

Water management & climate adaptation


Rotterdam, The Netherlands 



Connecting water with opportunities - Rotterdam's approach for climate change adaptation

In order to approach climate change as an opportunity rather than a threat, the City of Rotterdam launched the Climate Proof program in 2008. As a city, situated in a low-lying delta, with Europe's largest international port, Rotterdam has developed sustainable water management systems to fight climate change consequences - rising sea level, increases in cloud bursts, extremes in river water levels, longer periods of drought and higher temperatures. The Rotterdam Climate Proof program is based on three pillars: knowledge, action and communication, and aims to ensure that Rotterdam is "climate proof" by 2025. Implementation of new technologies and solutions in the framework of the program are enhancing the safety and the quality of life in the City, while offering considerable economic potential to the entire region. Innovative measures like green roofs or flood controlling water plazas are positioning Rotterdam as leading national and international water savvy and climate city [1].

Country/ City profile

	Country		City	
	Population (2014)	16.85 million [6]	Population (2014)	619,879 [9]
	Land area (km ²)	41,500 [7]	Land area (km ²)	325.79 [9]
	GDP per capita (2014, current international \$, at purchasing power parity)	47,662.5 [8]	GDP per capita / GDP per capita at purchasing power parity	n/a
Region	Western Europe	Region	Coastal	

City's physical geography	Location	<ul style="list-style-type: none"> ✓ situated about 40 km inland on the Nieuwe Maas river-one of the Rhine-Maas delta channels(flood risk, risk of sea level rising, risk of high precipitation) ✓ the largest harbour(and marine gateway) in Europe ✓ medium sized city with a strong industrial sector ✓ very low altitude, below the sea level (~-6m)
	Climate	<ul style="list-style-type: none"> ✓ Temperate oceanic climate(average temperature: 10.2 C°) ✓ 856 mm/year annual rainfall, with an average of 132 precipitation days

Initiating context

As an international port with a large CO₂ intensive industrial sector, which is expected to grow in the coming years, Rotterdam is aware of its responsibility to act on the climate change issues it is facing. Along with the fact that the sea level along the Dutch coast has already risen by approximately 20 cm over the past century, Rotterdam, which is situated about six meters below sea level, is aware of the concerns that come along with sea level rising. After some announcements of new power plant construction plans, Rotterdam organized a major energy related conference in 2006 during which the city's International Advisory Board (an unique advisory council comprised of international experts in academia and the private and public sectors), recommended that Rotterdam should become a pioneer in climate change mitigation and adaptation with the main focus on water. Following that advice in 2007 the City of Rotterdam established the Rotterdam Climate Initiative [5]. It was founded as a platform offering companies, governments, citizens, institutes and others to work together on reducing CO₂ emissions by 50% by 2025. The Rotterdam Climate Initiative addresses both the causes of climate change (mitigation) as well as climate change impacts (adaptation). As a part of the Rotterdam Climate Initiative, in 2008 the Rotterdam Climate Proof program was established in order to build up the city's resilience to the impact of climate change. In 2009, the first adaptation program was developed specifying measures that could be taken to make the city

“climate proof”. Since 2013, the Rotterdam Climate Change Adaptation Strategy is the main document setting clear direction and providing the framework for future implementation documents [2].

Project description

The concept of the Rotterdam Climate Proof program is to connect climate change related water issues with opportunities. The program is based on three pillars: knowledge, action and communication (exposure and spin-off). In the framework of the program, climate adaptation, spatial planning and design are deeply interwoven and some very innovative projects have been developed to fight effectively water related impacts of climate change (sea level rising, flooding, cloudbursts, drought periods, etc.). In parallel, these projects are improving the city's attractiveness and perhaps, even more importantly; they are offering an economic opportunity to the City. Implementing innovative techniques enables the scientific and corporate sector to get a powerful competitive advantage and to share its expertise worldwide. For this reason, Rotterdam has set up an international knowledge network called 'Connecting Delta Cities' and established partnerships with cities facing similar issues due to climate change impacts on water [1].

Flagship projects created under the Rotterdam Climate Proof program:

1. Rainwater harvesting-green roofs

Water storages in Rotterdam are integrated in urban environment wherever possible, but the City is also encouraging the installation of green roofs, which provide a valuable solution as temporary water storage during heavy rainfall. These roofs absorb precipitation, reduce the speed of rainwater runoff and delay the peak discharge. As a result, the pressure on the sewer system is reduced in times of heavy rainfall. Rotterdam promotes the installation of green roofs in several ways. While green roofs are mandatory for municipal buildings, for private buildings there is a subsidy scheme in place granting 30€ for every square meter of green roof installed [3].

2. Water plazas - water squares

Water plazas act as additional water storage in a densely build-up city and additionally serve as an inviting public space with playgrounds during dry but also rainy periods. During heavy rainfall these water plazas fill up with rainwater, limiting flooding on surrounding streets. The plazas are composed of several spaces set at different levels where people can sit, have a picnic or play with children. Plazas are framed with grass and trees, which border the square. Design ensures that the spaces flood in a gradual manner and collected rainwater flows into the water square and fills up different parts of the plaza. It is expected that a plaza is able to hold a maximum of 1,000 m³ of rainwater. The first water plaza, Bentemplein, was completed in 2013 [3].

3. Multifunctional car parks

Other water storage applications involve multifunctional car parks. The new car park near the Museumpark, for instance, will be equipped with an underground water storage facility intended to become the largest water storage facility in the Netherlands. Under the entrance to the Museumpark, underground water storage is being constructed for sewage, with an extra capacity of 10,000 m³ [3].

4. Floating pavilions

Designed as an eye-catching sphere floating on the water, the floating pavilion also has climate-proof, innovative, sustainable and flexible qualities. As the water level rises, the floating pavilion will automatically rise accordingly. The level of sustainability of the pavilion is determined by the materials used, its flexibility, as well as its fittings. For instance, the building's heating and air conditioning systems rely on solar energy and surface water while the energy is used only in places where it is required at any specific moment. The floating pavilion is a pilot project and serves as pioneering model for future floating communities in Rotterdam [1].

5. Climate Game

This game offers access to knowledge about climate, water, spatial planning and building. It puts players in the shoes of various stakeholders involved in redevelopment of deltas, river areas, polders and districts in response to climate change. Budgetary considerations and the possibility of applying for a grant are also part of the game. In

addition, measures can be weighed against one another. In this way players become aware of possible barriers and bottlenecks, which need to be overcome by “climate-proof” construction [1].

6. Climate societal cost benefit analysis (SCBA)

It is assessing the costs and benefits of investments in climate change adaptation from the society’s point of view. This also involves the comparison of two scenarios: one shows the situation in absence of the project and one shows the results in the case of the project being implemented. The difference between these two scenarios represents the effects, which the project would have on the society. This SCBA is special because it is taking a whole range of measures in consideration and not just the effects of one single project. By now, adaptation measures, which are incorporated in projects, show a positive SCBA outcome, not only if fully implemented but also even if they are in its initial stage [1].

Implementation process

The program has been implemented as 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. The Water Management section of the Municipal Public Works Department is responsible for project coordination. All parties involved report directly to the mayor and aldermen. The Rotterdam Climate Initiative board also monitors coherence, quality and progress. Depending on the project, many participative parties like different water boards, ministries, neighbouring municipalities, universities and others, get involved [2].

Results

The Rotterdam Climate Proof program has achieved the following results:

Knowledge [1,4]

- Rotterdam Adaptation Strategy (2013)
- Rotterdam Climate Societal Cost Benefit Analysis (SCBA)
- Rotterdam Climate game (2012)
- International design contest ‘Delta City of the Future’ in Rotterdam (2010)
- International conference ‘Deltas in Times of Climate Change I’ visited by more than 1,200 scientists, politicians, policy-makers and entrepreneurs (2010)
- Plenty of research projects under the national research program - Flood risk in non-embanked areas, closable-but-open Rhine estuary, heat stress in the City of Rotterdam, consequences of climate change for inland shipping, etc.
- Several publications and books - *Connecting Delta Cities, Climate Adaptation and Flood Risk in Coastal Cities, Research Summaries Rotterdam’s Climate Adaptation*, etc.

Implementation [1,4]

- Rotterdam has over 185,000 m² of green roofs (2014)
- Underground water storage at the Kruisplein car park with a size of 2,300 m³ and at the Museumpark car park with a size of 10,000 m³ (2013)
- Multifunctional water plaza Benthemplein (2013)
- Floating pavilion in Rotterdam Rijnhaven completed (2010)
- Start of Nassauhaven floating house developments (2014)
- Design and agreement for Blue Corridor, construction started
- Green wall (5,000 m²) at Westblaak car park (2010)

Exposure and spin-off [1,4]

- Connecting Delta Cities network set up within C40 - a network of world's megacities working dedicated to address climate change (2008)

- The Ecofys study shows that making Rotterdam climate proof will result in an investment of 4 to 5 billion euros (2010)
- Expansion of Connecting Delta Cities: New Orleans (2010), Ho Chi Minh City (2011), Melbourne (2011) and Copenhagen (2013)
- Cooperation with the City of Rotterdam has allowed Ho Chi Minh City to develop its own climate adaptation strategy (2013)
- Rotterdam selected as Peer City by the European Commission (2012) in the EU Cities Adapt project
- Delta City Rotterdam App (2013)
- More than a hundred international delegations have visited Rotterdam and over one hundred presentations have been held all over the world

Lessons learned

The key factor for success is the strong commitment to an ambitious goal to combat climate change and boost the economy. Knowing what makes the city unique, what are its advantages and opportunities, creating a distinctive profile and taking maximum of it - these are the points of this best-practice case. Pioneering research, innovative knowledge development and a dynamic and decisive implementation of the suggested measures has resulted in strong economic incentives. Having the support of industrial and political leaders and organized cooperation also greatly helps. For many years, Rotterdam has served as a pioneering and good practice example to other Delta cities.

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