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On your roofs – get set – green!



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Summary

Hamburg is the first German city to have developed a comprehensive green roof strategy, aiming to plant a total of 100 hectares of roof surface in the city in the coming decade, to deal with the challenges climate change, densification, biodiversity, and air quality. The strategy combines different policy instruments: incentives, public relations and regulation. The implementation process comprises an incentive programme about 3 Mill. Euro, combined with mandatory requirements and quality standards. A local communication campaign is to raise awareness and knowledge among important actors. In the context of the ongoing scientific support in the implementation of the strategy, the strategy is being assessed to identify success factors of- and barriers to the successful implementation. In the first, qualitative assessment it is found that the essence of the success of the green roof strategy lies in the comprehensive approach, with the three action points enhancing each other in a continuous process.

Keywords: Green roofs, Subsidies, Legal Framework, Communication, Science-Practice

1. Introduction

The city of Hamburg faces diverse challenges in the daily praxis of urban planning and development: climate change, densification, biodiversity and air quality are all important issues that have to be dealt with throughout the coming decades. Climate change not only requires the reduction of greenhouse gas emissions, it also requires new solutions to adapt to the effects of climate change. In a growing city with a limited building space, questions arise how the densification induced by the necessary housing programme can be combined with an upgrade of the quality of green- and recreational space, with care for the biodiversity in the city.

Green roofs provide an answer to these challenges, or a way to better deal with them. Besides the improvement of the urban water cycle by retention of rain water and subsequently evapotranspira-

tion (Bengtsson et al. 2005; Mentens et al. 2006; VanWoert et al. 2005), there are additional benefits like reduction of heating and cooling costs and reduction of the urban heat island effect (Fang 2008; Takebayashi and Moriyama 2007; Nicholls et al. 2007), reduction of noise (van Renterghem and Botteldooren 2009) and air pollution (Currie and Bass 2008; Yang et al. 2008), biodiversity enhancement (Brenneisen 2003; Dunnett et al. 2008; Gedge and Kadas 2005) and (long-term) economic benefits (Berndtsson 2010).

Driven by these challenges, Olaf Scholz, the First Mayor of Hamburg, presented his vision of flying over Hamburg with a view over the green rooftops in 2030 at an international green roof conference in 2013 (see Figure 1). In due course, the Senate of Hamburg commissioned the city administration to develop a green roof strategy to realise this vision. The strategy was adopted in April 2014, formulating the aim to increase the green roof surface within the city by 100 hectares in the coming decade, to cover at least 70% of new buildings with green roofs and to make at least 20% accessible, for instance as public garden or rooftop terrace. Since then, the first actions were taken to put this strategy into action.



Fig. 1 Vision of green rooftops in the inner city
(c) BUE/TH Treibhaus Landschaftarchitektur, Background Image: Matthias Friedel

In this paper we present an assessment of the first experiences in the implementation of the strategy. Chapter two outlines the organisation of the implementation process and the actions taken to realise the aims. Chapter three presents the assessment of the first experiences in this process, from April 2014 until September 2015. The assessment is based on qualitative interviews with key players in the implementation. In a later stadium, this assessment will be complemented by a quantitative evaluation of the goals that are laid down in the strategy and a quantitative analysis of the reach of the instruments, e.g. by measuring the green roof surface, the amount of applications in the subsidy programme, the clicks on the website and the mentions in the press. The goal of the qualitative assessment is to define success factors and hurdles that can enable or hamper a widespread implementation of rooftop greening within Hamburg. Chapter four presents the first adjustments of the implementation process, which were made to overcome the hurdles. We conclude with the conclusions of the first assessment, identifying the main success factors in the implementation of the green roof strategy.

2. The implementation process

After the assignment by the Senate to develop a green roof strategy, the city administration at the federated state (*Bundesland*) level has taken up the challenge to create a strategy with a broad instrumental approach, covering the range of instruments that are available to the public sector: creating (financial) incentives and providing good examples, communicating about the positive

aspects of green roofs and stipulating the greening of rooftops where necessary. These instruments were encapsulated into four action points, which will be further explained throughout the following paragraphs.

2.1 Action point 1: Promotion

The first action point comprises the promotion of rooftop greening through positive financial incentives and good examples. The main activity in this action point is the subsidy programme for voluntary rooftop greening measures by private and commercial land owners. Since January 2015, every private and commercial land owner in Hamburg can be financially supported if he or she decides to build a green roof. Although a green roof results in similar costs as a conventional flat roof, calculated over the entire lifespan of a green roof, the initial investment costs are higher. The subsidy encourages land owners to overcome the hurdle of the initial investment and to make a contribution to a more sustainable urban development and an increase in quality of life.

The Senate has made three million Euro available for the subsidy programme. The subsidy itself comprises a lump sum of 40% of the investment costs for green roofs on owner occupied houses (including outbuildings) with a net vegetation surface of 20-100 square metres. For larger measures and commercial buildings, the subsidy is defined by the net vegetation surface and the thickness of the substrate. Additionally, supplements are possible. The basic funding conditions and the possible supplements are summed up in Table 1.

Table 1: Basic funding conditions and supplements

Owner occupied houses (20-100 m ² net vegetation surface (NVS))	All other buildings
Lump sum of 40% of the investment costs for the green roof and the maintenance in the first year	6,- €/m ² NVS, plus 1,- €/m ² NVS per centimetre substrate (max 50 cm) Maintenance in the first year (compulsory): 50% of the maintenance costs /m ² NVS.
Supplements:	Supplements:
Statical improvements and improvements in root-resistancy on existing buildings (100%, max 5,- €/m ² NVS)	Measures in the inner city (basic subsidy + 15%) The inner city is defined by the outer border of the second green ring within Hamburg's Green Network
Extensive green roof combined with solar panels (attachment of the solar panels, 100%, max 5,- €/m ² solar panel)	Areas for recreational purposes (14,- €/m ²)
Increased retention capacity (50 %, max 2,- €/m ² NVS)	Statical improvements and improvements in root-resistancy on existing buildings (100%, max 5,- €/m ² NVS) Extensive green roof combined with solar panels (attachment of the solar panels, 100%, max 5,- €/m ² solar panel) Increased retention capacity (50 %, max 2,- €/m ² NVS)

If we take a closer look at the funding conditions, we see that many of them are in line with the political goals that are laid down in the strategy. The dependency of the base funding on the thickness of the substrate is related to the goal of retaining as much rainwater as possible. Thicker substrates can store more rain water and thus contribute to a decreased pressure on the rainwater discharge systems. The supplement in the inner city is related to the special climatic conditions in dense urban areas. Rooftop greening is especially preferred in those areas that are known to develop into heat islands during summer and that are characterised by a high amount of sealed surfaces. The supplement for combining a green roof with solar panels is in line with the task of transforming to renewable energy and is an incentive to use the clear advantages of both measures and their synergies.

Another financial incentive to build a green roof was created by the introduction of the so called split waste water fee, dividing the original waste water fee into two parts, one for dirt water and one for rain water. Since the introduction of the split waste water fee, every land owner pays for the rain water that is being discharged from his or her property into the sewage system. The fee is calculated according to the amount of square metres sealed surface that is connected to the sewage system. If a land owner decides to build a green roof, he or she benefits from a reduced rain water fee by fifty percent for the roof surface, due to the water retention capacity of a green roof.

The city itself gives the right example by greening the rooftops of public buildings, like schools, universities and the premises of the city administration. These publicly owned green roofs are not only used as an example for other land owners in the city, but also to gain a better insight into the financial aspects of building and maintaining a green roof. Furthermore, on two locations, publicly owned green roofs are used in a real time measurement of the retention capacity of these roofs, as part of the action point scientific support.

2.2 Action point 2: Dialogue

The second action point comprises a broad dialogue with key players in the implementation of the green roof strategy. The dialogue is aimed at providing information about green roofs and communicating about the positive effects of rooftop greening within the city. Furthermore, the dialogue intends to discover and overcome hurdles towards a widespread implementation of green roofs. The approach within this action point can be divided into three separate elements: providing information, internal communication and external communication.

In order to create a uniform and coherent visual appearance in the communication in the course of the green roof strategy, a key visual and a style guide were developed. The key visual, with the slogan “On your roofs – get set –green!” and the image of a woman on a rooftop, carrying a vegetation blanket with the skyline of Hamburg in the background is the central element on the information material (See figure 2). The key visual appears on the cover of the brochure that was developed, as well as on the flyer, the poster and the standard digital presentation format. Furthermore, several visualisations were designed, to provide a positive image of the potential of green roofs in Hamburg and on the possibilities that a green roof provides (See figure 3).



Fig. 2 Key visual: on your roofs – get set – Green!

(c) BUE/mount. Design und Kommunikation für soziales Wachstum, Background Image: Michaela Stalter

The information material provides an overview of the positive aspects of a green roof and gives detailed insight into the range of possibilities of green roofs, from extensive sedum roofs towards intensive rooftop gardens. Furthermore, it provides information on the process of planning, building and maintaining a green roof, including information on the subsidy programme. Besides the already mentioned traditional hardcopy information material, the city has made a website to provide the information in a digital way as well (www.hamburg.de/gruendach). The standard information material is complemented by contributions in diverse media, such as journal articles, television interviews and newspaper articles, as well as presentations at conferences or trade fairs.



Fig. 3 Visualisation rooftop terrace

(c) BUE/TH Treibhaus Landschaftsarchitektur

The broad implementation of green roofs is not yet self-evident in Hamburg; there are several hurdles to be overcome, some of them within the city administration itself. Therefore, the dialogue in the internal communication process concentrates on providing information about the green roof strategy throughout the internal organization of the city administration. The responsibility for the implementation of the strategy is allocated within the department for environment and energy at the federated state level, whereas many other departments – at the federated state level as well as at the lower level of the boroughs (*Bezirke*) - make decisions that directly affect the actual realisation of green roofs. The dialogue within the internal organization is organised as a series of workshops and presentations, as well as support in concrete cases.

The external communication concentrates on building up a dialogue with key players in the planning, construction and maintenance of green roofs, such as private and commercial land owners, architects, building companies, housing companies, landscape architects and gardeners. The reach of the city is limited and the cooperation of these key players is needed to realise the ambitious goals. As such, the dialogue concentrates on conveying the positive aspects of green roofs, providing information on the subsidy programme, finding good examples from within the city and better understanding the hurdles towards a widespread implementation of green roofs. The external dialogue is organised as a series of workshops, presentations and individual conversations.

2.3 Action point 3: Stipulation

The action point stipulation concentrates on developing and implementing ways to enforce rooftop greening through the instruments of spatial planning and nature protection. Since the 1980's it has already been common to make rooftop greening on flat roofs compulsory in new detailed development plans within Hamburg. There is however a larger potential to use the existing instruments; the activities in this action point concentrate on utilising these potentials.

The department for environment and energy at the federated state level works on the creation and implementation of a map on urban climate and ecosystems as part of the city wide landscape programme, which is part of the city's comprehensive planning instruments. Climate change has not been considered yet in the currently valid landscape programme, the renewal of the landscape programme *inter alia* intends to define climate change as one of the essential challenges. The new map contains action points on urban heat islands and rain water management and shows areas within the city with explicit needs for action, with concrete measures to deal with these challenges of climate change adaptation. Green roofs are part of these measures.

Although the obligation to build green roofs is already quite common in new detailed development plans, there are still several challenges to be overcome. First, there is no standard yet for substrate thickness; every borough can freely decide which substrate thickness is laid down in the detailed development plan, resulting in a variation that ranges from eight to fifty centimetres. Second, there are large areas in the city that are regulated by large scale detailed plans that were adopted under an older legal framework, without the possibility to include rooftop greening. The task is therefore to find possibilities within the valid legal frameworks to overcome this hurdle. Third, the obligation to build green roofs is often the result of a negotiation in the context of the legal framework on nature protection, utilizing green roofs to reduce the impact on the natural values in the area under consideration. It would be interesting though if green roofs can also be recognised as compensatory measure, as this would create new incentives to build green roofs. To uncover these challenges and to find ways to deal with them, several working groups within the city administration have the task to explore the possibilities and to develop solutions.

2.4 Action point 4: Scientific support

The scientific support for the green roof strategy concentrates on quantifying the rain water retention capacity of green roofs under the local climatic conditions of Hamburg and on getting an overview of the worldwide scientific knowledge regarding water management on green roofs. Furthermore, this action point includes the assessment of the implementation of the green roof strategy in the other three action points, the first results of which are presented in this paper. As a starting point in the scientific support, a literature review of worldwide studies regarding water management and green roofs was carried out. The results of this review are the starting point for the real

time measurement programme of the rooftop of the HafenCity University building. In the measurement programme that started in March 2015, the rainfall on the rooftop is compared to the runoff in the downspout. The difference between both values represents the retention capacity of the green roof. Ten similar measurement installations are to be installed on five different green roof systems with special techniques to retain more rain water, to compare different roof types.

The assessment of the implementation of the green roof strategy concentrates on finding the important lessons that should be learned from the implementation process. To assess the success factors within the strategy, qualitative interviews are being conducted with key players in the implementation process. The outcomes of the interviews are used to define the success factors and to uncover where other or new approaches or steering mechanisms are necessary to overcome hurdles that are discovered throughout the implementation process. In the next chapter we turn to the first and most prominent results of this assessment.

3. First experiences in the implementation process

3.1 Promotion

In the first assessment of the activities in the action point promotion, it becomes apparent that there has been a continuous interest in the subsidy programme. The programme itself is being administered by the *Hamburgische Investitions- und Förderbank*, a city-owned bank that administers all subsidy- and loan-programmes initiated by the Senate. In the course of the first months, over a hundred consultations took place and several concrete applications for the subsidy were handed in. Nevertheless, it is hard to say if the subsidy programme can already be defined as a success. Experience with other subsidy programmes shows that the initial phase of a programme usually needs some time before a larger sum of applications comes in. It was experienced though that the subsidy conditions were not attractive enough for smaller measures, for instance the greening of a bicycle shed or a garage. Furthermore, it became clear that there were some legal questions to be answered that were not specified enough in the subsidy conditions.

3.2 Dialogue

The assessment of the action point dialogue shows a more differentiated pattern. In the internal communication process, many workshops and presentations were organised to discuss the added value of the green roof strategy and the consequences for other departments at the federated state level and at the level of the boroughs. The most prominent issues that were discussed were the investment costs and the water retention capacity of green roofs. The installation costs for gravel roofs are estimated at about 10 €/m², whereas the installation costs for extensive green roofs range from 15 to 50 €/m² roof surface, depending on complexity of the roof, substrate thickness, producer, etcetera. In attempts to make the cost calculation more transparent, it became clear that there were many diverging assumptions, for instance about the necessity of including specific technical elements in the calculation and the necessity of including the costs of an extra week of scaffolding around the building.

In the first activities in the external communication, for instance with representatives from the housing industry, logistics and architects, the discussion often also circulated around the investment costs. More importantly, the discussion concentrated on the question who should carry the higher initial investment costs. It is legally not possible to provide a subsidy for measures that are already marked as obligatory in a detailed development plan. For the housing industry it would be

more attractive to get a subsidy, whereas the question for the city administration is which instrument is most efficient to reach its goals. It also became clear that there are still doubts about the quality of green roofs and about potential negative impacts. Doubts were for instance raised about the impermeability for water and roots. These doubts have been reinforced, especially in Hamburg, by the media coverage of the “*Heidberg Villages*”, a case where roof constructions were damaged by moist and fungi due to incorrect insulation construction. Although the problems with were not caused by the green roofs, the media coverage still made this connection. Another special example comes from a logistics company with an extensive green roof where the largest seagull colony of Hamburg (<1.500 breeding pairs) established. In this media-covered case the company is annoyed about pollution from seagulls and it serves as role model for companies with i.e. high demands on hygiene and cleanness to prevent higher installation costs of green roofs.

3.3 Stipulation

The first assessment of the action point stipulation has brought deeper insight into the possibilities and consequences of making green roofs obligatory through the instruments of spatial planning. Although only first steps were made in the stipulation process, one particular point of discussion became apparent: the potential conflict between solar panels and green roofs. In cases where a detailed development plan prescribes green roofs, the possibility of using the rooftop for solar energy panels is included as a potential alternative solution. In such cases, the green roof strategy envisages a combination of green roof and solar panels, as these solutions can easily be combined and because the cooling effect of a green roof increases the efficiency of the solar panel by around three to four percent. There are however examples of rooftops that are entirely covered with solar panels, positioned in a flat position instead of the traditional angled position. In such cases, the green roof would not be able to function due to the shade of the panels and the lack of rain water in the substrate. The challenge is thus to find a formulation in the detailed development plans that does not exclude solar energy, but that guarantees a fully functioning green roof in case solar panels are installed. Furthermore, it is important that such a formulation is also used in concrete cases, which requires knowledge about the potentials of combining green roofs and solar panels among the employees within the responsible departments in the boroughs.

4. Fine-tuning the green roof strategy

The results of the first assessment uncover several issues that need to be considered in the further implementation of the green roof strategy. Most of these issues have already been incorporated into adjustments of the actions within the action points. It is interesting to see that several issues that were uncovered within specific action points had to be dealt with in the activities within other action points. It is here where the synergies between the action points come to live and where the added value of a comprehensive and broad implementation strategy becomes apparent. In the action point promotion, we have uncovered two issues: the attractiveness of the subsidy programme for smaller measures and the legal questions that arose during the implementation. In order to deal with the first issue, the subsidy conditions were adjusted to better suit the special requirements for smaller measures. The lump sum of 40% of the investment costs for owner occupied buildings with a NVS of 20-100 m² was introduced during this adjustment of the subsidy conditions. The second issue had to be dealt with in both the action point promotion and stipulation. It needed to be cleared under what circumstances a rooftop greening measure can be considered a voluntary measure and in which cases a legal obligation would imply a negative verdict on a subsidy application. This aspect also needed to be specified in order to be able to provide clear answers to the housing industry during the workshops in the action point dialogue, to explain

clearly why an obligatory green roof cannot be subsidised. Moreover, due to the discussion on the building- and maintenance costs, it was decided to monitor these costs for the rooftops of public buildings. The results of this monitoring process will provide valuable insight into these costs and enable a factual discussion on the costs of a green roof over the entire lifespan.

In the action point dialogue, the intensive discussions during the workshops and the media-coverage have led to the recognition of more specific reservations towards green roofs. Many of these can be countered by providing more information. The brochure that was developed for instance provides a balanced over-view of the positive effects of green roofs and the possibilities land owners have. Furthermore, the information on the website was improved, to provide more specific answers on the most common reservations. Another specific issue that was dealt with in the action point dialogue stems from the work within the action point promotion. In order to provide the good example with green roofs on public buildings it was found that the largest potential on public buildings resides with the state agency that is responsible for building schools and its accompanying buildings. To increase the knowledge within this agency, a separate workshop was organised to discuss the steps that are needed to make green roofs standard on school buildings. This dialogue has inter alia lead to the funding of green roofs on several schools.

In the action point stipulation several questions were made more specific in order to be able to find answers to the issues that arose in the other action points. The working groups are still in this process, it is therefore too early to assess the progress within the existing working groups. To deal with the above mentioned issue of combining green roofs and solar panels, the department for environment and energy at the federated state level has supported the responsible persons within the internal organisation with the necessary information on the possibilities of combining green roofs and solar energy. Furthermore, the green roof strategy was included in an event on solar energy, to raise awareness for these possibilities in the solar energy industry.

5. Conclusions

The comprehensive character of the Hamburg green roof strategy is unique in Germany. The strategy raises national and international awareness, as the experiences in Hamburg can provide valuable lessons for other cities that have to deal with similar contemporary challenges. After assessing the implementation process during the first seventeen months, we argue that the comprehensiveness of the implementation process, covering a range of policy instruments is one of the main success factors in this process. The action points are mutually enhancing each other in a continuous process, creating a “carrot and sticks” approach. In many cases, as described in the assessment and fine-tuning of the strategy, the issues that arose in one action point could or should be dealt with in one of the other action points. This is amplified by the actuality of the challenges and the political will behind the strategy, making it possible to make the necessary resources within the responsible departments available.

In a next step, the results of the implementation process will be quantified in order to monitor the factual progress in the sense of square metres green roof within the city of Hamburg. With the help of quantitative data, the success factors within the action points can be better defined. For instance with the amount of square metres green roof that were built with the financial support of the subsidy programme or the square metres that were obligated in new detailed development plans. Before these quantitative data are available we can only speculate about the success factors within the action points. Based on the experiences in the implementation, we however argue that the workshops within the dialogue, especially with the representatives from the housing indus-

try, logistics and architects are an important step towards a widespread implementation. The open dialogue enables to discuss the different possibilities, to exchange ideas and to overcome hurdles in the implementation. We therefore recommend other cities to at least create such an environment for a dialogue in order to bring their policies to deal with the actual challenges of climate change, densification, biodiversity and air quality a step further.

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