

Governing green roof retrofitting by housing associations in the Netherlands



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Cover: Green roof on a high school in the city center of Groningen, with view on the Martinitoren. Picture by Optigroen, the company that developed and installed this roof, which can temporarily retain 35 liters of stormwater per m² and is home to over 40 plant species. See “De Dakbegroener” brochure 1-2013 at www.optigroen.nl



Abstract

In the challenge of urban climate adaptation, retrofitting the existing housing stock with green roofs offers a way to reduce urban flooding and mitigate the Urban Heat Island effect. In the Netherlands, housing associations own and maintain a significant share of the housing stock, and could therefore play an important role in urban climate adaptation. However, housing associations generally have little concern for climate adaptation and even less incentives to engage in green roof retrofitting. Against this background, this thesis investigates the governance of green roof retrofitting by housing associations in the Netherlands. It studies the governance arrangements that are available to and used by municipalities and housing associations in three case studies of green roof retrofit projects by housing associations in Amsterdam, Enschede and Groningen. Data is collected by reviewing policy documents and conducting and transcribing 14 semi-structured interviews. The research shows that green roofs are valued by municipalities primarily for their water retention capacity and by housing associations for their aesthetic qualities. The research reveals that a higher degree of problems with a city's water management will lead to more dialogue and collaboration between municipality and housing associations to address climate adaptation. It is found that there is an unexploited hierarchical potential for municipalities to include the issue of climate adaptation in institutionalized performance agreements with housing associations. In addition, introducing differentiated green roof subsidies can facilitate the upscaling of green roof retrofitting in social housing. Based on the findings, policy recommendations and suggestions for future research are made.

Key words:

Urban climate adaptation, green roofs, governance arrangements, municipalities, housing associations

Preface

If I could go back in time and tell myself that I would look at *governance of green roof projects by Dutch housing associations* in my master thesis, I would probably have to explain quite a bit. During my bachelor in International Relations, I've always focused on themes that relate to the environment and climate change. I wrote papers on the Kyoto Protocol, the role of water in the Israeli-Palestine conflict, and my bachelor thesis about governance of the Mekong river by the Association of Southeast Asian Nations (ASEAN). "But green roofs? Social housing? How did I ever end up there?" are questions that would probably be asked. An explanation would entail something like this:

Whilst travelling in Central and North America after my bachelor, I visited wonderful cities like Mexico-City, San Francisco, Portland, Seattle, and Vancouver. Right before starting my master of International Development Studies in Wageningen, I read the book "If mayors ruled the world" by the American political theorist dr. Benjamin Barber (2013). The subtitle of the book is 'dysfunctional nations, rising cities', which summarizes the book quite well. Barber's ideas about the political potential of cities and the linkages between the urban and global level were fascinating to me. Because I could relate these ideas to my recent travel experiences, the stage was set for my undertakings as a master student at Wageningen University. Needless to say, I enrolled for the course 'Governing Sustainable Cities' with Dr. Ingrid Boas and guest lecturer Dr. Jennifer Lenhart, who opened my eyes to the challenge of urban climate adaptation and topic of green roof governance. So thank you Ingrid and Jennifer for the wonderful course and inspiring me to venture into the field of urban climate governance.

Writing my thesis has been an interesting, sometimes tough, but mostly fun journey. I'd like to express my gratitude to everyone who took time to share their insights in conversation, phone calls and emails, and of course in the interviews. Special thanks to my supervisor Dr. Ir. Bas van Vliet: Thank you for the guidance and support, your patience (especially during the proposal writing), and the pleasant feedback sessions that never failed to energize me for each next step.

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CHAPTER 1: INTRODUCTION

1.1 PROBLEM DESCRIPTION

1.1.1 CLIMATE CHANGE ADAPTATION

Cities are increasingly vulnerable to the effects of climate change like increased levels of precipitation and rising temperatures, which cause urban flooding and heat stress (Mees & Driessen, 2011). The initial response to the climate problem focused on climate change mitigation: reducing the emission of greenhouse gases to minimize the predicted harmful consequences. However, as time passed by, the research community as well as policy makers have been increasingly taking climate adaptation into account: adapting to inevitable consequences (Bulkeley, 2010). Cities are especially vulnerable for the effects of climate change like increasing levels of precipitation and rising temperatures. In dense urban areas, streets and buildings retain heat, causing the urban heat island effect. This can cause health problems and reduces worker productivity, while energy demand rises to cool buildings (Roders et al., 2013). Moreover, sewages are often unable to process increasing quantities of precipitation, leading to urban flooding. The 2050 climate scenarios for the Netherlands specifically are an increasing average temperature up to 2,3°C and an increase in average precipitation up to 5,5%. Moreover, there will be more hot summer days and a higher chance of heatwaves (KNMI, 2014).

1.1.2 GREEN ROOFS

One way to reduce the negative impact of these effects are the installation of green roofs, also called vegetation roofs. They can slow down water run-off from buildings, helping to prevent urban flooding and through evapotranspiration they can help reduce urban heat stress. (Bianchini & Hewage, 2012; Hop & Hiemstra, 2013). As such, green roofs can potentially play an important role in adapting urban environments to climate change. However, the upfront costs of green roofs are carried by property owners, while the benefits are spread out across the city. This situation is called a split incentive: investments are impaired because of an uneven division of costs and benefits (Bird & Hernández, 2012).

1.1.3 URBAN GOVERNANCE OF CLIMATE ADAPTATION

Due to the split incentive, an active role for the government seems necessary to stimulate societal actors to install green roofs on their buildings (Mees et al., 2012; Rietveld, 2010). While some local governments in neighboring countries like Germany have made green roofs mandatory, Dutch municipalities lack the authority to introduce such legislation (Hop, 2010). This raises the question of how climate adaptation action can be best governed. Although various investigations have been made into the governance of urban climate adaptation, the specific focus of green roof retrofitting by frontrunner housing associations and governance thereof has not been taken (c.f. Corfee-Morlot et al., 2011; Harman, Taylor, & Lane, 2015; Massey et al. 2014; Mees et al., 2012; Runhaar et al., 2012; Williams et al., 2013).

1.1.4 CLIMATE ADAPTATION AND HOUSING ASSOCIATIONS

If cities are to adapt to climate change, we have to take into account the built environment, especially the existing housing stock, because at least 60% of the building stock in use in 2050 has already been built today (Rodgers et al., 2013, p. 268). Housing associations own about 2.4 million dwellings, which equals 32% of the total Dutch housing stock (Rodgers, 2015). Based on this significant share of the entire Dutch housing stock, it is worthwhile to investigate their potential contribution. However, research has shown that housing associations are limitedly aware of climate change adaptation (Rodgers et al. 2012). Climate adaptation measures like green roofs are being obstructed by financial hardship and a low priority of adaptation on the policy agenda. Nevertheless, there are some exceptions, and a few 'frontrunner' housing associations have a positive outlook on adaptation and see possibilities for implementation of climate adaptation measures (Rodgers and Straub, 2014). It will be this more proactive group of housing associations that will be focused on in this thesis. The term 'frontrunner' housing associations refers to that group that is either inclined to implement green roofs, or has already done so. Whereas governance of climate change adaptation has been researched on the national level (e.g. Biesbroek et al., 2010) and municipal level (Bulkeley, 2010), there are little governance strategies for adaptation focused on housing associations (Rodgers, Straub and Visccher, 2013).

1.2 RESEARCH AIM

Taking the above into consideration, this thesis sets out to research the current role of Dutch (frontrunner) housing associations and their interactions with municipalities in the climate adaptation challenge of retrofitting the existing housing stock with extensive green roofs. Specifically, I will explore the link between municipal climate adaptation policy and green roof retrofitting by housing associations, using the concept of governance arrangements. Furthermore, I aim to uncover the motivations of housing associations to install green roofs, so that their perspective can be accounted for in (future) governance arrangements.

This thesis will contribute to literature on climate adaptation and green roof governance by focusing on the green roof governance arrangements as they are found in Dutch cities, and the role that (frontrunner) housing associations have in installing green roofs for climate adaptation. The research will generate knowledge on how to better understand green roof governance in the Netherlands. Despite the specific focus on housing associations, valuable insights for other contexts or areas may be gained, especially in terms of how we understand governance arrangements and tools directed at climate adaptation governance.

Furthermore, the research can indicate if and how Dutch public authorities could make more effective green roof policy towards housing associations, and thereby advance climate adaptation through green roof retrofitting. The results may lead to policy recommendations for public policymakers as well as for housing associations.

1.3 RESEARCH QUESTIONS

Given the considerations and research aims as described above, the following research questions have been formulated. In answering these questions, descriptive knowledge on the role of housing associations in Dutch green roof retrofitting will be gained.

Main research question:

- Which governance arrangements are available to and employed by municipalities and housing associations to advance green roof retrofitting in the Dutch social housing sector?

Theoretical subquestion:

- What is green roof governance and which arrangements and tools are relevant for the context of green roof retrofitting by housing associations?

Empirical subquestions:

- Which green roof governance arrangements are found in Amsterdam, Enschede and Groningen?
- What are the motivations of frontrunner housing associations to implement green roofs, and how is the influence of the respective governance arrangements described by stakeholders?

Analytical subquestion:

- What are the opportunities and barriers to developing the full green roof retrofit potential of housing associations?

1.4 METHODOLOGY

1.4.1 STUDY DESIGN

The research is divided into three stages: desk research, empirical data collection, and analysis. During the desk research academic literature is reviewed to develop the conceptual framework. Moreover, this stage will prepare the data collection by reviewing policy documents, selecting case studies, contacting potential interviewees, and writing interview guides.

The second stage consists of empirical data gathering through conducting semi-structured interviews with relevant stakeholders. Since the particular focus on the current functioning of Dutch green roof policies and the effect on green roof retrofitting by frontrunner housing associations has not been taken yet, I am conducting explorative research. Consequently, a case study approach will be used, as this allows for an in-depth explorative study that generates holistic knowledge. Gerring (2004, p. 351) defines a case study as “an intensive study of a single unit for the purpose of understanding a larger class of (similar) units”. In this thesis, the unit, “a spatially bounded phenomenon”, will be a housing association engaged in extensive green roof retrofitting located in a certain city. Therefore, interviewees include mainly municipal officials and staff of housing associations. An overview of all interviewees is given in Annex B. After the interviews have been done and transcribed, the analysis can commence. The interview transcripts are coded manually in Microsoft Word by coloring and grouping words and phrases that relate to specific topics and concepts. This facilitates the writing of the discussion, in which the elements of the conceptual framework are analyzed.

1.4.2 SAMPLE SELECTION

In order to gain as many insights as possible regarding the motivations of housing associations to install green roofs, a purposive sampling strategy was used. I looked for suitable projects using Google as well as LexisNexis, as I expected that the installation of such green roofs would spark media attention in (local) newspapers. After having found a number of different green roof projects of housing associations in various cities, I made a selection that scored differently on various parameters like ‘size of the housing

association', 'type and size of green roof project', 'presence of municipal subsidy'. Three case studies were selected: the Halve Wereld project in Amsterdam, the Lewenborg project in Groningen, and the Transburg project in Enschede, see table 1. When studying a diverse or heterogeneous phenomenon, a relatively large sample size is expected (Kumar, 2011). Nevertheless, by the end of the data collection, the saturation point was reached as many interviewees confirmed what had been said in other interviews. In other words, for this research, the sample size sufficed for the research aim.

An underlying motivation for the selection that was made is the intention to contribute to the literature on climate adaptation by looking at cities other than the usual suspects, e.g. Rotterdam or Amsterdam. Den Exter et al. (2014) have investigated the climate strategies of the 25 largest municipalities in the Netherlands, and their analysis shows that the largest cities (Amsterdam, Rotterdam, The Hague) dominate their climate strategy performance ranking. A number of challenges for Dutch local authorities, like the ending of national subsidy schemes that include financial provision and knowledge support, make the development and implementation of climate strategies difficult. Especially in smaller cities, that tend to have less capacity or experience to apply for EU funding and knowledge sharing, climate policy may then become marginalized (den Exter et al., 2014, p. 1076). However, the issue of climate adaptation is not exclusive to the bigger cities found in the Randstad region. Therefore, the case study selection includes Enschede in the East, and Groningen in the North.

Name project	Housing Association (# dwellings)	City (# inhabitants)	Type / Size of project	Was the roof scheduled for renovation? y/n	Financed by
Halve Wereld	Ymere (80,000)	Amsterdam (821,000)	One complex, 1,300 m ² ,	yes	Ymere and municipality (subsidy)
Lewenborg	Lefier (30,000)	Groningen (200,000)	Entire neighborhood, 20,000 m ²	yes	Lefier and various subsidies
Transburg	Domijn (16,000)	Enschede (158,000)	Several houses, 238m ²	no	Domijn

TABLE 1. SELECTION OF CASE STUDIES

1.4.3 VALIDITY

In doing qualitative research, internal validity can be defined as credibility of the research. As the data collection involves the perceptions and opinions of interviewees, the internal validity can be guaranteed by having the interviewees agree with the results of the research (Kumar, 2011). This was done firstly by checking with the interviewees during the interview whether I understood correctly what they were saying, or what their point was. Secondly, every interview transcript was sent back to the interviewee by email to ensure that they (still) agreed with what they had said.

Regarding external validity, in qualitative research we may speak of transferability, meaning “the degree to which the results [...] can be generalized or transferred to other contexts or settings” (Kumar, 2011, p. 185). Given the focus on green roof projects by Dutch housing associations, the results are unlikely to be generalizable for other countries, given the differences in housing policies. Moreover, given the differing local contexts in which housing associations perform, the sample size is likely too small for the results to be transferrable to all similar projects.

1.5 READING GUIDE

The rest of the thesis is structured as followed. Chapter two will develop the conceptual framework, in which the notion of governance and governance arrangements will be explained. It discusses the differences between hierarchical, market, and network governance, and also introduces the concept of policy stages. Before moving on to the results of the data collection, chapter three will first provide background information on social housing and green roofs. Chapter four starts by introducing the three case studies in Amsterdam, Enschede, and Groningen, and then displays the empirical data gathered by conducting interviews and analyzing policy documents. Some observations regarding the results are discussed, and the chapter concludes by filling in the policy stages for each case study. Chapter five consists of the discussion and conclusion. The discussion focuses on critically evaluating the results in light of the conceptual framework, thereby also reflecting on the choices made in devising the conceptual framework. Finally, the research questions are answered and policy recommendations and suggestions for further research are given.

CHAPTER 2: CONCEPTUAL FRAMEWORK: GREEN ROOF GOVERNANCE

2.1 INTRODUCTION

This chapter will develop a conceptual framework to analyze the governance of green roof retrofitting by frontrunner housing associations in the Netherlands. This will be done by first discussing the concept of governance on a more general level. Then, the concept of ideal typical governance arrangements is introduced in 2.3, and sections 2.4 to 2.6 will apply the arrangements to the context of this thesis: green roof governance. Each governance arrangement (hierarchical, market, network) will be fitted with concepts taken from literature on urban climate governance, a field of study that is emerging since cities are increasingly being recognized as places that have significant potential for climate action (Betsill & Bulkeley, 2007; Dodman, 2009). Section 2.7 gives an overview of the possible consequences of interaction between the different arrangements and explains the policy stages that will be relevant to identify in the discussion. An epilogue is provided in 2.8.

2.2 DEFINING GOVERNANCE

The shift from government to governance, in which the division of roles and responsibilities of public and private actors becomes blurred, has become an important debate in social sciences (Mees et al., 2012). Since the 1990s, the term governance has been increasingly referred to in policy-related publications, found in disciplines like public administration (e.g. Peters & Pierre, 1998; Stoker, 1998), international relations (e.g. Finkelstein, 1995; Krahmann, 2005), development studies (e.g. Hyden, 2007) and environmental governance (e.g. Lemos & Agrawal, 2006).

Governance can be used descriptively and advanced as a theory to explain the processes underlying new modes of governance and the way different modes of governance affect policy outcomes (Bulkeley, 2005; Kjaer, 2011); it can also be used normatively, i.e. to achieve a certain quality (Jordan, 2008). An example of a normative approach is the formulation of 'good governance' principles as promoted by the UN, the World Bank and the OECD (Crabbé & Leroy, 2008). As this thesis will be exploring the governance of green

roof retrofitting by frontrunner housing associations, governance will be used as a tool to describe the relevant processes found and to explain why certain outcomes are found.

Governance is generally associated with a changing role of the state, which has to deal with other actors that increasingly have a share in the policymaking process. Governance refers to a process of governing which is different from the “traditional model where collectively binding decisions are taken by elected representatives within parliaments and implemented by bureaucrats within public administrations” (Treib et al., 2007 p.3). Yet, Jordan (2008) points out, governance is not the same as governing itself. Where *governing* denotes efforts to steer or manage (parts of) society, governance describes the patterns that arise from those governing activities. So governance is both a process of governing as well as the patterns that arise from it. What then characterizes this process of governing?

We can approach this question from different dimensions, namely that of politics, polity and policy (Treib et al., 2007). Explaining governance like this paves the way to the framework of three ideal typical governance arrangements that will be ultimately used as analytical framework for this thesis, which will be explained below.

Taking a politics perspective, governance is explained with a focus on the actor constellation and power relations between political actors (Treib et al., 2007). This relates to the division of responsibilities between public and private actors. Whereas traditionally the government was usually a single actor working on policymaking and implementation, different governance arrangements feature private actors with diverging responsibilities across different stages of policymaking. This division of responsibilities differs according to the policy field at hand. Considering the issue of climate adaptation for example, Rietveld (2010) points out that an active role for the government is indispensable here to guarantee implementation of climate policy. Theoretically, this perspective distinguishes between only public actors in a hierarchical state on the one hand, and exclusively self-organizing private actors on the other hand. However, in real life various constellations can be found, with a certain type of actor possibly being predominant (Treib et al., 2007).

With a polity perspective, governance refers to the institutional structure of interactions between actors. These interactions can be *hierarchical*, where binding decisions can be

reached without consent of all parties, or resemble a *market* structure, in which actors can freely choose a desired course of action, (Treib et al., 2007). To this institutional spectrum a third ideal type structure can be added: *network* or *interactive* governance, where decisions are reached through dialogue between interdependent actors (Klijn & Koppenjan, 2000). Another aspect according to which governance can be distinguished is the degree of institutionalization of decision-making and implementation processes (Treib et al., 2007). For example, rules and processes may be either legally fixed by law, or can be of an informal nature and be developed and reformulated as time goes by (Klijn & Koppenjan, 2000).

With a policy perspective, governance is understood as a mode of political steering, in which the steering instruments define how particular policy goals should be achieved. An important aspect of this dimension of governance is the degree to which policy is legally binding, but also the presence or absence of sanctions (Treib et al., 2007). The policy dimension of governance will be discussed in more depth below. Figure 1 shows the dimensions of polity, politics and policy and their respective continuums of state intervention on the one hand, and societal autonomy on the other.

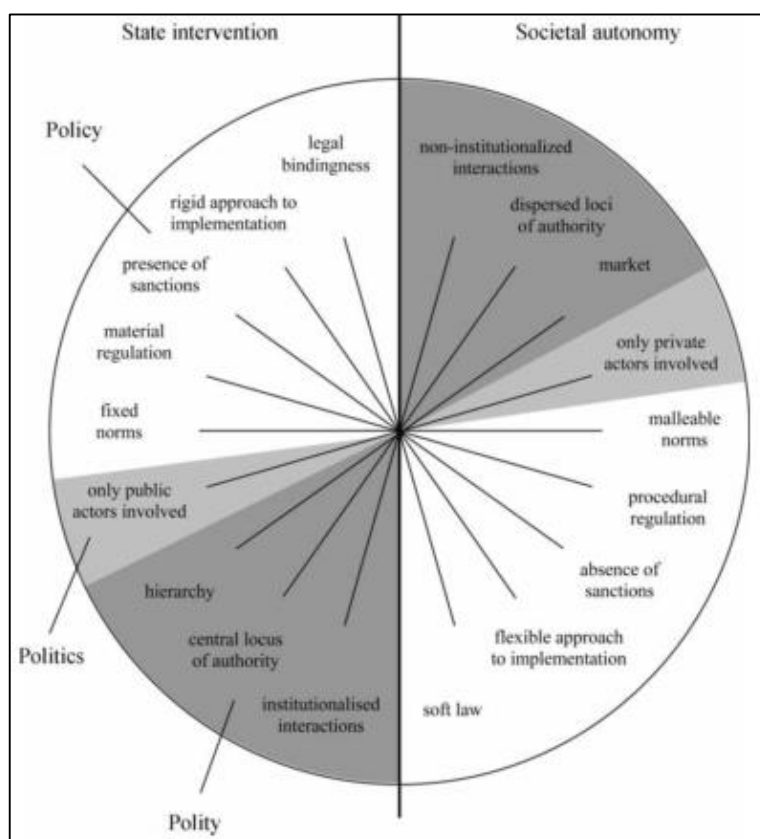


FIGURE 1. DIFFERENT DIMENSIONS OF GOVERNANCE MODES.
TAKEN FROM TREIB ET AL. 2007

This overview of different perspectives on governance shows that different modes or arrangements are possible, depending on how particular governance dimensions are characterized. Meuleman (2008, p.11) defines governance as “*the totality of interactions, in which government, other public bodies, private sector and civil society participate, aiming at solving societal problems or creating societal opportunities*”. This definition captures the politics dimension by referring to both public and private actors, and accounts for the policy perspective by indicating the need for solving a specific societal problem. However, the institutional perspective runs into a somewhat ambiguous term ‘totality of interactions’. When taking into account the three ideal types of institutional structures, and in preparation of the analytical framework, this definition should include the notion of government arrangements. I will define governance arrangements as “the arrangements which structure all interactions between government, other public bodies, private sector, and civil society within a particular policy domain to overcome societal issues”, focusing on the interactions between municipality and housing associations, and the societal issue being climate adaptation through green roof retrofitting.

2.3 IDEAL TYPICAL GOVERNANCE ARRANGEMENTS

To investigate governance of green roof retrofitting by housing associations, I will use a triad of ideal typical governance arrangements consisting of hierarchical, market, and network governance. These three are generally found in the literature, although the terms may differ (c.f. Thompson et al., 1991; Gunningham and Sinclair, 2002; Kjær, 2004; Driessen et al., 2012). This particular triad was used by Mees (2014) and Roders (2015) for analyzing green roof governance and climate change adaptation by Dutch housing associations respectively, so it has been shown that this concept lends itself to my research focus. One should note that ‘governance arrangement’ is a theoretical construct that is commonly used when describing governance in Western settings, but in reality one finds hybrid forms in which elements of more than one arrangement are found. This is why they are referred to as ‘ideal-typical’ arrangements, but for practicality I will henceforth refer to them without this adjective (Meuleman, 2008; Treib et al., 2007).

Each governance arrangement will be further specified according to responsibility, governing capacities and policy instruments. Responsibility refers to which actor is most typically predominant in that arrangement, e.g. governmental or private actors. In

researching the role of local authorities in climate governance, Lenhart (2015) discusses the concept of governing capacities of local authorities. Development and implementation of green roof policy can be seen as part of climate governance, so governing capacities are included in the conceptual framework of this research for both municipalities and housing associations. Policy instruments can be defined as “a deliberate structured effort by governors to solve a policy problem by modifying actions of the governed” (Brukas & Sallnäs, 2012, p.605) In the literature, they are usually classified in three categories: legal, economic, and communicative or informational instruments (c.f. Bemelmans-Videc, et al., 2010; Brukas & Sallnäs, 2012; Glasbergen, 1992). Each category is underpinned by a different rationale regarding the way actors are steered: legal instruments restrict or allow certain behavior, economic instruments change the cost/benefit analysis that actors make, and communication can be used to inform actors about different options. While all categories can potentially be applied in each of the three governance arrangements, each arrangement is usually dominated by one particular type of policy instrument. For example, hierarchical governance arrangements will be characterized by especially legal instruments (e.g. binding regulations), and market governance by economic instruments (e.g. subsidies). However, under market governance, economic instruments may contain legal components that create a level-playing field or ensure that subsidies recipients meet all requirements (Bähr, 2010; Mees, 2014).

The historical narrative of the ideal typical arrangements will now be followed to discuss each arrangement in detail. This means starting with hierarchical governance, followed by market and network governance. Each type will be fitted with the concepts of governing capacities and policy instruments, and as much as possible apply them to the current research focus.

2.4 HIERARCHICAL GOVERNANCE

The term ‘hierarchical’ by definition indicates a hierarchy with some actor having authority over another. Indeed, it is characterized by hierarchies in which especially public actors, i.e. governmental agencies at various levels, are responsible for policy making (Mees, 2014). Hierarchical governance is historically depicted as one side of the hierarchy-market dichotomy. Initially, when the term ‘network governance’ emerged, it was considered a hybrid of these two governance styles, lying somewhere in the middle

of the hierarchy-market continuum. Some authors still refer to network governance as a hybrid form of the other two (e.g. Bähr, 2010), but an extensive field of literature has increasingly developed network governance as a 'third' ideal type of governance arrangement, which will be discussed below (Meuleman, 2008; Ruys, Bruil, & Dix, 2007).

Interestingly, while 'governance' is usually defined as taking in other societal actors into the policymaking and implementation equation, the hierarchical governance arrangement has a strong focus on the more conventional 'government' top-down style of governing. Hierarchical governance has its roots in the ideal type of bureaucracy as developed by Max Weber, and this type of governance became the role model for public administration the 1950s and 1960s (Meuleman, 2008). It was valued for its efficiency and standardization, produced by a strong top-down regime in which the government lays out rules that all of society adheres to (Roders, 2015). A clear and relevant example can be seen in Dutch housing policy after the Second World War. The Dutch national government assumed the role of housing procurer and developer to overcome the great housing deficit. The number of houses built each year was centrally organised and regulated, ordering and financially enabling municipalities an important role in executing those plans (Ruys et al., 2007).

2.4.1 HIERARCHICAL GOVERNANCE FOR GREEN ROOFS

In this research, the main governmental actors that are relevant within this governance arrangement are the national and local government. This section will add the dimensions of governing capacities and policy instruments relevant to these actors.

GOVERNING CAPACITIES

The factors that influence local authorities' governing capacities include their internal organizational dynamics and rules and resources (Bulkeley, 2010). The organization's rules and resources include financial and human resources, knowledge and expertise on particular topics (Lenhart, 2015). A local authority's *internal dynamics and coordination* that influence its capacity refer to the location of climate rules and resources (i.e. in one or several departments) as well as the division of responsibility between departments and sectors (Lenhart, 2015). Local leadership and the organizational structure (e.g. communication between senior/junior staff) are mentioned as well (Lenhart, 2015).

In addition, there are additional components found in other stakeholders that can support local authorities, which Lenhart refers to as the *rules and resources* of other authorities (e.g. legislation or financial support from national government) and the rules and resources of other local stakeholders (e.g. corporate policy of housing associations or investment by property developers). Local authorities may draw on these external rules and resources, gaining financial support, technical guidance, or knowledge of a certain topic (Juhola & Westerhoff, 2011; Lenhart, 2015).

Engaging the *resources of local stakeholders and citizens* has also been suggested as a way in which capacity can be enhanced. When climate strategies are devised in collaboration with local stakeholders, more capacities and expertise can be used, which can help improve the diffusion of said strategies (Lenhart, 2015).

POLICY INSTRUMENTS

Governmental actors in hierarchical governance can make use of all types of policy instruments, but the most important are legal instruments. A general overview of policy instruments would become too big for this research, so the focus here is on policy instruments for green roofs, or climate adaptation. Carter and Fowler (2008) have identified specific policy instruments used for stimulating green roof infrastructure, which I will categorize accordingly. *Technology standards* include building code requirements that make green roofs mandatory in particular cases. *Performance standards* can specify the amount of on-site stormwater retention by green roof technology. In addition to legal instruments, local governments can also apply economic instruments: Green roof *subsidies* to help building owners pay for construction of green roofs (Carter and Fowler, 2008). *Taxes* can be differentiated to reduce taxes when green roofs lower water runoff, thereby lowering the impact a building has on the sewage. Moreover, green roofs can increase a building's value, which in the Netherlands causes an increase in real estate tax through the assessed market value (Dutch: WOZ-waarde). Local governments have the authority to differentiate these building value taxes and thereby stimulate or discourage building behaviour (Waarderingskamer, n.d.). Lastly, local governments can use public information campaigns, e.g. in the form of municipal advice on how to avoid heat stress, which green roofs are able to mitigate (Mees, 2014; Runhaar et al., 2012).

The clear advantage of regulations, or ‘command and control’ instruments is that they create a strong incentive to behave as the regulator desires, provided that enforcement of the rules and sanctions for not adhering to the rules. However, there are also some well documented disadvantages (Conelly et al., 2012). Introducing new regulations “is subject to high transaction costs” (Roders, 2015). The transaction costs include the time-consuming and expensive process of gathering all knowledge required to produce a comprehensive regulation. This may also produce a time lag and reality may develop faster than regulators can keep up with. Another drawback of command and control is that it does not provide an incentive to perform better than the standard (Conelly et al., 2012). This contributes to the pitfall of the hierarchical governance arrangement, which is its rigidity, making it hard to adapt to changing circumstances (Roders, 2015). Hierarchical governance does possess a relatively large toolbox of policy instruments, but it is limitedly effective in solving multi-actor, multi-level problems as these problems are too “fuzzy” to handle (Meuleman, 2008, p. 43)

2.5 MARKET GOVERNANCE

The term ‘market’ does not refer to the economic market, rather it represents mechanisms and attitudes found in the market. It does not relate to governance of the private market, but it is a (public) governance style which emerged during the 1980s (Meuleman, 2008).

The 1980s witnessed a wave of public sector reform across the globe, in which the principles of New Public Management (NPM) spread throughout OECD countries. The core idea of NPM is that public administration would perform better when private sector principles and market mechanisms are incorporated (Meuleman, 2008). While the NPM discourse has been heavily criticized (c.f. Bevir et al., 2003; Christensen & Lægreid, 2007; Kickert, 1997), the market governance arrangement has remained very influential in Western public administration and private sector principles like have become more important. Where the government is the main actor of hierarchical arrangements, private actors assume responsibility in market arrangements. This arrangement is sometimes also called ‘self-governance’ (c.f. Driessen et al., 2012), which refers to the self-regulating mechanisms of the private sector. Private actors initiate policy to regulate competition and to pre-empt public policy (Mees, 2014). This extension of private actors, or non-

governmental actors at least, to the equation of governing processes creates the hierarchy-market dichotomy.

Under market governance, new actors emerged in the form of hybrid organizations: independent partnerships of state- and market organizations whose main task is the implementation and monitoring of voluntary agreements. Such voluntary agreements can for example relate to measures of corporate social responsibility, a concept that has been embraced by governments as well as business actors. Here we see another difference from hierarchical governance, namely the process in which non-governmental actors voluntarily perform better than is required by law (Driessen et al., 2012). In this process, the state takes up a role that is more facilitating, and even sharing tasks as monitoring, inspecting and auditing with specialized businesses (Driessen et al., 2012; Kokx, 2011). Market governance thereby promotes competition rather than co-operation -although businesses may cooperate to become more competitive- and more than under hierarchical and network governance one finds performance contracting and benchmarks (Meuleman, 2008; Roders, 2015).

2.5.1 MARKET GOVERNANCE FOR GREEN ROOFS

Since market governance is characterized by a large share of responsibility for actors other than the government, this section will map the actors relevant for the present case. In green roof market governance, private actors can be divided into those with commercial interests (consultants, architects, green roof suppliers) and property owners (developers, real estate companies, housing associations, citizens) (Mees et al., 2012).

GOVERNING CAPACITIES

The governmental capacities have been discussed under hierarchical governance, so this section will focus on the governing capacities of market actors. This is not to indicate a complete absence of government authority, as market mechanisms still require some hierarchy (Meuleman, 2008). Andrade and Puppim de Oliveira (2015) describe the evolution of the private sector in climate and energy governance from being primarily a rule-taker (following a set of rules established by other actors) to the role of rule-maker (taking part directly in the construction of the rules of the game). Where hierarchical

arrangements fail or remain unsatisfactory, especially on a global scale, private governance initiatives can fill in regulatory gaps.

Due to organizational reforms in the public sector like NPM, the *internal dynamics and coordination* within market arrangements or private sector may resemble those found under hierarchical governance. An important factor is an organization's institutional capacity (Bulkeley, 2010). This includes the organizational structure; intra- and interdepartmental communication, since just as in governmental organizations, climate or environmental issues may crosscut across departmental borders. The size of the organization is also important, since this can affect the relationships between staff and departments. The size of the organization might also influence the degree to which the organization feels responsibility or opportunity to play a role in a certain issue. This can be seen as the private version of the 'fit problem', which indicates a gap between a municipality's jurisdictional size (its authority) and the scale of the issues that need to be addressed (Bulkeley, 2010). Also, the degree to which employees can practice 'intrapreneurship' (entrepreneurship within an organization) can affect institutional capacity (c.f. Augusto Felício, Rodrigues, & Caldeirinha, 2012)

When looking at *rules and resources*, the presence or importance of climate adaptation can be verified by the organization's mission, vision, and other statements. A company may have developed a policy of corporate social responsibility (CSR). CSR policies or other codes of conduct may come from an individual organization, but may also be linked to its branch or sector (Schrijvers, 2004). While CSR policies may indicate which considerations underpin a housing association's way of working, these documents are unlikely to shine light on the motivations of housing associations to install green roofs. Since this is exactly what I want to find out, I include 'motivation' as a factor of market governance, which will be discussed in the interviews with the housing association staff involved in the case study green roof projects. Motivation is then defined as the direct reason(s) for installing that particular green roof. *Resources* relate to the organization's skills and expertise, knowledge, and financial resources. These are the resources that allow the private sector to support municipalities with a certain issue when municipalities draw on the resources of local stakeholders. Moreover, private actors may also engage in private partnerships to share resources among each other to initiate a rule making process (Andrade & Puppim de Oliveira, 2015). An example of this is the German Landscape Research, Development

and Construction Society (FLL), whose green roof guidelines are adhered to globally (Mees, 2014). Housing associations have been described as retaining significant resources due to their housing stock and financial reserves, that municipalities often need to draw on (Hoppe, 2012; Kokx, 2010).

INSTRUMENTS

Market governance is characterized by economic instruments, although we also come across legal (though not binding) and communicative instruments. The main steering mechanism under market governance is pricing and competition among the private actors (Mees, 2014). This translates into the following instruments: Through *fee differentiation*, insurance companies have the capability to change the cost/benefit analysis that property owners make when considering to install a green roof. The rationale behind this is based on reduced flood risks due to green roofs retaining water (Mees, 2014). Other qualities that green roofs have, such as heat reduction, might lead to differentiation in insurances in a similar fashion. The legal instruments in market governance are of a voluntary nature, yet may be influential nonetheless. Through *private labelling*, private actors can set standards that raise the quality of products and thereby make e.g. green roofs more interesting for property owners (e.g. lower energy bill) and public policymakers (climate adaptation function). Private labelling also has an element of informational value in it, since it conveys *product information* and may create valuable knowledge (Driessen et al., 2012; Mees, 2014).

2.6 NETWORK GOVERNANCE

In the 1990s, and in the Netherlands already in the 1980s, a new understanding of governance arose in the form of network governance, which has also been dubbed interactive governance and horizontal governance (Edelenbos, 2005; Juhola & Westerhoff, 2011; Meuleman, 2008). This ideal type emerged as a new alternative to top-down hierarchy as well as to the “anarchy of the market” (Meuleman, 2008, p. 31). As was explained in the previous section, market governance led to private actors gaining prominence in governance processes, thereby limiting the state’s ability to act effectively, a process that Rhodes (2007) refers to as the ‘hollowing out of the state’. By involving its citizens, social organizations, enterprises, and other stakeholders in public policy making, governments may halt the hollowing out of the state (Edelenbos, 2005).

The resulting mixture of public and private actors engaged in policymaking is referred to as a network, which can be defined as a: “set of formal and informal institutional linkages between governmental and other actors (e.g. trade unions and big business) structured around shared interests in public policymaking and implementation” (Rhodes, 2007, p.1244). There are numerous benefits of network governance, like flexibility and a more smooth policy implementation. Especially informal networks can be very flexible regarding membership and the distribution of roles and power among members. As a result, knowledge and different understandings thereof can be easily shared (Pahl-Wostl, 2009). This flexibility stands in stark contrast with the rigidity of hierarchical governance, and the cooperative work style contrasts with the competitiveness of market governance. Another perceived benefit of network governance is the increased support for policy due to the inclusion of actors in the decision-making process. As more actors become ‘rule-makers’, the final policy produced is less likely to receive unexpected resistance and this creates certainty in policymaking (Pahl-Wostl, 2009; Roders, 2015).

Where hierarchical and market arrangements are underpinned by command and competition respectively, *trust* is the central coordinating mechanism for network governance (Davies, 2005). Ill handling of trust by network members can nullify the added value of network governance: When private actors feel that the network approach ends up anyway with a top-down policy without including their preferences, the government may lose trust rather than gain or maintain it (Meuleman, 2008). Given the wide variety of actors (different levels of government, civil society groups, businesses), all with their own goals, interests and positions, this raises questions of how such networks are to be managed (Kickert, 1997). In fact, the characteristic of networks that they are difficult to steer or control is an often mentioned criticism of network governance (Keast et al., 2006; Rhodes, 1996). Therefore, the issue of network management is inherently linked to network governance and this will be discussed under the heading of governing capacities in the following section.

2.6.1 NETWORK GOVERNANCE FOR GREEN ROOFS

The relevance of network governance in the context of climate adaptation becomes apparent by recent initiatives found in the Netherlands such as the Knowledge for Climate Network, a research network of different governments, businesses and research institutes, and the Green Roof Green Deal, in which various public and private actors seek to stimulate green roofs by developing business models and mapping policy barriers and opportunities (Kennis voor Klimaat, 2014; Ondernemend Groen, 2014). These examples indicate the variety of purposes that networks may serve, including knowledge creation and (preparation of) policymaking. Yet, even when a certain outcome is expected from the network, interactive policy processes are vague and the high amount of uncertainty requires careful process management (Driessen et al., 2001).

GOVERNING CAPACITIES

Relating this process management to network's governing capacities, the *internal dynamics and coordination* of networks will be now be discussed. Klijn & Koppenjan (2000) mention the following four elements that are important for process management: The selection and activation of actors, actors should be selected on bases of what they can offer and then be motivated to participate; the mutual perception regarding the issue at stake, since diverging ideas may become a barrier to success; the creation of (temporary) organizational arrangements between organizations to create coordination and sustained interactions; the improvement and supervision of interactions by means of process and conflict management, which requires a network manager.

When it comes to *rules and resources* of network governance, Rhodes (1996, p.657) states that "all actors in a particular policy area need one another. Each contribute relevant knowledge or other resources. No one has all the relevant knowledge or other resources to make the policy work". Some resources can be of critical importance to the realization of policy outcomes, giving the members that hold those resources veto power in the policy game (Klijn & Koppenjan, 2000). For example, while governments have specific resources as legislative powers, they can be dependent on financial resources of private network members (Kokx, 2011). With regard to resources, the quality and quantity of the resources of the various members should be considered, as well as the exchange thereof. Furthermore, I consider the findings of Edelenbos (2005) regarding the importance of

institutional implications in network processes. Using a sociological interpretation of institutions as 'rules of and roles in the game', Edelenbos studied network processes in five Dutch municipalities. He concludes that existing institutions (e.g. usual municipal processes, working structures of civil servants) can conflict with the institutions of newly introduced interactive processes (e.g. deliberate democracy). As too much friction might lead to a complete rejection of the new institution, and too much similarity between old and new institutions may lead to minimal outcome, "a workable balance has to be found between the rejection and absorption of new institutions of interactive decision making"(p.130). Just how this balance should be found is open for discussion, but Edelenbos concludes with the following actions that can prevent institutional tensions between the interactive process and the existing decision making structure. First, politicians should be informed and consulted before the interactive process begins, since a lack of commitment of political officeholders can obstruct the interactive process. Secondly, there should be opportunities for feedback from the interactive process to the political arena (e.g. the municipal council, civil servants). Without such feedback, politicians and civil servants may lose track of what is going on, while their cooperation is crucial if the interactive process is to have lasting results.

POLICY INSTRUMENTS

For the purpose of this research, an instrumental perspective on network governance and policy instruments will be used. This perspective deals with the question of how one actor can influence the behavior of other actors, since in a network each actor possesses steering capabilities to some extent (Kickert, 1997). Yet, the governmental actor in the network occupy a special position, based on the resources exclusively available to them: significant budgets and personnel, access to mass media, a monopoly on the use of force, and democratic legitimization (Klijn & Koppenjan, 2000). While governmental resources are not limitless, they are important for the creation of legal contracts in the form of *covenants*. Covenants are a particular type of 'voluntary agreements' between multiple actors, especially between government and private actors. As the name suggests, covenants are voluntary and non-binding, although more formal and binding elements can be added (Jordan et al., 2005). In the Netherlands, covenants usually supplement regulation, meaning they co-exist with existing regulations. Covenants can be linked to other (more hierarchical) instruments like subsidies or binding regulations to support

their implementation. As such, covenants are a way for governments to get a large number of companies to take action in a certain field, rather than merely stimulating a few ‘first movers’ (Bressers et al., 2009). This interactive policy instrument has been criticized for giving businesses the opportunity to showcase a willingness to address an environmental issue through negotiations, thereby evading binding regulations (van der Heijden, 2014). While voluntary agreements are also associated with market governance, I consider them as elements of network governance, in line with Kalders et al., (2004) and Mees (2014).

An economic instrument of network governance is a *smart subsidy*, in which a subsidy is allocated through an auction mechanism, so that the subsidy size is kept as small as possible. Smart subsidies can be an effective and flexible way of handling public money, yet it remains a voluntary agreement, so it may not stimulate adaptation measures like green roofs as much as other instruments (Mees et al., 2014).

Dimension ↓	Hierarchical governance	Market governance	Network governance
Responsibility	Governments and public actors	Private actors	Shared between public and private actors
Governing capacities	Governmental Dynamics and coordination: location of climate policy; leadership and organizational structure; Rules and resources: legislation and policy, financial resources (drawing on other governments and local stakeholders)	Private Dynamics and coordination: internal communication, size of organization, intrapreneurship Rules and resources: mission, vision, CSR, code of conduct, motivation; expertise, financial resources (partnerships to share resources)	Networks Dynamics and coordination: actor selection & motivation mutual perception of issue organizational arrangements improvement & supervision of interactions Rules and resources exchange of resources among members institutional implications of existing framework and interactive process
Policy instruments	Legal(binding/non-binding): technology and performance standards Economic: subsidies and taxes Communicative: informational campaign	Economic/Legal (not binding): fee differentiation Communicative/Legal: private labelling, product information	Legal: covenants, negotiated agreements Economic: smart subsidies

TABLE 2. OVERVIEW OF THE THREE GOVERNANCE ARRANGEMENTS

2.7 MIXING GOVERNANCE ARRANGEMENTS

Now that all three ideal types have been discussed, it is worthwhile to consider how they relate to each other. Furthermore, the different stages of the policymaking process will be explained here, as different elements of governance arrangements may vary throughout the policymaking process.

2.7.1 CONFLICT AND COMPLEMENTARITY

When different governance arrangements with different rationales and steering mechanisms are put together, they may function as complements to each other, but it may also become a source of conflict. The relations between the governance arrangements will therefore be discussed here.

BETWEEN HIERARCHICAL AND MARKET GOVERNANCE

As became clear in the previous sections about hierarchical and market governance, these arrangements traditionally formed the opposing ends on the governance continuum. One of the main contrasts between them is that hierarchical governance would promote centralization, while market governance is in favour of decentralization (Meuleman, 2008). The neoliberal reforms of the 1980s and 1990s in several European countries can be seen in the shift from hierarchical control towards decentralization and privatization in many sectors, including social housing in the Netherlands (Czischke, 2014). Sources of frustration can be the government's lacking legal steering ability when market governance promotes more autonomy of the private sector, or when hierarchical control measures are consequently (re)introduced (Meuleman, 2008). On the other hand, hierarchy and market can be complementary when top-down regulation is used to create more autonomy within the public sector, thereby introducing features of market governance (Meuleman, 2008).

BETWEEN HIERARCHICAL AND NETWORK GOVERNANCE

Simply stated, comparing hierarchical and network governance makes the former look structured and the latter chaotic (Meuleman, 2008). While hierarchical elements can be linked to elements of network governance, e.g. regulations coupled with covenants, there are numerous prerequisites for this mix to be successful and accepted. In addition to the

issue of institutional (mis)fit discussed above, there are some other documented problems of mixing hierarchical and network governance. Meuleman (2008) mentions for example the 'accountability curve', in which a decentralized government is held accountable for the performance of a partner organization, while lacking hierarchical relations vis-à-vis that partner. A 'steering split' occurs when an actor seeks to adhere to norms and expectations of hierarchical and network arrangements simultaneously, which may be difficult when these are not sufficiently synchronized. A recurrent issue is that of accountability, since interactive decision between elected politicians and non-elected private actors can make it difficult for the electorate to see who is deciding what and can ultimately be held accountable (Meuleman, 2008).

On the other hand, networks and hierarchy can go hand in hand too, especially when top-down guidance through state intervention is deemed a prerequisite for a proper functioning network (Davies, 2005). Some Weberian concepts like integrity, stability, and reliability, typically associated with hierarchical governance, can help give networks a welcome degree of structure. Networks can be initiated through hierarchical decisions, and can also be used to establish hierarchical structures in which the network interaction is turned into action (Meuleman, 2008).

BETWEEN MARKET AND NETWORK GOVERNANCE

Market competition is about making quick decisions to protect one's own interest in a competitive environment. On the other hand, network decision making is about reaching consensus, which is not quickly realized, nor does consensus necessarily represent each actor's interest. The autonomy and competitiveness associated with market governance can therefore limit the development of trust between network members (Meuleman, 2008). On the other hand, the introduction of market governance within the public sector can produce turbulence within the public sector's institutional infrastructure, which networks can help restore (Davis & Rhodes, 2000).

2.7.2 POLICY STAGES

When analysing the relationship between respective governance arrangements and the behaviour of actors involved in case study projects, it will be helpful to discern the phase of policymaking. A key element which distinguishes governance arrangements from each

other is they main actor carrying responsibility, and responsibilities can vary across policy stages (Mees, 2014). For example, while a government or municipality may engage in policy making by setting specific climate adaptation targets, it may be up to private actors to execute the physical implementation to reach those targets (see Lenhart, 2015). However, in later stages of policymaking (implementation, evaluation, maintenance), market arrangements prevail as cities face administrative and financial constraints. This is where the green roof industry and actors like housing associations play an important role (Mees et al., 2012). Following Mees (2014), this thesis will distinguish the policy stages as according to the PLAN-DO-CHECK-MAINTENANCE cycle. 'Plan' or the policy making stage refers to agenda setting, knowledge creation, and initiation of policy. 'Do' or the policy implementation phase refers to developing strategies, providing information, financing measures and physical implementation of green roofs. 'Check' or the policy evaluation stage includes monitoring results, enforcement through sanctions or incentives and policy adjustment if necessary. Finally, the last stage consists of maintaining the quality of what has been established as a result of the preceding stages (Mees, 2014). For an overview of the policy stages, see figure 4 on the next page.

Policy Stages	Roles	Green roof example
PLAN	Agenda setting	Convincing politicians/staff of the importance of adaptation/green roofs
	Knowledge creation	Gathering information on risks, impacts, costs, benefits of green roofs
	Initiation of policy	Bringing together stakeholders, especially housing associations, for dialogue to inform policy decision
DO	Strategy making	Developing a strategy to become climate proof or to stimulate green roofs
	Information sharing	Active sharing of information to society (e.g. benefits of green roofs, subsidy)
	Financing	Paying for the installation costs, compensating additional costs
CHECK	Monitoring	Monitoring implementation and the consequences thereof
	Enforcement/Incentives	Establishing fines for not adapting or making incentives for adapting
	Policy adjustment	Optionally adjusting policy on basis of feedback or evaluation
MAINTENANCE	Maintenance	Inspecting and maintaining green roofs

TABLE 3. POLICY STAGES AND ROLES. ADAPTED FROM MEES (2014).

2.8 EPILOGUE

This chapter has discussed the concept of governance, introduced the notion of ideal-typical governance arrangements, and subsequently developed the triad of hierarchical, market and network governance arrangements. This triad will function as the theoretical framework and analytical tool in the next phase of the research, namely the desk-based research and interviewing of stakeholders of various green roof retrofitting projects by housing associations.

CHAPTER 3: SOCIAL HOUSING AND GREEN ROOFS

3.1 INTRODUCTION

Before proceeding to the actual research, this chapter gives some background information on Dutch social housing and climate adaptation in the Netherlands in section 3.2. Also, since this research deals with governing green roofs rather than their technical details, this chapter also explains the adaptation value of green roofs in section 3.3, so that reader understands the relevance of green roofs as an instrument of climate adaptation.

3.2 SOCIAL HOUSING IN THE NETHERLANDS

This section will briefly explain the history of social housing in the Netherlands as an introduction to the present day situation. The purpose of this section is to provide the reader with sufficient knowledge about the functions of housing associations and how responsibilities are divided among them and governmental actors. By explaining the policy context of social housing, the reader is prepared for the empirical chapter which will deal with the implications of this context regarding green roofs as a climate adaptation instrument.

3.2.1 A BRIEF HISTORY OF SOCIAL HOUSING

The roots of contemporary social housing go back to the dawn of the twentieth century, when the Housing Act (Dutch: Woningwet) was introduced in 1901. Until then, social housing was provided by well-endowed citizens and entrepreneurs, churches, and labor unions. With the Housing Act, the government took responsibility to ensure the availability of affordable housing. This came with a special financial arrangement of subsidies made available only to a special kind of organization, which could only use its resources for the purpose of social housing without generating profits to third parties. The housing association was born: essentially a private, nonprofit organization, that is connected to public housing policy through specific legal and financial arrangements. Housing associations proved convenient vehicles to deal effectively with the issue of providing sufficient and affordable housing in difficult times like the aftermath of the 2nd World War. However, over the years, housing associations have been delegated varying

degrees of autonomy and they have enjoyed varying degrees of exclusiveness as actor on the housing market (de Jong, 2013). It would be too lengthy of a discussion to go into the evolution of housing associations and social housing policy, so the most relevant developments of the last three decades will be outlined here.

By the end of the 1980s, the Dutch government felt the need to introduce significant changes to the social housing sector. The sector was characterized by high and sometimes poorly controlled expenditures, still tapping into state subsidies, while the government faced a growing budget deficit. Consequently, the system was reformed in 1995 with what is referred to in Dutch as the 'brutering', a grossing and balancing operation in which the subsidies were set off against the loans that the housing associations owed to the government. This financial independence for housing associations was coupled with less top-down guidance regarding their activities, as new rules had been introduced in 1993 through an amendment of the Housing Act and the introduction of the Social Housing Management Decree (Besluit Beheer Sociale Huursector, BBSH). From then on, housing associations were supposed to:

1. Assure good quality in all homes;
2. Guarantee the financial continuity of the enterprise;
3. Rent on a priority base to the 'special attention groups intended in policy';
4. Involve tenants in the policy and management of the organization;
5. Make a contribution to the quality of life in neighborhoods and communities;
6. Make a contribution to the housing of persons in need of care or supervision.

With these responsibilities written down, it was up to the housing associations to decide how they would act upon them. The state had retreated as supervisor, making room for municipalities to interpret these guidelines within the local context. Municipalities and housing associations were seen as more or less equal partners who had to make deals by means of covenants to ensure the implementation of social housing policy. In the following years, it became apparent that the reforms lacked sufficient steering capacity for the government, and national policy goals were not sufficiently implemented through those local covenants (Aedes, 2013; de Jong, 2013).

Housing associations became hybrid organizations; on the one hand they implemented the public task of providing housing for lower income groups, on the other hand the

liberalization made them private organizations operating on the housing market (Kokx, 2010). The housing associations sector, represented by Aedes, the national association of social housing associations, defended the autonomy of housing associations in consultations with the government. However, political concerns grew about the independence that the housing sector had gained. These concerns turned out to be legitimate, as the sector became the scene of a series of incidents. Three categories can be identified: mismanagement and excessive risk-taking in development projects, financial mismanagement and speculation, fraud and self-enrichment (Aedes, 2013; de Jong, 2013).

These incidents led to a public debate about the positions of housing associations, which enjoyed public support while engaging in matters not of public interest. In 2014, a parliamentary enquiry into the state of the social housing sector delivered a critical report. Together with other inquiries and the new national coalition accord, these developments culminated in a stringent revision of the Housing Act, which entered into force on 1 July 2015 (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2015).

3.2.2 THE REVISED HOUSING ACT

The revised Housing Act introduces a more austere policy, which should be taken into consideration for this research. A striking feature of the revision is the focus on the ‘core task’ that housing associations have to get back to: constructing, renting, and maintaining a social housing stock for people with a low income or for other reasons have difficulty finding suitable housing. Housing associations may also maintain real estate with a societal function such as community centers, neighborhood libraries and elementary schools. Under the term ‘liveability’ (leefbaarheid), housing associations may invest in the direct living environment of their buildings, like maintaining greenery. Specific guidelines regarding liveability are set in consultation with tenants organizations and municipalities. In terms of sustainability, housing associations can introduce measures, or support tenants in doing so, that contribute to sustainable energy use like solar panels, provided that the measure benefits the tenants (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2015).

With the revised Housing Act, municipalities have gained more influence than they had before. Municipalities and housing associations are used to working together in the so-called performance agreements, introduced in 2004. However, these performance

agreements have become more binding with the revised Housing Act. Municipalities are now required to develop a comprehensive plan for social housing together with housing associations and tenants organizations, which has to be proposed to and is monitored by the Ministry annually. In these agreements, housing associations are required to follow the municipality's housing policy. For example, the municipality can develop binding guidelines regarding the development of the housing stock, affordability, targeting special groups, quality and sustainability of the housing stock and the direct environment (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2015).

3.2.3 SOCIAL HOUSING, SUSTAINABILITY AND CLIMATE ADAPTATION

Since the installation of green roofs on existing housing can be categorized as a sustainability measure, it is worthwhile to look at the importance of sustainability in social housing policy.

In the context of social housing policy, sustainability is first and foremost interpreted as measures of renewable energy (e.g. solar panels) and energy efficiency (e.g. insulation). In 2012, a covenant was signed by the Ministry of Internal Affairs, Aedes and two other market parties to achieve an energy efficiency average of energy label B in the entire social housing stock by 2020 (Rijksoverheid, 2012). With this covenant, the government commits itself to promoting renewable energy by taking away legal, financial and fiscal barriers for the social housing sector. An example of such a barrier is the limited room for investment when housing associations are not able to pass on the cost of the investment to the tenants. To solve this, a special compensation arrangement has been introduced, which allows housing associations to receive a compensation for energy neutral homes (Nul-op-de-meter woningen). Another financial compensation is the STEP subsidy arrangement, which housing associations can use as financial support in energy efficiency measures. (Aedes, n.d.; Rijksoverheid, 2012).

It seems that sustainability in the form of renewable energy and energy efficiency is an important issue for both the government and the social housing sector, reflected in numerous initiatives and covenants. However, considering the focus on climate adaptation this research has, we need to look further for specific adaptation policy.

Whereas some European countries have already developed National Adaptation Strategies (NAS) in line with the EU Adaptation Strategy, the Dutch NAS is expected to be finalized in 2016 (see: European Commission, 2013). The NAS consists of a long term (20-30 years) strategy and a biennial agenda of activities implemented by governments, businesses and societal organizations (Rijksoverheid, 2016). The Delta Program was launched in 2010 as a large-scale water management program, and thereby constitutes a sectoral approach to climate adaptation. The aim of the program is to develop and implement policies that defend the Netherlands from rivers and the sea, as well as securing fresh water supply (Bauer & Steurer, 2014). While these issues may seem much larger than the scope of this thesis, the Delta Program is a relevant governance framework nevertheless. The way in which climate adaptation has been framed in the Delta Program, namely being intrinsically linked to water management, has been crucial for gaining political commitment and financial reservations. Furthermore, while it is a national program, it involves sub-national authorities with relevant responsibilities. Among those authorities are municipal representatives dealing with spatial planning and housing regulations, which can bring in valuable local expertise. For example, international front runner Rotterdam had already formulated an adaptation strategy and implemented some adaptation measures before the Delta Program was launched (Bauer & Steurer, 2014). For smaller municipalities, those less far advanced in terms of climate adaptation policies, or those located in areas which the Delta Program simply does not geographically cover (e.g. Groningen or Enschede), there may not be as much relevance as hinted at by Bauer and Steuer. Nevertheless, it shows that climate adaptation is taken seriously by the government with a strong focus on water, and this is where green roofs come in. The following section will explain the relevance of green roofs for climate adaptation by listing their wide variety of benefits and advantages over conventional roofs.

3.3 GREEN ROOFS

3.3.1 A VERY BRIEF HISTORY OF GREEN ROOFS

The added value of green roofs has long been appreciated by civilizations across the planet, in cold areas for retaining heat and in warm climates to keep the heat out. The oldest known green roofs were the rooftop gardens on the ziggurats¹ of ancient Mesopotamia, where trees and shrubs provided relief from the relentless heat. Green roofs were also known to exist in the Roman Empire, where they provided shade in densely populated urban areas, and trees decorated the top of institutional buildings like the Mausoleum of Augustus. Examples of green roofs in colder climates can be found in the Scandinavian Peninsula, as well as in Iceland and the Faeroe Islands (Kuhn & Bass, 1999; Magill et al., 2011).

Green roofs thus have been around since written history, yet the renewed interest in green roofs starts in the 1960s, when especially German and Swiss researchers started to study and improve green roof technologies. Over the years, knowledge about different components of green roofs increased rapidly, as research was carried out on root repelling agents, waterproof membranes, drainage, light-weight growing media, and plants. Accompanied by favorable legislation and subsidies by state and municipalities, the technological development allowed the German green roof market to expand rapidly in the 1980s, with an average annual growth of around 15%. In 1989, one million square meters of green roofs were installed in Germany, by 1996 this had increased to 10 million (Magill et al., 2011).

As Germany may be considered the cradle of the green roof revival, it is interesting to note that neighboring country the Netherlands is lagging behind in the installation of green roofs and in terms of policy that can support the development thereof (Damen & Brouwers, 2012). In reaction to this situation, the green industry represented by the Vakgroep Dak- en gevelbegroeners, as well as individual green roof businesses and knowledge partners (e.g. Delft University) are researching the qualities of green roofs and

¹ Ziggurat: temple tower in the form of a terraced pyramid with successively receding stories

lobbying for more pressing policies to stimulate the development of green roofs (Damen & Brouwers, 2012).

3.3.2 EXTENSIVE VS. INTENSIVE GREEN ROOFS

Before explaining the wide variety of benefits that green roofs provide, the difference between extensive and intensive green roofs should be explained. Hop and Hiemstra (2013) have done a literature review on the benefits of green roofs and green walls, and provide a clear overview of the differences between intensive and extensive green roofs. This research focuses on extensive green roofs, which in comparison to intensive green roofs have a thinner substrate layer, weigh less, and are generally less costly. These are the vegetation roofs filled with moss, sedum, herbs, and grasses that can usually be applied to existing roofs without additionally strengthening the roof construction. Extensive green roofs are usually not to be tread, and once installed they require relatively little maintenance, but once or twice a year some weed may have to be removed. On the other hand, intensive green roofs are much heavier due to their thick substrate layer, requiring a suitable roof construction, and therefore come at a higher price. They can include the vegetation of extensive green roofs, but also bigger plants, lawns and even trees. They are very suitable to function as a roof terrace. An overview of the main, but not all differences is given in table 1 on the next page, adapted from Hop and Hiemstra (2013). Below in figure 3 the difference is shown by two projects of the Amsterdam based company De Dakdokters.



On the left an extensive green roof with various small plants and grass. On the right an intensive green roof with paths to walk through the roof garden.

Source: <http://www.dakdokters.nl>

FIGURE 2. DIFFERENCES BETWEEN EXTENSIVE AND INTENSIVE GREEN ROOFS

	Extensive	Intensive
Substrate layer	5-15 cm	12-200 cm
Total weight kg/m² (water saturated, excluding snow, people, etc.)	30-350	200-3500
Vegetation	Moss, sedum, herbs, grass	Lawn, shrubs, plants, trees
Treadable	Usually not treadable	Usually treadable
Price (installation cost including materials and labor, excluding VAT)	€20-75/m ²	€40-2000/m ²
Maintenance	Little (1-2 times per year)	More often than 2 times a year

TABLE 4. DIFFERENCES BETWEEN EXTENSIVE AND INTENSIVE GREEN ROOFS. DATA FROM HOP & HIEMSTRA (2013)

3.3.3 ADVANTAGES OF GREEN ROOFS

Green roofs have a wide variety of benefits to offer. According to the literature review by Hop and Hiemstra (2013), stormwater retention is the most researched aspect of green roofs, with 74 articles dealing with this topic. In terms of climate adaptation, this quality is of great interest for municipalities insofar as they are preparing for more frequent and more intense precipitation. Another climate adaptation benefit is the contribution to lowering the Urban Heat Island (UHI) effect. The UHI effect makes dense urban areas much hotter than suburban or rural areas because heat is absorbed by buildings and streets during the day, and slowly emitted back during night. At the same time, green roofs can also provide insulation from heat in summer and cold in winter (Hop & Hiemstra, 2013).

Other benefits that make green roofs an interesting feature are not necessarily related to climate adaptation, but are often mentioned as additional reasons to install green roofs. Because of the lower temperature directly above green roofs in comparison to conventional roofs, solar panels can function more efficiently. The vegetation layer also provides extra protection for the roof itself, making it last longer. Finally, the greenery does not only have an aesthetic value, however subjective that may be, but it can also have a positive effect on biodiversity in the urban environment (Hop & Hiemstra, 2013). Green

roofs are also associated with rooftop farming, but since this requires intensive green roofs by definition, I choose to omit it from this section.

Based on the literature review, Hop and Hiemstra (2013) conclude that the private costs of installing and maintaining a green roof are higher than the private benefits. However, if all societal benefits are included in the equation, the benefits are higher than the costs. This is an aspect that should be kept in mind, since building owners face considerable costs, as shown in table X in the previous section. On the next page, table X lists the abovementioned benefits, based on the literature review of Hop and Hiemstra (2013).

Benefit	What advantage?
Stormwater retention	Depending on the specific characteristic of the green roof, like the substrate layer and the materials used, the vegetation layer will soak up stormwater, thereby slowing down the flow of water onto the streets below or into the sewage. This creates extra temporary water storage capacity, especially with small to medium sized showers. With heavy showers or storms, the vegetation will soon be saturated, and other tools are necessary to retain more water, e.g. water basins.
Urban Heat Island mitigation	Because the vegetation layer lowers the surrounding temperature through evapotranspiration, the lowering of the urban heat island effect (UHI) is often mentioned as a benefit. However, the actual effect that green roofs have on ambient temperatures is unknown. Nevertheless, it can be reasonably expected that the more green spaces an urban area has, the greater the cooling effect on city level, up to a couple of degrees Celsius.
Insulation	The vegetation layer provides insulation for the building underneath it. This effect works both in winter and summer, although the cooling effect in summer is greater, on hot days the savings on cooling can reach up to 25%. This counts both as climate adaptation (to more heatwaves) as well as mitigation (lowering electricity demand for cooling). Vegetation also absorbs and diffuses sound, which can amount up to 10dB less noise inside the building with a 15-20 cm substrate layer. This effect is also audible on street level, and green roofs on row houses can cut street sounds by a couple of decibels as measured in the backyards.
Solar panel efficiency	Solar panels work less efficiently in higher temperatures. Above 25°C, every degree Celcius lowers the panel's output by 0.25-0.5%, so green roofs can effectively improve the panel's output by cooling the rooftop temperature.
Aesthetics	The sight of greenery has a positive effect on people's health, so green roofs can help people become and feel healthier. Hospital patients with view on a green roof need less painkillers and recover faster, office employees with a view on green roof experience stress reduction and lower blood pressure.
Roof life expectancy	the life of the roof membrane below the vegetation layer is prolonged, even doubled from 20 to more than 40 years. This is because the vegetation layer protects the roof from UV radiation, big temperature differences and hail.
Biodiversity	While the precise effect of green roofs on a city's entire ecosystem has not yet been studied, green roofs can increase biodiversity as habitats for plants, insects and small birds.

TABLE 5. OVERVIEW OF GREEN ROOF BENEFITS. DATA FROM HOP AND HIEMSTRA (2013)

CHAPTER 4: EMPIRICAL RESULTS: GREEN ROOF PROJECTS AND POLICIES

4.1 INTRODUCTION

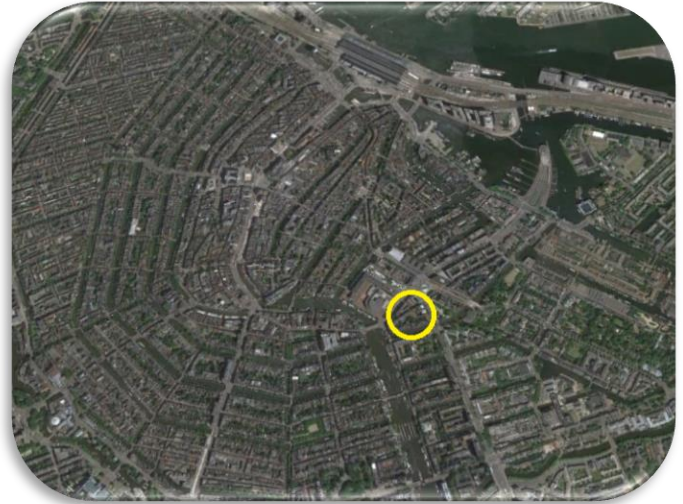
This chapter presents the empirical findings of the data collection, based on desk-research and semi-structured interviews. This chapter will display the collected data by selecting relevant and striking accounts of the case study interviews that can be used to answer the empirical subquestions. In addition to interviews, policy documents and other materials have also been reviewed and are included as well. Before going to the data, the case studies will be introduced.

4.2 CASE STUDY SELECTION

The three case studies will now be introduced: the green roof on housing complex “De Halve Wereld” in Amsterdam owned by Ymere, the Lewenborg project by Lefier in Groningen, and the Transburg project by Domijn in Enschede.

4.2.1 YMERE AND THE HALVE WERELD PROJECT

The Halve Wereld project took place in 2010 in Amsterdam, and upon completion was the biggest green roof of that city, measuring 1,300 m². It was installed on buildings of “de Halve Wereld” complex, which is for the most part maintained by a very active and autonomous tenants association. The owner is Ymere, one of the biggest housing associations in the country that manages almost 90,000 buildings in the metropolitan area of Amsterdam, of which 44,000 in the city of Amsterdam. Ymere and the tenants association agreed that a green roof would suit the complex and made use of a municipal green roof subsidy to help finance the installation (Interview M. Kootwijk, 2016; Interview M. Storm, 2016; Ymere, n.d.)

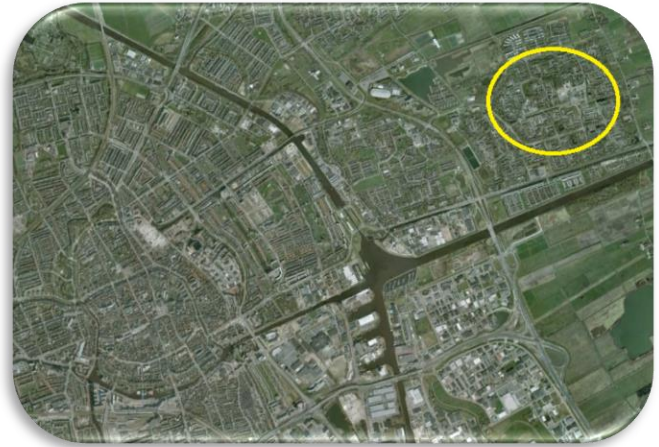


Halve Wereld green roof (author's picture) and location in the city of Amsterdam (Google Earth)

FIGURE 3. THE HALVE WERELD GREEN ROOF

4.2.2 LEFIER AND THE LEWENBORG PROJECT

The Lewenborg project also took place in 2010, which initially was a large renovation of 400 houses by housing association Lefier in the Lewenborg neighborhood in Groningen. Lefier is the result of three smaller associations merging in 2009 and now owns 25,000 houses in 6 municipalities in the North of the country, of which 6,500 houses in Groningen (Lefier, 2015). After consultation with the municipality, who helped to arrange financial support for sustainability measures, it was decided to install a green roof. It involved 400 houses, adding up to 20,000m² of green roof. They used a newly developed product, produced by the roofing company Icopal, which was a light weight mat that could be rolled over the existing roofs, and moss seeds would eventually grow into a moss-lawn on top of the roofs. Unfortunately, a spring storm in 2013 blew off some of the mats, and it turned out that some construction errors had been made. A lengthy and difficult search for who was to be held accountable started, but a lawsuit could eventually be prevented. Icopal replaced the roofs with another light weight system made of sedum and moss, which is still in place today.



Similar type green roof as used in Lewenborg project (source: www.icopal.nl) and the location of the Lewenborg neighborhood in the city of Groningen (Google Earth).

FIGURE 4. THE LEWENBORG GREEN ROOF

4.2.3 DOMIJN AND THE TRANSBURG PROJECT

The Transburg project is an innovative project by Domijn in the city center of Enschede, which was finalized in 2013. Domijn has about 16,000 houses in three municipalities, the largest of which is Enschede. Housing association Domijn held a sustainability contest among employees to collect ideas on how to become a more sustainable housing association. Domijn's property manager Arno Weppel had been thinking about a green alternative to the standard concrete roof tile and, inspired by the contest, proposed to set up a pilot project to test his eco-tile called 'Ecopan'. The Ecopan weighs as much as the concrete roof tiles and has been designed so that the roof construction does not need to be refitted. His idea was well received by the director and a pilot project was set up to lay the green roof tile on 11 houses in the Transburg neighborhood. What makes the ecopan special is the fact that it can be laid relatively easily on tilted roofs, up to 50 degrees. In figure 5 on the next page a picture is included of the installation process. Enschede does not offer a subsidy, but the municipality got involved by setting up a research project together with the water board Vechtstromen to analyse the effect of water retention offered by the Ecopan (Interview A. Weppel, 2016).

FIGURE 5. THE TRANSBURG PROJECT.



View from the street
(authors picture).



Installation of the Ecopan
(www.pioneering.nl).



Location of Transburg
neighborhood in city of
Enschede (Google Earth).

4.3 MUNICIPAL CLIMATE ADAPTATION AND GREEN ROOF POLICY

This thesis set out to explore the influence of governance arrangements on green roof retrofitting by housing associations. Since the extent to which climate adaptation and green roofs in particular are given importance in the municipal organizations and policy documents is an important element of the hierarchical governance arrangement, this section will examine that accordingly. In terms of organizational dynamics and coordination, the issue of climate adaptation is being addressed in all municipalities, though in varying degrees. Based on the results of den Exter et al. (2014), it comes as no surprise that climate adaptation and specific green roof policy is most clearly and comprehensively found in the Amsterdam municipality. Although some elements of adaptation policy and strategy were found in Groningen and Enschede, these municipalities only provided some hints of green roofs being identified as a possible instrument of climate adaptation. The main insights will now be elaborated upon, and summarized in a conclusion.

In Amsterdam, the department of Planning and Sustainability has a team working on (spatial) sustainability. This team consists of 25-30 people, coming from only one or two five years ago (Interview A. Brouwer, 2016). The green roof subsidy arrangement was developed by this department, which has to help reaching the target of creating an extra 50,000m² of green roofs by 2018, as stipulated in the Green Agenda. For this, €1,65 million has been reserved, which translates into a record breaking budget of €550,000 per year for green roof subsidies until 2018 (Interview M. Nijboer, 2016). Specific target groups like schools, companies, and housing associations are actively approached about greening their roofs (Gemeente Amsterdam, 2015a). The Sustainability Agenda, developed by the same department, has a chapter on climate adaptation, in which all attention goes out to water resilience. It recalls the intention to fully integrate climate adaptation in all municipal policy by 2020.

Furthermore, the implementation of municipal adaptation policy is linked to Amsterdam Rainproof (Gemeente Amsterdam, 2015b). Amsterdam Rainproof is a network organization that offers a platform to collectively think about how the city can adapt to extreme precipitation. Housing associations are also involved in the network to explore their potential of developing their housing stock (e.g. gardens, direct living environment). Through Amsterdam Rainproof, the municipality is actively contributing to knowledge

creation and supporting innovative projects (Interview K. Spaan, 2016; Interview M. Kootwijk, 2016)

Overall, climate adaptation has become increasingly important, and the importance is exemplified by the intention to embed climate adaptation into general municipal policy by 2020 (Gemeente Amsterdam, 2015b).

When looking at Enschede and Groningen, it is noticeable that the importance of climate adaptation is lower than in Amsterdam. For example, the coalition agreement of Enschede does not even mention climate change, and while that of Groningen does mention the “climate problem”, this is in the context of becoming climate neutral, i.e. in the frame of climate change mitigation (Gemeente Enschede, 2014; Gemeente Groningen, 2014). Nevertheless, in more specific policy documents, like Enschede’s ‘Sustainability Action Plan’, climate adaptation gets specific attention in the form of tackling water problems. To be precise, targets are; to control living costs related to water, to create more awareness among citizens regarding water, and for the water organizations to collectively take care for water quality and quantity. Green roofs are not mentioned as an instrument here, instead the ‘Enschede approach’ focuses on capturing stormwater in urban streams and brooks, and reducing heat by planting more trees (Gemeente Enschede, 2015). Interestingly, while green roofs are not specifically mentioned here, the chapter on climate adaptation in the sustainability policy document does feature a picture of the Ecopan green roof in the Transburg project, as shown in this screenshot.



FIGURE 6. PICTURE OF TRANSBURG PROJECT IN ENSCHEDE SUSTAINABILITY POLICY DOCUMENT

Another feature of the 'Enschede approach' is the distribution of sustainability portfolios among the aldermen, in addition to their normal portfolios. Climate adaptation is one of those special portfolios, given to the alderman dealing with water. As a result, the municipality became involved by setting up and supporting the research project that is connected to the Transburg project. This research project analyzes the water retention capacity of the Ecopan (Interview H. Teekens, 2016). Moreover, the municipality has set up a 'water vision group', in which housing associations are invited to think about cooperating and dealing with risks of urban flooding (Interview A. Weppel, 2016).

In Groningen, the risks associated with a changing climate are identified within the municipal organization, but not from an overarching perspective regarding climate adaptation. For example, issues that could be placed under the banner of climate adaptation are found in the Energy Strategy under 'sustainable infrastructure' (peak rainfall water management) and 'living environment' (dealing with a warmer and wetter climate) (Gemeente Groningen, 2015). There is a sustainability team consisting of staff from various departments, in which elements of climate adaptation can be found (Interview P. Corzaan, 2016; Interview S. Poyck, 2016). The Water Department has been responsible for the green roof subsidy from the start, so this department is quite familiar with climate adaptation. In the Energy department there is attention for making the housing stock more sustainable, though mostly in terms of energy efficiency (e.g. insulation). Ecologists at the Green Department are very much in favor of more green in the city, including green roofs, yet this department lacks funding and staff to stimulate this theme (Interview S. Poyck, 2016). The current coalition of the Groningen municipality has stated that 'sustainability is the point of departure in everything that we do' (p. 6), and housing associations are identified as partners in making the existing housing stock more sustainable (Gemeente Groningen, 2014). However, sustainability is interpreted as making housing more energy efficient, and climate adaptation or green roofs play no role in this policy (Gemeente Groningen & Groninger Woningcorporaties, 2014; Interview L. van Diemen, 2016). While climate mitigation and especially energy are well developed themes with ambitious policy targets, climate adaptation per se is not felt as a topic that requires its own 'vision' or strategy. Instead, the alderman for sustainability has asked for an action plan that focuses on linking climate adaptation measures to existing policies and visions, rather than writing 'yet another' vision. For example, the adaptation goal of more green to reduce the UHI effect should be connected to the economic goal of making

Groningen an attractive city for visitors and businesses. Currently, the Groningen municipality is evaluating the extent to which climate adaptation is actually being implemented under different headings. For example, Groningen was one of the first Dutch cities to have introduced a green roof subsidy, which was initiated by the sewage and water department. Also, new park and ride locations have been built using pervious and reflecting concrete, reducing both water runoff and reducing heat absorption. So climate adaptation is not absent, it is just not framed as such, nor communicated enough to be visible (Interview S. Poyck, 2016).

4.3.1 CONCLUSION

When overlooking the municipal dimension of all three case studies, the following insights are gained. Firstly, green roofs are identified by all municipalities primarily as a tool in preparing for increasing precipitation in the future. Secondly, climate adaptation seems to be increasingly felt as an issue that requires specific attention. Amsterdam stands out for having marked climate adaptation to be as an important issue within sustainability and green space policy, but Enschede and Groningen have shown to develop interesting alternatives of attending to climate adaptation: Enschede created an additional adaptation portfolio for the alderman while Groningen seeks to connect adaptation issues to existing policy goals. Regarding the link with social housing, all municipalities are actively engaging with housing associations to make their housing stock more sustainable, but relating to energy efficiency. In the case of Amsterdam and Enschede, there is also a dialogue which underlines the potential of housing associations to help the municipality in making the city more resilient to water problems. While Groningen does not include climate adaptation aside in housing policy, it does, as opposed to Enschede, have a green roof subsidy.

4.4 POLICY INSTRUMENTS

4.4.1 LEGAL INSTRUMENTS

One of the underlying premises of this research is the fact that Dutch municipalities do not have the authority to make green roofs mandatory. Still, they have other regulatory tools to increase the chance that buildings will be built with green roofs or that existing buildings will be retrofitted with green roofs.

One such tool is setting criteria to construction. Amsterdam has introduced a so-called 'building envelop', which is defined when a piece of land is sold for construction. In this document, a range of characteristics and preconditions are defined that form rules to what can be built in that area, besides the general construction regulations from the Building Decree. The municipality and Waternet are now looking to include 'water neutrality' as an obligatory aspect of new construction, so that buildings need to handle 60 mm of stormwater runoff per hour (Interview K. Spaan, 2016). While this does not guarantee that green roofs will automatically be included, the popularity of green roofs, the green roof policy goals of municipality and Waternet and the availability of a green roof subsidy will certainly have a stimulating effect vis-à-vis developers to also use advanced green roofs to fulfill the water neutrality requirement. A further advantage is that this requirement in the building envelop will reduce the work load of the water board, since less water will run into the water system (Interview K. Spaan, 2016). This tool is not applicable to existing housing, but it shows the creativity of how municipalities have other ways to stimulate green roofs by means of regulation.

On the other hand, there is a trend to cut down on rules, rather than introducing new ones (Interview H. Teekens, 2016; Interview J. Duut, 2016). In the case of green roofs, this relates to changing regulations that forbid green roofs being installed in certain areas or on certain buildings. It was reported by interviewees in Amsterdam and Enschede that conventional rules of the *welstandscommissie*² are identified as barriers to the development of green roofs, and that these rules have been changed or at least dialogues

² Welstandscommissie is a municipal commission that assesses whether new constructions or renovations adhere to rules regarding the appearance of a building in its environment.

have started to discuss the possibilities for allowing green roofs (Interview A. Brouwer, 2016; Interview A. Weppel, 2016).

Another potential legal tool are covenants; agreements between municipalities and other parties like citizens, companies, or housing associations. For social housing policy, performance agreements are commonly reached by municipalities and housing associations. Due to the decentralization of social housing in the 1980s and the privatization of housing associations in the 1990s, the government got a more facilitating role and the market players (i.e. housing associations) were given more responsibility. Performance agreements were introduced to have municipalities and housing associations commit to shared goals, rather than their own policy objectives (Boon & Sunnika, 2004). The topics that performance agreements address are not just about investments in real estate, but also about liveability, rent policy, selling of dwellings, and sustainability. Moreover, it is advised that the national government's priorities in housing policy are considered. Currently, these are 1) affordability and availability for social housing target groups, 2) realizing an energy efficient social housing stock, 3) housing urgent target groups (e.g. refugees), and 4) realizing housing with care and elderly homes. Within this framework, municipalities are required to develop a housing policy, preferably together with the housing associations, which will be guiding in the performance agreement. Municipalities may include additional themes and can prioritize specific themes within the housing policy (Platform 31, 2016a). In all the case studies, energy efficiency was seen as an important topic for social housing (Interview A. Weppel, 2016; Interview J. Duut, 2016). From the term liveability we might expect an opportunity to include green roofs in these housing policies or performance agreements, but this turns out not to be the case. Liveability (*leefbaarheid* in Dutch) is interpreted mostly as a responsibility to facilitate social capital through property management. For example, by making a vacant shop or dwelling available for social activities for neighborhood residents, housing associations can increase social cohesion (Platform 31, 2016b). Given this social interpretation of liveability, intensive green roofs might be considered for offering a place to gather, but extensive green roofs are a different category. So while the revised Housing Act has given municipalities more authority to introduce binding elements in the covenants, it is unlikely that this will include climate adaptation let alone green roofs (Interview L. van Diemen, 2016).

Finally, I will briefly discuss the insights regarding the Building Decree (bouwbesluit), which was often mentioned as an ultimate means to make green roofs obligatory. The Building Decree is national legislation that prescribes minimum quality requirements in terms of, amongst others, energy efficiency for both new construction and major refurbishment (Rodgers, 2015). Retrofitting existing housing with green roofs fall could theoretically under refurbishment, but based on the responses of interviewees in practice this seems difficult to realize, and certainly not in the short term.

There is a general tendency to take out rules from the Building Decree rather than adding new ones, so the added value of green roofs has to be supported by very clear and undisputed evidence, which is currently lacking (Interview J. Bults, 2016). Changing the Building Decree is a lengthy and political process, many parties will become involved and start to lobby, as they may not be convinced about their gains (Interview K. Spaan, 2016). While Spaan thinks that there might be a possibility that green roofs would be included in the Building Decree in the long run, Bults disagrees and points out that it is simply not necessary to make green roofs obligatory in the entire country. It would create extra costs for every building, when it is essentially an urban problem (Interview J. Bults, 2016; Interview K. Spaan, 2016).

4.4.2 ECONOMIC INSTRUMENTS

From the literature review, green roof subsidies and taxes were found as common economic instruments to stimulate green roofs. Subsidy arrangements were found in Amsterdam and Groningen, but not in Enschede. Tax differentiation is not applied in any of the case studies, although there seems to be a shared feeling among interviewees that this instrument would be a welcome additional incentive. Another economic instrument that was not found in the literature is the fee reduction on building permits by the municipality of Enschede. These instruments will now be discussed in more detail.

GREEN ROOF SUBSIDIES

Amsterdam first introduced a green roof subsidy in 2006, and Groningen was one of the first cities to follow in 2008 (Interview M. Nijboer, 2016; Interview S. Poyck, 2016). Both municipalities have adjusted their subsidy arrangements to be differentiated according to

certain criteria. This seems to be an important characteristic for having an effective subsidy arrangement, depending on the preferences of the municipality.

Amsterdam has recently (February 2016) introduced a new green roof subsidy, ranging from €30 to €50 euros per m², which is differentiated according to various values, including the water retention capacity, biodiversity quality, and location in the city, with city center having priority. There is a minimum roof size of 30m², a maximum pay of 50% of total costs, and maximum €100,000 total subsidy. The higher a green roof proposal scores, the higher the probability of being granted a subsidy, and the higher the subsidy. Based on a comparison of subsidy arrangements in The Hague, Rotterdam and Utrecht, where the subsidy is 'first come, first go', the current Amsterdam subsidy arrangement seems to be the most advanced subsidy in the Netherlands, focused specifically to help make Amsterdam rainproof. As such, it could be classified a smart subsidy, which was included under network governance in the conceptual framework. Whereas the former subsidy arrangements lasted usually a year, after which a new administration and budget was set up, the new arrangement has a prolonged duration of three years. This was done after societal voices had indicated that the one year term was too short to arrange everything needed (Nijboer, interview, 2016).

In Groningen, the subsidy is differentiated for roof size, meaning that roofs up to 100 m² receive €30/m², 100-250 m² receive €20/m², and 250-1000 m² receive €10/m² (Gemeente Groningen, n.d.). Normally, about €30-40,000 is spent on subsidies per year, and it is expected that the subsidy will remain in place the coming years (Helbig, personal communication, 2016).

In terms of monitoring the green roofs installed, those that were supported with a subsidy in Amsterdam and Groningen will be checked by municipal staff to guarantee that the roofs fulfill the requirements of the subsidy (Gemeente Groningen & Groninger Woningcorporaties, 2014; Interview A. Brouwer, 2016).

PERMIT FEES DISCOUNT

Enschede does not have a green roof subsidy, but it has created an incentive for sustainable construction by giving discounts to construction permit fees (Dutch: bouwleges) when certain criteria are fulfilled. While this is not applicable for installing green roofs on existing buildings, it is comparable to subsidies, as the amount of money

saved can reach up to €50,000. Moreover, it is reasoned that when applicants for this measure fulfill the requirements, they are likely to be eligible for loans with lower interest rates based on the sustainability aspects of the proposed construction. As such, a double incentive is thereby created (Interview H. Teekens, 2016).

TAXES

Differentiating water taxes is an instrument that is not (yet) used by any of the case study municipalities, but has been frequently discussed in the interviews as having a lot of potential in the future. This is acknowledged by the national government, as the Minister of Infrastructure and Environment in 2015 wrote in a letter to Parliament that the cost of water management could increase substantially due to, amongst others, climate change. Since a large share of the costs that water boards make in water treatment is caused by 'clean' stormwater running into the sewage, the minister called for an exploration of instruments that could prevent this from happening (Rijksoverheid, 2015). The Union of Water Boards (Unie van Waterschappen, UvW) is currently investigating the possibilities of changing the water tax system by consulting with all water boards and external stakeholders, by the end of 2016 the results are expected to be published (Unie van Waterschappen, n.d.). While water boards collect taxes for taking care of the sewage and maintaining the water system, municipalities collect taxes for distributing the sewage water to the treatment facility. Currently, the municipal waste water tax is based on a building's assessed market value (WOZ waarde), which is likely to increase after installing a green roof. Thus, currently the water tax system is discouraging green roofs. Instead, taking the example of German states like Hamburg, these taxes could be differentiated according to the amount of water a property uses (encouraging less water usage), but also to the amount of impermeable surface so that green roofs become rewarding options for home owners (Interview J. Buitenweg, 2016).

4.4.3 COMMUNICATIVE INSTRUMENTS

An important communicative instrument is setting an example with a showcase project. This instrument was only found to be used in Amsterdam, where the roof on the Stopera was chosen as showcase project. This complex houses the city hall and the Dutch National Opera & Ballet, and coincidentally is located opposite of the Halve Wereld complex (Interview A. Brouwer, 2016). Another communication tool which makes the

development of green roofs, as well as many other initiatives, insightful to anybody who is interested, is the interactive maps website of the municipality as shown in figure 7.

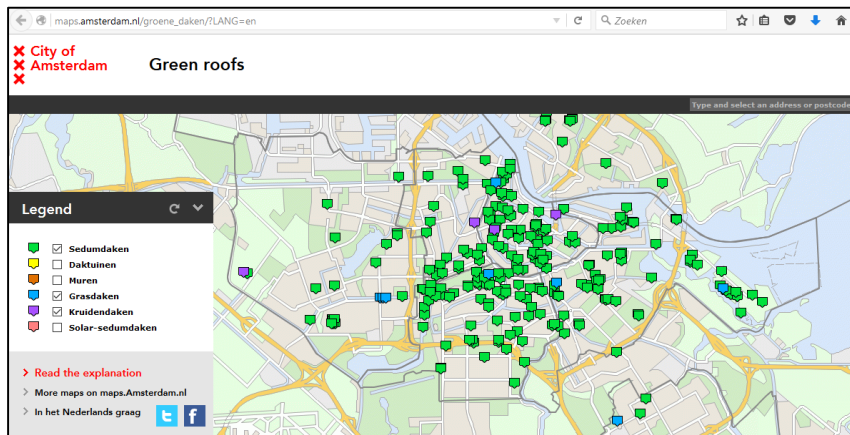


FIGURE 7. INTERACTIVE MAP OF AMSTERDAM GREEN ROOFS
[HTTP://MAPS.AMSTERDAM.NL/](http://maps.amsterdam.nl/)

Aside from providing information on municipal websites, no significant other examples of communicative instruments were found. However, the importance of communicating to society about sustainability initiatives is understood, as exemplified by the following statement of a municipal policy advisor:

We are working on climate adaptation, it just has to be put in the limelight. [...] When you communicate better about climate adaptation, you're showing the world that you're going for it. That stimulates people to also become active in sustainability.

(Interview S. Poyck, 2016)

4.5 MOTIVATIONS FOR HOUSING ASSOCIATIONS

To find out why Ymere, Domijn and Lefier decided to go ahead with the respective green roof projects, I arranged interviews with employees who could elaborate on the decision making process of the green roof projects. Bearing in mind that the installation of green roofs is more expensive than conventional roof, as explained in chapter 3, I asked them why this investment was made. The stated motivations can be divided into two categories: financial benefits on the one side, and aesthetic benefits on the other side. Interestingly, climate adaptation per se was not mentioned as a leading motivation, although it is understood that the installation of green roofs by housing associations ultimately helps the city in adapting to climate change.

4.5.1 FINANCIAL BENEFITS

The financial benefits of installing a green roof as identified by the housing associations are the improved lifespan of the roof itself and the insulation against high temperatures in summer. Johan Duut, who was project manager of the Lewenborg renovation, explained that his calculations of the total cost of ownership (TCO) were a decisive factor to add green roofs to the renovation. By looking at the TCO, Duut concluded that the ultimate life span of the bitumen roof would be improved by such a degree that it would justify the additional costs of the green roof. Moreover, Duut recalled that there had been complaints from tenants about high temperatures in bedrooms during hot summer days, caused by the black bitumen radiating heat down into the house (Interview J. Duut, 2016). Because of the insulation effect the tenants will have cooler bedrooms and possibly might need less cooling.

Interestingly, these motivations are refuted by other interviewees as being valid reasons why housing associations should choose to install green roofs. Regarding the prolonged lifespan of the roof, it was mentioned that the costs of replacing the roof eventually will cost more because the green roof components will have to be removed (Interview M. Kootwijk, 2016). Moreover, the insulation benefit is regarded as quite limited – certainly not as insulating as regular insulation material – and difficult to measure (Interview J. Bults, 2016; Interview M. Kootwijk, 2016). This is not to say that this benefit is not appreciated by the housing associations of the other case studies; both Ymere and Domijn have noted the insulating effect to be helpful in limiting indoor temperature fluctuations, but they mention other motivations for choosing green roofs, which brings us to the next category.

4.5.2 AESTHETIC BENEFITS

I refer to the second category of stated motivations as aesthetic, since these are not based on financial or technical gains, but rather on the visual effect that green roofs have. The green vegetation, whether moss, sedum, or grass, improves the quality of the living environment. For Ymere, green roofs were put on the agenda especially because they can add green space, which is a prerequisite for a good living environment.

“We are active in quite densely built areas, so we want to create green space as much as possible. If we cannot do it on the ground floor, then we will do it on the roofs, to keep that compact city liveable.”

(Interview M. Kootwijk, 2016)

A similar line of reasoning was found to underpin the Transburg project of Domijn. In fact, whereas the roof on the Halve Wereld complex was scheduled to be replaced anyway, the Transburg case study involved roofs that were not. Because the roofs are sloped, replacing the regular concrete roof tiles with the Ecopan would be visible from the street (Interview A. Weppel, 2016). Admittedly, the Transburg project was ‘only’ a pilot project, as opposed to the Halve Wereld and Lewenborg projects. The significance of this difference is that for pilot projects, housing associations usually are willing to invest: “The problem is upscaling” (Interview J. Bults, 2016).

4.5.3 CONCLUSION

Now that the stated motivations of the housing associations to install green roofs have been discussed, the following can be said. In the case study green roof projects, the motivations were based mostly on the contribution that green roofs can make in terms of green space and liveability, as seen in the Halve Wereld and Transburg case. Technical benefits like insulation and a prolonged roof lifespan, that could be calculated to bring financial gains, played an important role in the Lewenborg project. The fact that this latter line of reasoning was doubted by other interviewees underlines the problem of green roofs having additional costs compared to regular roof types. So far, there is no hard proof of the insulating effect, so the financial gains are open for discussion. Concerning the benefit of a prolonged roof lifespan, which is contradicted by additional costs when the roof ultimately has to be replaced, this discussion is purely technical and outside the scope of this research. But what becomes clear is that these projects have been executed despite the additional costs thanks to a corporate willingness to install green roofs and financial support from the municipality, and, in the case of Domijn, thanks to the limited scale of a pilot project. Climate adaptation as such was not a concern in any of the cases, which brings us to the next section.

4.6 ON THE RESPONSIBILITY OF HOUSING ASSOCIATIONS

Interestingly, climate adaptation was not found as a motivation to install green roofs. As ‘responsibility’ is one of the main elements in the conceptual framework, interviewees were asked about their perception regarding the responsibility of housing associations in the context of climate adaptation. This generated a range of opinions, varying from idealistic to more pragmatic insights regarding the role of housing associations in this issue.

When it comes to societal responsibility, I think housing associations are preeminent organizations to do something about [green roofs]. If they don't do it, who will?

(Interview J. Duut, 2016)

While it makes sense to link green roofs and climate adaptation to housing associations’ societal responsibility, the recent amendment of the Social Housing Act forces housing associations back to their primary task: to provide affordable housing (Duut, interview, 2016; Ministerie van Binnenlandse Zaken en Koninkrijksrelatie, 2015). It seems that green roof projects are not really compatible with their primary task, unlike other sustainability measures that can be clearly calculated to reduce living costs, like insulation or solar panels (Interview L. van Diemen, 2016).

At the same time, when the housing stock of a housing association makes up for a significant share of a city’s built environment, as in the case of Ymere, it is felt that this creates a responsibility to take care of the city in those areas. Especially when such a large association has the resources to act on that responsibility, and the association has affinity with greenery, then such a responsibility may also include installing green roofs (Interview M. Kootwijk, 2016). Nevertheless, the large scale installation of green roofs is still a costly operation, so financial support, like the Amsterdam green roof subsidy, is then a welcome incentive if not a prerequisite for living up to that responsibility. This is shown by the fact that around 2013, when Ymere had to reorganize and introduce budget cuts to stay financially healthy. Under these circumstances, green roofs lose priority compared to general maintenance, and become seen as a ‘luxury’ (Interview M. Kootwijk, 2016; Ymere, 2013).

The perception of green roofs as a luxurious sustainability feature is based on the lack of financial sense that it makes for housing associations to make the investment. Until the price difference between a green roof and conventional roof disappears, the following degrees of responsibility can be identified. Housing associations should at least consider installing a green roof when a roof is up for renovation (Interview A. Brouwer, 2016; Interview P. Corzaan, 2016). However, there can be at most a shared responsibility between municipality and housing associations to promote and install green roofs for the goal of ensuring a liveable environment for tenants and citizens (Interview J. Bults, 2016).

4.7 ON THE IMPORTANCE OF LEADERSHIP

While leadership was included in the conceptual framework as an element of the hierarchical arrangement, its actual importance turns out to be much larger than anticipated. In each case study examples are found of certain persons playing the role of important catalysts in the green roof projects. First of all because of their intrinsic motivations and expertise related to sustainability or a green living environment, but also because of their personal network and connections.

Within municipalities, examples of such personal leadership are the Lewenborg case, where Paul Corzaan saw the opportunity to upgrade Lefier's renovation project by adding green roofs, thereby using his acquaintance with the green roof company Icopal (Interview P. Corzaan, 2016). In the Transburg case, municipal water designer Hendrikjan Teekens was responsible for generating municipal interest to facilitate and further develop the Transburg project. Using his network, he managed to engage the water board to collectively set up a research project into the water retention capacity of the Ecopan green roof (Interview H. Teekens, 2016).

Within housing associations, employees' personal affinity with green roofs seems to be highly influential in the development and implementation of relevant policy. For example in the Halve Wereld case, Ymere's green roof policy was developed by one employee, who was first working as a tenants advisor, but became green space advisor after following a gardening course. As a policy advisor on green space, she functioned as the main advocate within Ymere to do more with green roofs (Interview M. Kootwijk, 2016). In the Transburg and Lewenborg cases, the project managers both had a background in architecture, and were able to convince the board of directors about the added value of

installing green roofs (Interview A. Weppel, 2016; Interview J. Duut, 2016). It was mentioned by several interviewees that housing associations, especially since the revised Housing Act, are very focused on their 'primary task' of providing housing, and green roofs are more often than not considered to be an unnecessary luxury (Interview J. Bults, 2016; Interview J. Duut, 2016). In other words, project or property managers that are personally convinced about green roofs seem to require quite some persuasiveness and dedication to get green roofs implemented.

4.8 NETWORKS AND COOPERATIONS FOR GREEN ROOFS

Both within the case studies and in the Netherlands as a whole, several forms of networks and cooperation were identified that reflect elements of the network governance arrangement. For example, the Amsterdam Rainproof network, as discussed in section 4.3, offered a platform where various local actors, public and private, can discuss and develop initiatives like green roof projects. In an interview with a Waternet employee who is also active in Amsterdam Rainproof, it was mentioned that the specific focus on water resilience was

... deliberately chosen, because a story with a range of issues tends to become woolly, [...] instead we point out the problem and the solutions clearly. That makes it easier to focus.

(Interview K. Spaan, 2016)

The Transburg case showed how the Ecopan pilot project evolved into a research project in which Domijn, the municipality of Enschede, the water board Vechtstromen and the network organization Pioneering was involved. Pioneering and Domijn had previously worked together, and initially got involved to research the insulating capacity of the Ecopan. Being a network organization that offers a platform for innovation in the construction sector, Pioneering organizes meetings and presentations based on the results of the research, which are also published in their magazine. The insulating effect turned out to be not significant enough, but there are high expectations concerning the water retention capacity. When the research is finished, Pioneering is able to showcase the results within their network, after which the Ecopan might be picked up by housing association across the country. Until then, the added value of Pioneering lies in bringing

together housing associations with the municipality to specifically explore possibilities to upscale initiatives like the Transburg project (Interview J. Bults, 2016).

A more general network that is relevant for this topic is the Green Deal on green roofs. The Dutch government introduced the Green Deal concept in 2011, as a way to stimulate and support sustainability initiatives by working together as central government with other governmental actors, but also businesses and other private organizations (Rijksoverheid, n.d.). The Green Deal for green roofs was set up by the consultancy company Leven op Daken to develop a business case of green roofs in the Netherlands. In 2014, 11 organizations, including roofing companies, horticulture businesses, and municipalities signed the Green Deal with the Ministry for Economic Affairs. During the first phase, more organizations joined in, including water boards, knowledge organizations and financial institutions, and among these are the municipality of Enschede and housing association Domijn. Together, these organizations have developed five concepts for improving the business case for green roofs: Differentiating taxes like sewage taxes; preventing and insuring water damages; label schemes for buildings (e.g. BREEAM); ecosystem repair; and mindset, meaning expanding knowledge and awareness of green roofs. This phase was finalized early 2016, and the participating organizations will experiment with these five paths to improve the business case of green roofs in the second phase (Bor, Mesters, & Steegman, 2016).

In an interview with an employee of water board Vechtstromen, it was mentioned that there is a growing awareness among public authorities that climate adaptation, in particular the water dimension of it, is not something that can be done by one actor alone:

[...] we water boards have come to see green roofs as part of the solution whereas it was first just a nice gadget. I think we realize that not one party has the solution; neither the municipality nor the water boards. We wouldn't even have the money for it! So we have to do it integrally with several partners and several solutions. And green roofs fit very well in that.

(Interview J. Buitenweg, 2016)

4.9 CONCLUSION

The empirical results from the three case studies have now been discussed, which produced the following insights. In terms of municipal policies, the issue of climate adaptation has received more attention over the last few years, especially regarding the water component. Green roofs are identified as part of the solution for the adaptation challenge, but only Amsterdam has the ambition and resources to set a concrete green roof goal. The connection between adaptation policy and housing policy is barely made, with the exception of ad hoc dialogues between municipality and housing associations on reducing flood risks. For legal instruments, municipalities can introduce construction criteria that stimulate green roofs or reduce aesthetic regulations that may hamper the development of green roofs. The only economic instrument that is used to stimulate green roofs on existing housing are green roof subsidies. Amsterdam has developed a sophisticated arrangement, differentiated to reward owners who install green roofs with the best effect on water retention. In terms of communication, only Amsterdam has a 'showcase' green roof and an interactive map showing the city's green roofs. Aside from information regarding municipal policies on the respective websites, no noteworthy communication tools were identified. The case study housing associations primarily noted the aesthetic benefit of green roofs as reason to install them. While acknowledging technical benefits like insulation and protection of the roof itself, these are insufficient to make green roofs financially interesting. Without financial support, it is thus unlikely that the installation of green roofs in social housing can be scaled up. When climate adaptation is the goal, and green roofs in social housing are identified as possible way to achieve that goal, a collaborative approach is required.

In the next chapter, the insights gained will be discussed more deeply. On the next page, table 6 offers an overview of the findings in terms of the policy stages.

Policy Stages	Roles	Amsterdam (Halve Wereld case)	Enschede (Transburg case)	Groningen (Lewenborg case)
PLAN	Agenda setting	Climate adaptation and green roofs scheduled to be fully internalized by 2020	Aldermen have additional sustainability portfolios, including climate adaptation	Currently more attention for climate adaptation within municipal organization
	Knowledge creation	Municipality contributes to Rainproof network	Municipality initiated and involved in research project about Ecopan qualities	No specific green roof knowledge creation
	Initiation of policy	Municipal sustainability targets are seen as guideline for sustainability goals in social housing policy	Watervision group together with housing associations.	Internally the municipality is stimulating more interdepartmental cooperation on climate adaptation
DO	Strategy making	“Green Agenda” and “Sustainability Agenda” are basis for adaptation action	“Action plan sustainability” has climate adaptation chapter, but no green roof plan	“Sustainable City” strategy identifies the need to prepare for hotter and wetter climate
	Information sharing	Through Rainproof network and on municipal website	Municipal website*	Municipal website *
	Financing	2015-2018 annual subsidy budget of €550,000	2016-2018 annual budget of €230,000 for sustainability measures, plus possible alternative finance sources.	Annual budget of €30-40,000 for green roof subsidy
CHECK	Monitoring	Municipal ecologist checks whether green roof is in order	N/A**	Municipal inspector checks green roofs
	Enforcement/Incentives	Differentiated green roof subsidy on basis of water retention capacity and other values	Discount on administration fees (bouwleges)	Differentiated green roof subsidy on basis of roof type and size
	Policy adjustment	Amsterdam has extended the subsidy arrangement for the duration of current coalition, also centralized	N/A ***	N/A***

TABLE 6. POLICY STAGES AND ROLES IN THE CASE STUDIES. BASED ON EMPIRICAL DATA AS DISCUSSED IN THIS CHAPTER

*: On the municipal website, anyone can get informed concerning the municipality's policies and possibly financial support. However, in Enschede and Groningen this cannot be considered to be active information sharing.

**: Enschede lacks a subsidy, so there is no monitoring.

***: Only Amsterdam has significantly adjusted its green roof subsidy.

Also note that the MAINTENANCE phase was omitted since green roof maintenance is always done by professionals.

CHAPTER 5: DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

Having discussed contextual factors in chapter 3 and presented the results of the data collection in chapter 4, this chapter will evaluate and discuss the findings in light of the conceptual framework, which was built up around three ideal typical governance arrangements. Section 5.2 will discuss my observations regarding the empirical results and reflect on findings of other authors regarding green roof governance. This section also includes some concluding remarks concerning the conceptual framework, which have affected the outcome of this research. Section 5.3 will then answer the research questions. Section 5.4 gives policy recommendations to municipalities and housing associations, and finally section 5.5 gives recommendations for future research.

5.2 A REFLECTION ON GREEN ROOF GOVERNANCE ARRANGEMENTS

Having discussed the three case studies in the previous chapter, an obvious observation is the lead that Amsterdam takes in comparison to Enschede and Groningen. Using the concepts of governance arrangements, it can be said that the municipality of Amsterdam uses its hierarchical capabilities to the fullest extent. In terms of agenda setting, all three cities have developed climate adaptation policies and strategies, but Amsterdam even has a specific target that quantifies the municipality's green roof ambition. In terms of (co)financing, all municipalities have reserved a special budget for sustainability or climate adaptation, but Amsterdam has recently introduced a green roof subsidy that is probably one of the most sophisticated arrangements with an unprecedented large budget. The remarkable differences between the capital and the other two municipalities that have been described in this research resonate with the findings of den Exter et al. (2014), who classified Amsterdam as one of the frontrunner cities in climate strategies. Some of the interviews for my research show that there is much to learn between these cities in terms of instruments for climate adaptation. For example, when I mentioned the economic incentive of construction permit fee reduction used in Enschede in an interview with an Amsterdam municipal policy advisor, this turned out to be a new and interesting idea, which the interviewee quickly took note of. On the other hand, Amsterdam's subsidy

arrangement is an example for other cities of how a subsidy can be differentiated to get the most out of the available budget.

A second observation is the absence of climate adaptation as a policy issue in the performance agreements. National guidelines for social housing performance agreements focus on energy efficiency, which is backed up by national covenants and subsidy programs. As a result, climate adaptation is only addressed through alternative platforms as seen in Amsterdam and Enschede. These optional consultation rounds are based on past experiences with urban flooding and the perceived risk of similar or worse scenarios in the future. This suggests that as soon as the pressing need for climate adaptation becomes noticeable, municipalities are more likely to meet with housing associations to discuss the possibilities for collaboration on adaptation action. While these special consultation rounds have the advantage of discussing climate adaptation and possibilities for action in social housing, a downside is that it takes place in addition to the institutionalized rounds of performance agreements already taking place. This means additional time and resources spent on getting together and devising agendas and plans, whereas municipalities could include adaptation in the performance agreements by taking it into account in their housing policy. This could prevent institutional tension which Edelenbos (2005) pointed out, as discussed in the conceptual framework.

Facing a lack of hierarchical steering ability, the natural response by municipalities and associated public actors is a mixture of network and market governance, based on trust and reciprocity, but also, given the lack of resources among all parties, efficiency and competition. There has been a long collaboration between municipalities and housing associations in which they have been able to develop a relation based on trust. It was pointed out by an interviewee of the Groningen municipality that the relations with the housing associations had been very good, whereas the city of Leeuwarden had seen periods of strong distrust of housing associations towards the municipality. Consequently, we might conclude that the specific focus on housing associations as municipality's partner in climate adaptation may offer opportunities for green roof governance arrangements, provided that the relations conform to the requirements that were identified by Klijn and Koppenjan (2000): an active and motivated participation, a mutual perception regarding the issue, and a well-managed organizational arrangement for sustained interaction. Such set ups of municipalities and housing associations for

climate adaptation were seen in Amsterdam and Enschede. An advantage compared to other possible non-governmental partners, for example the construction sector, is the special mixed public-private status of housing associations. Mees, Driessen and Runhaar (2012, p. 322) conclude that the public-private divide inhibits collaboration due to “differences in organizational cultures”. Although my research has not looked into the precise differences, the case studies suggest that this ‘divide’ may be less strongly felt in the field of social housing, since housing associations are not entirely private, as they are regulated by the government, nor entirely public, as they are required to compete against private actors on the housing market.

A third observation is the use of instruments by municipalities. In terms of legal instruments, the only regulatory options are setting up certain criteria for new construction that may stimulate green roofs, or reducing the aesthetic regulatory pressure that sometimes obstructs the installation of green roofs. Mees, Driessen and Runhaar (2012) suggest that green roof governance arrangements might have a more active role for governments by introducing performance targets and consequently monitoring the extent to which targets are met. My research has shown that this is unlikely to happen on a national scale, since the current lack of calculable advantages of green roofs make the inclusion of green roofs in the Building Decree very unlikely. On a local scale, this could take shape in the social housing performance targets, but it is then dependent on the political will and a certain sense of urgency to adapt.

In terms of economic instruments, subsidies, fee reduction, and taxes were discussed. Green roof subsidies can be criticized for using public money for projects with unclear societal benefits. Some municipalities specifically choose not to have a subsidy, like Enschede. Since resources are scarce, green roof subsidies are an obvious target for budget cuts. But the Halve Wereld case showed how the Amsterdam green roof strategy made efficient use of public money by differentiating the subsidy in various ways, and how this was appreciated by housing associations. Fee reduction is being done by the municipality of Enschede, which offers an interesting alternative to subsidies, but is focused on new construction, and therefore outside the scope of this research. Stormwater taxes and waste water taxes are not being used in either of the case study cities, but have been discussed in the interviews as having a lot of potential. The national government and the Union of Water Boards have initiated an investigation to see how this

tax system can be changed to stimulate citizens to minimize run off, and this may function as a stimulant for green roofs on existing housing as well.

Based on the above, I consider a differentiated (smart) green roof subsidy and tax differentiation to be a promising public policy instrument for the development of green roofs on existing social housing. Whereas there have been national subsidy arrangements for energy efficiency measures in social housing, green roof subsidies are organized by municipalities. The case study of Amsterdam showed how a green roof subsidy, under a certain set of requirements, can offer an effective way to steer society toward climate adaptation action, while spending money only on the most efficient green roofs. The set of requirements will be explained shortly, but the essential part is the fact that the subsidy should be differentiated, rewarding climate adaptation action based on water retention. This fact has hitherto been underestimated in discussions about policy instruments for climate adaptation. Mees et al. (2014, p. 58) performed a detailed assessment of a range of policy instruments for climate adaptation. Smart subsidies are mentioned in the context of auctioning subsidies to those with *low cost*. A downside, they mention, is the fact that subsidies are voluntary and would not ensure climate adaptation for all. However, it is not the *cost* of the installation but rather its *effectiveness* that counts: subsidizing green roofs with high retention capacity at a higher price will arguably have a better result than subsidizing low cost green roofs with little water retention. The same authors did not consider taxes a suitable instrument for green roofs as an adaptation measure because *“they are intended to discourage harmful behavior rather than to encourage good behavior such as the implementation of adaptation measures. [...] [I]magine taxing an individual for not wanting to install a green roof”*. However, various interviewees, indicated that tax differentiation is one of the more promising instruments that could help make green roofs more interesting, whether for owner-occupiers or housing associations. Rietveld (2010) also identified tax cuts to be a stimulant for private adaptation action.

In addition to the observation on policy instruments, an important feature of green roof governance arrangements is the communicative instrument. Throughout the case studies it became clear that there is a need for communicating internally about the added value and possibilities of green roofs, as well as externally, to show, inspire and involve citizens and society in climate adaptation. This concerns both municipal organizations and housing associations. In municipal organizations, various departments that deal with

climate adaptation (e.g. housing, infrastructure, water, sustainability) should be aware of what is being done by their colleagues, so that initiatives that qualify as adaptation, whether green roofs or something else, can be better coordinated and executed. Internal communication is also important to facilitate political support for climate adaptation action (Uittenbroek, 2012). We have seen that climate adaptation is not a concern for housing associations, as green roofs are primarily used for improving green quality of the living environment. This should then be clear to all departments, so that property managers, financial and technical staff, as well as sustainability advisors have a shared vision of green roofs, and how green roofs can support the housing association in its primary task.

Finally, one element of green roof governance arrangements was not included in the conceptual framework, but was mentioned by various interviewees to be an important factor for green roof projects by housing associations: having the right people on the right places. This concerns not leadership as in political leadership but rather the importance of personalities of staff working on green roof projects. Each housing association had at least one employee who had been primarily responsible for promoting green roofs within the organization. When proposing a green roof initiative to the board of directors, a sustainability minded board is also crucial in getting the green light. Likewise, municipal staff may go the extra mile based on an intrinsic motivation to support green roof initiatives that make them an outlier relative to general municipal policy. It is difficult to give conclusive answers regarding this aspect given the lack of conceptual tools for analysis, but it seems too important to be left unmentioned. Therefore, I suggest in section 5.5 that future research from for example a management approach investigates personal competencies of staff working in housing associations in relation to climate adaptation action.

Finally, a reflection on my choices in devising the conceptual framework. The core element has of course been the triad of hierarchical, market and network governance arrangements. As Mees (2014) and Roders (2015) apply this framework to green roof governance and climate adaptation by housing associations respectively, I deemed it applicable to my research focus. It helped me to look at hierarchical elements like municipalities' regulatory power and national legislation and policies that could affect housing associations' capacities and duties regarding climate adaptation. Likewise, the

network arrangement offered a way to look at public-private partnerships and the collaboration between municipalities and housing associations. However, Mees looked at green roofs on a more general level, for which the market arrangement was very worthwhile. I, on the other hand, looked specifically at housing associations which already had installed green roofs. This focus seems too specific to do justice to the market governance arrangement: While it was helpful in looking at for example the applicable *rules and resources* of housing associations, some economic instruments (e.g. private labelling, product information) that came with it have remained unaddressed. With this knowledge, I would have adapted the market governance arrangement such that it looked more into housing associations' financial situation and their interactions with other parties like construction companies. This revision would have required more time to get acquainted with such deeper layers of social housing, as this field was practically unknown to me before starting my thesis.

5.3 ANSWERING THE RESEARCH QUESTIONS

The theoretical subquestion was:

What is green roof governance and which arrangements and tools are relevant for the context of green roof retrofitting by housing associations?

This question was addressed in chapter two by developing the conceptual framework by building on existing literature on urban climate adaptation and governance arrangements. Governance arrangements were defined as “the arrangements which structure interactions between government, other public bodies, private sector, and civil society within a particular policy domain to overcome societal issues”. The ‘societal issue’ at hand in this thesis was green roof retrofitting by housing associations, so the interactions focused on were between local government and housing associations. Three arrangements were identified to be relevant for this context: hierarchical, market, and network governance. Especially given the special status of housing policy in comparison to other policy fields, and in light of the revised Housing Act, the hierarchical arrangement includes the development of housing policy according to which associations have to act. For the purpose of green roofs, the usually large toolbox that hierarchical governance provides, turns out to be not that big, since Dutch municipalities lack regulatory power to make green roofs mandatory. They can however introduce subsidy arrangement as an

economic incentive, and even better are smart subsidies as shown in the case of Amsterdam.

The market arrangement for green roof governance concerns actors with commercial interest and property owners, and this thesis focused on latter actors in the form of housing associations. It guided the analysis to review organizational setups and resources that are relevant for green roofs, such as sustainability policies, knowledge, and financial resources. Most of the identified instruments (e.g. fee differentiation, and private labels) seem more relevant for the commercial side of green roof governance, whereas this research focused on housing associations as property owners. The network or interactive governance arrangement was found to be relevant on various levels, especially through national networks for the creation of knowledge (e.g. Green Deal network) and on the local level as project based networks (e.g. the network based on the Transburg/Ecopan project). Covenants are a typical network tool, and this is often used in social housing already. When networks receive (local) governmental input, such covenants are a useful tool for upscaling green roof retrofitting projects by housing associations.

There were two empirical subquestions, the first of which asks:

Which governance arrangements are found in Amsterdam, Enschede and Groningen?

In all case studies, elements of hierarchical governance have been identified in municipal policies, though to varying degrees. For example, Amsterdam takes most responsibility by setting specific green roof targets and aiming to integrate climate adaptation in all of its policy. The policy instruments used are non-binding regulations and economic instruments, especially green roof subsidies. Market arrangements are found in the implementation phase of green roof projects, where housing associations voluntarily decide whether or not to invest in green roofs. When they do, it is often in the form of small scale projects, since large scale projects require additional financing. This can come from municipal subsidies (hierarchical governance), or by working together with other actors (network governance). Network governance is particularly found in Amsterdam and Enschede, and this seems to be related to these cities' experience and perceived risk concerning water management. Through additional dialogues and collaborations, these municipalities put climate adaptation on the agenda of housing associations, thereby creating a platform where green roof retrofitting can be discussed. Especially given the

absence of climate adaptation in the performance agreements, and the stated motivations for housing associations to install green roofs, the hierarchical approach can be complemented by the practices associated with network governance.

The second empirical question asks:

What are the motivations of frontrunner housing associations to implement green roofs, and how is the influence of the respective governance arrangements described by stakeholders?

The main motivations for housing associations to install green roofs is the contribution to liveability by providing extra greenery in dense urban environments. Also, the insulating effect and a prolonged lifespan of the roof were mentioned as leading motivations for one of the green roof project studied. Clearly, climate adaptation is hardly relevant for the daily reality of housing associations, even though a lack of adaptation may in the long run be detrimental to liveability of neighborhoods. The influence of the governance arrangements on the green roof retrofitting by housing associations comes mainly from the agenda setting and use of economic instruments by the municipality. Compared to Enschede and Groningen, which have lower scores for green roof agenda setting, Amsterdam's agenda setting has been said to have positively affected Ymere's willingness and capability to invest in green roofs. In particular, the green roof subsidy was acknowledged for having sufficient budgets and being accessible for housing associations. In addition, it can be inferred from the interviews that it is important that municipalities use communicative instruments to inform housing associations about the climate adaptation goals and facilitate them accordingly.

The analytical subquestion was:

What are the opportunities and barriers to developing the full green roof retrofit potential of housing associations?

Opportunities for upscaling green roof retrofit projects by housing associations are 1) plentiful possibilities for pilot projects to test green roof innovations and their added value for urban climate adaptation, as well as the potential economies of scale that can be realized when upscaling successful pilot projects; 2) There is already a well-developed relationship between housing associations and municipalities, with institutionalized

annual performance agreements that often include climate mitigation efforts like energy efficiency measures; 3) The revised Housing Act provides a framework which could include climate adaptation as a policy issue, as it already asks from municipalities to develop sustainability goals (climate mitigation) in their housing policies; 4) Climate adaptation is becoming more important in policy making, as reflected by the increase of climate adaptation in municipal strategies and the introduction of the National Adaptation Strategy in 2017; 5) The inclusion of green roofs in building sustainability labels like BREAAAM will help to develop the business case for green roofs, just like potential changes in runoff related taxes; 6) Innovation and technological development of green roofs will further improve certain benefits like water retention capacity, as well as combining green roofs with other functions, e.g. solar panels on green roofs.

Barriers that can be identified on the basis of this research are 1) housing associations are unlikely able to install green roofs on existing housing stock without financial support, while municipalities also have little room for large subsidy arrangements; 2) the pressure from national government to focus specifically on primary task of providing affordable housing may reduce the willingness and ability of housing associations to invest in green roofs.

Finally, the main research question was:

Which governance arrangements are available to and employed by municipalities and housing associations to advance green roof retrofitting in the Dutch social housing sector?

The current role of housing associations in adapting Dutch cities to climate change is quite limited. Over the last years, the Dutch government and social housing sector have focused more on climate mitigation; retrofitting the existing housing stock with energy efficiency measures. A crucial difference between this focus and climate adaptation, in particular green roofs, is that energy related retrofitting can be relatively easily calculated and are profitable for tenants. Whether insulation, double glazing, the installation of solar panels, or renovation of kitchen or bathroom, such investments will benefit the tenant through a lower energy bill, which legitimizes a contribution or rent increase. Supported by national policy and subsidy schemes, there have been various initiatives in Dutch social housing that have made great contributions in updating the existing housing stock. However, with green roofs, the bottom line is that it remains an unprofitable investment. The case studies

have shown that housing associations opt for green roofs for their aesthetic qualities, i.e. adding green space in dense urban areas, while the varying financial benefits of insulation and protection the roof are disputed. There is however no general concern of housing associations for climate adaptation, so a proactive approach of the municipality is required to activate housing associations in the climate adaptation challenge. However, while the performance agreements, since the revised Housing Act, offer municipalities more authority vis-à-vis housing associations, this does not lead to more hierarchical governance for green roof retrofitting. It was seen that climate adaptation is only marginally, if at all, included in municipal housing policies, which form the basis of the performance agreements. Here lies the unexploited hierarchical potential, but it cannot be assumed to be a general scenario; it depends on the occurrence and perceived future risk of urban flooding. Processes of network governance can complement hierarchical governance by involving housing associations in urban water management, thereby discussing green roofs as an instrument for climate adaptation. While such dialogues, collaborations and partnerships are available to any city, their employment by municipalities and housing associations is dependent on the good relations between these actors and on the degree of water management issues in the city.

5.4 POLICY RECOMMENDATIONS

Based on the findings of this thesis, and taking into account the perceived need to utilize green roofs to help make cities more adapted to climate change, especially increasing levels of precipitation, I have formulated a number of policy recommendations. These recommendations may help municipalities and housing associations to find solutions for the financial barrier that hinders climate adaptation action that will benefit both actors.

5.4.1 FOR MUNICIPALITIES

1. Include climate adaptation as a theme in performance agreements.

This recommendation is directed at cities facing issues in urban water management with dense city centers with a high share of impervious surfaces. When housing associations own a significant share in the city center housing stock, the performance agreements can be used as a platform for a dialogue on climate adaptation. This dialogue should be focused on how the city can adapt as efficiently as possible, and this could be done by

mapping the locations where adaptation action (i.e. green roofs) is most necessary. Both actors have to do their homework: the municipality locates, using for example GIS³, where urban flooding occurs or is likely to occur in future, while housing associations look into the renovation cycles of their housing stock. When combining these insights, an overview is created of where green roofs could contribute most to climate adaptation through water retention, as well as the possibilities to make use of the existing social housing stock to realize these green roofs. Such a collaboration does not exclusively stimulate green roofs, as other measures that retain water or mitigate urban flooding can be targeted as well.

2. Introduce and/or reorganize green roof subsidy schemes.

Green roof subsidies can be used to support housing associations in their green roof retrofitting investments, but there are a number of things to be taken into account. First of all, given the scale and share of existing social housing, there needs to be a significant budget. Secondly, the subsidy should be differentiated according to location in the city and the water retention capacity of the intended green roof. When other goals, e.g. increased biodiversity are aimed for, other elements could be rewarded too. Finally, extend the arrangement to last longer than one year. This allows property owners interested in installing a green roof to carefully consider their choice of green roof, without the risk of missing deadlines or an empty subsidy budget.

3. Communicate clearly about climate adaptation both internally as well as externally.

Considering that the municipality's role is increasingly one of facilitating and supporting societal initiatives rather than initiating and enforcing, it is of great importance that the municipality is undivided internally concerning climate adaptation. That means that all departments need to be aware of how they can contribute to climate adaptation and how they can support each other in policy development and implementation. This will help to integrate the issue of climate adaptation in all policies and sectors. In addition, it should be communicated externally to society in general and to housing associations in particular

³ Geographical Information Systems

what the municipality's adaptation goals are and how it is working to reach those goals. This facilitates the dialogue and may inspire societal actors to contribute to climate action.

5.4.2 FOR HOUSING ASSOCIATIONS

1. Consider to install green roofs when a roof is scheduled to be replaced or renovated

Especially in neighborhoods where there is little green space, green roofs can improve the liveability of these areas in various ways, an overview is given in chapter 3. This falls within the limitation that the revised Housing Act has set on housing association investments in neighborhoods, since it involves investing in the dwellings itself. It could be coupled with scheduled renovations or energy efficiency investments, e.g. placing solar panels on green roofs. Combining green roof projects with energy measures could potentially open up financial support, e.g. provincial subsidy arrangements.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

It would be interesting to see similar analyses of governance arrangements for green roof retrofitting by housing associations in other Dutch cities. Larger samples could allow for insights in the different situations between large and midsized cities, as well as between larger and smaller housing associations. Furthermore, whereas this research has used a qualitative approach, a quantitative approach could generate numerical insights regarding the current and potential role of social housing rooftops being used for green roofs as a climate adaptation instrument. Also, given the indications related to the importance of leadership of certain employees in both municipalities and housing associations, I would be interested to see management oriented investigations focusing on the relation between competencies of individual employees and the organizational attitude and behavior concerning climate adaptation.

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APPENDIX A: INTERVIEW TOPIC LIST

About the green roof project

- Where did the idea for the green roof project initially come from?
- What were the motivations for this green roof project?
- Were there any objections? If so, how were they dealt with?
- How was the project financed?
- What was the reaction of tenants?
- Did the project receive attention from media, other housing associations, municipality etc.?
- Were there any other parties involved in this project?
- What did you personally learn from the project?

About climate adaptation and housing associations

- Do you think that housing associations have a responsibility to install green roofs on existing housing?
- To what extent has climate adaptation been a concern or motivation for this project?
- Is climate adaptation a concern in performance agreements?
- Do you think that green roofs will be installed more often in the future?

About the relation between housing associations and municipality

- Is there a need for the municipality to stimulate adoption of green roofs?
- How is the collaboration with the municipality on sustainability issues?
- Did the municipality support this project in any way? If so, how did that cooperation go. If not, would that have been welcomed?
- Are there any other instruments that the government should use to stimulate the adoption of green roofs by housing associations?

About the municipality

- How was this green roof project conceived within your department?
- How important is climate adaptation for the municipality, and how did this develop over the years?
- How is climate adaptation embedded in the organization?
- In what way is climate adaptation stimulated in the city?
- To what extent should municipalities take responsibility to stimulate green roofs?
- Are there collaborations with other organizations to reach climate goals?
- What instruments are likely to be implemented in the future?
- Do you think green roofs will become commonplace in the future?

APPENDIX B: LIST OF INTERVIEWEES

Case study	Name	Function	Organization	Date
De Halve Wereld, Amsterdam	Auke Brouwer	City ecologist	Municipality	8-2-16
	Marjan Kootwijk	Former green advisor, now strategy/policy advisor	Ymere	8-3-16 (telephone)
	Marc Nijboer	Policy advisor	Municipality	23-2-16
	Marijke Storm	Tenant	Tenants associations De Halve Wereld	8-2-16
	Frans Suijkerbuijk	Tenant	Tenants associations De Halve Wereld	23-2-16
	Kasper Spaan	Plan advisor	Waternet	8-2-16
Transburg, Enschede	Joke Bults	Project manager	Pioneering	1-3-16
	Jeroen Buitenweg	Policy advisor	Water board Vechtstromen	1-3-16
	Hendrikjan Teekens	Advisor water policy	Municipality	11-2-16
	Arno Weppel	Real estate manager, inventor of Ecopan	Lefier	11-2-16
Lewenborg, Groningen	Paul Corzaan	Former sustainability advisor	Municipality	1-2-16
	Leo van Diemen	Advisor societal issues	Lefier	3-3-16
	Johan Duut	Former project manager	Lefier	1-2-16
	Suzanne Poyck	Advisor climate adaptation	Municipality	3-3-16