschaft

44: M. Stumpe, Bottrop

45: top to bottom: Emscher-genossenschaft, P. Stein, Emscher-genossenschaft

46: top to bottom: Hastings Borough Council; D. Lycett

47: top to bottom: B. Mazzer, Hastings Borough Council; Hastings Trust

48: Sea Space

49: left: D. Morrison, Hastings; right: Hastings Borough Council

50 – 56: Nijmegen

57 – 58: Rouen Seine Aménagement

59: L. Perreau (Perspective), Devillers et Associés (Landscape Architects)

60: S. Greis, Infrastruktur & Umwelt

61: J. Bouwhuis, Tiel

62: A. Spit, Tiel

63 top to bottom: De Urbanisten; H&S adviseurs

64: Tygdon, Delft

65: top to bottom: S. Lenzenholzer, Wageningen University; Lippeverband

66: West-Vlaamse Intercommunale

67: background picture: J. Maenhout

68: West-Vlaamse Intercommunale

69: top to bottom: J. Maenhout; S. Saelens, West-Vlaamse Intercommunale

70: J. Maenhout

71: West-Vlaamse Intercommunale

73: Lippeverband

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