

# Co-Design and Citizen Participation Processes in the Climate Change Adaptation Projects of Copenhagen



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*Image 2. List of the organisms contacted during the research work.*

## ABSTRACT

In the advancement of the global climate change that is already causing dramatic impacts globally, governments and international organisms are redefining the frameworks that will affect our future. A growing population in the cities foresees that urban environments will play a key role for generating innovation towards the climate change adaptation<sup>1</sup>.

This design research illuminates the ongoing dynamics within the climate adaptation projects in the city of Copenhagen related to rainwater. In selected private roads and courtyards, citizens are called to participate in public-private partnerships with the municipality, the utility company and private companies. Thus, the actor-network constellation related to this project processes is unfolded.

Inspired by Actor-Network Theory and Co-Design, a design process has been created in order to develop concepts that can benefit both citizens and the municipality to access knowledge on climate adaptation of their properties, while expanding planning boundaries of the urban development regime.

Through the development of co-design workshops it is found that the municipality has interest in experimenting with new approaches. To help the citizens take an informed decision on climate adaptation of their properties, a design process and conceptualizations of three digital tools have been presented.

**KEYWORDS:** Copenhagen Transitions, Climate Adaptation, Sustainable Urban Development Policies, Cloudburst Projects, Citizen Participation, Co-Design, Open Innovation.

*“Climate change has happened because of human behaviour, therefore it’s only natural it should be us, human beings, to address this issue.”*

*“It’s not only government, government cannot do it alone. There should be full partnership, then we should have civil society coming together. Even one normal citizen, they have a role to play.”*

*“All these policies should be people centered, without people they are meaningless. It’s a collective endeavour, it’s collective accountability, and it may not be too late.”*

**Ban Ki-Moon, UN-Secretary General and  
Christine Lagarde, IMF-Managing Director**

(World Economic Forum, 2015)<sup>2</sup>

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# COPENHAGEN

*Background Image. A typical courtyard of the city.*

# 1.1. INTRODUCTORY HISTORICAL BACKGROUND

## Overview of Denmark's historical key policies and plans towards sustainability: Influence on Copenhagen's green transition

The Municipality of Copenhagen has a decades-long history on its back embedding the concept of sustainability within modern city planning.

The following descriptions aim to give a non-exhaustive list of key historical moments where Danish decision makers settled the path towards a green transition of socio-technical systems on national, regional and local levels.

Already in the late 1940's, Copenhagen created the strategic masterplan 'Finger Plan'<sup>3</sup>. A plan that had a dramatic positive impact on the urban development of the city and the whole region. Represented by the shape of a hand, the plan's five fingers were interlinking transportation infrastructures with housing, businesses and services.

The design not only increased the mobility by decreasing the dependency on cars in society, but also provided access to green spaces using the land in between the fingers<sup>3-ibid</sup>. This was a clear sign of the transition from an agricultural to a modern industrial society.

Furthermore, the municipality engaged in adopting national-level policies and plans that were characterized by the improvement of the social and environmental spheres. In the 1960's the welfare state policies introduced by the social democrat party influenced the local administration to increase the expenditures on the social and public sector<sup>4</sup>.

Moreover, due to the raising awareness of environmental issues, the Danish Ministry of Environment was established<sup>5</sup>. This led to the generation of pioneering environmental legislation like the 'Environmental Protection Act', the 'Planning Act' and the 'Act for Nature Protection'<sup>6</sup>. These policies created the regulative framework to fo-

cus on environmental pollution and its impact on human health, and the use of action plans to underpin environmental objectives<sup>6-ibid</sup>.

During the course of 1973, Denmark decided to join the European Union<sup>7</sup> and started to participate on the international arena of environmental and health policy making. Thereby, the administration of Copenhagen was tied to encompass the international cooperation and commitments established by Denmark as an EU-state member.

The adoption of EU laws and principles regarding rights and obligations created the framework that opened a window for entering into international markets. In the same year, the oil crisis provoked critical supply shortages in the whole country reaching up to 90%<sup>8</sup>.

This fact made politicians react to legislate towards energy efficiency in buildings and wind as an alternative energy source<sup>9</sup>.

In Copenhagen, residents started to change their transportation priorities and selected bicycles as the preferred mode of transportation. The crisis caused the local administration to rethink both the dominant auto-centric urban planning and the energetic model.

Thereupon, environmental policies were integrated into sectors like mobility and energy taking inspiration from the concept of 'Sustainable Development' presented in hand with the UN-Brundtland report<sup>10</sup>.

Such concept advocates for the social-economical progress in order to achieve 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987)<sup>10-ibid</sup>.

In 1990, the action plan 'Energy 2000' was rolled out aiming to reduce CO<sub>2</sub> emissions (20% by 2005)<sup>11</sup>.

Four years later, the European Environment Agency (EEA) was settled in Copenhagen in order to help EU members to 'make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability'<sup>12</sup>.

In addition, United Nations revealed 'Local Agenda 21', an action plan for creating sustainable urban policy at municipal level with a holistic approach<sup>13</sup>.

The Municipality of Copenhagen was one of the 98 Danish municipalities to take an active part in the adoption of such a programme. The main action of the plan focuses on aspects like the creation of democratic activities around topics such as bottom-up and empowerment, planning with local group work, or environmental issues<sup>14</sup>.

Furthermore, the 'Aarhus Convention' was held in 1998 to provide the public 'access to information and the right to participate in environmental decision-making'<sup>15</sup>. The reached agreements served to make decision-making processes related to environmental project plans and programmes more democratic<sup>15-ibid</sup>.

These events were a clear sign for showing that the concept of Sustainable Development was permeating in Denmark, and particularly em-

phasized the role of Copenhagen as a reference in the international environmental arena.

Since the conference 'UN-COP15'<sup>16</sup> the city intensified efforts to mitigate climate-change. Thus, following the legislative line related to the creation of environmental policies targeting administrative plans, norms and regulations at global, national, and local levels, the 'CPH 2025 Climate Plan' was presented<sup>17</sup>.

The overall aim of the climate plan is to reduce greenhouse gases emissions. In an updated version of the plan, the municipality increased the ambition of its goals and stated that Copenhagen wanted to become world's first 'green, smart and carbon-neutral city by 2025'<sup>17-ibid</sup>.

Often referred as the 'Copenhagen Model', the strategy focused on the implementation of long-term plans to fuel the city's sustainable urban development in terms of energy production and consumption, public transportation, and cycling, or the use of seawater for recreational purposes<sup>17-ibid</sup>.

This vision to make the transition from 'an industrial port city' into a 'world's leading green city' lead to an increase in the city's international benchmarking parameters that caused Copenhagen to be awarded the title of the 'European Green Capital 2014'<sup>18</sup>.

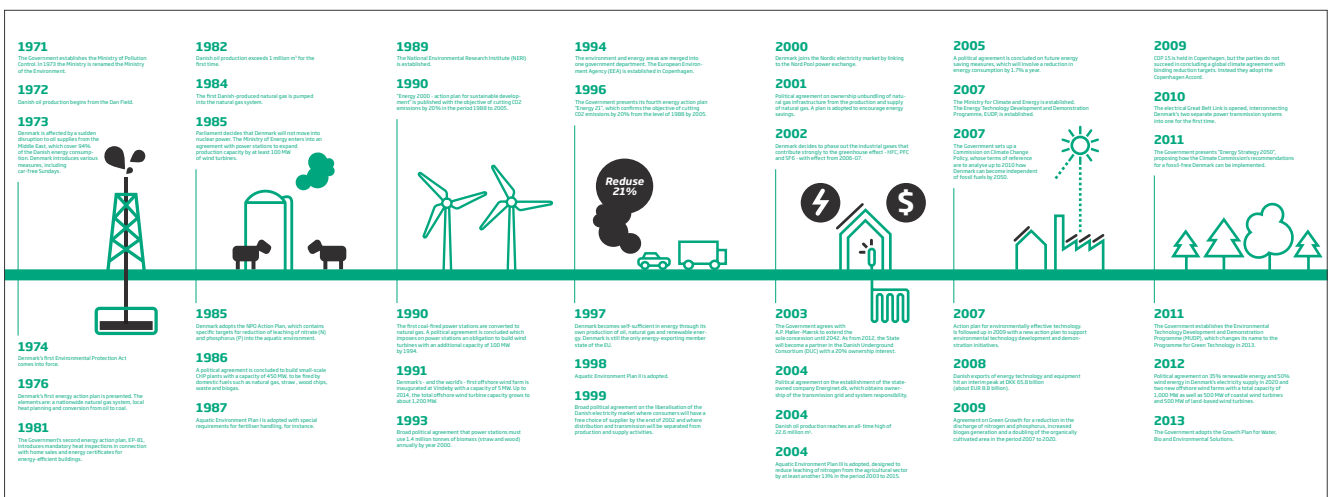


Image 4. The Danish Political Framework. (Source: State of Green).



## Overview of Copenhagen's current policies and priorities on Climate and Environment: Setting future scenarios

Since 2003, the Municipality of Copenhagen has been concentrating efforts on developing the whole city in a sustainable manner. Having as key drivers the improvement of the environment and the raise of awareness towards nature, such endeavour has resulted in the adoption of a set of policies and priority guidelines<sup>19</sup>.

The following summaries and descriptions seek to give an overview of the main strategic pillars that the city planning systems base their sustainable projects on.

Given a future scenario where the city weather will be marked by its instability (DMI, 2014)<sup>20</sup>, the climate adaptation plan focuses on identifying challenges and solutions to make Copenhagen more robust towards 'heavy rain events, floods, and high temperature increments'<sup>21</sup>.

In 2012, the climate adaptation strategy integrated the Cloudburst Management Plan<sup>22</sup> in its core. This plan was elaborated to act as a risk assessment tool to create estimations and decisions on which level of security against flood to plan for.

As a way to encompass the adaptation of the city, a prior strategy was presented in 2009. The strategy for a 'Carbon neutral capital in 2025'<sup>23</sup> paved the way of the current climate adaptation vision, setting targets for reducing CO<sub>2</sub> emissions from energy consumption and supply 'in all of the city's levels'<sup>23-ibid</sup>.

As a way to complement the main climate adaptation plan, the municipality generated a set of policies and plans that helped to broaden the scope of city interventions.

The strategy Copenhagen Agenda 21<sup>24</sup> represents the opportunity framework for involving a large spectrum of city actors in tackling municipal environmental and climatic challenges. Thus, until 2019 the sustainable development of the city will follow principles related to 'citi-

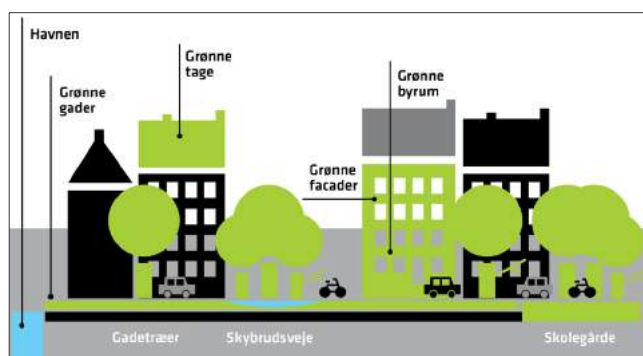
zen participation, co-creative communities and private public partnerships using an holistic and interdisciplinary approach'<sup>24-ibid</sup>.

Accompanying the same line of work the municipality presented Copenhagen Community vision (Fællesskab København)<sup>25</sup>. The vision advocates to improve the environment and urban living conditions by inviting a wide range of stakeholders to help developing the city together. By 2025, Copenhagen wants to be internationally recognized as 'the global leading city for quality of life and green growth'<sup>25-ibid</sup>.

In what refers to more nature-centred actions, the municipality launched both the City Nature strategy (ByNatur)<sup>26</sup> and Tree policy (Træpolitik)<sup>27</sup>. Having in the horizon the year 2025, both initiatives seek to increase the city's liveability by integrating plants and living creatures with recreational services<sup>25</sup>. For instance, targeting natural areas such as the lakes, harbor but also street spaces or bike trails.

A significant popular initiative, which is already approved is the pool of '100,000 trees'<sup>27-ibid</sup> that will be planted in public spaces. The result will not only be that the city will have more green areas and biodiversity, but also help to handle rainwater, reduce air pollution and the heat island effect, while providing a more relaxing environment.

Despite the good intentions behind the adoption of the above-mentioned policies, strategies, and visions, they are not exempt of critic. Some of the controversies will be highlighted in the Analysis chapter.



**Image 5.** Vision #1. Mere bynatur til københavnernerne (Source: Bynatur i København. Strategi 2015-2025)

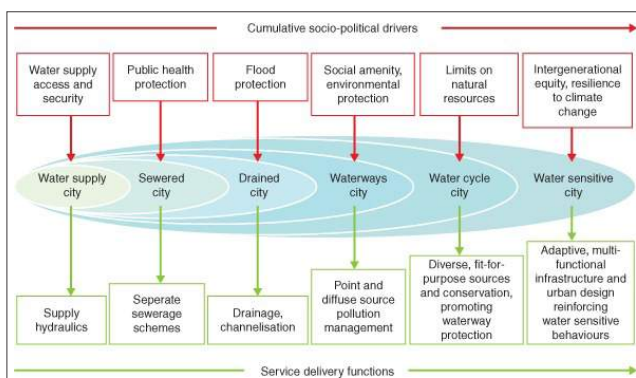
## A remark on the city's water system: a transition in wastewater infrastructures

To underpin the importance of the cloudburst management plan on the transformation of Copenhagen's urban fabric, the role that large-scale water systems play will be described. As the concern about rain water infrastructures is one of the central elements of this study, the evolution of the sewage system will briefly be described.

Taking as a reference Brown's 'transition stages of urban water management' (Brown et al. 2009)<sup>28</sup>, Copenhagen has embarked on the transition from a 'Sewered city' (monofunctional system to provide hygienic sanitation) to a 'Drained city' (multifunctional system to protect against flood)<sup>28-ibid</sup> (see image 6).

This transition has been motivated by the lack of capacity for handling large amounts of rainwater in the current sewage systems<sup>22</sup>. With more than 150 years of age<sup>29</sup>, the underground-based pipe network needs to be redesigned to keep the system service levels, avoid failures, and protect the city properties and infrastructures against floods.

As a comparative study showed that alternative surface-based solutions appear to be more cost-efficient than traditional sewer solutions (see image 7). Hence, the municipal investment strategy aims for the combination of systems below the ground and on the surface in order to enlarge the overall system capacity and lower the damage risks provoked by sewage overflows.

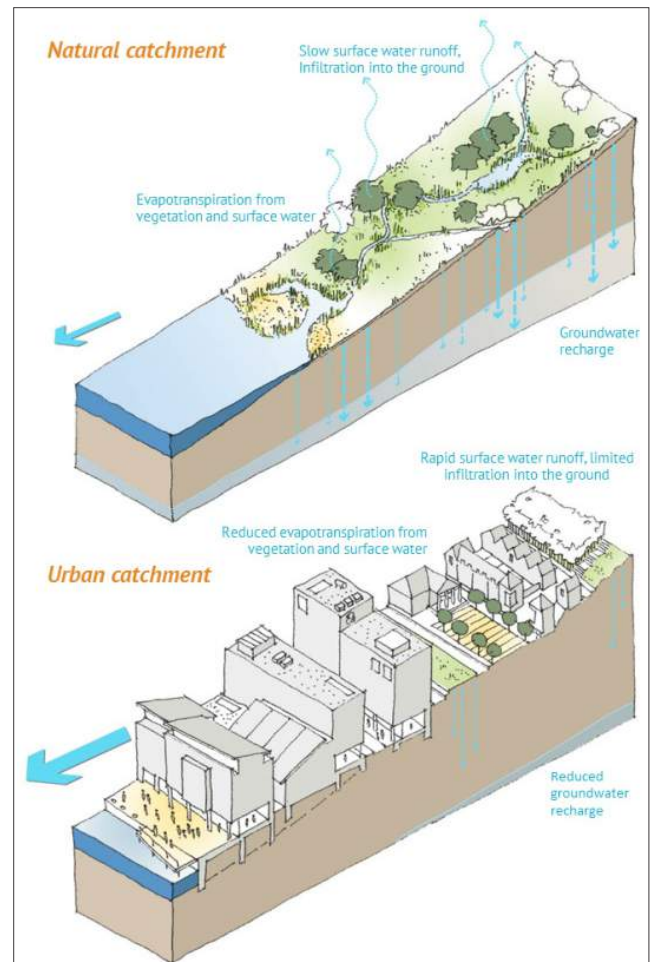


**Image 6.** Urban water management transitions. (Source: Brown et al., 2009)

RAINWATER AND CLOUDBURST (Billion DKK)	TRADITIONAL SEWER SOLUTION	ALTERNATIVE SOLUTION
Damage cost without action	16	16
Costs by taking action	20	11
Reduction of damage costs	16	16
Net gains	-4	5

**Image 7.** Economic assessment of costs and benefits of climate adaptation in Copenhagen (Source: CPH Municipality, 2014)

A potential alternative solution is the implementation of 'sustainable drainage systems (SuDS)<sup>30</sup>, which consists of directing rainwater to nearby watercourses, often via surface-based 'local drainage infrastructure solutions' (LAR)<sup>30-ibid</sup> such as infiltration or evapotranspiration (see image 8).



**Image 8.** SuDS Impact of urbanisation on the water cycle. (Source: susDrain.org, 2016)

Despite the economic parameters, there is an added value on the social and environmental spheres when embracing an alternative solution. By considering rainwater as a resource, new blue-green natural elements can be implemented in the city.

Elements with recreational purposes such as parks or canals can add value to the city and leverage its liveability. Thus, LAR projects trigger the sustainable development of the city while taking adaptation measures to counteract the negative impacts of climate change (see image 9).

*“With respect to rainwater, the city will be reconstructed for the forecasted challenges for the year 2100 (IPCC-DMI); “We are planning infrastructures to transport and delay water by combining surface and underground solutions such as roads and retention basins”. “In the advent of a 100 year rain event, occurring once every 100 years, we might need to lead as much water as we can out to the sea in order to reduce floods. This might sound as an unpopular measure in cases like the harbor where people go to swim but we are responsible for protecting the city”<sup>31</sup>.”*

*Aske Benjamin Akraluk Steffensen, Projectleader at Climate Adaption Team, Copenhagen Municipality.*

In this way water and green areas become a new multifunctional layer within the city offering recreation and protection.

*“During cloudbursts the cities will act as big machines immediately diverting the water out”<sup>32</sup>.”*  
*Christian Nyerup Nielsen, head of department in Rambøll.*

## 1.2. PROBLEM AREA

### Natural events as the disruptors of city networks-systems

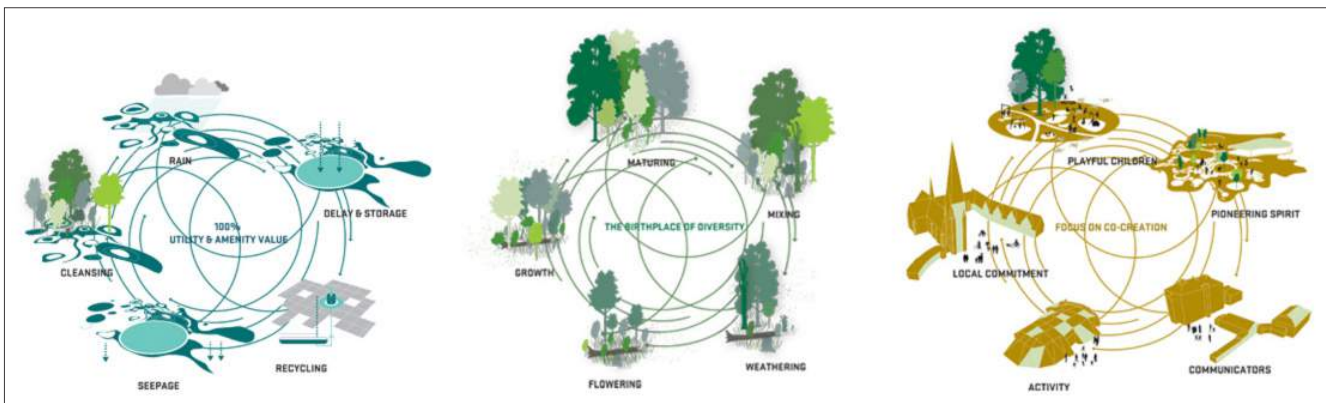
The future changes of the climate projected in the UN-IPCC report<sup>33</sup> alerted the Danish Ministry of Climate and Energy to recommend the municipalities to adapt their planning for a scenario where the planet temperature could rise approximately 3 degrees Celsius over the next 50 years<sup>33-ibid</sup>.

The Municipality of Copenhagen, being aware of the coming changes in the weather patterns, created in 2011 a departmental unit dedicated to climate<sup>31</sup>.

Organized under the City Development’s Technical and Environmental Administration, the climate unit was in charge of preparing a new version of the report ‘Copenhagen climate adaptation plan’ from 2009<sup>17</sup>.

Until that time, the activities related to the environment were a responsibility of the ‘Parks & Recreation’ department which was in charge of creating and planning strategies to implement green elements in the city<sup>31</sup>.

Thus, the city administration had no previous experience in planning or implementing exclusively climate-oriented strategies, at least not considering the whole city<sup>31-ibid</sup>.



**Image 9.** LAR solution for the project ‘The Soul of Nørrebro’: Hydrological, Biological, and Social circuits working together in a symbiosis to waterproof the city (Source: SLA, 2016).

With the adoption of the 'Copenhagen Climate Adaptation Plan' the municipality created the planning framework to implement measures to cope with future climate impacts. The plan outlined the main threats that the city could face in the coming years, and rainwater was identified as one of the most critical<sup>17</sup>.

Henceforth, the principal large-scale urban renewal projects for adaption in Copenhagen were oriented to intervene in the multiple infrastructural elements of the city (sewage, roads, parks, etc.) in order to mitigate risks of damages provoked by floods.

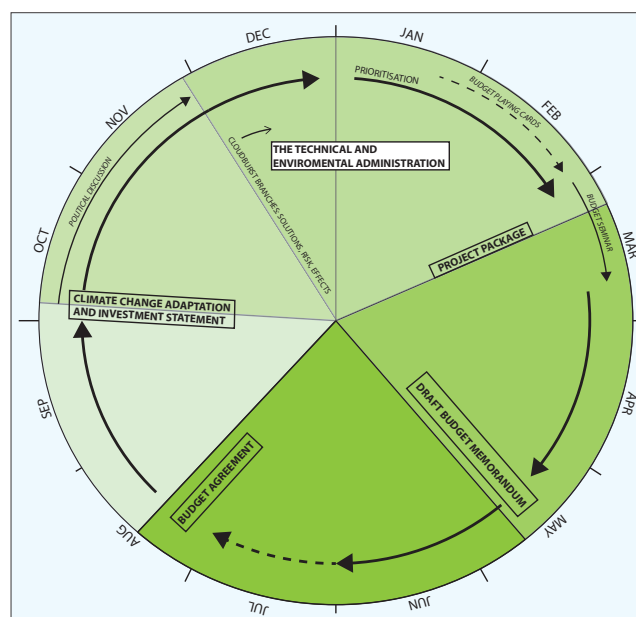
*"[...]development of methods to discharge during heavy downpours"; "Establishment of green solutions to reduce the risk of flooding[...]" (CPH Climate Adaptation Plan, 2011)*

Such ambitions were clearly marked by the historical massive rain event, which occurred the 2nd of July 2011<sup>22</sup>. In less than two hours, the cloudburst dropped rain that reached up to 150mm in some parts of the city (e.g. Vesterbro district). The overflow of the sewage network provoked failures in different systems of the city such as transport, energy, communication and health. As a result, the material damages were estimated to 6 mia. DKK (billion Danish Krone)<sup>22-ibid</sup>.

This event not only exposed the lack of capacity of the sewage system for handling large amounts of water, but the need for political action. Thereby, political decisions to accelerate the whole adaptation process were urgently made<sup>31</sup>. The development of the 'Cloudburst Management Plan<sup>22'</sup> served to fast-track the political decisions for adopting a climate adaptation strategy.

With an estimation of 300 project packages, an investment of 10 mia. DKK (1.5 billion USD), and 20 years for its implementation<sup>34</sup>, the adaptive measures for the city to mitigate the risk of floods were settled.

The definition of the city's critical areas were determined by 'water catchments' based on a risk assessment analysis<sup>22</sup>. The prioritization of the projects was established via a yearly basis process (see image 10).



**Image 10.** Annual cycle climate adaptation (Source: CPH Municipality: Climate adaption and investment statement, 2015)

Furthermore, the adaptive measures were identified as the separation of rainwater from waste water in the sewerage system, and the drainage of stormwater to the harbor area and city lakes<sup>22-ibid</sup>.

Likewise, the creation of blue and green infrastructure aims to slow down and store the surface runoff<sup>24</sup>. Thus, this new network will follow the natural flow of water in the city by adopting a system configuration like cloudburst boulevards (transporting water), retention boulevards (delaying water), or central delays (storing water)<sup>24-ibid</sup>.

The integration of blue-green surface infrastructures is not only cost-effective in comparison to traditional underground sewerage solutions<sup>24-ibid</sup>, but also has the potential to increase city liveability through the incorporation of recreational functions.



**Image 11.** Copenhagen surface solutions (Source: IWA, 2016).

## New era for Copenhagen's urban development: Resilience towards Climate Change

Developed in collaboration with the local water utility company (HOFOR), the cloudburst masterplan became the backbone of the creation of synergies with other city planning systems like roads, and parks<sup>31</sup>.

Thereby, the hydraulic masterplan acts as the key driver for the urban development of Copenhagen in the path towards climate resilience and green growth.

Before the cloudburst event of 2011, the municipality was already planning to renew some areas of the city (e.g. Østerbro district). However, after the rain event the administration took the decision to integrate the new climate adaptation strategy into the plan<sup>35</sup>.

This was the starting point of the promotion of Østerbro as the climate-resilient neighbourhood (Klimakvarter): 'Copenhagen's first district adapted to climate change'<sup>36</sup>.

Klimakvarter appears as the platform initiative created by the municipality as a bridge for making HOFOR, the local organisms (MiljøPunkt Østerbro & Områdefornyelsen), and the area residents collaborate to achieve the green-blue vision<sup>36-ibid</sup>.

During five years, Klimakvarter acted as a local and global showroom of projects that combined the multi-functionality to carry rainwater away while creating a greener and biodiverse landscape.

Projects like Tåsinge Square located within the area of Sankt Kjeld rapidly attracted the attention of international communication media, which enhanced the reputation of Copenhagen as a climate adaptation front-runner<sup>37</sup>.

These events propitiated the perfect environment to execute the municipal strategy of exporting knowledge around the world<sup>24</sup>. Thus, politicians, in hand with business consultants were making collaboration agreements with cities like New York<sup>37-ibid</sup>.

The City Administration and HOFOR will work to find solutions that can be repeated/copied, for example on cloudburst roads, retention roads, and retention spaces.

*"The aim here is to reduce costs by standardising the solution methodologies and creating a basis for reproducible solutions that businesses can refer to and, if appropriate, sell on." (Copenhagen Climate Change State of Investment, 2015)*

As beforehand explained the municipality conceived a new vision (Copenhagen Community<sup>25</sup>), a strategy (City Nature<sup>26</sup>), and a policy (Tree Policy<sup>27</sup>). With this movement the municipality aims to develop the future sustainable urban fabric by integrating natural elements and invite all city users to participate<sup>25</sup>.

In the context of Klimakvarter, this vision helped to create project synergies for urban development while managing rainwater.

*"Climate adaptation and cloudburst management planning presents a unique opportunity for the city's population jointly to create change and guide the way that change in urban spaces can be brought about jointly and assist towards added value and innovation." (Cph Climate Change State of Investment, 2015)*

Added in parallel to the Green-Livable, Climate-Resilient, and Sustainable-Growth city strategies, is the ongoing ambition of becoming a Smart City<sup>38</sup>. The adoption of a data-driven management has already improved the use of resources in the city leading to a reduction CO<sub>2</sub> in fields like energy and transportation<sup>39</sup>.

*"Smart Cities need smart insights, and that's only possible if everybody has all the facts at their disposal. The City Data Exchange makes that possible; it's the solution that will help us all to create better public spaces and - for companies in Copenhagen - to offer better services, and create jobs." (Frank Jensen Lord Mayor of Copenhagen, 2016<sup>40</sup>)*

All the projects, plans, and visions have been constructing the strategic framework where the municipality will be taking future decisions on urban development over the coming years.

Nevertheless, the current framework might be subject to changes in order to accommodate a potential new wave of policies and recommendations adopted nationwide.

Since Denmark has a dilated history of commitments regarding environmental policies, Copenhagen's municipality might need to open its agenda to integrate policies from accords like COP21-Paris Agreement<sup>41</sup>, UN-Sustainable Development Goals<sup>42</sup>, or UN-Habitat III<sup>43</sup>.

As the current global political tendency is to focus on urban development in 'a bottom-up process via cities and regions'<sup>44</sup>, it could be a time of new opportunities for Copenhagen City to increase its role in leading changes in the Danish legislation.

*"Cities act, collaborate and lead but can only reach their ambitious goals through visionary collaboration with industry partners and continued dismantling of national and international barriers to city legislation and initiatives reducing emissions"<sup>45</sup>.* (Morten Kabell, Copenhagen's Mayor for Technical & Environmental Affairs, 2016)

With respect to the near future, Copenhagen is in the process of defining its smart city strategy. This will mean the adoption of a data-driven management to improve resource efficiency and reduce CO<sub>2</sub> emissions in fields like energy or transport.

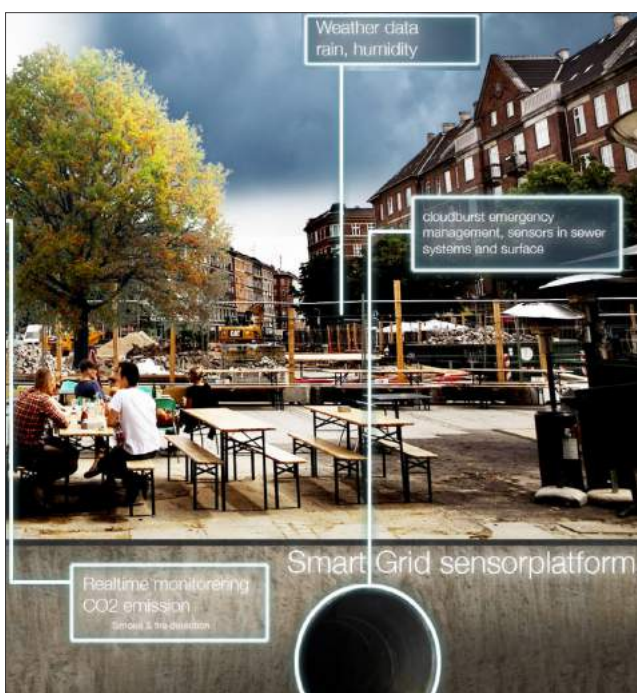


Image 12. Climate Adapted Smart City (Source: CPHSolutionsLab, 2013).

## Challenges within the planning of projects: Financing and Citizen Participation

Despite the efforts of the city administration to position Copenhagen as the pioneer in climate change adaptation, there are still some aspects that need to be considered to pave the way towards a holistic city development. The financing of some projects from the cloudburst management plan is one of them.

Approved by the city council authorities late 2015<sup>45</sup>, the overall cloudburst plan is ready for the implementation phase. With an expectation of 20-50 years the whole 300 projects solution could potentially be functioning in 2035.

As mentioned beforehand, the prioritization and selection of project packages will be based on a yearly-basis decision process (see image 10). The purpose of establishing a short-term planning process is to create better coordination with other planning systems in the city<sup>31</sup>. Thus, the technical administration will pivot from the hydraulic masterplan to the specific development of the selected project<sup>31-ibid</sup>.

Nevertheless, both the water utility company (HOFOR) and the Municipality of Copenhagen as the project owners have the common goal of mitigating the risk of flooding in city public spaces, and to improve livability by merging visions and strategies such as urban nature<sup>47</sup>.

The problem on one hand, is that 100 of the 300 projects packages will need to intervene private roads. These roads are the property of private citizens that have the responsibility of the maintenance<sup>47-ibid</sup>.

On the other hand, some of the hydraulic solutions on roads have been developed in collaboration with private companies. This partnership has created a negotiation framework where citizen participation is tied to a co-financing scheme, and a set of technical requirements that often offer little room for supporting the finance of alternative green solutions (e.g. trees)<sup>47-ibid</sup>.

*"We help the communities with private roads to apply for the financing scheme. Therefore, we act as consultants and operators for the implementation of the road solutions."; "We seek the most favorable solution for HOFOR, the municipality, the community and ourselves having the financial requirements from the Forsyningssekretariatet in mind"<sup>48</sup>." (Mikas Schmidt, MT Højgaard, 2016).*

Moreover, there is a crescent interest to integrate public and private courtyards spaces into the official cloudburst masterplan.

With an estimate of 600 courtyards spread around the city premises, this could represent an opportunity to help the existing and upcoming hydraulic infrastructures delaying or percolating rainwater<sup>49</sup>.

In the same way, green areas that could benefit the quality of life in the city and within the communities can be created<sup>49-ibid</sup>. The possibility of integrating courtyards within the overall plan is still recent, so there is an ongoing discussion on how to make it happen.

Nonetheless, the integration of these private courtyards with the public infrastructures also represents a new opportunity for the utility company (HOFOR) to continue expanding operation and maintenance-related services<sup>51</sup>.

An additional challenge is related to citizen participation processes. The traditional predominant top-bottom approach from the municipal planning systems and the utility company, makes the path for inclusive development arduous.

Although some of the project initiatives related to courtyard renewal like Klimakvarter courtyards have been opened for citizens participation, the processes are still perceived as too costly in the eyes of the administration<sup>35</sup>.

Projects related to Klimakvarter are still being perceived as an exception mainly because of its exploratory character and political support.

This could also mean that probably the municipality will opt for a different approach in the future.

*"In the climate-resilient neighbourhood we are developing the methods and expertise to be used in the rest of Copenhagen"<sup>50</sup> (Klimakvarter, 2016).*

An emblematic project with high citizen participation is the so-called 'climate resilient block' (klimakarré)<sup>52</sup>. Since 2013, Klimakvarter has created an open framework where the municipality together with the residents, external consultants and other organizations have been helping to develop future solutions for the block.

Currently, Klimakvarter has been closed, but the project is still under development, and the municipality is in the process of analysing the obtained results from the different project processes, in order to learn what worked and what can be improved in the future.

If taking into consideration the intrinsic complexities within the projects related to Klimakvarter, it can be assumed that the city administration will find it difficult to define a standard formula with which to create a common strategy and even assign budgets to start replicating these sort of participatory processes all over the city<sup>53</sup>.

*"[...]the wishes and dreams of the residents were identified and innovative producers made their bids for solutions to achieve sustainable urban renewal."; "The selected team of consultants has worked on the development of specific solutions for both the courtyard and the buildings and has now delivered an outline design."; "There has therefore been close involvement of residents from the block throughout the project period. This has taken place through interviews, questionnaires, planting events, residents' dinners, meetings and in many other ways"<sup>52</sup>." (Klimakvarter, 2016).*

The perception of a 'standardize participatory climate adaptation planning processes' might be compromised if the synergic opportunities for collaboration between the diverse city planning 'department silos' are viewed as a too laborious process.

# 1.3. PROBLEM FORMULATION

Since the mid-60's, the danish policies have been environmentally oriented. This fact is reflected in the urban planning of cities like Copenhagen, which has become a pioneer. Climate change has challenged the municipality to rethink wastewater systems, thus enforcing citizens to climate adapt their own properties. However, there is little financial or technical support for the citizens.

Through interviews and an extensive literature study, the empirical material was collected, and the character of the problem was defined by following research:

A historical review on the Danish national and municipal political framework towards the protection of the environment. Following, the Municipal Climate Change adaptation strategy will be understood. As a way to deal with rainwater in Copenhagen, the municipal planning has embarked into a transition where rainwater is considered a resource with multiple functions on the surface instead of waste. Following, the framework that the citizens need to comply to in the municipal strategy is mapped.

A detailed analysis of the problem will be carried out by using a pragmatic approach inspired by Actor-Network Theory. Seeking to unfold the actor-network constellation and inform the creation of the design concept that will help to answer the following research question:

***How can design concepts lead citizen participation to expand knowledge and the legislative boundaries of co-financing and governance related to climate adaption in Copenhagen?***



## 1.4. PROJECT DESIGN

The current chapter contains the overall description of how the project structure has been designed. The following visualization and the subsequent description of its elements, aims to explain how the research activities are organized and what their purpose is.

The design of this project has been created by using the 'double diamond' design process model<sup>54</sup> as a reference. This model helps designers map each stage and activity of the design process with a simple graphical representation. The double diamond model is formed by four stages (Discover, Define, Develop, Deliver), and divided into two process spaces (Problem, Solution).

Reading from left to right, the first diamond shows both the divergent and convergent stages of thinking during the problem process, and the second repeats the same operation but in relation to the solution process<sup>54-ibid</sup>. The red circles serve to give details of every stage's key activities, and the arrows show the way they are linked within the overall design process. The texts within the blue brackets pretends to summarize the content of each stage.

Having introduced the model, the following description contains a summary of the process' stages and key activities of this project.

### Problem-Convergent Stage: 1.Discover

- *Research Challenge*: overall discover of the problem area and main actors.
- *Empirical Studies*: qualitative data collection through semi-structured interviews, and documentary evidence (mainly reports).

### Problem-Divergent Stage: 2.Define

- *Theory & Analysis*: conceptual analysis model based on data synthesis and the selection of a theoretical background.
- *Problem Formulation*: work hypothesis based on the analysis. How to involve the citizens from private areas?

### Solution-Convergent Stage: 3.Develop

- *Concept Creation*: design brief based on participatory design approach and co-design methods.

### Solution-Divergent Stage: 4.Deliver

- *Co-Design Workshop*: prototype of courtyards design via the interaction of a design game (artefact).
- *Challenge Solution*: report with the insights from the co-creation of future scenarios (digital sketches).

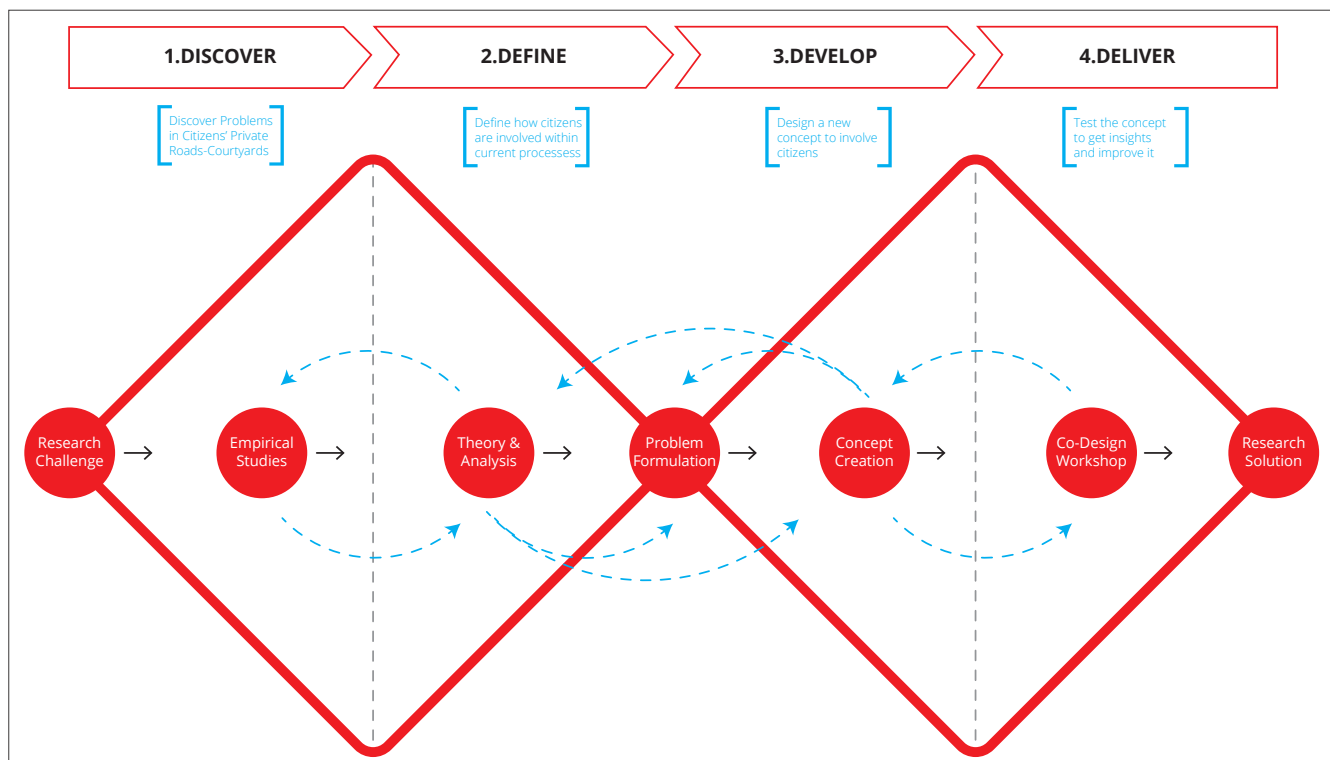


Image 13. Visualization of the project design structure and key activities using an adapted version of the double diamond diagram.

## 2. THEORETICAL FRAMEWORK

The following theoretical concepts have been selected in order to inform the analysis, and to provide a framework for approaching the design process, while linking the methodological choice to answer the research question.

As this action-research is being developed in a pragmatic manner, the theoretical notions have been sought in order to coalesce into this flexible framework. In this way, approaches such as Actor-Network Theory and Participatory Design appears as the appropriate theoretical frameworks.

Additionally, to illuminate the ongoing transition processes occurring within the city, concepts from transition studies will be briefly exposed. Concretely, the role that socio-technical systems (e.g. water) have in transforming urban governance will be argued.

### Actor-Network Theory (ANT)

ANT is broadly used to generate contemporary scientific knowledge in fields such as science, technology and society (STS).

As the social analysis is one of the strongest pillars forming this study, ANT appears as the key method to analyze how networks are constructed and maintained, but also to identify the different actor constellations embedded within particular actor-networks and their associated relationships.

On the other hand, ANT has been criticized to provide just descriptions and not explanations about the intentions behind actors' agency (e.g. power relations).

Nevertheless, ANT offers a set of concepts that can help the researcher understand and represent the complexity of our world without imposing a particular way of usage (Law & Hassard, 1999).

This flexibility allows ANT to be combined with ideas with distinct theoretical disciplines, for instance in this case the design studies.

Classical ANT concepts have been chosen to illustrate in a practical way the dynamics within the diverse networks around water infrastructures during both the analysis and design process.

These concepts have been applied previously in many others studies with different contexts. Hence, it is pertinent to clarify their meaning before using them. A brief introduction based on Bruno Latour, Michel Callon, and John Law lenses is described as follows.

As a departure point, an actor-network consists of 'a group of unspecified relationships among entities of which the nature itself is undetermined' (Callon, 1993, p.263).

Human and non-human, actors are considered as 'entities that do things' (Latour, 1992a, p. 241) integrated into networks in a constant state of 'becoming', 'stabilising' and 'dissolving'.

*"[...]An actor-network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of." (Callon, 1987, p.93).*

As Callon argues, 'Intermediaries' and 'mediators' are the elements of meaning interlinked to these actors and networks (e.g. texts related to climate change).

Although both concepts transport meaning, they have distinct connotations. As Latour articulates, intermediaries can do it 'without transformation', whereas, mediators can 'transform, translate, distort, and modify' it (Latour, 2005).

*"Intermediaries is anything passing between actors which defines the relationship between them." (Callon, 1991:135).*

Following on Latour's perspective, the concept of 'black box' and the associated terms of 'inputs' / 'outputs' can be viewed as a sort of system where 'scientific and technical work is made invisible' (Latour, 1999).

*“When a machine runs efficiently, when a matter of fact is settled, one needs focus only on its inputs and outputs and not on its internal complexity. Thus, paradoxically, the more science and technology succeed, the more opaque and obscure they become.”*  
(Latour, 1999).

An additional concept for referring to network-making is ‘translation’. According to Callon, translation is the process consisting of four phases during which ‘the identity of actors, the possibility of interaction, and the margins of manoeuvre are negotiated and delimited’ (Callon, 1998).

These phases are ‘problematization, interessement, enrolment, and mobilisation’ (Callon, 1998). For instance, the translation of specific knowledge about water infrastructures into a competing network like roads.

## Participation in Design: Co-Design and Design Games

A participatory design approach has been chosen as the framework for developing activities towards the design challenge of this study. A design challenge that explores future opportunities for redesigning a courtyard with the active involvement of different users (actors).

*“The users are seen as competent in their everyday practice and designers are urged to create settings in which this competency can be made an active asset in design.”*  
(Brandt, 2006).

As Brand et al. defined, participatory design is a family of design practices tools and techniques (Brandt, Binder & Sanders, 2015).

Nevertheless, it is also described as the participation practice that provides the ‘participatory mindset’ (Sanders & Stappers, 2008), and the conceptual approach to organize the design process.

In this study, the design process is motivated by the search of change in multiple socio-technical systems, and it is catalyzed by the embracement of democratic participation via multiple actors.

*“In a particular design project, participatory tools and techniques can be seen as the scaffolding for the temporary community of practice in the making. They support collaborative enquiry into the intertwinement of the essential questions about ‘what to achieve’ and ‘how to achieve it’. Bringing together a network of actors with different backgrounds, competencies, experiences and interests challenges participation.”*  
(Brandt, Binder & Sanders, 2015).

As Bratterteig articulates, ‘users at many levels participate so that change can be shaped from several perspectives’ (Bratteteig & Gregory, 2001).

Although participation implies the active involvement of many actors, it can be used for different purposes. As Mikkelsen argues, there is a wide range of participatory approaches: from ‘passive participation’ to ‘manipulation’ (Mikkelsen, 2005).

Thus, the approach adopted will clearly affect the end result of the design process. The participation process in this research has a purpose of matching interests and agendas from selected actor-networks: the courtyard community, the municipality, and other semi-public organisms.

*“Designing is about rethinking, envisioning and making”*  
(Vaajakallio & Mattelmäki, 2014)

Such enterprise is encompassed by the use of co-design methods and tools inspired by the concept of ‘exploratory design games’ (Brandt, 2006).

Design games appear as an arranged platform where designers, users, and other design partners can participate in the design process via design activities.

This design process can be ‘event-driven’ (Brandt, 2001). For instance, when a co-design workshop is temporary ‘staged’ (Binder et al., 2011) contextualizing a particular design game

and its 'enacting' of future scenarios via the democratic dialog and negotiation.

Design games appear as a 'boundary object' (Carlile, 2002) where actors interact and create design artefacts (Brandt, 2006).

According to Carlile, boundary objects 'allow individuals to specify what they know, what they worry about, as concretely as possible to the problem at hand' (Carlile, 2002).

Thus, a set of artefacts are collaboratively created and integrated into the game in order to facilitate actors' expression.

*"[...]designing is a social process which involves communication, negotiation and entering compromises"; "[...]the design process itself is just as important as designing the artefact."* (Brandt, 2006).

## Transition Studies

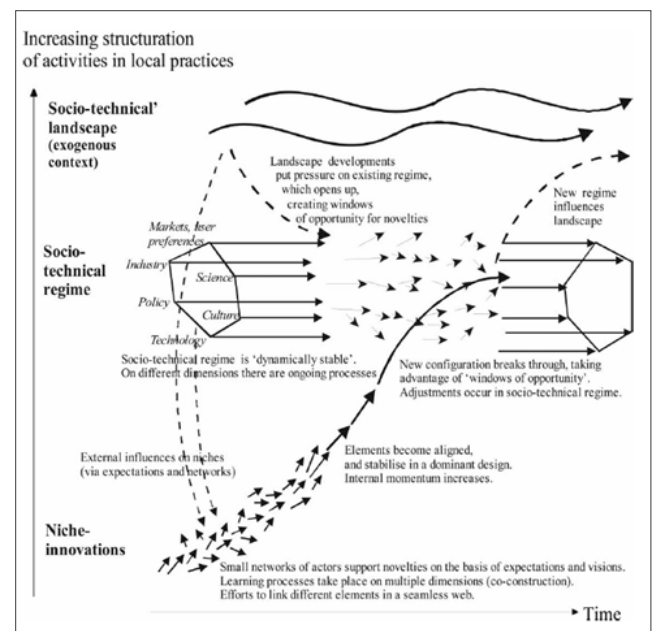
With the sole purpose of grasping the surface of the field of transition studies, the following arguments aim to identify the theoretical concepts behind transition processes. Thus, helping to understand the current city transition.

In particular, by elaborating on multilevel perspective (MLP) it is attempted to shortly illuminate how policies related to sustainability and climate resilience can help to trigger changes on large-scale socio-technical systems of Copenhagen.

According to Geels MLP model, transitions are composed of three frames: 'Socio-Technical Landscape', 'Socio-Technical Regime', and 'Niche-Innovation' (Geels, 2005).

For a transition to happen it is often required that the stability of the regime frame (e.g. wastewater policies) is compromised, thus, opening for a 'window opportunity' due to pressures from the landscape frame (e.g. climate change effects).

Then, innovations from the niche frame (e.g. new technology) can provoke the present regime to shift or be replaced.



**Image 14.** Multi-Level Perspective on transitions (Geels, 2005).

Despite this, transition studies have been criticized due to 'a lack of sensitivity to scale and place' (Coenen et al., 2012). Concretely this is caused by its exclusive focus on socio-technical systems at a national level (Jensen et al., 2015).

A priori this myopic fact could jeopardize the outcome of a design research like in this study by offering an incomplete analysis.

However, as Jensen articulates, new theories have been addressing socio-technical systems at the urban level, for instance, identifying how these are 'shaped by endogenous tensions and ambiguities' (Jensen et al., 2015).

These inquiries created a different logic about urban socio-technical systems. For instance, as Emelianoff argues 'socio-technical systems are often subject to contradictory regulations and interventions enacted by different policy platforms' (Emelianoff, 2014).

But also as Jensen states, 'the politics and contestations involved in defining socio-technical systems are objects of governance' (Jensen, 2012). By having in mind these perspectives the boundaries of the research can be broadened.

### 3. METHODOLOGY

This chapter serves to argue the selection of methods and approaches behind this design-research.

Inspired by Actor-Network Theory (ANT), this study two-folds in a process where it is firstly aimed to identify the actor-constellations that are involved in the climate adaptation of Copenhagen, their logics, and the ongoing dynamics behind the destabilization of these networks.

Secondly, the design process seeks to build an actor-network around a specific local project of a courtyard renovation. In particular, it will be illuminated how Copenhagen's Municipality involves private citizens in the transformation of the city's socio-material in order to be aligned with the official urban development strategies.

The pragmatic and network-oriented approach of this study finds in ANT the ideal framework to inform both the analysis and the design processes. Although ANT can help to unfold and to explore a constellation of an actor-network (Callon, 1991), it does not necessarily illuminate the reasons why or how actors act (Law, 1999). Therefore it is crucial to collect empirical material.

The empirical work carried out and used in this research is based on qualitative methods like face-to-face semi-structured interviews and document analysis.

Such approach and artefacts provide insights on 'how people construct the world around them' (Kvale, 2007). For instance, how actors like citizens relate to concrete municipal strategies statements.

Although evidence based on interviews has been criticized due to possible 'selective perspectives' on the truth from the interviewee (Dean & Whyte, 1958), the data collected through the qualitative methods has been key for identifying a wide range of actors to design this study.

Precisely, the participatory dimension is one of the central elements of this design-research. The study advocates for the 'collective creativi-

ty' generated from the participation of multiple actors with the goal of creating a more inclusive, sustainable and resilient city.

For this reason, participatory design provides us with the methodological framework for organizing the design intervention.

Participatory methods such Co-Design, can help to accommodate the collected empirical material with a democratic design process.

As Sanders argues, 'co-design involves both designers and non-designers in a temporary collaborative design process to achieve a shared purpose' (Sanders et al., 2008).

In this study, the co-design process has been conducted through a co-design workshop. The purpose of the workshop was to invite the courtyard residents into a constructed 'game space' in order to create a 'shared language' for commonly envisioned future scenarios (Brandt et al., 2000).

The co-design workshop offers a space for interaction where the democratic dialogue can flow. Through the use of a participatory design game and the creation of artefacts via design thinking activities, these dialogues help to understand every actor wishes and concerns regarding the courtyard renovation project.

As traditional games, design games also include rules and game pieces to provide guidance and support during the play and 'convey what players can or cannot do in the temporary world' (Vaajakallio & Mattelmäki, 2014).

However, it is also contested that rules and artefacts should be open for reinterpretation by the users. According to Brandt, this boundarylessness helps to move the process due to the meaningful interpretation of the players (Brandt, 2006).

Thus, co-design tools and methods can provide a unique mutual learning experience both for the designer (facilitator) and non-designers (partners).

## 4. ANALYSIS

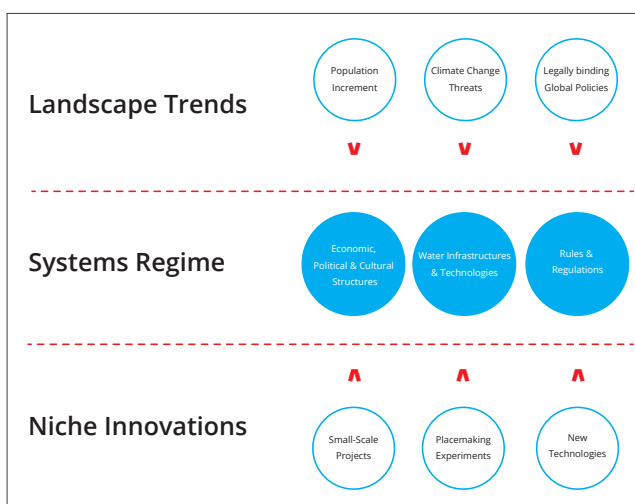
This chapter attempts to expose some of the ongoing issues regarding the relations between the main public-private actors (organisms and businesses) involved in developing the Copenhagen Climate Change Adaptation Plan<sup>22</sup>, and the citizens (private communities) who participate in these processes.

In particular, two cases related to the city's private property realm will be presented where local communities act as the owners of the courtyards and roads surrounding their building properties.

These cases will serve both to illuminate the actor-network dynamics during the process of a private intervention, and to gain insights to further inform the creation of the design concept.

The case descriptions will use the theoretical concepts presented in the previous chapter 2. Theoretical Framework. However, ANT concepts will be the main focus, whereas the concepts from design and transition studies will be used as a complement.

As a departure point, an example of how transitions are taking place in the city is given. The image below shows how the current established regime systems in the center are challenged both by the pressing trends from the top landscape level, and from the upcoming innovation niches from the bottom level.



**Image 15.** Multiple levels as a nested hierarchy. (Adaptation from Geels, 2002).

To elaborate, a concrete example of how a transition could be initiated is the pressure that climate change is exerting on the city water systems, which causes material damages by floods.

Then the political regime is pressured to make a shift and create new policies and economic structures in order to accommodate the new reality. This will open up to opportunity windows for innovations to be integrated in the urban fabric.

### Case 1. Analyzing the processes in the climate adaptation of private courtyards

This analysis will describe how private courtyards of the city have recently been considered to be integrated as a complement for the public projects determined within the Cloudburst Management Masterplan<sup>22</sup>.

The Municipality of Copenhagen has often been providing co-financial instruments for lifting neighbourhoods through the urban renewal projects<sup>58</sup>. Thus, residents with private courtyards have already had the possibility in the past to apply for economic support for renovating their spaces.

However, when it comes to the recent period of the climate change context and the related heavy rains provoking floods in basements, the scenario is more complex.

Initially, as the Climated Adaptation Plan, and Cloudburst Management plan were launched, the municipality stated that citizens are obliged to invest in climate adaptation<sup>55</sup>. Moreover, 'sewer companies are not required to protect basements against flooding'<sup>22</sup>. This means that the implementation of defensive measures against flooding lies within their own responsibility.

*"[...] protection of the individual property at present rests with the owner of the building. If the property is privately owned, this means that the individual owner himself bears the economic burden and responsibility for the damage that occurs as a result of inadequate drainage, defective sewer systems at the property and failure of building structures<sup>17</sup>."*  
(Copenhagen Climate Adaptation Plan, 2012)

With approximately 600 courtyards allocated within the city<sup>49</sup>, the amount of citizens who needed to invest in flood prevention solutions was considerable. This was a group of people, that the political regime could not afford to ignore.

Despite the delegation of responsibility, the government now launched a task force and an online portal, which would inform and guide citizens about climate adapting their property (Klimatilpasning.dk). The portal was regularly updated and optimized with new tools as they were developed, financed by the government.

Thus, the civil society has received the support and guidance from the national, regional and local governmental agencies and organisms<sup>56-ibid</sup>.

This illustrates a transition in the political system, shifting from initially excluding the protection of private properties to creating bridges for support through digital campaigns.

Taking an ANT perspective, this can be viewed as a potential actor-network destabilization (citizens with private courtyards) and the subsequent process of translation initiated by a dominant actor-network (private-public organisms).

To further continue with this process, in 2013 the municipality established a collaboration between the 'Future Courtyards'<sup>57</sup> departmental unit and the platform Klimakvarter<sup>50</sup>.

The purpose of such a collaboration aimed to develop three LAR-oriented projects in courtyards that could serve as a demonstration of potential solutions.

With a total budget of 40 million DKK financed 50/50\* by the municipality and the State<sup>57</sup>, these renovation projects did not only seek to manage rainwater, but to integrate recreational values that could increase liveability<sup>49</sup>.

*"Demonstration projects must uncover the Copenhagen courtyards contribution to meeting the Climate Adaptation Plan target that 30% of rainwater must be recycled or handled locally instead of running into the sewer." (TMF, Fremtidens Gårdhaver, 2013)*

By following this statement, it can be appreciated how different city regimes (public authorities, rules and regulations of wastewater, etc.) are immersed in a transition.

We see a change from perceiving rainwater as a polluted element that needs to be removed from the surface into the hidden sewer network under ground, to recognizing rainwater as a resource to retain in surface systems due to the diverse values that it offers in terms of nature, aesthetics and recreation.

The three projects were Sankt Kjelds Plads, Otto Malingsgade, and Klimakarré<sup>50</sup>. Although, the material describing each case is vastly available, the collected empirical evidence is focused on describing the case of the 'Climate-Resilient Block' (Klimakarré)<sup>59</sup>.

#### Shortlist of activities carried out during the workshops in Sankt Kjelds Plads project<sup>61</sup>:

- Communicate via a Facebook Group
- White Sheets: answers to frequent asked questions about the project.
- Speed Dating: residents and advisors creating thematic boards inviting for talks and questions about biodiversity, LAR and communities.
- Map the Good, Bad & Dreams Places: residents mark their favorite places with tape on the grass.
- Sketch the Future: sketches of potential scenarios based on participants' previous inputs.
- Model-ideas 1:1 : participants build models of their visions and talk with the advisors.
- Election: residents can vote for or against getting a new courtyard.
- Evaluation: residents give feedback on the services received during the process.

Source: Fremtidens Gårdhaver: Skt. Kjelds Plads

\* due to budget cuts nowadays the financing is distributed 70/30 by the Municipality and the State.

Thereby, the following description will be based on the interviews with one of the two board members (Bjarne Gantzel)<sup>60</sup> who represents the courtyard community, and a resident of one community opposed to the plans (Jakob Peterhänsel)<sup>61</sup>. The purpose of these interviews was to get insights on the relationships between the different actors summarising a time span of three years.

With an estimation of five years for its completion, the municipality created an agreement to renovate the courtyard that surrounds the building blocks at Landskronagade, Thomas Laubgade, Helsingborggade and Kildevældsgade.

To begin with, the selection of the community was based on the positive financial situation. In the expected outcomes, the handling of rainwater was one of the main pillars (4450 m<sup>3</sup>/year)<sup>59</sup>.

It needs to be clarified that at the present situation, the four buildings forming the block each have their own private courtyards. The renovation project aims to merge the courtyards into one common space.

Therefore, the transition will unite the diverse communities in a common shared area. It is expected that during the transition, the actors-networks will be destabilized.

According to Gantzel, the courtyard renovation process began in 2013 with a set of preliminary activities facilitated by the consultants 'Smith Innovation' and 'Rekommanderet'.

During 15 months, the consultants organized and facilitated up to 10 workshops where community members were asked to participate<sup>60</sup>.

The activities were organized following design thinking methods which inspired and encouraged the participants to express their wishes and even making small prototypes of their ideas<sup>60-ibid</sup>.

*"The workshops were organized really well, the consultants prepared a lot of visual materials. I remember the workshops as a rich experience, and the community felt that we were contributing in creating meaningful ideas."*  
(Bjarne Gantzel, 2016)

Despite of the long duration, these workshops were highly valued by the community. The process created a mindset that brought the energy to engage.

Additionally, the communication was really easy since the municipality installed a stand where residents could pass on their claims and doubts to a representative<sup>60-ibid</sup>.

In a second phase, the municipality opened a call for tendering the project. The selection of the application teams were based on a set of criterias such budget, innovation, nature, rainwater, etc.

Thus, a team of five new actors were selected to continue leading the renovation process: Henning Larsen Architects, Henrik Larsen Rådgivende Ingeniørfirma, V!GØR, TagTomat, and BvB<sup>59</sup>.

As Gantzel argues, this change of team generated confusion for some community members. Fortunately, having a consultant with experience in facilitation participatory processes at the early beginning helped to soften the phase-change.

*"Louise Heebøll from V!GØR and the municipal teams did a great job, we got the feeling of being contributing."*  
(Bjarne Gantzel, 2016)

From an ANT point of view, it can be identified how both the municipality and the consultants successfully stabilized the actor-network around the courtyard. To recall on Callons', they went through the phases of 'problematization, interesement, enrolment, and mobilisation' (Callon, 1998).

Unfortunately, the 'feeling of progress' was started to dissolve when the architects and engineers took over the lead.

*"After a few workshops, the communication was not the same. It was more difficult to know the status of the project; we started to get impatient, and feel that they forgot us because it so long to receive news from them."*  
(Bjarne Gantzel, 2016)

Having this as a reference, the dissolution of the relationships between the actors is defined. This provoked the subsequent network destabilisation caused by the lack of communication.



Moreover, the participatory process was narrowed down to a series of community meetings where the members could have a dialog with the architects.

*“Basically, the consultants brought some drawings in which they were supposed to put our ideas. But sometimes we felt that they were pushing for their own agenda (maybe to gain fame). For example, we really wanted to have a lot of green areas, but we can see that the areas with water were occupying too much space. For some of us this was interpreted as a lack of project ownership.” (Bjarne Gantzel, 2016)*

This statement clearly distorts what the municipality claims to be doing:

*“It is important in the Copenhagen Climate Resilient Block that the residents are motivated and take ownership of the project. There has therefore been close involvement of residents from the block throughout the project period. This has taken place through interviews, questionnaires, planting events, residents’ dinners, meetings and in many other ways.”*

*“In the next phase the building owners are to decide what building renewal projects they wish to implement, and the lead consultant team is to continue working on specifying a project proposal for the courtyard which is expected to be sent out for comment during the spring of 2017.” (Copenhagen’s Climate-Resilient Block, 2016)*

Additionally, the municipality has been highly criticized by some of the community members. In some cases, due to ‘authoritarian top-bottom approach’ and ‘the lack of sensibility to listen the minority groups’<sup>61</sup>.

*“In our community we are highly opposed to making the courtyard a common space, 95% of our building voted No. In my opinion this is an authoritarian approach imposing top-down planning and seems that overall they just want to gain international prestige, meanwhile they say they are democratic participation but instead they are creating a conflict in our community.”*

*“During years we have been investing in renovating and maintain our private courtyard, whereas, many of the others communities haven’t, but we will need to pay again.” (Jakob Peterhänsel, 2016)*

This has provoked that some community members feel that they have been forced into an unfair situation.

*“We are one of the few areas of the block that have plenty of Sunlight, and we don’t want people that we don’t know from the rest of communities to come here to our courtyard space.” (Jakob Peterhänsel, 2016)*

By causing such negative dynamics, the municipality therefore not only has untap old conflicts between the communities that belongs to the block, but also has generated a negative image on himself.

*“We are angry because we have been spending a lot of money in the project, but we have been doing a lot ourselves. Yes, it’s nice to have the opportunity to express our wishes as we did. However, the municipality should listen carefully the citizens, and plan according. If people don’t want to join why they should be enforced?” (Jakob Peterhänsel, 2016)*

Despite the possible tensions between the community members and the municipality, it was in the municipality’s best interest to provide the appropriate service and solutions.

A last example focuses on the co-financing opportunity that the municipality offered to the community. As a way to complement the overall climate adaptation of the block, an external EU funding scheme was identified.

According to Gantzel, this fund provides financial support to improve energy-related savings, for instance, isolating windows, roof or facade elements<sup>60</sup>.

This possibility exemplifies how the coordination between planning systems caused project synergies that go beyond the sole purpose of renovating the courtyard.

*“We got a fantastic offer, on top of the courtyard project, we can now apply for fixing elements in some of the facades and windows”. Apparently, there is an EU fund that can cover up to 80% of the costs. I think it is great! However, we didn’t know that this possibility existed until now.” (Bjarne Gantzel, 2016)*

Through ANT it can be seen how the municipality used mediators, in this case fundings, for the translation to occur.

This strategy aims to stabilize a network destabilized by the blackboxing of the design solutions presented by the consultants during the second phase of the project.

Besides the demonstration projects, the municipality has been working on helping to renovate many other private courtyards in the city.

According to the publication 'New life to your Courtyard' already 14 cases of the 300 potential courtyards have benefitted from the urban renewal support <sup>62</sup>.

*"All Copenhageners should be able to live near a green area where they can destress from daily life. The courtyards are helping to make Copenhagen greener. Therefor, part of the urban renewal funds go to common courtyards. It also makes the city more resilient to climate change".*

*"When cloudbursts hit Copenhagen, lawns, green roofs and flower beds absorb water that would otherwise flood the sewers, and enter people's basements"<sup>62</sup>*  
(Københavns Gårdhave, 2016)

This opportunity goes hand in hand with the adoption of the 'Law on Urban Renewal and development of cities'<sup>63</sup>, and the requirements 'Sustainability in Civil Engineering'<sup>64</sup>, both approved recently by the city council.

With the establishment of this legal framework, a co-financing scheme was created, which allows private citizens to apply for renovation of their courtyards spaces.

Each year, up to 12 applications for courtyard renovations will be processed by the municipality, who will be in charge of paying the costs related to the whole intervention.

*"We have a calculation model that establishes the financial support for courtyard renovations. Often the budget results in 4-5 million DKK"<sup>79</sup>. (Lene Andersen, 2016).*

Thus, the community will only be responsible for the future maintenance of the courtyard space and its furnishings <sup>62</sup>.

The municipality estimates that each renovation project can be completed in 2 years, once the application is approved<sup>62</sup>.

During this time, the process is divided into the following phases. First, the renovation application is assessed by the municipal technicians who will check if the community fulfills the requirements.

Secondly, a Courtyard Committee (Gårdlaug) will be formed, which consists of community representatives among all the different buildings within the complex.

Thirdly, the future courtyards unit from the municipality organizes and facilitates a design process where the residents participate in envisioning potential solutions. According to Jesper Langebæk<sup>62</sup>, this process can be summarised in the following steps:

- Information meeting
- 2 workshops for finding potential solutions
- Political validation
- Contract and certification

Source: Jesper Langebæk

In these projects, the strategy from the municipality, is that the citizens should be the first movers of the process.

*"My community has been applying for support to renew the courtyard for more than 4 years; we are still receiving excuses and we are stuck in a waiting list"<sup>84</sup>.*  
(Pia Koppelman, 2016)

On one hand, this approach works as a bottom-up process, which only opens up for truly interested communities, giving a higher degree of ownership.

On the other, it also provokes delays on the waiting list where the pool of projects in some cases already exceeding the 2 year framework.

Moreover, these delays could affect the coordination negatively with other city planning systems such as HOFOR and their implementation of cloudburst projects.

*“If you look at the potential contributions that the courtyard projects will create, you can see that it represents a huge opportunity for HOFOR’s future business interests. Obviously our unit works in collaboration with HOFOR, but sometimes it gets complicated due to different planning logics in the two organisms<sup>51</sup>.”*  
(Jesper Langebæk, 2016)

The coordination is crucial, specially if the applicant community is seeking additional elements, for instance, as in the case of the climate-resilient block with the isolation of windows, facade and rooftops based on an external EU funding scheme.

In this case, these sort of benefits might not be considered if the municipality keeps the approach of delegating the responsibility for action to the community.

The result could be that the citizens are unaware of additional possibilities, which can complement the courtyard renovation. In that case the municipality may be tempted to simplify the renovation plans to stay on budget and time schedule.

These considerations could have an influence on the project outcome, but to better understand the ongoing dynamics it will be necessary to look at a deeper level.

Image 17 aims to illuminate the different relations embedded in the Actor-Network constellation.

This graphical representation provides an overview, both of the different actor-networks around the courtyard in the climate-resilient block, and the interlinked relations which were identified through the collected empirical material.

As can be observed in the image, the small circles represents an actor linked under a network. The different color codes and lines represent the type of actor, and the lines indicate both the interconnections and the network status.

For instance, in the case of the two different actor-networks, Residents and Private Consultants, it can be seen that there is a destabilization.

The cause is rooted in the feeling that some community members have of lack of communication and ownership.

This can be attributed to one private consultant (Henning Larsen Architects), which according to Bjarne Gantzel<sup>62</sup>, has been leading the development process where residents participation decreased into feedback meetings.



**Image 16.** The Climate Resilient Block (Klimakarréen). (Københavns Klimakarré, 2016).

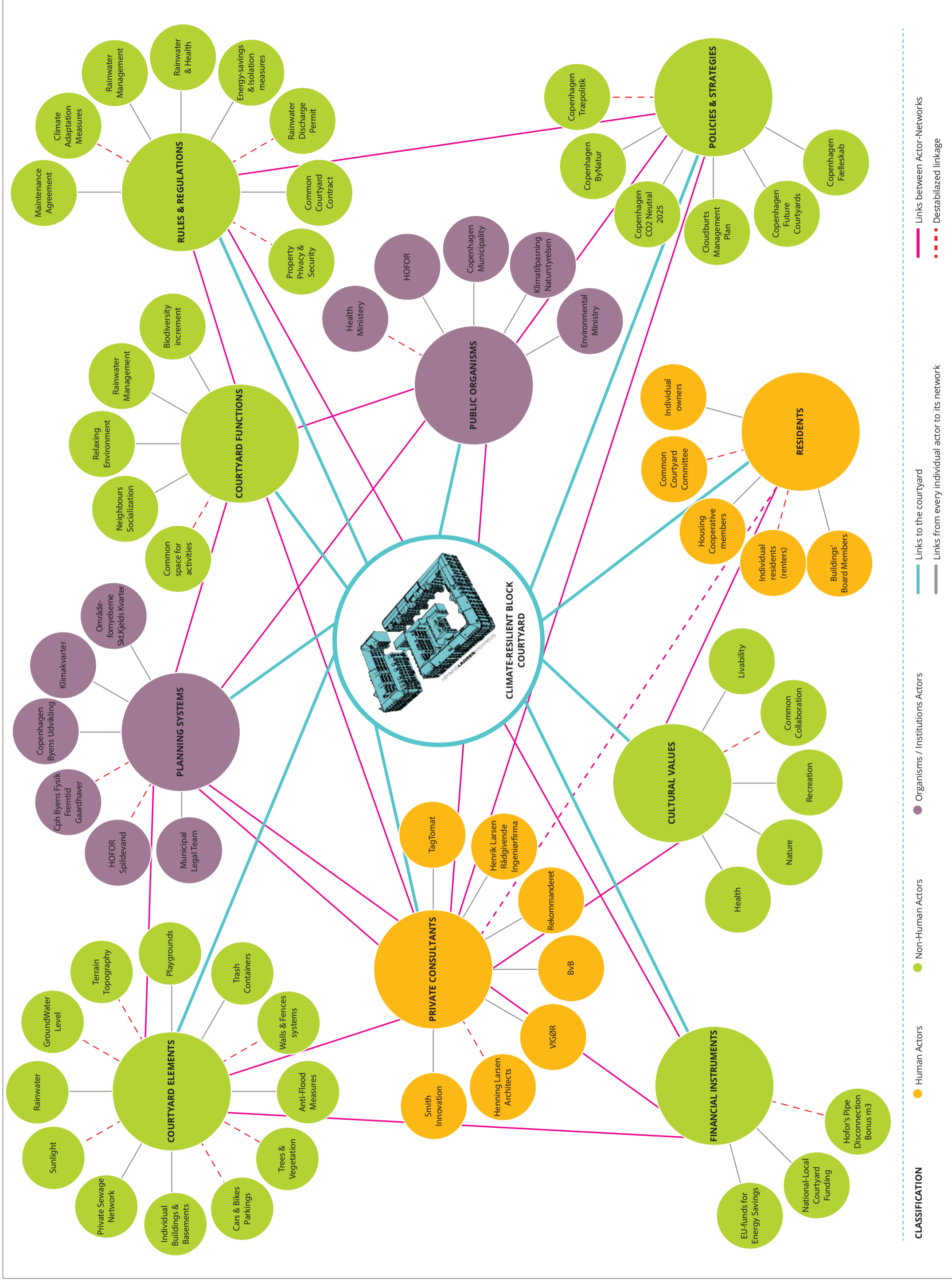


Image 17. Mapping of the Actor-Network constellation within the Climate-Resilient block project (Klimakarré), and a representation of the interlinked relations identified via the collected empirical material.



## Case 2. Analyzing the general strategy for climate-adaption of private roads

This analysis will describe how the municipality of Copenhagen along with the utility company HOFOR is tackling the challenges related to climate change and rainwater through the adaptation of the city's public and private roads via the Cloudburst Management Masterplan<sup>22</sup>.

Private roads are owned by the citizens. The responsibility and the cost of road maintenance and climate adaptation thus lies with the road owners and the municipality is reluctant to take over these obligations<sup>69</sup>.

To accomplish such endeavour, the municipality has established a partnership with private companies with the purpose of enrolling private roads owners to create a common application for a national co-financing scheme under Forsyningssekretariatet<sup>66</sup>. (See more details about the application process in Appendices. Worksheets).

Created by the Danish government in late 2014, this funding opened the opportunity for municipalities to adapt roads for handling of rainwater surface run-off<sup>67</sup>.

The municipality of Copenhagen considered that private road owners could be included in the application process, thus creating a multiple beneficial agreement by creating a common application.

This idea was based on the fact that 100 of the 300 projects related to the Cloudburst Masterplan are estimated to affect private roads. Therefore, the negotiation process with private owners will become critical and absolutely necessary.

The benefits of the multi-lateral agreement are on one hand, that it gives the municipality and HOFOR a possibility to pave the way for rolling out the masterplan with the co-financed projects while involving the citizens.

On the other hand, the processing time for the private courtyards will be shortened by the mu-

The image shows a sample of an application form titled "Ansøg om medfinansiering af privat klimatilpasningsprojekt". The main heading is "SKAB PLADS TIL REGNVAND" (Create space for rainwater). The form contains two sections: 1. "Beskrivelse af formålet": "Beskriv formålet med og motivationen bag projektet samt hvilke løsningsprincipper i arbejder med." (Describe the purpose and motivation of the project and which solution principles you are working with.) Below this is a text input field. 2. "Matrikler der deltager i projektet - Hvilke matrikler deltager i projektet?": "Print et matrikelkort fra Københavns Kommunes hjemmeside (kbhkort.kk.dk), og tegn med to forskellige farver, hvilke matrikler der deltager, og hvilke der ikke gør. Angiv i tekstfeltet herunder de matrikelnumre, der deltager i projektet." (Print a plot card from the Copenhagen Municipality's website (kbhkort.kk.dk), and draw with two different colors, which plots participate, and which do not. Indicate in the text field below the plot numbers that participate in the project.)

**Image 18.** Sample of the application on cofinancing of a climate change adaptation project. (Source: HOFOR, 2015)

nicipality's efforts, which will increase profit for the private companies. The creation of this market is also a clear priority of the municipality<sup>69</sup>.

*"HOFOR has the opportunity to co-finance climate adaptation projects on private roads and recreational areas with public access. HOFOR may finance up to 100% until 31.12.2015, then it is 75%<sup>68</sup>." (HOFOR, 2015)*

The process of developing a climate adaptation project will furthermore be eased for the citizens. As the municipality, via its partners, offers consultancy, contacts and inspiration for solutions, the citizens are spared from having to contact consultancies, architects and entrepreneurs individually.

*"Each landowner is the project owner and is responsible for the climate change adaptation project and the process. Co-financing means that the project owner takes a loan for the project, and HOFOR will refund the costs for the initial 25 years<sup>68</sup>." (HOFOR, 2015)*

This illustrates a transition in how the Municipality and HOFOR are shifting from initially abstracting from developing private roads, to considering private roads owners as partners.

The other transition is related to roads and sewage infrastructures. For many years the planning systems of roads have been responsible for keeping roads dry by leading the rainwater to the underground sewage system.

With the Cloudburst Masterplan as the backbone of the whole municipal organization, roads are going to play an important role in transporting and delaying water on the ground surface.

So the shift is based on the interdepartmental collaboration, which opens for infrastructures to offer multiple functionalities.

Taking an ANT perspective, this can be viewed as a potential actor-network destabilization (the actors being the citizens with private roads) and the subsequent process of translation initiated by a dominant actor-network (HOFOR and the municipality).

According to Per Andreasen, the municipality is taking the role of representing the city with the interest of developing the masterplan to work<sup>69</sup>.

With an estimated initial workload of 15 projects per year, both the municipality and HOFOR have been preparing private companies to take the assignment of creating an agreement with private road owners and redesign roads to manage to a 5-10 years rain event, which is HOFOR's city service goal<sup>69</sup>.

*"There are many ways to do this, we have been discussing a lot about how to carry out these projects. We concluded that we should try with the solution that looks the most logic and easy to develop with the current context; a context where the given timeframe is really short and the complexity and uncertainty levels are really high<sup>69</sup>." (Per Andreasen, 2016)*

Currently, there are 158 km of private roads in the municipality of Copenhagen. Many of the private road owners are already organized in groups of neighbours committees (vejlaug)<sup>69</sup>.

These groups are self-created in order to discuss road maintenance issues a few times per year (i.e. contracting companies to put salt during the winter, cover holes, general cleaning, organizational issues, etc.).

However, many others are still unorganized. This makes the negotiation process between private road owners and the municipality really tedious and time consuming<sup>69</sup>.

During months, the two members from the climate unit dedicated to private roads Per Andreasen and Jeppe Tolstrup, have been organizing information seminars with citizens often, and lately, at least once per week<sup>69</sup>.

The purpose of the meetings with the private road communities is to explain the overall plan and to gain their support for creating the common funding application and send it on time (before the 15.4.2016)<sup>68</sup>.

According to Tobias Pedersen (former Klimavej.dk employee in 2015), an information seminar presented by HOFOR and the municipality in mid-August generated a lot of criticism.

*"Many people attending to the general information seminar were surprised about the proposed solutions, the conditions, and the short time for making agreements for the applications. I remember people leaving comments such as: "how can you tell us to take a loan if we don't know yet what we are going to pay for?<sup>70</sup>". (Tobias Pedersen, 2016)*

From an ANT point of view, it can be seen how the municipality and HOFOR tried to stabilize the private road's diverse actor-networks.

However, the translation processes were identified as being too complex, thus provoking the creation and involvement of new actor-networks (private companies) in order to achieve the enrolment of other actor-networks (private road owners).

In order to tackle such a challenging scenario and generate opportunities in favor of the market, private companies were involved in the process via partnerships.

These partnerships were initially established with the consultancy Klimavej.dk. According to Per Andreasen, a company created by some of the municipality workers<sup>69</sup>.

*"The people from Klimavej.dk did a great job. As some of them were our old colleagues we were really happy to see how they tried to generate new jobs based on the knowledge about roads and climate adaptation<sup>69</sup>."*  
(Per Andreasen, 2016)

Having the opportunity to make profit, local consultancies got involved in the development of the projects. The municipality assigned the private roads projects to the companies, who in turn could avoid the tendering and bidding process.

In this way, the companies such as Klimavej.dk helped the process to motivate private road owners to take part in the common application for funding.

By October 2015, the consultants representing Klimavej.dk had created a pool of 25 project pre-agreements.

*"[...] approximately 25 homeowner's associations entrusted Klimavej.dk with handling their applications for co-funding of climate adaptation measures in 2015."*  
(Lerer, S. et al., 2016).

These agreements were achieved by contacting community board members door-to-door, and facilitating meetings where the members could express their wishes on how to adapt their roads.

According to Andreasen, these pre-agreements were rejected by HOFOR in October 2015. Apparently, the work of the consultants clashed with the calculative framework that HOFOR had developed in collaboration with external advisors<sup>69</sup>.

The calculative framework was developed according to a series of analyses of every city area with the need of adaptation. Then, the results were aligned to the efficiency-oriented financial conditions established by Forsyningssekretariatet. Among others, the role of this national organism is to balance the price level of water. (See more details about the impact on water charges in Appendices. Worksheets).

What this means for the climate change adaptation projects, is that Forsyningssekretariatet ensures that Danish utility companies do not finance projects containing non-hydraulic elements.

*"As wastewater companies cannot co-finance non-hydraulic elements Forsyningssekretariatet has no knowledge about the expenses related to alternative projects<sup>72</sup>."*  
(Martin Bruun-Houmølle, 2016)

Unfortunately for Klimavej.dk their pre-agreements contained non-hydraulic elements such as trees and vegetation and other urban elements, which increased the budget estimations significantly.

*"The project budget estimated by Klimavej.dk in some cases exceeded the funding budget with an average of 10-15 Million DKK. Proposals can not be this expensive and be able to go further. Everybody in this business has the interest not to raise the price per m<sup>3</sup> of water usage. I think there is a financial indicator, which should not increase by more than 0.4 - 0.6 yearly<sup>48</sup>."*  
(Mikas Schmidt, MT Højgaard, 2016).

#### **Forsyningssekretariatet economic framework for wastewater utility companies<sup>73</sup>:**

For the purposes of Forsyningssekretariatet's control of the economic framework and pre-approval of appendices, of the Decree on economic framework for water companies on the alternative project, including to make plausible the selected projects effectiveness provided.

The wastewater utility company submits:

1) Agreement on the alternative project concluded between the wastewater utility company and project owner.

2) Brief description and cost estimate for the cheapest possible usual remedy solution which offers the same service as the alternative project. The estimate must include the cost of investment, operation and maintenance so that the two solutions can be compared. The selected usual remedy solution may in special cases be rejected by Forsyningssekretariatet.

3) For privately owned alternative projects a municipal declaration that the project from a municipal view is considered appropriate and cost effective. The decision may for example include a climate change adaptation plan, waste water plan or proposals thereof.

Source: Retsinformation.dk



The failure of Klimavej.dk opened the door for other private companies to develop a different business model.

Having previous experience in working with municipal administrations, and relations with the utility companies, the consultants from MT Højgaard created a partnership. These five standard models were developed to adapt private roads to climate change.

The partnership was established by the communication agency 2+1 Idébureau, the architect studio Årstiderne Arkitekter, and the lawyer Winsløw<sup>74</sup>.

These five standard models were created having the financial requirements from Forsyningssekretariatet, the hydraulic conditions from HOFOR, and the strategies from the municipality in terms of nature integration and citizen participation in mind<sup>48</sup>.

*"We know what HOFOR wants, and how the Municipality works. With their help I believe we can make a potential application for Forsyningssekretariatet to be approved. We are also concerned about the community members. We understand that they have a key role, so we are carrying out meetings and activities where they can participate and have a say in what kind of solution they want.*

*I think we have a good business model<sup>48</sup>.  
(Mikas Schmidt, MT Højgaard, 2016).*

*(See details about the business model in image 20).*

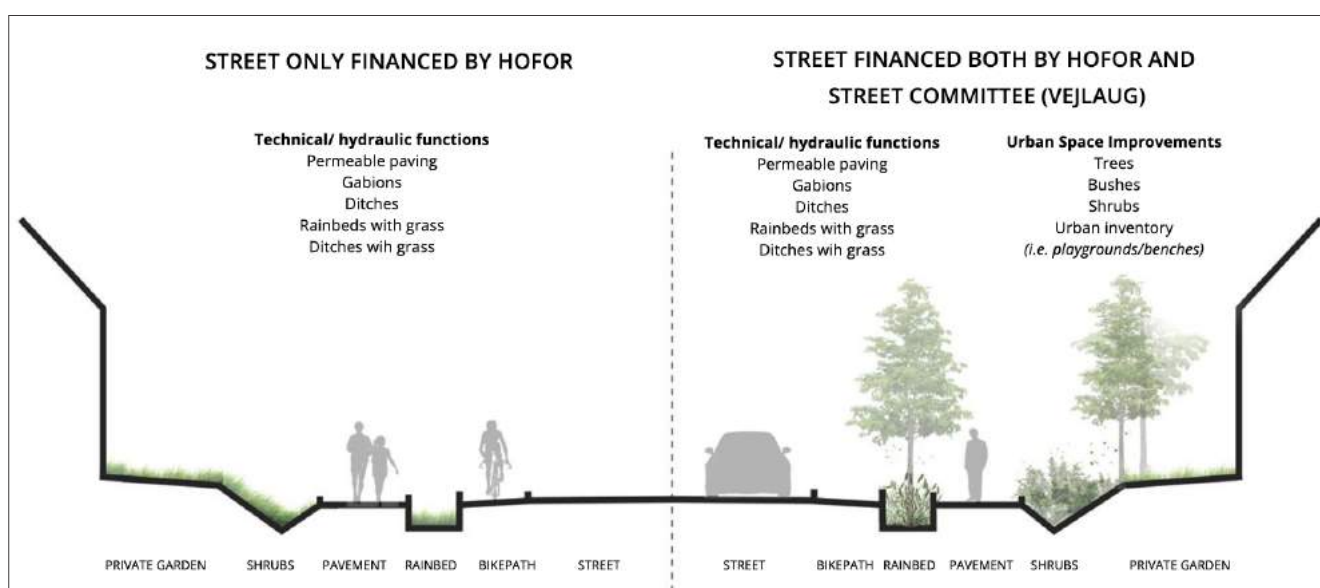
The role of the consultants is to interest, enrol, and mobilize the various board members from the private road communities with the purpose of minimizing the risk of flooding rainwater.

*"This offer of co-financing of climate adaptation in your area should be seen as a supplement to your existing sewer system. We do not give a guarantee that you will never experience flooding, but we guarantee that you can handle more rainwater in the cheapest possible way<sup>74</sup>."  
(Klimateam, 2016)*

This is done by presenting pre-made solutions that integrate elements, which naturally benefit both residents and biodiversity.

Meanwhile, the role of HOFOR is to cover all expenses associated with increased rainwater capacity in the road including the hydraulic technical solution and some extra beautification elements at a grass level. If the project owners want to implement extra features such trees, they will be in charge of paying (see image 19).

*"Most of the measures will be financed by the water rates. Where a clear water feature exists, it will be paid by the utility. As soon as we go above ground then it becomes a little more complicated because a cloud-burst boulevard is a street 95 percent of the time. In those cases we have to get the projects approved by a national secretariat, that will determine what the city pays and what will be paid by the utility<sup>34</sup>."  
(Lykke Leonardsen, 2016)*



**Image 19.** Financing solutions in private roads (Adapted version from: Klimateam, 2016).

**Conditions for financing private road projects: PROJECTS DO NOT INCLUDE<sup>74</sup>:**

- Street trees, shrubs, bushes and flowers are financed by the land owner associations them selves. Grass and the rain water managing elements are financed by HOFOR.
- We do not prevent flooding in case of cloud bursts. We climate adapt your area, so it will be able to handle an at least 5-year rain event.
- Rain water from roofs are not included in the projects and will continuously be handled by the sewer system.
- The project does not include big sewer pipes underground. Underground sewers are the responsibility of HOFOR.
- We do not solve groundwater problems in this project. We work with rain water, which falls on streets and pavements. When we begin the detailed projecting, we will make investigations and boreholes, which show if it is possible to infiltrate the rain water in stead of retaining it.

Source: Klimateam, 2016

From an ANT point of view, it can be seen how a newly created actor-network (Klimavej.dk & private road owners) was dissolved by the dominant actor-network (Forsyningssekretariatet & HOFOR) and their mediators.

Then a new actor-network (MT Højgaard) occupied Klimavej.dk's position, and tried to stabilize the private road owners' actor-networks and enrol them by using up to five blackboxed solutions as mediators.

Thus, aligning to Forsyningssekretariatet, HOFOR and the municipality actor-networks.

By taking a system transitions perspective, it can be seen how the dominant systems (Forsyningssekretariatet, HOFOR and the municipality) are challenged by new innovative solutions (Klimavej.dk consultants integrating extra elements driven by citizen participation).

However, these systems reinforce their position by exercising their power through the use of the current legal systems. As a result, the niche gets dissolved, opening the opportunity for a competing niche to take over.

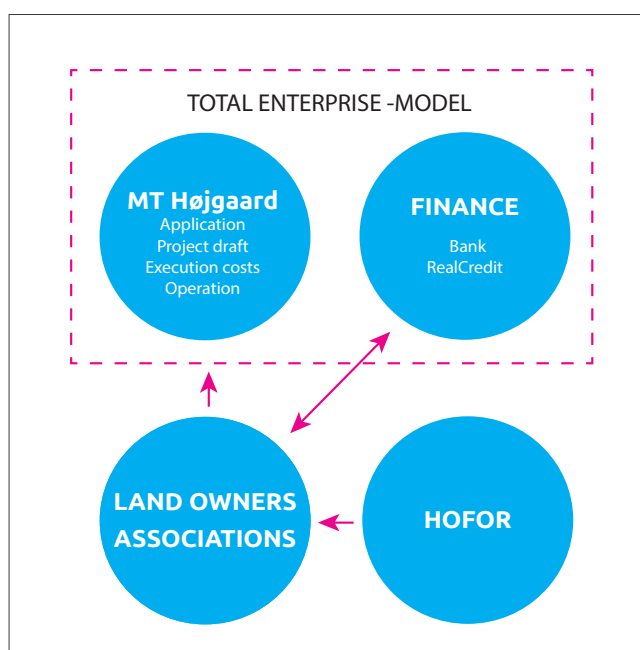
What refers to the internal organizational challenges, clear signs of transformation on both the municipality and HOFOR can be identified.

Although the internal mantra from top management positions in both organizations is to make the cloudburst masterplan the backbone of the different internal departments, this is still far from the norm.

According to Per Andreasen, there are still employees who find it difficult to have an overview of what other departments are doing.

Therefore, they do not have a clear idea of when it could be relevant for them to get involved and with whom.

Besides, there are people who are reluctant to change the way they work, and dislike to get assignments from a completely different department<sup>69</sup>.



**Image 20.** MT Højgaard's financial model for climate adaptation of private roads. (Adaptation from Klimateam, 2016).

*“Every planning department has its own logics and settled goals. Sometimes it is really challenging to break these boundaries and create synergies, but we are working on it and I guess in the future it will be easier<sup>69</sup>.”*  
(Per Andreasen, 2016)

In HOFOR, some employees have the opinion that the municipality should take the responsibility to deal with the citizens and pave the way for the projects to take form<sup>75</sup>.

*“The problem is that the vision of the municipality is to ask for citizen involvement in a field where traditional engineering has been focused on solving pure technical issues, not social<sup>75</sup>.”* (Nis Fink, 2015)

These resistances are common in processes of change. The municipality is aware that climate adaptation will also include the adaptation of the internal organization.

The creation of units that have a leg in each organization is becoming common (i.e. Per Andreasen and Jeppe Tolstrup<sup>69</sup>).

These initiatives are helping to build bridges between the collaboration strategies from the municipality and HOFOR, creating the ground for synergies within multiple planning systems to occur.

*“Stormwater does not follow municipal boundaries or divisions between private and public land<sup>34</sup>.”*  
(Lykke Leonardsen, 2016)

Image 21 aims to illuminate the different relations embedded in the Actor-Network constellation. This graphical representation provides an overview of the different actor-networks around the private road projects and the embedded interlinked relations.

As can be observed in the image, the small circles represent an actor linked under a network. The different color codes and lines represent the type of actor, and the lines indicate both the interconnections and the network status.

For instance, in the case of the two different actor-networks, ‘Residents’ and ‘Private

Consultants’, it can be seen that there is a destabilization.

The residents (i.e. property owners) are obliged by law to take part in the climate adaptation of the city. Both the co-financing scheme and collaboration with the private consultants (i.e. MT Højgaard) opens an opportunity window for the communities to solve their challenge.

Nevertheless, the residents need to invest heavily in a solution that will only mitigate certain levels of flood risk. They will not have ownership of the technical solution, and will have a limited choice of customization.

Since the solutions from the private consultants are developed in a closed framework (blackboxed), participation is translated into a series of information meetings where community representatives can express their concerns and wishes for selecting a pre-designed element.

Ultimately, the delegation of responsibility from the municipality to the private companies can be two-sided.

On one hand, the municipality can benefit from the expertise in order to have a merged application to co-finance multiple road projects.

On the other hand, by following this approach the municipal visions, strategies and visions might be relegated to a secondary plan.

Thus, the green, inclusive agendas can be compromised and not prioritized if the private consultants and the utility company consider them not applicable.

The approach of the municipality and of the private companies might provoke a lack of governance in the communities.

For instance, the communities do not get the opportunity to participate in the development of alternative solutions as only five, blackboxed solutions are offered to them.

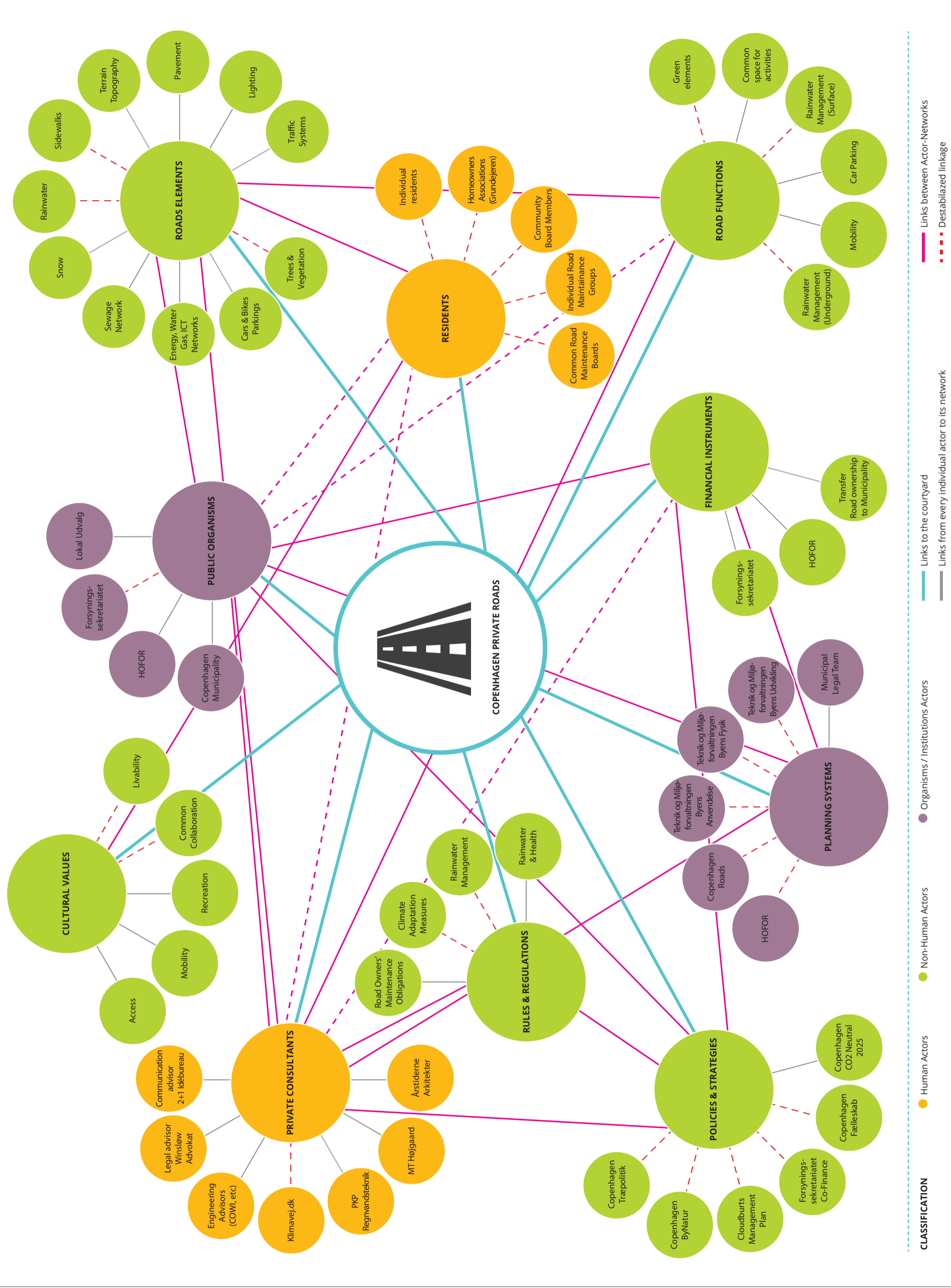


Image 21. Mapping of the Actor-Network constellation within the private roads projects, and a representation of the interlinked relations identified via the collected empirical material.



## Working Case: Private courtyards

From analysing the 2 cases it has been identified that the current dynamics between actor-networks such as residents, municipality and private consultants are provoking destabilization that is affecting the whole actor constellation.

As a way to improve these dynamics and relationships, it is sought to create a design concept that could act as a new mediator to help translation processes in the realm of private courtyards.

The following chapter will describe both how this design concept has been created, and what the results are.

The selection of case has been chosen according to personal interests, perception of design potential, and in facts of the processes.

For instance, in what refers to private roads, the application for funding was sent in May and there will be no new activities until the end of October to the beginning of December when Forsyningssekretariat will resolve the applications. If the applications are approved, the projects will be initiated.

However, the process with private courtyards is still very active and the number of new actors (interested communities) is only increasing.

This means that the municipality is still far from solving the issues and will need to develop new solutions in order to face the old and new challenges.

Personally, this complex scenario seems appealing to work with. The current ongoing dynamics, relationships, conflicts, tensions, resistances between citizens, municipality and consultants appear from a design point of view both as a challenge and opportunity.

Thus, the expected outcome of such exercise aims to elaborate a tangible design solution that could contribute to the project processes by benefiting the different actor-networks, for instance, by reducing the frictions between actors.

## 5. DESIGN

### 5.1 Concept Design

The following design concept is based both on the empirical material exposed in the analysis and the theoretical background which served to inform the design.

Consequently, the design requirements have been identified. Inspired by Cross criteria and requirements (Cross, 2000), these parameters contributed to specify some of the desired outcomes from the design.

The table below shows the requirements that helped to inform the further creation of both the co-design workshop and concept design.

ACTOR	REQUIREMENTS
Municipality's Courtyards Departments	<ul style="list-style-type: none"><li>Should help to ease the formation of courtyard committees.</li><li>Contribute in engaging the community members to participate in the adaptation process.</li></ul>
Community Residents Christianshavn	<ul style="list-style-type: none"><li>Should be easily informed about the project status and communicate with the responsible parts.</li><li>Receive guidance about solutions, specially on how to reuse rainwater and how to select trees, plants and flowers.</li><li>Should not require too much time and effort, while keeping the power to influence and decide .</li></ul>

*Source: Future & Common Courtyards - Sofiegade residents, 2016*

The creation of the design concept has been influenced by the approach of participatory design and co-design tools and methods.

*"[...] co-design in a broader sense refers to the creativity of designers and people not trained in design working together in the design development process."*  
(Sanders & Stappers, 2008).

Thereby, co-design helps to create a 'temporary collaboration process between the designer and the actors without a design background 'to achieve a shared purpose' (Sanders et al., 2008).

The process was established via the creation of a workshop, where the different actors could express their wishes and concerns by participating in a democratic dialogue.

Through the use of concepts inspired by design games, the workshop appears as a 'constructed game space' (Brandt et al., 2012).

This open space was settled in order to provoke interaction and dialogue between actors, help to understand each other's logics, and 'create a shared language' (Brandt, 2006).

The shared language can be built and take place through the use of 'game artefacts' within the game space, for instance, pictures (Brandt, 2006).

As can be seen in the picture below, that the initial workshop concept was divided into a process of five different steps.

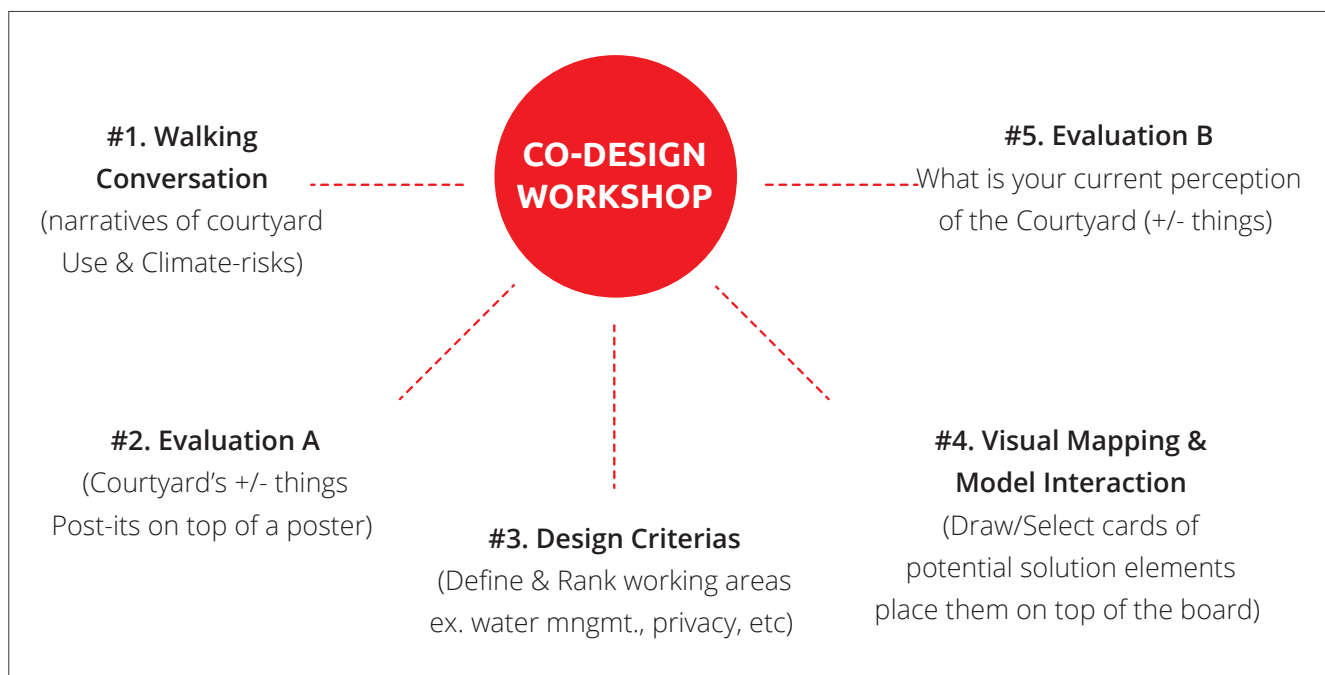
Presented to Miljøpunkt members and to community members of the climate resilient block during the interviews, the first iteration served to create a discussion about the previous processes facilitated by the private companies and the municipality members.

Overall, the received critics emphasized the need of including images of solutions with the purpose of providing inspiration. In addition, a knowledge base where the community members could follow the project anytime / anywhere was also a matter of interest.

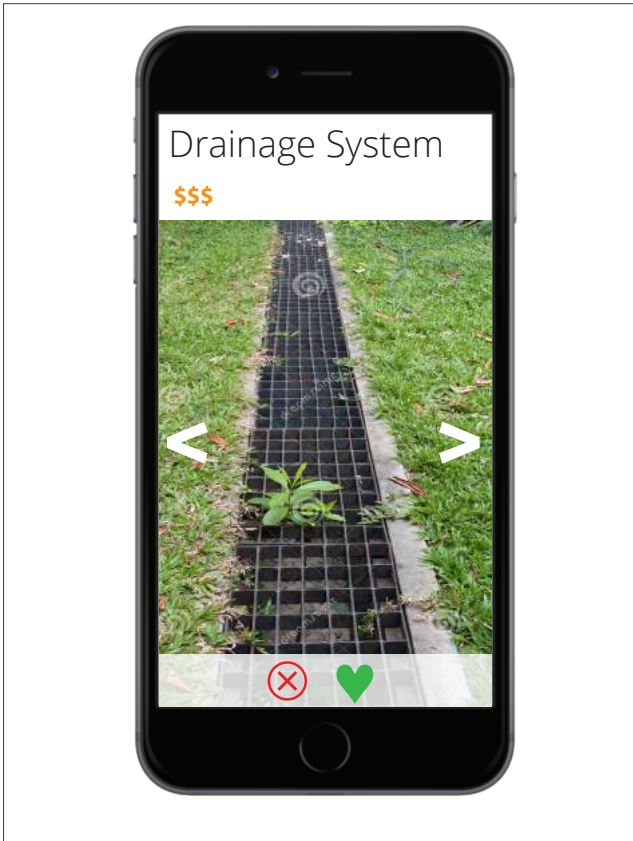
After collecting these insights, both a second iteration of the workshop was created, and two sketches of potential digital tools in order to cover the before mentioned needs.

The new version of the workshop was created by taking the approach of Placemaking as reference <sup>77</sup>.

Furthermore, two digital tools were developed using the Idea Catalog from Områdefornyelse indre Nørrebro<sup>76</sup> and a basic example of a timeline. (See more details in Appendices. Worksheets: Workshop).



**Image 22.** First iteration of the process concept (game space) to be rolled out during the co-design workshop.



**Image 23.** Sketch of the knowledge base concept tool showing the 'Solutions Bank', a compilation of potential solutions.

As can be seen in the image above, the digital tool (Solutions Bank) consists of a database of images related to solutions comprising of areas from rainwater management to nature and urban elements.

The purpose of this tool is to give the user a source of inspiration of potential solutions. Nevertheless, the tool will be open to upload scenarios and ideas generated by private citizens during the workshops facilitated by the municipality and private consultants.

Thus, the generated ideas could be reused and shared with other citizens once the renovation of the courtyard project starts.

In what refers to the interface, the tool it is divided in three areas. The upper part shows the name of the solution and a cost ranking. The central area is reserved for a visualization of the solution and two navigation elements to scroll backwards/forwards. The bottom area acts as a filter, where the user can save or discard the solution.

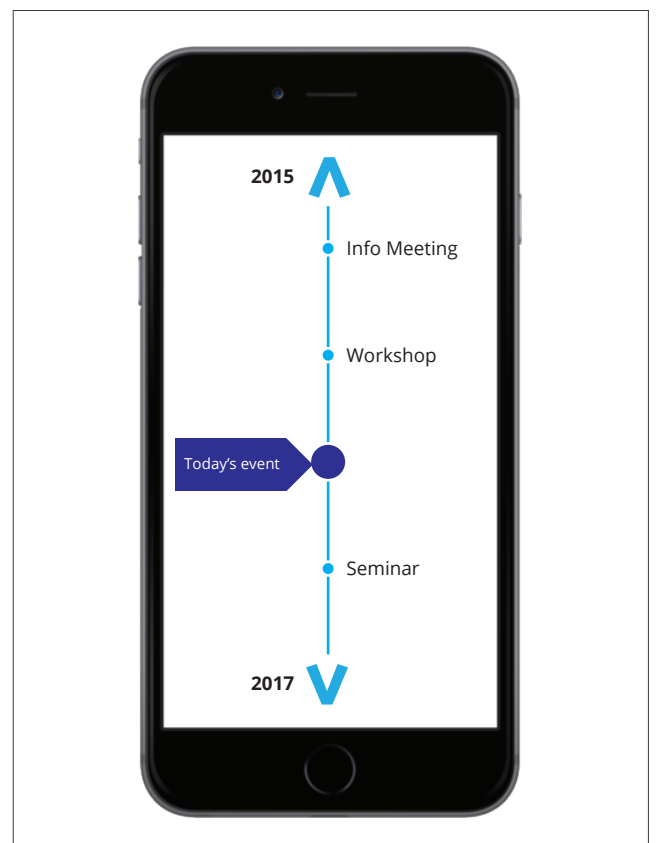
The image below shows the digital tool (Timeline) which consists of a calendar with a database attached. The content of the database will load key events related to the project showing a brief description and the date.

The purpose of this tool is to provide the user an overview of the project status and communicate key information both from the municipality and private consultants.

This tool acts as a complement to the physical information dashboard installed in the courtyard surroundings. Thus, having both communication artefacts helps the users to feel being informed.

In what refers to the interface, the tool is composed by one area in which all the information is loaded chronologically. With the help of two navigation elements the user can see both the past and future events.

Both Solution Bank and Timeline can be accessed via web, and it can be managed by the project responsible from the municipality.



**Image 24.** Sketch of the knowledge base tool showing a prototype of 'TimeLine', a project calendar.



## 5.2 Workshop

As can be seen in the image 22, the departure point for creating the workshop was the 5-step activity oriented to the courtyard community members.

By attending to the workshop, the citizens of a selected courtyard (i.e. Sofiegade in Christianshavn) can establish an open dialogue about their courtyard renovation having rainwater as a common potential resource.

After receiving feedback, the second iteration of the workshop is oriented to identify the values, wishes, and future courtyard scenarios from the community members.

In addition, the workshop will be open for inviting representatives from the municipality (i.e. project leader from the courtyard unit).

This can be useful to broaden the dialogue and share the official municipal perspective on the community wishes and concerns regarding their courtyard renovation.

The new iteration has a change in the way that it is organized, by implementing the design game as a central element for the dialogue to occur.

The design game is created upon the concept of Placemaking, the popular approach for intervening in public spaces, and uses a set of categories and cards as a way to interact.

The artefacts of the workshop include: 4 categories for creating courtyard scenarios (Sociality, Uses & Activities, Comfort & Image, Access & Linkages), 2 categories for creating the project process (Communication & Governance) and a few inspiration cards with keywords written related to values for the place and the process (i.e. 'Safe' or 'Motivation').

*(See more details about the workshop artefacts and materials in Appendices. Worksheets: Workshop).*

The workshop creates the game space while both the categories and cards provide with the game artefacts to provoke the democratic dialogue between the different workshop attendees.

The six categories divided in two sets act as the boards of the game, while the cards are used as a way to collect the different values, wishes, and ideas from the interaction of each player, helping to understand each other.

Following the described process, the workshop is organized as it is shown in the box below. Divided into 3 acts, each part of the workshop session had a specific purpose.

ACT 1. Introduction

ACT 2. Sharing experiences

ACT 3. Ideation & Co-Design

*See more details in Appendix. Worksheets: Workshop*

The first act is oriented to create the contextualization of the activity, opening the space to introduce every participant to each other. Moreover, the role of each participant and the expected outcome from the session is outlined.

In the second act, the opportunity for the participants to share their project experiences is provided. For this purpose, a representative from the climate resilient block, a representative from Sofiegade, and a project leader from the municipality courtyards department are selected.

During this act, the different participants will both share experiences and write down wishes in relation to their respective project examples.

For the third and final act, the participants will engage in co-creating visions for the courtyard project of Sofiegade.

Together, each participant share their values and wishes in order to generate ideas for the future renovation of the courtyard.

Thereafter, these ideas are prioritized in a ranking according to the criterias that the participants will create.

The workshop will be finalized with a summary of the activities carried out, and the evaluation of the workshop process and the facilitator (myself).

The workshop was organized for up to 6 participants. However, the number was reduced to a half due to last minute cancellations for illness and mobility issues.

This fact forced the workshop format to be quickly rethought and to be focused on the interests of the participants attending: A municipality's courtyard project leader, and a project leader of Miljøpunkt Indre By - Christianshavn.

Therefore, the design game, instead of being used intensively, served to initiate a discussion with regards to the way that the municipality carry out project processes.

*"As you might already know, during the development of the demonstration projects we have been trying to approach citizen participation in many different ways. Some methods have resulted to be more effective than others, it is very complex and every project varies to another. I can recognize in your proposal that we have used a similar model before<sup>79</sup>." (Lene Andersen, 2016)*

Nevertheless, even though the community representatives did not participate, their perspectives on many critical points collected during interviews were shared during the discussion.

This opened the opportunity for sharing opinions with negative connotations with the project leader in charge of the climate resilient block itself.

*"I myself have been involved in many projects where I needed to include citizen participation. Through my experience, I can recognize a pattern. Usually it is only 20% of the participant members who are active and persistent. The rest care too little or are interested only for a while. So my guess is that the negative critics are coming from the ones who don't know what is happening<sup>79</sup>." (Lene Andersen, 2016)*

In addition to the workshop concept, the two sketches of the digital tools (Solutions Bank & Timeline) were also created.

The feedback was focused on the final use of the tools and highlighting the fact that the municipality is partnering with a company which can offer the a digital platform solution.

*"We focus on identifying what citizens need. What your concept is showing is giving the citizens a list of pre-made solutions. It might be a risk to use this approach because it can create confusion or wishes for something that cannot meet the feasibility for its realisation."*

*"Besides, currently we have diverse project timelines which are communicated to the citizens during the project. We are also moving from communicating via Facebook groups to a new digital platform (Samvejr). This means that we are changing the way that we communicate our proposals<sup>79</sup>." (Lene Andersen, 2016)*

*(See more details about the municipality timelines in Appendices. Worksheets).*

### 5.3. DESIGN SOLUTION

After receiving such feedback, the workshop kept moving and the Act 3 was initiated. The programmed activities were adapted to the new context and thus the outcome.

It was decided to focus on the co-design of a concept that could benefit both agendas of the municipality and Miljøpunkt, but keeping the citizens as the major beneficiaries.

In this way, a third iteration of the digital tools was created, and the first sketch of the concept of a citizen platform was created.

Inspired by an old idea of Miljøpunkt, the concept refers to the creation of a platform where citizens have access to relevant information related to the climate adaptation of their courtyard.

The concept can be materialized in the digital realm as a web platform where you can find information and resources. The web platform will also show information about physical events such as meetings and tours organized by citizens where experiences can be shared.

This concept rapidly gained the interest of the municipal representative due to the alignment with the perspectives of the municipality, but also, due to potential the benefit that can be provided to the citizens.

*"I think it might be interesting to try and see if this works. So far, it seems to be in line with our strategy<sup>79</sup>." (Lene Andersen, 2016)*

The opinion from the side of Miljøpunkt was also positive, and opened for new ideas to arise.

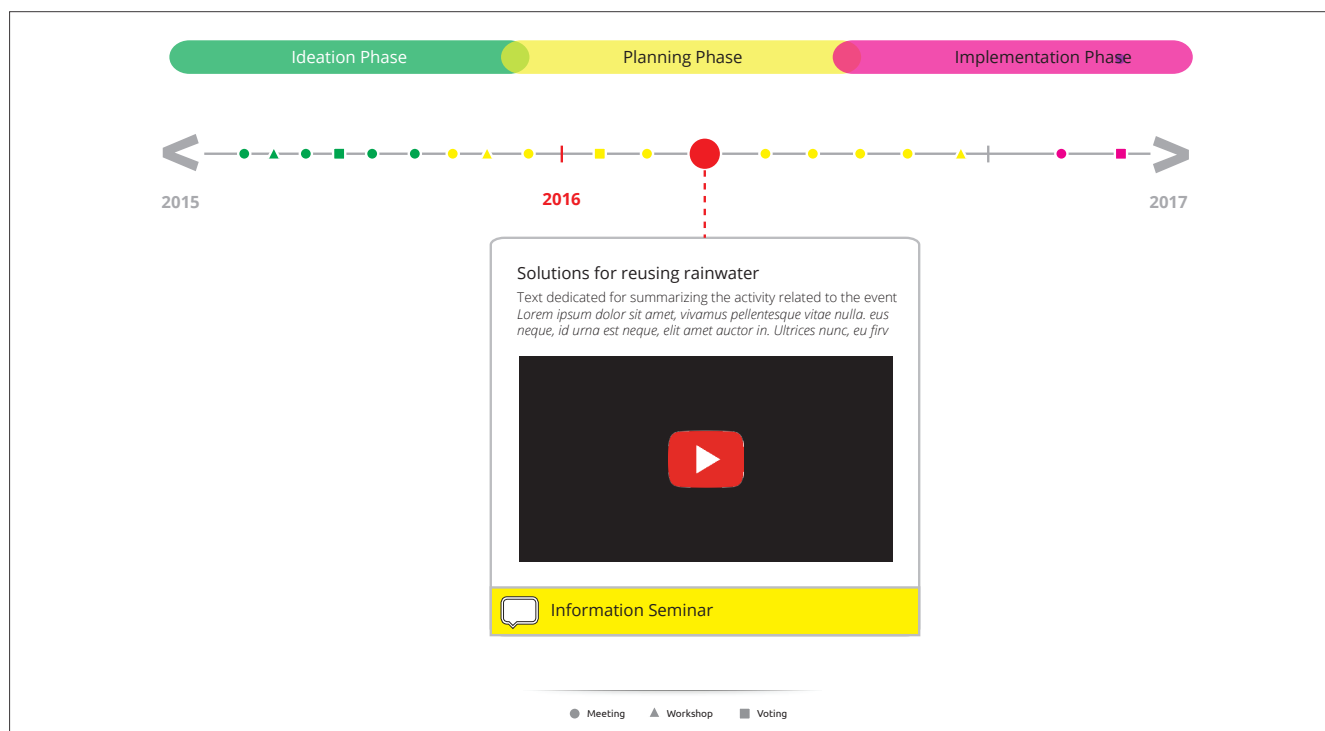
*"The network could be a parallel complement to the courtyard project processes, so they can feed each other. This can help communities to start getting familiar with what such a project means, but also, open the opportunity to explore solutions related to the nature, health, noise, etc."*

*"For example, at Miljøpunkt we have access to a pool of trees from the construction of the new highway. These trees are a free resource and we can help citizens to access them through a campaign. In this way, the municipality and Miljøpunkt could organize and coordinate campaigns that are beneficial for the citizens, but also*

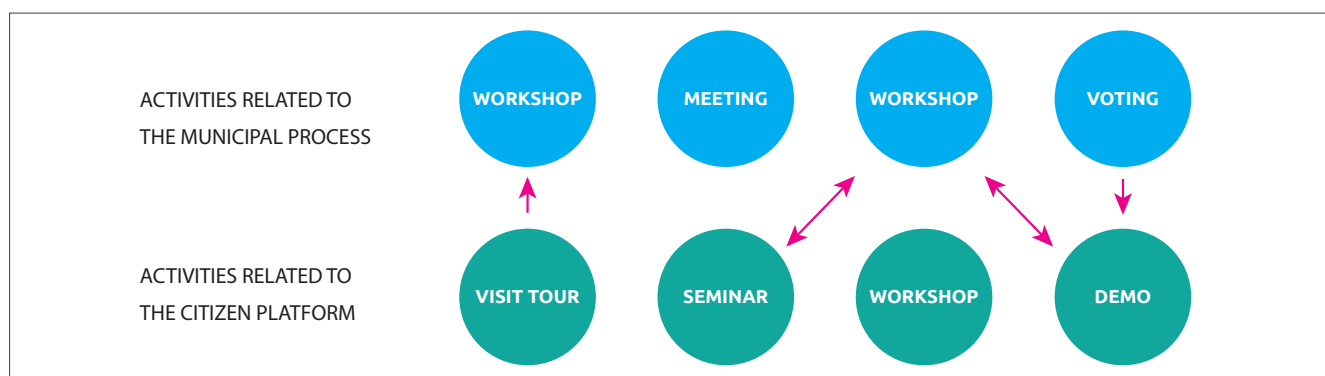
*follow the municipal visions of creating a green, resilient and livable city<sup>79</sup>." (Marianne Spang, 2016).*

The image below represents a sketch of the digital tool's new iteration, and the new platform concept running in parallel. In order to discuss the potential of such concepts, a new workshop will be organized. At this occasion, the workshop will include new actors in order to have a broader view when co-designing the platform.

Among others, the list of the 10 to 15 invited actors includes representatives from the municipality, utility company, private consultants, and community members. The workshop will be held on August 22nd in Miljøpunkt Indre By - Christianshavn and the results will be presented during the defence of this thesis project on September.



**Image 25.** Sketch of the new digital tool merging together the previous concepts of "TimeLine and Solutions bank" into one .



**Image 26.** Sketch of the integration of the activities related to the citizen platform with the municipal timeline project.

## 6. DISCUSSION

### Findings

The purpose of this study was to analyse the ongoing dynamics related to the citizen participation in the 300 climate adaptation projects of Copenhagen. Concretely, in what refers to the participation of citizens in projects of private roads and private courtyards.

By using a pragmatic approach inspired by Actor-Network Theory (ANT), the analysis of the empirical material shows how the dominant actor-networks (the municipality, HOFOR and private companies) are approaching these projects and causing tensions in the relationships between them and the participant citizens.

These tensions are related to the framework that projects are established in, thus provoking issues with citizens such as lack of communication, ownership and governance.

Through the empirical findings, the potential causes of these issues can be identified. Some of these causes, for instance, are the rigid co-finance schemes and the calculative mechanisms embedded within the national and municipal policy framework.

It also seems to be the case when selecting the level of citizen participation in these projects. The official municipal vision is oriented to integrate rainwater, nature and society when developing the city, but through the empirical findings, it seems evident that the vision is within a closed framework where, in some cases, citizens are called to collaborate to select specific solutions.

Another reason to evidence tensions, is the way projects are lead and how communication is organized during these projects.

To begin with, the municipality and HOFOR agreed to take a path where a big part of the responsibility for leading the project processes is in the hands of partnerships formed by private companies (i.e. architects, constructors, engineers, etc).

As can be identified in the empirical material, in some projects this approach is provoking clashes between the interests of citizens and private companies. Thus, making it difficult for citizens to incorporate new ideas to a framework created by experts.

Even though the project leaders from the municipality are actively involved in these processes, some citizens participating still feeling that they have limited power of decision.

In particular, there are cases where a minority of participants feel that they do not want to continue participating in the project due to the unfavorable conditions.

Moreover, the communication processes have been also questioned due to a limited information cycle and the lack of more detailed content which make some citizens to feel disconnected to the project.

### Results & Limitations

The use of ANT approach helped to illuminate the relationships between the identified actors-networks. However, it does not contribute to discover the power relations embedded.

The ANT approach was chosen to unfold the actor-networks related to the problem. For further analysis of the power relations and interests in the climate adaptation of private courtyards, the Stakeholder Analysis could be relevant. This could be carried out on a specific case in future works.

While analysing the process of implementing climate adaptation, citizens' negative connotations towards the municipality and the project could be triggered by personal interests.

These are factors that the municipality or private companies can not manage, such as internal conflicts in the courtyard, thus giving further friction in the project. This is a known challenge, that should be considered in the project process.

The presented design concepts are developed, seeking to contribute to solving the before mentioned issues while empowering citizens during their participation in climate adaptation projects.

Although, there is no current evidence indicating that these concepts will solve them. So, further research and new iterations will be needed to be developed in order to create a concept that can act as a translator for enrolling the dominant actor-network.

For this purpose, it will be appropriate to interest and mobilize actors from the municipality in order to attract the necessary resources to carry out the process of experimenting with the designed concepts.

The results of hosen as hothe initial exposition of such proposal will be presented during the defence of this thesis.

## 7. PROCESS REFLECTION

The development of this study has been challenged by the changing conditions of the projects due to the insights collected during the empirical studies.

The initial focus was set on the involvement of key actors working in the field of climate adaptation planning with citizen participation from cities such New York, Tokyo, and Barcelona.

These expectations were based on the previous knowledge and the assumptions on the current climate adaption plan of Copenhagen. However, due to political pressure, the whole planning and policy development oriented to roll out the climate adaptation strategies has been speeded up recently.

This fact provoked me to rethink the scope of the research and start navigating among different challenges in order to discover the main problem, and set a potential outcome.

Due to the complexity encountered while illuminating the main research issue, this process was extended timewise. This is a fact that has affected the overall research planning and expected outcomes.

While it is considered that this study was carried out by a foreign student, it can be argued that the workload summed to the language disadvantage has been managed well enough to grasp and understand the organizational culture of multiple Danish organizations and institutions.

In what refers to the challenges of using of theories and methods, it can be said that ANT has provided just a way to identify and illuminate the way actors' relationships are interlinked. This study, does not provide other solution than a mapping of actor-networks. Thus, it might be considered irrelevant for city planners seeking to use the approach as a way to solve their planning challenges.

Co-design is closely related to democratic processes where non-designers participate in designing solutions with a common purpose. However, the question remains on who should participate in this process, and how to make sure that the interests, agendas of the dominant actors do not take over the process.

In the case of the first co-design workshop, it can be identified how the municipal agendas where influencing the potential design outcome, thus aligning the concepts to their interests.

The same can be applied to the collaboration with external partners such as Miljøpunkt. Having them as a collaborative partner helped to open doors and contact relevant actors.

Nonetheless, this study gave them access to approach the municipality and create a new project partnership in relation to their agenda. Thus, it can be identified how they have influenced the design outcome.

Overall, a key learning experience remains in how the research process has forced my personal ambitions and expectations to be adapted and be aligned with external actor's interests.

# 8. CONCLUSION

The following conclusion has been assembled in order to answer the problem formulation of how design concepts can lead citizen participation to expand knowledge and the legislative boundaries of co-financing and governance related to climate adaptation in Copenhagen.

The collected empirical material has evidenced diverse issues embedded within the relations between the citizens, the municipality and private companies participating in the climate adaptation of private roads and courtyards with strategic interest for the city's planning regime.

These issues, which are identified to appear along the initial phases of the project process, can be described as a lack of communication and visibility of the project status, strict conditions provided by the co-financing schemes, which makes integrating alternative elements in preconceived solutions difficult, or a lack of governance and knowledge sharing.

Through the design process that drives this research, a contribution for solving these issues has been sought. Thus, by taking a pragmatic approach adopting Actor-Network Theory and Co-Design tools and methods different design concepts have been informed. Empirical material was collected through literature study and 25 interviews with citizens, municipal workers and private companies.

These concepts are formed as follows: A co-design workshop inspired by the participatory approach of design games, two digital tools; 'Solutions Bank' and 'Timeline', and a first ideation of a citizen-oriented platform seeking participation and interaction in both the digital and physical realms.

It is believed that the concepts can contribute to fuel bottom-up initiatives and generate synergies that can be aligned with the municipal processes.

Thus, these concepts advocate for the common alignment of citizens initiatives and the municipal urban development strategies. It's final purpose is to improve the relations and dynamics within the participatory process and the project frameworks.

The common alignment could open the boundaries of the diverse planning systems and create better project coordination with other municipal departments, thus, establishing a co-creation environment where innovative ideas generated by citizens are incorporated.

*“Innovation by users tends to be widely distributed rather than concentrated among just a very few very innovative users. As a result, it is important for user-innovators to find ways to combine and leverage their efforts.”*

***(Eric von Hippel, Democratizing Innovation, 2005)***

# 9. APPENDICES



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## 9.4. WORKSHEETS

The following set of images helps to extend the information in relation to the previously indicated text arguments.

### SKAB PLADS TIL REGNVAND

## FASE 3 OG 4

Forløbet i fase 3 og 4 sker i et tæt samarbejde mellem den private part, HOFOR og Københavns Kommune

## FASE 1 LAV EN PROJEKTSKITSE



## FASE 2 PRÆKVALIFICERING



## FASE 3 FINANSIERING OG PROJEKTERING



## FASE 4 PROJEKTET UDFØRES



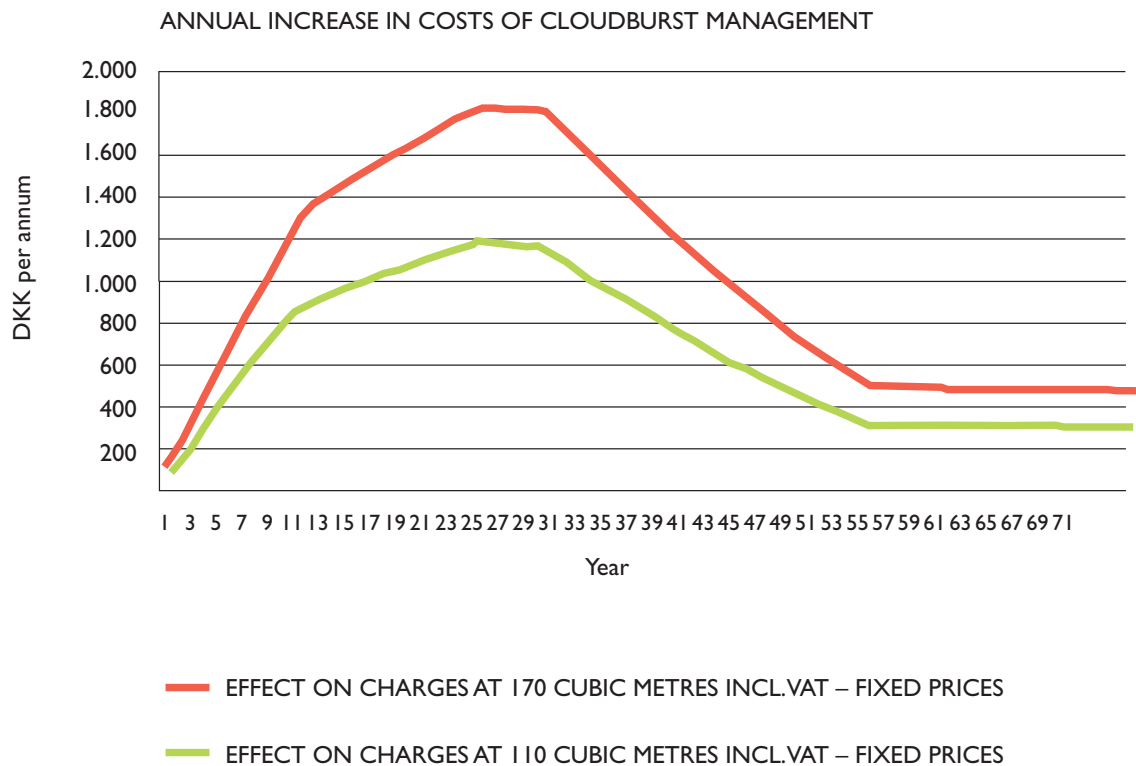
## 9.4. WORKSHEETS

### THE INVESTMENT STATEMENT

# IMPACT ON WATER CHARGES

Annual water consumption of 110 m<sup>3</sup> (apartment) means that the water charges will rise by an average of DKK 890 per annum. Consumption of 170 m<sup>3</sup> (house) will mean an increase in charges averaging DKK 1375 per annum over a period of 75 years. The operating costs are included in the impact on charges.

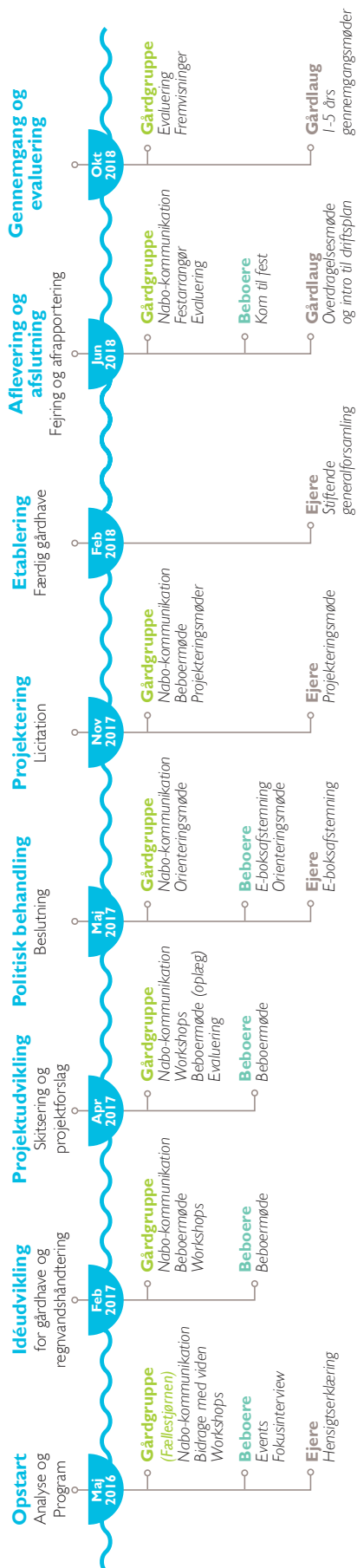
It should be noted that this increase in charges varies depending on the rate of expansion with selection of projects and other possible savings under way in implementation. The impact on charges does not take account of the projected rise in population in the City of Copenhagen. An estimate of the trend in rates over time is presented below.



## 9.4. WORKSHEETS

### Fremtidens Gårdhave ved Straussvej

Samskabelsesforløb: Ejer- og beboerinddragelse



FREMtidens GÅRDHAVER

LAR — LOKAL AFLEDNING AF REGNVAND



## 9.4. WORKSHEETS

The consultants at Klimavej.dk assessed that an application for co-funding had very little chances of success if it could not demonstrate that the WSUD-plan suggested could manage rainfall up to at least a 5-years return period, based on the existing regulatory framework. Using the “WSUD-potential”-tool they assessed that assigning about 700 m<sup>2</sup> of the impermeable areas to bio-retention units (i.e. raingardens upgraded with underground storage and drainage) could reach this goal; Figure 1 below shows the outputs from the tool for this scenario.

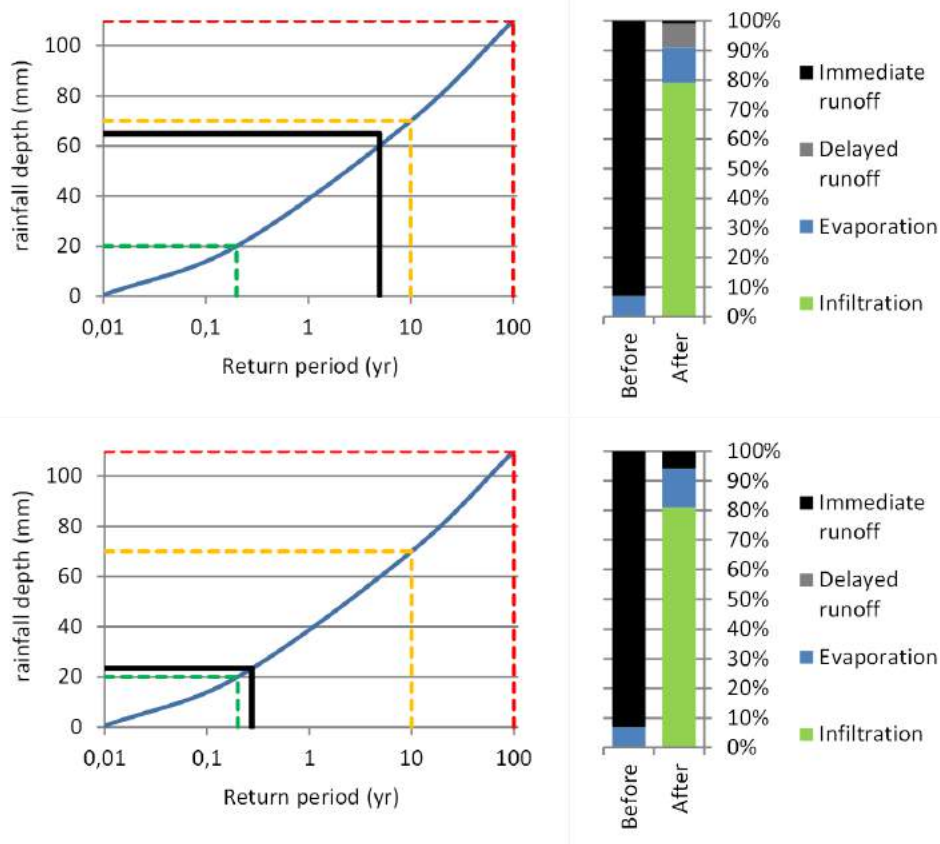
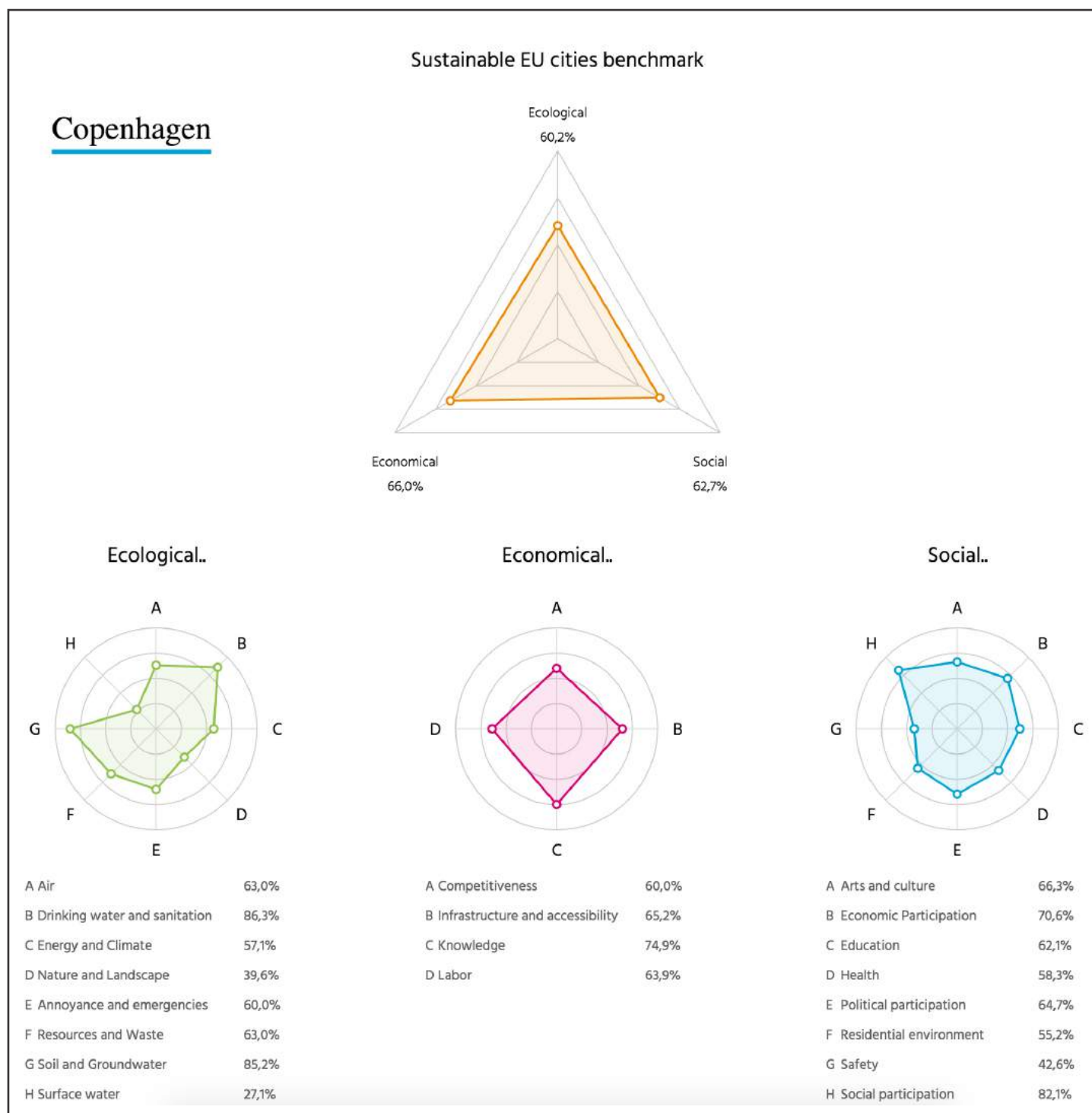


Figure 1: Impact assessment for two scenarios of WSUD implementation in Gåsebæk Vejlaug. Left panels show return period of overflow while right panels show annual water balance before and after WSUD implementation. Top figures show the impacts of plan 1: repurposing 700 m<sup>2</sup> of the road area to bio-retention units with underground soakaways with drainage. The lower figures show the impact of plan 2: repurposing the same amount of area for simple raingardens.

Results from the assessment measuring scenario with the Cloudburst Management Plan (100-year storm event), and the scenario with the Climate Adaptation Plan (5-10-year storm event) applying the Water Sensitive Urban Design (WSUD) tool. (Source: Lerer, S. M., et al., 2016).

## 9.4. WORKSHEETS



European benchmarking on sustainability parameters in Copenhagen<sup>81</sup>.

### X Civil Society, Knowledge Institutions and Business

**The Ministers agree:**

- 52 To recognise the potential of civil society to co-create innovative solutions to urban challenges, which can contribute to public policy making at all levels of government and strengthen democracy in the EU.
- 53 To invite the EESC to contribute, within its competence, to the further development of the Urban Agenda for the EU.
- 54 To invite civil society organisations, knowledge institutions and businesses to provide informed advice on all actions within the framework of the Urban Agenda for the EU aimed at Better Regulation, Better Funding and Better Knowledge.

*Chapter describing the role of civil society in the Urban Agenda for the EU Pact of Amsterdam<sup>82</sup>.*

## Areas of Action: From Practice to Policy

We can conclude that by emphasising culture and civil society, the EU Urban Agenda can be strengthened on a profound level. This new emphasis has the potential to give cities efficient tools and catalyses change towards sustainability and inclusion.

To connect local practices to European policy, we need to translate the lessons learned into the goals of the EU Urban Agenda, which are to strengthen cities by: 1) improving the development, implementation and evaluation of EU legislation (better regulation); 2) providing better access and use of EU funds; and 3) improving knowledge and stimulating the sharing of best practices and cooperation.

*Chapter suggesting the areas of action that can strength civil society in the policies of the Urban Agenda<sup>83</sup>.*

## 9.4. WORKSHEETS: WORKSHOP

The following set of images shows the material developed for creating the first workshop.

# WORKSHOP AGENDA

## CLIMATE ADAPTATION OF COURTYARDS

**1st August 2016. 10h - 12h**  
Miljøpunkt Indre By-Christianshavn  
Regnbuepladsen 7, 1550 København

### ACT 1. Introduction (30 min)

- 10.00 - 10.10h**      **Welcome to Miljøpunkt: Presenting the workshop context**  
by Marianne Spang Bech (på Dansk)
- 10.10 - 10.30h**      **Presenting the Agenda, the workshop purpose & expected outcome**  
by Jaime Palomino

### ACT 2. Sharing Experiences (30 min)

- 10.30 - 11.00h**      **Learning about courtyard renovation projects:**  
#1. Presenting Klimakarré-Østerbro  
#2. Presenting Sofiegade-Christianshavn  
#3. Presenting perspectives from Copenhagen Municipality  
*Mapping feelings: Each participant will take 5 minutes to write their 'Wish Cards'*

### ACT 3. Ideation & Co-Design (1hour)

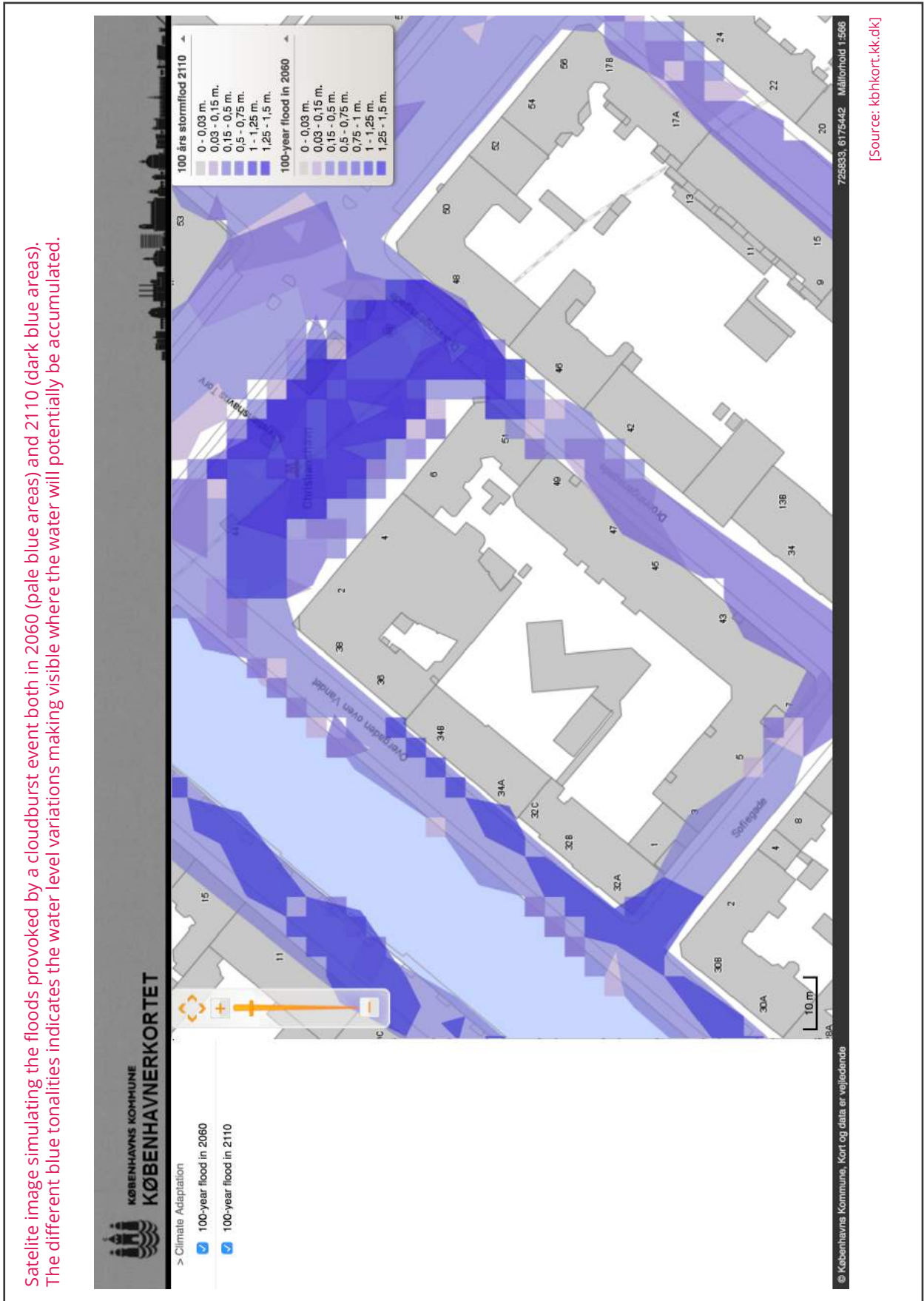
- 11.00 - 11.25h**      **Generating ideas for Sofiegade's Courtyard**  
by using inspiration cards, post-its & poster
- 11.25 - 11.50h**      **Ranking the ideas & How could we realise them**  
by co-designing potential scenarios / solutions
- 11.50 - 12.00h**      **Common key takeaways & Individual workshop evaluation**  
discussion about the most interesting issues and personal feedback

## 9.4. WORKSHEETS: WORKSHOP



Aerial view on Sofiegade 1 block, Orthophoto extracted from [www.kbhkort.kk.dk](http://www.kbhkort.kk.dk)

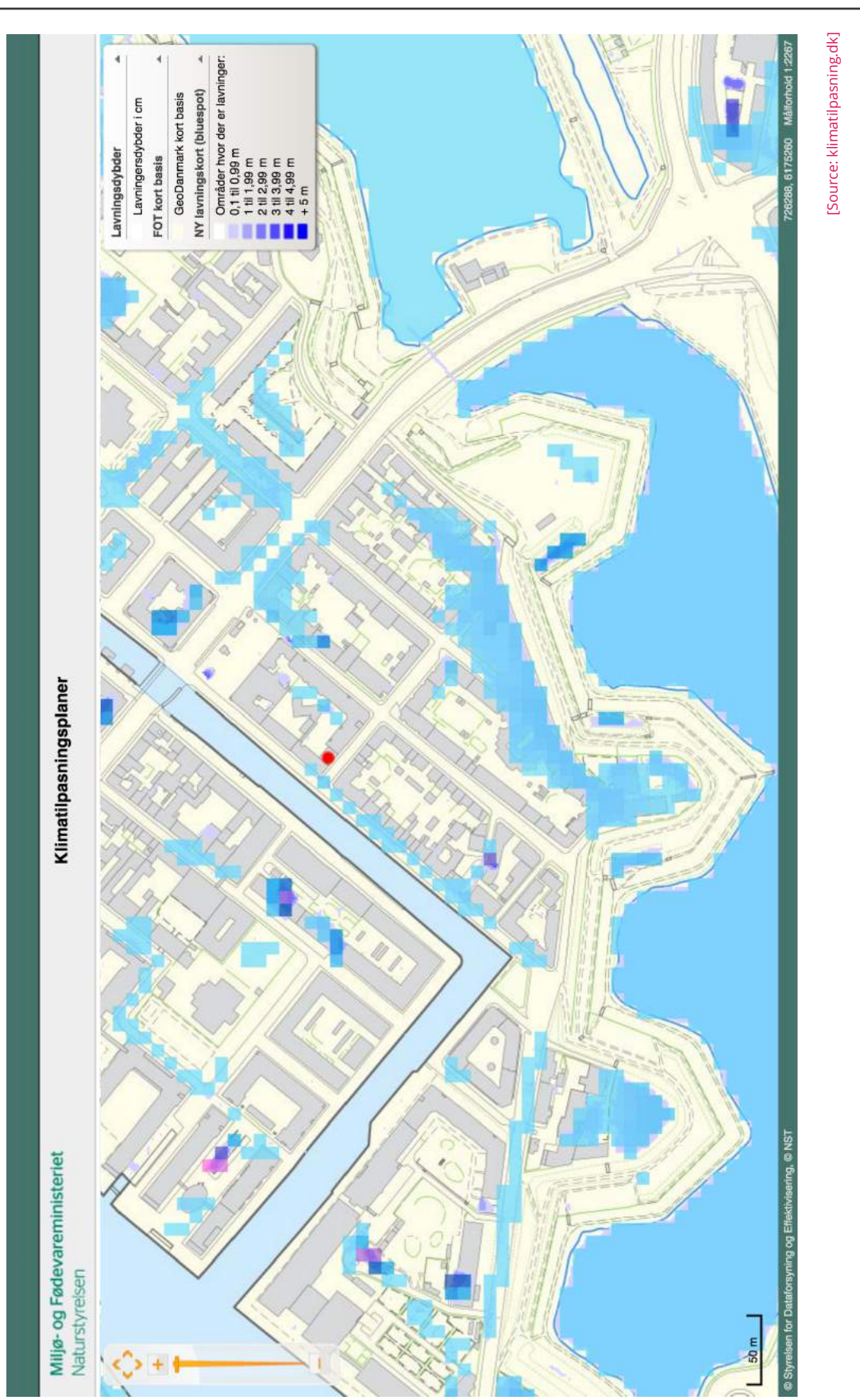
## 9.4. WORKSHEETS: WORKSHOP



Aerial view of Sofiegade 1 applying a filter with the effect of future rainwater events. Extracted from [www.kbhkort.kk.dk](http://www.kbhkort.kk.dk)

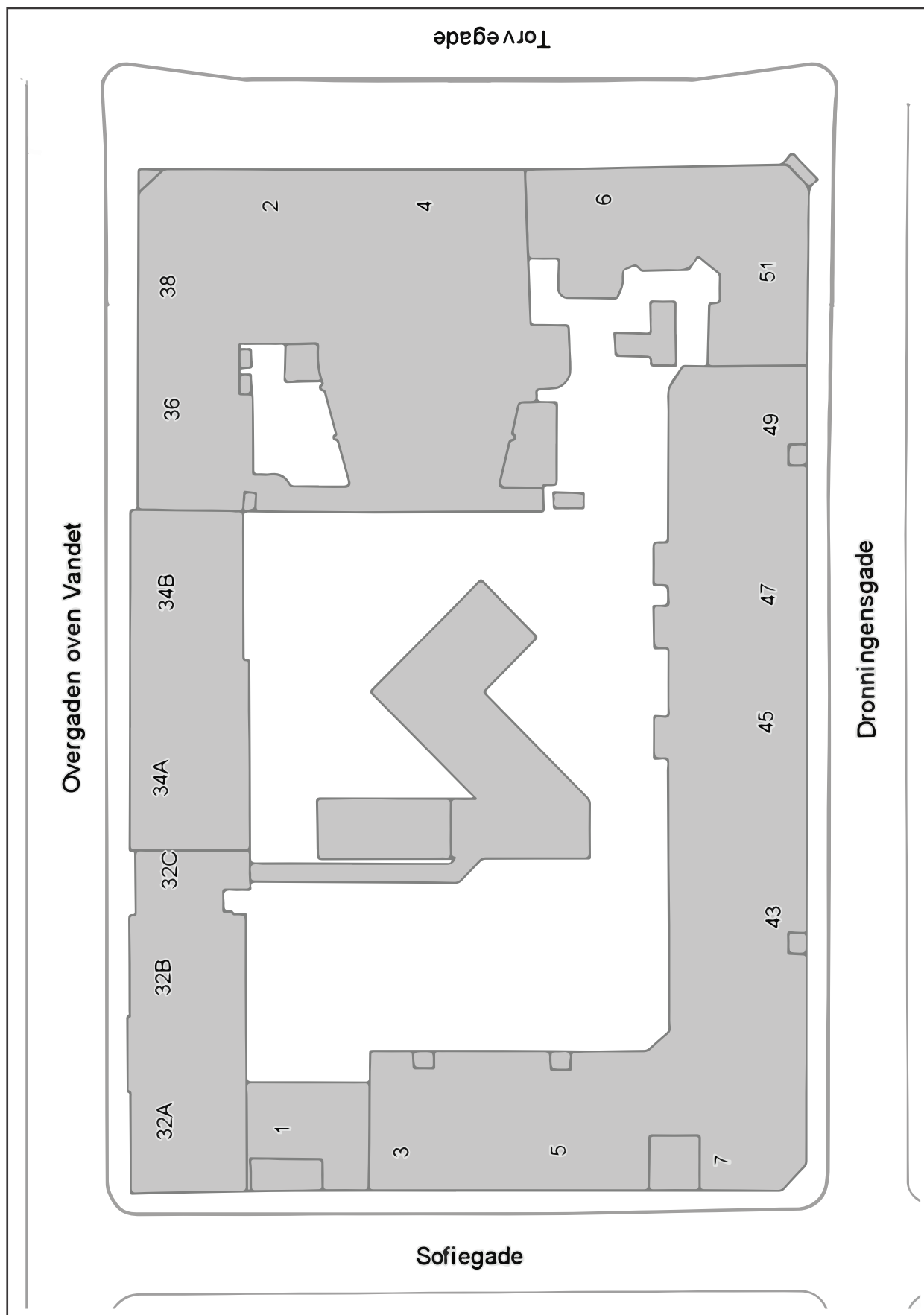
## 9.4. WORKSHEETS: WORKSHOP

Satellite image showing the spots where rainwater will be accumulated according to the topography of the terrain. The different blue tonalities indicates the water level variations.



Aerial view of Sofiegade 1 applying a filter of rainwater accumulation points and level. Extracted from klimatilpasning.dk

## 9.4. WORKSHEETS: WORKSHOP

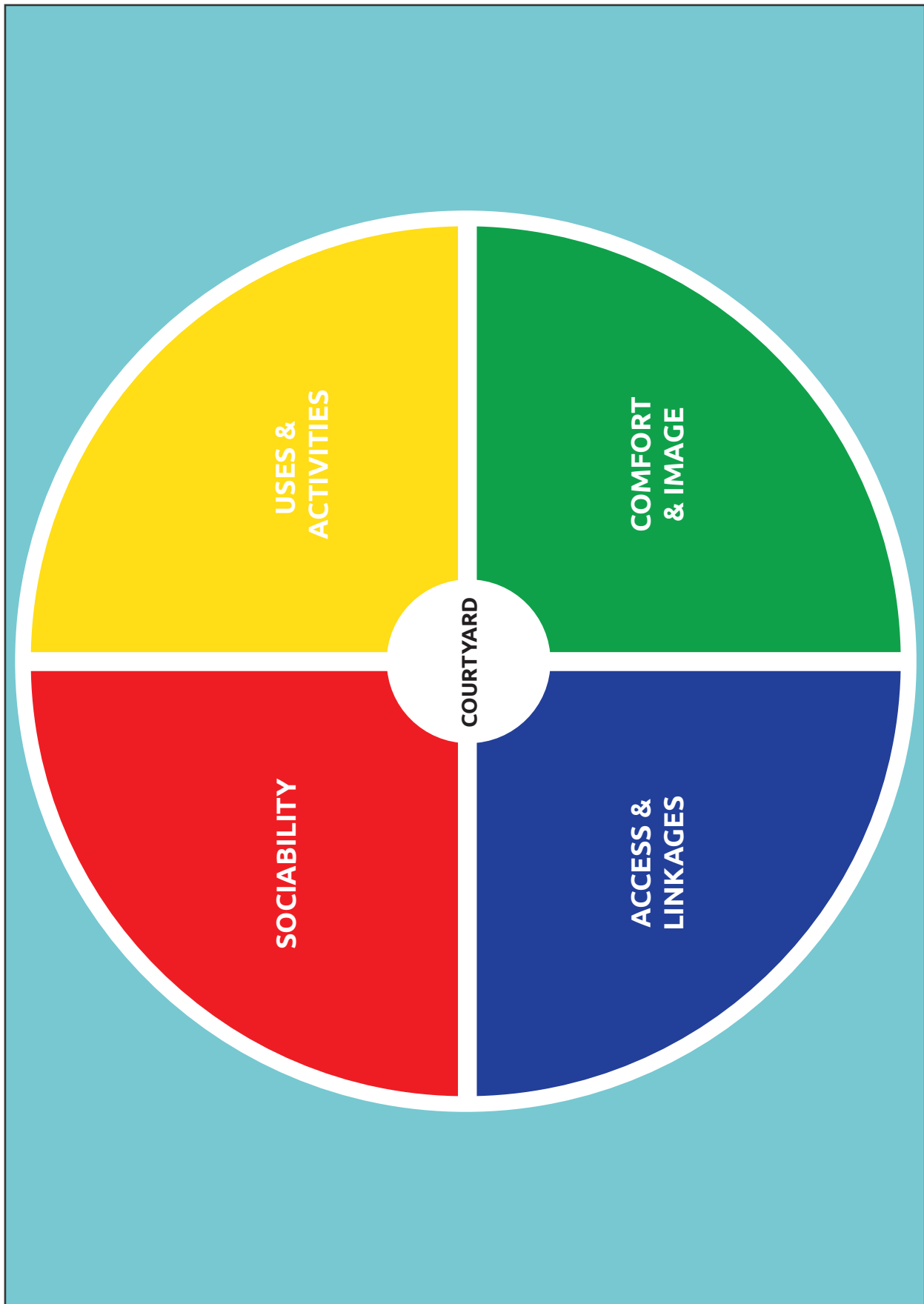


Contourlines view of Sofiegade 1 showing the number of the buildings. Extracted from [www.kbhkort.kk.dk](http://www.kbhkort.kk.dk)



## 9.4. WORKSHEETS: WORKSHOP

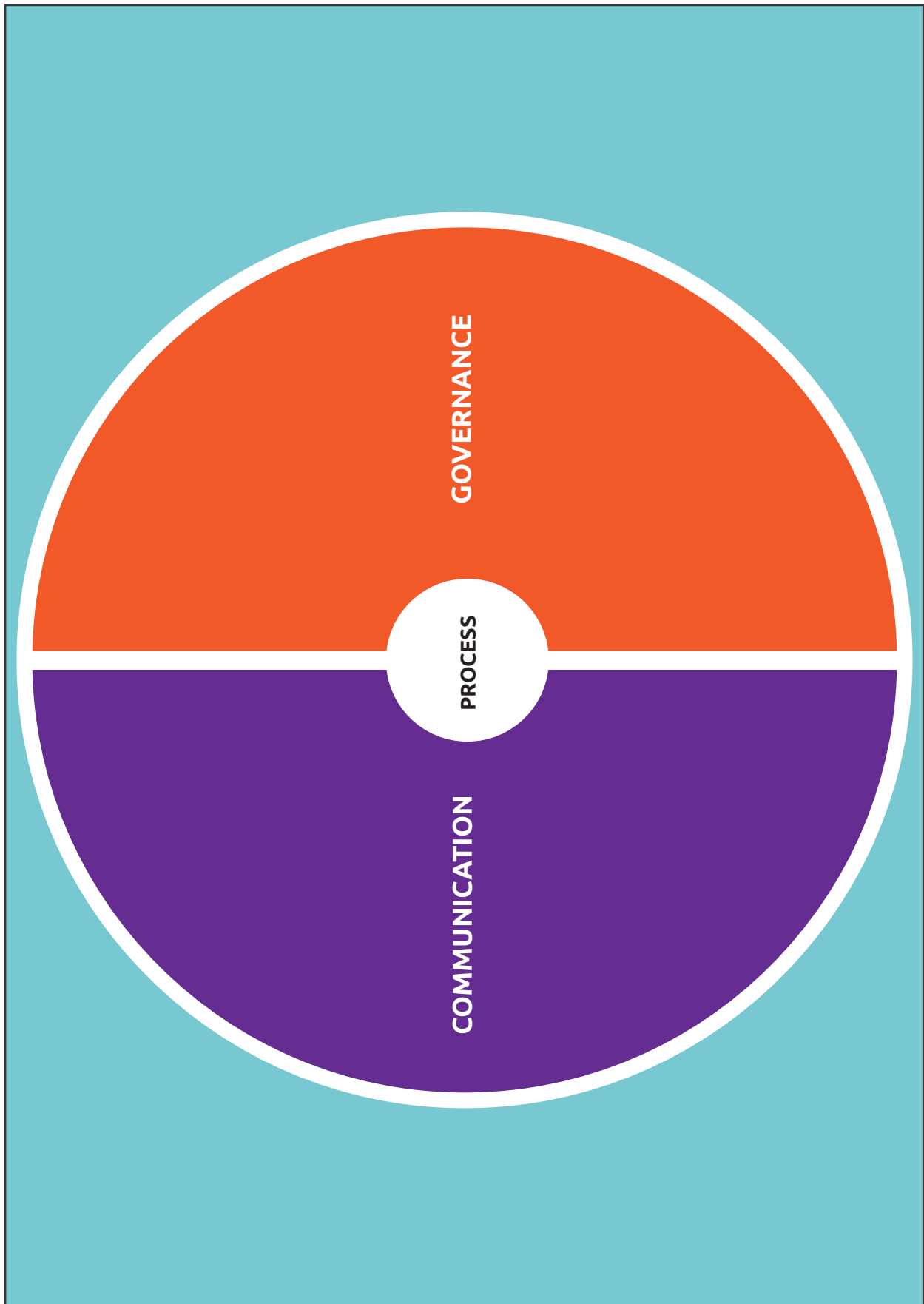
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*The 4 categories where to place the scenario cards.*

## 9.4. WORKSHEETS: WORKSHOP

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*The 2 categories where to place the value cards.*

## 9.4. WORKSHEETS: WORKSHOP

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SAFE	ACCESSIBLE	INDIVIDUAL
PLAYING	OPEN	COOPERATIVE
COOKING	GREEN	DIVERSE
CELEBRATING	RELAXING	RAINWATER

3 different examples of Scenario Cards for the courtyard space.

## 9.4. WORKSHEETS: WORKSHOP



*Value Cards for the Process and some pictures of solutions to inspire the attendees.*

## 9.4. WORKSHEETS: WORKSHOP

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**if I could wish I would like to have MORE...**

write here

**if I could wish I would like to have LESS...**

write here

*2 versions of the Wish Cards: More (with a positive connotation) and Less (with a negative one).*

## 9.4. WORKSHEETS: WORKSHOP

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### WORKSHOP EVALUATION

1) What is your overall assessment of the event? (1 = insufficient - 5 = excellent)

1                      2                      3                      4                      5

2) Which topics or aspects of the workshop did you find most interesting or useful?

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3) Did you gained new knowledge or information from the workshop?

If no, why?

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4) Could you feel that you will apply the knowledge gained from participation at this event?

Met your expectations

Yes

No

Somehow

Will be useful/applicable in my work

Definitely

Mostly

Somehow

Not at all

5) How do you think the workshop could have been made more effective?

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7) Comments and suggestions (including activities you think would be useful, for the future)

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