

ROTTERDAM

THE ROTTERDAM CHALLENGE ON WATER AND CLIMATE ADAPTATION

CLIMATE PROOF



ROTTERDAM **CLIMATE**.INITIATIVE

2009 ADAPTATION PROGRAMME



RCI MISSION STATEMENT

RCI Mission Statement: To reduce CO₂ emissions by 50% and prepare Rotterdam for the consequences of climate change. This is the challenge and mission of the collective initiators, Port of Rotterdam, City of Rotterdam, DCMR Environmental Protection Agency Rijnmond, and Deltalinqs. The Rotterdam Climate Initiative offers a platform for companies, knowledge institutes, citizens, national government and local government bodies and other organizations to work together on a future-proof, attractive, and safe city and port.

ROTTERDAM CLIMATE INITIATIVE (RCI) Our climate is changing. In order to limit climate change, national and international climate agreements have been reached with a specific focus on the reduction of greenhouse gas emissions. For this reason, the Rotterdam Climate Initiative (RCI) was set up in Rotterdam, an initiative of the City of Rotterdam, the Port of Rotterdam, DCMR Environmental Protection Agency Rijnmond, and Deltalinqs. The objective of the RCI is to reduce CO₂ emissions in Rotterdam by 50% in 2025, as compared with 1990. The aspiration for the future is to become the first climate neutral port city in the world. To this end, Rotterdam participates in the Clinton C40 Initiative and plays a leading role worldwide in making port cities climate neutral.

CLIMATE CHANGE: PREVENTION AND ADAPTATION

ROTTERDAM CLIMATE PROOF (RCP) All these efforts notwithstanding, the city and the port will at the same time have to arm themselves against the present and future consequences of climate change. The Delta Committee has clearly indicated that climate change may have a dramatic impact on safety in terms of flood protection. Apart from the risk of flooding, climate change can also lead to extended periods of aridity and high temperatures with a significant impact on society as a whole. In view of these risks, RCI is working on a new principal programme to build up the city's resilience to the impact of climate change: the Rotterdam Climate Proof (RCP) programme. This programme addresses issues such as: How should a port city like Rotterdam deal with climate change? Which opportunities may arise for Rotterdam from a proactive approach to climate change? Which plans and actions are to be expected for implementation?



In October 2007, the International Advisory Board (IAB) advised the City of Rotterdam as follows: 'Rotterdam should become a key player in **climate adaptation** and a **water knowledge city**.'

MOTIVE TO ADOPT A 2009 ADAPTATION PROGRAMME

RCP MISSION STATEMENT *The Rotterdam Climate Proof programme will ensure that Rotterdam will be climate proof by 2025. Permanent protection and accessibility of the city and the port are the key elements. The full focus of the programme is on creating additional opportunities to enhance the attractiveness of the city in terms of living, recreation, working and investments. Trendsetting research, innovative knowledge development and decisive implementation will result in strong economic impulses. Together with prominent partners, Rotterdam will become one of the world's leading innovative water knowledge cities and an inspiring example for other delta cities. Rotterdam Climate Proof participates in the Rotterdam Climate Initiative.*

Adaptation to the consequences of climatic developments is essential for Rotterdam and proper and ambitious water management offers economic opportunities. The City of Rotterdam received the IAB water recommendation with great enthusiasm. On 5 February 2008, the IAB recommendation was adopted in its entirety and the City of Rotterdam commissioned the elaboration of this recommendation into a programme which was the basis for the RCP programme. In May 2008, the instruction was further specified by the request for a specific work plan which led to the present 2009 adaptation programme. Together with the RCP brochure issued in May 2008 (in support of the administrative decision) this programme provides an overall view of the content, corresponding objectives, working method and the products for 2009. In addition, it gives an insight in projects that have already been started and a selective preview of those planned for 2010.

The adaptation programme specifically states the objectives of the RCP in 2009 and the products derived from it. The RCP is an active programme, designed to promote and link initiatives in the area of climate adaptation. This adaptation programme is, therefore, also

an explicit invitation to link initiatives which have not yet been included, to the RCP. In this way, the aspiration to make Rotterdam leader in the area of climate (with regard to implementation in its own city, as well as developing an international export product) can actually be achieved. An updated programme of activities is issued annually.

ROTTERDAM CLIMATE PROOF Rotterdam is one of the safest port cities in the world. Maintaining this position requires considerable effort. At the same time, these efforts should be converted into opportunities. Flood protection in Rotterdam, for example, is realized in close connection with strengthening of the Rotterdam economy and making the city an attractive location for citizens, businesses and knowledge institutes.

The main objective of the RCP programme is to ensure that Rotterdam will be fully climate proof by 2025. This is quite a challenge, as we intend to realize this ambition while at the same time adding maximum social and economic value. This added value is based on the following complementary basic principles:

1. Rotterdam will develop into and present itself on a national and global scale as one of the world's leading water knowledge and climate cities.
2. Innovations and knowledge will be developed, applied, exchanged and marketed as export products.
3. The investments will make the city and the port more attractive for citizens, businesses and knowledge institutes.

MAIN OBJECTIVE: ROTTERDAM CLIMATE PROOF The first priority with regard to making Rotterdam climate proof is sustainable protection against flooding of the city and port, both on the landside and outside the levees. Apart from physical safety, the perception of safety of citizens and companies should be addressed as well. For the sake of economic development it is of vital importance for investors to perceive our city and world port to be permanently safe, accessible and attractive. If the safety of the region is questioned, the investment climate will suffer. At this point, it is still relatively easy to boost the perception of safety. PR is of crucial importance in this respect.

RCP ADAPTATION STRATEGY
It is important, even at this point in time, to reserve the space that will be required in the future for water storage, and to prepare projects that in due course will be necessary to enhance protection against flooding and guarantee accessibility. In addition, we need to adjust our design and construction concepts both at the level of urban planning and with respect to individual buildings. This will generate innovations that can also be marketed elsewhere in a later phase. The climatic developments we will have to face in the future need to be taken into account in the present urban and port development plans.

In addition to flood protection, it is necessary to prepare the city and port for a whole range of other aspects of climate change. In order to be future-proof, we must, for example, prepare for new and varying inland water transport modes, periods of extreme precipitation or aridity, more heat waves, groundwater salinization and more extreme water level fluctuations. The key concept in climate resilience is an adaptive strategy, in which Rotterdam adapts itself proactively and flexibly to changing circumstances. With the implementation of this climate adaptation strategy, Rotterdam is prepared for the future!

In order to be able to implement this proactive strategy, we need knowledge and tools, such as a Rotterdam climate atlas and an assessment framework with indicators for climate resilience. Ultimately, climate resilience must already be included in the initial phases of the development of all spatial plans, policy-making, execution and management. We can depart from the definition of

climate resilience in the sense that the outcome depends on resistance, resilience and the ability to adapt. Within the RCP, a normative collection of indicators for climate resilience will be developed for Rotterdam: the Rotterdam Climate Proof Barometer, which can be applied in delta cities worldwide.

Equally important is that the above is implemented in the next few years in such a way that Rotterdam will become more attractive and will demonstrably become a key player in the area of water management and climate adaptation. The knowledge developed and experience gained will become export products due to the positioning of Rotterdam as a leading party in the area of delta technology. With this integral and innovative form of climate adaptation, Rotterdam is unique in the world.

WORLD PORT ECONOMY Like Rotterdam, many other delta cities will have to face the consequences of climate change. In the next few decades, delta cities all over the world will invest in measures to increase the quality of life in these cities and particularly to protect these ports as driving forces of the economy and keep them accessible. The Rotterdam region harbours an exceptional combination of knowledge institutes, delta technology companies and architectural firms which can provide new solutions. The RCP programme pools this knowledge and innovation power to reinforce the climate for establishing businesses and port activities. In this manner, the Rotterdam region is developing into a global testing ground for delta technology, an international knowledge centre for water and climate issues, and a location of choice for companies in the field of climate-specific international services (specialized consultancy and engineering firms, internationally active research agencies and knowledge institutes) and industry (climate-related high-tech industry). With this testing ground, RCP is also pursuing commercial tourism opportunities in, by and on the water. The important role that is reserved for the city in resolving the global climate issues, is a new cornerstone of the Rotterdam economy.

ATTRACTIVE WORLD CITY Which opportunities do we have to make the city even more attractive for residential, working, studying and entertainment purposes? How can we prevent the city from becoming unattractive due to risks of flooding, aridity or heat stress? And how can we ensure that the measures are not only aimed at solving these problems, but also give an extra boost to the quality of life in the city? The creation of new canals for water storage is a good example. In an urban environment such as Rotterdam, these types of interventions and other traditional solutions such as



Dutch Delta Committee: an open yet lockable Rijnmond

DELTA COMMITTEE The Dutch Delta Committee report shows that climate resilience is not easy to define, nor to implement. The proposals of the Delta Committee tighten up the current standards and reduce the risk of incidents. And this merely concerns the risk of flooding. A solid and innovative concept has been devised for the Rotterdam region, entitled 'an open yet lockable Rijnmond'. Within the RCP, this recommendation from Delta Committee will be technically elaborated and tested for feasibility. This will be realized in collaboration with the Water Plan partners as part of the Knowledge for Climate Research programme.

levee strengthening are not sufficient. For the further development of the city it is, therefore, essential to include innovations such as green roofs, water plazas, underground water storage and cooling in urban design commissions. These innovations can enhance the quality of the living environment.

Water disarms and binds people. In adaptation projects in the city, citizens and different cultures come together. This can reinforce social ties and the sense of safety. The construction of green roofs, for example, can be set up as a neighbourhood project. Climate adaptation also generates new leisure opportunities such as floating parks. Water offers beautiful and safe possibilities for varied living environments, such as waterfronts and floating structures. In short, climate adaptation reinforces the physical, economic and social pillars of the city.



Design Bloemhofplein, depicting different weather situations. Water plazas are an innovative way to deal with heavy rainfall.



STADSHAVENS (CITY PORTS) AS A TESTING GROUND *The Stadshavens area is cherished as an area of special focus within the RCP. Particularly in this transformation area, which is entirely situated outside the levees and consists of many harbour basins with large areas of water, climate resilience and sustainability are essential preconditions. The area offers ample space for experiments with all sorts of forms of climate adaptation, as well as opportunities for companies engaged in climate-related activities. For this reason, Stadshavens is currently setting up the Rotterdam Climate Campus, a joint initiative of RCI, Stadshavens and RCP. This initiative explicitly seeks to forge strategic alliances in order to pool all climate-related knowledge. In addition to the large infrastructural and development projects in the city, Rotterdam aims to showcase itself with this physical testing ground, the largest development location in the Randstad conurbation. This is also emphasized by the intention to realize a floating pavilion in this area, a floating icon that will serve as an example of adaptive building. In this floating pavilion, the city can show the new developments in the area of spatial planning, urban architecture, water and climate management.*

Rotterdam Climate Proof is based on the following three theme-transcending and mutually reinforcing pillars: **Knowledge, Actions and Marketing Communication.**

RCP WORKING PROCEDURE

Rotterdam Climate Proof has high ambitions. Their realization requires decisiveness, knowledge development, experiments and new alliances. Rotterdam Climate Proof expresses the City of Rotterdam's intention to generate and pool knowledge, arrive at new solutions, actually implement these solutions in Rotterdam and share them on a global scale.

KNOWLEDGE: ROTTERDAM KNOWLEDGE CITY FOR CLIMATE AND WATER The Rotterdam region concentrates and stimulates knowledge development in the area of delta technology and, moreover, actually realizes new concepts. This provides opportunities for the economy and enhances the quality and appeal of the city and the port. The programme ties in with the wish to attract innovative and creative companies and students to the city. Innovation, knowledge development, research, cooperation with various institutes in the region and the pooling of know-how are of great importance for the realization of climate resilience and flood protection in Rotterdam and for a protected and accessible world port. The integrity of this knowledge is effectively secured in urban development procedures.

ACTIONS: ROTTERDAM AS A TESTING GROUND Investing in flood protection and a climate proof city contributes towards a safe, healthy and attractive living environment. The necessity to continue to guarantee physical safety is beyond dispute. This RCP pillar is geared towards implementation: developing extra surface water areas where possible and applying innovative solutions where necessary. Additional investments concern the implementation of the adaptation strategy for flood-proof building. Innovative and climate-change-adjusted building forms are being developed for the improvement of the city climate. 'Stadshavens' (city ports) could develop into the centre of the Rotterdam showcase for 'urban delta technology'.

MARKETING COMMUNICATION: ROTTERDAM AS AN EXAMPLE FOR DELTA CITIES ACROSS THE WORLD Rotterdam will present itself to the outside world as a delta city and world port with the ability to deal with future climate change in a very natural, safe, and innovative manner. This must be imprinted on the minds of the residents and companies in the Rotterdam region. Also on an international level, Rotterdam projects the image of being a protected city, where knowledge is pooled and where it all happens. Rotterdam is marketed as an example for flood protection and climate adaptation in a structural and professional manner.

The relationship is clear: knowledge development and sharing are necessary for the implementation of innovative measures and the realization of a safe, robust city with sufficient resistance and resilience. 'Taking action' yields significant results and generates practical experience, creating a breeding ground for new, practice-based knowledge questions. This enables Rotterdam to develop into a leading knowledge city and testing ground for climate issues and delta technology. Marketing the theme of climate adaptation will contribute to Rotterdam's visible and identifiable image as an example and water knowledge city. This will increase its appeal on knowledge institutes, companies, citizens and visitors.

ROTTERDAM KNOWLEDGE CITY FOR CLIMATE AND WATER

- Gain insight into the problem
- Develop innovative solutions
- Secure in working procedures



- ROTTERDAM AS A TESTING GROUND**
- Rotterdam becomes climate proof
 - Learning by doing
 - Showcase for marketing communication

ROTTERDAM AS AN EXAMPLE FOR DELTA CITIES AROUND THE WORLD

- Economic spin-off
- Develop export products
- Attract knowledge and experiments

FIVE MAIN THEMES Within the programme, the activities for 2009 are clustered in five themes: Flood Management, Accessibility, Adaptive Building, Urban Water System and City Climate.

Each theme carries an objective and a coherent set of products, addressing knowledge development, implementation and marketing communication. Depending upon state-of-the-art developments, the balance between these three may vary. Coherence between the three pillars (actions, knowledge and marketing communication) is managed at programme level. All three pillars must be given sufficient attention. Within the pillars, theme-transcending activities will also be carried out. Marketing, for example, as part of the marketing communication pillar, with the World Expo in Shanghai as a provisional highlight, will mainly take place at programme level. The objectives and products per theme and the theme-transcending portfolios are described in the following sections.

ROTTERDAM CLIMATE PROOF COMMUNICATION RCP communication is expressed across a wide variety of media. Depending on the target group, objective and momentum, the emphasis is on information or promotion. The key message is expressed in all publicity. Implementation at programme, theme and project level ensures a strong basis and recognition. The stated aspirations, themes and pillars create a favourable spectrum to elucidate various aspects of RCP and enrich it. The communication effort is aimed at a mixture of basic media (digital media, gadgets, exhibition materials, publications, etc.) and specific media. This will be detailed in the 2009 Communication Plan.



The Rotterdam Water City project is proclaimed Urban Best Practice at the World Expo Shanghai.



Rotterdam Climate Proof is the city's vehicle to generate and pool knowledge, devise new solutions, actually implement these solutions in Rotterdam, and share them with cities around the world.

THEMES AND PRODUCTS

1. FLOOD MANAGEMENT

PRODUCTS

2009
Detailed flood models and maps of the area outside the levees in the Rotterdam region, taking climate change into account.
Rotterdam Delta Plan phase 1: report regarding first detailing of the recommendation 'an open yet lockable Rijnmond' of the Delta Committee, including its translation into opportunities for the Rotterdam region.
Landside safety: report on research results (risk assessment concerning landside flooding, vulnerability review, consequences, suggested solutions) and follow-up questions.
Rotterdam climate levees: report on results of the feasibility survey concerning integration of primary levees. Analysis of current situation, typological research, study of alternatives on the basis of a number of example locations, feasibility study and pilot study.
Perception: report on survey of residents' perception of flood protection.
2010
Urban Flood Management 2: report regarding elaboration of follow-up phase of Urban Flood Management strategy jointly with water partners, city of Dordrecht and private parties.
Report regarding possibilities of evacuation and integration into emergency plans, including communication in this respect with residents.
Pilot innovative levee
2011
Emergency plans updated, residents informed.
Rotterdam Delta Plan adopted and in progress.
2015
All water defences up to sufficient strength in accordance with applicable standards.
Pilot executed - Urban Flood Management in Stadshavens area.

WHY IS THIS A THEME? The Rotterdam region is pre-eminently a delta area. Any breach in primary or secondary water defences would have dramatic consequences for the hinterland and the areas downstream. At present, the Rotterdam region is protected. But in order to guarantee safety in a changing climate, proactive action is required. Failure to tackle this could result in an increased risk of flooding due to storms, rising sea levels, estuarial flow changes, increased precipitation or even aridity. It is precisely for this reason that the recommendation of the Delta Committee with regard to a new Delta Plan has caused such a stir.

Up until now, substantial demands for space for water defences often met with a lot of resistance. Surprisingly so, since a creative response to climate change could offer great opportunities for innovation and enhancement of spatial quality. Water defences, for example, provided that they are properly blended in with the urban fabric, could enrich the surroundings and provide new residential, professional and recreational opportunities. It is of pivotal importance for the Rotterdam region not only to offer physical protection, but also to instil the perception of safety in citizens and companies. This positive perception is the basis for the confidence required for people to live and invest in Rotterdam.

OBJECTIVE What effects does climate change have on safety, both on the landside and outside the levees? Which strategy (set of measures) deserves preference in maintaining an acceptable level of flood protection (delta projects, management of spatial planning, disaster control)? Our goal is to gain insight into the effects and determine the strategy. Measures that allow us to cash in on economic and spatial opportunities deserve preference. A good example are innovative primary levees in an urban context. Publicity will be used extensively to promote a positive perception of safety among citizens and companies. The activities in the Rotterdam region should receive explicit attention from the press and the public.

By 2011, the views of the Delta Committee will have been implemented in the visions of the City of Rotterdam. Translated into practical terms, these views have been laid down in the Rotterdam Delta Plan, which has been adopted and is currently being implemented. By 2025, the Rotterdam Delta Plan will have been completed. All water defences, for instance, will have been adequately fortified, in accordance with the views of the Delta Committee. As a result, the city and port will remain protected even in the (distant) future.

PRODUCTS

2. ACCESSIBILITY

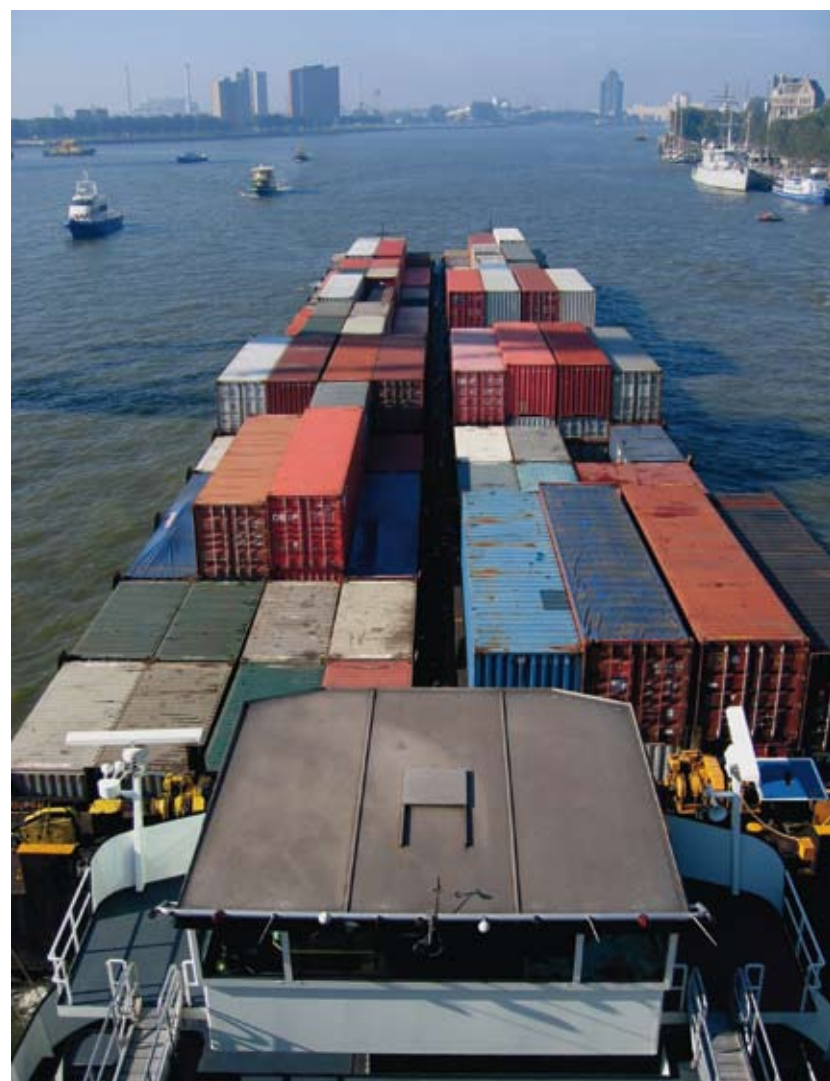
2009
Report regarding study into the effects of climate change on water transport, also in relation to other sectors.
Report regarding results of an analysis of the administrative views on sustainable mobility and climate dependence.
Results of study concerning water terminal (ambition, location, feasibility).
2010
Report regarding investigation into the climate elasticity of the demand for mobility and the mobility infrastructure.
Plan for modes of transport to be developed, mobility issues or additional measures. How is transport over water reinforced, how should adaptation measures be worked out in greater detail, and which follow-up research is required?
2012
Providing guarantees in response to climate effects for accessibility in visions, plans and implementation projects in the working and planning procedures.

WHY IS THIS A THEME? Accessibility (access to the city and port from the surrounding area and vice versa) is an important aspect of the climate for establishing a business. Goods and passenger transport are both important in this respect. For its hinterland transport, the Rotterdam port relies heavily on inland shipping. What is the impact on navigability of stronger fluctuations in river levels? How can the share of inland shipping be maintained or increased? How can passenger transport over water in the region be further reinforced?

Climate change affects mobility and accessibility. If the weather is nice more often and the summer recreation season draws out, recreational traffic will increase over longer periods of time. Heavier downpours will limit accessibility, while an increase in the number of hot and dry days will lead to more cycling and walking traffic.

It is important to know to what extent the current transport infrastructure of the city and port is climate proof. Research is required into the climate elasticity of the infrastructure and the impact of climate change on the demand for mobility. The next question is which steps still need to be taken. Sustainable accessibility can only be achieved with sustainable mobility.

OBJECTIVE Accessibility of the city and the port must be safeguarded. If water plays a more significant role in spatial planning and more housing accommodation is realized on the water, by consequence, transport over water should equally be stepped up. By 2025, the transport infrastructure of the city and port will be climate proof and an intensive public transport network over water will contribute significantly to the accessibility of the city.



PRODUCTS

3. ADAPTIVE BUILDING

2009
Report regarding typologies of adaptive building methods: about applicable adaptive building methods in the area outside the levees (in relation to both buildings and defences).
Rotterdam Climate proof Barometer: delivery of the initial version of this climate proof barometer.
Stadshavens test of climate resilience: using the first version of the climate proof barometer.
Quicksan of area outside the levees: result of the scan concerning climate resilience of the existing area outside the levees (including the port area) using the improved Climate Proof Barometer.
Adaptive building atlas: using a set of technical, financial, organizational, legal and urban development parameters that allow testing of the various forms of adaptive building for usefulness and applicability.
Transition scenarios for floating districts: report on the opportunities and transition scenarios of floating districts in Stadshavens Rotterdam, including 3D presentations.
Schedule of requirements and business case for floating architecture icon project for the realization of a floating pavilion in the Rijnhaven.
2010
Construction of floating working platforms in the Heijsehaven.
Typological review of adaptive building types: final overview for the Rotterdam region.
Climate guide: tool which shows the basis upon which choices can be made and under which conditions adaptive building offers advantages.
Realization of floating architecture icon project: construction of the floating pavilion in the Rijnhaven.

WHY IS THIS A THEME? The development of areas outside the levees is of great importance to Rotterdam. How this is done also depends on the impact of climate change. Adaptive building is necessary in order to be able to realize safe and attractive housing and office accommodation outside the levees. This concerns safety (theme 2), but certainly also opportunities for the economy, and quality of life.

One of the objectives of the Rotterdam City Vision (2007) is to realize densely populated residential environments in the port areas in and around the city centre (Stadshavens). The recently formulated national objective to reinforce the urban environment and to build less in the green areas around the towns and cities is in keeping with this trend. Building in these areas outside the levees requires a proactive response to the effects of climate change. In the Rotterdam region, a great deal of knowledge is available with regard to climate proof building and flood protection. This knowledge can be further developed, applied and marketed worldwide. New developments and experiments with adaptive building (such as floating cities) enable Rotterdam to enhance the city's attractiveness as a business and residential location.

OBJECTIVE How will climate change impact the areas to be developed? Which forms of adaptive building are possible? Which strategies will contribute towards the realization of the opportunities of adaptive building, both for existing and new buildings? Insight into these questions is the first thing we need.

The first step in this process will be the testing of Stadshavens against the ROTTERDAM CLIMATE PROOF BAROMETER in 2009. This barometer, which is yet to be developed, will be designed to enable us to describe the climate resilience of parts of Rotterdam, or of the city as a whole. At the same time, applicable adaptive construction methods will be developed, which will be implemented in pilots. This will form the input for yet another tool to be developed: the CLIMATE GUIDE. The climate guide will offer support in deciding which adjustments or measures can best be made/taken in respect of spatial developments. The experiences will be translated into preconditions on the basis of which planning procedures and schedules of requirements for new developments will be compiled. By 2025, the existing area outside the levees (including the waterfront and port area) will be adequately protected, and construction will be limited to adaptive building only. In addition, a section of the Stadshavens area will consist of floating districts.



PRODUCTS

4. URBAN WATER SYSTEM

2009
Result of research into effects of climate change on current water systems (quantity and quality, including sources for drinking water) and the sensitivity of the city and the region to these effects. The findings of the Delta Committee with regard to drought and fresh water will have been included in this.
Initial results of research into strategies for water storage, possible solutions and a social cost-benefit analysis.
Monitoring techniques and methods: monitoring networks for groundwater, surface water, sewers, precipitation.
Green roofs: by 2009, 50,000 m ² of green roofs will be realized.
Water plazas: consultation and construction of first water plaza commenced, designs for other water plazas complete.
Dynamic Geographical Information System and 3D presentations for visualization of results, progress, scenarios for the future.
Blue waterway connection: decision regarding execution strategy from island of IJsselmonde to Zuiderpark.
2010
Replace 40 km of sewers per year and as a result contribute to a robust basic system.
10 pilots for green roofs realized , including monitoring programme.
Green roof policy implemented , including associated regulations.
First public water plaza realized , including monitoring and management programme.
The adaptation measures have been incorporated into the municipal (district) water plans.
2015
80% of the current water storage target will have been realized by the construction of additional open water, underground storage, water plazas and green roofs.
Blue connection: realizing a water passageway under the A15.

WHY IS THIS A THEME? Climate change can lead to increased precipitation, but also to longer periods of aridity. Even today it is clear that the old method to design sewers and pumping stations is no longer sufficient to keep 'our feet dry'. More insight is required in order to determine what is necessary and how measures can be taken in addition to the suggested solutions of the Rotterdam Water Plan 2 and the Municipal Sewer Plan (GRP). Furthermore, it is important to determine in which manner the strategies can best be implemented. The measures which are taken for water storage can also contribute visually towards an attractive city. It is important to increase awareness in this respect.

It is not only important to ensure that there is sufficient water (not too much and not too little) in the right place. Sufficient quality of the water should likewise be guaranteed. Together with the water boards and other parties, Rotterdam also addresses this aspect of the water system, taking Rotterdam Water Plan 2 as a guideline. The water temperature influences the cooling capacity and the ecological quality of surface water (habitat function).

Finally, climate change will also have an effect on the groundwater. Both the level and the quality of the groundwater will be affected, possibly with harmful effects on the buildings and greenery in the city. The urban water system theme, therefore, concerns the effects of climate change on both the quality and quantity of surface water, drinking water, groundwater, waste water and rainwater in the Rotterdam region.

OBJECTIVE Due to climate change, we can expect large quantities of rainfall in short periods of time. Prevention of peak discharge levels requires the retention of rainwater and the slowing down of rainwater discharge. Also in dry periods, Rotterdam should have sufficient water of sufficient quality. Flexible water level management in watercourses and ponds is used to realize additional seasonal storage. In addition, large diameter water connections to the regional water system will be constructed to increase the supply of fresh water.

Additional measures are required to meet the desired ecological and water quality standards and to ensure that Rotterdam will remain an attractive city with clean, clear water with healthy vegetation. By 2025, 800,000 m³ of water storage will have been realized by developing extra surface water areas, and the implementation of innovative solutions such as water plazas and green roofs. By 2015, 80% of these plans will have been completed. In 2025, the supply of fresh water will be guaranteed at all times in periods of drought due to the construction of additional water connections.

The water quality will comply with national and European standards and will contribute added value to the perception of the city. All functional purposes are maintained. By 2025, the water in Rotterdam will comply with the water quality standards defined in the Rotterdam Water Plan.



Water storage at the 'Museumpark' Parking. Under the slogan 'Developing extra surface water areas where possible and applying innovative solutions where necessary' the City of Rotterdam searches for new solutions to deal with excess precipitation.

PRODUCTS

5. CITY CLIMATE

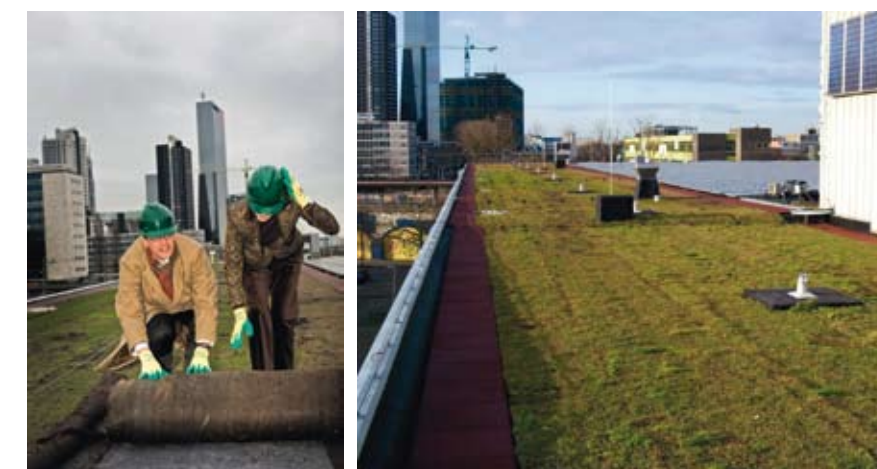
2009
Analysis of heat stress: an overview of urban districts stating at which level heat stress becomes a problem there, and a first scan of possible measures (including green roofs).
Climate change and air quality: report regarding the relationship between climate change and the effectiveness of air quality measures in Rotterdam.
Climate change and cooling: result of research into the relationship between climate change and the need for cooling in external spaces and in buildings.
Results of an indicative study into the effect of climate change on climate control in buildings (the need for cooling) and the (urban development) measures required for this.
Climate atlas: physical effects on the city climate in Rotterdam.
Climate change and greenery policy: study of problem and analysis of consequences for greenery policy and initiation of adaptation strategy.
2010
Climate atlas: picture of the social impact of climate change on the city climate in all aspects such as heat stress, health and greenery.
Plan of approach on which urban districts must be tackled with priority for which aspects of the city climate, how adaptation measures must be developed, what follow-up research is required and which measuring and monitoring programme must be set up for this purpose.
Basic principles of how management of greenery can be used effectively for the improvement of the physical (external) climate, paying attention to the habitat function of greenery.
2011
Zero measurement for the monitoring programme for the whole area for air, heat and water completed.
Pilot 'Pleasant climate' in an urbanized district with high densities, for example a section of the city centre.
2015
Climate proof urban greenery policy: the design and management of greenery in urban development designs is safeguarded in the working procedures and is executed accordingly.

WHY IS THIS A THEME? The physical climate in the city determines whether it is a pleasant place to be. It has a great influence on the attractiveness of the city, which ties in with a central objective for 2030 as expressed in the City Vision (realization of an attractive residential town and a strong economy). Whether the expected effects of climate change on the city and the region are favourable or unfavourable, in all cases responding to climate change can be a drive that at the same time enables us to achieve a better living environment. In the area of flood protection, this process has already been set in motion, while for other sectors this is only just starting (see, for example, the draft city centre plan 2008-2020).

The city climate is influenced by the layout and design of the city. Examples include heat stress as a result of ever more frequently occurring heat waves, the extra impact of particulate matter on health in times of drought and other plagues. The demand for recreational areas, shade and cool areas in outdoor spaces increases during hotter summers. Green areas should be climate proof. These themes will become ever more important as building density increases.

OBJECTIVE The objective is to make the living environment more attractive by means of adapting the layout of the external space and the design of the urban area to climate change. The physical living environment is positively influenced by good design, layout and management of the public space and by optimum design of the elements water, greenery, roads and buildings.

As from 2015, a climate proof city climate will be included as a standard consideration in the (re)organization, restructuring and management of the city. Attention will be paid to the distribution of green/blue areas, heat stress resistance, presence of sheltered and cool places in the open space, etc. By 2025, the physical living environment will be acceptable everywhere in the city throughout the year.



Alderman Lucas Bolsius opens the implementation of the programme 'green roofs'. By 2009 some 50.000 m² will be realized.



The launch of Rotterdam Climate Campus with Minister Cramer, alderman Harbers and the ambassador of City Ports (Stadhavens) Burgmans.

KNOWLEDGE FOR CLIMATE RESEARCH *Within the Dutch national research programme Knowledge for Climate Research (KvK), the Rotterdam region has been appointed as one of the key hot spots. For the period between 2009 and 2013, an amount of over 10 million euros has been made available for research into water management and climate adaptation. These studies are being carried out by renowned local and national knowledge institutes, as well as by professional consultancy agencies.*

Knowledge for Climate Research does not limit itself, as financing has also been arranged for international research. An example of this is the cooperation between the City of Rotterdam and Jakarta on dredging and knowledge exchange concerning overall water management. Another example is the workshop on climate adaptation developed by Rotterdam together with New York. All these activities will contribute to the Connecting Delta Cities Network.

Rotterdam Climate Proof is based on the following three theme-transcending and mutually reinforcing pillars: **Knowledge, Actions** and **Marketing Communication.**

THEME-TRANSCENDING PROJECTS

WHY THEME-TRANSCENDING PROJECTS? A number of projects transcend the themes and are managed at programme level. Marketing, for example, as part of the pillar of marketing communication, with the World Expo in Shanghai as a provisional highlight, will mainly take place at programme level. The securing of the knowledge developed in many places with regard to adaptation in all relevant working procedures, so that these are organized in accordance with the principles of climate resilience from the outset, is another example. The theme-transcending projects are described below per pillar.

KNOWLEDGE

CLIMATE ATLAS For all themes it is necessary to deduce region-specific climate effects from the global climate models. The data are incorporated in the climate atlas for the Rotterdam region, which will be complete in 2010. This tool guarantees that all themes are based on the same input and that the knowledge results of various projects are shared across the whole programme. The climate atlas answers the question as to which effects are important to a project and what is the extent of their impact. Apart from merely primary (higher incidence of heat waves) or secondary (warming up of urban areas) physical effects, this also concerns the consequential effects on society (such as decreased labour productivity).

ROTTERDAM CLIMATE PROOF BAROMETER AND CLIMATE GUIDE The knowledge developed with regard to the tasks and possible solutions to the effects of climate change must be integrated in the regular working and planning procedures. The aim is to ensure that by 2012, future climate developments are anticipated in all spatial plans, implementation projects and management activities (so that they are 'climate-inclusive') and their implementation is carried out accordingly.

Two tools are available to promote this effect. The first is a standard for climate resilience: the ROTTERDAM CLIMATE PROOF BAROMETER (initial version to be completed by 2009). On the basis of this barometer and underlying indicators, scores can be awarded to specific plans or to the whole city. This barometer helps to assess Rotterdam's performance relative to the ideal situation and in comparison with other cities. In due course, the barometer may be raised to a standard. The second tool, the CLIMATE GUIDE (to be completed by 2010), indicates possible solution strategies and their performance in terms of relevant criteria such as robustness, flexibility and financial and social feasibility. This provides substantiation to the decision as to which adjustments or measures constitute the best possible course of action. In 2009, an initial version of the climate guide will be delivered in order to conduct a pilot analysis of Stadhavens with regard to climate resilience.

ROTTERDAM CLIMATE CAMPUS Starting from 2009, a high-tech science and business community will be set up in Stadhavens in an open environment of cooperation and knowledge exchange. A cluster of knowledge institutes and (innovative) companies in the area of energy transition, climate change mitigation, water management and climate adaptation in the Rotterdam Climate Campus expresses the joint ambition to position Rotterdam as an (international) testing ground for sustainable and climate proof delta development. The campus offers mental *and* physical space for innovative thought processes and is an international showcase for the concepts and (export) products developed. The Rotterdam Climate Campus initiative is supported and realized by a broad coalition of national and local government bodies, companies, knowledge institutes and NGOs. RCP participates in this development. By 2009, the business case will be completed and its implementation will have been started up.

ACTIONS



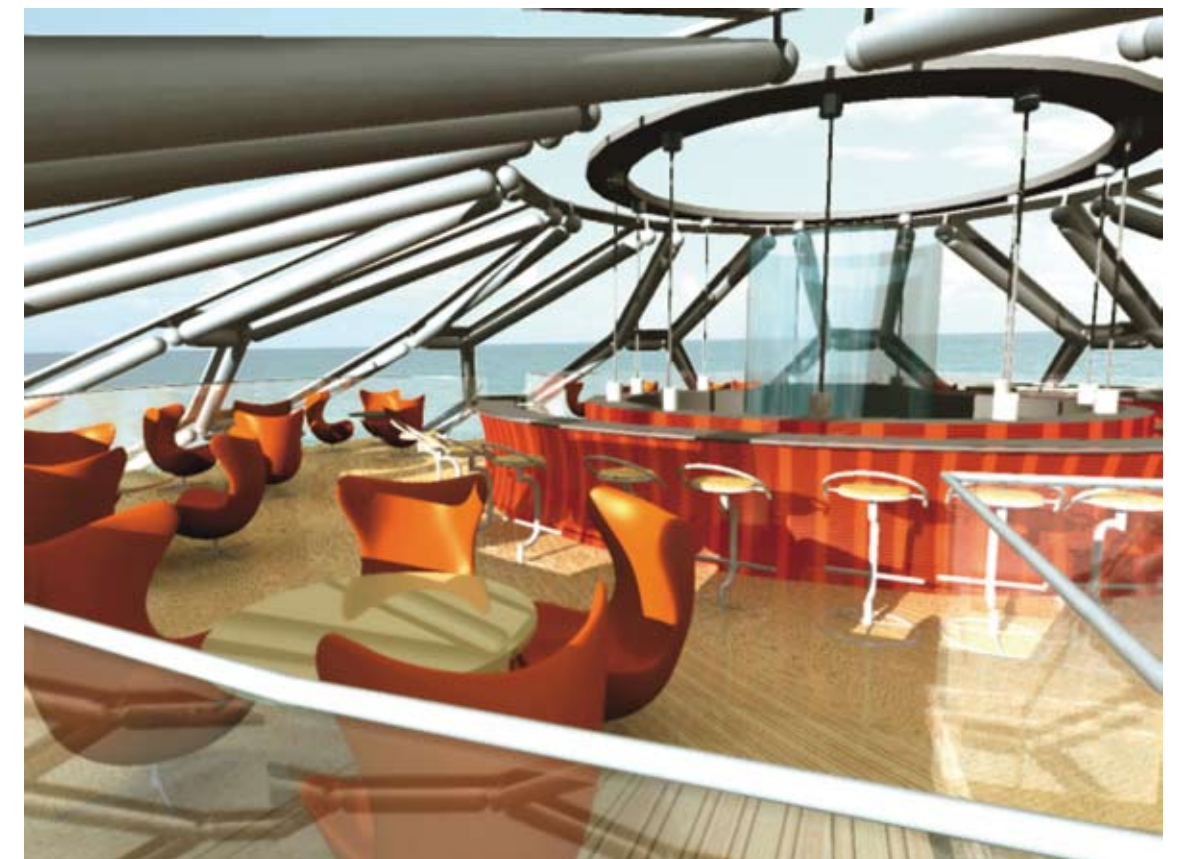
RCP ROUTE PLANNER At programme level, we will determine which intermediate steps will be required for optimum achievement of the envisaged goal (Rotterdam climate proof by 2025). A number of interim objectives can be added to the concrete actions already in progress in order to secure the achievement of the end goal. For each interim objective, we will state the activities that are necessary and how they relate to each other. This results in a route planner which provides a step-by-step route to the objective to be achieved. The RCP route planner will be ready in 2009.

REALIZATION OF ICON PROJECT: FLOATING PAVILION Floating constructions offer a solution to the space problem in low-lying delta areas and have a positive effect on the increasing vulnerability of these areas where flood protection is concerned. In addition, floating structures offer an opportunity for flexible urban development of international stature. In practice, floating constructions still appear to be difficult to realize, due in part to unclear regulations and unfamiliarity on the part of clients and developers. Rotterdam aims to resolve these issues by means of the quick realization of an icon project, the floating pavilion. Currently, we are investigating the possibilities of accommodating all of the information supply on Rotterdam in this single building, thus creating *the* showcase for the development of the city (the City Vision), area developments (Stadshavens) and water- and climate-related expertise (RCI/RCP/Rotterdam Climate Campus). This will provide the City of Rotterdam with an attractive space for public functions, possibly including the new location for the City Information Centre (CIC). The floating pavilion will also serve as a reception and conference facility for the increasing number of domestic and foreign delegations. For the time being, we are considering the Rijnhaven as a primary location, taking as a prime consideration that the building should have a number of distinctive features, including relocatability (due to the floating construction, the pavilion can be relocated relatively easily), exceptional quality, spatial compatibility and financial feasibility. The schedule of requirements and the business case for the floating pavilion will be completed in 2009. Subsequently, we will decide on where and how this icon project can be realized. The realization of the floating pavilion is expected to accelerate the construction of floating structures in general.



The 'blue connection' is a passageway between the area of IJsselmonde and the Zuiderpark that enables a connection over water as well as new ecological and economic opportunities.

Water and greenery Living near water





URBAN WATER MANAGEMENT *In 2005, a flood disaster hit New Orleans. Rotterdam and New Orleans share many features in common: the number of inhabitants, their location at the mouth of a big river near the sea, the threat the water presents, their low position in a delta, and subsidence. In October of 2008, a workshop was held in New Orleans on the subject of Urban Water Management. For four days, experts from New Orleans explored the options of a water plan for New Orleans together with water management experts and urban planners from Rotterdam.*

MARKETING COMMUNICATION

BRANDING: CONNECTING DELTA CITIES Rotterdam intends to play a prominent role at all times in the global water and climate forum. The city organizes and participates in trendsetting water and climate symposiums. Validating the confidence of investors and citizens in the safety of the region is of paramount importance in this respect. The development of such an (international) branding programme is a theme-transcending project.

If we want to become *the* water knowledge city, we will need to join and exchange knowledge from the region. It is essential to the branding strategy to apply focus, making targeted choices as to which parties and which themes are relevant. In view of the Rotterdam motto: 'World Port, World City', which expresses the importance of the port and the city and of Rotterdam's delta location, the primary focus is placed on climate adaptation in global delta cities. The key element in this respect is the cooperation with Shanghai, Jakarta, New Orleans, London, Hong Kong and New York. This has resulted in a programme entitled Connecting Delta Cities, led by Rotterdam. A number of specific activities in this programme are:

- 2009: Premiere of the film 'Connecting Delta Cities'
- 2009: World Water Forum 5 in Istanbul: Rotterdam chairs session 'Connecting Delta Cities'
- 2009: Hudson 400 in New York: Rotterdam active at Water Conference
- 2010: World Expo Shanghai: Rotterdam presents Urban Best Practice featuring Rotterdam Water City
- 2011: International Rotterdam Climate Adaptation Week
- 2012: National Water Initiative, with Rotterdam in leading group
- 2013: International Major Water and Climate Event Rotterdam ('World Climate & Adaptation Expo')

MARKETING Many knowledge institutes and companies that are active in the Rotterdam region have know-how and expertise in the area of water- and climate-related issues. Investments in the development of knowledge lead to new concepts and innovations in this field, the demand for which is expected to increase on a global scale, resulting in economic advantages both for the City of Rotterdam and regional public and private parties. Under which conditions the knowledge developed in this region can best be marketed and defined as an export product on a global scale, is part of a study that will be completed in 2009.





RCP MISSION STATEMENT

Rotterdam Climate Proof programme will ensure that Rotterdam will be climate proof by 2025. Permanent protection and accessibility of the city and the port are the key elements. The full focus of the programme is on creating additional opportunities to enhance the attractiveness of the city in terms of living, recreation, working and investments. Trendsetting research, innovative knowledge development and decisive implementation will result in strong economic impulses. Together with prominent partners, Rotterdam will become one of the world's leading innovative water knowledge cities and an inspiring example for other delta cities. Rotterdam Climate Proof participates in the Rotterdam Climate Initiative.

COLOPHON Rotterdam Climate Proof (RCP) is the Rotterdam programme for water management and climate adaptation. RCP participates in the Rotterdam Climate Initiative (RCI). Implementation of the programme is a joint activity of the following three departments of the City of Rotterdam: the Municipal Public Works Department, the Municipal Housing and Planning Department, and the Rotterdam Development Corporation. Coordination is the responsibility of the section Water Management of the Municipal Public Works Department. All parties involved report directly to the mayor and aldermen. The RCI board also monitors coherence, quality and progress.

PARTICIPATING PARTIES INCLUDE the Dutch Delta Water Board; the Higher Water Board of Schieland and the Krimpenerwaard; the Higher Water Board of Delfland; the South Holland Department of the Directorate-General for Public Works and Water Management; the Province of South Holland; the Ministry of Transport, Public Works and Water Management; the Ministry of Housing, Spatial Planning and the Environment; the Port of Rotterdam (HbR); the Economic Development Board Rotterdam (EDBR); Stadsregio Rotterdam (Rotterdam Metropolitan Region); the Municipality of Dordrecht; the Municipality of Delft; DCMR Environmental Protection Agency Rijnmond; Deltalinqs; Hogeschool Rotterdam (Rotterdam University); Delft University of Technology; Erasmus University Rotterdam (EUR); Deltares; Wageningen University and Research Centre (WuR); the Netherlands Water Partnership (NWP); the Co-operative Programme on Water and Climate (CPWC); Stichting Bouwresearch (SBR – Building Research Foundation) and Unesco-IHE.

The RCP 2009 adaptation programme was drawn up by Arnoud Molenaar, John Jacobs, Wim de Jager, Peter Pol, Wilco Verhagen and Nicolien Wirschell.

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DESIGN: Antenna-Men, Rotterdam / PRINT: Thieme MediaCenter Rotterdam / PHOTOGRAPHY: Cover: Paul Martens, Bloemhofplein: VHP/Florian Boer and Urban Affairs/Marco Vermeulen / TRANSLATION: Coline Lugassy



FEBRUARY 2009

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