

Four pillars to Hamburg's Green Roof Strategy: financial incentive, dialogue, regulation and science ^[1]

Image from Climate Adapt about this case study

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In response to climate change, one of Hamburg's objectives is to become greener, in the city and on the roofs. In this context, Hamburg is the first German city to have developed a comprehensive Green Roof Strategy. The goal is to plant a total of 100 hectares of green roof surface in the metropolitan area in the next decade. The Hamburg Ministry for Environment and Energy is providing financial support for the creation of green roofs to the sum of € 3 million until the end of 2019.

Building owners can receive subsidies to cover up to 60% of installation costs. Additional benefit stems from lower maintenance costs due to the longer lifetime of green roofs, lower energy costs because of improved building insulation and a 50% reduction on rain water fees thanks to the rain water retention function of green roofs.

Case Study Description

Challenges:

For Northern Germany, depending on the scenario considered, scientists forecast an average temperature rise of 2.8° to 4.7° Celsius by the end of the century. Through the urban heat island effect, an amount of up to 5° Celsius needs to be added to this average increase when considering temperature rise in urban areas. Long term temperature data demonstrate that in 2013 the average annual temperature in Hamburg was 9° Celsius, 1.2° Celsius more than it was 60 years ago. For Northern Germany, there will probably not be more rainfall in the future, but there will be a change in its distribution over the year. The overall amount of precipitation in the region could increase by 40% in winter, while from newest research summer rains may increase, remain as today or decrease by the same amount. Northern Germany will likely also suffer more frequently from extreme weather situations, such as dry summers with extreme heat periods and locally heavy cloudbursts, and high precipitation levels in winter with severe storms. These changes are already seen today. Green roofs can provide part of a solution to these projected climate change impacts by mitigating increased temperature and extreme rainfall events.

Hamburg is also affected in other ways by climate change. These cannot be addressed by the Green Roof Strategy. Specifically, the city is to be affected both by rising storm surges (floods) from the North Sea and by higher levels of the River Elbe, the latter due to rain and snow melt from inland. Further, a rise in sea level would also have an impact on water levels of the Elbe, and carry increased amounts of sediment into the port and urban river stretches. Compared to 60 years ago, the sea level in the port city has risen by 20 centimetres. It is forecasted that storm surges could result in a further rise by another 30 to 110 centimetres by 2100.

Objectives:

Hamburg has a growing number of residents leading to an urban expansion policy requiring a great number of additional housing. To maintain Hamburg's compact urban structure the objective is to improve the quality (rather than the quantity) of open green city spaces. In this context, Hamburg's objective is to be greener – on top. The goal is to plant a total of 100 hectares of green roof surface with plants and flowers in the metropolitan area by 2020, the equivalent of double the surface of 'Planten un Blomen' city park (45 hectares). New residential constructions alone provide a 44 hectare green roof potential over 5 years, new business constructions provide

an additional potential of 66 hectares. The city's ambition is to have 20% of the green roofs on new buildings to be made available to residents or employees for recreation, in the form of sports fields and parks, or as gardens in shared use by the housing community. By promoting green roofs, the city aims to encourage space efficient leisure areas, improve the city's rainwater retention capacity, increase biodiversity and reduce extreme temperature effects (c.f. reduction of the heat island effect).

Solutions:

Hamburg is a constantly growing city, demonstrating that the creation of new living space and green awareness can be compatible. The city's environment strategy as stated in the Climate Plan of 2016 addresses the effects of climate change such as increase in heavy rains, flooding and heat waves. Green roofs in this context improve both the city climate and water management.

With respect to the city's climate, green roofs cool the surrounding and increase humidity, which reduces the urban heat island effect. Also, green roofs provide improved insulation to buildings and therefore better adaptation to more extreme temperatures. Further, greened roofs improve water management through rain water retention and natural evaporation. They retain between 40 and 90% of rain water. Most of the water evaporates and returns directly to the natural water cycle. This in turn eases the burden on the sewage system.

The Green Roof Strategy therefore complements the city's RISA (Rain InfraStructure Adaptation 2030) project. RISA is the city's strategy for the sustainable management of rainwater. Less water can be drained away in the increasingly dense city while heavier rainfalls as a result of climate change are becoming more frequent. As a consequence the sewage system is overloaded and rivers are bursting their banks. This has made 'Hamburg Wasser', the city's water utility, to impose strict restrictions on water discharge per house and time. This strict allowance implies that excess rainwater should be temporarily retained to avoid an overload of the sewage system. Calculations show that on average 60% of rainwater has to be retained to avoid a sewage overload. Dealing with stormwater in Hamburg is a cross-disciplinary and cross-administrative objective and recommendations are contained in the document 'Structure Plan Rainwater 2030', which was released in 2016. Hamburg's green roofs can contribute to relieving the drainage infrastructure by reducing the total amount of rainwater run-off and slowing down the speed of the remaining run-off.

Green roofs also clear the air by absorbing dust and harmful substances. Further, green roofs offer space for recreation in the densely populated city centre opening up new spaces. The city explains that companies and landlords will have a clear competitive advantage with a green roof. These new green spaces right in the middle of the city are particularly attractive to residents and employees. They can relax, do sports, or plant vegetables and flowers. In order to succeed with the Green Roof Strategy the city combines promotion, dialogue, policy and research:

- Promotion: with an incentive programme the city is providing subsidies until 2020 for each owner (private or public) voluntarily deciding for a green roof. The subsidy will be paid both for refurbishing the roof as well as green roofs in new buildings.
- Communication and dialogue: the incentive programme is communicated strongly with a city-wide awareness campaign "On Your Roofs, Get Set, Green!". Using posters, brochures, press articles and internet promotion, the green roof benefits are shared with Hamburg inhabitants and visitors. The greening of public roofs is an excellent promotional example. A full-time communication officer in the Hamburg Ministry of Environment and Energy is in charge of all communication actions. A dialogue is necessary with local politicians, authorities, architects, engineers and economists.
- Policy and regulation: embed the Green Roof Strategy in urban landscape planning. The Strategy aims to incorporate or enhance green roofs into legally binding instruments such as the Hamburg Building law, the wastewater law, planting regulations on structural systems and land-use plans.
- Scientific support: the HafenCity university is providing scientific support to the Green Roof Strategy. Scientists at the university are evaluating international findings on green roofs, developing their own recommendations for Hamburg's green roof construction, and collecting data on water retention and the

water management effectiveness of green roofs especially with severe cloudbursts (the latter to convince sceptics that question the green roof's water retention capacities of large roofs). In fact, the city of Hamburg and the HafenCity university want to develop guidance for the promotion of green roofs which other cities can then use to create their own measures for climate change adaptation. The scientific work is partly funded by the federal government of Germany as a part of the "Measures to Adapt to Climate Change" project.

Importance and relevance of the adaptation:

PARTFUND_AS_CCA;

Additional Details

Stakeholder engagement:

Hamburg is using a wide range of networks and cooperation with other cities to present itself as a climate action centre at regional, national, European and international level. The experience gained in this process is used in its own response to climate change. When developing the incentive programme for green roofs, Hamburg involved other cities in a search for good practice and soliciting for feedback on draft versions of the incentive programme. Based on this interaction with other cities Hamburg decided to have their financial incentive program based on surface and thickness of the green roofs instead of water retention capacity as is the case in most other programs in other cities. This decision led to constructors not only focusing on water retention but also considering other benefits that green roofs may have such as in the context of biodiversity and space utilization.

Within the city a stakeholder group was established including housing estate companies, constructors, landscape architects and urban planners. Parallel to the dialogue with other cities this group was involved in defining the incentive programme. The group has remained active since and during its bi-annual meetings the Green Roof Strategy is evaluated by the working group.

Finally, Hamburg seeks to raise awareness among the general population about all aspects of climate change and protection. It is systematically building up and expanding the range of easy-access information for the general public.

Success and limiting factors:

The Green Roof Strategy fits within Hamburg's aim to be a growing, yet climate-friendly and resilient, compact city. For this purpose green rooftops provide a financially beneficial and multifunctional solution. In addition to reducing climate change threats, they highly improve green quality space in the city. Investing in green roofs for adaptation to increased stormwater management and flooding risk is financially beneficial and minimizing the cost of upgrading the current sewage system. The German Federal Ministry for the Environment, Nature, Building and Reactor Safety supports Hamburg's Green Roof Strategy as a pilot project within their programme "Measures for adaptation to climate change", providing financial support, networking and transfer of knowledge (information at www.ptj.de/folgen-klimawandel) [3].

Promotion and communication of the Green Roof Strategy are a top priority and several hurdles still have to be taken. For example, it has been questioned whether green roofs indeed provide the needed water retention capacities especially with a heavy storm water event. The concern is that support for this only stems from small scale experimental settings and that real and large roofs would not provide adequate retention service. To solve the matter HafenCity University is currently researching this question. Further, when initiating the Green Roof Strategy it was challenged whether Hamburg was having sufficient flat roofs to be able to succeed with the strategy. GIS-based research solved this question, showing that over 40% of the cities roofs are flat and suitable for greening. Another particular challenge requiring strong communication efforts on the positive benefits of green roofs has been the appearance of specific animals on the green roofs. On one of the industry flat roofs a sea gull colony of >5000 individuals has found a new home, putting off other businesses to also install green roofs. Similarly, green roofs attract insects which may result in people deciding to not choose for a green roof. Communication and research for Hamburg therefore have shown to be a crucial component for succeeding with the Green Roof Strategy.

Budget, funding and additional benefits:

This section provides information regarding the specific benefits and costs of green roof installations in Hamburg, as well as the financing set-up of the Green Roof Strategy and the corresponding incentive programme that is provided via the strategy. Green roofs are an investment with clear future returns. A green roof can create a more pleasant building climate and help to save on heating or cooling costs. It insulates in winter and cools in summer resulting in energy savings varying from 2-44% depending on roof insulation measures separate from the green roof. It also protects the roof water proofing from weathering effects so that green roofs last up to twice as long as conventional flat roofs. Plants and substrate on green roofs retain a large amount of rain water, which results in additional savings of 50% on rain water fees for the owner in Hamburg. In those instances where the water discharge does not require connection to the sewage system, fees can be eliminated completely.

When comparing roof types, estimated costs for installation, maintenance and replacement over a period of 40 years cumulate to € 20.500 for 300 square meters surface both for grey and green roofs. When focusing only on the initial installation, a green roof costs € 9.500 versus € 3.000 for a grey roof for 300 square meters surface. Green roofs have got a bit higher maintenance cost; in many cities 50% reduced rain water fees and a longer lifetime of the roofing explaining the same overall costs over a period of 40 years.

Hamburg's Ministry for Environment and Energy invests ca. € 500,000 of its own resources for the implementation of the overall Green Roof Strategy, including efforts in all four areas of activity: promotion/support, dialogue and communication, scientific support, and policy/regulation. It also includes a full-time employee based at the Ministry.

In addition, Hamburg's Ministry for Environment and Energy and the Harbour City University receive € 300,000 in federal grants on expenditure basis from the German Ministry of the Environment under a funding programme supporting local activities for the adaptation to climate change. This federal grant on an expenditure basis is used to pay a full time communications officer and a part-time HafenCity researcher for 2-3 years.

The Green Roof Strategy's incentive programme has € 3 million at its disposal until the end of 2019. This amount includes the total remuneration to be provided under the financial incentive programme implemented via Hamburg's investment and development bank (IFB), which handles all applications and transactions for the Green Roof incentives programme. Of the total € 3 million, € 2 million are sourced from the 'implementation and service' budget line of the Ministry responsible for city development and environment; the other € 1 million stems from the innovation fund of the Senate Office. The general approach taken is that financial incentives are available to those that voluntarily decide for a green roof before 2020. After that date Hamburg plans to have green roofs are compulsory by law. In particular, until 2020 building owners can receive subsidies to cover up to 30-60% of construction costs for the greening of their roofs.

The multi-functionality of green roofs is reflected in the subsidy system supporting the Green Roof Strategy. A basic subsidy creates incentives to build a basic green roof while additional funding encourages more

specialized, sustainable measures. Optional additional subsidies are then provided for: constructing high quality rooftops (root penetration protection and improving load bearing capacity for existing roofs), sustainable urban develop (inner city roofs, a green roof in combination with solar energy generation, and/or space utilization area) and an extra flood prevention by reducing rainwater discharge (improving run-off delay). The following minimum standard criteria must be fulfilled before a green roof can be eligible for a subsidy under the Green Roof Strategy:

- Minimum 20 square meters net vegetation area and a maximum 30° roof pitch.
- Minimum 8 cm substrate soil thickness on new and existing commercial and garage buildings or existing residential and office buildings.
- Minimum 12 cm substrate soil thickness on all new residential and office buildings.
- Public buildings owned by the city itself are not eligible for the subsidy.
- Owners who voluntary decide for a green roof, and when it is not part of a binding green roof regulation.

The basic financial incentive then depends on the type of owner and size of the green roof:

- Private owners with a 20 -100 square meters green roof who live themselves in the building receive a 40% subsidy on the total construction cost, including materials and contractor, and even up to 60% on material cost if the constructors are trained (professionals) either in architecture, roofing, landscaping or gardening thus ensuring high quality in construction.
- For all other owners with a >20 square meters green roof - commercial, private, public - an owner receives a basic financial incentive ranging from € 14/square meters (on 8 cm substrate soil thickness) to € 56/square meters (on 50 cm substrate soil thickness) net vegetation area (maximum can be achieved via additional subsidy of € 1/ square meters of net vegetation area per additional centimetre substrate soil thickness (rooting layer thickness)).

Legal aspects:

The current Green Roof Strategy combines the urban development policy objectives of sustainable area development with the objectives of adaptation to global warming and climate change. In Hamburg binding green roof regulation has been incorporated in many land-use plans for 20 years. Also, in accordance with the Nature Conservation Act green roofs are considered a possible measure in the context of compensating building impact on nature. From 2020 onwards Hamburg plans to have green roofs to be compulsory by law. The city of Hamburg also regularly reviews its green roof legislation in particular with regards to the ecological quality standards for the roofs. Specifically, when updating Hamburg's regulations next time, the aim is to increase the standard green roof thickness up to 12-15 cm.

Implementation time:

The Green Roof Strategy started in 2014 when Hamburg had a total of 80 ha of green roofs. The incentive programme runs from December 2015 to 2019. Today Hamburg's green roof surface has already increased to 124 ha.

Reference Information

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Websites:

<http://www.ifbhh.de/gruendachfoerderung> [6]

<http://www.hamburg.de/gruendach> [7]

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