



DAKEN DRAAIBOEK



Daken Draaiboek

GUIDELINES FOR AN INTEGRAL APPROACH TO TRANSFORMING ROOFTOPS

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Preface

WHY?

The Daken Draaiboek is written to show the enormous potential of using rooftops to create more liveable cities. Using rooftop space can be an answer to current issues such as climate change, housing shortage and the energy transition. In combating these challenges rooftops are still not taken into account enough, even though the Netherlands has over 600 km² of flat rooftop space available.

In the past decade, there has been a growth in the installation of solar panels on roofs in the Netherlands. However, there is so much more where rooftops can be used for than just generating energy. The exploration of possibilities for rooftops is still in an early phase. There are multiple functions possible that provide different benefits for the city. So, it is important when transforming rooftops to make well weighed decisions. This Daken Draaiboek shows steps for stakeholders to take in making these decisions.

FOR WHOM?

We do see that individuals are already getting started with their rooftops. But, it is important for big players such as the municipality, developers and social housing associations to align their ambitions. So, this Daken Draaiboek is for every organisation that wants to set ambitions and make balanced choices in the rooftop transition.

This Daken Draaiboek should not be seen as a guideline just for Amsterdam, it can inspire other cities to set their ambitions for rooftop transformations. The guidelines described in this booklet can be applied to every neighbourhood in every city. We would like to share our knowledge and inspire everyone in any position related to roofs. This Daken Draaiboek provides the tools to do so. To give an example/indication on how to implement these guidelines, a case study is done in the Dapperbuurt in Amsterdam.

The Daken Draaiboek team is part of the TU Delft, Wageningen University and Research, and the AMS Institute and commissioned by Jungle Amsterdam. Jungle Amsterdam is an independent information and advice center in the field of social and environmental sustainability. They saw the opportunity flat roofs have to offer and therefore asked us, students of the master Metropolitan Analysis, Design & Engineering, to take a further look at this.

We hope this booklet will stay alive after writing and will start the discussion in many neighborhoods in the Netherlands and possibly the rest of the world. We like to see stakeholders make well weighed steps in the rooftop transition. This booklet could serve as a first step to get these conversations going and bring important stakeholders together to realise change.



Showing possibilities

This chapter explores the utopic future of multifunctional rooftops without financial or legal constraints. We aim to inspire and dare the reader of this booklet to dream big.

The Netherlands has around 600 km², almost 100.000 football fields, flat rooftop space that can potentially be transformed. We identified enormous potential in developing these rooftops, which can impact not only the people living under the roof or people using the roof, but also the surrounding area. Moreover, a network of multifunctional rooftops can have enormous benefits for the local and regional development and it can provide momentum for a movement that so far did not tap into its full potential. But first, we explain the five main rooftop functions.



Blue
Water storage during heavy rain events. It acts as a buffer, delaying the release of water.



Green
A green roof is a layer of vegetation planted over a waterproofing system that is installed on top of a flat or slightly-sloped roof. Green roofs are also known as vegetative or eco-roofs



Yellow
Roof used for renewable energy production, installed on the existing (grey) roof. Sometimes a gravel bed is used.



Purple
A retrofitted (grey) roof which adds housing on top of the existing structure. (i.e. tiny house)

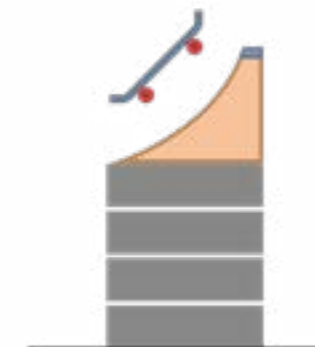


Red
A rooftop used for social activities, privately or publicly accessible. (i.e. light social activities, private events etc.)



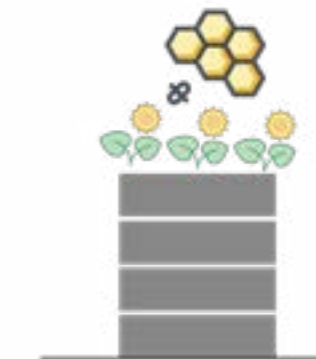
Grey
A conventional flat rooftop, represented by insulating layers and a black bitumen top layer.

Imagine if we start using all that available rooftop space, it's the equivalent of adding another layer to the city. Green, clean, social, car-free, bee-friendly space. Some of the possibilities are shown here.



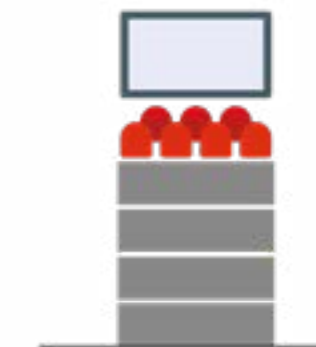
Skate park
Rooftop functions

● Social cohesion



Bee garden
Rooftop functions

● Product sale
● Biodiversity



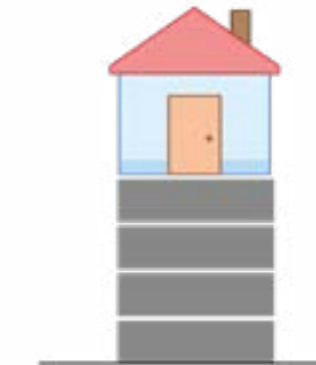
Open-air cinema
Rooftop functions

● Social events
● Electricity generation



Swimming pool
Rooftop functions

● water buffer
● Social activity
● Vegetation



Tiny House
Rooftop functions

● Additional housing



Sport field
Rooftop functions

● PV for lighting
● Social activity
● Vegetation

Process guidelines



This chapter explains the process on how to realize the rooftop transformation and provide guidelines to replicate the integral approach. The process is has four phases: Discover, Dream, Design and Destiny.

In the previous chapter you got inspired by all the possible rooftop functions. However, in reality it can be a difficult process to decide which rooftop function should be implemented. In this process it is important to involve all the stakeholders and finally come to a common understanding and set ambitions. This part of the booklet will explain the process on how to realize the rooftop transformation and provide guidelines to replicate this integral approach. The process is based on the 4-D cycle, which entails four phases: Discover, Dream, Design and Destiny. The goals, methods and steps to take are explained for every phase.

Each phase has several steps which should be taken in the correct order as every step generates information which serves as input for the next step. Although, it is an iterative process, meaning there are opportunities to re-engage the cycle in each phase. The previously performed steps could therefore be re-taken when information for a following step is missing.

Discover



1. Neighbourhood context
2. Stakeholders
3. Current rooftops

Dream



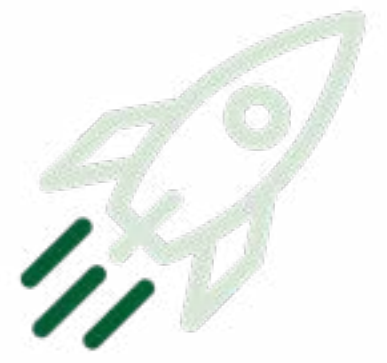
1. Co-creation
'Make your roof'
2. Co-creation
'100 points test'
3. Extra co-creation

Design



1. Criteria
2. Criteria importance
3. Multi-criteria decision analysis (MCDA)
4. Rooftop rankings

Destiny



1. Missing elements
2. Legal requirements
3. Technical requirements
4. Financial feasibilities
5. Realise rooftop



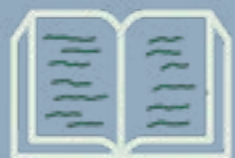
Discover

Goal

Understand the context of the neighbourhood and rooftop stakeholders.

Gaining trust with stakeholders to engage them further in the process.

Methods



Literature/documents



Expert interviews



Site visits

Research the following topics, while connecting with the wide variety of stakeholders who are involved and/or affected.

NEIGHBOURHOOD CONTEXT

Characteristics of the neighbourhood

- Demographics
- Neighbourhood characteristics
- Housing typologies

Neighbourhood challenges

- Social
- Environmental

STAKEHOLDERS

Who are involved and/or affected

Make a stakeholdertree of all stakeholders

Identify aims of stakeholders

CURRENT ROOFTOPS

What is currently happening with rooftops in the neighbourhood? Are there rooftop transformations taking place, and if so which transformations and at what locations?



Dream

Goal

Stakeholders understand possible rooftop transformations.

Understand if and what kind of rooftop transformations stakeholders want and their reasoning behind their choices.

Methods



Co-creation sessions

CO-CREATION 'MAKE YOUR ROOF'

Organise a co-creation session with residents within the neighbourhood, preferably at a location which is familiar to many residents (for example at a community centre). Before organising the sessions, try to talk with residents whom fulfill a social function in this neighbourhood and start building trust and relationships with and via them.

When preparing the session identify the following elements:

- Whom to invite
- How many people (hence you can decide to host one or more of this type of session)
- How to reach participants
- Time and location

During a session, all the comments and explanations given by participants should be documented.

The session is build up by the following elements:

- Goal
- Knowledge you want to gain
- Set up
- Discussion format

These elements are the same for all resident co-creation sessions.

Goal

- Residents feel involved and heard in the project
- Inspire residents on possible rooftop transformations
- Developing alternative roof functions together with the residents
- Find residents that want to voice the dreams of their neighborhood towards other stakeholders



Knowledge you want to gain

- Understand challenges in the neighborhood where roofs can be an answer to
- Understand the wishes and needs of residents of Dapperbuurt

Set up

U shape, tables facing each other or set up with similar characteristics;

- so participants can look at each other (during discussions)
- are able to view the presentation and flip over
- allows presenters to approach and engage with the audience

Discussion format

- Introduce yourselves
- Ask the following two questions:
What do you enjoy?
What do you need, for yourself and for the neighbourhood?

- Let participants write their answers on post-its and have an open conversation about the answers
- Introduce the project
- Show what current roofs in this neighbourhood look like
- Show possibilities of rooftop transformations
- Show roofs which are not realised but might be possible
- Let participants create their own dream roof, by putting their preferred images on the rooftop template (*next page*).

Explain they should think about what they prefer on their roof because they cannot place everything on there. The images are made on scale and therefore represent the actual space it would take on a roof.

- Let participants explain why they created this roof
- Wrap up of the session

Dream roof template and images

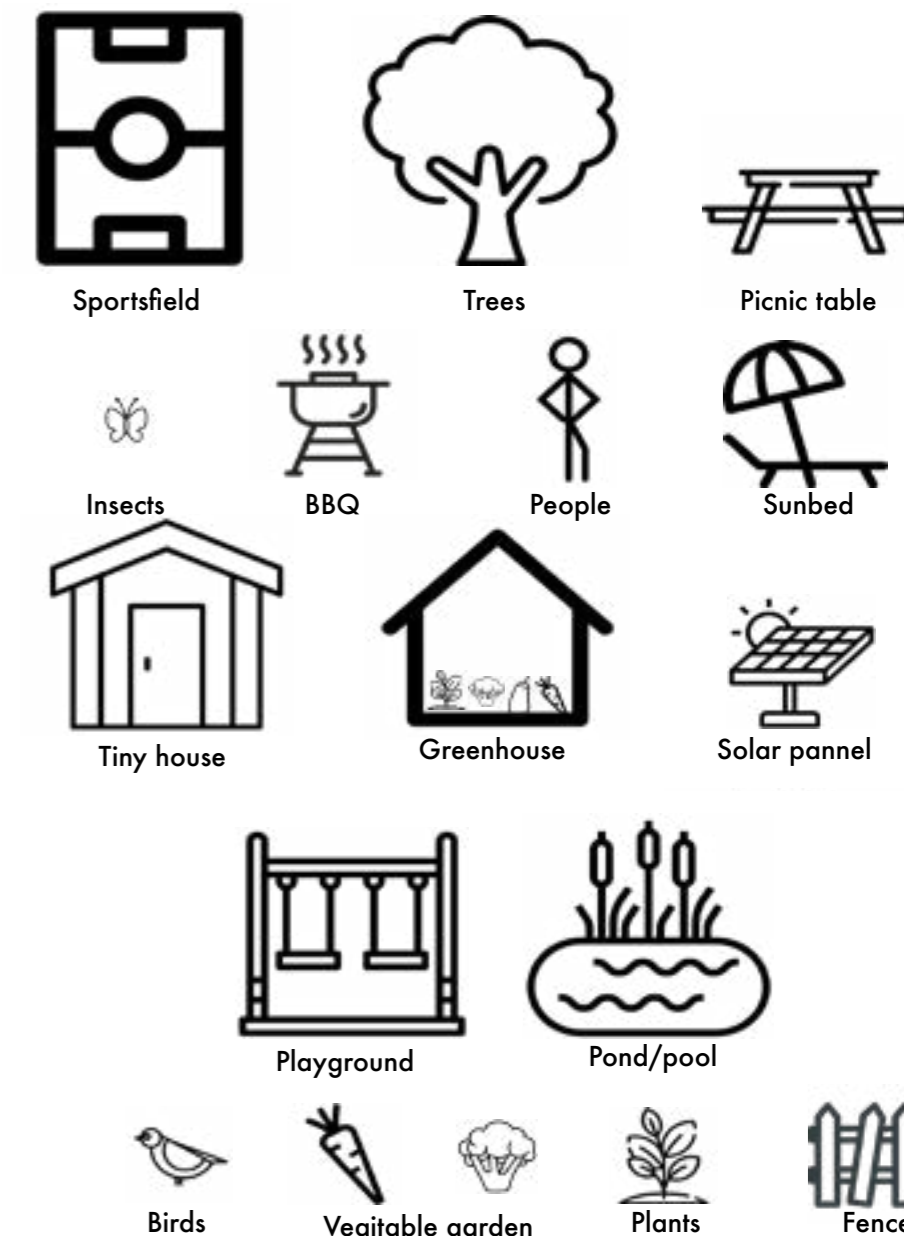
Rooftop name:

Floor of your home:

Age:

Household:

Comments:



Use the comments, explanations and created rooftops to draw conclusions on challenges in the neighbourhood and what residents wish to have on the rooftops in their neighbourhood. Furthermore, create personalia based on the given characteristics of the residents, to ensure the privacy of participants.



CO-CREATION '100 POINTS TEST'

Organise a co-creation session with representatives of all stakeholder groups. As opposed to the previous co-creation session not only residents are invited. In addition to some representative residents, local government, business, owner associations, etc can be invited. This session is preferably at a location in the neighbourhood of concern (for example at a community centre). Before organising the sessions, try to talk with residents who fulfill a social function in this neighbourhood and start building trust and relationships with and via them.

The session is build up by the following elements:

- Goal
- Knowledge you want to gain
- Set up
- Discussion format

These elements are the same for all '100 points test' co-creation sessions.

Goal

- Stakeholders feel involved in the project
- Connect stakeholders
- Develop individual rooftop function balance

Knowledge you want to gain

- Importance of rooftop function balance of stakeholders
- What commons, differences and discussion points are between stakeholders

Set up

U shape or set up with similar characteristics, to ensure stakeholders see each other as equal collaborators;

- so participants can look at each other (during discussions)
- are able to view the presentation and flip over
- allows presenters to approach and engage with the audience

Discussion format

- Introduce yourselves and the project
- Let all stakeholders introduce themselves
who they are
from which perspective they are looking
their relation to roofs
- Explain challenges of the specific neighbourhood
- Explain different meaning of different roof types
- Let participants make an individual scoring of rooftop functions, by using a 100 point test
Where participants have 100 points to divide over the different roof functions according to their preference in an ideal situation (not considering legal, technical and financial aspects)
- Let each participant explain their scoring
- Let participants discuss about their agree- and disagreements of fellow participants
- Wrap up of the session

When preparing the session identify the following elements:

- Whom to invite
- How many people (hence you can decide to host one or more of this type of session)
- How to reach participants
- Time and location

During a session, all the comments and explanations given by participants should be documented.



100 point test

Roof type	Percentage	Why?
Grey		
Blue		
Green		
Yellow		
Purple		
Red		
<i>Total</i>	100	-

After about a week, send all participants an evaluation form to discover the following points:

- If and what new insights were gained in the session
- If and how they would change their 100 point test
- Feedback on how they experienced the session

Use the comments, explanations, rooftop function divisions and results from the evaluation form to draw conclusions on values of different stakeholders. Furthermore, identify the common interests and conflicting points of discussion.

EXTRA CO-CREATION

In case of absence of certain stakeholder groups in the previous session, organise extra co-creation sessions with a smaller group. Hence, you will be able to gain insight on their perspective. Analyse these sessions similarly to previous mentioned co-creation sessions.



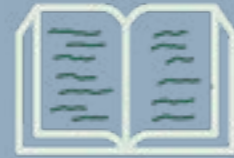
Design

Goal

Identifying importance of criteria for stakeholders.

Ranking of rooftop functions based on stakeholders wishes.

Methods



Literature/documents



Multicriteria design analysis

In order to initiate a design process, our product shows the pros and cons of several types of roofs. The classification is merely intended for putting all the information about the neighbourhood and the stakeholders together and making a decision, rather than visualizing the full spectrum of clear outcomes. It is the metadata of the actual roof. But the organic, final result of such a process is the implementation of the multifunctional roof.

In order to navigate the complex process of designing a multifunctional rooftop, a Multi-Criteria Decision Analysis (MCDA) model has been used. It is the bridge between the stakeholders' wishes and the development team. This phase explains why we used such a model and how the reader is supposed to use it as well.

CRITERIA

The MCDA was developed to account for all the criteria which might influence the final multifunctional roof. There are a total of 16 criteria and 13 rooftop alternatives, with each weight representing the wishes and aspirations of the stakeholders, as identified from interviews, co-creation sessions and policy documents. To assess the ideal rooftop function, a set of criteria has been established. On the next page a description of the criteria is given. A positive sign (+) means its increase will be beneficial for the scope, while a negative sign (-) means its reduction is beneficial for the scope. They are divided in four categories:

Environmental: criteria that relate to environmental factors and have an impact on the local climate.

Economic: criteria that have a direct economical impact.

Performance: criteria which affect the technical performance of the roof.

Social: criteria which affect the socio-cultural landscape.



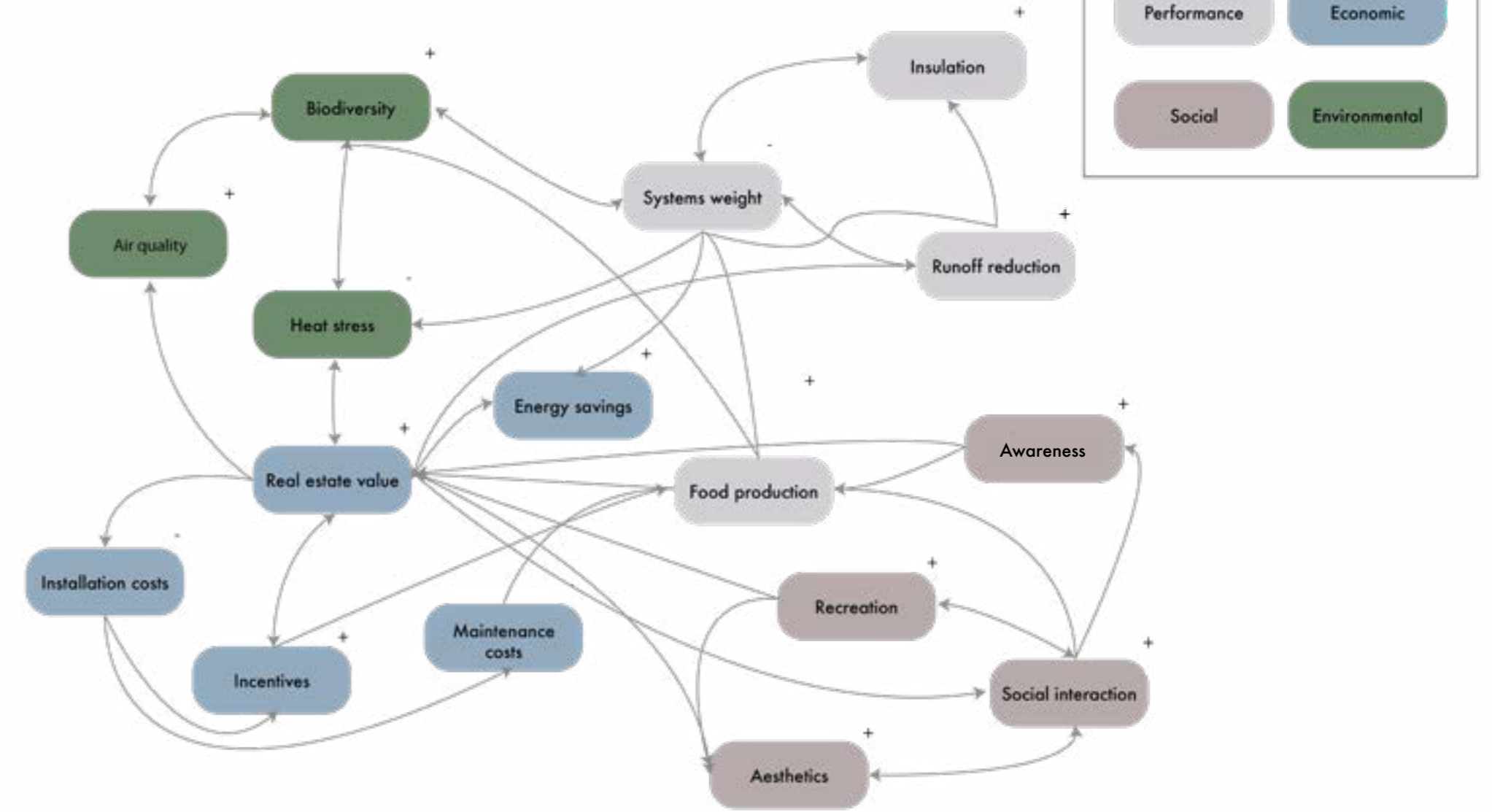
Category	Criterion	Desired change	Description	Unit of measurement
Environmental	Air quality improvement	+	The ability of the rooftop to locally improve air quality. This either relates to the ability of vegetation to store carbon and produce oxygen, or on its ability to filter air micro-pollutants.	AQI (Air Quality Index)
	Heat stress reduction	-	The capacity of the rooftop to reduce heat stress (perceived temperature), achieved by better thermal insulation, shade from vegetation, evapo-transpiration from plants, and by (natural) wind barriers.	
	Biodiversity	+	The extent to which the rooftop improves local biodiversity. This is done by plant addition, but the variety of the vegetation is of crucial importance.	Biodiversity metric
Economic	Incentives	+	The possibility and ease of accessing incentives and other financial schemes in order to achieve the desired goal.	EUR
	Installation costs	-	The financial costs associated with the production and installation of the retrofitted roof.	EUR
	Maintenance costs	-	The financial costs associated with the maintenance and use of the retrofitted roof, in order that it fulfills the predetermined goal.	EUR/year
	Real-estate value	+	The extent to which the rooftop increases the real-estate value of the building.	% of initial value
	Energy savings	+	The possible energy savings by means of thermal insulation or energy production.	EUR/year/person

Criteria explanation

Category	Criterion	Desired change	Description	Unit of measurement
Performance	Runoff reduction	+	The ability of the rooftop to decrease runoff, store water, and manage stormwater.	% compared to grey
	Systems weight	-	The total added weight of the rooftop system.	kg/m ²
	Food production	+	The ability of the rooftop to produce food, either by natural means or by artificial lighting, ventilation and warming.	kg/year
Social	Recreation	+	The ability to add recreational functions to the rooftop (i.e. meeting people, sport activities, events etc.).	-
	Aesthetics	+	The added aesthetic value. It can be applied to the users of rooftop or to people viewing the rooftop.	-
	Education / Awareness	+	The ability of the rooftop to provide educational activities, training, or information dissemination.	-
	Social interaction	+	The ability of the product to accommodate social interaction.	-



However, all product criteria are correlated and are part of an interconnected system that describes the scope of our living lab, increasing the livability of Dapperbuurt. The exact functional representation and distribution will be assessed according to the described criteria but it is also highly dependent on qualitative properties regarding the location, such as accessibility, cultural landscape, and social perception. The mentioned properties are crucial for implementing any type of rooftop project, which deems them to be the most significant challenges we face. Therefore the ambition is not only in deciding the ideal combination of functions but also in identifying the reason why they are not implemented on available rooftop space. The decision matrix and the weights of each criterion will be established for the next step, according to the SMART concept (Specific, Measurable, Achievable, Relevant, Time-bound).



Multi-criteria mapping



In order to perform a more thorough analysis, we identified a number of 13 roof typologies in addition to previous explained 6 roof types. This contributes to the design and implementation of multifunctional roofs. They are clearly defined with the help of colours and sometimes a combination of colours (functions). Of course a functional overlap is not only possible but also desirable, yet we have only included the most common two-type combinations because of lack of available data. One important mention is that the food production roof type also shows in the criteria list as green food production. This is because a food production rooftop can range from a dense urban garden to an aquaponics system and it almost always includes the social (red) function because of the need to collaborate.

These images show the roof typologies that we use to assess their performance, and the assumptions we made in order to accurately score them. Let these not be a hindrance when letting yourself get inspired, but a guide that helps you choose the right rooftop.



Blue
Water storage during heavy rain events. It acts as a buffer, delaying the release of water.



Blue-green
A combination of water storage (blue) and vegetation (green).



Green intensive
The typical plants are succulents, herbaceous, and grasses and they require no extra irrigation. The substrate layer is 6-20 cm high.



Green semi-intensive
The roof allows for a thicker substrate (15-25 cm) and a higher variety of plants (i.e. herbaceous, grasses, and shrubs). It requires periodic irrigation.



Green extensive
The equivalent of a rooftop garden, a green intensive roof requires regular irrigation. The vegetation is represented by grasses, shrubs, and trees, with a substrate thickness of more than 25 cm, which typically reaches 100 cm. The added ecological benefits are represented by shading and wind barriers. Typically used in recreational areas.



Green foodproduction
Similar to green intensive, a food production roof can host a variety of plants, but these have a specific purpose and are rotated periodically. This type of roof can also host vertical food production and/or greenhouses, with artificial lighting, ventilation, and irrigation, or even aquaponic systems. It encourages social interaction. If successfully implemented, its benefits are not only food products, but also social, environmental and economic advantages.



Yellow-green
Instead of installing the system on the existing surface, the rooftop is retrofitted with an extensive green roof layer. It is assumed that the surface is 80% occupied by energy systems and the rest is green.



Yellow
Roof used for renewable energy production, installed on the existing (grey) roof. Sometimes a gravel bed is used.



Red intensive
A rooftop mostly used for social activities, privately accessible. (i.e. light social activities, private events etc.)



Red extensive
A rooftop mostly used for social activities, publicly accessible. Might require an extra bear-loading structure due to a higher user density and higher dynamic loads. (i.e. sport fields, playgrounds etc.)



Purple lightweight
A retrofitted (grey) roof which adds lightweight (< 4500 kg) housing on top of the existing structure. (i.e. tiny house)



Purple heavyweight
A retrofitted (grey) roof which adds heavy (> 4500 kg) housing and might require an extra bear-loading structure. (i.e. extra floor)



Grey
A conventional flat rooftop, represented by insulating layers and a black bitumen top layer.



CRITERIA IMPORTANCE

In order to correctly represent the stakeholders' values and wishes in the development of a multifunctional rooftop, the outcomes of the co-creation sessions and the interviews will be used, as well as discussions and/or policy documents. A good understanding of the location and its residents is of great importance when using the MCDA. It is important to perform a thorough analysis, which will lead to accurate criteria weights and therefore a more optimal final outcome (rooftop ranking). Some iterations might be necessary before successfully completing all the steps.

The preferences indicated by the stakeholders will now be added as weights to the criteria. In order to do that, three scenarios will be implemented:

1. Residents
2. Municipality / government
3. Social housing associations

So far, each stakeholder group has been thoroughly questioned with regards to the ideal distribution of rooftop functions (grey, blue, green, yellow, purple, red). These representations will further be implemented in the MCDA model, yet not all of them can be directly transformed to criteria weights. Therefore, careful consideration should be taken when performing the analysis of the interviews, discussions, and co-creation sessions in order to properly and completely "translate" the stakeholders' value into criteria weights.

Some criteria can be weighted by a rule-of-thumb, the rest have to be understood from interviews, co-creations sessions and other discussions. The following assumptions can be done with regards to the criteria weighting, if a prior distribution of roof types is already available:

- The environmental criteria (i.e. air quality improvement, heat stress reduction, biodiversity) represent the percentage indicated for green and the weights can

be divided between them according to the given explanations.

- The percentage indicated for blue can be used as an estimation for runoff reduction.
- The system weight is constant at 5%.
- The social criteria (i.e. recreation, aesthetics, education / awareness, social interaction) represent the percentage indicated for red and weights can be divided between them according to the given explanations.

MCDA

After defining the importance of the different criteria for the diverse stakeholders, run the MCDA model. This will result in a ranking of the best rooftop types for a specific stakeholder group.

ROOFTOP RANKING

The outcome of the model is a ranking of the best types of rooftops, with grey being the neutral option. The scoring of each criteria is done on a scale from 1 to 9, where the performance of grey rooftops is a 5. The scores included in the MCDA model are final, science-based, and universal, hence they stay the same for every scenario.

The exact representation of the final rooftop should be a combination of functions and it is up to the designer to properly make a decision. Some rooftop types can overlap others if they are compatible (i.e. system greater than the sum of its parts). The outcome of the MCDA is therefore not a financial or a space division of the final rooftop, but rather an indication of the most suitable functions to be included in the final design. The MCDA is used here because of the high complexity of the project.

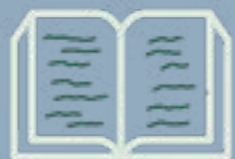


Destiny

Goal

Understand and identify next steps.

Methods



Literature/documents



Expert interviews

MISSING ELEMENTS

Identify missing elements from previous phases. Repeat and/or re-do these phases to assure sufficient knowledge and input is available.

LEGAL REQUIREMENTS

Safety

When designing a transformed rooftop, various safety measures should be taken into account. Amongst which, but not limited to, fire protection, fall prevention, exits, electrical shock prevention. For many of these safety measures policies and laws are in place, within this booklet we do not include them, however, they should be taken into account.

Policies

Research existing policies related to roofs and consult experts on policies and regulations which should be considered. Moreover, when changing the purpose of a rooftop permits are needed for this

specific usage. Therefore, for a specific location, a permit application should be done when the legal purpose of the rooftop changes or when the building has a specific status.

TECHNICAL REQUIREMENTS

Technical requirements are location specific and should therefore be reconsidered for every rooftop transformation. There are multiple elements recognised as technically important, which should be taken into account when choosing a rooftop function at a specific location. These include, but are not limited to, carrying capacity, accessibility, slope, height, functional obstacles, orientation and shading. Using professional expertise for acquiring the correct information about indicators is advised, and often required, to have a realistic and tangible transformation plan.



Carrying capacity

The carrying capacity defines how much weight a transformed roof can carry and hence has a large influence on the purpose. This criteria is a definitive indicator, and thus is a decisive tool for the new rooftop function.

The foundation and year of construction could give an indication of the carrying capacity. However, often specific information about a building is not present. Even if the information is present, the actual carrying capacity might be different due to for example elements added to a building in a later stadium. Hence, when looking at a specific roof, a constructeur should always calculate the carrying capacity. Moreover, there are several options to increase carrying capacity.

Accessibility

Each roof purpose has different requirements in terms of accessibility, for safety reasons. Hence, the possibilities to adhere to these requirements should be taken into account.

Slope

The slope of a rooftop also has influence on the function and most suitable transformation, as a maximum slope is identified for certain transformations.

Height

The height of the building should also be taken into account when deciding the purpose of a roof. For example, the level of biodiversity on a green roof is influenced by the height of a building, as many animals who are expected to inhabit green roofs cannot access great heights. In addition, take into account the maximum height the building is allowed to have according to local restrictions.

Functional obstacles

The current functions on the roof should be taken into account, i.e. chimneys, and find manners to replace them and create a larger area to transform, if desired.

Orientation

The orientation of the rooftop in relation to incoming sunlight and wind influences the rooftop functionality. For example, when applying the solar panels as a yellow function, the orientation of the roof (north-east-west-south) influences the energy yield.

Shading

The location of the building relative to its surroundings is also important. For example, certain plants cannot survive with little sunlight and much wind, hence yellow with limited sunlight would not be a recommendable option. Moreover, the number of people who are viewing the rooftop should also be considered when transforming a rooftop, to limit nuisance.

FINANCIAL FEASIBILITY

Explore the possibilities to finance the transformation of the specific rooftop. By looking at:

- Subsidies which might be present for a particular transformation, or at that particular location
- Return on investment
- Interested investors
- Shared cost distribution (with i.e. fellow residents)

REALISE ROOFTOP

Now it is time to transform your roof!



Case study: Dapperbuurt

This part of the booklet shows the implementation of the guidelines in a case study. This case study originates from the request of Jungle Amsterdam to research the rooftop potential in the Dapperbuurt. Each step of the 4D process is applied to the case study. The outcomes are described and visualised, leading to the optimal roof distribution of the Dapperbuurt.

Goal

Understand the context of the neighbourhood and rooftop stakeholders.

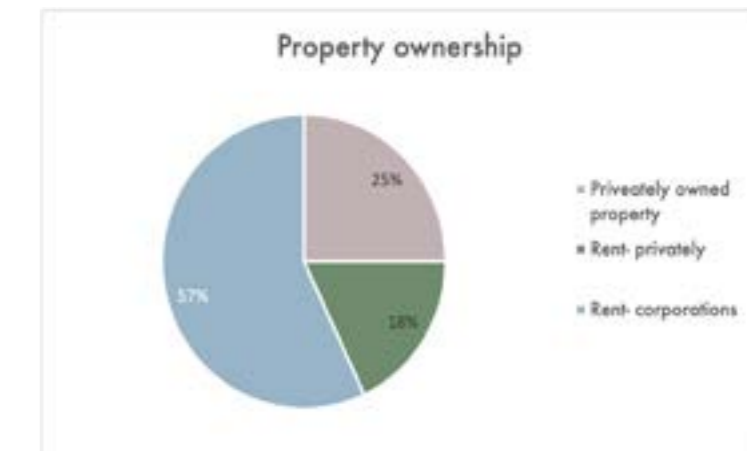
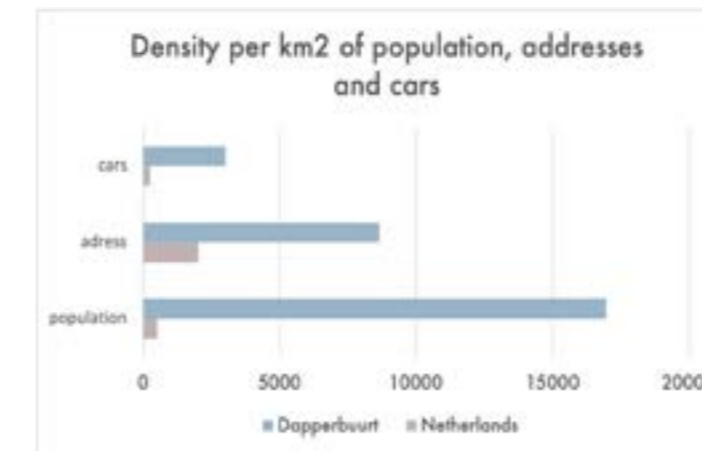
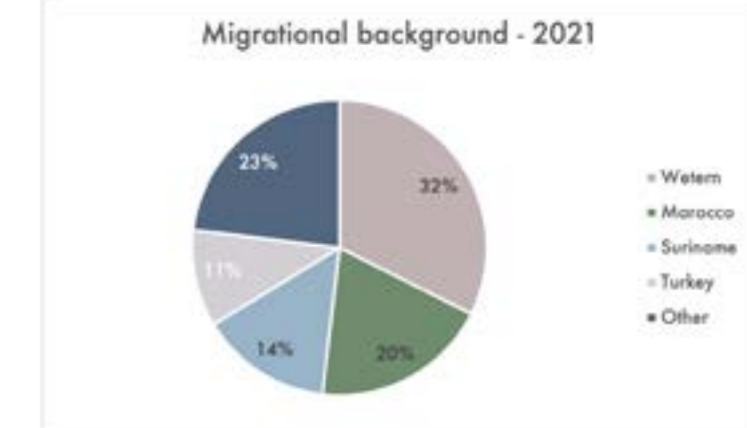
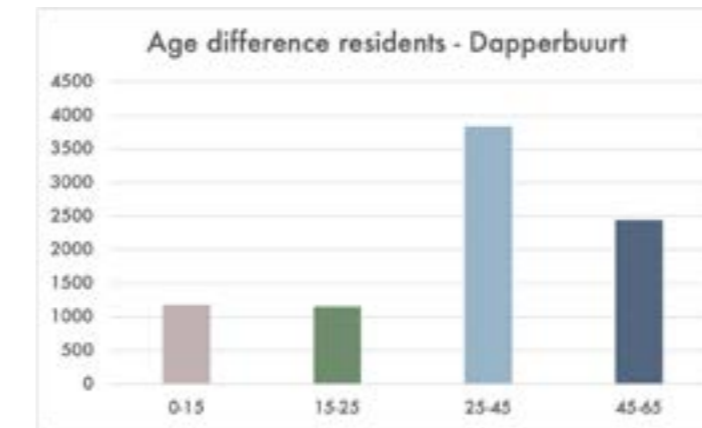
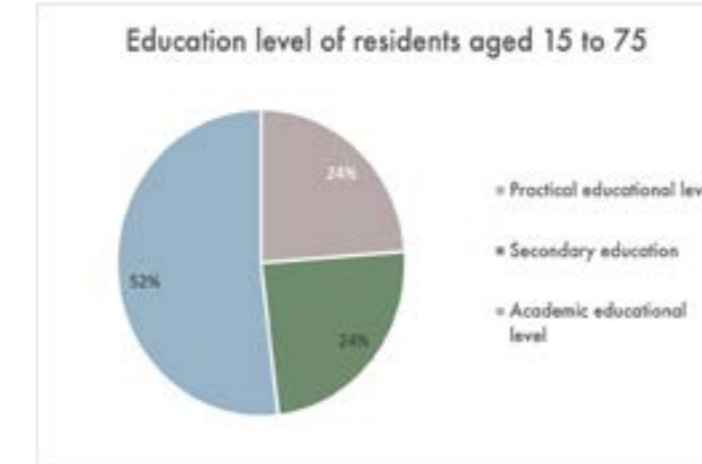
Gaining trust with stakeholders to engage them further in the process.

NEIGHBOURHOOD CONTEXT

Demographics

To better understand the context of the Dapperbuurt and the residents we researched the demographics. When walking around the neighborhood there is a lively and vibrant atmosphere with relatively young urban residents from different ethnic backgrounds. When looking around the neighborhood there are mainly apartment blocks with similar design and functions. This is due to the fact that 57% of the housing stock is owned by social housing associations. The rest of the housing stock is either privately owned or private rent. What is striking about the Dapperbuurt and contributing to gentrification in the Dapperbuurt, is the average home value increase of 78%, from an average value of €167,000 in 2013 to €380,000 in 2019.

The images on the next page show the demographics of the Dapperbuurt.





Building typologies

To get a better understanding of the Dapperbuurt we researched four generic building typologies that are common in the Dapperbuurt.

1. Apartment block flat roof
2. Apartment block inclined roof

In the Northern-East part of the Dapperbuurt most apartment blocks were built between 1960 and 1975. These apartments were built relatively quickly and with cheap building material. In this period it was more about quantity than quality, and most of these buildings will nowadays be either demolished or need to be heavily renovated to assure better living quality. Most buildings in this part of the Dapperbuurt have a flat roof, however due this style of building the carrying capacity of these buildings are limited.



Apartment blok flat roof

In the North-West part of the Dapperbuurt the apartments were build before 1850. This is a traditional way of building with a lot of architectural details. In this period labour was relatively cheap in comparison to nowadays and qualitative building materials were used to assure solid foundation. This results in better carrying capacity of the building. However, most of the apartments built in this time period have an inclined roof.

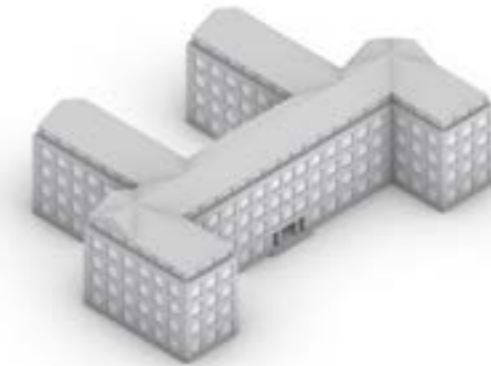
The southern part of the Dapperbuurt consists of buildings from different building years. However, the bigger apartment blocks were built between the 1960's and 1990. From the 1980's onwards there was more detail for energy saving materials and low maintenance costs. The foundation of these buildings need to be taken into account. When heavy load are located on the roof this might cause subsidence of the foundation.



Apartment blok inclined roof

3. Monuments

There are several monuments located in the Dapperbuurt. Due to the monumental status of the building there are a lot of rules and regulations. This makes it hard to transform the roofs. In this case study we therefore didn't research the roof potential of monumental buildings.



Monument

4. School building

In the Dapperbuurt there are three public schools located. These buildings are recognised by their bigger rooftop surface. These rooftops could be ideal to host more publicly accessible social functions.



School building



Neighbourhood challenges

The Dapperbuurt is facing multiple challenges. These arise due to climate change and new configurations of the city, as more people want to live in the city. In these changing environments you want to assure the neighborhood is inclusive for all and create a liveable city. When these challenges aren't resolved it could even cause safety issues such as heat stress for the residents of the Dapperbuurt. It is therefore important to understand these challenges in the Dapperbuurt in order to provide suitable solutions.

The challenges that arise for the Dapperbuurt are, based on interviews and literature documents:

1. Climate adaptation
 - Heat stress
 - Flood risk

2. Energy transition
 - Renewable energy
 - Additional insulation
 - Biobased construction circular construction
3. Quality of life in the neighborhood
 - More green
 - Healthier residents
 - Safer neighborhoods
 - Increased biodiversity
4. Growth of the city
 - Densification
 - Rising housing stock prices
5. Inclusive and diverse city
 - A neighborhood for everyone with places meet
 - A diverse store stock with all amenities available

STAKEHOLDERS

The second step of the discovery phase researches the stakeholders involved in the rooftop transformation.

The main stakeholders who are affected in the rooftop transition in the Dapperbuurt are:

- Municipality of Amsterdam
- Social housing associations
- Residents
- Rooftop experts

Aims

Municipality of Amsterdam:

- (1) create more climate resilient cities
- (2) use energy that is generated from sustainable sources
- (3) create safe neighborhoods with healthy residents
- (4) stimulate upscaling of innovative technologies and
- (5) assure general prosperity of the city and its residents.

Social housing associations:

- (1) provide affordable housing for the lower income residents
- (2) strive for a carbon neutral housing stock by 2050

Rooftop experts:

- (1) further mobilise the rooftop transition
- (2) gain new insights in innovative technologies
- (3) sharing knowledge and have experience in transforming rooftops, conceptually and practically (installation)

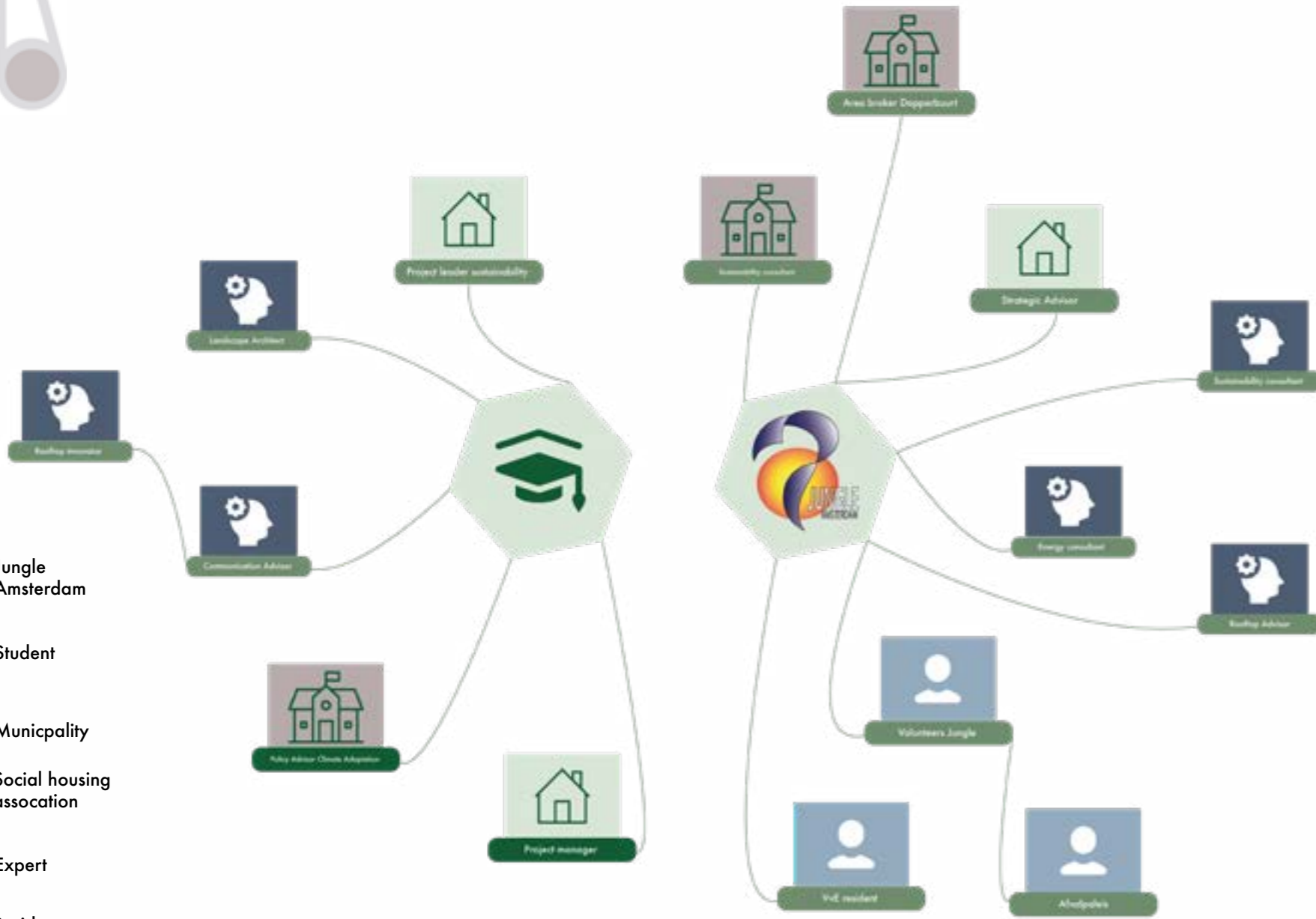
Residents:

- (1) Live a comfortable and qualitative life



-  Jungle Amsterdam
-  Student
-  Municipality
-  Social housing association
-  Expert
-  Resident

Stakeholdertree



To better understand the perspective of the relevant stakeholders multiple interviews were conducted. The most important outcomes are shown.

Municipality of Amsterdam

"We see the potential for a integral rooftop approach for Amsterdam"

"Municipality is not the owner of the roofs, we can only stimulate and facilitate"

"Without EU subsidies, multifunctional roofs are difficult to implement. Funding was received (for the Resilio Project) because of the cooperation between different stakeholders. The main challenge is the cost of retrofitting roofs and social housing associations do not have the necessary funds. Including VvEs is difficult because they are slow and everyone has to agree. The municipality is not the owner of the roofs, they only stimulate and facilitate. The Municipality of Amsterdam sees great value in an integral approach for multifunctional rooftops."

"There is a lack of policy and incentives. We should find the solution that the community is asking for. The owner might not be the one who maintains the roof. I agree such a roof type has value, but not economically."

Social housing associations

"We want to keep peoples' feet dry, so we are looking at possible ways to limit flood risk and heat stress in the neighborhood. If we want to choose between solar panels and green roofs, it is important that they are subsidized. If a roof does not have to be changed in the next 20 years, then we should have solar panels on it. After 50 years, a new roof is needed, after 25 the bitumen has to be changed."

"If a living complex has to be renovated, KPIs do not play any role. If the residents want to place solar panels, they will be placed when possible. Roof teams look at what else is possible, but the priority is the energy transition and being carbon-neutral. Except for the green, blue, and yellow, the other functions are a bit of a blind spot for us, but we are open to new ideas and solutions. However, our current policy does not include such alternatives."

"We are trying to implement biodiversity and sustainable materials in order to become energy-neutral by 2050. Other than that, we are not looking at anything else. If a roof is going to be changed, we are always looking if we can implement green. Since recently, we are also considering PV and we are offering a guarantee to the residents that they will receive an energy cost reduction. Concrete construction is needed for green roofs, therefore a combination of green and PV is more difficult to implement. Without a subsidy, we don't do anything. Blue-green with PV is difficult in practice."

Rooftop experts

"Altering rooftop functions works best for newly build buildings"

"Green or blue roofs have high investment costs. Benefits are not directly applicable to the owner of the building such as is the case with solar panels"

"Biggest hurdles are a lack of information. There should be someone who takes the lead."

"In deciding which rooftop function to implement I recommend to first look at the ground level. What is less prevalent on the ground level that you fill in with the rooftop space."



Residents

"Social contact is missing in the neighborhood, I would love to have more contact with neighbors, a rooftop terrace would be very nice"

"Not interested in developing our flat roof, I cannot imagine how we would go up there, it's unsafe."

"Tiny houses might be a solution but I don't want to be disturbed by the new residents. A rooftop garden would be nice as I go to the park quite often."

"Flat roofs should be used more and at least PV panels should be installed. ROI is not feasible as houses are not built to last (30 years)."

"I like to be outside a lot, meeting my neighbors on the roof is a great idea but unfortunately there is not such a strong community now."

"I see rooftops as inaccessible, too many stairs to climb, but I would like to have a rooftop terrace that I can easily use."

"Too much black and brown on the roofs now, I would like to see more green, rooftop gardens with PV, art expositions, and room for creativity."

"An accessible rooftop is a very luxurious thing, I see it as exclusive and quite expensive to have."

"I would not go on the rooftop because I am afraid of heights. I would also not allow my children to play on the rooftop."

CURRENT ROOFTOPS

The third step of the discovery phase researches the current rooftop project in the neighborhood. At this moment there are a few rooftop transformations realized in the Dapperbuurt. Besides the realization of a few sedum roofs, solar panels and privately owned rooftop terraces there is no other rooftop function yet realized in the Dapperbuurt.



Current top view of the Dapperbuurt



Current sedum and solar pannels of the Dapperbuurt



Dream

Goal

Stakeholders understand possible rooftop transformations.

Understand if and what kind of rooftop transformations stakeholders want and their reasoning behind their choices.

Before diving into what is possible, we want to define what the current perception on rooftops is. We want to understand why this urban space is not fully developed. The stakeholders we identified have different perspectives on this topic, yet most of them agree that the roof should first of all be functional. This currently means it has to serve the functions which are agreed upon as rooftop functions: providing insulation (thermal, sound, water, wind), providing shade, and sometimes serving as social spaces.

Through this phase we aim for stakeholders to understand possible rooftop transformations, and understand if and what kind of rooftop transformations they desire. This is done by organising co-creation sessions which lead to understanding the broad perspective of all the stakeholders and getting a grasp of where the differences and disagreements lie. We end the dream phase by giving a conclusion of the session.

CO-CREATION 'MAKE YOUR ROOF'

When organising the first co-creation sessions we invited residents from different backgrounds, family situations, renters or homeowners in order to have a good representation of the Dapperbuurt. We held two different sessions to assure we reached as many residents as possible.

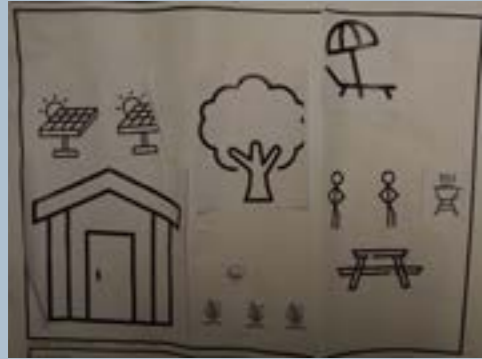
We first held a session on Thursday morning during the weekly women's breakfast meeting at Jungle Amsterdam. This meeting is a recurring event where different workshops are held every week. So, this was a good moment for us to host our first sessions. We invited all the regular visitors of the women's morning to join our workshop. This event took place on the 28th of October 2021 from 9:00 to 11:00 at Jungle Amsterdam.

In the second session we invited residents that were in some way involved with Jungle. They either worked together with them on the Groenplan, were volunteers at the Afval paleis or contacts from the Fixbrigade. We created flyers and distributed

these over the mail. The invitation list was about 75 people. The second session was held on the 6th of November 2021 from 14:30 to 17:00 at Jungle Amsterdam.

The inputs of the different participants were turned into personalia. Because the participants remained anonymous during these sessions the personalia are shown by way of the name they gave to their roof. Each roof has a short explanation of the design and some information about the participant in question.

Cosy roof for me , my kids and the neighbourhood



“A small house for my kids, invest in solar panels to generate energy for the house, space to get together with friends and family and to meet the rest of the neighbourhood.”

Accessibility: Only for residents



Age: 25-45
Household: Family of 5
Level: 4th floor
Likes: Taking the kids to the playground, being in the garden.
Needs: Solar panels, playground for her children, place to meet the neighbours, garden.



Age: 45-65
Household: 5 people
Level: Entire house
Likes: Meet extraordinary people, working with greenery, hiking, working outside
Needs: More benches, less rules and control, more meeting places, more freedom for people to realise their ideas, larger parks.



Age: 25-45
Household: Family of 3
Level: 2nd floor
Likes: Jacuzzi
Needs: Balcony, shelter from the rain.

Terrace fun



“Enjoying the sun on the couch, have a coffee or a barbeque. I need space secluded from the neighbours. A jacuzzi or a swimming pool. A tree on the roof, shade from the sun. Storage space. Solar panels to generate energy for the building beneath. A swing for the kids.”

Accessibility: Only for my household

Neighbourhood roof



“A coffee room for the neighbourhood, a (amphi) theater for music and poetry, space to have a picnic, vegetable garden with fruit trees, a tiny house for a student who can keep an eye on the roof, a bookcase where people can put stuff to give away. Kids play on the roof so it needs rails. Solar panels generate energy to light the roof and other electrical needs.”

Accessibility: For everyone

Second home for all



“Space for kids to play, a vegetable garden, and a seating / relaxation area. There is a large slide. I’m prepared to share the roof with neighbours.”

Accessibility: Share with neighbours



Age: 45-65
Household: 2 people
Level: Ground Floor
Likes: Garden
Needs: Family, a bench with a view.

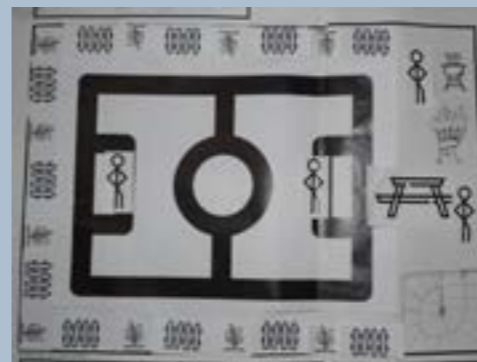


Age: 25-45
Household: 1
Level: 5th (top) floor
Likes: Gardening, drawing, (folk)dancing, baking, playing board games and cooking.
Needs: Less noise, shade, cheaper parking spaces, less hard surfaces in the neighbourhood.



Age: 45-65
Household: 1
Level: 1st floor
Likes: Watching tv about technical stuff, working with hands.
Needs: A drivers license.

Meeting Roof



“There is a huge basketball field. That makes a lot of noise so it would be best if this roof is placed over a school or a business space. There should be green as well. A barbecue and a fire pit, to bring people together.”

Accessibility: For everyone wjp os wo;;omg tp play bal

Oasis



“A mix of a vegetable garden and decorations. So you can do things with produce and enjoy the plants. There are fruit trees and a pond. There is a covered area as well in case it rains. Chairs can be folded up and moved. There is a stove for when it’s cold.”

Accessibility: Perhaps it should be accessible for all, but that would mean there is a lack of social control and that could lead to nastiness. If every complex in the neighbourhood would have a nice roof, I would keep it exclusive for residents of each complex.

Dapper roof



"A combination of plants and energy supply. I like it when there is a swing in a tree. It would be nice if rainwater would go to the plants. That would lead to more birds and butterflies. I would like to work in the vegetable garden. I put a fence so you won't fall down when you're working. It would like a climbing wall, to climb up on the roof. There shouldn't be any noise disturbance. No water leakage either."

Accessibility: For the whole neighbourhood



Age: 45-65
Household: 3
Level: 4th floor
Likes: Hanging out together, photography, creativity, cleaning, sitting on the swing.
Needs: Time, space, money.

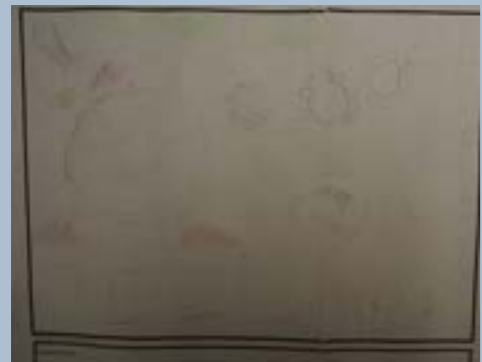


Age: 65+
Household: 1
Level: 3rd floor
Likes: Music, dancing, painting with watercolours, plants and animals, gardening.
Needs: Rest, absence of noise, coolness.



Age: 0-25
Household: Family of 4
Level: House
Likes: Halloween, amusement parks, reading, parties.
Needs: People around me, playgrounds and parks for walking the dog.

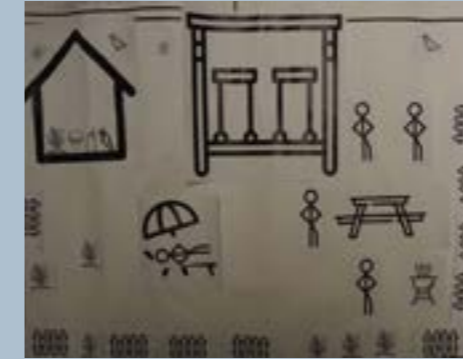
Entertainment roof



"A small theater with solar panels for lighting, cover against the rain, dancefloor, a bar, tables and a waterfall."

Accessibility: For everyone

Cosy roof to relax



"A safety fence for kids, a slide, room for relaxation and chairs to sit down, vegetables and flowers."

Accessibility: Share with neighbours



Age: 25-45
Household: Family of 4
Level: 3rd level
Likes: Plants, playing area, spot for in summer, drinking coffee.
Needs: More space, larger space, a meeting place to meet each other.

Nature & vegetable garden roof (with place to just sit)



"As much green as possible, plants that attract insects. A vegetable garden, because that's just fun. An area for a wild garden with flowers. An insect garden. A seating area to facilitate socialisation with the neighbours. Walking paths so the vegetation won't be trampled down."

Accessibility: The roof is accessible for everyone in the housing complex. Other people from the neighbourhood are allowed given that they are prepared to help with the maintenance. Or when they are simply very kind.

Conclusion 'Make your roof' sessions

There are a couple of challenges and problems in the neighbourhood we assessed during these co-creation sessions by way of asking questions and analysing the results. The residents indicated that there are limited meeting places, too many hard surfaces in the neighbourhood and limited playspaces for kids. They also suffer from heat stress in their home, leakages, draft, mold and have high energy bills. The choices the residents made in designing their roof mostly reflected the issues they face in their homes and during their daily life. Notable was that the focus was very much on social functions, but you could argue that that is a logical outcome since the residents mostly designed their roof based on what they could gain from it. Blue functions for example, are less immediately beneficial for the residents.

The residents had some questions regarding roofs and what would happen if they would be retrofitted. They wondered what their rights as renters are, if they have influence on what happens on the roof and whether the rent will increase in case of retrofitting - some mentioned they would rather leave the roof empty if this would be the case. These are questions that should be answered when informing residents about roofs.

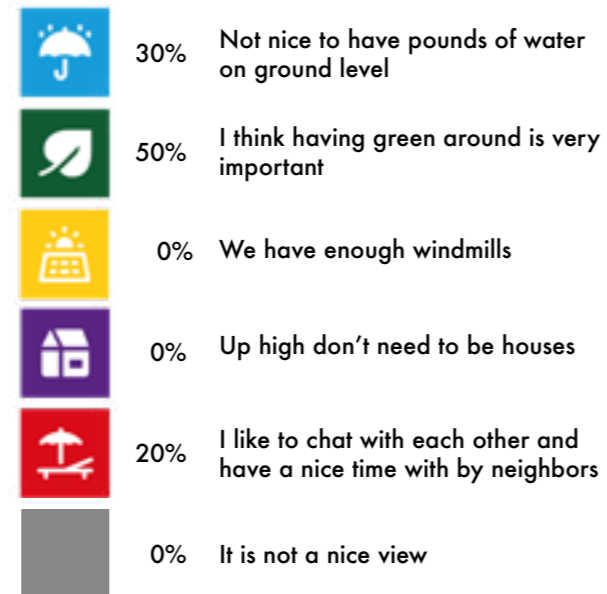



CO-CREATION '100 POINTS TEST'

This co-creation session was used to assess how different stakeholders would divide different roof functions in an area. Each stakeholder got the opportunity to explain the reasoning behind their rooftop function division, which later led to a discussion.

 Perspective: Resident Dapperbuurt
Interest area: Small - Dapperbuurt
Relation with roofs: Finds the rooftop terraces in her building cosy and fun

"Purple not too much, it is already busy enough in our neighbourhood."



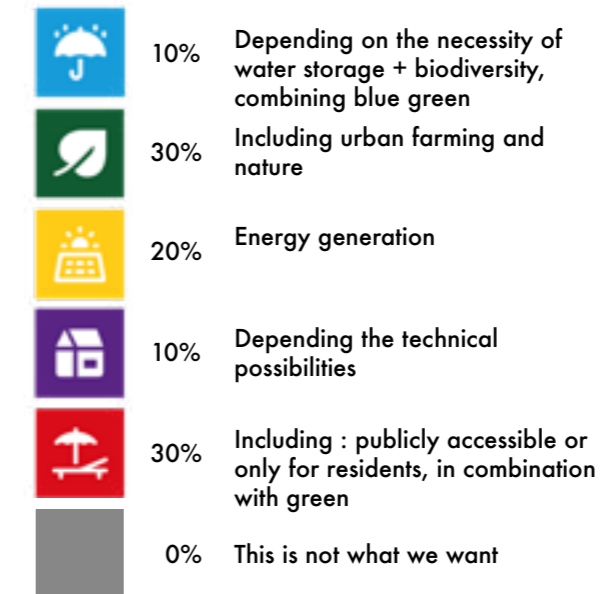
 Perspective: Resident of Dapperbuurt
Interest area: Small - Dapperbuurt
Relation with roofs: Interested in sustainability, sees roofs as a good place to green the city


"Also think about the people living underneath the roof. I wouldn't really place a basketball field on by apartment."



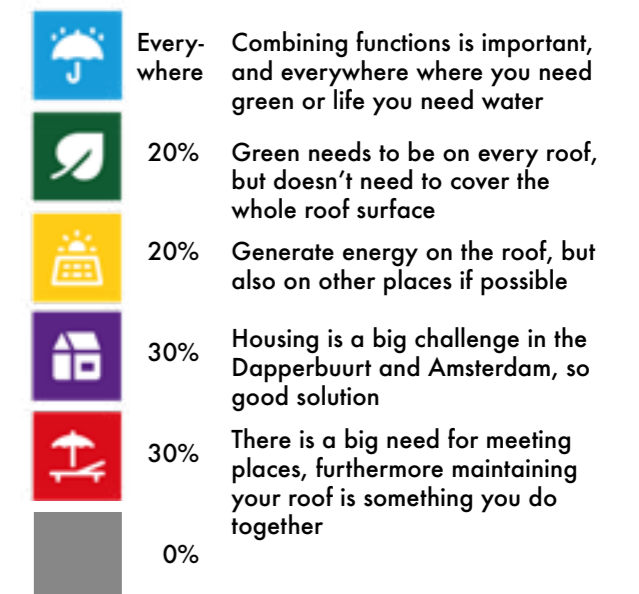
 Perspective: Municipality of Amsterdam - sustainability advisor
Interest area: Medium - Amsterdam
Relation with roofs: Interested in integral approach

"Roof use has a value. It is now often empty, which is a shame. It has a cost to do something with it, but it also has a value (...). The costs that generate social benefits should not be borne by the owner but by the community. If that switch can be made, a lot of resistance can be removed."




 Perspective: Director Jungle Amsterdam
Interest area: small Dapperbuurt
Relation with roofs: Case owner - looks out her window everyday and sees something different, so it was time to have expert looks at the possibilities


"The advantage of the roofs compared to the ground is that it is a safe place."







 Perspective: Greening public spaces
Interest area: Large - Whole of Netherlands
Relation with roofs: Started new company specifically focused on greening roofs

 Perspective: Patina Dakdenkers
Interest area: Large - Whole of Netherlands
Relation with roofs: Works on circularity and innovation of roofs

 Perspective: Project manager Rooftop Revolution
Interest area: Large - Whole of Netherlands
Relation with roofs: Advises on rooftop transformations

 Perspective: Resident Dapperbuurt
Interest area: Small - Dapperbuurt
Relation with roofs: Lives on a roof, part of association of homeowners for his own building

 Perspective: Municipality of Amsterdam
Policy advisor climate adaptation
Interest area: Medium area - whole of Amsterdam
Relation with roofs: Worked mainly of the Resilio project

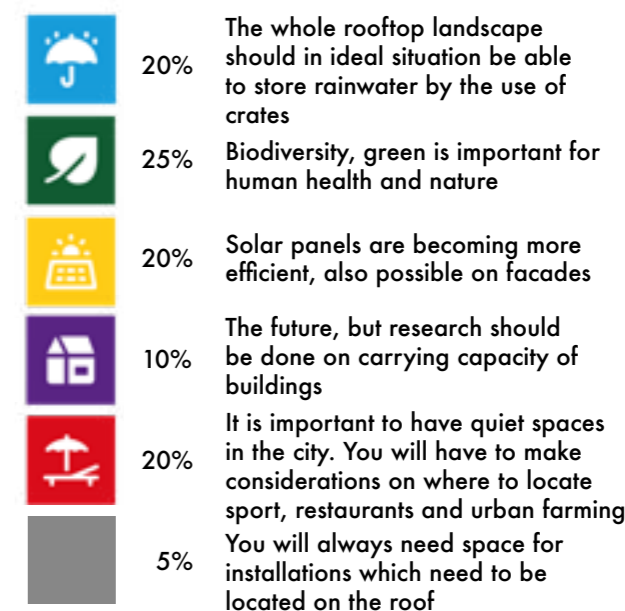
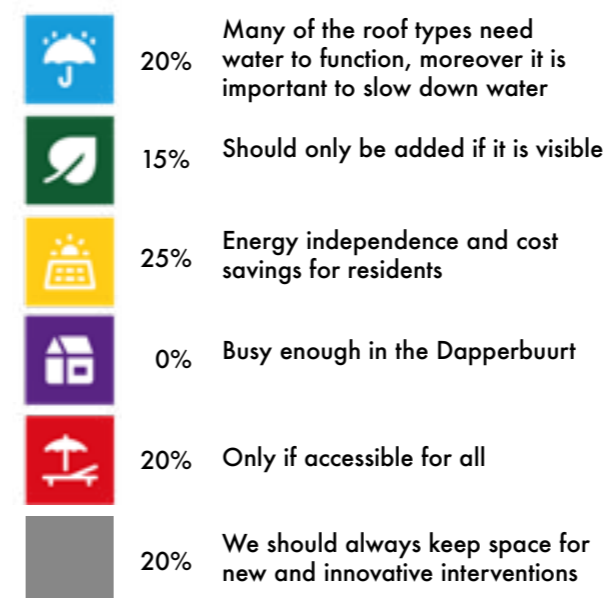
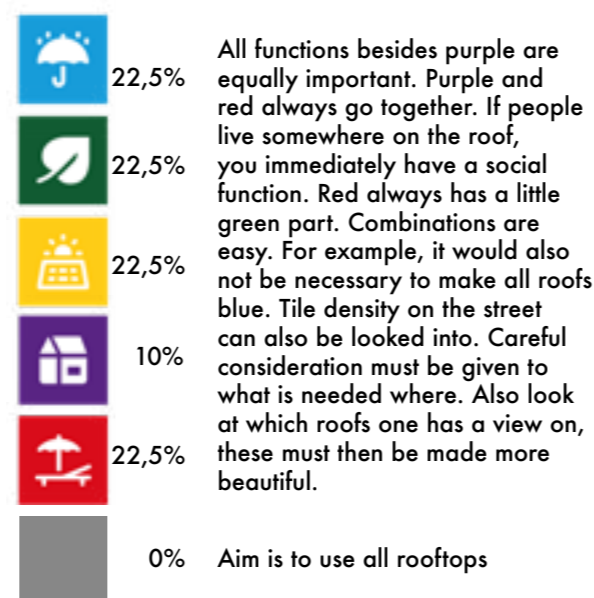
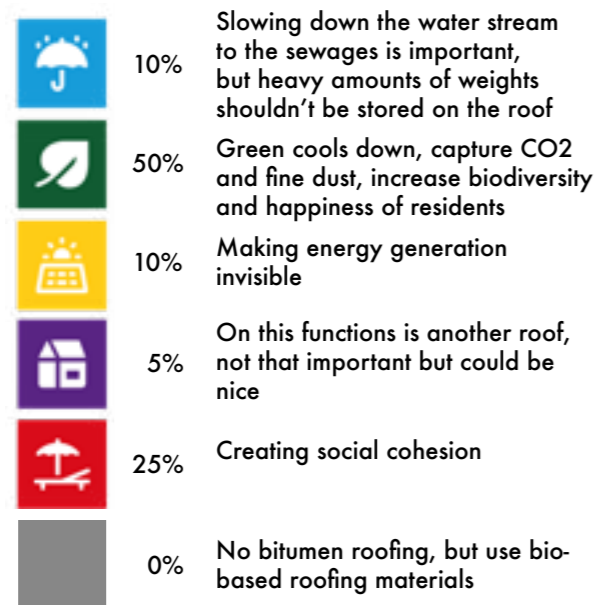
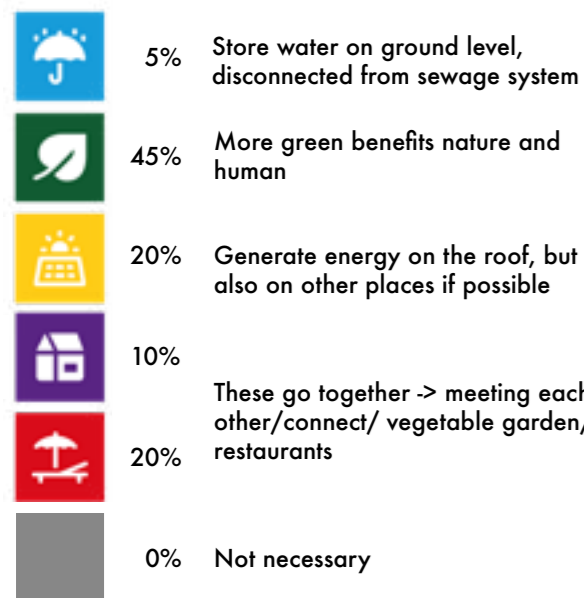
“Projects with many actors can take a long time. Long conversations, many concessions. But in the end something really cool can be created with relatively few financial resources. There are also projects where a bag of money is thrown at it that have completely collapsed. Togetherness will often lead to success.”

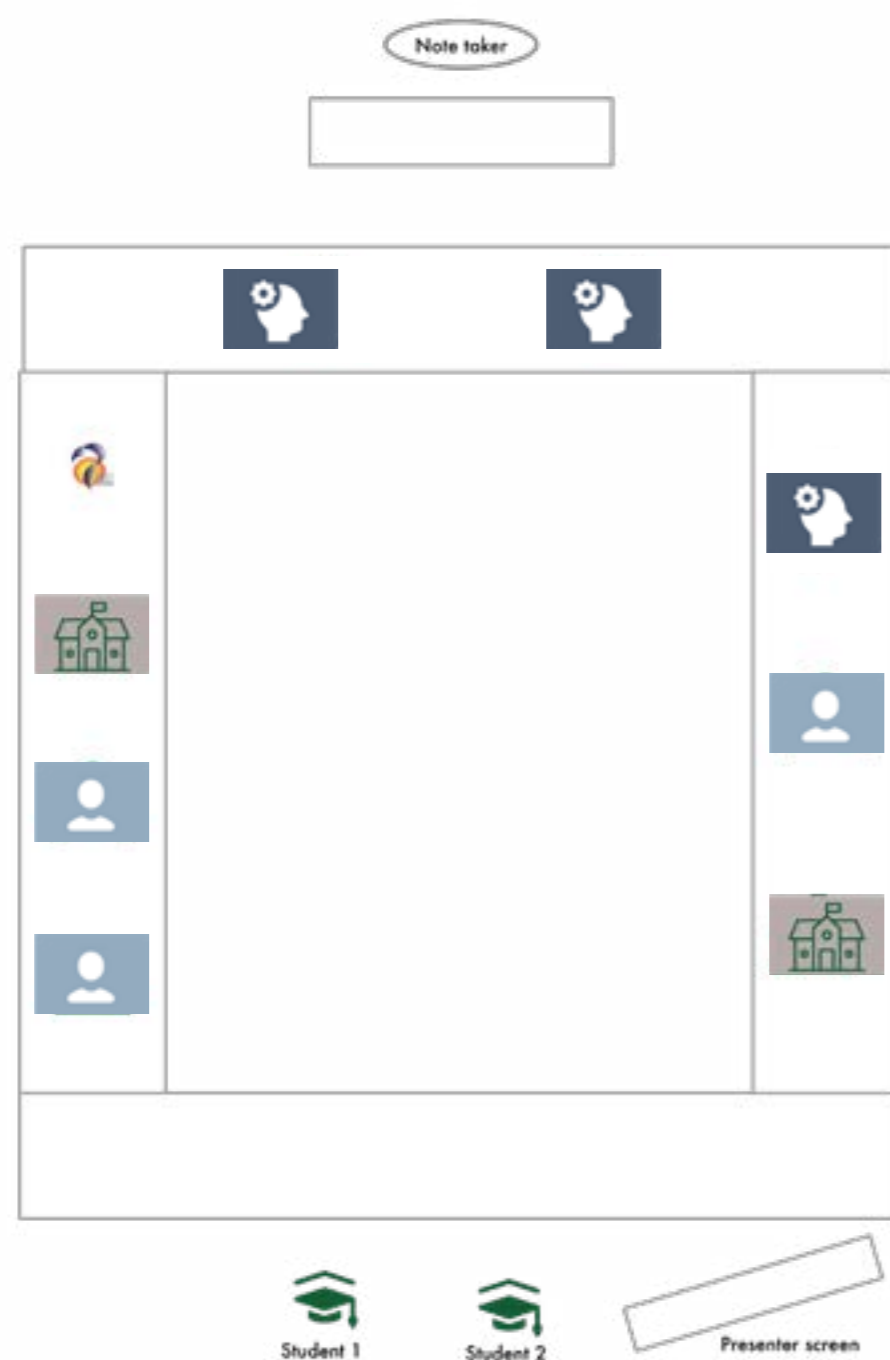
“Does it start with money, or with a dream or an idea, a group of people coming together? I think it also starts with making people aware and enthusiastic.”

“When we’re talking about money: You could introduce a measure where a mandatory amount of water must be stored. If you don’t want to or can’t do that, you can buy it off and that money can be used to do it somewhere else.”

“Policy is necessary to direct, otherwise money is the determining factor. I have a hard time when the roof will be used to continue with how we already do things on the ground. (...) Some things just need to be changed on the ground level first.”

“A social cost/benefit analysis already creates a lot of friction. People disagree about how value is determined. You will get policy based on assumptions.”





Set up '100 points test' co-creation session

Conclusion '100 points test' session

All of the stakeholders are positive of implementing green on the roofs as can be seen by the average percentage given to green roofs. Grey scores the lowest, even though it is not at zero as we expected it would be. One of the reasons for this was given by a resident, he stated that a small percentage of roofs should be kept empty in order to leave space for innovative functions in the future. Lastly, yellow scores lower than we expected based on conducted interviews, compared to red for example. This is an interesting outcome because we believe that solar panels are an important and also easy transformation for roofs, they are one of the first choices made in practice and from information gathered in expert interviews we deduced it would be a popular choice.

The stakeholders agreed on many points but there were some small disagreements. Some stakeholders believe all suitable roofs should have water catchment whereas other stakeholders believe water

should be kept in the ground as much as possible. Also, there was a bit of disagreement regarding the role money should play in planning rooftop space.

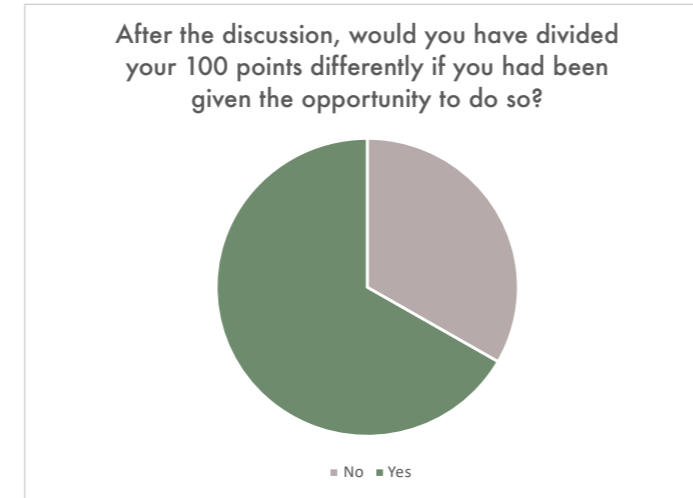
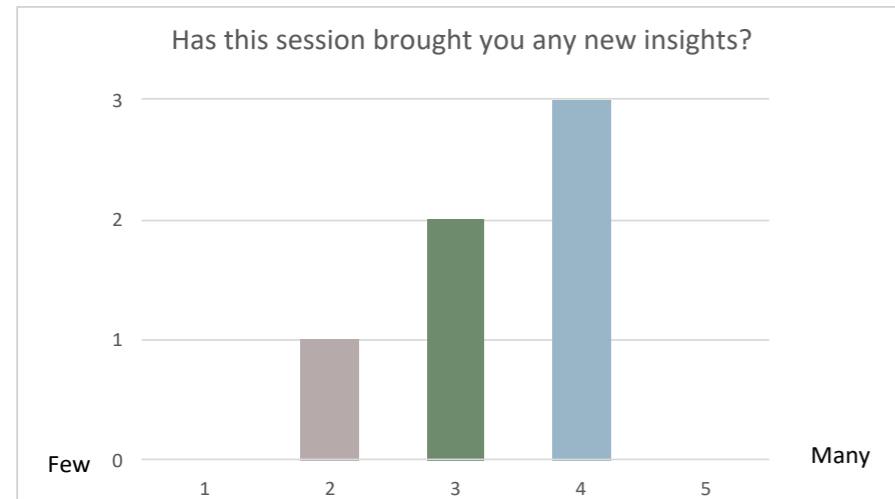
A rooftop expert changed his perspective on purple - at first he did not like the idea of homes on top of buildings (0%) but after hearing everyone's individual opinions he changed his mind and altered it to 5%.

During the individual task to divide the 100 points, rooftop experts started to discuss among each other on how they would distribute the points. We conclude from this that it might be better to not put people that know each other next to each other as it might influence the scoring process.



Questionnaire

We sent out a questionnaire to the participants of the '100 points test' co-creation session to assess what they might have learned from the session and whether the discussion changed their mind on certain topics. Six of the participants responded, the results are as follows:



Conclusion questionnaire

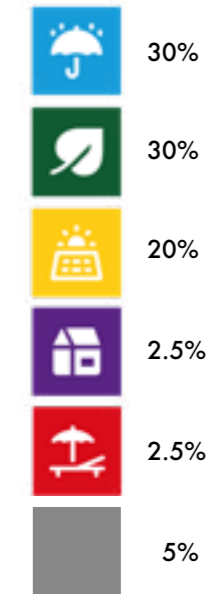
Overall, it seems that participants were quite happy with the session. They felt that there was adequate room for them to give their input and enjoyed the discussion that followed. As we expected, some were slightly disappointed with the absence of social housing associations. We tried to somewhat remedy this by conducting a separate interview with someone from Ymere and having them do the 100 point game.

Most of the respondents indicated that the session gave them new insights which in our opinion is very positive. Some even stated that they would (slightly) change their 100 point distribution when they would be given the chance to redistribute. We believe this is a very good sign as it should inherently be a part of every successful co-creation session.

EXTRA CO-CREATION

Since housing corporations could not be present in the '100 points test' session, we organised an extra meeting with the social housing association Ymere to gain their insight.

The representative from Ymere we interviewed mentioned that green would be their favourite function, which is in line with the results from the co-creation session. Their second priority would be blue. Purple and red would be somewhat less of a priority. The explanation for this balance of functions was mostly because of practical experience. Ymere is simply not doing that much with red and purple functions. The representative admitted that this could be a bit of a blind spot for Ymere. Because they are missing an integral approach to retrofitting roofs but are looking at it case by case, so-called innovative functions are not quite on the radar. Even though the department of concept development is looking at different functions, in practice they are not being applied yet.





Design

Goal

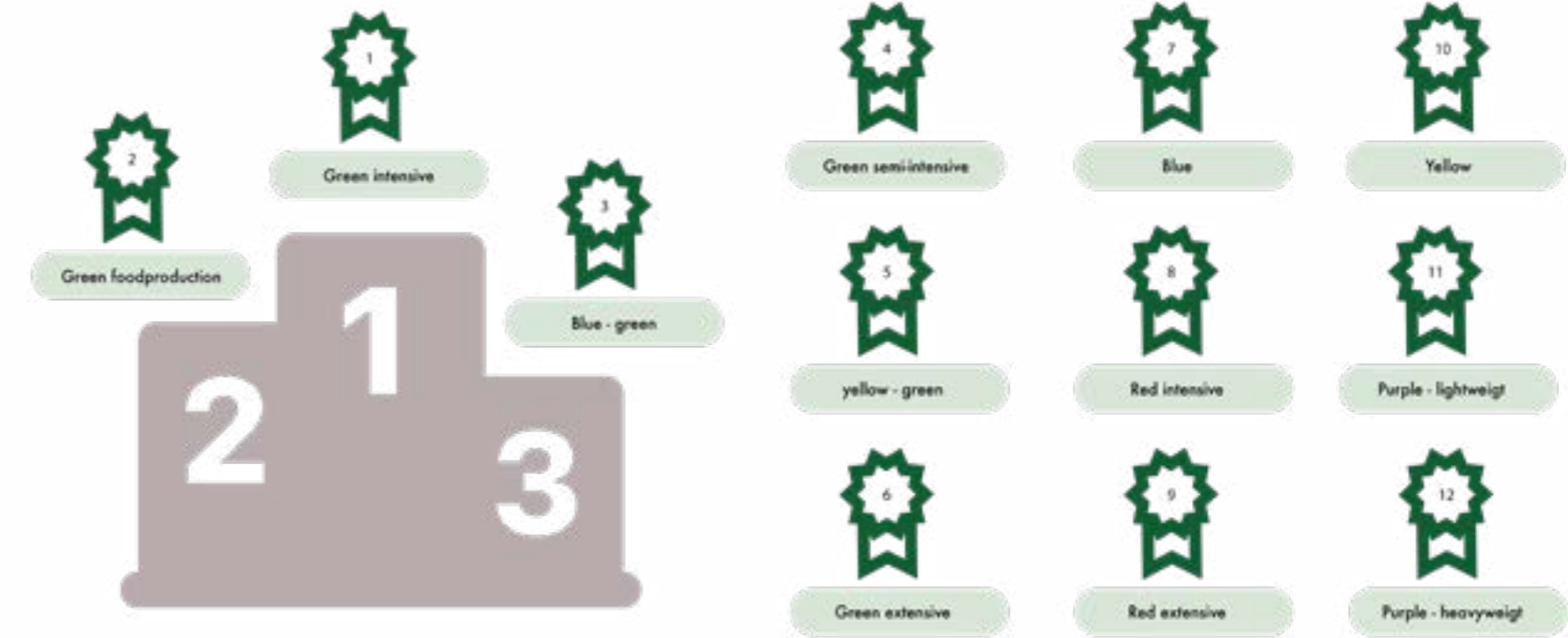
Identifying importance of criteria for stakeholders.

Ranking of rooftop functions based on stakeholders wishes.

CRITERIA IMPORTANCE

After the analysis of the interviews, co-creation sessions and other discussions we had with our stakeholders in Dapperbuurt, we now transform their values into clear criteria weights.

As for the Dapperbuurt, this phase is considered as an initiation of discussion and collaboration, and not as a definitive conclusion on which the best rooftop is. Incorporating the values of so many and diverse stakeholders is a dynamic process and a work-in-progress. Nevertheless, the results of our method when applied to Dapperbuurt are as follows.

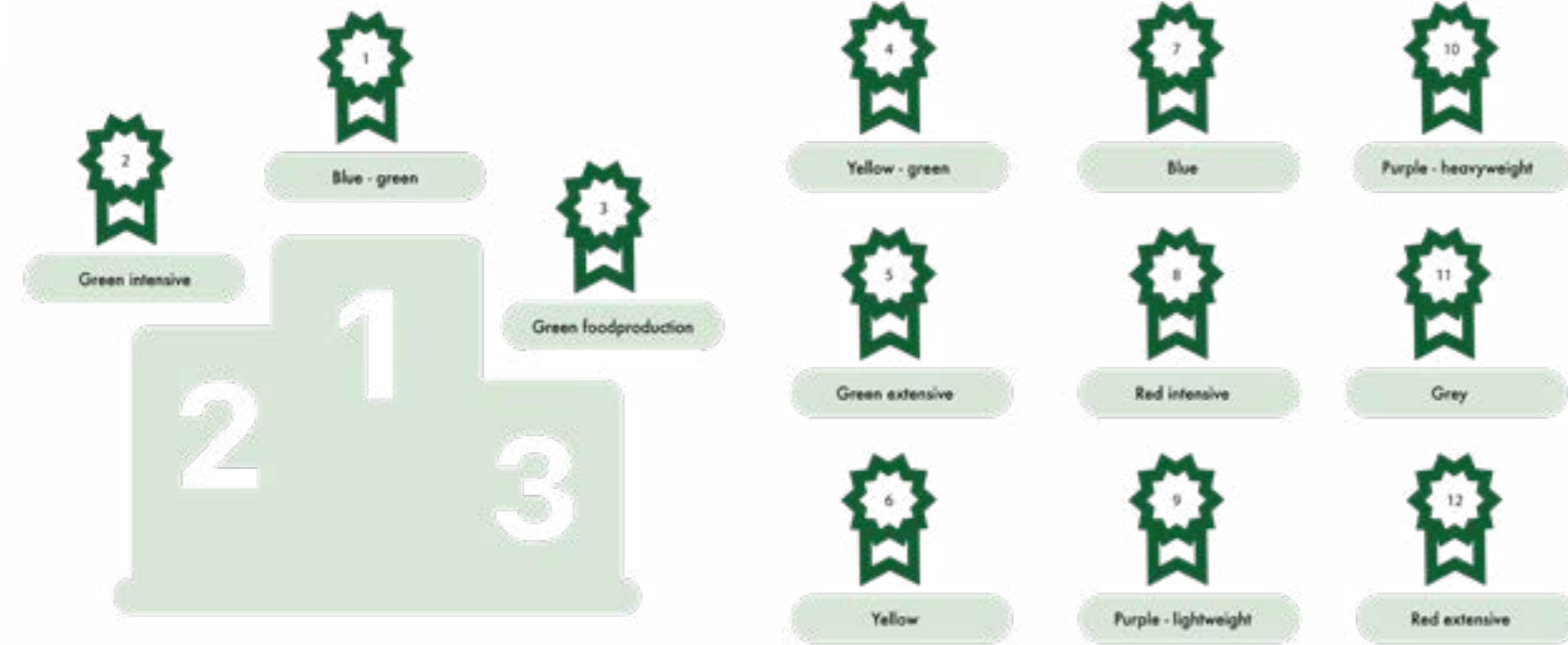


Rooftop ranking municipality

Conclusions for the municipality

The municipality of Amsterdam considers many criteria as important, therefore they want to strike a balance between the different functions. They are less concerned about the financial aspects, except lowering the energy bills. The main difference here is regarding subsidies, which the municipality is offering, as opposed to receiving the subsidies in case of home owners and/or residents. Other high weights are for runoff reduction, which directly

relates to blue roof preferences, as reducing runoff implies some type of water buffer and water retention. The social and the environmental criteria also receive high scores.

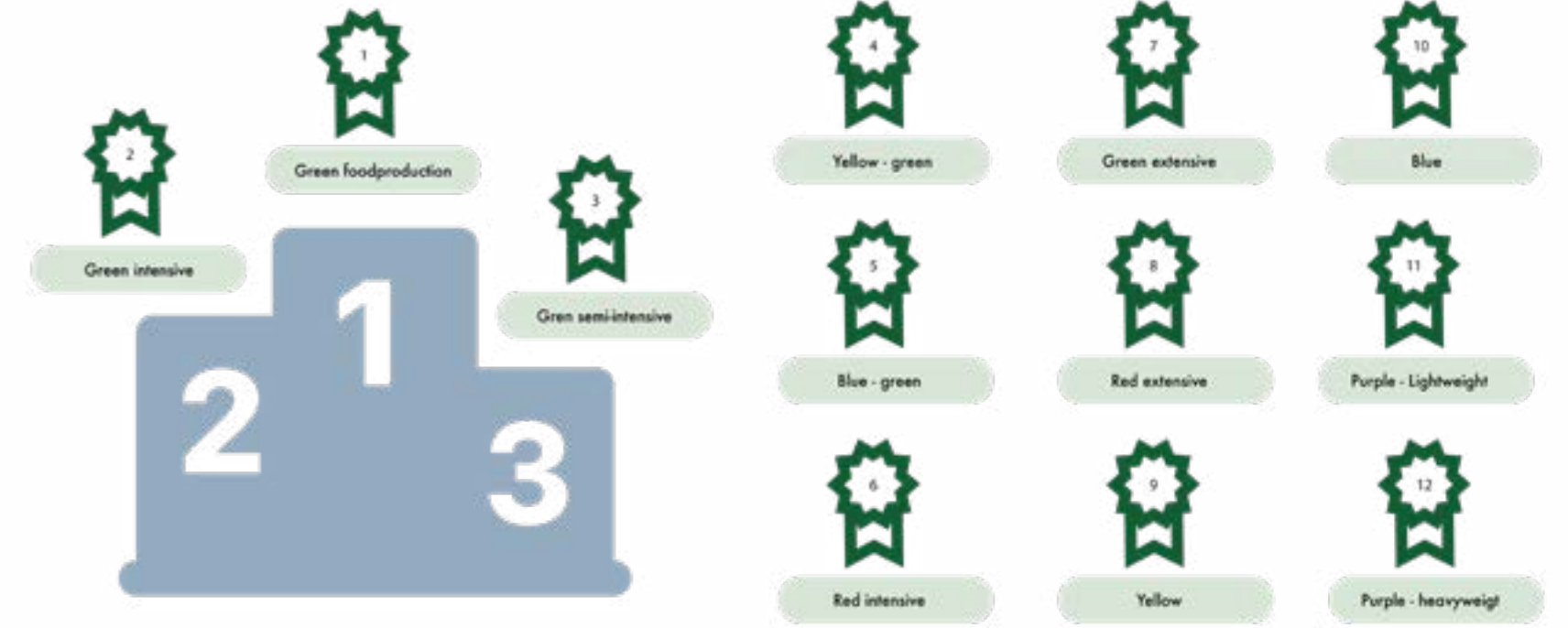


Rooftop ranking social housing associations

Conclusions for social housing associations

Unfortunately, no representatives from the social housing associations were present at the co-creation sessions. However, we managed to interview them and conclude on their values, wishes, and concerns regarding multifunctional rooftop implementation in the Dapperbuurt.

They mostly valued financial aspects, but also reducing some environmental risks and getting in line with their ambition to be carbon-neutral.



Rooftop ranking residents

Conclusion for residents

This group of stakeholders sees social activities on the rooftop as important. Equally so, they want more green around their homes, lower energy bills, more local cultural events, and a stronger sense of community and social interaction. Some perceive rooftops as dangerous and most of them would also like to have a private space on the rooftop, or to have the whole rooftop only open for residents.



Destiny

Goal

Understand and identify next steps.

The Destiny phase is the final phase and indicates which next steps need to be taken, but are not limited to what is put on paper. It is about translating the design of the product into actionable steps as well as ways in which future learning can be achieved. This is done by addressing missing elements in the previous phases, identifying technical and legal requirements in a specific location, and ensuring the project is financially feasible.

MISSING ELEMENTS

As mentioned in the conclusions from the dream phase, the social housing associations were missing in the co-creation session. Since they are owners of about 60% of the houses in the Dapperbuurt they are an important actor in the rooftop transition. We therefore advise the executive party, in this case Jungle Amsterdam, to organise another co-creation session to get the social housing associations more involved in the rooftop transition of the Dapperbuurt and understand the common ground and differences between them and other stakeholders. This could help identify how to cooperate and find fitting rooftop transformations.

LEGAL REQUIREMENTS

Safety

The regular safety requirements and restrictions should be taken into account when designing a specific location.

Policies

There are several policies in place which concern the Dapperbuurt. We provide a selection on which we deem to be of greatest importance for the transformation of roofs, as these arose from conversations with our interviewees. Regarding permits, this should be discovered per specific location.

Nationaal Daken Plan

The Nationaal Daken Plan (national roof plan) is a plan that emphasises the importance of a multifunctional roof design instead of focusing on just solar panels for example. The aim of the plan - among other things - is to embed these ideas in policy and to set up incentive financing models, two points we believe are of extreme importance in order to stimulate the implementation of smart roofs.



Rainwater regulation

The rainwater regulation (hemelwaterverordening) in Amsterdam offers both restrictions and offers opportunities and incentives regarding the retrofitting of roofs. The rainwater regulation states that new buildings and buildings that undergo a drastic renovation need to store 60 liters of rainwater per square meter. This regulation makes it interesting for new buildings to implement a green or a green-blue roof as these are a way to comply with this regulation. For existing buildings however the regulation only applies when a new building layer is added or the built area is extended. Lots of existing buildings are being excluded this way and are not being incentivised to tackle rainwater issues. In order to change this the regulation regarding existing buildings should be tightened, by having the regulation be put in place for all buildings that renovate their roofs.

Bouwbesluit 2012

Bouwbesluit 2012 is a collection of regulations regarding the building, using and demolishing of buildings. The publications contain a set of regulations for example regarding fire safety and rainwater drainage. It also states the roof needs to be strong enough to support basic functions such as being able to support the weight of snow (article 3.23). There are however no regulations in place regarding roofs having to support extra functions such as solar panels, water catchment or even tiny houses. When regulations like these would be included in the Bouwbesluit it would be much easier to implement smart roof functions in the future.

Tiny Houses

The regulations around tiny houses are still developing as the first 'rooftop villages' are arising. Nonetheless, currently there are already restrictions in place which limit the number of tiny houses on one roof and require a specific distance between the tiny house and the edge of the rooftop.

TECHNICAL REQUIREMENTS

However, we will give an impression on a few technical requirements of the buildings in the Dapperbuurt, based on the interviews we have conducted, site visits and the available literature and documents.

A significant number of buildings in the Dapperbuurt were built in the 1960's which would and mostly have a concrete construction. These building types often have a relative high carrying capacity which could mean there are possibilities for additional weight of a transformed roof. Moreover, about 52.000m² roof, similar to 8 football fields, in the Dapperbuurt are flat, or have a very slight slope, which could host many alternative rooftop functions. Regarding shading, most buildings are of similar height and therefore do not limit many neighbouring rooftops in terms of sunlight.

FINANCIAL FEASIBILITY

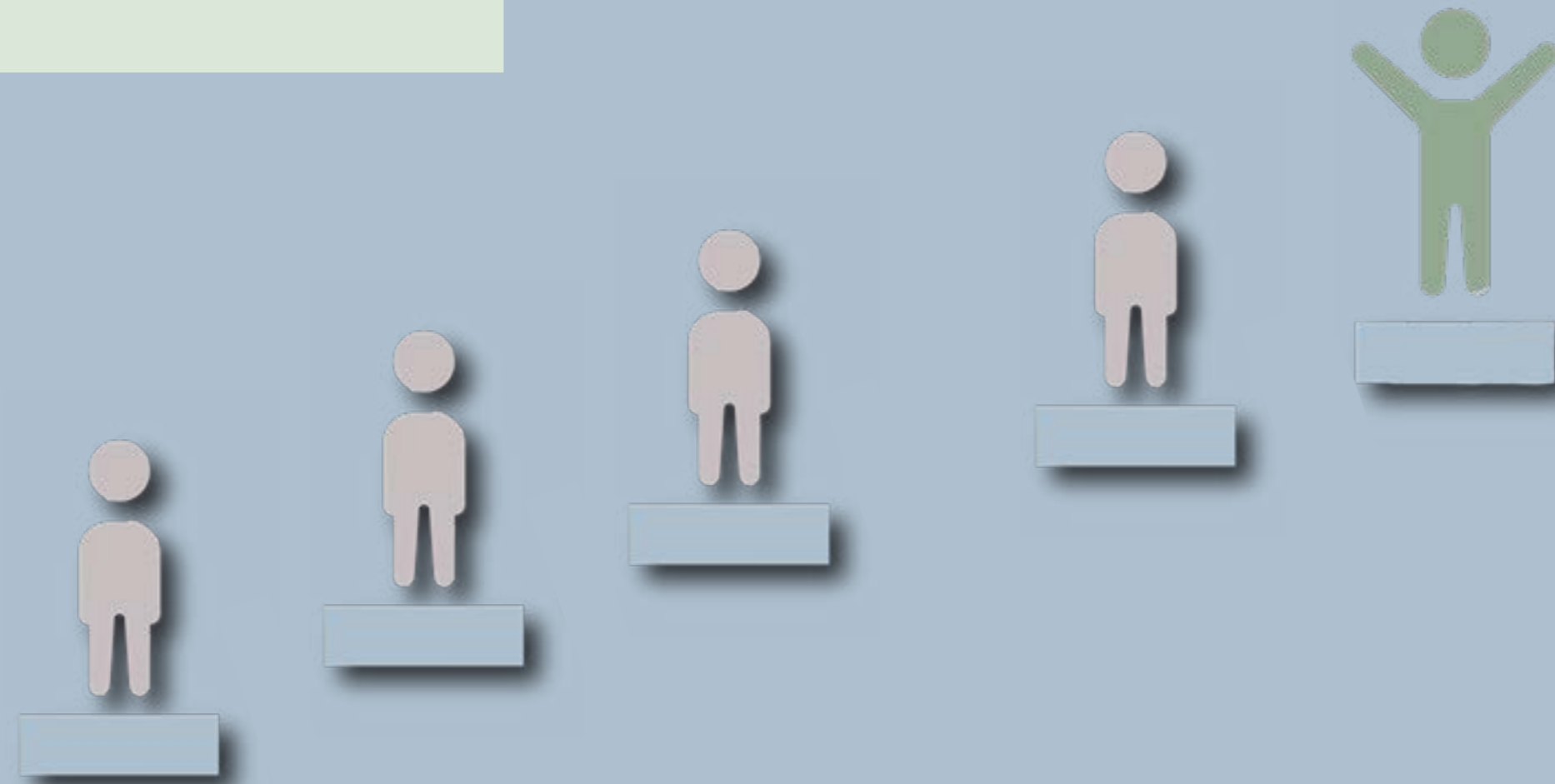
The financial feasibilities should be discovered for each location, as the owner-user situation differs per building. However, we provide an indication of present subsidies.

There are multiple subsidies in place right now that might incentivise stakeholders to add functions to their roof. A green roof can be subsidised when it is larger than 30 m², or when this is not the case, multiple roofs can be added together to reach this surface. When more water than 50 litre/m² can be detained and more than 50% of the roof holds other plants than sedum the subsidible amount increases.

REALISE YOUR ROOFTOP

In order to realise your specific rooftop, stakeholders should collaborate and aim to realise a compromise. Design the desired rooftop and contact parties who can realise the rooftop transformation.

Next steps



Now it is time to take action and start transforming the rooftop landscape together.

To change the rooftop landscape of the Netherlands and beyond, all the steps explained in the guideline should be repeated for each neighbourhood involving all stakeholders. Hence, we can optimally use all the space which is currently unused and improve our urban liveability.

We ask you to not only read this booklet, but also to take action. Realise the execution of the guidelines and change the neighbourhoods you live in and are responsible for.

Enter the discussion of rooftop transformations with everyone you encounter, but specifically with your own neighbours, homeowner and colleagues to inspire and activate each other.

Let's transform roofs!

Do you want to use our model?

**Visit our website and download the MCDA
excel file to get started!**





FLAT ROOF REVOLUTION