ORGANISATION OF LARGE SCALE GREEN COVERED ROOFS IMPROVING THE COLLABORATION OF POLICY MAKERS WITH URBAN DESIGNERS

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ABSTRACT: During the last two decades the use of plants on rooftops to produce ecological and architectonical quality in city landscapes has grown fast. The technology is well known amongst specialized firms. Technological problems should not be of any hindrance for transition of this technology on a larger scale. For many kind of roofs there are suitable technical solutions to construct a green covered roof with high quality. Many cities around the world developed policies to support the implementation of green covered roofs because of the benefits for the city. Most importantly the slowing down of rainwater run off is mentioned. Secondly the positive influence of large scale covering of roofs with plants on the city climate is argued. However, some of the arguments used to support urban policies do not match urban designers arguments. It seems that making a green covered roof is more an activity of retrofit than part of spatial de and urban design policy. The paper summarizes the arguments of cities, as part of their policy and concludes there is a gap between the intentions of policy makers and design criteria of urban planners. The paper concludes with a set of recommendation for policy makers and urban designers where to smoothen their relationship.
KEYWORDS: Green roofs; Social cost benefit analysis; Water-management; Process innovation; Sustainable Development.

1 LARGE GREEN ROOFS REALISATION

During the last two decades the use of plants on rooftops to produce ecological and architectonical quality in city landscapes has grown fast. How do cities argue to make policies on a large-scale possible and to fit these policies into design strategies and design processes? There seems to be a gap between intentions of policy makers and design criteria for urban designers. We try to find the answers.

1.1 Technological

The technology of making green covered roofs is well known amongst specialised firms. You can recognize those firms at the specified information of their roofing and greening systems. If a company does not offer special advise on its products and if the company does not show a list of successfully finished projects, you might get suspicious.

Specified information should be provided on:

- Roofing material and technical handling of the materials, including detailing of special devices and detailing of the edges and corners of roofs;
- The kind of substrate and specific characteristics of the different layers of materials supporting the substrate; Specifications should include information about the amount of water that is retained by the substrate, the delay of rainwater flowing down from the roof, the insulation value during winter and summer time, as a function of soil humidity and information about noise reduction through the roof or above the roof;

- The kind of vegetation, especially on the choice of plants for special purposes and within price ranges;
- Product qualifications and quality guarantees during construction and during maintenance;
- Certification of the product qualifications and certification of the construction;
- Certification and insurance of the finished roof for some years, with a minimum of the legal obligations;
- Arguments for investment in green covered roofs are: protection of the construction and membrane which led to al longer lifetime, lower risk for damage, extra buffering for cooling in summer conditions, providing green in the city and nice surface to look at.

Although these are all arguments on the scale of one roof, it gives a clue for the arguments that cities and urban designers need to support large-scale implementation of green covered roofs. If principals are aware of the specific information mentioned above, technological problems should not be of any hindrance for transition of this technology on a larger scale.

1.2 Types of roofs

For many kind of roofs there are suitable technical solutions to construct a green covered roof with high quality. Most typologies distinguish four types depending on the sloop of the roof and the kind of vegetation growing on it. Since this four types of green roofs also fit to the different profiles of environmental effects, it seems only logical to use this typology worldwide. This would make exchange of information for research and for design easier.

Table 1 Make examples of typical solutions for four categories

Maintenance \ sloop	**Flat roof**	**Attached roof**
Intensive	Sometimes subsidised	Never subsidised
Extensive	Always subsidised	Sometimes subsidised

Other distinguishing arguments between the four types of green roofs can be:

- Technical details that are locally determined like: Height, amount of square meters and type of roof as well of choice of materials;
- Design conditions such as: City climate, surrounding environmental restrictions, interaction with the surrounding buildings, interaction with the surrounding green and water;
- Policy interaction: The roof is part of the green mapping and planning in an area, the roofs is part of environmental policies to reduce hazardous environmental effects on the scale of a larger area, the roof is part of a political campaign to raise awareness about environmental city problems;

From these arguments three design levels can be distinguished:

1. Technical design level of scale and choice of materialisation.
2. Organisation level of how much interaction is supposed to be taken into account.
3. Social level of how much a green covered roof contributes to the realisation of higher political and social goals.

2 CITY POLICIES

Because of the benefits for the city many cities around the world developed policies to support the implementation of green covered roofs. Many of the programs do take the levels mentioned above into account. We highlight some of them.

2.1 Toronto

Although the total amount of realised surface of green roofs is not available, studies has been done for the effects of green roofs up to 100% of the flat roofs in the city.

Under the actual program owners of commercial, industrial or institutional buildings can receive subsidies up to $50 per square metre to a maximum of $100,000 for a green roof, which supports vegetation. For a cool roof, which is designed to reflect the sun’s rays, they can qualify for $5 per square metre up to a

maximum of $50,000.

Most important reason to support green roofs is to save money. Money can be saved on Rainwater management; Combined Sewer Overflow (CSO); Air Quality; Building Energy; Urban Heat Island. Also other benefits are mentioned like availability of green space and so on, but these are not directly related to save money. [1,2]

2.2 Düsseldorf

Düsseldorf promotes green roofs for a long time. Already in the nineties of last century green roofs were even obligatory for new (flat) roofs in the inner city. Nowadays over 730.000 square meters of roofs do have vegetation. Main reason is to increase the quality of the city climate, especially to decrease the city-temperature in summertime. Besides other positive effects are mentioned like rainwater management, binding of CO2, filtering of dust and pollution out of the air and insulation value of the roof. [3]

2.3 Chicago

In 2008 more than 3.1 million square feet (279.000 square meters) of green roofs were installed in North America according to Green Roofs for Healthy Cities. Which is a 35% increase from year-ago levels. But also 2007 was a 'good' year for the green roof. Chicago was the leader in green roof construction, with more than 548,000 square feet (49.320 square meter) installed in 2008.

2.4 Other cities

These are just some examples, many other cities subsidise the greening of roofs, e.g. Hamburg, Paris, London, Montreal, Antwerp.

And the number of cities subsidising green roofs is increasing, so the mentioned cities are only a few examples. Not only municipalities give money, sometimes also other organisations like Washington DC where one can get a green roof subsidised by a foundation ($5.00 per square foot = per 0,09 square meter).

3 DUTCH CITY POLICIES

Examples of Dutch cities that have policies to support the implementation of green covered roofs are Groningen, Rotterdam, Amsterdam and The Hague.

These cities just started realising several square kilometres of green roofs and subsidise the construction of green roofs in large areas of their cities. Most cities do have specific technical demands for the roofs to be subsidised.

The green covered roof has to consist of at least four or five layers of techniques:

a. A roof membrane resistant to roots of plants so that no damage can be done by the plants during dry times;
b. A specifically constructed layer to provide draining during times of excessive water;
c. A membrane that is filtering the water from the substrate, to prevent the drainage to be silted up;
d. A substantial amount of substrate to feed the plants with air, water and nutrients;
e. A visible layer of plants and vegetation.

Most cities limit the subsidising of green roofs to flat or slightly tilted roofs. Roofs steeper than 45 ° are not subsidised.

3.1 Groningen

In this city subsidy can be obtained of € 30 per square metre to a maximum of €1.500. The subsidy is only for private households.

Groningen emphasises the saving of energy in winter and summer situation, the rainwater management, and the effects on flora and fauna. Besides the positive effects on human health an bringing nature in the city in general.

3.2 Rotterdam

Rotterdam has high ambitions already over 2400 square meters has been realised. Subsidy can be obtained of € 30 per square meter, €25 from the Municipality, another € 5 can be obtained from the district water board. There are no data of a maximum available.

Main reason to support the green roofs is the water-management of the city related to water storage. Like the other cities also other effects are mentioned as buffer the air-pollution, providing a better air quality, saving energy by insulation, decrease the air temperature in the city and making the city more green, which increase the liveability and makes room for flora and fauna.

3.3 Amsterdam

Subsidy can be obtained of € 20 per square metre to a maximum of €1.000.

As main reasons, Amsterdam mentions the roofs have a positive effect on the environment, can provide a better (rain)water management, and increase the (air)humidity. Besides the positive effect on the quality of the run-off of the rainwater, the positive effects the air quality by binding Particulate Matter (PM), the insulation, the indoor climate and the life time expansion of the roof covering

3.4 The Hague

Subsidy can be obtained of € 25 per square metre to a maximum of €20,000.

Most important reasons mentioned by this city are the insulation values (summer and winter); rainwater management; longer lifetime of the roof covering; noise reduction, more nature in the city and a better air quality.

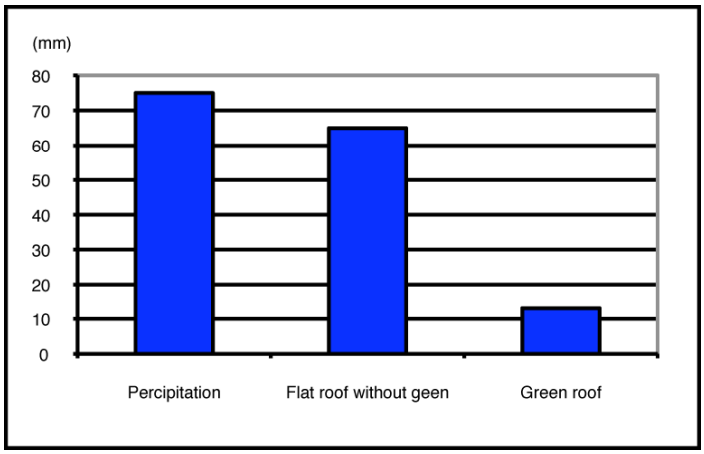

Figure 1 Peak run-off of green roofs compared with not greened roofs [6]

4 EFFECTS

The effects mentioned by the cities above are extrapolated form research in the last century. However these data are only validated on the scale of single roofs.

Already in the eighties of the last century plants grown roofs have been appearing all over Western countries. At the same time the discussion started about the benefits of these roofs. Some of the ‘experts’ claim various benefits for plants grown roofs. For over fifteen years the authors of this article did research whether these claims are true [4]. During the research, three groups of claims were investigated: intangible claims, tangible claims (both regarding advantages) and negative claims. Intangible claims were most difficult to describe. They included claims about aesthetic and psychological aspects as well as claims about using the roofs. Tangible claims were the most important part of the research. This second group of claims included all tangible benefits of plants grown roofs. That plants grown roofs benefit the (micro-) climate is an example of these claims. Other benefits of these roofs that belong to the second group of claims are: energy saving, noise reduction, providing a place for plants and animals to live, preventing rainwater flushing away into the drains, protecting the skin of the roof, low maintenance requirements and so on. Negative claims mostly concerns the high weight of the roof, the risk of fire, the risk of making construction errors and not to forget the often-mentioned higher initial costs.

In the new millennium the focus changed. Partly due to the research there was more agreement about the benefits. Also it became clear which benefits were most important. Due to ‘environmental hypes’ e.g.

initiated by Al Gore and the Cradle to Cradle philosophy the interest in environmental issues increased and more and more the consciousness arises one could make money about the benefits of green roofs.

So starting to inform architects and project-developers on how to deal with green roofs, here also the focus changes in addressing to municipalities and get them interested for the challenge to get green roofs actually realised on al large scale.

5 RETURNS ON INVESTMENT

When we look at the reasons why cities subsidise green roofs, most importantly the slowing down of rainwater run off is mentioned.

Secondly the positive influence of large scale covering of roofs with plants on the city climate is argued. Some cities perform Cost Benefit Analysis to calculate the cost for the parties involved and the benefits. These benefits are often not only for the investing parties. This is the purpose for that the policy of most cities is tailored. The policies for green covered roofs is to make private investors willing to contribute on their small scale of several square meters of roof to make it possible tat the cities benefit from positive effects on a much larger scale. Small pieces of green covered roofs apparently can make a noticeable difference.

It seems that no Dutch city makes a difference, yet, for the place in the city where a green covered roof is constructed. E.g. subsidies are connected to selected areas in these cities. From the benefits of green covered roofs, it would be advisable to subsidise inner city and down town areas more. In these areas city climate problems like urban heat island effect and Particulate Matter problems are most severe and urgent. Also water problems are most common in these high-densely populated and high-density built areas.

It seems that here arguments used to support urban policies do not match urban designers arguments.

Also it seems that making a green covered roof is more an activity of retrofit than part of spatial and urban design policy.

How can you expect them to cooperate, they are not subsidised for their effects to develop large areas of green covered roofs.

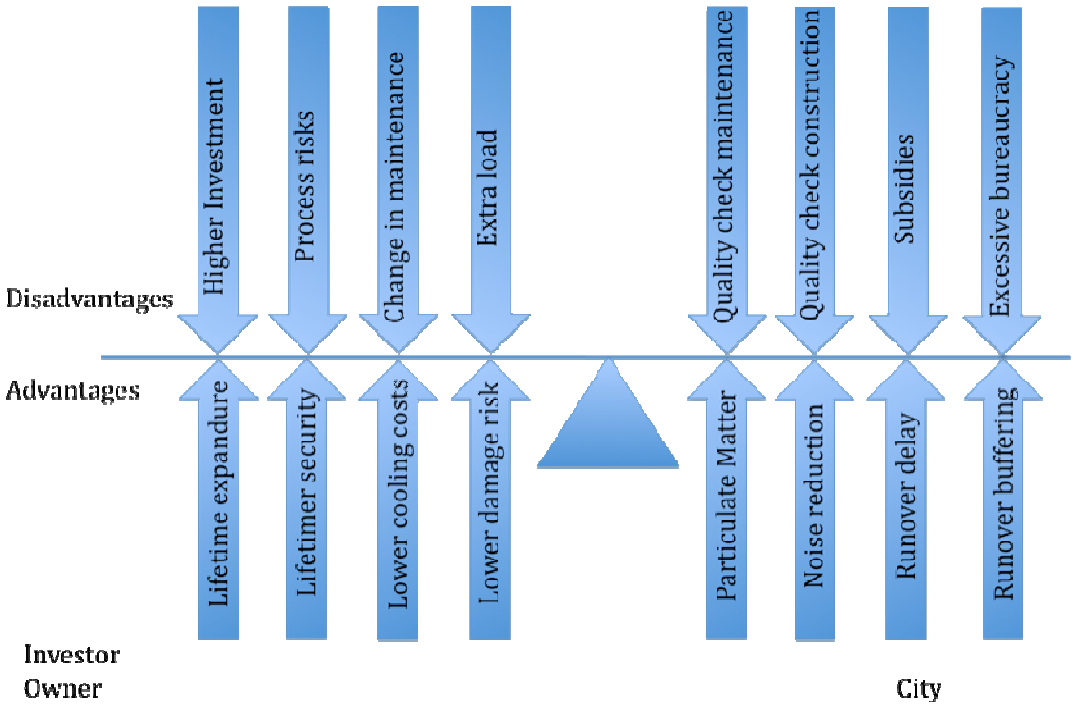

Figure 2 Social cost benefit analysis

5.1 Organisation process

From the designers perspective it seems also not clear how the potential of green covered roofs can be fully organised. Remarkable results where achieved in a London City survey for participants in the design and construction process [5]. The thesis: “The physical structure of many buildings prevent the use of green covered roofs” has to be answered. Only yes and no answers were allowed.

Table 2 Results of the English survey

Profession	Percentage of agreement
Actor analysts	67
Architects	40
City designers	33
Construction engineers	27
Developers and investors	92
Advisors ecology and water	13

6 CONCLUSIONS

It is very interesting to see that especially the initiators and decision makers do not specifically approve to using green covered roofs. Even 92 percent of the interviewed persons in this group agree with the thesis.

Whereas only 27% of the construction engineers can agrees with them. The explanation is found in lack of knowledge on this aspect. Other secondary explanations could be:

- Lack of policy from public authorities;
- Benefits and positive effects are unknown;
- Many participants think to know that costs are higher, but do not have any clue about how much higher;
- Many parties do not want to take risks in design tasks they do not know;
- Most of all the collaboration between design parties is insufficient.

The research summarises the arguments of cities, as part of their policy and put them opposite of the arguments of urban designers in order to distinguish gaps between intentions of policy makers and design criteria of urban planners, which led to recommendations for both.

This paper concludes with a set of recommendation for policy makers and urban designers where to smoothen their relationship, which are:

1. Differentiate subsidised green covered roofs according to local urgency and need;
2. Use green covered roofs to enlarge the effects of urban water management;
3. Do not hesitate to invest in green roofs;
4. Subsidise efforts to get urban quality by means of green roofs;
5. Subsidise the work of architects and urban designers in their effects to realise green roofs.

Since work is still in progress al over the world and some data is never measured, we don’t have the intention the list in complete, but it’s enough to start implementation.

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