

Factsheet - Benefits and beneficiaries of green - blue measures

Economic and social benefits

Green-blue measures offer solutions that make the urban system more climate resilient and attractive. To get a better grip on the range of benefits related to these measures and their beneficiaries, first the range of (potential) services per measure is discussed. Second, the type of benefits (financial, health, environmental) and the distribution of benefits over various beneficiaries are discussed below.

Potential services delivered by blue-green measures

For each of the measures included in the blue-green adaptation scenarios 'Green Development' and 'High density urban', the table below shows whether a specific service is expectedly delivered (yes: black circle), possibly delivered (maybe: half black circle) or not delivered (no: white circle). The potential services can be divided in four sections: climate adaptation, climate mitigation, circular economy and other services.

The primary focus of opportunity 3 is on reducing pluvial flooding and heat stress (in the table under 'urban climate'), and improving the liveability in the area. The latter is a combination of multiple factors, such as landscape quality, social cohesion, level of noise and air pollution and recreational and physical activities. Various other services can be delivered by spatial green-blue interventions, like climate mitigation and the closing of energy – nutrient – and water cycles.

In table 3, the effect of each of the proposed measures is estimated qualitatively based on literature (e.g. Centre for Neighborhood Technology (2010) and ACC report work package 4), results of the AST-tool (verwijzing) and expert judgement: for further elaboration of the method, see (ACC report WP1).

As can be seen in the figure, the measures have numerous potential services: especially the intensive green roofs and parks provide a range of services. The most prominent services the green-blue measures deliver - apart from decreasing pluvial flooding and improving the urban climate - are:

- Improvement in air quality
- Increased recreation options

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- Increased landscape quality
- Improved habitats and biodiversity

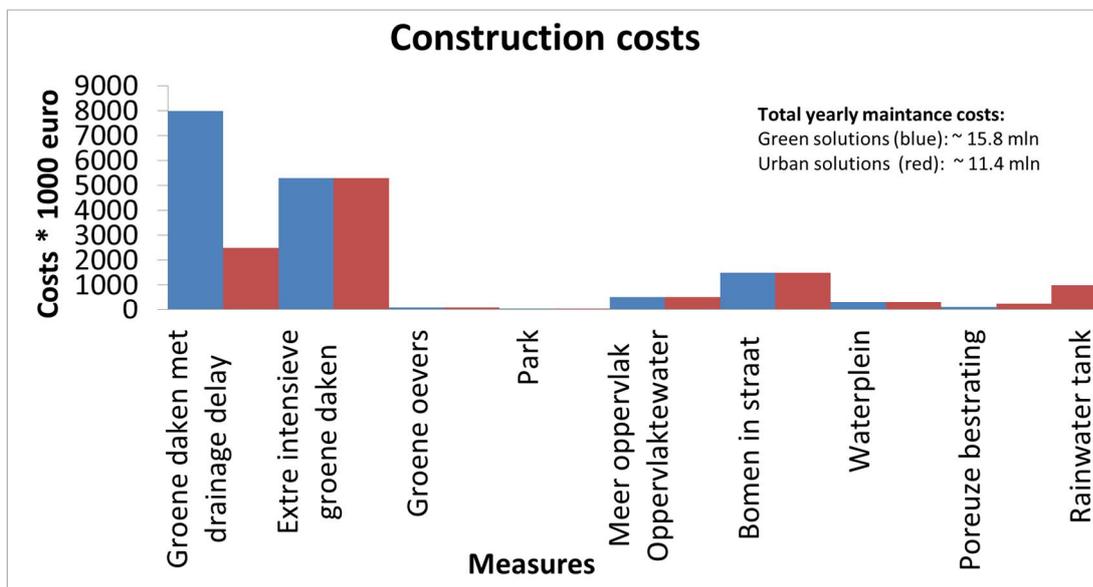
It is important to note that this table only provides an indication of the presence of these services, but nothing about the order of magnitude of the effect. Additionally, whether or not these services will actually be delivered depends strongly on the future development of the region, related local circumstances and the specific design of the measures (verwijs naar ACC rapport).

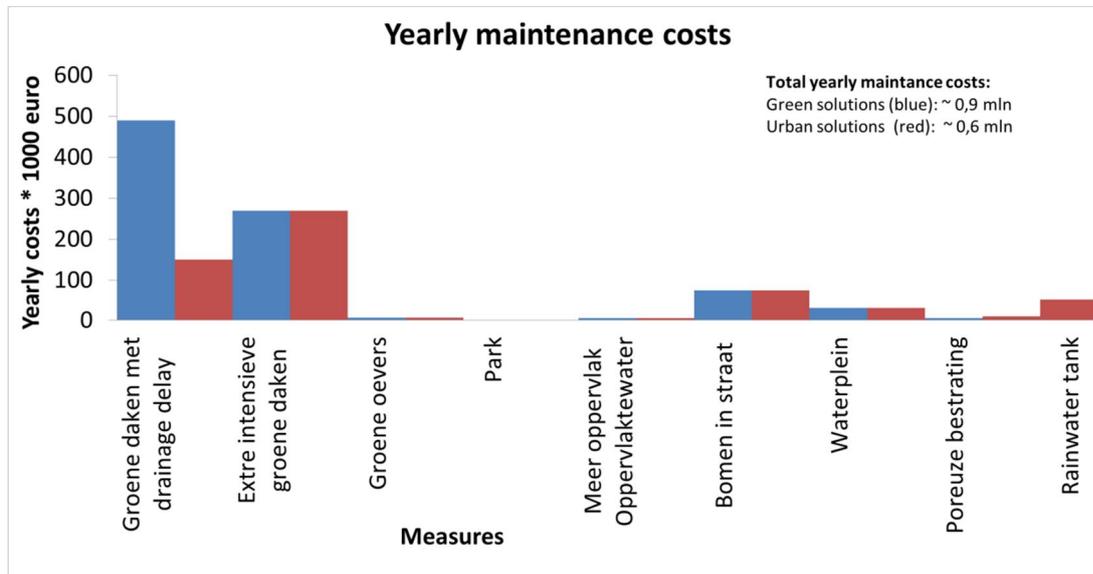
Services/ Measures	Green roofs drainage delay	Extra intensive green roofs	Green shores	Park	Increase surface area surface	Trees in streetscape	Water square	Permeable pavement	Rainwater tank
Climate adaptation									
Decrease pluvial flooding	● 2	● 2	● 2	● 2	● 2	● 2	● 2	● 2	● 2
Increase air quality	○ 0	● 1	● 1	● 2	● 0	● 1	○ 0	● 2	○ 0
Increase urban climate	● 1	● 1	○ 0	● 2	○ 0	● 2	○ 0	● 1	○ 0
Increase water quality	○ 0	○ 0	● 1	○ 0	○ 0	○ 0	○ 0	● 1	○ 0
Replenish ground water	○ 0	○ 0	● 1	● 2	○ 0	○ 0	○ 0	● 2	○ 0
Climate mitigation									
Decreased energy use	● 1	● 1	○ 0	○ 0	○ 0	● 2	○ 0	● 1	● 1
Decreased CO2 emission	● 1	● 2	○ 0	● 2	○ 0	● 2	○ 0	○ 0	○ 0
Circular economy									
Increase lifetime of infrastructure	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	● 1	○ 0	○ 0
Add to closing water cycle	● 1	● 1	○ 0	● 2	○ 0	● 1	○ 0	○ 0	● 1
Add to closing energy cycle	○ 0	○ 0	○ 0	○ 0	○ 0	● 1	○ 0	○ 0	○ 0
Add to closing nutrient/resources cycle	○ 0	○ 0	● 1	● 2	○ 0	● 1	○ 0	○ 0	○ 0
Other services									
Increase recreation opportunities	○ 0	● 2	● 1	● 2	● 1	● 1	● 2	○ 0	○ 0
Increase landscape quality	● 1	● 2	● 2	● 2	● 2	● 2	● 1	○ 0	○ 0
Increase social cohesion	○ 0	● 2	○ 0	● 2	○ 0	○ 0	● 1	○ 0	○ 0
Increase physical activity	○ 0	● 2	● 1	● 2	● 1	● 1	● 1	○ 0	○ 0
decrease noise pollution	○ 0	● 1	○ 0	● 2	○ 0	● 1	○ 0	○ 0	○ 0
Improve habitat function and biodiversity	● 2	● 2	● 2	● 2	● 1	● 1	○ 0	● 1	○ 0
Increase food production	○ 0	● 1	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Decrease criminality	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Decrease management & maintenance	● 1	● 1	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0

Benefits & stakeholders

The biggest difference between the two design scenarios is the prominence of green roofs in the 'Green Development' scenario, and the application of a rainwater tank in the 'High Density Urban' scenario. The designs differ in the degree to which they reach the goals (figuren vergelijking desings in H6 > blue-green adaptation scenarios) goals and how much they cost (figures below): the 'Green Development scenario is more effective in reaching the defined goals, but as this is reflected in higher costs.

Especially the large amount of green roofs in this scenario adds to this: this is the most expensive measure in both construction and maintenance costs. However, in general the two design scenarios have similar benefits and beneficiaries, as the applied measures mostly overlap.





Types of benefits

The various services that are delivered by the proposed measures can be specified further in benefits. This gives a better overview of who may gain from the measures, which in turn helps in defining the stakeholders that are affected by the measure or service. In this study, four types of benefits are regarded:

- Financial: actual profit or loss can be gained, e.g. avoided damage or decreased costs for certain activities)
- Health: benefits to the physical or psychological health of humans. In some cases this can be translated in financial costs, but as this is an indirect effect and in some cases disputed, health benefits are regarded separately here.
- Environmental: benefits to the environment, without direct effect on humans or business. This may encompass increased biodiversity, decreased pollution, improved connectivity, etc.
- Other: benefits that do not directly fit in the benefit types above for example reputational benefits.

The magnitude of these benefits depends on the context. Since the project is still in an explorative phase, the benefits are not yet monetized. The results should be seen as a rough estimates of the benefits of the two alternatives.

As in this chapter only a rough estimate is done of the benefits of the scenario, it can be seen from figure (below) that the expected benefits from both scenarios do not

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differ substantially. In the figure, a half circle means limited benefits; a full circle means many benefits and empty circle no expected benefits.

Services/ Benefit Type	Green solutions				Urban Solutions			
	Financial benefits	Health benefits	Environmental benefits	Other benefits	Financiele baten	Gezondheidsbaten	Milieubaten	Andere baten
Climate adaptation								
Decrease pluvial flooding	● 2	○ 0	○ 0	◐ 1	● 2	○ 0	○ 0	◐ 1
Increase air quality	○ 0	◐ 1	○ 0	○ 0	○ 0	◐ 1	○ 0	○ 0
Improve urban climate	○ 0	● 2	○ 0	◐ 1	○ 0	● 2	○ 0	○ 0
Increase water quality	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Improve replenishment ground water	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Climate mitigation								
Decrease energy use	◐ 1	○ 0	○ 0	◐ 1	○ 0	○ 0	○ 0	○ 0
Decrease CO2 emission	◐ 1	○ 0	○ 0	◐ 1	◐ 1	○ 0	○ 0	◐ 1
Circular economy								
Increase life infrastructure	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Add to closing water cycle	◐ 1	○ 0	◐ 1	○ 0	○ 0	○ 0	◐ 1	○ 0
Add to closing energy cycle	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Add to closing resources cycle	◐ 1	○ 0	◐ 1	○ 0	◐ 1	○ 0	◐ 1	○ 0
Other services								
Increase recreation opportunities	◐ 1	◐ 1	○ 0	◐ 1	○ 0	◐ 1	○ 0	○ 0
Increase landscape quality	◐ 1	◐ 1	○ 0	● 2	◐ 1	○ 0	○ 0	● 2
Increase social cohesion	○ 0	◐ 1	○ 0	● 2	○ 0	○ 0	○ 0	● 2
Increase physical activity	○ 0	● 2	○ 0	○ 0	○ 0	● 2	○ 0	○ 0
Decrease noise pollution	○ 0	● 2	○ 0	○ 0	○ 0	● 2	○ 0	○ 0
Improve habitat function and biodiversity	○ 0	○ 0	● 2	○ 0	○ 0	○ 0	● 2	○ 0
Increase food production	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Decrease criminality	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0	○ 0
Decrease management & maintenance	◐ 1	○ 0	○ 0	○ 0	● 2	○ 0	○ 0	○ 0

Stakeholders

In the area there are several stakeholders that may benefit from the measures. A distinction is made by direct stakeholders, who are directly affected by the project, and indirect stakeholders. These have indirect benefits – there is no direct need of including them in the decision making process, but they need to be informed.

Municipality Utrecht: The municipality has several responsibilities and ambitions in the project area. Among others, they want the quality of the surroundings to be good: not only in order to increase the liveability for inhabitants, but the area also serves as

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'visiting card' for Utrecht, as it is the first part of Utrecht that visitors may see. The municipality faces the challenge of dealing with an increasing numbers of travellers, and an increasing number of inhabitants living in the area. They are also responsible for ensuring a healthy environment, and management and maintenance of the sewer system.

Jaarbeurs: this large conference centre is an important actor in the project. They own a large part of the project area, and are directly involved in the redevelopment of the area. The Jaarbeurs aspires sustainable development of their grounds, with increased quality of the nearby environment.

Inhabitants: Currently there are few inhabitants in the project area, but in future scenario's more housing opportunities will be provided, among others in the top floors of the Amrath hotel. Inhabitants will be strongly affected by the spatial and environmental quality in the neighborhood.

Indirect stakeholders

Travellers: The Utrecht CS area is one of the most important transport hubs in the Netherlands: within 10 years 360.000 travellers a day are expected to use Utrecht CS as a hub.

Water managers: Rijkswaterstaat (Merwedekanaal), the Regional Water Authority Hoogheemraadschap De Stichtse Rijnlanden (HDSR), and a part of the Utrecht municipality (sewer system, storage).

Leisure companies: Three large leisure companies will be established in the project area in the coming years: Wolff Cinema Group; Holland Casino and Amrath Hotelgroup. They may benefit from an increased spatial quality in the area. Currently, there are two large hotels in the (adjacent) area: NH Hotel and Park-Plaza.

Other companies: There are various offices in the area (e.g. Rabobank), and more are anticipated in the future. They benefit from a healthy and high-quality working environment, and good accessibility.

Figure (below) shows which stakeholders are expected to benefit from each service that is delivered by the measures (eerste figuur in stuk)

Services/ Stakeholders	Municipality Utrecht	Water manager	Jaarbeurs	Inhabitants	Travelers	Visitors	Other companies	Leisure companies
Climate adaptation								
Decrease pluvial flooding	+++	+++	++	++	+	+	++	++
Increase air quality	++		+	+++	+	+	+	+
Increase urban climate	++		+	+++	+	++	+	+
Increase water quality*	+	+++		+		?		?
Replenish ground water**		++						
Climate mitigation								
Decreased energy use	+++		+++	+			++	++
Decreased CO2 emission	++		++					
Circular economy								
Increase lifetime of infrastructure***	+++							
Add to closing water cycle		+++						
Add to closing energy cycle****	+++		+++	+			++	++
Add to closing nutrient/resources cycle		??						
Other services								
Increase recreation opportunities	++		+++	+++	+	+++	+	+++
Increase landscape quality	+++		+++	+++	++	+++	++	+++
Increase social cohesion	+++			+++				
Increase physical activity	++			+++		++		
decrease noise pollution	++		+++	+++		+		
Improve habitat function and biodiversity	++							
Increase food production								
Decrease criminality								
Decrease management & maintenance	+		+				+	+
?: only if water recreation is part of the new developments - in this case water recreationst and - companies will benefit								
??: Financial benefits may be derived by the waste water treatment plants as costs are lower when water quality is higher								
*: Only if there is demand for improved water quality and a substantial improvement is realized, this is a benefit								
**: Only if there is currently a problem with the ground water level - unknown at the time of writing								
***: Undertain effect, and not likely very strong								
****: There is double counting here with 'decreased energy use'								

Distribution of benefits over beneficiaries

In this section the expected benefits and main beneficiaries will be discussed for each of the proposed measures (based on the two above tables) that are expected to have a significant benefit (full black circle) or multiple moderate benefits (half circle). In the last part, the differences between the design scenarios will be shortly discussed.

Climate adaptation

Decreased pluvial flooding

Decreased regional flooding is one of the most important goals of this project. There are financial benefits, mostly in the shape of damage to property, and other benefits, such as meeting safety obligations:

- **Municipality Utrecht** is responsible for the maintenance and management of the urban drainage system, and for any damage in the public domain (financial benefits). The municipality may have reputational damage if nuisance and damage from flooding occurs often (other benefits).
- **Water manager**: responsible for ensuring a low flooding probability. By decreasing the flood probability/ robustness of the area future requirements and investments in drainage and pumping infrastructure may be decreased, as well as current pumping costs during storm events (financial benefits). Reputational damage plays a role here as well (other benefits).
- **Jaarbeurs/ Other companies/ Leisure companies**: Owners of buildings are often responsible for damage caused by local flooding, unless it can be proved to be caused by negligence by water manager or municipality – this is not often the case. These parties all have a stake in decreasing flooding, as they are responsible for damage themselves (financial benefits). This damage can be direct, but also indirect in the form of foregone income during temporary closure or inaccessibility of the building

Other beneficiaries include **inhabitants** and **travellers**. Damage from flooding may be direct for home owners, but also indirect due to inaccessibility of houses and increased travel time (financial benefits).

Improved air quality

It is not expected that the air quality will be improved substantially as a result of the proposed measures. If after further research they do prove to have a significant effect, this connects to the following benefits and beneficiaries:

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Improved air quality leads to health benefits: decreased health costs, increased length of life and increased quality of life. This is especially relevant for **inhabitants** and in lesser degree also to others staying in the area: **visitors, (frequent) travellers and employees of companies**. Other benefits are derived by the **Municipality Utrecht** that has the obligation to ensure a healthy living environment and meet regulations.

Urban Climate

In the context of this project, 'Urban climate' relates mostly to the urban heat island effect. This is especially relevant for **inhabitants** – providing health benefits mostly for elderly. The municipality has a responsibility for providing inhabitants with a high quality living environment (other benefits). Other beneficiaries may include visitors to the area, and companies – a pleasant environment will increase attractiveness of the area for clients and increase their length of stay (other benefits).

Increasing water quality and quantity

In this case, it is not expected the proposed measures will strongly affect water quality – especially green shores may improve the water quality in the surface water. It is unknown whether there is currently a problem with water quality and (too low) ground water levels. The latter are recharged by increasing the permeable surface. If there is an ambition/ need to improve both water quality and quantity in the area, this potentially relates to the following benefits and beneficiaries:

Improved water quality will benefit **water managers** responsible for surface water quality (financial benefit), – if part of the future developments in the area - **water recreants** (health benefits), and improved habitats (environmental benefits).

Climate mitigation

Energy use

Energy used is decreased through green roofs providing better insulation, and trees in the streetscape causing decreased cooling demands in summer (they provide shade) and decreased heating demands in winter (by decreasing the cooling effect of the wind). Though this could be seen either as a financial or environmental benefits, it is primarily a financial benefit, mostly for the **Jaarbeurs**, which has many buildings in the area and will have most green roofs. As the ambition of the **Municipality Utrecht** is to develop the area in an energy-neutral way, the decreased energy demand also adds to reaching this goal (other benefit).

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CO₂- reduction

Storage of CO₂ in biomass can be seen as either a financial, environmental or other benefit. Some stakeholders, like **companies**, may have reduced taxes, less costs for emission rights or advantages with respect to customers or clients when they operate in a sustainable way (financial benefits). It could also be less tangible: more beneficial in a marketing context, and in meeting their own sustainability goals: such as **the Jaarbeurs** and the **Municipality Utrecht** (other benefits). CO₂ reduction has benefits for the environment as well.

Other services

Increase recreation opportunities

Increasing the recreation opportunities in the area, through parks, intensive green roofs and water squares and possibly green shores and increased surface water as well, has various benefits. The attractiveness and multifunctional use of the area increases, which is an ambition of **Municipality Utrecht** (other benefits). For **inhabitants** the quality of the area increases, with more relaxing activities in green areas nearby: this has various health benefits, though the exact effects and enabling variables need to be further investigated (Hunter et al., 2015; Lee & Maheswaran, 2010). Especially for leisure companies, including the Jaarbeurs, the increased recreation opportunities attract more visitors to the area and/ or make the area more attractive for clients (financial benefit).

Increase landscape quality

An increased landscape quality in the area is the specific ambition of the **Municipality Utrecht and Jaarbeurs**. This improves the entrance of the city and Jaarbeurs, serving as a visiting card. This will improve the image of the municipality and the Jaarbeurs (other benefits), and may attract more tourists and visitors to the region (financial benefits). Another important beneficiary are those people who often visit the area: **inhabitants, travellers and visitors**. They will be happier during their stay in the area (health benefits). Leisure companies, and in some degree other companies will also benefit from the improved quality of the neighbourhood, as this may attract more customers or increase their length of stay. It is also known that the value of buildings (especially houses) is larger when there is green-blue space nearby (financial benefit).

Increase social cohesion

If green roofs, parks and water squares are designed in such a way that they can serve as community centre/ community activity or meeting place, they increase social

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cohesion in the area. This is one of the ambitions of **Municipality Utrecht** (other benefits). **Inhabitants** directly benefit from increased social cohesion: they are the main target group (other benefits).

Increase physical activity

Parks, intensive green roofs where gardening or walking is possible, and green shores can add to increased physical activity, depending on their design: green urban spaces encourage participation in physical activity (Hunter et al., 2015). This has health benefits for **inhabitants**, possibly also attracts visitors. The health of inhabitants - and decreasing health costs - is an ambition for the **Municipality Utrecht** (other benefits).

Decrease noise pollution

Though strongly dependent on the configuration of the green measures, especially parks and trees in the streetscape can decrease noise pollution. Noise pollution in the area originates from traffic and occasionally from the **Jaarbeurs** (music events). Currently, noise pollution may especially harass employees from regular companies, but when in the future the area will house more inhabitants, the noise pollution problem may increase. Keeping noise pollution and nuisance to a minimum is a responsibility of the **Municipality Utrecht** (other benefits). The **Jaarbeurs** may suffer from complaints, reputation damage and possibly even fines if the area is used more intensively in the future (financial and other benefit from decreasing pollution). The third party benefiting from decreased noise pollution are **inhabitants**: noise pollution leads to increased stress and sleeplessness (health benefits).

Improve habitat function and biodiversity

Green roofs, parks and green shores positively affect biodiversity by providing habitats for flora and fauna (environmental benefit).

Decrease management and maintenance

If a green roof is properly designed, the maintenance requirements are small: the green roof can protect the roof from weather influences (Low Impact Development Centre, n.d.). This goes especially for extensive green roofs, included in the 'Green urban' scenario. Especially the owners of the buildings will benefit from the decreased maintenance costs: at least the **Jaarbeurs**, but also other companies owning the

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buildings in the area (financial benefits), though whether this is an overall benefit also depends on the construction costs of the green roof.

Summary

The most important benefits of both scenarios are the reduction of pluvial flooding, improvement of the urban climate and improvement of the spatial quality, including increased physical activities, biodiversity, recreation options and social cohesion. The main beneficiaries of the scenarios are the Municipality Utrecht, Jaarbeurs and inhabitants; visitors and other companies present in the area benefit as well.

'Green Development' scenario

This scenario is distinctive for the large number of green roofs. This decreases the risk of pluvial flooding, of which the main beneficiaries are the Municipality Utrecht and water managers; also to a lesser degree the Jaarbeurs and other companies affected by direct damage or decreased income during and after floods, and other stakeholders like travellers and visitors. The green roofs also increase spatial quality (if visible to the public) and biodiversity

'High Urban Density' scenario

This scenario includes less green roofs, but adds a rainwater tank to the design. Its main purpose is to store rainwater during floods. During droughts, this water can be used for various functions that do not require drinking-water quality.

Evaluation

This section discussed the benefits related to the proposed measures, and their division over various stakeholders in the area. This gives insight in who has what type of benefits from the design scenario. This information can be used in the following project phases to identify relevant stakeholders that can be involved and kept informed in further specification of the design. It is also helpful in identifying potential co-financiers. To further address this last topic, it is necessary to further quantify the expected benefits and identify uncertainties in costs and benefits. This will help in making clear to private financiers how the project could be attractive to them. Overall, the information in this section can be used to draft a business case for the alternative designs.

Recommendation

To see if the proposed designs are indeed feasible, and evaluate if – and which design - they are optimal solution to meet the challenges in the area, a more elaborate study is needed. This could include a business model to see how the proposed designs can be implemented, and a social-cost benefit analysis in which the design(s) are compared to a reference scenario. To this end, more in-depth information is needed on the reference scenario (and related costs to e.g. flood risk and heat stress) and the various services the measures deliver need to be quantified; and their benefits monetised.

Another topic for further research is to assess sustainability of the measures in a broader context: including the use of materials and resources when constructing and maintaining the measures.

References

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