Hamburg Green Roof Strategy

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Background and objectives

In cities, where concrete and asphalt absorb and radiate heat, the **Urban Heat Island (UHI)** effect increases the need for space cooling. High outdoor temperatures hinder nighttime ventilation and cause a rise in the energy use of space cooling devices. Tackling UHI is important for reducing space cooling demand. UHI can be addressed in policies on local / municipal levels, through smart urban planning and strategies that promote **green infrastructure** like pervious paving, Nature-based Solutions, including green roofs. Hamburg is an example where the installation of green roofs is successfully promoted through policy measures. Green roofs help reduce indoor temperatures and combat UHI by increased insulation level and using evapotranspiration to release moisture into the air, which not only lowers energy demands for air conditioning but creates a more comfortable and sustainable living environment.

The **Green Roof Strategy of Hamburg** was launched in 2014 as part of water-sensitive and heat-adapted urban and open space development to activate previously untapped open space potential, develop opportunities for the multiple use of open spaces, and contribute to climate protection and adaptation. Hamburg was the first major German city to launch such a comprehensive green roof strategy, where the success of the program is due to its comprehensive nature: it encompasses four levels of action: **promotion, dialogue, demand, and support.** The initiative is in constant evolution, now including green walls and raising the bar through requiring mandatory installation of green roofs in the building codes. The scheme was developed by the Free and Hanseatic City of Hamburg, which is both a municipality and a city-state within the Federal Republic of Germany. The Ministry for Environment, Climate, Energy and Agriculture (Behörde für Umwelt, Klima, Energie und Agrarwirtschaft – BUKEA) is responsible for this initiative, involving several other actors and partners.

Key features

The has a long history in incorporating binding green roof regulations in land-use plans for more than 20 years. The majority of green roofs have been achieved through regulations in development plans or urban development contracts. To assist with the planning of green roofs, the municipality's Ministry of Environment and Energy (Behörde für Umwelt und Energie) published the brochure "Green Roofs. Guidelines for Planning" with the three main focuses of "Knowledge, Planning, Action." The brochure is intensively used by stakeholders in the city's administration, as well as by architects and developers, such as housing cooperatives and investors, and, as feedback and mailing requests show, in other cities. The guidelines provide support for arguments in urban land-use planning and building permit procedures, among other areas, and standardize regulations and justifications for green roofs in development plans.

The strategy has been extended to vertical greenery as well. The Green Wall Strategy consists of the three building blocks "Knowledge, Communication, and Construction." The "Green Walls Handbook" has been developed for this purpose so far, providing colorful, richly illustrated information.

Regulatory side – overarching and consensus-based

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The strategy was pushed forward by Hamburg's Environmental Ministry, while the Green Roof strategy was developed in close cooperation with different special authorities. Integration of the common goals of the green roof strategy into overarching strategies like the Hamburg Climate Plan, Rainwater InfraStructure Adaptation (RISA) Strategy, and the Qualitäts Offensive Freiraum (quality offensive for open space), and vice versa, increased the strategy's legitimacy, giving it a wide and stable foundation. The implementation is also supported by the district authorities – to apply the developed instructions for green roofs and facades. The city of Hamburg regularly reviews its green roof legislation, in particular the ecological quality standards for the roofs. As a result, the latest regulations already set out requirements for the mandatory installation of green roofs. According to the Hamburg Climate Protection Act (HmbKliSchG), owners of buildings whose construction begins after January 1, 2027, must permanently green any new roofs with a pitch of up to 10 degrees on at least 70% of the gross roof area, using diverse and structurally rich vegetation, with a minimum of extensive green roofing. This requirement also applies to significant roof renovations that begin after January 1, 2027, with the condition that the net roof area must be greened. At the same time 30% of the roof area must be equipped with PV from January 1, 2024.

Financial support – multiple incentives

Financial support consists of direct and indirect elements. On one hand, a split wastewater fee was introduced for buildings with green roofs, on the other hand, a voluntary program was launched to support the installation costs for green roofs and facades, as outlined below.

Technical Support

A comprehensive set of digital, accessible information is available in for planners, builders, and associations in the format of booklets and planning guidance, maintenance and care, and well documented case studies, including technical, legal aspects and cost ranges that also help practical implementation. Fundamental questions regarding fire protection and green facades are compiled in FAQs (frequently asked questions) on planning and publication (www.hamburg.de/broschueren/).The platform #moinzukunft also supports active discussion on climate protection and adaptation measures, including the green roof strategy.

The city also offers advice about green roofs free of charge through the EnergieBauZentrum and the "ZEWUmobil" energy experts from the Centre for Energy, Water and Environmental Technology (ZEWU). Information booklets on the case studies present not only the system specification but also include indications on the level of total costs and benefits.

Public Relation and Dissemination

The initiative has a strong PR and dissemination background, which requires a dedicated full-time communication officer and structured co-creation processes. An own brand is created with a website, brochures and flyers, posters in the urban area, film contributions, and publications in daily newspapers and trade magazines as well as on social media. Publicity campaigns are organized, with international outreach; regular meetings with multipliers from professional associations and contributions to trade fairs, lectures and events for different stakeholders are provided. The promotion of roof greening is also important recognition options for parties involved, it can be seen as a flagship for sustainable companies in the city, as well as competitions are provided for individuals where green roof and facade projects are awarded and also used to generate best practice examples and promote the funding program.

Public recognition campaigns

The "Hamburg Award for Green Buildings" recognizes green roofs and green facades that exemplify quality, design, and use in Hamburg and neighbouring districts. It had been opened three times, in 2017, 2022 and 2025. In 2025, the winners will receive a total of €6,000 in prize: €2,500 for first place, €2,000 for second place, and €1,500 for third place. Companies who receive funding can receive recognition as "Hamburg Environmental Partners" providing visibility to their sustainable and responsible practices.

Science-based evidence

The strength of the program also lies in the scientific research supporting the development of the promoted solution. A federal grant was used to pay a part-time HafenCity researcher for 2-3 years. The green roof strategy also takes advantage of joint programs for example EU funded research to support the improvement of the implementation of green roofs and facades. These include experimenting with design options to increase biodiversity, providing smart flow control for the water management of the roofs, and monitoring of the retention capacity.

Implementation

One of the key aspects to the success of the program is the **constant evolution** of its components, with **multifaceted elements**. The strategy was launched in 2014, followed by the funding scheme in 2015. In 2017, the prize was introduced. In 2018 the study "Hamburg's Green Roofs - An Economic Assessment" was published examining the economics of extensive green roofs in Hamburg. The same year, a flagship project of the municipality was completed.

In 2021, the program expanded to include green facades, with support from the Green Urban Labs pilot project, within the federal research program Experimental Housing and Urban Development (ExWoSt). The initiative was taken to a next level from January 1, 2024 when the Hamburg Climate Protection Act was amended with the Climate Protection Strengthening Act that requires the combination of photovoltaic systems with vegetation, as **solar green roofs** for new buildings as far as it is technically and economically feasible after 2027. The biosolar roofs further enhance efficiency, as these solar panels will work more efficiently over green roofs, while at the same time, shades the vegetation on the roofs, enhancing biodiversity.

Budget (or other cost data)

Hamburg itself showed leadership and an **exemplary role** in the implementation of the program. In 2018, €7.5 million was allocated for green roofs for public school construction. Municipal bodies are also committed to increasing roof and façade greening. A flagship project is the greening of the DESY research hall in Bahrenfeld — one of the largest building greening projects in the Hanseatic city: around 4,600 m² of façade and flat roof area of the existing Hall 36 were planted with approximately 25,000 grasses, perennials, and climbing plants, with total funding of €410,000 provided by Hamburg’s Environmental and Energy Authority.

Green roofs are also indirectly supported through the **reduction in wastewater fee splits**. As green roofs retain a large amount of rainwater, rainwater fees can be reduced by an average of 50% for a house owner or can even be eliminated if rainwater is fully retained on site. This is a practical example about how multiple benefits can contribute to co-funding.

An essential point for financing the measures is **blending funding sources.** The necessary resources for staff to address the action levels were financed, among other things, through federal grants and provided by the municipalities own budget and climate adaptation funds. Material resources, such as those for public relations, were acquired through separate printed materials and future budget appropriations. This requires long lead times and decision-making processes, patience, and attention to seeking and finding synergies. The Hamburg’s Ministry for Environment, Climate, Energy and Agriculture invested about € 500,000 of its own resources until 2022 for the implementation of the overall Green Roof. In addition, the Ministry and the Harbour City University received € 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.

Financial incentives boost the uptake of the implementation of the strategy: while the benefits of Nature-based Solutions including green roofs are received by the community, most of the roofs are privately owned. Financial incentives are particularly relevant to bring on board the general public, experts and get media attention. The support by national funding programs from the Federal Ministry of Environment is helpful as those programs foster the exchange also beyond the city scope.

In **2015**, the Hamburg Ministry for Urban Development and Environment allocated **€3,5 million** to encourage green roof construction on both new and renovated buildings in Hamburg. In the first six years, 280 applications had been submitted, and 86,000 m² of green roofs had been approved, receiving over €2 million in total. Private individuals and companies applied equally for the grants. The buildings where the green roofs were installed were mainly new buildings (75%). The initial funding rate was 60 % for the installation costs of the green roof, with a limit of 50.000 € per building. In 2020, the funding program was extended for five years, and subsidies were increased by 20% due to rising construction costs, as well as expanded to include facade greening.

In **2023**, the green roof strategy funding program has been endowed with a further **€3.5 million** and is currently available until the end of 2026. Property owners will receive grants of 60 % of the construction costs for **private owner-occupiers and homeowners' associations** and between 40% and 60% for **commercial applicants**, for new or existing buildings. Funds can be applied for voluntarily by planning to install at least 20 m² of green roofing with a soil layer of at least 8 cm in depth. Green roofing measures for residential and non-residential buildings are subsidized with up to **€100,000 per applicant** via the Hamburg IFB bank.

An estimation from 2021 calculated at least **€22 million investment** in the creation of green roofs in Hamburg **over seven years**, based on the growth of **50 hectares of green roofs** in Hamburg.

Results and impacts

The study "Hamburg's Green Roofs - An Economic Assessment" from 2018 concluded that the cost of building a green roof amounts to about 0.4-1.3% of a buildings' overall construction costs. Repair costs are on the hand smaller, as thanks to the protection from climate impacts, the life expectancy of a green roof increases to 30-50 years compared to the 15-25 years of black roofs (i.e. without greening). In contrast, a black roof is subject to regular renovation cycles every 15-25 years. When considering life-cycle costs over a 40-year period, the black roofs and green roofs have similar costs. On the benefit side, green roofs reduce cooling needs through a higher thermal inertia and summer the evaporative cooling and have advantages on a wider scale. While this had not been quantified for Hamburg, A study conducted by Niachou in Greece revealed that green roofs can reduce the energy utilized for cooling from 2 % up to 48 % with an indoor temperature reduction up to 4 K. Apart from the reduction of UHI already mentioned, social benefits if are seen when used as an open space, they provide an area for biodiversity, increase air quality, and offer an increase in performance if installed together with solar panels. Direct cost benefits can come from the "green added value" of usable intensive green roofs, which increases rental income by 6-8%, according to an estimate by TÜV Süddeutschland.

GIS-based research evaluated the potential impact of the program, assessing that over 40% of the city's roofs are flat and suitable for greening. In the first seven years of the program, until 2021, the area of green roofs in Hamburg had increased by approximately 50 hectares. The total urban green roof area was reported to be approximately 175 hectares, of which 39% was created in residential buildings, 35% in industrial and commercial buildings, and 26% in other buildings. Half of Hamburg's roofs are flat or low sloping, where the share of green roofs was approximately 5%.

Lessons learnt

The success of the strategy lies in the **comprehensive approach** through multiple actions including regulatory, financial, participatory and informational branches. By recognizing the **synergies** of different positive aspects (i.e. reducing energy demand directly and through UHI, improved rainwater management and increasing biodiversity) involving all bodies of the city in the process with regular updates about the progress helped raise the awareness of the topic and show the successful implementation.

The main **challenges** were mentioned as low technical knowledge and trust. Real estate industry and planners were identified as key stakeholders in the field of green building projects, who need to be convinced with sufficient evidence-based arguments to support the implementation – e.g. in aspects of fire safety, water retention potential, and also maintenance issues were raised. For example, the increased presence of animals, e.g. the case of seagulls breeding on a large green roof during spring were not celebrated by all parties – which calls for dialogues and awareness raising as well as management needs.

However, through well composed, detailed **educational materials**, cutting-edge **scientific research**, the barriers are being overcome, which result in the project being a beacon for cities worldwide. To take the strategy to the next level, further challenges need to be addressed. For example, in lack of correlations for noise mitigation and air quality improvement of green walls, these concepts are difficult to make mandatory in the planning sector. There is still room for research to provide suitable scientific evidence.

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