

# Green-Roof programme

Copenhagen, Denmark 



Encouraging climate adaptation, aesthetics and biodiversity

In 2008 Copenhagen Municipality implemented a Green-Roof policy programme to tackle challenges such as impacts of climate change, increasing density and the need for healthier neighbourhoods. Green roofs are unique combinations of technical installations and ecosystems enabling cities to benefit from green areas without reducing development sites. Green roofs cool cities, enhance biodiversity and reduce rainwater runoff. They also beautify grey and anonymous places. By involving local communities in implementation, green roofs may become communication platforms for residents of all ages and origins. By 2010, Copenhagen Municipality has integrated the establishment of green roofs in most local plans, aiming to realize about 200,000 m<sup>2</sup> of green roofs in years to come. Green roofs are aimed to be realised at all scales of buildings; from cycle shelters, schools and mixed used buildings to underground garages.

## Country/ City Profile



Country	City	
Population (2015)	5.7 million [5]	Population (2015) (1.3 million in Greater Cph) [5]
Land area (km <sup>2</sup> )	42,924 [5]	Land area (km <sup>2</sup> ) 86.2 [5]
GDP per capita (2015, current international \$, at purchasing power parity)	46,635 [1]	GDP per capita (2014, US\$, at purchasing power parity) n/a
Region	Europe	Region Capital region of Denmark

## City's physical geography

Location	<ul style="list-style-type: none"> <li>✓ Flat terrain (low altitude)</li> <li>✓ 55°40'34''N, 12°34'6''E (snow and low temperatures during winter, large seasonal differences in the number of daylight hours)</li> <li>✓ Coastal (flood risk due to sea level rise, urban heat islands, storm surge risks - Baltic Sea)</li> <li>✓ Connected to Sweden by the Øresund Bridge (regional + international turntable)</li> </ul>
Climate [2]	<ul style="list-style-type: none"> <li>✓ Temperature: 8.0 C° (av.) 11.1 C° (day) 5.0 C° (night)</li> <li>✓ Rainfall: 613 mm/year</li> <li>✓ Sunshine: 1,539 h/year</li> </ul>

## Initiating context

The idea of integrating green roofs in urban planning came from an internal civil servant at a politically opportune moment. The upcoming UNFCCC COP9 in Copenhagen, the wish to brand Copenhagen as a green metropolis, first steps on the development of a strategy for climate adaptation and the political agenda to create a greener city led to an agreement by the board of directors and the mayors to go for a Green-Roof policy programme in Copenhagen. Strong leadership was key in bringing the idea to reality [7].

## Project description

Based on the Municipality Plan of 2011, local plans require the establishment of green roofs on new buildings with a roof slope below 30°. Exceptions are only possible if the establishment of a green roof would conflict with special aesthetic considerations [3]. Further, the requirement concerns new buildings only, not affecting retrofitting of existing buildings. The implementation of green roofs is not financially supported and developers and owners need

to bear implementation costs solely. However, there are no detailed requirements on the characteristics of green roofs. Developers and owners are allowed to decide freely on the size, the type of habitat developed and type of access to the roof.

## Implementation process

The process towards a Green-Roof policy programme in the Municipality of Copenhagen started with the development of the Waste Water Plan 2008 [1]. This was the first time the Municipality considered alternative ways for rainwater handling, establishing the framework for local rainwater management.

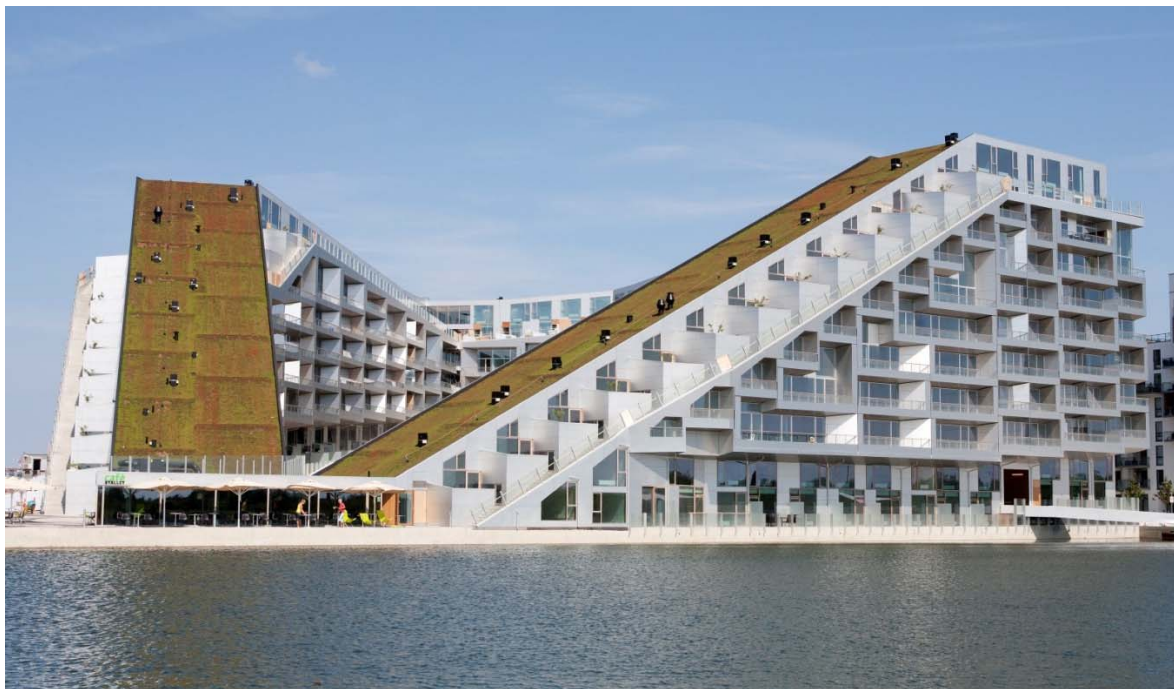
In 2009, the Climate Plan [2] integrated the establishment of green roofs as one of the adaptation measures intended to encounter increased rainfall and rising temperatures. This is considered as a milestone for the process towards a Green-Roof policy programme in Copenhagen. In May 2010 the City Representation decided that green roofs are obligatory for all new buildings with a slope below 30°. This strategy was incorporated into the 2011 Municipality Plan [3] and in the Climate Plan 2025 [4]. Based on these plans, the obligation to establish green roofs on new buildings was incorporated into local plans. Local plans require also the establishment of green roofs to be in line with the architecture of already existing buildings.

## Benefits of green roofs [6]

Habitat provision	Regulating services	Utility services	Cultural benefits
<p><b>1. Biodiversity/species protection:</b> Green roofs...</p> <p>(a) ...provide new habitats for various species</p> <p>(b) ...enable permeability for migrating species</p> <p>(c) ...connect neighbouring habitats by creating a green corridor /stepping stones</p>	<p><b>1. Climate change adaptation:</b> Green roofs...</p> <p>(a) ...counteract the urban heat island effect through evapotranspiration, thus decreasing ambient temperatures</p> <p>(b) ...lead to an improvement in surface water run-off, thus reducing the risk of flooding</p>	<p><b>1. Water management:</b> Green roofs...</p> <p>(a) ...act as sustainable drainage systems, thus diminishing surface water run-off through retention and absorption</p> <p>(b) ...support the removal of pollutants from rainwater</p>	<p><b>1. Recreation, well-being and health:</b> Green roofs...</p> <p>(a) ...encourage recreation</p> <p>(b) ...encourage sense of space and nature</p> <p>(c) ...encourage cleaner air</p> <p>(d) ...encourage relaxation</p> <p>(e) ...encourage physical and mental well-being</p> <p>(f) ...enable children and young people to enjoy green surroundings</p> <p>(g) ...increase aesthetic experiences through changing colours of living roofs</p> <p>(h) ...create a communication platform for citizens</p>
	<p><b>2. Climate change mitigation:</b> Green roofs...</p> <p>(a) ...encourage carbon sequestration</p> <p>(b) ...encourage sustainable movement through the provision of biking/walking routes</p> <p>(c) ...optimize performance of solar cells through reduced ambient surface temperatures</p> <p>(d) ...decrease energy use in buildings through improved insulation/passive cooling</p>	<p><b>2. Food production and security:</b> Green roofs...</p> <p>(a) ...enable a direct food production on community roof gardens</p>	<p><b>2. Land values:</b> Green roofs...</p> <p>(a) ...lead to a positive impact on property and neighbourhoods</p> <p>(b) ...extend the lifetime of roof material through UV protection and surface temperature reduction</p> <p>(c) ...enable further use of areas already serving a specific purpose</p>
	<p><b>3. Noise levels</b> Green roofs...</p> <p>(a) ...reduce outdoor noise levels by absorbing noise waves</p> <p>(b) ...reduce indoor noise levels</p>		<p><b>3. Culture and communities:</b> Green roofs...</p> <p>(a) ...encourage local distinctiveness</p> <p>(b) ...may serve as platform for education, training and social interactions</p> <p>(c) ...provide opportunities for increased tourism by branding Copenhagen as a green metropolis</p> <p>(d) ...provide opportunities for working with and solving social problems</p>

## Results

The Green-Roof policy programme implemented in the Municipality of Copenhagen is an example of a regulatory initiative that set the ball rolling for the cooperation of building developers, architects, green roof companies and research institutions. Today, green roofs shape the cityscape of Copenhagen by being spread over all scales of buildings. Green roofs are present on cycle shelters, bus stops, schools and mixed used buildings and became a defining element in architecture. An example of a green-rooftop established on a residential building is the 'The number 8 Residential Building in Ørestaden' (see picture below). Given the existing local plans, an estimated area of 200,000 m<sup>2</sup> of green roofs should be established over the coming years [7].



'The Number 8 Residential Building in Ørestaden, Copenhagen'. Photo: News Øresund - Jenny Andersson

## Lessons learned

Key in the succes of the Green-Roof policy programme was and is a strong and continued leadership by the Municipality. Without making the establishment of green roofs on new buildings with a slope below 30° obligatory, the administration would hardly have had the power to impose additional costs upon developers [7].

## References

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- [3] Copenhagen Municipality, 2012a Municipality plan 2011. [www.kk.dk/kp11](http://www.kk.dk/kp11)
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- [6] EEA (2011) Green infrastructure and territorial cohesion - The concept of green infrastructure and its integration into policies using monitoring systems.
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