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# **THE DRIVERS AND BARRIERS OF THE DEVELOPMENT OF AN ADAPTATION INSTRUMENT: THE CASE OF ARNHEM**

MASTER'S THESIS

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## Colophon

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## Abstract

While cities are contributing the most to climate change, they are also the most vulnerable to the effects of climate change. Therefore, building climate resilient infrastructure is of great importance as it could significantly reduce vulnerability and exposure in urban areas. The aim of this research is to advise the municipality of Arnhem about the development of a process instrument for the climate adaptation of new developments. To be able to develop a climate adaptation instrument it has to be known what the drivers and barriers are to design and implement such an instrument within this specific institutional context. While there is already a lot of literature on the different drivers and barriers of climate adaptation mainstreaming, this specific context has not been studied yet. In this research government documents are analysed, experts working for the municipality of Arnhem are interviewed and focus groups are organised to give insight into the drivers and barriers for each step of the development process of the adaptation instrument. First, practical choices are made about the best way to design and implement the adaptation instrument. It would be best to expand the existing points system for nature-inclusive development with climate adaptation measures. Second, while the legal enforcement of the instrument is done with the use of the zoning plan, it is also important to point out the adaptation standards from the beginning of a development project. Finally, the drivers and barriers for the development of the adaptation instrument are mostly found in the internal organisation. These factors include: the level of leadership and the presence of policy entrepreneurs; the amount of staff and resources; the level of awareness and the organisational structure; the level of political support; the amount of conflicting spatial interests; the level of cooperation between the different departments; and the level of knowledge and expertise on the different themes of climate adaptation. The remaining factors are: the cooperation with other organisations; the willingness of developers to work with the adaptation instrument; and the amount of legal barriers.

Keywords: *climate adaptation; mainstreaming; drivers; barriers; planning instrument*

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# 1. Introduction

## 1.1 Research problem

Samen Klimaatbestendig, Tauw and &Flux (2020) created a guide for climate adaption instruments for buildings and area developments. They state that in the Netherlands there are already many instruments in place for the climate adaptation of new developments. However, they state that there is still a need for a set of instruments for unambiguous monitoring and evaluation and they want to reduce the high multitude of instruments and methods. This could be done with the development of a singular process instrument that will assess the climate adaptation of new developments.

The city of Arnhem is located at the place where the Rhine splits into two and is therefore surrounded by rivers. This causes the Southern area of the municipality to have a high probability of fluvial flooding. In addition, due to the slope of the city the Southern part is also more likely to suffer from pluvial flooding. On top of that, the Southern part suffers from a lot of heat stress (Atlas Leefomgeving, n.d.). While it may not be preferable to build in areas suffering from heat stress and flooding, cities such as Arnhem may not have another option as the main area of the municipality of Arnhem is already built up (Atlas Leefomgeving, n.d.).

The municipality of Arnhem is one of the front runners in the Netherlands when it comes to climate adaptation. They are actively greening the areas of the city where climate related problems such as heat stress, drought and flooding are the most urgent (Gemeente Arnhem, 2021). Next to that, there are already many instruments in place for the climate adaptation of different aspects of urban developments. However, there is still a high number of instruments and the municipality is still missing one holistic climate adaptation instrument for this purpose.

Therefore, the municipality of Arnhem asked for advice on the development of a 'climate test'. This would be a planning instrument to assess whether new developments are sufficiently adapted to problems caused by climate change, such as flooding, heat stress and drought. These new developments are not only new houses, but all new buildings, renovations and repurposing, including the surrounding area development.

## 1.2 Research aim and research questions

The aim of this research is to advise the municipality of Arnhem about the development of a process instrument for the climate adaptation of new developments. Based on the research aim the intervention question is formulated:

"What is the best way to design and implement a policy instrument, which will sufficiently assess the climate adaptation of new developments for both flooding, heat stress and drought within the municipality of Arnhem?"

To be able to give an answer to this intervention question, the main research question needs to be answered, which is:

"What are the drivers and barriers to design and implement a climate adaptation instrument within the institutional context of the municipality of Arnhem?"

This research question looks into two phases of the policy lifecycle of the development of a climate adaptation instrument: the design of the instrument and the implementation of the instrument. Therefore, three sub-questions are formulated, where the first sub-questions looks into the institutional context of the municipality of Arnhem, the second sub-question looks into the design phase of the instrument development and the third sub-question looks into the implementation phase of the instrument development.

The sub-questions are formulated as follows:

1. “Which standards are already in place within the institutional context of the municipality of Arnhem for the climate adaptation of area developments, and are they sufficient?”
2. “Which standards for climate adaptation are most suitable in making new developments more resilient against heat stress, droughts and flooding?”
3. “How can the climate adaptation standards for new developments best be implemented and regulated?”

### 1.3 Social and scientific relevance

#### Social relevance

Currently, more than half of the world’s population lives in cities. In Europe, this is even 75% of the population and it is expected to grow up to 82% by the year 2050 (Tapia et al., 2017). While cities cover less than 2% of the Earth’s surface, they produce more than 60% of all greenhouse gas emissions. Therefore, as they are home to half of the world’s population, they have the highest contribution to climate change (Mi et al., 2019; United Nations, n.d.). At the same time, urban areas are the most vulnerable to the effects of climate change (Kabisch et al., 2016). Climate change has a substantial effect on urban areas as it causes “heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges” (IPCC, 2014, p. 15). Cities are experiencing more heat stress due to the urban heat island effect caused by the material use in cities and more flooding due to the high amount of impermeable surfaces (Dai et al., 2018; Gillner et al., 2015). Thus, while cities are contributing the most to climate change, they are also the most vulnerable to the effects of climate change. Therefore, building climate resilient infrastructure is of great importance as it could significantly reduce vulnerability and exposure in urban areas (IPCC, 2014).

Moreover, in addition to climate change one of the main problems is the housing shortage in the Netherlands. The need for houses is expected to increase up to 1 million by the year 2035 (Jonkman et al., 2022). Therefore, as a lot of new buildings are being developed within the next few years, it is crucial that these buildings are being adapted to climate change as quickly and efficiently as possible. Moreover, earlier this year the Dutch minister for Housing and Spatial Planning stated that it is important to have a national measuring instrument for making buildings adapted to climate change (Kennisportaal Klimaatadaptatie, 2022). Thus, as Arnhem is one of the frontrunners when it comes to climate change adaptation, it is important that they are one of the first municipalities to report on the drivers and barriers for the creation of a process instrument for the climate adaptation of new developments. This way other municipalities can learn from them in the future.

#### Scientific relevance

In their research about the barriers to mainstreaming nature-based solutions (NBS) Dorst et al. (2022) state that “overviews of systemic barriers [...] tend to overlook [...] sensitivity to geographical and policy context, hampering tailored and possibly more effective approaches at a solution” (p.2). While this research speaks about NBS mainstreaming, this can also be applied to climate adaptation mainstreaming in general. Drivers and barriers to the mainstreaming of climate adaptation are very context specific. There is already much literature on drivers and/or barriers to adaptation mainstreaming. For example, Runhaar et al. (2018) documents the drivers and barriers mentioned by 87 different papers. Ekstrom and Moser (2014) study the adaptation mainstreaming barriers in five different cities and counties in America. Uittenbroek (2016) studies the adaptation mainstreaming barriers for the case of the city of Amsterdam in depth. Thus, looking into the adaptation mainstreaming drivers and barriers for the municipality of Arnhem can contribute to the body of knowledge as this specific context has not been studied yet.



## 2. Literature review and theoretical framework

### 2.1 Literature review

For this thesis the drivers and barriers for the development of a climate adaptation instrument are studied. To be able to find fitting literature on these drivers and barriers it is important to first clearly define climate adaptation instruments. Climate change adaptation can be defined as “the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities” (IPCC, 2012, p. 36). Moreover, in the Netherlands there is a so-called Delta Program. One part of the program is the Delta Plan on Spatial Adaptation (Deltaplan Ruimtelijke Adaptatie; DPRA) which considers the challenges of climate change for spatial planning (de Klerk et al., 2021). The DPRA intends to “render the spatial planning of the Netherlands climate-proof and water-resilient, in order to be better prepared for extreme weather by 2050: both waterlogging and prolonged periods of drought and heat” (Delta Commissioner, 2018, p. 8) and highlights four adaptation themes: “extreme precipitation, heat stress, drought, and (urban) flooding due to dyke breaches” (de Klerk et al., 2021, p. 2). The IPCC refers to the development of policy as one of the opportunities for climate adaptation (Henstra, 2016). Henstra (2016) defines adaptation policy as “a course of action chosen by a government to reduce vulnerability to the effects of climate change, and to increase adaptive capacity to moderate damages or cope with consequences”(pp. 498-499). This is supported by Keessen et al. (2013) who state that “adaptation plans generally aim to decrease vulnerability to climate change and increase resilience” (Theoretical framework section, para. 1). One of the key components of a public policy is an instrument (Henstra, 2016). “Instruments are the tools by which governments seek to change the behaviour of targets or ameliorate problematic conditions” (Henstra, 2016, p. 497).

Therefore, in the theoretical framework first attention is given to literature on the development of an instrument for the climate adaptation of cities. First, an elaboration is given on the different cycles of the development of a climate adaptation instrument. This is done with the use of the article of Jansen et al. (2007) as this article is specifically aimed at the policy lifecycle of the tool development in the environmental sciences. Furthermore, the different types of adaptation instruments are distinguished with the use of the theories of Henstra (2016) and Van der Heijden (2014). Van der Heijden (2014) focusses on the governance approaches to increase the climate adaptation of buildings and cities. One of which are tools developed and implemented by governmental actors. Then, Henstra (2016) focusses on the different types of policy instruments these governmental actors can use for climate adaptation. Finally, the different phases of the area development are distinguished to be able to explain where planning instruments can be implemented during an area development project. For this purpose the information provided by the Ministry of Infrastructure and Water Management (Ministerie van Infrastructuur en Waterstaat, n.d.) is used as the national government is the most reliable source when it comes to legislative procedures.

Furthermore, according to Reckien et al. (2019) the implementation success of climate adaptation policies is strongly related to the mainstreaming of climate policies and actions. Climate adaptation mainstreaming is defined as “the integration of policies and measures to address climate change in ongoing sectoral and development planning and decision-making” (Reckien et al., 2019, p. 949). It is one of the two policy options to address climate change, next to the what Uittenbroek et al. (2014) refer to as the ‘dedicated approach’ (Reckien et al., 2019). Therefore, the first step in this section of the theoretical framework is to distinguish these two approaches to climate adaptation with the use of the article by Uittenbroek et al. (2014). According to Uittenbroek et al. (2014) “the added value of [their] discussion lies in the conceptualisation of the nature and implications of political commitment in the case of mainstreaming, which [they] apply to the specific field of climate adaptation” (Uittenbroek et al., 2014, p. 1045). Then, the article by Runhaar et al. (2018) is used to define the mainstreaming

approach more clearly. This article is used for this purpose because it critically reflects on the article of Uittenbroek et al. (2014).

Then, to be able to partially answer the research question, the different drivers and barriers to climate adaptation mainstreaming are collected. First, it is important to look into how the structure of an organisation can be a barrier itself. For this purpose, the article of Uittenbroek (2016) is used as it builds on the theory of Uittenbroek et al. (2014). Second, the article of Runhaar et al. (2018) is used to find the most mentioned drivers and barriers to adaptation mainstreaming. Runhaar et al. (2018) researched the mainstreaming barriers and drivers by reviewing 87 papers. This means that an extensive amount of recent literature is taken into account for this research. Third, to know the barriers specific to the design phase and implementation phase of the development of a climate adaptation instrument, the article by Ekstrom and Moser (2014) is used. This choice is made as the article of Ekstrom and Moser (2014) is part of the factors defined by Runhaar et al. (2018). Moreover, the article of Ekstrom and Moser (2014) is used because it specifically mentions barriers for each phase of the adaptation cycle. These barriers are more in depth than the factors mentioned by Runhaar et al. (2018) and they can be applied to the specific phases of the design and implementation of an adaptation instrument. Finally, a summary is made of all these drivers and barriers and they are operationalized in a conceptual framework.

## 2.2 Theoretical framework

### Climate adaptation instruments

#### *The development phases of a climate adaptation instrument*

The development of climate adaptation instruments is an important part of an adaptation plan to increase the resilience of a city (Henstra, 2016). The policy lifecycle used for the instrument development in the environmental sciences has five phases: the initial renaissance phase, the recognition phase, the policy development phase, the implementation phase and the operational management phase (Jansen et al., 2007). The renaissance initial phase is limited to the scientific world as the problem has not yet been acknowledged by the policy makers as being real, relevant or serious enough (Jansen et al., 2007). In the recognition phase “there is sufficient consensus within the scientific community and interest groups, to convince politicians, the press and the general public, that the environmental issue is relevant enough to be examined in more detail” (Jansen et al., 2007, p. 336). In the policy development phase action-oriented questions are being asked and policies are being developed. In the implementation phase the policy measures are designed in more detail and institutional infrastructure such as laws, regulations, methods and procedures are put into place. In this phase the designed policies are also executed. The last phase is the operational control phase. In this phase the problem is being managed and the institutional infrastructure is maintained, monitored and evaluated (Jansen et al., 2007).

In the case of climate change adaptation, a lot of research has already been conducted and in the Netherlands policy makers are already taking climate change adaptation very seriously (Delta Commissioner, 2018). Therefore, the first two phases defined by Jansen et al. (2007) (the initial renaissance phase and the recognition phase) are less relevant to this thesis than the last three phases (the policy development phase, the implementation phase and the operational management phase). However, as this thesis speaks of the development of climate adaptation instrument for area developments, it is better to replace the term ‘development phase’ with the ‘design phase’ to avoid confusion.

#### *Governance approaches to increase urban resilience*

Van der Heijden (2014) addresses three specific governance approaches to increase the resilience and sustainability of buildings and cities: voluntary programmes and market-driven governance; collaborative governance; and direct regulatory interventions. First, voluntary programmes and market-driven governance addresses tools that are developed and implemented by non-governmental actors. Examples of these instruments are best-of-class benchmarking and certification; tripartite financing; green leasing; contests, challenges and competitive grants; and sustainable procurement (Van der Heijden, 2014).

Second, collaborative governance addresses tools that are developed and implemented by NGOs, businesses or citizen groups. Examples of these instruments are: networks and partnerships; and agreements and covenants (Van der Heijden, 2014).

Third, direct regulatory interventions addresses tools that are developed and implemented by governmental actors. This governance approach is most relevant to this thesis, as this adaptation instrument is being developed by the municipality of Arnhem. Examples of these instruments are: subsidies, taxes and statutory regulation. Subsidies are a form of financial support to incentivise desired behaviour. Another economic instrument are taxes, which aim to make harmful practices less profitable. The third instrument is statutory regulation (Van der Heijden, 2014). According to Van der Heijden (2014) “urban resilience is relatively easy to address through statutory regulation for new and future buildings” (p. 134). Statutory regulations can be divided into prescriptive standards; performance-based

standards; or target or goal-oriented standards. Prescriptive standards state the exact requirements for particular parts of a building. However, a critique is that prescriptive standards leave little room for flexibility or innovation. For example, a novel technology may not be applied because the prescriptive regulations do not allow for it. Performance-based standards partly overcome this critique of prescriptive standards as they only specify the performance of a building in terms of resilience, but not how that performance is to be achieved. Target or goal-oriented standards directly link behaviour to a regulatory goal and leave it fully to the ones being regulated how to achieve this goal (Van der Heijden, 2014). Moreover, Van der Heijden (2014) mentions that these different types of standards can also be combined. For example, “points [can be] awarded for meeting particular requirements [...] and a certain number of points is required for a building permit” (Van der Heijden, 2014, p. 35). In the municipality of Arnhem such a tool is already in place for making buildings nature inclusive. It is called the points system for nature-inclusive development (NID; puntensysteem natuurinclusief bouwen). Different types of buildings have to meet different scores by building a habitat for animals and insects and including green infrastructure on and around the building (Gemeente Arnhem, 2021).

#### *Government resources for climate adaptation instruments*

Henstra (2016) divides policy instruments for climate adaptation into four key government resources: nodality, authority, treasure and organization. First, nodality is the “use of information dissemination, knowledge generation and knowledge mobilization to inform adaptation responses” (Henstra, 2016, p. 500). These information-based instruments assume that the recipients are motivated to reach the policy goals, but only lack sufficient knowledge on how to do that (Henstra, 2016).

Second, treasure is the “use of public funds to (1) produce and maintain public goods and services that contribute to adaptation; (2) confer benefits to induce adaptation behaviour; or (3) impose costs to discourage behaviour that undermines adaptation” (Henstra, 2016, p. 501). Examples of instruments are: direct programme spending, such as on public goods and services, infrastructure, ecosystem management or relocation; financial incentives such as grants or subsidies; and taxation (Henstra, 2016).

Third, organization is the “use of government resources and personnel to implement adaptation policy objectives” (Henstra, 2016, p. 502). Organization tools are for example demonstration and procurement. Demonstration entails the ‘climate-proofing’ of facilities, assets and operations controlled by the government. Procurement, on the other hand, is the integration of adaptation objectives into the purchasing of goods, works and services (Henstra, 2016).

Finally, authority is the “use of the legitimate power of the state to permit, prohibit, or command adaptation action” (Henstra, 2016, p. 501). This type of instrument is most relevant to this thesis, as the municipality of Arnhem prefers the development of a legal process instrument that can be implemented during an area development process. The first authority instrument is legislation. Here statute law can allocate responsibilities between policy actors; provide legal authority for decision making; define liabilities and enable other instruments. The second instrument is intergovernmental mandates, which are legal directives demanding the implementation of climate adaptation policy by local governments. The third instrument is regulation. A regulation is a binding rule prescribed by the state, that has the force of law. They can be divided into zoning; standards; and building codes (Henstra, 2016). According to Henstra (2016) zoning means the “rules about acceptable uses for parcels of land”, standards are “rules about the design, construction, and maintenance of buildings and infrastructure systems” and building codes are “sets of rules specifying minimum standards for construction” (p. 501).

### *The implementation phases of planning instruments*

According to the Ministry of Infrastructure and Water Management (n.d.) the area development process has four different stages: the initiation phase (initiatiefase), the feasibility phase (haalbaarheidsfase), the realisation phase (realisatiefase) and the management phase (beheerfase). However, the feasibility phase has three sub-phases of its own: the definition phase (definitiefase); the design phase (ontwerpfase); and the preparation phase (voorbereidingsfase) (Figure 1). The policy document of the metropole region of Amsterdam (n.d.) about the implementation of a climate adaptation instrument in this area development process speaks of the same phases. However, they substituted the feasibility phase for the design phase, which does not have three sub-phases.

In the initiation phase it is investigated if the area development is desired or if there are better alternatives. In this phase the structural vision (structuurvisie) and the environmental impact report (m.e.r.) are the most important planning instruments (Ministerie van Infrastructuur en Waterstaat, n.d.).

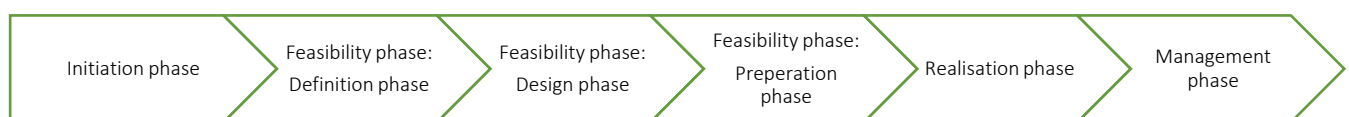
In the definition phase the government draws up preconditions for the location in an urban planning program of requirements (Stedenbouwkundig Programma van Eisen; SpvE). For example, they can decide how many buildings are allowed to be build; which aspects need to remain in sight; or the preconditions for water, safety or nature reserves. Sometimes it is useful to put these preconditions in an area structure vision (gebiedsstructuurvisie), which is a legal instrument (Ministerie van Infrastructuur en Waterstaat, n.d.).

In the design phase the urban design is drawn up by a market actor or the government. Here the requirements from ecology, water management and archaeology are taken into account. In both the design phase and the preparation phase the zoning plan (bestemmingsplan) and the environmental impact report (m.e.r.) are the most important planning instruments (Ministerie van Infrastructuur en Waterstaat, n.d.).

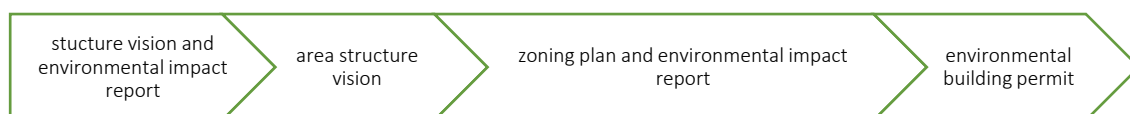
The realization phase focuses on the actual implementation of the urban design as determined during the feasibility phase. In this phase the application for the environmental building permit (omgevingsvergunning bouwen) is prepared (Ministerie van Infrastructuur en Waterstaat, n.d.).

The management phase is aimed at maintaining the development. At the beginning of this phase, the environmental permit is applied for (Ministerie van Infrastructuur en Waterstaat, n.d.).

### *Stages of the area development process:*



### *Planning instruments:*



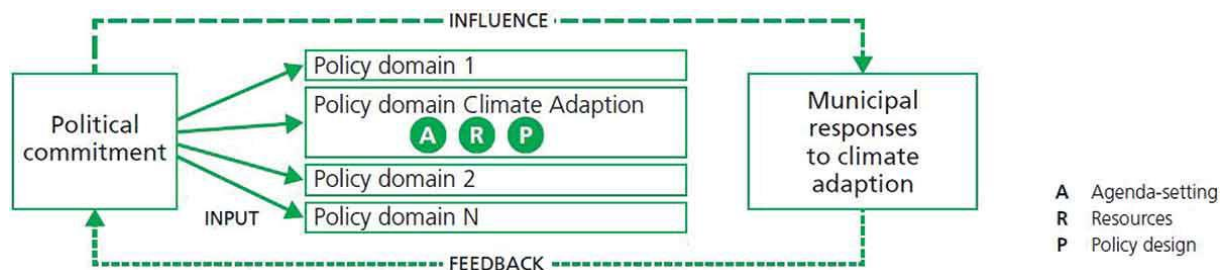
**Figure 1.** Stages of the area development process and the associated planning instruments. Based on Ministerie van Infrastructuur en Waterstaat (n.d.).

## Climate adaptation mainstreaming

### *The dedicated approach versus the mainstreaming approach*

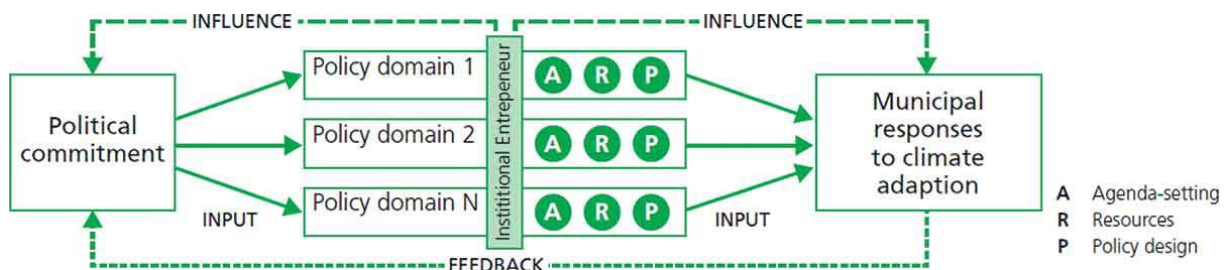
The number of cities that are adapting to climate change is increasing. However, there are still many barriers perceived by policymakers during the initiation and implementation of the climate change adaptation by municipalities. These barriers include uncertainties about the risks and impacts of climate change, the financial constraints, the lack of local expertise, the undefined role for local governments and the lack of political commitment (Uittenbroek et al., 2014).

There are large differences between municipalities in their approach towards the climate adaptation of their urban environment. Some municipalities have placed climate adaptation high on their agenda. They have installed departments dedicated to climate adaptation and have created ambitious adaptation strategies (Uittenbroek, 2016). This is what Uittenbroek et al. (2014) refer to as a ‘dedicated approach’, where climate adaptation is presented as a new policy domain. According to Uittenbroek et al. (2014) “the dedicated approach is based on direct political commitment that provides opportunities, such as political pressure and new organisational structures” p. 1058; Figure 2). However, it is important that new policies are clearly positioned, as direct political commitment can sometimes be discontinued when new issues arise on the political agenda (Uittenbroek et al., 2014).



**Figure 2.** The dedicated approach to climate adaptation (Uittenbroek et al., 2014, p. 1049).

However, due to overfull political agendas and limited investment capacities other cities are not able or willing to apply such a dedicated approach. In order to still be able to address climate adaptation, several municipalities have chosen to integrate it directly in existing policy domains and their related organizational processes. This is called ‘mainstreaming’ and it is a more pragmatic approach to organizing municipal responses to climate adaptation (Uittenbroek, 2016; Uittenbroek et al., 2014). The mainstreaming approach depends on indirect political commitment (Figure 3). “Indirect political commitment often leaves organisational structures and routines unchanged, which can hamper municipal responses, as actors cannot reallocate their resources to climate adaptation themselves” (Uittenbroek et al., 2014, p. 1058).



**Figure 3.** The mainstreaming approach to climate adaptation (Uittenbroek et al., 2014, p. 1049).



### *The different notions of mainstreaming*

In their literature review Runhaar et al. (2018) state that climate adaptation mainstreaming has no agreed-upon definition. “In the literature as well as in policy practice, different meanings, assumptions and objectives are associated with climate adaptation mainstreaming” (Runhaar et al., 2018, p. 1202). Currently, climate adaptation is already a new policy field standing on its own, which would be a considered a dedicated approach according to Uittenbroek et al. (2014). However, according to Runhaar et al. (2018) where Uittenbroek et al. (2014) distinguish the mainstreaming approach from the dedicated approach, others see the dedicated adaptation policies as an integral element of adaptation mainstreaming (Wamsler & Pauleit, 2016). As the article of Runhaar et al. (2018) has both Uittenbroek and Wamsler as co-authors, it can be concluded that the first definition of mainstreaming defined by Uittenbroek et al. (2014) is revised and the definition formulated by Wamsler and Pauleit (2016) is the final definition. Thus, in the current situation where climate adaptation is already a sector on its own, mainstreaming is considered a means to implement climate adaptation policies in different governmental levels and different sectors (Runhaar et al., 2018).

Runhaar et al. (2018) use the following mainstreaming strategies first identified by Wamsler and Pauleit (2016) to analyse the differences in the pursued mainstreaming strategies: programmatic mainstreaming; managerial mainstreaming; intra- and inter-organisational mainstreaming; regulatory mainstreaming; and directed mainstreaming. First, the programmatic mainstreaming entails the integration of aspects related to climate adaptation into on-the-ground operations, projects or programmes. The managerial mainstreaming strategy is the modification of working structures such as norms, job descriptions and sections of departments to better address climate adaptation. Intra- and inter-organisational mainstreaming is the collaboration and networking with other departments and other governmental and non-governmental organisations to generate a shared understanding and knowledge to steer collective issues of climate adaptation. Directed mainstreaming is a higher level of support to redirect the focus to the mainstreaming of climate adaptation, such as providing funding or promoting new projects. Finally, the regulatory mainstreaming strategy is the modification of formal and informal planning procedures, such as planning strategies, regulations, policies, legislations and related instruments that lead to the integration of climate adaptation (Runhaar et al., 2018). The regulatory strategy “ranges from including climate adaptation as an objective in sectoral policy documents to changes in strategic planning and legislative tools” (Runhaar et al., 2018, p. 1205). Therefore, it is the strategy that is most relevant to this thesis. Moreover, Runhaar et al. (2018) found that it is the most frequently reported mainstreaming strategy of them all.

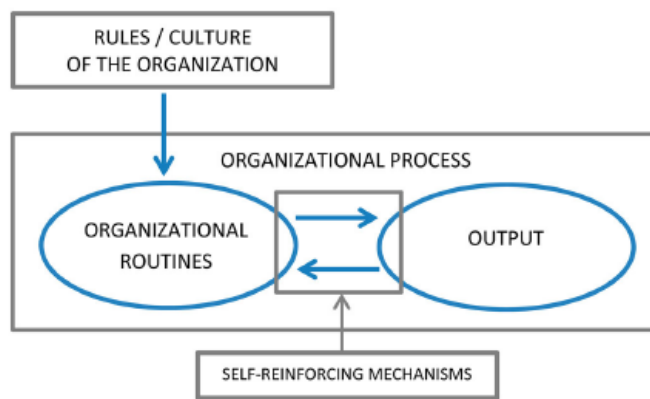
Thus, Integrating climate adaptation into existing policy domains is called mainstreaming, which can be done through the development of an adaptation instrument (Runhaar et al., 2018). According to Runhaar et al. (2018) there was less integration of climate adaptation in the sector ‘housing and infrastructure’ compared to other sectors. However, it is a sector that would benefit from this, as they have a long planning and investment horizon (Runhaar et al., 2018). Therefore, developing a climate adaptation instrument for area developments would be particularly critical.

## Drivers and barriers to climate adaptation mainstreaming

### *Organizational routines and self-reinforcing mechanisms*

The aim of mainstreaming is to search for linkages between climate adaptation and existing policy objectives and to combine their resources. It is considered to be more effective and lead to more efficient policymaking. However, while the mainstreaming of climate adaptation into policy documents is relatively easy, there are also barriers that occur during the implementation stage of the policies as the implementation of the policies is generally undertaken by other actors than the policy-makers. During this implementation stage the connections made between the objectives of climate adaptation and those of other policy departments (such as spatial planning, water management and public health) need to be translated into practice. However, reallocating resources and reorganising practises often proves to be difficult in practice. Thus, organizational structures can form a barrier in the mainstreaming of climate adaptation (Uittenbroek, 2016).

Uittenbroek (2016) uses the theory of Sydow et al. (2009) about 'organizational routines and self-reinforcing mechanisms' to explain the occurrence of these barriers in the mainstreaming of climate adaptation. Routines are behavioural patterns that are carried out by multiple actors that belong to different organizational units. These routines are structured by the rules, the culture and the preferred practices of an organization. The standardization of routines occurs due to the self-reinforcing mechanisms, which are the positive feedback loops between the routines and their output (Figure 4; Uittenbroek, 2016). According to Uittenbroek (2016) "the concept of self-reinforcing mechanisms finds its origins in path-dependency literature" (p. 164). While these standardized routines can cause a certain continuity over time, they also withstand attempts to change them in the short term. When trying to address a new objective such as climate adaptation, problems may occur with the coordination and the interaction between the actors. This can lead to an implementation deficit (Uittenbroek, 2016).



**Figure 4.** Conceptual understanding of organizational routines and self-reinforcing mechanisms (Uittenbroek, 2016, p. 164).

In addition, Uittenbroek (2016) uses the theory of Sydow et al. (2009) to distinguish four types of self-reinforcing mechanisms: complementary effects, coordination effects, learning effects and adaptive expectation effects. First, complementary effects "are obtained by establishing synergies in a routine by combining interrelated resources and practices" (Uittenbroek, 2016, p. 164). In this case, actors can save costs by combining their resources and practices. However, according to Uittenbroek (2016) these effects can lead to a barrier when a certain type of synergy becomes dominant and it becomes deeply rooted in the routine. This will make it difficult to add new practices, such as climate adaptation measures. Thus, "mainstreaming climate adaptation might [...] only occur if the synergy between climate adaptation and the other objectives is considered superior by the actors involved in the

organizational process” (Uittenbroek, 2016, p. 165). Second, coordination effects occur when many actors adopt and follow the same routine. Therefore, the interaction between actors becomes more efficient if they anticipate each other’s moves. This can cause routines to become fixed and inflexible and actors to become unable to act outside of the rules. This can form a barrier for mainstreaming climate adaptation as actors might not be flexible enough to act upon new challenges that may arise when they need to take up responsibilities outside of their policy domain. Third, learning effects arise when actors become familiar with their routine and learn to use the routine more effectively (Uittenbroek, 2016). “The aim of this kind of learning is to increase the simplicity of the process through which the process becomes easier or faster to implement” (Uittenbroek, 2016, p. 165). However, this can create a barrier as learning through small adjustments can discourage the motivation to apply explorative learning. Finally, adaptive expectation effects are “based on the idea that the preferences of actors are not fixed, but vary to respond to the expectations of other actors” (Uittenbroek, 2016, p. 165). Actors continuously adjust their preferences to gain legitimacy for their actions. This can be a barrier for mainstreaming climate adaptation as actors adapt their preferences on their assumptions about the other actors without confirming whether these assumptions are correct. Therefore, it is important that there is legitimacy (shared preferences) about how to address climate adaptation (Uittenbroek, 2016).

### *Mainstreaming barriers and drivers*

Runhaar et al. (2018) define the effectiveness of climate adaptation mainstreaming in terms of policy outputs as well as policy outcomes. Policy outputs are the adoption of formal adaptation goals in sectoral policies (such as the goal to reduce heat stress in spatial plans), procedural instruments (such as formal reporting requirements) and changes in institutional structures (such as the creation of new inter-sectoral working groups; Runhaar et al., 2018). According to Runhaar et al. (2018) the policy outcomes go a step further. They are the response to policy outputs. Policy outcomes are the development and implementation of concrete local and national climate adaptation measures. For example, heatwave plans, embankments and other physical measures (Runhaar et al., 2018).

In order to evaluate the effectiveness of outputs and outcomes of the climate adaptation mainstreaming strategy, Runhaar et al. (2018) use mainstreaming barriers and drivers. The drivers and barriers are categorized as the following factors: political factors; organisational factors; cognitive factors; resources; characteristics of the adaptation problem at issue; and timing (Table 1; Runhaar et al., 2018).

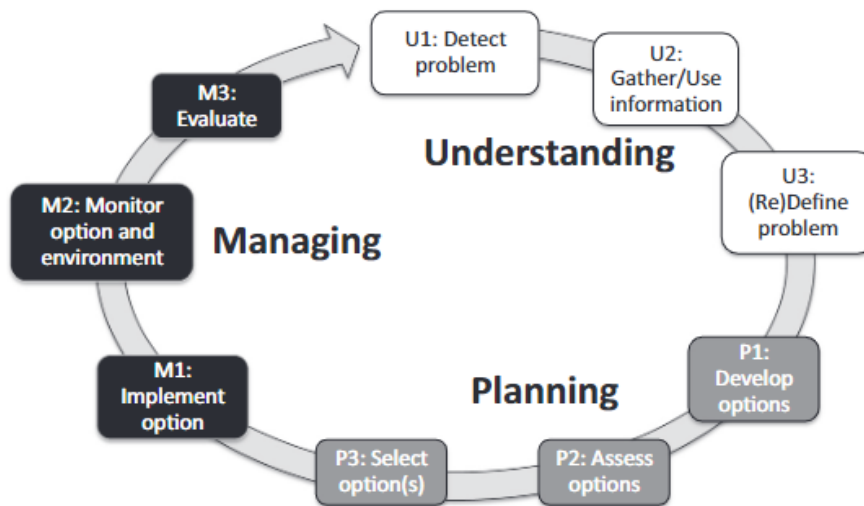
Runhaar et al. (2018) researched the mainstreaming barriers and drivers by reviewing 87 papers reporting on the empirical analysis adaptation of mainstreaming practices. They found that the literature reported differently on the factors on being drivers or barriers to climate adaptation mainstreaming. Their results show that “the most often mentioned drivers are, in order: political commitment; cooperation with private actors; the presence of policy entrepreneurs; focusing events; and lastly subsidies from higher levels of government which is on par with framing and linking to sectoral objectives” (Runhaar et al., 2018, p. 1207). Moreover, “the most frequently reported barriers are lack of: financial resources, information, guidance, coordination and cooperation between departments, staff resources and access to adaptation knowledge and expertise as well as conflicting interests” (Runhaar et al., 2018, p. 1207).

**Table 1.** The frequency of factors reported as being mainstreaming drivers or barriers. Adapted from Runhaar et al. (2018).

Category	Factors	Drivers (# of reports as enabling factor)	Barriers (# of reports as inhibiting factor)
<b>Timing</b>	Windows of opportunity	7	0
	Focussing events	<b>22</b>	1
	Waiting and sustaining momentum for adaptation	4	0
<b>Characterisation of problem at hand</b>	Narrowly defined adaptation objectives	0	1
	Timescales (conflicting or compatible)	1	4
	Framing and linking to sectoral objectives	<b>21</b>	5
<b>Resources</b>	Information or guidance	14	<b>18</b>
	Availability of and access to knowledge and expertise	11	<b>16</b>
	Subsidies from higher levels of government	<b>21</b>	12
	Financial resources	5	<b>27</b>
	Staff	4	<b>16</b>
<b>Cognitive factors</b>	Learning	19	6
	Sense of urgency	6	7
	Uncertainty	1	12
	Awareness	15	8
<b>Organisational factors</b>	Leadership/policy entrepreneurs	<b>23</b>	1
	Organisational structures, routines, and practices	3	14
	Institutional fragmentation	1	8
	Clarity about responsibilities for adaptation	4	12
	Cooperation with private actors	<b>25</b>	11
	Coordination among policy levels	3	12
	Coordination/cooperation between departments	17	<b>18</b>
	Expanded mandates or statutes	5	11
	Supportive regulative framework	8	8
	Formal requirements to develop adaptation plans	15	6
<b>Political factors</b>	Political (in)stability, political patronage, or short-termism	2	1
	(In)flexible legislative or policy contexts	0	2
	Policy (in)consistency across levels	2	3
	Public awareness or support	6	2
	Political commitment	<b>31</b>	12
	Conflicting interests	0	<b>16</b>

### *Barriers in the different stages of the adaptation cycle*

In the research conducted by Ekstrom and Moser (2014) they found that many barriers can be matched to particular phases within the adaptation cycle. This cycle contains three phases: the understanding phase; the planning phase; and the managing phase (Figure 5). Within the understanding phase, there are three steps: problem detection; information gathering; and (re)defining the problem. The planning phase contains the steps: development of options; assessment of options; and selection of option(s). The managing phase contains the steps: implementation of the option; monitoring the option and its environment; and evaluation (Ekstrom & Moser, 2014).



**Figure 5.** The adaptation cycle (Ekstrom & Moser, 2014, p. 22027).

When evaluating five cases, Ekstrom and Moser (2014) found that the most barriers occur in the first two steps of the understanding phase (U1 and U2), in the first two steps of the planning phase (P1 and P2) and the first step of the management phase (M1). However, it is important to note that the most barriers are reported in the understanding phase because several of the studied cases were still in this phase at that moment (Ekstrom & Moser, 2014).

Different barriers occur in the different phases of the adaptation cycle (Table 2; Ekstrom & Moser, 2014). In this thesis the focus lies on the design phase and the implementation phase of the development of a climate adaptation instrument. Moreover, in the Netherlands a high number of adaptation options has already been developed (Samen Klimaatbestendig et al., 2020). Therefore, only the steps ‘assessment of options’ (P2), ‘selection of option(s)’ (P3) and ‘implementation of option(s)’ (M1) and the corresponding barriers are relevant to this research. Moreover, phase P2 and phase P3 correspond to the second sub-question and M1 corresponds to the third sub-question.

**Table 2.** Adaptation barriers in phase P2, P3 and M1 (adapted from Ekstrom & Moser, 2014)

Phases	Barriers
<b>P2: Assessment of options</b>	Lack of funds for detailed assessments
	Lack of coordination among departments, agencies, institutions
	Lack of knowledge and expertise among staff
	Lack of data and science
	Lack of leadership
	Lack of time or staff
	Options perceived as unpleasant, negative, politically or publicly unacceptable
<b>P3: Selection of option(s)</b>	Limited or lack of options
	Politics and the political process
	Public or stakeholder opposition to choices
	Lack of or limited actual jurisdiction over option
	Lack of governance structure through which to make and implement decision
<b>M1: implementing option(s)</b>	Lack of funding to implement option
	Legal barriers
	Lack or fragmentation of governance structure
	Resistance from affected parties
	Lack of political will and commitment



## 2.3 Operationalization

As the drivers and barriers formulated by Runhaar et al. (2018) are partially based on the articles by Uittenbroek (2016) and Ekstrom and Moser (2014) there is an overlap between the drivers and barriers in this theoretical framework. Therefore, the drivers and barriers are compared and overlapping drivers and barriers are combined. This results in a summary of all the drivers and barriers from the theoretical framework. This way it is easier to compare the drivers and barriers of the theoretical framework with those that may emerge during the data analysis. The selection is made based on the detail level of the drivers and barriers. Thus, the more descriptive factors are chosen over the broader and more vague factors. Moreover, the drivers and barriers are two sides of the same coin as for each barrier there is a counteracting driver. Therefore the drivers and barriers are formulated as neutral factors that can both be a driver or a barrier.

First, the categories and barriers of Uittenbroek (2016) are combined with the drivers and barriers of Runhaar et al. (2018) (Table 3), as the factor ‘organisational structures, routines, and practices’ of Runhaar et al. (2018) coincides with the ‘self-reinforcing mechanisms’ of Uittenbroek (2016).

**Table 3.** Summary of the drivers and barriers of Uittenbroek (2014) and Runhaar et al. (2018).

Category	Driver/Barrier
Complementary effects	Synergy deeply rooted in routine
Coordination effects	Actors anticipating each other's moves
Learning effects	(Discouraged to apply) explorative learning
Adaptive expectation effects	Preferences respond to expectation of other actors

Second, the categories and barriers of Ekstrom and Moser (2014) are combined with the drivers and barriers of Runhaar et al. (2018) (Table 4). In the ‘assessment of options’ stage (P2) the “available resources, knowledge and expertise, and data or scientific understanding play a larger role in how deep or extensive such an options assessment is” (p. 65). For example, there is a lack of funds for detailed assessments, which falls under the ‘financial resources’ factor of Runhaar et al. (2018). Ekstrom and Moser (2014) also mention the ‘lack of coordination among departments, agencies, institutions (incl. lack of integrative or systems perspective; institutional fragmentation, stove-piping)’ (p. 65) as a barrier, which can be linked to the factors of Runhaar et al. (2018) call the ‘coordination/cooperation between departments’, ‘cooperation with private actors’, ‘coordination among policy levels’ and ‘institutional fragmentation’. The barrier ‘lack of knowledge and expertise among staff’ of Ekstrom and Moser (2014) is the same as the factor ‘availability of and access to knowledge and expertise’ of Runhaar et al. (2018). The barrier ‘lack of data and science’ of Ekstrom and Moser (2014) can best be fitted with the factor ‘information or guidance’. The barrier ‘lack of leadership (e.g., no lead agency, guidance, directive or mandate to undertake assessment, short-term perspective that prevents effective integration of climate change)’ of Ekstrom and Moser (2014, p. 65) is the same as the factor ‘leadership/policy entrepreneurs’ of Runhaar et al. (2018). The barrier ‘lack of time or staff’ of Ekstrom and Moser (2014) fits best with the factor ‘staff’ of Runhaar et al. (2018). Finally, the barrier ‘options perceived as unpleasant, negative, politically or publicly unacceptable’ of Ekstrom and Moser (2014) can be linked to the factor ‘public awareness or support’ formulated by Runhaar et al. (2018).

In the phase ‘selection of options’ (P3) fewer barriers are mentioned because only a few actual decisions had been made to date (Ekstrom & Moser, 2014). The barrier ‘limited or lack of options (dislike of feasible options, cost of options, negative side effects of options, narrow range of options, limitation on innovation)’ (Ekstrom & Moser, 2014, p. 65) cannot directly be linked to a factor of Runhaar et al. (2018) as it is very specific to the phase ‘selection of options’. The barrier ‘politics and the political process (e.g.,

property rights issues, political ambition of decision-makers, fear of legal repercussions, resistance to collaboration, people's values, narrow interests)' (Ekstrom & Moser, 2014, p. 65) can be linked to the factor 'political commitment' of Runhaar et al. (2018). The barrier 'public or stakeholder opposition to choices (e.g., campaign against policy change)' (Ekstrom & Moser, 2014, p. 65) can again be linked to the factor 'public awareness or support' of Runhaar et al. (2018). The barrier 'lack of or limited actual jurisdiction over option' (Ekstrom & Moser, 2014) can be linked to '(in)flexible legislative or policy contexts' (Runhaar et al, 2018). Furthermore, the barrier 'lack of governance structure through which to make and implement decision' (Ekstrom & Moser, 2014) could be linked to 'institutional fragmentation' (Runhaar et al, 2018).

The majority of the barriers from the managing phase were encountered during the first phase called the 'implementing options' phase (M1). According to Ekstrom and Moser (2014) many of the barriers were anticipated rather than actively encountered already. The most important barriers fall into the funding and institutional categories. The barrier 'lack of funding to implement option (competition for funds with other jurisdictions, other priorities, overall budget cuts, economic crisis, lack of revenues, different revenue sources and funding structures)' (Ekstrom & Moser, 2014, p. 66) can be linked to the factor 'financial resources' of Runhaar et al. (2018). The barrier 'legal barriers (current law preventing implementation of option, lengthy process of obtaining permits, bureaucracy, lack of state or federal mandate)' (Ekstrom & Moser, 2014, p. 66) can be linked to the factors '(in)flexible legislative or policy contexts', 'formal requirements to develop adaptation plans', 'expanded mandates or statutes' and 'supportive regulative framework' of Runhaar et al. (2018). The barrier 'lack or fragmentation of governance structure (lack of regional policy or guidance, lack of decisionmaking structure that cuts across jurisdictions, resistance to regional approach, lack of coordination across agencies, divisions, jurisdictions, different missions)' (Ekstrom & Moser, 2014, p. 66) can be linked to the factors that Runhaar et al. (2018) call 'institutional fragmentation', 'coordination/cooperation between departments', 'cooperation with private actors' and 'coordination among policy levels'. The barrier 'resistance from affected parties (property rights issues, general resistance to regulation, power issues, greed, reluctance to cede local authority to higher-level authorities' regulation of land use for climate adaptation' (Ekstrom & Moser, 2014, p. 66) cannot be directly linked to a factor of Runhaar et al. (2018). Finally, the barrier 'lack of political will and commitment' of Ekstrom and Moser (2014) is the same as the factor 'political commitment' of Runhaar et al. (2018).

**Table 4.** Summary of the drivers and barriers of Ekstrom and Moser (2014) and Runhaar et al. (2018).

Category	Driver/Barrier
P2: Assessment of options	Funds for detailed assessments
	Coordination/cooperation between departments
	Cooperation with private actors
	Coordination among policy levels
	Knowledge and expertise among staff
	Data and science
	Leadership or policy entrepreneurs
	Time or staff
	Options perceived as (un)pleasant, politically or publicly (un)acceptable
P3: Selection of option(s)	The amount of options
	Politics and the political process
	Public awareness or support
	Actual jurisdiction over option

	Governance structure through which to make and implement decision
M1: implementing option(s)	Funding to implement option
	(In)flexible legislative or policy contexts
	Formal requirements to develop adaptation plans
	Expanded mandates or statutes
	(Un)supportive regulative framework
	(Lack or fragmentation of) governance structure
	(Lack of) resistance from affected parties
	Political will and commitment

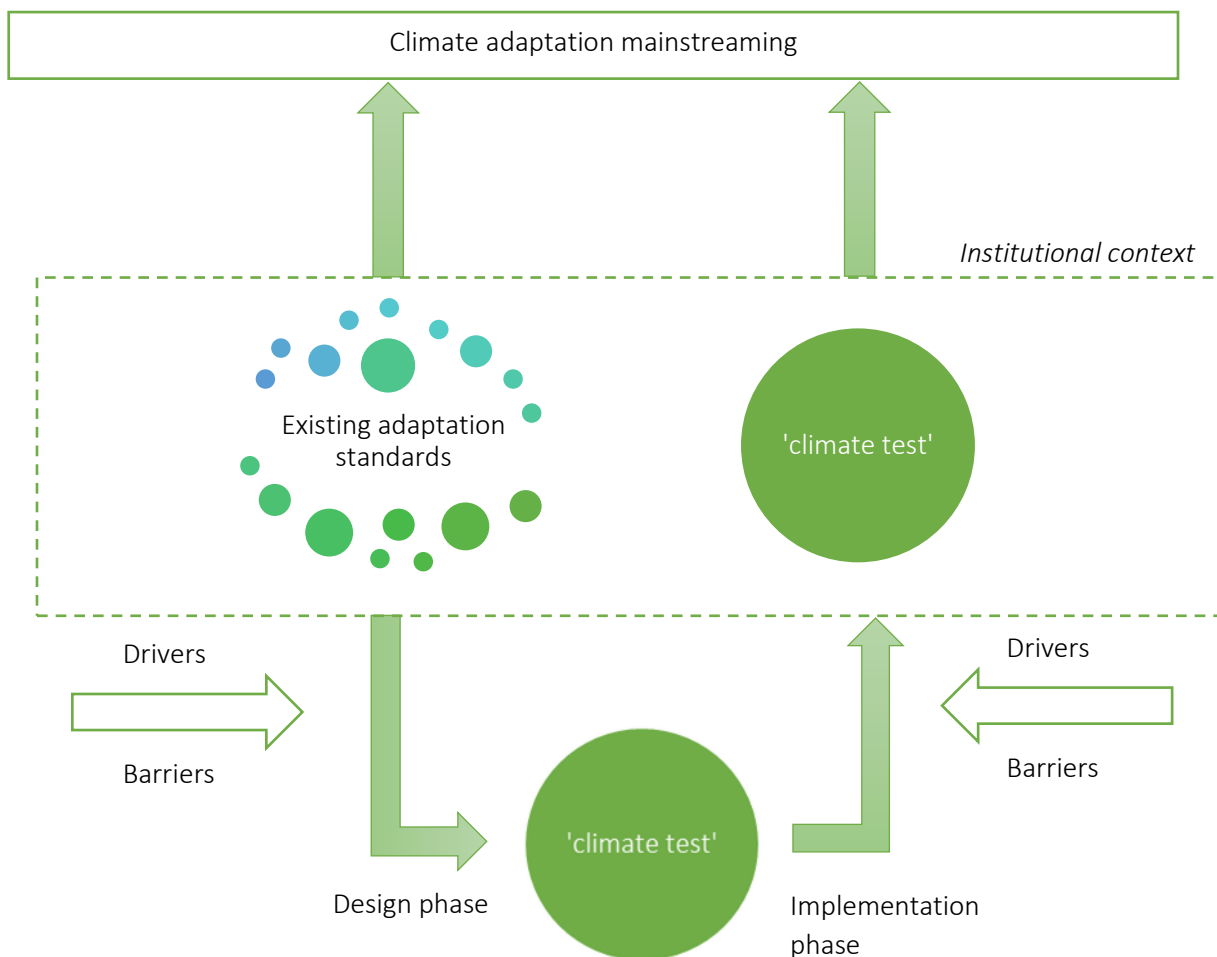
Finally, Table 5 contains the remaining drivers and barriers of Runhaar et al. (2018) with the corresponding categories. The cognitive factors are the “level of awareness, level of uncertainty, sense of urgency, and degree of social learning” (Runhaar et al., 2018, p. 1203). The factors of timing are “waiting and sustaining momentum for climate adaptation, focussing events, and windows of opportunity such as urban renewal” (Runhaar et al., 2018, p. 1203). The characteristics of the adaptation problem at issue are “the way in which the adaptation objective is framed and linked to sectoral objectives, level of detail in which adaptation objectives are defined and compatibility of time scales” (Runhaar et al., 2018, p. 1203). The remaining political factors are ‘policy (in)consistency across levels’, ‘political (in)stability, political patronage, or short-termism’ and ‘conflicting interests’. The remaining organisational factor is ‘clarity about responsibilities for adaptation’. The remaining factor from the category ‘resources’ is ‘subsidies from higher levels of government’ (Runhaar et al., 2018).

**Table 5.** Summary of the remaining drivers and barriers of Runhaar et al. (2018).

Category	Driver/Barrier
Cognitive factors	Learning
	Uncertainty
	Awareness
	Sense of urgency
Timing	Windows of opportunity
	Focussing events
	Waiting and sustaining momentum for adaptation
Characterisation of problem at hand	Narrowly defined adaptation objectives
	Timescales (conflicting or compatible)
	Framing and linking to sectoral objectives
Political factors	Policy (in)consistency across levels
	Political (in)stability, political patronage, or short-termism
	(Lack of) conflicting interests
Organisational factors	(Lack of) clarity about responsibilities for adaptation
Resources	Subsidies from higher levels of government

### The conceptual model

To be able to develop an adaptation instrument for the municipality of Arnhem it has to be known what the drivers and barriers are to design and implement such an instrument within this institutional context. Therefore, first an inventory has to be made of all the existing adaptation instruments within the municipality of Arnhem. Then, these different adaptation options have to be assessed and selected as part of the design phase (phase P2 and P3 according to Ekstrom and Moser (2014)). Then, the best options which will be part of the 'climate test' have to be implemented within the institutional context of Arnhem (M1 according to Ekstrom and Moser (2014)). All these steps face different barriers. First, there are barriers within the institutional context (Runhaar et al., 2018; Uittenbroek, 2016). Second, there are barriers specific to the design phase and the implementation face (Ekstrom & Moser, 2014; Runhaar et al., 2018). Finally, there are not only barriers for each of these steps, but there are also drivers (Runhaar et al., 2018). Thus, in this conceptual model the drivers and barriers influence both the design phase and the implementation phase of the development of an adaptation instrument (Figure 6).



**Figure 6.** The conceptual model.

### 3. Methodology

The research of this thesis contains four steps (Figure 7). Each of the steps is linked to the (sub-) question it is aimed to answer. The first step looks into the adaptation standards that already exist within the municipality of Arnhem, the second step looks into the design phase of the instrument and the third step looks into the development phase of the instrument. Moreover, the content analysis of the first step looks into the institutional context of the municipality of Arnhem. This is called the internal (institutional) context in this thesis. The content analysis in the second and third step looks into the external (institutional) context. Finally, the fourth step aims to answer the main research question and thus looks into the drivers and barriers of the design and implementation phase.

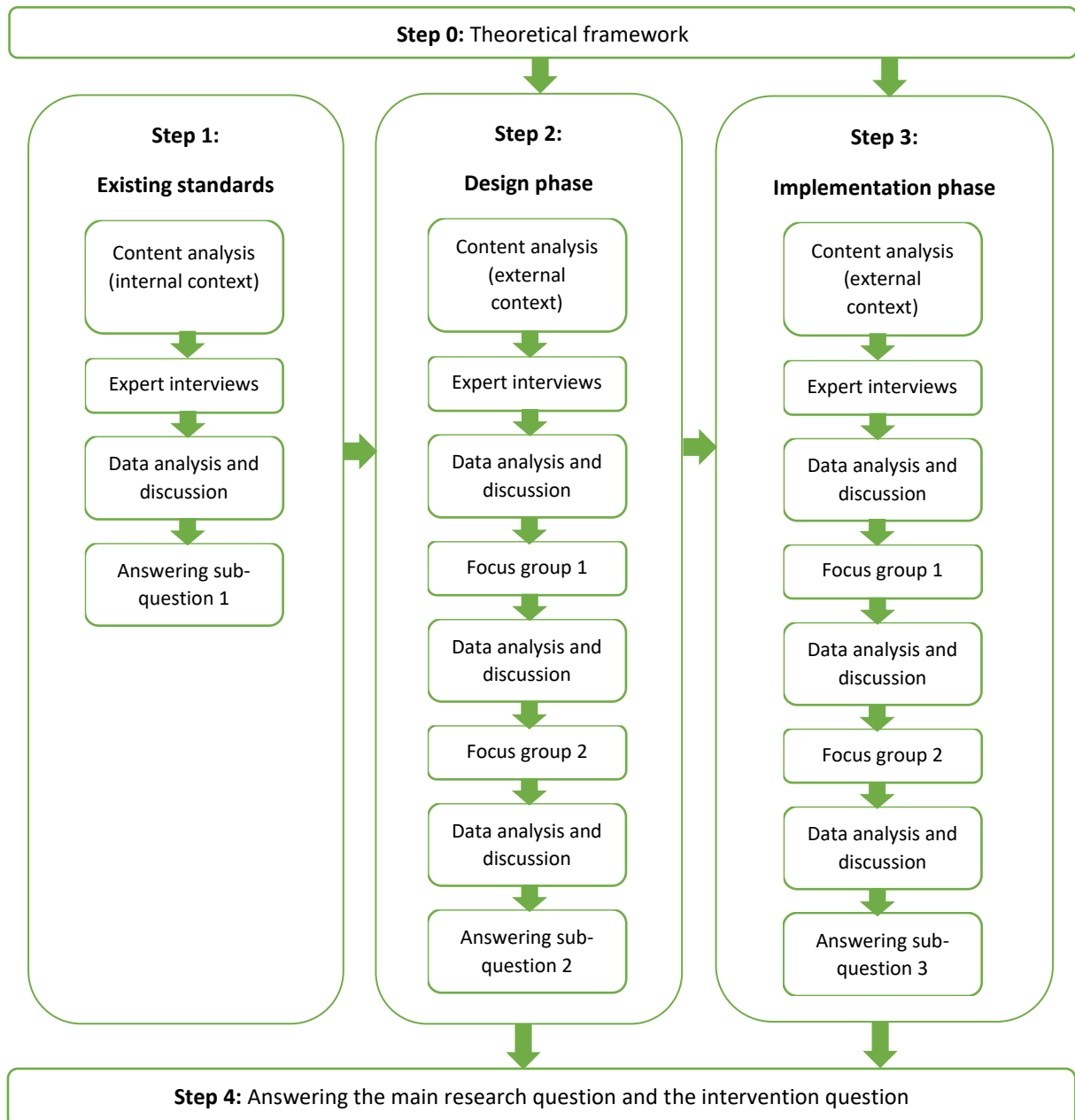
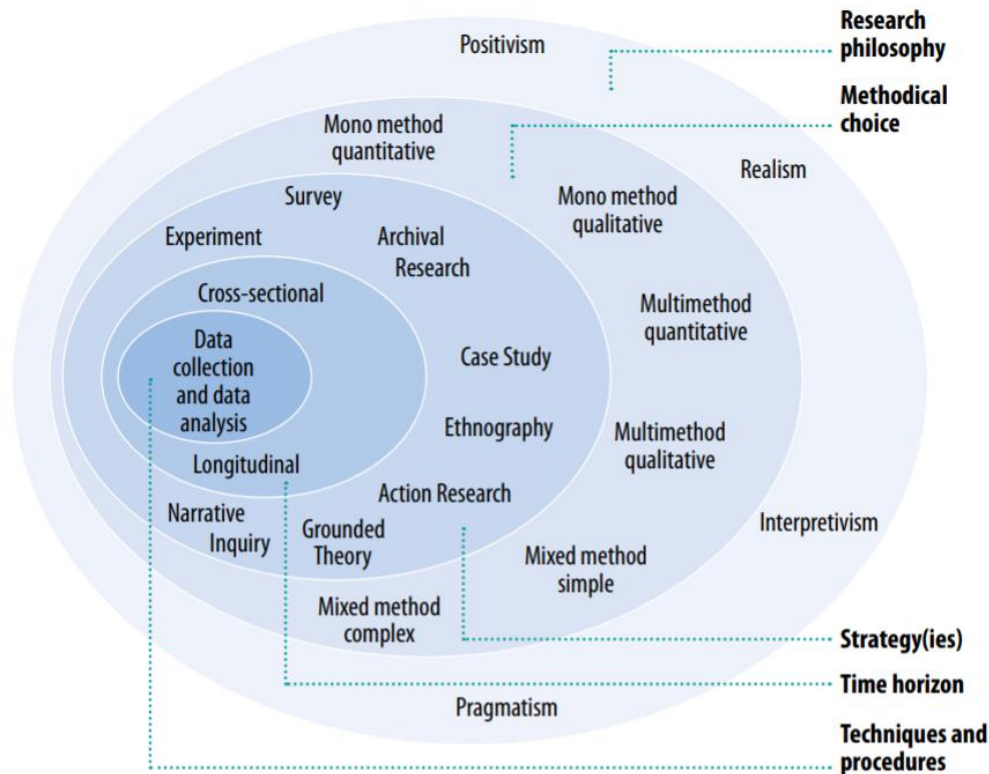


Figure 7. The research steps.

In the following sections the methodology of the research will be elaborated upon with the use of the ‘research onion’ created by Saunders and Tosey (2013; Figure 8). First, the research philosophy behind the steps will be explained. Then, the methodological choice will be explained, and respectively the research strategy, the data collection and data analysis. Moreover, the validity and reliability and the ethical considerations of this research will also be addressed.



**Figure 8.** The research onion (Saunders & Tosey, 2013, p. 59)

### 3.1 Research philosophy

The set of basic beliefs that defines the way we see the world is called a paradigm (Guba & Lincoln, 1994). This research paradigm or research philosophy is what underlies all research. “Beneath any given research design and choice of methods lies a researcher's (often implicit) understanding of the nature of the world and how it should be studied” (Moses & Knutsen, 2012, p. 1). Therefore, as researchers have an implicit bias, it is important that they clearly state the research philosophy that underlies their research. Each paradigm gives its own answers to the three fundamental questions of ontology (“What is the form and nature of reality?”), epistemology (“What is the relationship between the researcher and the thing to be known?”) and methodology (“How can the researcher go about finding out the thing to be known?”) (Guba & Lincoln, 1994).

Guba and Lincoln (1994) distinguish four research paradigms, with one side positivism and on the other constructivism. In this thesis two different research philosophies are being applied: post-positivism and constructivism. The ontology of positivism entails realism, where it is assumed that an apprehendable reality exists that is driven by natural laws and mechanisms. The ontology of constructivism, on the other hand, is relativism. Here it is assumed that realities are apprehendable in the form of multiple mental constructions, which are socially and locally based. Moreover, these constructions are not more or less true, but are more or less informed or sophisticated (Guba & Lincoln, 1994).



### The existing standards

Researching the development of a policy instrument, one first looks into the sufficiency of the adaptation standards that already exist. This is a matter of an existing 'true' reality. It is however "only imperfectly apprehendable because of basically flawed human intellectual mechanisms and the fundamentally intractable nature of the phenomena" (Guba & Lincoln, 1994, p. 110), which leads to the research philosophy of post-positivism. Because the effects of adaptation measures on the problems caused by climate change are true, but only imperfectly apprehendable.

### The design phase

There is a vast amount of climate adaptation instruments that do exist in the Netherlands (Samen Klimaatbestendig et al., 2020). However, there is a possibility that not every single instrument will be taken into account during this research, due to its limited scope. This also supports the presumption that the true nature of reality can only be known imperfectly.

However, when selecting, combining or improving the existing standards to develop a new adaptation instrument, the research philosophy of constructivism applies, as the "findings are literally created as the investigation proceeds" (Guba & Lincoln, 1994, p. 111). Moreover, according to Henstra (2016) "instrument choice is not purely technical, but rather political, in that the selection of a particular instrument affects whose interests will be served and the distribution of benefits and costs, and entrenches institutional procedures and resources that are difficult to redeploy" (p.498). Therefore, as instruments are mental constructions that are socially based, the philosophy of constructivism applies (Guba & Lincoln, 1994).

### The implementation phase

For the research on the implementation phase of the development of the climate adaptation instrument the same research philosophies apply. The collection of data on the different possibilities and looking into examples of the implementation of the instrument is a purely post-positivist approach. However, deciding on the best option is a constructivist approach.

### 3.2 Methodological choice and research strategy

The second layer of the research onion of Saunders and Tosey (2013) is the methodical choice and the third layer of the research onion is the research strategy. In this thesis a multimethod qualitative approach is used to gather data. This means that there are multiple methods used, but they are both qualitative methods. This is in contrast with a mixed methods approach, where multiple methods are used which are both qualitative and quantitative (Saunders et al., 2019).

The research strategy of this thesis is a case study. The goal of a case study is to understand complex issues in real world settings (Mills et al., 2017). Case studies “contribute to our knowledge of individual, group, organizational, social, political, and related phenomena” (Yin, 2009, p. 4). Phenomena that can be studied in a case study are for example: small group behaviour and organizational and managerial processes (Yin, 2009). According to Mills et al. (2017) for case study research it is encouraged to use multiple methods to collect and analyse data as together they provide a more synergistic and comprehensive view of the issue being studied. A case study strategy can be focussed on a single case or multiple cases (Saunders et al., 2019). A single case is used when one particular context is to be studied in depth. This is often the case when the research is commissioned by one particular organisation (Saunders et al., 2019), as is the case for this thesis.

#### The internal context

The main case to be researched for the drivers and barriers for the design and implementation of an adaptation instrument is the municipality of Arnhem. Therefore, the main part of this research is a single case study.

#### The external context

To be able to know how an instrument should be designed and implemented more in depth, multiple other cases should be studied also. This provides more insight in how a similar instrument is being designed and implemented by other regions and provinces. These cases are: the metropole region of Amsterdam, the province of Zuid-Holland and the province of Utrecht.

A multiple case study conducts theoretical replication when the contextual factor is deliberately different. This is in contrast with literal replication, where similar results are predicted (Saunders et al., 2019). In this thesis both types of replication are used. The contextual factors of the cases are very different. However, while the content of their ‘climate test’ might differ, their approach to develop the ‘climate test’ might be similar and can be used as an example.

### 3.3 Data collection

Van Thiel (2014) distinguishes six different research methods: observations, questionnaires, interviews, content analysis, secondary analysis and meta-analysis. In this research semi-structured expert interviews and focus groups will be conducted and data will be gathered through a content analysis, depending on which question is being answered (Table 6).

**Table 6.** Overview of data collection and data analysis.

Question	Subject	Data collection	Data analysis
<b>Main question</b>	Drivers and barriers	Interviews	Coding in Atlas.ti
<b>Sub question 1</b>	Existing standards	Interviews	Coding in Atlas.ti
		Documents (internal context)	Overview in Excel
<b>Sub question 2</b>	Design climate test	Interviews	Coding in Atlas.ti
		Documents (external context)	Overview in Excel
		Focus groups	Coding in Atlas.ti
<b>Sub question 3</b>	Implementation climate test	Interviews	Coding in Atlas.ti
		Documents (external context)	Overview in Excel
		Focus groups	Coding in Atlas.ti

#### The internal context

For the internal context the drivers and barriers for the design and implementation of the adaptation instrument are studied with the use of expert interviews. Moreover, information is gathered on the different adaptation measures that already exist within the municipality of Arnhem and how the ‘climate test’ should be designed and implemented within this institutional context with the use of expert interviews, focus groups and content analysis.

#### *Semi-structured interviews*

The semi-structured interviews are conducted with climate adaptation experts, project managers and urban planners working for the municipality of Arnhem (Table 7). Not only are the participants selected on their expertise, but also on their previous work experience. According to van Thiel (2014) this is a non-probability sampling approach as these individuals are selected based on their knowledge. As this selection is made on theoretical grounds, this is a purposive sample (van Thiel, 2014). According to Hennink et al. (2017) “the most common guiding principle for assessing the adequacy of a purposive sample is saturation” (p. 591). Theoretical saturation means that no new insights emerge or new conceptual categories are identified. This type of saturation is more about sample adequacy and less about sample size (Hennink et al., 2017). Due to the limited scope of this research, a small sample size is used for the interviews. However, in the last interviews no new insights emerged and theoretical saturation is achieved.

**Table 7.** List of interviewees.

Expert #	Expertise	Interview	Focus group 1	Focus group 2
CA1	Climate adaptation; Greening	15/03/22		
CA2	Climate adaptation; Water	17/03/22		
CA3	Energy; Climate adaptation	24/03/22	21/04/22	30/04/22
CA4	Climate adaptation; Greening	05/05/22 21/04/22	21/04/22	30/04/22
CA5	Climate adaptation		21/04/22	30/04/22
HS	Heat stress	05/04/22		
WM	Water management	24/03/22		
PM1	Project management	31/03/22		30/04/22
PM2	Project management	31/03/22		
PL1	Urban planning	07/04/22		30/04/22
PL2	Urban planning	08/04/22		

For the semi-structured interviews an interview guide is created (Appendix A). To be able to answer the first sub-question, questions are asked about the different adaptation measures that already exist within the municipality of Arnhem. Questions about the perceived sufficiency of these existing measures are also asked. To answer the second and third sub-question questions are asked about how the experts think the adaptation instrument can best be designed and implemented. Moreover, to be able to answer the main research question questions are asked about the perceived drivers and barriers for the design and implementation of a climate adaptation instrument.

### *Content analysis*

To be able to answer the first sub-question two policy documents of the municipality of Arnhem are analysed (Gemeente Arnhem, 2020, 2021) (Table 8). An inventory of the different adaptation measures is made in Excel.

**Table 8.** List of the analysed documents.

#	Institutional context	Document name	Year	Government level
1	Internal context	Uitvoeringsagenda Klimaatadaptief Arnhem	2021	Municipality of Arnhem
2	Internal context	Strategie Klimaatadaptatie Arnhem 2020-2030	2020	Municipality of Arnhem
3	External context	Handreiking klimaatbestendige nieuwbouw Metropoolregio Amsterdam		Metropole region Amsterdam
4	External context	CONCEPT BASISVEILIGHEIDSNIVEAU KLIMAATBESTENDIGE NIEUWBOUW 2.0	2021	Metropole region Amsterdam
5	External context	Afspraken klimaatadaptief bouwen	2021	Province of Utrecht
6	External context	Leidraad Klimaatadaptief bouwen 2.0	2022	Province of Zuid-Holland; metropole region Amsterdam; Province of Utrecht; Province of Gelderland

### *Focus groups*

Asbury (1995) states that “focus groups may be particularly well suited for needs assessment, development or refinement of instruments, and exploration of the interpretation of research results” (p. 415). Therefore, to make some final decisions on the design and implementation of the adaptation instrument, two focus groups are organised. The first focus group only consists of three experts working for the municipality of Arnhem (Table 7). This first focus group is planned early on in the analysis so that some of the basic choices can be made about the development of the instrument. All the expert interviews are conducted beforehand and the preliminary findings are shared before this first focus group. Moreover, the inventory that is made during the document analysis is used to guide the focus group. Thus, this focus group is used to member check the preliminary findings as well as to make certain choices about the further direction of the development of the adaptation instrument.

The second focus group is conducted at the end of the research with one person for each of the expertise the interviewees were selected on (Table 7). This means that experts from both the department of project management, climate adaptation and urban planning are part of the second focus group. It would have been best to also invite the expert from water management. However, due to full schedules this is not possible within the limited time frame of this research. Moreover, this focus group is also used to member check the final findings of the research so that a final recommendation can be formulated. Furthermore, for both the focus group a questioning route is created (Appendix B). A questioning route is similar to an interview guide that is used in semi-structured interviews (Silva et al., 2015). Finally, it is important to note that while the aim as a researcher is to not participate in the focus groups, the focus groups also have to be moderated and sometimes during discussions the line between observer and participant may be more vague.

## The external context

### Content analysis

The external context is only studied to explore how a 'climate test' can best be designed and implemented, not to study the corresponding drivers and barriers. Therefore, a content analysis alone is sufficient. For the content analysis government documents from different levels of government are studied (Table 8). These include documents from the metropole region of Amsterdam (Metropoolregio Amsterdam, n.d.; Metropoolregio Amsterdam Klimaatbestendig, 2021), the province of Zuid-Holland (Van den Dool & Valkenburg, 2022) and the province of Utrecht (Provincie Utrecht, 2021). These documents are selected because they mention the climate adaptation of new developments and because these provinces and regions are the frontrunners concerning the development of an instrument for the climate adaptation of new developments. This external content analysis is also a case of purposive non-probability sampling (van Thiel, 2014). Moreover, during this research a new document has come out, which is a guidebook created by the provinces of Zuid-Holland and Utrecht, the metropole region of Amsterdam and the province of Gelderland. This guidebook 'Leidraad Klimaatadaptief bouwen 2.0' functions as the main guide for the design and implementation of climate adaptation standards for area developments (Van den Dool & Valkenburg, 2022).

## 3.4 Data analysis

### Interviews and focus groups

The interviews and the focus groups are transcribed and analysed with the use of Atlas.ti. As the same set of transcripts is used to answer different questions, first distinctions are made between the different sub-questions and the main question with the use of differently coloured codes. Each important quote is coded as a brief statement and each statement is coded with the colour of the questions it answers. For each question an individual network is created in Atlas.ti. This results in four networks and six main categories (Table 9).

**Table 9.** Division of categories between the networks.

Question	Network	First category	Colour
Sub-question 1	1	Existing standards	Green
		Shortcomings	Purple
		Successes	Blue
Sub-question 2	2	Content design of the adaptation instrument	Yellow
Sub-question 3	3	Implementation of the adaptation instrument	Orange
Main question	4	Drivers/Barriers	Turquoise

Where deductive codes come from the theoretical framework, inductive codes are constructed and emerge as a researcher reviews the data (Mihás & Odum Institute, 2019). All the transcripts are coded with an inductive approach. For each network the patterns and themes are observed between the statements. These statements are then merged into overarching codes. So instead of coding directly in the transcripts, the statements within each network are converted into codes. This is then repeated until no new connections or codes are found to make sure there is a so-called exhaustive coding scheme (van Thiel, 2014).

The codes are analysed using the constant comparative method. It is called a constant comparative method because the coding occurs throughout the entire research and the coding scheme is constantly being re-examined and refined. The first type of coding that is done in this method is called 'open coding'. Here the transcripts are read and codes are applied to distinct fragments of data. After this, the codes are compared and categorized into overarching categories. This is called 'focussed coding' (Silva



et al., 2015). During these steps the codes about the drivers and barriers are also continually compared to the drivers and barriers from the theoretical framework. Using the guidelines created by Mihas and Odum Institute (2019) a codebook is created for both the codes for the sub-questions as well as the codes for the drivers and barriers (Appendix C). These codes align with the codes in the networks made in Atlas.ti (Appendix D).

### Content analysis

The inventories of the documents from the internal and the external context are made in Excel. This inventory in Excel contains the existing adaptation standards within the municipality of Arnhem together with the standards from the so-called guidebook 'Leidraad Klimaatadaptief bouwen 2.0' created by the metropole region Amsterdam and the provinces of Utrecht, Zuid-Holland and Gelderland (Appendix E). These inventories are also used to guide the discussion during the focus groups.

Moreover, to be able to know how the 'climate test' can best be designed and implemented, analysing the 'Leidraad Klimaatadaptief bouwen 2.0' is also useful. Therefore, the codes that are used for the answering of sub-questions 2 and 3 are compared to the overviews of the 'Leidraad Klimaatadaptief bouwen 2.0'. These include an overview of the different types of standards that could be formulated (Appendix F) and an overview of all the planning instruments that could be used to implement the climate adaptation standards (Appendix G). It is important to note that the guidebook is not analysed for the drivers and barriers.

### 3.5 Validity and reliability of the research

The validity and reliability of a research are of great importance. First, there are two types of validity. Internal validity means that the researcher has actually measured what they intended to measure (van Thiel, 2014). In a case study this can be achieved by cross-checking the results, which will increase the internal coherence of findings in the data analysis phase (Riege, 2003). This is achieved in this thesis by using the same codes on all the interviews and the focus groups. Moreover, member checking is used to validate qualitative results by returning the analysed data to the participants (Birt et al., 2016). Thus, member checking the preliminary results from the interviews with the use of focus groups also increases the validity of this research.

External validity, on the other hand, is the extent to which a study can be generalized. This means that the results of the research should also hold for other persons, moments, time or locations (van Thiel, 2014). In a case study this can be achieved during the data analysis phase by comparing the evidence with the existing literature (Riege, 2003). First, this is done by comparing the found drivers and barriers with the drivers and barriers in the theoretical framework. Second, this is done by comparing the found existing standards from the interviews and focus groups with the inventory created from the documents of the municipality of Arnhem. Third, this was done by comparing the codes about the design and implementation of the instrument from the interviews and focus groups with the guidebook document 'Leidraad Klimaatadaptief bouwen 2.0' (Van den Dool & Valkenburg, 2022). Furthermore, high validity is also achieved through the use of semi-structured interviews as a researcher can gather information about the actions and perceptions of interviewees (Ahlin, 2019).

Second, reliability is the accuracy and the consistency of the measurement of the variables (van Thiel, 2014). "The more accurately and consistently the variables are measured, the more certain it is that results will not be coincidental, but paint a systematic and representative picture" (van Thiel, 2014, p. 48). For example, in a case study this can be achieved by mechanically recording data with a voice or video recorder (Riege, 2003), as is done in this research. Moreover, reliability can be increased with "the assurance of meaningful parallelism of findings across multiple data sources" (Riege, 2003, p. 83). This is assured as the interview guides are the same for all the semi-structured interviews. Moreover, as mentioned before, all the interviews and focus groups are analysed with the same codes in Atlas.ti.

Furthermore, according to van Thiel (2014) data triangulation enhances the reliability and validity of the research. Triangulation means that there are more than one method used in a research to double check the data collection and research results. It can be achieved through the use of multiple different research methods (van Thiel, 2014). This is done in this research as interviews are conducted, focus groups are organised and documents are analysed.

### 3.6 Ethical considerations

According to van Thiel (2014) there are five ethical rules to take into consideration while conducting a research. These ethical rules are: beneficence, privacy, informed consent, veracity and confidentiality. Beneficence entails the fact that the research should do no harm (van Thiel, 2014). As this research does not touch upon sensitive topics, this rule is not broken during this research. Second, before each interview and focus group the aim of the research and research questions are made clear to the participants. This coincides with the rule of veracity, which states that participants should be made aware of the intended aim of the research (van Thiel, 2014). The participants are also told that the recordings are transcribed and analysed and that the recordings and transcripts will not be made public. This follows the rule confidentiality, as the participants are made clear how their information is used (van Thiel, 2014). Moreover, the participants are informed on the fact that recordings are made during the interview or focus group and that the interview can be stopped at any time if they do not feel comfortable. After stating these facts the consent of each participant is asked. This follows the rule of informed consent. This rule states that permission should be asked for conducting the research and the publication of the results (van Thiel, 2014). The final rule is the rule of privacy, which states that participants have the right to refuse to participate or to withhold information (van Thiel, 2014). During this research some participants are using this right. Therefore, certain parts of the recordings are not analysed and some interviewees are not quoted directly. Moreover, as some interviewees want to remain anonymous, all respondents are made anonymous and their exact job descriptions are not shared publicly.

## 4. Results

### 4.1 The existing adaptation standards in the municipality of Arnhem

To be able to gather all the adaptation standards that already exist within the municipality of Arnhem an inventory is made of the existing climate adaptation policy of the municipality of Arnhem (Appendix E) and interviews are conducted with experts working for the municipality of Arnhem. The results are elaborated upon in the following sections.

#### Document analysis

In the two policy documents of the municipality of Arnhem (Gemeente Arnhem, 2020, 2021) there are different policy goals formulated for different areas of the city. Distinctions are made between the source areas for flooding and the area where the water ends up; new buildings, renovations and public spaces; and red areas where the heat stress is most urgent, orange areas where the heat stress is a bit less urgent, yellow areas where the heat stress is not a problem and blue areas which can be divided in dark blue for large parks, blue for rural areas and flood plains and light blue for smaller parks in the city (Gemeente Arnhem, 2021; Appendix E).

The fluvial flooding policy aims to disconnect as much rainwater pipes from the sewage system as possible; there is an aim to have 10% less impermeable surfaces in the city; to pay attention to the height of doorsteps and floors; the fact that heavy rainfall shouldn't cause flooding; that rainwater should be infiltrated within the plan area; and that water should be stored in public spaces. The heat stress policy mentions the use of trees that give shadow; the use of greenery and less impermeable surfaces; the use of cooling wind streams; lowering the perceived temperature with the use of shadow, material choices for buildings and green and blue spaces; and creating routes with shadow and cool areas. The policy documents do mention the problems of fluvial flooding and drought, but no policy goals are formulated (Gemeente Arnhem, 2020, 2021; Appendix E).

#### Interviews and focus groups

##### *Water standards*

For water the different measures mentioned by all the respondents (2022) are the fact that rainwater pipelines should be disconnected from the sewage system; that developments shouldn't cause flooding in the surrounding area; the fact that a water assessment has to be conducted by the water board when developments are located near waterways; and the fact that rainwater should be managed on the property. Overall, the standards for water were considered to be sufficient as they are taken well into account for every project (respondents CA1, CA3 and CA4, 2022). Moreover, because it is legally required to place the recommendation resulting from the water test in the explanation of the zoning plan it is taken very seriously (respondent CA4, 2022). As respondent CA4 (2022) states:

*“But if it is mandatory, as you now see with the water assessment of the water board and with the points system for nature-inclusive development, then we suddenly start thinking about it.”*

However, according to respondent CA3 (2022) the water assessment works well for large developments, but not particularly for the small developments. Moreover, according to respondents CA2, CA3 and WM (2022) because the water assessment is only executed at the end of the process, it sometimes does not fit within the spatial plan anymore.

The standard that rainwater has to be managed on the property is a national standard and is therefore also taken seriously (respondent CA4, 2022). However, there can be exceptions to this standard when

there is no room to manage the water on the property. This rule that it only has to be managed when it is reasonable to do so is considered a bit too lenient by respondent CA4 (2022).

#### *Heat stress standards*

According to the respondents (2022), for heat stress the policy states that temperatures in the red areas on the map should be lowered and that temperatures in the yellow areas should not increase. Moreover, there is a national standard named the 'TOjuli' standard. This standard is a regulation about the heat stress in buildings. However, according to respondent CA3 (2022) the TOjuli standard is not taken into account if there is an active cooling system, such as an air conditioner. Furthermore, the comfortability and heat stress in the indoor climate of a building is tested by the 'GGD' (Municipal or Community Health Service) according to respondent PM2 (2022).

A general shortcoming of the heat stress standards is that there are no concrete and obligatory standards for heat stress because there is a limited amount of expertise on heat stress within the organisation (respondents PM1, PM2, CA3 and CA4, 2022). However, according to respondents CA3, PM1 and PM2 (2022) a success of the heat stress standards is that during projects advice is given by different experts on how to mitigate heat stress. For example, about the orientation of the building in relation to the sun, the use of blinds or the use of colours that reflect the sun.

#### *Drought standards*

There are no obligatory standards for drought within the municipality of Arnhem as according to respondents CA1, CA4, PM1 and PM2 (2022) there is limited attention towards drought within the organisation.

#### *Other standards that contribute to climate adaptation*

Next to the standards for heat stress, flooding and drought there are also other standards that indirectly contribute to climate adaptation. For example, Arnhem has tree policies such as the fact that trees have to be protected during projects and that if they are taken down they have to be compensated elsewhere (respondent CA1, 2022). Moreover, the municipality has the policy that in areas with heat stress the percentage of the tree canopies has to be increased by 10% and the overall percentage of tree canopies within the municipality has to be increased by 5% (respondent CA1, 2022). Moreover, according to respondent CA3 (2022) the municipality has the policy that unnecessary impermeable surfaces such as pavements have to be decreased as much as possible.

Last but not least, the municipality has a points system for making buildings nature-inclusive (points system NID). The amount of points that has to be reached depends on the size of the project. A combination has to be made between green measures (such as trees, bushes or green facades) and nesting facilities for birds. It is a rule in the zoning plan that this points system has to be filled in in order to receive a building permit. Moreover, for large developments it is mandatory that the points system is filled in together with an ecologist (respondent CA4, 2022). According to respondent CA4 (2022) the points system is received very well by project developers as it is clear to the developers what is asked of them; there is a level playing field because everybody has to meet the same requirements; and the designers retain the freedom for customizations and creativity because they can choose their own measures. Moreover, because it is a rule in the zoning plan, the points system is taken seriously. As respondent CA4 (2022) states:

*"What I can say is that the response so far has been positive, because developers feel that they now know what they have to do. So thanks to that points system, they know what they have to do to comply with nature-inclusive development."*

*There is also a level playing field, because everyone has to comply with it. And they do retain the freedom and creativity to choose the measures themselves..”*

However, one downside to the points system NID is that no house is built yet with this points system. Therefore, it is not known if the buildings will actually be as green as what is aimed for by the municipality (respondent CA4, 2022).

#### *Climate adaptation policy in general*

Moreover, the respondents also mention shortcomings of the climate adaptation policy in general. The general shortcomings are that the integral aspect is missing as the department of climate adaptation doesn't always take other departments into account very well (respondent PL2, 2022). As respondent PL2 (2022) explains:

*“I think sometimes the integral aspect is still missing, and perhaps because those energetic colleagues think that things will go too slowly otherwise, and they want to move forward, and they want change, and it is probably also an assignment from the alderman.”*

Second, according to respondents CA1 and PL2 (2022) the climate adaptation policy is fragmented because there are so many different ambitions that are part of the climate adaptation policy, such as for example greening, water management and biodiversity. Finally, it is mentioned by respondents CA1, CA2, CA3, CA4, PM1 and PL1 (2022) that there is only policy for climate adaptation, but there are no concrete legal requirements formulated. This results in the fact that adaptation measures cannot be maintained or managed very well (respondent PL1, 2022) and that according to respondents CA4, PM1 and PL1 (2022) during projects these ‘soft’ policy goals always lose from the concrete requirements such as the standard for parking.

#### *Climate adaptation during projects*

Finally, the shortcomings of how well the climate adaptation standards are taken into consideration during projects are formulated. First, developers do not take climate adaptation into consideration from the start of the project (respondents CA1, CA2, CA3, HS and WM, 2022). During the project the climate adaptation advice is given and the project developers will state that the measures do not fit within the spatial plan (respondents CA1, CA2, WM and PM1, 2022) and the budget (respondents CA1 and PM1, 2022) anymore and you cannot go back in the process. As respondent CA1 (2022) explains:

*“When we wouldn't appoint anything, and a contract has already been signed with a developer, and then he goes into a project, and then you suddenly come up with those requirements. He will say: ‘We can no longer comply with that. We have not taken that into account in our business model. That is now becoming far too expensive.’”*

Furthermore, according to respondents CA1, CA3 and PM1 climate adaptation is not a standard part of the projects as it really depends on which advisor from the municipality is part of the project team. Some experts from greening or water will give advice about heat stress, while others might not. As respondent CA1 (2022) states:

*“In reality it often depends on the project manager of the projects. Who they get in their project team. And whether there is enough attention for the theme. Because if there is no one in the project team who has anything to do with climate adaptation, then it might just be forgotten.”*

Moreover, according to respondents PM1 and PM2 (2022) sometimes it is unclear to developers when they meet the climate adaptation requirements. And, according to respondent CA4 (2022) you cannot expect developers to have expert knowledge on all the different aspects concerning climate adaptation.

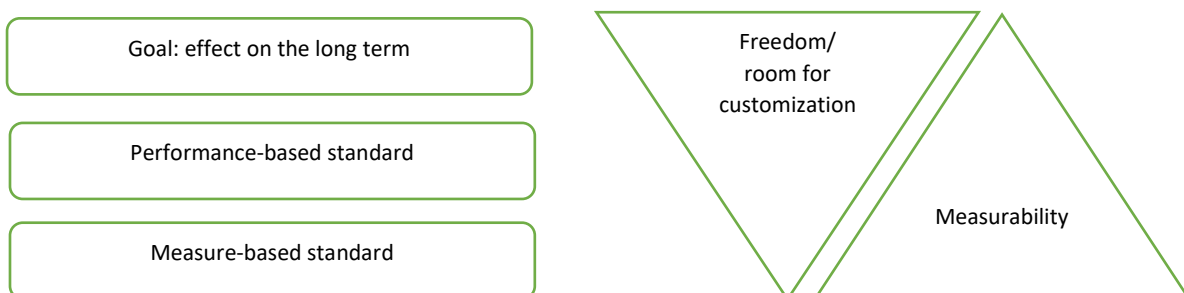
## 4.2 The design of an adaptation instrument

To know all the possible options for the design of an adaptation instrument it is important to know what the possible standards are that can be formulated for the ‘climate test’; which standards are the most favoured by different departments of the municipality; which types of instruments are most favoured; and what the most important considerations are that have to be made. Therefore, an overview is made of the possible types of climate adaptation standards formulated by the provinces of Utrecht and Zuid-Holland and the metropole region Amsterdam (Appendix E; Appendix F) and interviews are conducted with experts working for the municipality of Arnhem. The results are elaborated upon in the following sections.

### Content analysis

According to the guidebook ‘Leidraad Klimaatadaptief Bouwen 2.0’ (Van den Dool & Valkenburg, 2022) there are three types of standards that can be formulated for the adaptation of developments. First, there are goal-oriented standards, which state the long term climate adaptation goals. Second, there are performance-based standards, which describe the performance of the area, building or system. Third, there are measure-based standards which are based on specific climate adaptation measures (Van den Dool & Valkenburg, 2022).

According to the guide of metropole region Amsterdam (Metropoolregio Amsterdam, n.d.) measure-based standards offer a concrete assessment framework that is easy to enforce. However, when these standards are formulated in a zoning plan this makes it impossible to achieve the same adaptation goal with different measures. Thus, the measure-based standards offer little to no flexibility. With a goal-oriented standard, on the other hand, the test is more broad and enforcement may be more difficult. A goal-oriented standard offers the advantage that it is more flexible, so that you can also apply new (technical) measures. According to the guidebook for climate-adaptive development (Van den Dool & Valkenburg, 2022) with the formulation of performance-based standards there is room for customizations and the performances are measurable through calculations. Therefore, the performance-based standards can be placed between the goal-oriented standards and the measure-based standards in terms of freedom and measurability (Van den Dool & Valkenburg, 2022; Figure 9).



**Figure 9.** Level of abstraction of the goals and standards. Based on the guide of Van den Dool and Valkenburg (2022, p. 19).

The performance-based standards formulated in the guidebook (Van den Dool & Valkenburg, 2022) are based on the standards of the metropole region Amsterdam and the provinces of Zuid-Holland and Utrecht and have small differences between them (Appendix E). An example of a performance-based standard is: “at least 50% of the plan area has to be in the shadow on the highest position of the sun (June 21) for places where the traffic moves slowly” (Van den Dool & Valkenburg, 2022, p. 32). The



performance-based standards are the basis for all the other standards and for each of these performance-based standards a choice can be made between formulating a goal-oriented standard or a measure-based standard (Appendix F). Each type has a different way to measure it. For example, for heat stress a measure-based standard can be formulated as follows: "... trees with a canopy larger than 10 meters in diameter must be planted within the plan area before delivery" (Van den Dool & Valkenburg, 2022, p. 33). This could be measured by counting the amount of trees in the design and after the delivery of the project. On the other hand, a goal-oriented standard could be: "the perceived temperature has not increased after realization, compared to the current situation on July 1, 20... at ... (starting situation PET)" (Van den Dool & Valkenburg, 2022, p. 34). This could be measured with the use of a GIS-analysis or a PET model (Van den Dool & Valkenburg, 2022).

## Interviews and focus groups

### *New standards*

First of all, within the municipality of Arnhem there is already a lot of data on the problem areas within the city. Maps have been made with the areas where the problems of heat stress and flooding are the most urgent (respondent CA1, 2022). However, when formulating new standards it becomes apparent that there is a different level of attention towards the different climate adaptation themes. As respondent CA3 (2022) states:

*"Climate adaptation [...] arose from the sewerage group within the municipalities. And from the water people at the water boards. But that has now been broadened very much. And I do not know what it is like here in the municipality of Arnhem, to what extent it has already been broadened, or whether it still has a very strong basis in that group. Because that means that the focus is often not on heat stress."*

Because the climate adaptation department stems from the water and sewage department, there is a lot of attention for flooding (respondents CA1, CA2, CA3 and CA4, 2022). This results in the fact that climate adaptation is very focussed on flooding and less on heat stress and drought. Furthermore, for pluvial flooding it is mentioned by respondents CA2 and CA3 (2022) that the existing water policy should be converted into concrete standards for the 'climate test'. Also, most of the components from the water assessment can be put into the 'climate test' (respondent CA2, 2022). So, for pluvial flooding only new standards have to be formulated if the existing policy goals are not deemed sufficient (respondent CA4, 2022). On the other hand, fluvial flooding is considered to be the responsibility of the water board and is not seen as the highest priority for the 'climate test' (respondent CA2, 2022).

Furthermore, there is limited attention for drought within the organisation. (respondents CA1, CA4, PM1 and PM2, 2022). Therefore, there are different opinions about the formulation of drought standards. Respondent CA4 (2022) mentions that because there are no drought standards yet, this should be part of the 'climate test'. However, respondent CA2 (2022) states that there are no drought standards yet, because drought is less urgent in the municipality of Arnhem and it should therefore not have the highest priority in the formulation of standards for the 'climate test'.

While the attention for heat stress is less than the attention for flooding (respondents CA3 and CA4), there is a willingness among all the respondents (2022) to create heat stress standards for the 'climate test'. For heat stress, the existing policy should be converted into standards for the 'climate test' (respondents CA1, CA2, CA4 and CA5, 2022). Moreover, according to respondents CA3, CA4 and CA5 (2022) there are three different categories for heat stress: the effect of the building on the outdoor temperature; the effect of the building on the indoor temperature; and the effect of the outdoor space on the outdoor temperature. Therefore, for each of these three categories standards should be formulated. For the effect of the building on the outdoor temperature standards could be formulated

about the amount of buildings, the colour of the building, the material of the building and the effect of the wind on the temperature. For example, the cooling effect of the wind is affected by the shape of the building, location of the building and the orientation of the building (respondents CA2 and CA5, 2022).

Standards for the effect of the building on the indoor temperature could be formulated concerning the colour of the building, the placement of the windows, the use of sun screens, green facades and green roofs (respondent CA3, 2022). Moreover, the passive cooling of buildings is also considered an important aspect as active cooling with the use of air conditioners is not sustainable (respondents CA2 and CA3, 2022). However, indoor heat stress has a large behavioural aspect as it, for example, has to do with opening the windows at night (respondent CA3, 2022).

Moreover, to be able to formulate standards for heat stress, it would be most ideal to formulate a standard about the outdoor temperature (respondents CA1, CA2 and CA5, 2022). Standards on the effect of the outdoor space on the outdoor temperature can be formulated in terms of the maximum perceived outdoor temperature. However, there are no instruments to measure this outdoor temperature sufficiently. According to respondents CA1, CA2, CA5, HS (2022) the outdoor temperature can only be assessed through models, which are not precise and easy to manipulate.

Another possible standard that is popular among the respondents is formulating a certain mandatory amount of shadow. For example, a certain percentage of shadow can be formulated (respondents CA2, CA3, CA5 and PL2, 2022). Greening the outdoor space is often mentioned as another important standard by the respondents. For example, this can be done by formulating a certain maximum percentage of impermeable surfaces; a certain green and blue surface area; or a certain percentage of green space (respondents CA1, CA2, CA3, CA5 and HS, 2022). Moreover, the 3-30-300 rule is mentioned by respondents CA4 and PM1 (2022), which is the rule that from each house three trees have to be visible, 30% of the area has to be covered by tree canopy and there has to be a cool green space within 300 meters of each house. The standard that within a certain amount of meters a cool green space has to be available is also mentioned by respondent CA3 (2022) as a separate option. Finally, many of the respondents (respondents CA3, PM2, CA4 and HS, 2022) agree that having a standard about making a certain amount of trees mandatory for a project is not a good idea, as trees sometimes do not fit within a spatial plan (respondent PM2, 2022), trees can die and it can take a long time before a new tree has grown back (respondent CA3, 2022) and trees can block the cooling wind (respondent CA4 and HS, 2022).

#### *Type of instrument*

When thinking about the type of instrument that the 'climate test' could be, there are many different possibilities. First, many respondents agree that the 'climate test' should be an integral instrument where different ambitions are combined. For example, the climate adaptation standards should be combined with the biodiversity, circularity and energy transition ambitions (respondents CA1, CA2, CA3 and PL1, 2022). It is also possible to weigh these different requirements up against each other, as respondent CA2 (2022) states:

*"You can also think about whether you make that kind of relationship, such that you can say: 'okay, the climate adaptation is about neutral, but it still does a lot for biodiversity in itself, or circularity, or perhaps the energy transition'. When it contributes a lot to those aspects, then you say: 'then it can be neutral for climate adaptation. Otherwise it should be positive'. That you also make such a decision. That doesn't make it any easier, though."*

Second, respondents CA3 and PL2 (2022) mention the use of financial instruments. For example, a construction where house owners have to put money in a depot and receive their money back when they meet certain standards or that developers should receive a reward when they meet more than the minimal requirements. However, it is important to note that these instruments can only be used when the municipality owns the land where the house owners or developers want to build on.

Third, respondents CA2, CA4 and HS (2022) mention that the 'climate test' could be a process instrument such as the water assessment where it is mandatory to consult an expert. Similar to the advice given by the water experts for the water assessment, advice could be given by a heat stress expert. This way the water assessment is extended to a climate assessment for both water, heat stress and drought. However, while there are many water experts, there are no heat stress or drought experts (respondent CA4, 2022). This is not only important for the formulation of sufficient standards for heat stress and drought, but this is also important for the choice of the type of adaptation instrument. For example, to be able to make the choice to make the 'climate test' similar to the water assessment, expert advice would be mandatory for every project. This means that there have to be enough heat stress and drought experts, within the organisation as well as outside of the organisation. As respondent CA4 (2022) explains:

*"Well, another obstacle is that there is still a lack of knowledge, at all, about climate-adaptive development in terms of heat stress and drought. I have that impression anyway. With a points system for nature-inclusive development, you could demand of a large development: 'just hire an ecologist to fill it in with you'. Then we know for sure that everything will be fine. But how do you do that with climate-adaptive constructions? And also internally, in our municipality, we are now increasing that level of knowledge with [...]. But we don't really know much about it internally either."*

Finally, many respondents mentioned the use of a points system similar to the points system NID. The arguments for the use of a points system are the fact that developers have the freedom to choose their own options (respondents CA3 and HS, 2022); that it is more just because it is not dependent on the opinion of one advisor (respondent PL2, 2022); that developers are informed and inspired about the different adaptation options they have (respondents PL1 and CA3, 2022); that the requirements are clear to the developer before the projects starts (respondents PM2 and PL1, 2022); and that the points system is easy to test (respondents CA3 and PL2, 2022). The one argument against a points system is that respondent PL2 (2022) is afraid that a points system will cause a lot of administrative work.

#### *Considerations about the strictness of the standards*

When formulating specific standards choices have to be made between the concreteness of the standards and the freedom for creativity and customization. For a standard to be a rule in the zoning plan (bestemmingsplan) it has to be measurable (respondent CA3, 2022). As respondent CA3 (2022) states:

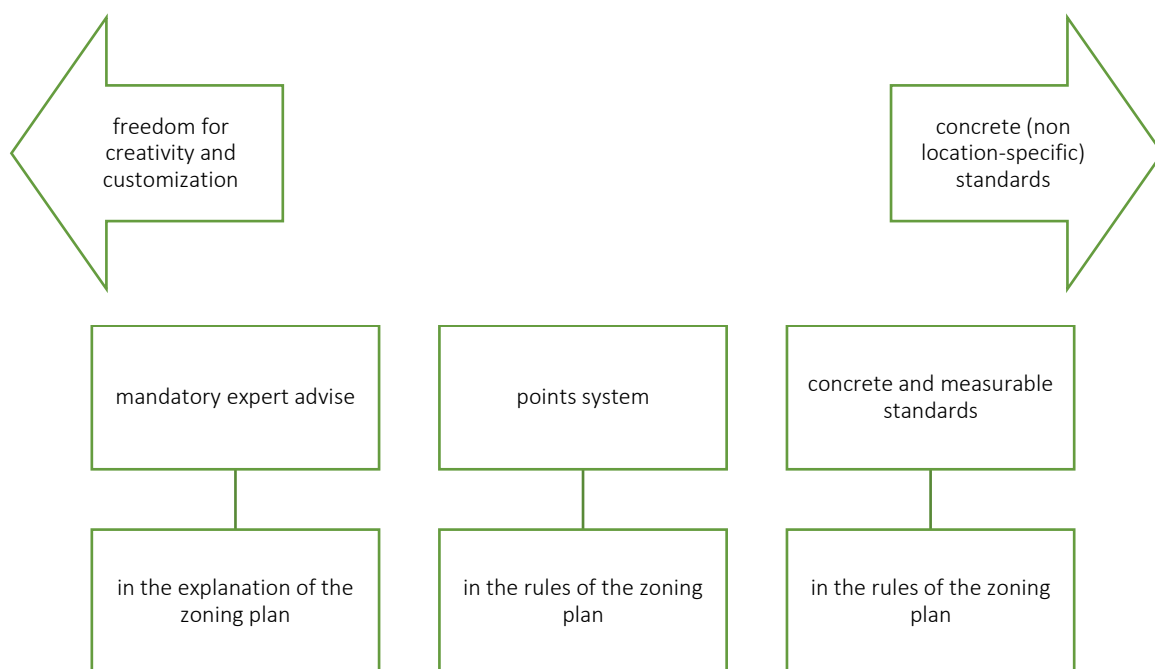
*"You can put it in the rules, but it cannot be tested. So, ultimately it is not taken into account when granting permits."*

This means that the standards have to be concrete and not location-specific. The advantages of these concrete standards is that they can go up against other concrete standards, such as for parking (respondent PM1, 2022) and that they are measurable and therefore enforceable (respondent CA3, 2022).

On the other hand, many respondents mention that they think it is important to give developers and architects the freedom to choose their own adaptation measures. First, there has to be room for exceptions and customizations as many adaptation measures are very location-specific (respondents CA1, CA2, CA3, CA4, WM and HS, 2022). Second, there should be room for creativity and innovation as the policy of the municipality cannot keep up with the innovation of the market (respondents PL2, PM2, CA4, CA5, 2022). As respondent PM2 (2022) states:

*“The moment you try to nail everything down, you might miss a fantastic solution because it is just not in the list. And I would find that a shame. Because the innovation outside is going much faster than we can keep up with with our policy.”*

Thus, the mandatory expert advice would give the designers room for creativity and customization because, similar to the water assessment, the architects retain the freedom to make their own design while still consulting with an expert (Figure 10). On the other hand, concrete standards would be able to be enforced in the rules of the zoning plan because they are measurable. Finally, a points system for climate adaptation can be placed in the middle of this consideration between measurability and freedom. With a points system developers and architects will still have the freedom to choose their own adaptation option, while it is still possible to make it a rule in the zoning plan that a certain amount of points have to be achieved.



**Figure 10.** Considerations about the strictness of the standards.

### *Drivers and barriers for the design of the adaptation instrument*

- **Conflicting spatial interests**

To be able to formulate standards for the 'climate test' it is important to take into account the many conflicting spatial interests of the different departments. For example, climate adaptation can be counterproductive with the ambitions of other departments such as the energy transition or circularity. For example, the materials that are circular are not always climate adaptive, and vice versa. Moreover, there is a limited amount of space within an area development which contains many different interests (respondents CA2, PL1, PL2, WM and PM2, 2022). As respondent WM (2022) states:

*"That one square meter must comply with extra greenery, extra homes. It must comply with underground infrastructure, cables, pipes and sewage. It must comply with parking. So that one square metre, it may contain 20 different ambitions."*

This means that, for example, when planting a tree there must not only be space available above ground, but also below ground. Above ground a tree may take up space that would otherwise be used for parking spaces or houses, while below the surface the roots of the tree can take up space that would otherwise be used for the cables that are necessary for the energy transition or the pipelines of the sewage system.

- **Cooperation between departments**

Currently the lack of cooperation between the different departments is a barrier according to respondents PL1, PL2, CA2 (2022). For example, the climate adaptation department is very ambitious and moves very quickly. However, this can also cause the problem that the interests of other departments are not always taken into account (respondent PL2, 2022). According to respondents WM, PL1 and PL2 (2022) it is important to keep talking to each other, to be able to avoid miscommunication and to help each other. For example, because of the conflicting interests it is important to consult with the department of mobility, the urban planning department and the management department when designing the 'climate test' (respondents PL1, PL2 and CA1, 2022).

- **Cooperation with other organisations**

In addition, when formulating new standards for the 'climate test' many respondents state that it would also be useful to inquire other organisations outside of the municipality. For example, the water board could think along about the water, heat stress and drought standards and the GGD about the heat stress standards (respondents PL1, CA2, CA3, PM2, 2022). Moreover, respondents CA5 and PL1 (2022) state that it is important to ask other municipalities how they are formulating their standard and that the standards for the 'climate test' have to fit with the standards that the province is formulating. Moreover, resources and knowledge from higher levels of government could be used, as the national government and the province are also working on a similar 'climate test' (respondents PL1 and CA5, 2022). According to respondent CA5 (2022) the province is already following a few other regions to develop a covenant for climate-proof development. This is the previously mentioned 'Leidraad Klimaatadaptief bouwen 2.0'. This is a prelude to the national benchmark that will be developed in a few years.

- **Knowledge and expertise within the organisation**

As mentioned before, the level of expertise on heat stress is still limited within the municipality of Arnhem. There is not only too little heat stress expertise within the departments of urban planning or project development, but also in the department of climate adaptation itself (respondents CA4 and CA5, 2022). While this is also the case for drought, this is seen as less urgent by respondent CA2 (2022). This is why respondent CA5 (2022) states:

*“The point about the fact that knowledge is missing. That's not necessary. It is true. But you can make sure that that knowledge is acquired. So if you think it's important that that knowledge is acquired, well then you could say: ‘there must be people from our department [climate adaptation] or urban planning, it doesn't matter to me. You have to get a certain level of knowledge.’”*

Thus, the amount of heat stress expertise should be increased within the organisation. This can be done by giving lectures about heat stress to the different departments, such as for example the urban planning department and the project management department (respondents CA4 and CA5, 2022). This way, the municipality has more expertise on all the different themes of climate adaptation.

### 4.3 The implementation of an adaptation instrument

To know all the possible options for the implementation of an adaptation instrument it is important to know which phases of the project development process are the most important; what the possible process instruments are that can be used for the implementation of the 'climate test'; and which type of legal instrument is the most favoured by the people working for different departments of the municipality. Therefore, an overview is made of the possible adaptation instruments that can be used formulated by Van den Dool and Valkenburg (2022) for the provinces of Utrecht and Zuid-Holland and the metropole region Amsterdam (Appendix G) and interviews are conducted with experts working for the municipality of Arnhem. The results are elaborated upon in the following sections.

#### Content analysis

There are four phases in the process of project developments: the initiation phase, the feasibility phase; the realisation phase; and the management phase. However, the feasibility phase has three sub-phases of its own: the definition phase; the design phase; and the preparation phase (Van den Dool & Valkenburg, 2022). According to Van den Dool and Valkenburg (2022) for each of these phases there are existing instruments that can be used to make developments better adapted to climate change. First, in the initiation phase the urbanization strategy (verstedelijkingsstrategie), urbanization agreement (verstedelijkingsakkoord) and land policy (grondbeleid) are created by the municipality and province and climate adaptation has to be taken into account for these strategic plans (Van den Dool & Valkenburg, 2022).

Then, in the definition phase of the feasibility phase a development vision (ontwikkelstrategie) is created, where climate adaptation ambitions are formulated by the party with the land position. In this phase an environmental impact assessment (milieu effect rapportage) is also performed, of which climate adaptation is increasingly becoming a separate theme. In addition, the land and real estate exploitation (grond- en vastgoedexploitatie) is made, where the costs for climate adaptation and the building-related adaptation measures should be included. Moreover, a tender (aanbesteding) is made when the land is owned by the municipality and an anterior agreement (anterieure overeenkomst) is made when the land is owned by the developer. In a tender climate adaptation should be part of the program of requirements (programma van Eisen), the zoning plan (bestemmingsplan), the environmental plan (omgevingsplan) or parcel passport (kavelpaspoort). In an anterior agreement relevant climate adaptation requirements and goals should also be included. For the urban development plan (stedenbouwkundig plan) and the visual quality plan (beeldkwaliteitsplan) climate adaptation should also be taken into account when, for example, determining the surface area of water and greenery. The manual for the design of public space (handboek inrichting openbare ruimte) is the basis for this urban development plan and it is important that this manual pays attention to climate adaptation or allows for climate-adaptive exceptions. Finally, the area recommendation could be a new instrument where a recommendation is given about climate adaptation (Van den Dool & Valkenburg, 2022). "In the plan, a developer or municipality, together with the water board, visualizes the space required for water, greenery and climate at the right time, including above and underground space, costs and the added value for the quality of the area" (Van den Dool & Valkenburg, 2022, p. 14).

Then, in the design phase of the feasibility phase the preliminary design (voorlopig ontwerp) of the building is made. Here climate adaptation measures for the building can be included. Moreover, the zoning plan (bestemmingsplan) or environmental plan (omgevingsplan) is made. Here the municipality can include the goals and requirements for climate adaptation (Van den Dool & Valkenburg, 2022). Moreover, "the water assessment is an essential part of the procedure for a zoning plan for water and climate adaptation" (Van den Dool & Valkenburg, 2022, p. 15). In this phase also the preliminary design (voorlopig ontwerp) and final design (definitief ontwerp) of the development plan (inrichtingsplan) are



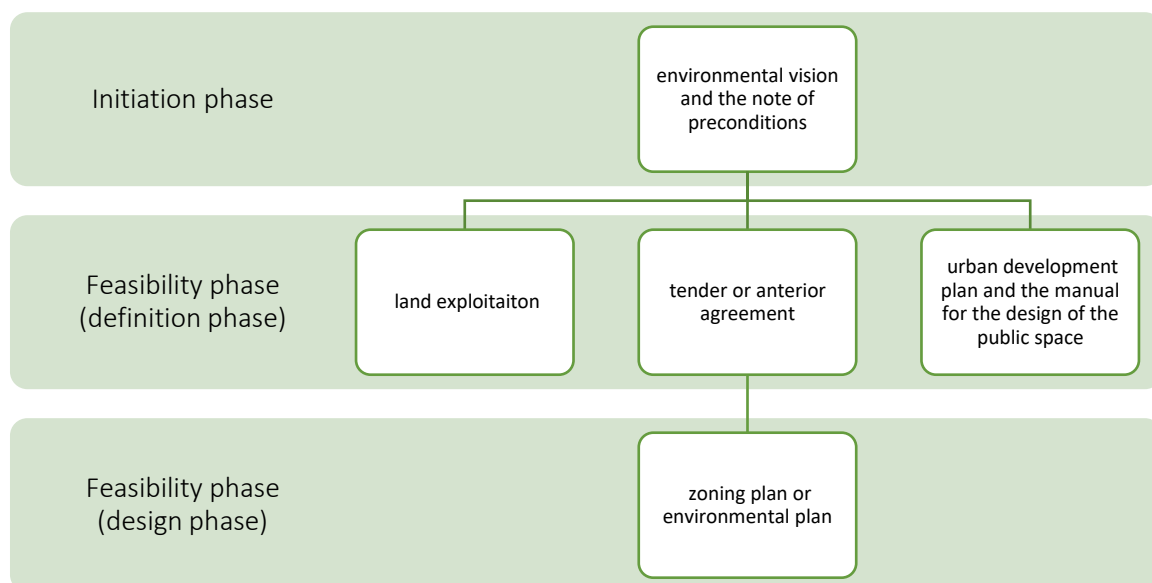
made, which is the technical elaboration of the public space. Here a management test is also executed. Moreover, the manual for the design of public space is an important instrument in this phase (Van den Dool & Valkenburg, 2022). Finally, “the development plan and the urban development plan can be calculated with a predictive climate stress test for optimization of the design” (Van den Dool & Valkenburg, 2022, p. 15).

In the preparation phase of the feasibility phase the purchase and construction agreement (koop- en aannemingsovereenkomst) is made where climate adaptation requirements can be included. Moreover, in the final design of the building, the architectural design of the building is recorded, including climate-adaptive and nature-inclusive facilities. The final design is the basis for the application for the environmental permit (omgevingsvergunning) for the construction of the building (Van den Dool & Valkenburg, 2022).

Finally, in the realisation and management phase no specific instruments can be used in order to make constructions better adapted to climate change (Van den Dool & Valkenburg, 2022).

### Interviews and focus groups

Of all the phases in the process of project developments the initiation phase and the feasibility phase are considered most important, as these are the only phases mentioned by the respondents (2022) (Figure 11).



**Figure 11.** The phases and planning instruments mentioned by the respondents.

### Initiation phase

According to respondents CA1, WM, PL2, PM1 and PM2 (2022) it is important that instruments are used to point out the standards formulated in the ‘climate test’ from the beginning. This way it is taken into account in the following phases of the development.

In the initiation phase the instruments mentioned are the environmental vision (omgevingsvisie) and the environmental quality plan (omgevingskwaliteitsplan) (respondents PL1 and CA4, 2022). The environmental vision is the successor of the current structural vision (structuurvisie). The environmental vision is a vision document of the municipality that is more integral than structural vision. The

environmental quality plan is a document specifically focussing on the quality of the living environment, where climate adaptation plays an important role. This document is being created on the initiative of a civil servant and is not yet commissioned by the council. According to respondent PL1 (2022) this document can help formulate specific ambitions concerning the 'climate test'.

According to respondent PL (2022) the use of vision documents is very important, as they can be used to point out the standards from the climate test from the beginning. As respondent PL1 (2022) mentions:

*"This is our policy. Once this has been established, you can also shape that policy when you are talking about area developments. Then you always make some sort of an ambition document, or a starting notice, or a document, or a note of preconditions [Nota van Randvoorwaarden]. So that is of course easy, if there is some kind of standard package of what you would like to demand of a development."*

The 'note of preconditions' (Nota van Randvoorwaarden), is often mentioned by respondents (respondents CA2, PL1, PL2 and PM2, 2022). It is a part of the vision documents and it is a notice of the preconditions preceding a project and it can be used to formulate the standards of the 'climate test'.

#### *The feasibility phase of the definition phase*

Then, in the feasibility phase there is a definition phase, a design phase and a preparation phase. In the definition phase the most important instruments are: the land exploitation (grondexploitatie; respondent PM1, 2022); urban development plan (stedenbouwkundig plan; respondents WM and CA2, 2022); the manual for the design of the public space (handboek inrichting openbare ruimte; respondents CA1 and PM1, 2022); the anterior agreement (anterieure overeenkomst; respondents CA and PM1, 2022); and a tender (aanbesteding; respondent CA3, 2022). Respondents state that for each phase the standards have to be taken into account on the appropriate level of detail (respondents CA1, CA2 and PM1, 2022). As respondent CA1 (2022) explains:

*"I think that the 'climate test' spans all phases. In every phase of the project, from initiation phase, to design phase, to implementation phase, everywhere, in all those phases, you will test certain aspects against that 'climate test'. And each phase of the project has a different level of detail. So I don't see it as an instrument that is used once, and then it's done. No, it runs through your entire project."*

For example, the climate adaptation measures should already be taken into account for the land exploitation. This way the adaptation measures will always fit within the budget (respondent PM1, 2022). Moreover, according to respondents CA2 and PM2 (2022) the sketch design and the preliminary design of the different plans are where climate adaptation has to be taken into account in each of the phases. As respondent CA2 responds to the question:

*I: "Well, and then, for the 'climate test', the assurance. Where are you going to assure it, at what stage?"*

*R: "Each. The same as you actually do now. Include it at the front, with a sketch design, preliminary design. Yes, with a sketch design you do need to know about the positioning, location. Because that is what it's already about. But you will mainly come across this in the preliminary urban development plan [voorlopig stedenbouwkundig plan]. Annex, preliminary development plan [voorlopig*

*inrichtingsplan]. Annex, preliminary water management plan [voorlopig waterhuishoudingsplan], and so on. So, we have to go along on those same scales.”*

This means that in each phase of the process the design should be checked against the climate adaptation standards that are formulated by the municipality. This way it is ensured that the climate adaptation measures always fit within the spatial plan. Thus, by taking the climate adaptation measures into account in each step of the process it is ensured that they fit both within the spatial plan as well as within the budget.

#### *The design phase of the feasibility phase*

In the design phase, the zoning plan (bestemmingsplan) is the most mentioned instrument that can be used to formulate climate adaptation standards (respondents CA2, PL1, PM1, PM2 and CA4, 2022). The respondents agree that in order for climate adaptation to be taken into account from the beginning, it has to be enforced at the end of the process and that the zoning plan is the only way to actually enforce the ‘climate test’ (respondents CA2, CA3 and CA4, 2022). However, as respondent PM1 (2022) states:

*“If you already establish that your plan must comply with the ‘climate test’ in the anterior agreement [anterieure overeenkomst]. Ultimately, of course, you have to do that for your zoning plan [bestemmingsplan]. But if you also indicate it earlier, then it is something you can take into account more consciously during your project. And also at interim test moments, you can clearly say: ‘this is not possible’. Because then you’ve already established it. If you only test it at the end, for the zoning plan [bestemmingsplan], then you muddle along and then we polish that right later. Then you write it to it so that it all fits. So I think if you capture it at the front, you can easily steer towards it during your project.”*

This means that just enforcing it with the zoning plan is not enough. Because if you only test it at the end of the project you will be too late to change anything in the plan. This relates to the concerns of respondents CA1, CA2, PM1 and WM (2022) mentioned before. When you are testing the plan too late, there is no room in the spatial plan or the budget to fit the climate adaptation measures in.

Moreover, when formulating standards a choice can be made between placing them as a rule of the zoning plan (respondents CA3, CA4 and PL2, 2022), or in the explanation paragraph of the zoning plan (respondent CA2, 2022). When it is a rule, it can be tested by the ‘ODRA’ (Environment Department Arnhem Region). However, in order to be enforceable it also has to be measurable. On the other hand, when placing the standards in the explanation of the zoning plan, it does not have to be measurable, but it is also not enforceable (respondent CA3, 2022).

#### *Drivers and barriers for the implementation of the adaptation instrument*

- **Legal barriers**

For the implementation of the ‘climate test’ there are no legal barriers according to respondents PL1 and CA4 (2022). However, according to respondent WM (2022) you can make the ‘climate test’ a legal requirement, but there is no actual enforcement. Therefore, respondent CA 2 (2022) states:

*“And I’ve always been lucky with the water assessment, and with climate adaptation. With heat stress it gets a bit more difficult. Well, you can use the GGD for that. However, they have no formal powers. But the water assessment is partly the responsibility of the water board. This is always an external party that cannot be manipulated by an urban planner or developer. They have an external advisor that can help you. And that is sometimes useful.”*

According to respondent CA2 (2022) there should be an objective party that enforces the 'climate test'. This could help because this party cannot be manipulated and the advisor could help to enforce the climate adaptation measures during the project. According to respondent PL1 (2022) the well-being quality test (welstandskwaliteitstoets) could be used for this purpose. This is an independent advice on the living quality. It would be part of the environmental quality plan which will probably be developed soon.

- **Cooperation between departments**

Finally, to be able to know how to best implement the 'climate test' it is important to advice with the spatial legal department of the municipality (respondent PL1 and CA4, 2022). Moreover, according to respondents PM1 and PM2 (2022) it is very important to inform and consult the project management department about the implementation of the 'climate test'. As respondent PM1 (2022) states:

*"And also, for example at PIM, the project managers, that they are also included. About the importance of it. And in the how. And how you are going to enforce things. And implement. The involvement actually. That you include as many people as possible, instead of developing something and then when it's completely finished, and you put it down like: 'now you have to start working like this.'"*

According to respondent PM1 (2022) this could be done with the use of the lectures the project management department plans during lunch breaks. Thus, it is not only important to inform the project managers about the new instrument, but to also include them in the development process as they have a lot of expertise that can be used (respondents PM1 and PM2, 2022).

- **Cooperation with other organisations**

For the implementation of the 'climate test' it is also useful to consult other municipalities on how they are planning to legally enforce such standards for climate adaptation (respondents CA4 and CA5, 2022). As respondent CA4 (2022) states:

*"Yes, you actually want to know whether there is a municipality in the country that has already legally arranged things in the area of heat stress. Right? That's actually what we'd like to know."*

For example, respondent CA4 (2022) mentions later on that the municipality of Ede is the only other municipality that developed a points system for nature-inclusive development and that they are currently expanding their points system with measures for climate adaptation. The legal enforcement of this tool could serve as an example for the municipality of Arnhem.

- **Willingness of the developers**

The developers also have to be willing to work with the instrument. Implementing extra climate adaptation measures will always cost the developers time and money. Therefore, the amount of rules that developers have to comply with can create resistance (respondents PL2, PM1, PM2 and CA5, 2022). As respondent PL1 (2022) states:

*"Well, the first thing that comes to mind is the resistance of: 'gosh, we already have so much to do and we already have so many rules to comply with and then this also has to be fitted in. So that, yes. And the resistance you have because these are things, they cost money and space. And in the end, of course, it's always about the profit.'"*

Moreover, the developers are also dependent on consultancy firms to advise them on these climate adaptation measures. Therefore, there have to be enough experts not only for water, but also for heat stress and drought (respondents CA4, CA5 and HS, 2022). As respondent CA5 (2022) states:

*“Of course, a lot of consultancy firms are always hired to do the work for a developer. If there is a lack of knowledge about the themes that we consider important. [...] But if those agencies lack the knowledge about how to apply that knowledge in a project, then we also have a big problem. And I can't estimate whether the knowledge at those bureaus is there, to be able to implement this in the projects.”*

According to respondent HS (2022) the field of heat stress expertise is growing, but it is not on the level it should be. Thus, even though the developers might be willing to work with such a ‘climate test’ it can be a barrier if there are not enough climate adaptation experts they can hire.

#### 4.4 General drivers and barriers for the development of an adaptation instrument

While some drivers and barriers influence only the design phase, some only influence the implementation phase, and some factors influence both. In addition to the factors that are specific to the design or implementation phase of the adaptation instrument, there are more general factors influencing the development of the adaptation instrument. These factors include: leadership; staff and resources; awareness and organisational structure; political support; and public support and awareness. In this section an overview is given of these more general drivers and barriers.

- **Leadership**

Within the organisation there is a certain eagerness to get things done, as can be seen by the development of the points system NID. The same goes for the development of this climate adaptation instrument, as respondent CA3 (2022) states:

*“But of course we can also turn it around. If nothing has been established nationally yet. And that may take years, we can of course also just start taking the first step. Then at least something happens. [...] And then when something comes up nationally, we just throw it away again. And then we do it perfectly afterwards.”*

Respondents CA3, CA4, PL1, PM1 and CA5 (2022) agree that it is important to just develop an adaptation instrument, even if it is not perfect yet. Instead of waiting a few years for the higher levels of government to come with something similar. However, as mentioned before, according to respondent PL2 (2022) the integral aspect can become lost when the development of certain climate adaptation tools go too quickly. This is something to take in mind to make sure this level of leadership does not become a barrier.

- **Staff and resources**

To be able to develop an adaptation instrument, there has to be enough staff and resources to do so (respondent PL1, 2022). As respondent PL1 (2022) states:

*“But where I do see a clear obstacle is in simply rolling this out. If you really have a climate ambition, then you just need manpower, brainpower. But we also have mobility issues, we also have housing issues. And we perish in the work, but not in the people and the resources. So I actually see the biggest barrier in simply: hiring people who should do that work.”*

Thus, while there is a high ambition within the municipality, there are not enough people at the municipality to actually carry out all these ambitions. The civil servants currently working for the municipality are already very busy and cannot take on the extra workload.

- **Awareness and organisational structure**

The ambition of the climate adaptation policy of the municipality of Arnhem is considered quite ambitious by respondent CA3 (2022). However, climate adaptation is not standard practice in some parts of the organisation. As respondent CA1 (2022) states:

*“It should simply be a natural part of our work and no longer something we do on the side. Like: ‘oh yes, climate adaptation, phew, one more task in my project’. No, that's just a standard assignment in your project. We are not in that dynamic yet. And yes, that's more of a culture and behaviour thing, I think, within an organization, and how you change that, yes, that is, that is independent of the technology, let's say. We can make a very nice technical ‘climate test’, but how do*

*you ensure that people also start working with it, that is also a challenge. But that's another subject, I guess. More the social profession."*

Therefore, increasing the climate adaptation awareness within the organisation is still very important. Not only by increasing the attention towards heat stress and drought, as is mentioned before, but by increasing the awareness of climate adaptation in general throughout the organisation (respondents CA1, CA2, CA4, PL1, PL2, PM1 and PM2, 2022). Especially in the management department there is an organisational structure that is difficult to change and causes an implementation deficit for climate adaptation measures (respondents CA2 and PL1, 2022). The management department is a very sectoral organisation that is steered by budgets. As respondent CA2 (2022) states:

*"And, yes, we sometimes want to fall back into the old habits: 'this is monodisciplinary, so I don't look at anything else'. Still. I caught my colleagues doing it last year. Just a simple project. Open the street, open the pipe out, put the pipe in, close the street. [...] Everyone should be convinced that monodisciplinary no longer exists. There are always certain tasks next to it. That may not be what we call professional disciplines, such as traffic, or green, sewerage, or [...] waste. But there are always tasks next to it, that we simply have to do something with."*

Thus, it is difficult for the management department to change their routine in order to implement climate adaptation measures. However, this is not because the people from the management department are not willing to change their way of doing this, but because the organisational structure does not allow them to (respondents CA5 and PL1, 2022). As respondent PL1 (2022) explains:

*"What I think, what is of course the case with management, is that they are money-steered, aren't they. So they can often only do what they have money for. So I don't think it's the management department's problem. But that's how we organized it. [...] So that's not because those people are so resistant, but because we as an organization do not tackle these kinds of things integrally."*

One final aspect of the organisation structure is the fact that according to respondent WM (2022) civil servants sometimes anticipate the expectations of the council. Therefore, respondent WM (2022) states that it is important to keep talking to each other, to avoid miscommunication.

- **Political support**

The current political movement of the municipal council has a large influence on the success of the development of the 'climate test'. Currently, greening and sustainability are high on the agenda of the council of the municipality of Arnhem. Respondents CA3, PL1 and PM2 (2022) state that it is important to use this window of opportunity to create and implement the 'climate test' as the political orientation of the council can change every four years. The political movement is also very important because there can be conflicting interests between the council and the civil servants working for the municipality (respondent WM, 2022). Thus, similar to the conflicting interests between different departments there can also be conflicting interests between the civil servants and the politicians. Because there are many different ambitions for the limited space that is available, tough choices sometimes have to be made. For example, WM (2022) states that the council sometimes rather builds more houses than adding more greenery. Moreover, according to respondent CA2 (2022) there can even be conflicting interests between the aldermen in the council. Thus, because of the limited space that is available there are not only conflicting interests between the different departments, but also between these civil servants and the council and between the aldermen within this council.

## 5. Discussion and conclusion

### 5.1 Discussion

In this section, first the three sub-questions are answered and the design and implementation of the adaptation instrument are compared to the broader academic debate. Second, the main question is answered and the drivers and barriers of the development of the adaptation instrument are compared to the broader academic debate. Third, a reflection is given on both the theory as well as the methodology of the research. Fourth, the limitations of the research are given. Finally, the practical recommendations are given and the intervention question is answered.

#### Existing adaptation standards within the municipality

The first sub-question to be answered is “which standards are already in place within the institutional context of the municipality of Arnhem for the climate adaptation of area developments, and are they sufficient?”. First, there is a very ambitious climate adaptation policy in the municipality of Arnhem. Moreover, there is a lot of knowledge on the problem areas for heat stress and flooding. However, there is only a climate adaptation policy and there are almost no enforceable standards. For example, there are many standards for water in place, which are deemed sufficient. There are national standards for flooding and there is a water assessment. However, there are no concrete standards for heat stress and drought which can be enforced. Therefore, the current standards for climate adaptation are not sufficient.

Second, because there are no concrete and enforceable standards in place, climate adaptation is not always taken into account from the beginning of the process of area developments. This can cause problems as the climate adaptation measures do not fit in the spatial plan or budget anymore at the end of the process. Moreover, it is not always clear to the developer what is expected of them in terms of climate adaptation measures and they do not always have enough expertise in the area of climate adaptation. Thus, for flooding the standards are sufficient, for heat stress and drought they are not. Moreover, the way the standards are currently taken into account during area development projects is not deemed sufficient by the respondents.

#### The design of the adaptation instrument

The second sub-question is “which standards for climate adaptation are most suitable in making new developments more resilient against heat stress, droughts and flooding?”. First, when formulating particular standards, a choice has to be made between formulating goal-oriented standards, prescriptive standards or measure-based standards. This is not only mentioned by the respondents, but also by the guidebook of Van den Dool and Valkenburg (2022). The same types of standards are mentioned by Van der Heijden (2014). However, Van der Heijden (2014) uses ‘prescriptive standards’ instead of ‘measure-based standards’. Where the prescriptive standards state the exact requirements to particular parts of the building (Van der Heijden, 2014), the measure-based standards are based on specific climate adaptation measures (Van den Dool & Valkenburg, 2022). However, they both face the same critique, namely that the prescriptive standards or measure-based standards leave no room for flexibility and innovation, while goal-oriented standards do (Metropoolregio Amsterdam, n.d.; Van den Dool & Valkenburg, 2022; Van der Heijden, 2014). However, the prescriptive or measure-based standards are easy to measure and therefore enforceable, while the goal-oriented standards are not. A solution to this problem is the use of a points system similar to the one that is already in place in the municipality of Arnhem. This points system NID can even be expanded to a point system for climate-adaptive development. This is supported by Van der Heijden (2014) as they state that these different types of standards can be combined with the use of a points system, where points are rewarded when certain requirements are met. This is not only easy to measure, but also possible to enforce. This is



supported by the fact that the points system NID is already proven to work according to the respondents.

Therefore, the selection of the adaptation standards depends on the type of instrument the 'climate test' will be, and vice versa. Thus, it is important to make a decision on the type of instrument. While different options are mentioned, creating a points system and making expert advice mandatory in every project are particularly popular among the people working for the municipality of Arnhem. Moreover, making it an integral instrument which takes into account more themes than just climate adaptation alone, is also considered an important option. Finally, the use of financial instruments are also mentioned by a few respondents. The use of financial incentives are what Henstra (2016) calls the government resource of 'treasure'. Whereas Henstra (2016) calls the use of legitimate power the governmental resource of 'authority'. A regulation can be divided into zoning, standards and building codes (Henstra, 2016). Only mentioned by the respondents is the use of zoning. This is the use of the zoning plan, which is a legal process instrument that contains the rules on how a certain parcel of land may be used (Henstra, 2016). However, the zoning plan can be used in two ways. Standards can be put into the rules of the zoning plan as well as in the explanation. Where the rules are enforced, the explanation paragraph only contains the justification of whether certain expert advice was listened to or not.

While measures for flooding are easy to formulate as prescriptive standards, this is more difficult for heat stress and drought. For example, the volume of water is easy to measure and calculate, while the perceived outdoor temperature is only measurable with unreliable models. For flooding, the respondents agreed that the current standards are sufficient and can be used for the 'climate test'. For drought people disagreed on whether new standards should be created because there are none yet, or whether it is the responsibility of the water board and therefore no drought standards should be created. On the other hand, the respondents agreed that for heat stress new standards should be formulated. However, no one finds it a good idea to formulate prescriptive standards for heat stress. Because heat stress is so dependent on the surrounding, the location and the spatial plan, prescriptive standards could stand in the way of creativity, customization and innovation. Moreover, while goal-oriented standards referencing to the perceived outdoor temperature are easy to formulate, they cannot be tested because the models are unreliable and therefore it cannot be enforced. Thus, while for flooding prescriptive standards can be formulated, for heat stress it would be best to make a points system. This way certain points are awarded for heat stress measures, while designers still retain the freedom to choose the measures of preference. These heat stress measures could be combined with measures for flooding and the points system NID.

### The implementation of the adaptation instrument

The third sub-question is "how can the climate adaptation standards for new developments best be implemented and regulated?" First of all, the respondents agree that the zoning plan is the only way to legally enforce the 'climate test'. They state that because it is enforced at the end, developers are forced to take it into account from the beginning of the project. Therefore, the best way to regulate the climate adaptation standards is with the use of the zoning plan. The zoning plan is also mentioned by Van den Dool and Valkenburg (2022) as a possible instrument for climate adaptation. However, there is still debate on whether the 'climate test' should be a rule in the zoning plan, or part of the explanation, just like the water assessment.

Moreover, the requirements from the 'climate test' should be pointed out from the beginning, with the use of policy documents such as the structural vision document (which will become the environmental vision in the future). The structural vision is a legal instrument that is used in the initiation phase of a project (Ministerie van Infrastructuur en Waterstaat, n.d.). On the other hand, Van den Dool and

Valkenburg (2022) mention the urbanization strategy, the urbanization agreement and the land policy as planning instruments that can be used to point out climate adaptation in the initiation phase. Moreover, the respondents mention the land exploitation, the tender or agreement and the urban development and the manual for the design of the public space as possible instruments that can be used to point out climate adaptation in the definition phase of an area development. These instruments are also mentioned by Van den Dool and Valkenburg (2022). Finally, because the 'climate test' is taken into account from the beginning, it can be taken into account in each step of the design process, following the appropriate level of detail. Thus, the 'climate test' should be legally enforced at the end of the process, in the zoning plan. And, it should be taken into account in each phase, using the appropriate planning instruments.

### The drivers and barriers for the development of the adaptation instrument

The main research question is "what are the drivers and barriers to design and implement a climate adaptation instrument within the institutional context of the municipality of Arnhem?". The drivers and barriers of the design and implementation of the adaptation instrument can be formulated as factors falling into the categories: internal organisation; external organisations; private actors; and legal framework.

#### *Internal organisation*

The first factor in the internal organisation influencing the development of the adaptation instrument is the level of leadership and the presence of policy entrepreneurs. Similar to the leadership that is shown by the officials that initiated the development of the environmental quality plan and the points system NID, certain respondents agreed that the municipality of Arnhem should take the lead when it comes to creating a 'climate test' and not to wait on other municipalities or the higher levels of government to do so. This factor can be related to the factor 'leadership/policy entrepreneurs' defined by Runhaar et al. (2018) and the barrier 'lack of leadership' of Ekstrom and Moser (2014).

Second, the amount of staff and resources is deemed to be a possible barrier for the development of this adaptation instrument. This is similar to the factor 'staff' of Runhaar et al. (2018) and the barrier 'lack of time or staff' of Ekstrom and Moser (2014).

Third, the 'awareness and organisational structure' is a factor that influences the success of the development of this adaptation instrument. The climate adaptation policy of Arnhem is quite ambitious and the adaptation awareness is deemed sufficient throughout the organisation. This can be related to the fact that climate adaptation awareness and sense of urgency are deemed drivers by Runhaar et al. (2018). However, the level of attention that is paid to the different adaptation themes is very different. First, there is a lot of attention for flooding within the organisation. However, there is less attention for heat stress and little to no attention for drought. This can be related to the fact that the climate adaptation department stems from the water and sewage department. There is a certain path-dependency in the organisation because of it, which can be related to the self-reinforcing mechanisms of Uittenbroek (2016) and the factor 'organisational structures, routines and practices' of Runhaar et al. (2018). Moreover, it is mentioned that officials working for the municipality tend to fill in what the local council might expect. This can be specifically related to the adaptive expectation effects formulated by Uittenbroek (2016). This can be a barrier to mainstreaming climate adaptation as actors adapt their preferences on their assumptions about the other actors without confirming whether these assumptions are correct (Uittenbroek, 2016). In addition, the organisational structure of the management department is considered a large barrier. This department is steered by money and there is a implementation deficit of the climate adaptation measures because of it. The department is very sectoral and often falls back into old routines. This can be related to the organisational routines defined by Uittenbroek (2016). While these standardized routines can cause a certain continuity over time, they

also withstand attempts to change them in the short term (Uittenbroek, 2016). These routines in the management department can be related to the coordination effects defined by Uittenbroek (2016). This means that the actors from the management department follow the same routine and therefore the interaction becomes efficient. However, this can lead to the fact that the actors are not flexible enough to act upon new challenges when they need to take up responsibilities outside of their policy domain.

Fourth, the level of political support is very high in the municipality of Arnhem as the political movement is currently very focussed on increasing the resilience of the city. Therefore, this is a driver for the development of the adaptation instrument, as a lack of political commitment can be a barrier to mainstreaming climate adaptation (Ekstrom & Moser, 2014; Runhaar et al., 2018; Uittenbroek et al., 2014). Interestingly, the factor 'political commitment' is the most reported driver according to Runhaar et al. (2018). Moreover, it is important to make use of this window of opportunity, as the political movement of the city council changes every four years. Therefore the factor 'windows of opportunity' formulated by Runhaar et al. (2018) can be a driver in this regard. However, there can always be certain conflicting interests among the aldermen and between the aldermen and the civil servant and certain adaptation options can be more politically sensitive than others. This can be related to the factor 'conflicting interests' of Runhaar et al. (2018) and the fact that options being perceived as politically acceptable can be a barrier to climate adaptation mainstreaming (Ekstrom & Moser, 2014).

Fifth, there are many conflicting spatial interests of the different departments. For example, climate adaptation can be counterproductive with other departments such as the energy transition or circularity and the limited amount of space within an area development contains many different interests. Therefore, the amount of conflicting interests can be a barrier to adaptation mainstreaming (Runhaar et al., 2018).

Sixth, the lack of cooperation between the different departments is considered a barrier. Therefore, for the design of the adaptation instrument it is important to consult with both the urban planning department and the mobility department. For the implementation of the instrument it is important to consult with the management department, the spatial legal department and the project management department. This way, the factor 'cooperation/coordination between departments' mentioned both by Runhaar et al. (2018) and Ekstrom and Moser (2014) can become a driver instead of a barrier to mainstreaming climate adaptation.

Finally, the level of knowledge and expertise within the municipality of Arnhem is both a barrier and a driver. There is a lot of data on the problems of flooding and heat stress. For example, maps are created for both themes. Therefore, there is not a 'lack of data or science' (Ekstrom & Moser, 2014) or lack of 'information or guidance' (Runhaar et al., 2018). However, while the amount of knowledge and data is a driver, the lack of expertise among staff (Ekstrom & Moser, 2014) and the lack of availability of and access to expertise (Runhaar et al., 2018) are both barriers and drivers. For example, there is a high level of expertise on water management and flooding inside the municipality. However, there is a large shortage of heat stress experts both inside and outside of the municipality. According to Runhaar et al. (2018) the availability of and access to knowledge and expertise is one of the factors that is most often reported as a barrier to adaptation mainstreaming.

However, it is important to note that the amount of heat stress experts can be increased within the different departments of the organisation with the use of lectures and trainings. Therefore, the level of expertise among staff can become a driver in the future.

### *External organisations*

The cooperation with other organisations is a potential driver for the development of the adaptation instrument. For example, knowledge and resources from higher levels of government can be used to develop the 'climate test'. This can be related to the factors 'subsidies from higher levels of government' and 'availability of and access to knowledge and expertise' of (Runhaar et al., 2018). Moreover, the knowledge of other municipalities, the water board and the GGD can be used for the design of the instrument and the knowledge of other municipalities can also be used to learn about the possible implementation of the adaptation instrument. Moreover, the expertise of consultancy firms can be used for the same purpose (Samen Klimaatbestendig et al., 2020); Van den Dool and Valkenburg (2022). This can be linked to the coordination/cooperation with agencies, institutions or private actors (Ekstrom & Moser, 2014; Runhaar et al., 2018).

### *Private actors*

The willingness of developers to work with the 'climate test' is an important factor for the success of the implementation of the instrument. First, there can be resistance from the developers, because of the high amount of rules they have to follow and because of the fact that adaptation measures always cost the developers time and money. Therefore, the resistance of affected parties can be a barrier to the mainstreaming of climate adaptation (Ekstrom & Moser, 2014; Runhaar et al., 2018). Furthermore, the developers are dependent on the level of expertise of consultancy bureaus. Thus, the limited level of heat stress expertise can be a barrier in itself, which can be linked to the availability of and access to expertise (Runhaar et al., 2018).

### *Legal framework*

Finally, no legal barriers are reported. Therefore, there is a supportive regulatory framework as there are no current laws preventing the implementation of the adaptation instrument (Ekstrom & Moser, 2014; Runhaar et al., 2018).

## 5.2 Conclusion

To answer the main research question, it can be concluded that the most drivers and barriers are reported regarding the internal organisation. The drivers and barrier regarding the internal organisation are: the level of leadership, the (lack of) staff and resources; awareness and the organisational structure; the level of political support; the amount of conflicting interests; the cooperation between departments; and the level of knowledge and expertise within the municipality of Arnhem.

Moreover, for the design of the adaptation instrument the (lack of) conflicting spatial interest, the cooperation between departments, the cooperation with other organisations and the knowledge and expertise within the organisation are the most important factors. The level of conflicting spatial interests can be reduced by the cooperation between departments when designing the 'climate test'. This can be done by consulting with different departments with the same spatial claims, such as the mobility department, the urban planning department and the management department. The cooperation with other organisations includes the water board, the GGD, other municipalities and the higher levels of government. Moreover, the level of knowledge and expertise on heat stress can be increased by training the people from the different departments.

For the implementation of the adaptation instrument the (lack of) legal barriers, the cooperation between departments, the cooperation with other organisations and the willingness of the developers are the most important factors. Because there is a supportive legal framework there are no perceived legal barriers. Furthermore, it is important to consult the spatial legal department and the project management department about the implementation of the 'climate test'. The willingness of developers

to work with the 'climate test' is also an important factor, as implementing new rules can cause resistance.

Furthermore, there are general factors influencing both stages of the development of the adaptation instrument, which are: the level of leadership; the (lack of) staff and resources; the awareness and organisational structure; and the level of political support. While the level of leadership is high, it is important to keep the integral aspect of climate adaptation in mind. The awareness and organisational structure has a large influence on the development of the 'climate test'. However, this is difficult to change in the short term. Finally, the level of political support is currently very high in the municipality of Arnhem and this will be the case for at least four years.

## Final recommendations

### *Recommendations for future research*

Ekstrom and Moser (2014) stated that it would increase confidence in their findings if other researchers applied the tools and analyses to other geographic locations and within different sectors. The same applies to this research. The municipality of Arnhem is one of the first municipalities in the Netherlands to legally require climate adaptation to be taken into account in every new area development. While it is useful to know the drivers and barriers for the development of an adaptation instrument within the municipality of Arnhem, this could also be researched for other municipalities. Thus, having case studies on the same topic, but for different municipalities would make the results of this research even more reliable. Moreover, according to Ekstrom and Moser (2014) instead of researching a broad set of barriers it would also be interesting to target only a specific type of barrier. This would help to understand the local context and history (Ekstrom & Moser, 2014). In the case of Arnhem it would be interesting to study certain barriers in depth, to learn how to reach the driving factors or how to convert limiting factors into driving factors. For example, it would be interesting to know how the organisational structure of the management department can be changed. This is supported by Uittenbroek et al. (2014) as they state that because it is so difficult to change organisational structures and routines it is relevant to explore how these existing structures can be changed in municipalities with a mainstreaming approach. Thus, for future research the drivers and barriers for the development of an adaptation instrument could be studied for other municipalities and it could be researched how the barriers for adaptation mainstreaming could be converted into drivers for adaptation mainstreaming.

### *Practical recommendations on how to develop an adaptation instrument*

Finally, the intervention question of this research is "what is the best way to design and implement a policy instrument, which will sufficiently assess the climate adaptation of new developments for both flooding, heat stress and drought within the municipality of Arnhem?". First, for the design of the instrument it would be best to make one integrated tool for climate adaptation. While water standards are easy to measure, this is not the case for heat stress measures. Therefore, the best option would be to expand the current points system NID with measures for flooding, heat stress and drought (Figure 12; Figure 13). With expanding the current points system NID with climate adaptation measures the points are easy to measure and therefore enforceable, while there is still room for customization, creativity and innovation. Furthermore, to make sure that the factors that influence the design of the adaptation instrument become driving factors instead of barriers some steps have to be taken. For example, the level of conflicting interests can be reduced by increasing the communication between the different departments involved. Moreover, different organisations can be consulted and knowledge can be shared between different municipalities and provinces. Finally, it is important that the level of expertise on climate adaptation is increased within the organisation. This can be done by giving trainings and lectures to the departments of mobility, urban planning, project management and management. Special attention should be given to the level of heat stress expertise within the climate adaptation

department itself. Thus, these trainings could be used to increase the level of climate adaptation expertise throughout the organization, to increase the level of cooperation between these departments and the climate adaptation department and to further increase the level of awareness throughout the organisation.

Second, for the implementation of the instrument the points system should be filled in together with an expert for the larger developments, similar to the points system NID. This way it is a rule in the zoning plan that the points system should be filled in, while experts are still being consulted. Moreover, it is important that the requirements are clear to the developer from the beginning. Therefore, the existing planning instruments should be used to point out the 'climate test' from beginning to end. Furthermore, to make sure that the factors that influence the implementation of the adaptation instrument become driving factors instead of barriers the following steps have to be taken. For example, it is important to consult with the spatial legal department and the project managers. Moreover, the adaptation instrument should be easily accessible and easy to use by the developers. This can be done by putting the points system online on the website of the municipality. This way the willingness of the developers to work with the adaptation instrument can be increased.

Finally, to make sure that the general factors influencing the development of the adaptation instrument are driving factors instead of barriers certain aspects have to be taken into account. For example, it is better to create an imperfect tool, than to wait on the higher levels of government to develop something similar. This is why the level of leadership is of high importance for the success of the development of this instrument. Moreover, it is important that enough people are hired so that the current points system can actually be expanded. Furthermore, while it is difficult to change the organisational structure of the management department, meetings between the management department and the climate adaptation department could be organized to brainstorm on how climate adaptation measures could become part of the management routine. Finally, the political movement of the current council is already a large driving factor. Therefore, it is important to use this window of opportunity to develop the adaptation instrument as soon as possible.





Green roof



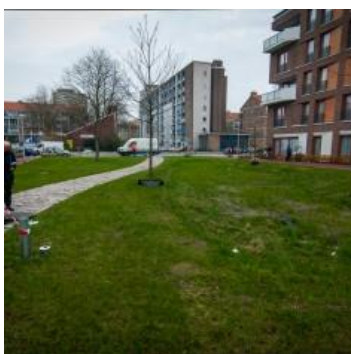
Green facade



Green front garden



Tree



Wadi



Green property division



No unnecessary pavement/



Water-permeable pavement



Planting green structure

**Figure 12.** Climate adaptation measures that are part of the current points system NID. Measures and images retrieved from Amsterdam Rainproof (2022).



Sun screens



Reflecting/schadow roofs



Blue roofs



Grass concrete blocks



Disconnecting rainwater pipe



Infiltration crates



Hightened floor level



Hightened doorstep



Rainwater storage



Re-using rainwater



Rainwater-storing fence



Sealable buildings

**Figure 13.** Examples of possible measures that can be used to expand the points system NID. Measures and images retrieved from Amsterdam Rainproof (2022).



## Reflection

### *Reflection on theory*

All the drivers and barriers found in this research are also defined by Uittenbroek (2016), Runhaar et al. (2018) and Ekstrom and Moser (2014). However, according to Runhaar et al. (2018) “the most often mentioned drivers are, in order: political commitment; cooperation with private actors; the presence of policy entrepreneurs; focusing events; and lastly subsidies from higher levels of government which is on par with framing and linking to sectoral objectives” (p. 1207). While the level of political commitment; and the presence of policy entrepreneurs are reported as drivers in this thesis, the cooperation with private actors is a barrier. Moreover, the factors ‘focussing events’, ‘subsidies from higher levels of government’ and ‘framing and linking to sectoral objectives’ are not mentioned by the respondents at all. On the other hand, “the most frequently reported barriers are lack of: financial resources, information, guidance, coordination and cooperation between departments, staff resources and access to adaptation knowledge and expertise as well as conflicting interests” (Runhaar et al., 2018, p. 1207). While the financial resources and information and guidance are not reported as barriers by the respondents, the lack of staff and resources, the lack of coordination and cooperation between departments, the lack of access to adaptation knowledge and expertise and the conflicting interests are.

### *Reflection on methodology*

There are a few things that can be noted on the methodology of this research. First of all, there are certain critiques on the use of a case study approach. For example, it can be noted that a case study does not allow for the generalization of results (van Thiel, 2014). As van Thiel (2014) states: “usually it will be difficult, if not impossible, to generalize findings to other situations, either because the case is unique or because results only apply to the particular context that has been examined” (p.87). Therefore, the external validity of a case study is limited, whereas the internal validity is high because of the high level of detail in which a case is studied (van Thiel, 2014). On the other hand, as the cases from the metropole region of Amsterdam and the provinces of Zuid-Holland and Utrecht are also taken into consideration, this concern can be reduced. However, these cases are not studied in detail, as only a content analysis is conducted for these cases. Thus, while there is data triangulation for the case of Arnhem, there is none for the other cases (van Thiel, 2014).

### Limitations of the research

A critique on the theoretical framework of this thesis could be the fact that only three different articles are taken into account for the drivers and barriers for climate adaptation mainstreaming (Ekstrom & Moser, 2014; Runhaar et al., 2018; Uittenbroek, 2016). This choice is made because the relevant theories on the practical aspect also have to be taken into account within the limited scope of this research (Henstra, 2016; Ministerie van Infrastructuur en Waterstaat, n.d.; Van der Heijden, 2014). However, this concern is reduced by the fact that the article of Runhaar et al. (2018) as it takes into account the drivers and barriers of 87 recent articles.

Moreover, due to the limited time frame (of six months) of this research only 11 expert interviews are conducted and two focus groups are held. However, according to Hennink et al. (2017) it is important that theoretical saturation occurs, which is the case. According to Asbury (1995) the same goes for focus groups. When the moderator can anticipate what will be said next, enough focus groups are conducted. According to Asbury (1995) this takes about three to four focus groups. While it would have been best to organise more focus groups, this was not possible within the limited time frame.

In addition, for the first focus group there are only 4 participants and for the second group 6 (both including the researcher). According to (Asbury, 1995) “a focus group is 6 to 12 individuals who are similar in some way and come together to discuss an issue of specific interest to the researcher” (p. 415). Therefore, these meetings are not officially a focus group as there is a limited number of participants. However, it is important to note that as the first focus group is organized to make the first practical choices for the design and implementation of the ‘climate test’, having 4 participants is sufficient. For the second focus group, there are 6 participants (including the researcher) and not only the preliminary results on the design and implementation of the adaptation instrument are discussed, as well as the theoretical aspect of the drivers and barriers for the development of the adaptation instrument. Finally, these individuals are similar in the way that they are all civil servants working together for the municipality of Arnhem.

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## Appendices

### Appendix A. Interview guide for the semi-structured expert interviews

*Allereerst wil ik u graag bedanken voor uw tijd.*

- *Mezelf kort voorstellen en uitleg geven over het doel van mijn onderzoek.*
- *Uitleg geven over het doel van de expert interviews.*

*Wilt u, in verband met uw privacy, graag dat ik alleen uw functie noteer, of mag ik ook uw naam vermelden in mijn onderzoek? Dit interview zal waarschijnlijk een half uur tot een uur duren. Ik zal het interview ook opnemen. Na afloop van dit onderzoek zullen de opnames worden verwijderd en zullen ze niet publiekelijk worden gedeeld. Als u met het interview wil stoppen dan kan dit op ieder moment en zal ik de opname stopzetten. Gaat u hiermee akkoord?*

*Dan zal ik nu de opname starten.*

#### **Introductie:**

- 1) Kunt u misschien iets over uzelf vertellen? Wat is uw functie bij gemeente Arnhem en wat doet u zoal?

#### **Deelvraag 1: Bestaande eisen bij gemeente Arnhem**

*Ten eerste wil ik samen met u gaan kijken naar de bestaande eisen die er al liggen bij gemeente Arnhem.*

- 2) Welke eisen rond klimaatadaptief bouwen geeft gemeente Arnhem, voor zover u weet, nu al mee bij nieuwe ontwikkelingen?
  - voor waterveiligheid?
  - voor wateroverlast?
  - voor hitte?
  - voor droogte?
- 3) Waar zijn deze eisen meestal geborgd in de verschillende fases van een ontwikkeling?
  - Initiatiefase?
  - Haalbaarheidsfase?
  - Ontwerpfase?
  - Voorbereidingsfase?
  - Realisatiefase?
  - Beheer- en exploitatiefase?
- 4) In welke fases liggen er volgens u nog kansen om het beter of anders te doen?
- 5) Wat werkt er volgens u goed aan de opgelegde eisen en normen?
  - Waarom?
- 6) Wat werkt daarin volgens u niet goed?
  - Waarom niet?
- 7) Als je kijkt naar wat gemeente Arnhem al heeft liggen aan eisen, wat ontbreekt er volgens u dan nog?
  - Waarom?
- 8) Hoe borgt gemeente Arnhem klimaatadaptatie bij projecten die de gemeente zelf uitvoert in de openbare ruimte?

## Deelvraag 2: Ontwikkeling nieuwe Klimaattoets

*Dan wil ik nu graag met u gaan kijken naar de ontwikkeling van de Klimaattoets.*

- 9) Welke randvoorwaarden, doelen of eisen zou u in een toekomstige Klimaattoets dan aan het specifieke project of plan stellen?
  - voor waterveiligheid?
  - voor wateroverlast?
  - voor hitte?
  - voor droogte?
- 10) Wat zijn volgens u mogelijke obstakels voor het creëren van een Klimaattoets?
  - Waarom?
- 11) Waar liggen volgens u kansen en mogelijkheden voor het creëren van een Klimaattoets?
  - Waarom?

## Deelvraag 3: Borging van nieuwe Klimaattoets

*Tot slot wil ik met u gaan kijken naar de mogelijke borging van de Klimaattoets.*

- 12) Hoe kunnen de eisen in de Klimaattoets volgens u het beste geïmplementeerd en geborgd worden?
  - Voor waterveiligheid?
  - Voor wateroverlast?
  - Voor hitte?
  - Voor droogte?
- 13) In welke fase van een ontwikkeling zou u deze eisen dan plaatsen?
  - Waarom?
- 14) Wat zijn volgens u mogelijke obstakels voor het borgen van een Klimaattoets?
  - Waarom?
- 15) Wat zijn volgens u kansen en mogelijkheden voor het borgen van een Klimaattoets?
  - Waarom?

## Afsluiting:

- 16) Heeft u verder nog vragen voor mij of zou u nog iets willen toevoegen?
- 17) Wie zou ik volgens u verder nog moeten spreken over dit onderwerp?

*Dan wil ik u nogmaals bedanken voor het beantwoorden van al mijn vragen en dan zal ik nu de opname stopzetten.*

## Appendix B. Questioning routes for the focus groups

### Questioning route for focus group 1

- Korte presentatie geven over de **voorlopige** resultaten van het onderzoek.
- Uitleg geven over de opbouw en het doel van de focusgroep.

*Willen jullie, in verband met uw privacy, graag dat ik alleen uw functie noteer, of mag ik ook uw naam vermelden in mijn onderzoek? Deze focusgroep zal waarschijnlijk een half uur tot een uur duren. Ik zal de focusgroep ook opnemen. Na afloop van dit onderzoek zullen de opnames worden verwijderd en zullen ze niet publiekelijk worden gedeeld. Als iemand met de focusgroep wil stoppen dan kan dit op ieder moment en zal ik de opname stopzetten. Gaan jullie hiermee akkoord?*

*Dan zal ik nu de opname starten.*

### Implementatie Klimaattoets

1. Zouden jullie er voor kiezen om de Klimaattoets als regel in het bestemmingsplan te zetten (net zoals het puntensysteem NIB) of als toelichting (en dus de waterparagraaf van de Watertoets uitbreiden)?
  - a. Waarom?
2. Zouden jullie er voor kiezen dat de ontwikkelaar zelf de toets mag invullen of dat dit samen met een expert moet worden gedaan?
  - a. Waarom?
3. Zouden jullie een onderscheid maken tussen grote en kleine ontwikkelingen?
  - a. Waarom?

### Inhoud Klimaattoets

#### Wateroverlast

4. Zouden jullie voor wateroverlast kiezen voor eisen gericht op maatregelen of eisen gericht op het gewenste effect?
  - a. Waarom?

#### Hitte in buitenruimte

5. Zouden jullie voor hitte in de buitenruimte kiezen voor eisen gericht op maatregelen of eisen gericht op het gewenste effect?
  - a. Waarom?

#### Hitte in binnenruimte

6. Zouden jullie voor hitte in de binnenruimte kiezen voor eisen gericht op maatregelen of eisen gericht op het gewenste effect?
  - a. Waarom?

### Algemeen

7. Willen jullie meer concrete en toetsbare eisen of willen jullie vrijheid laten voor de innovatie en creativiteit van de ontwerpers?
  - a. Waarom?
8. Zouden jullie er voor kiezen om de eisen voor hitte en water in dezelfde tool/puntensysteem of toets te zetten?
  - a. Waarom?
9. Zouden jullie de eisen locatie-specifiek maken of niet?
  - a. Waarom?

*Dan wil ik jullie graag bedanken voor het beantwoorden van al mijn vragen en dan zal ik nu de opname stopzetten.*



## Questioning route for focus group 2

- *Uitleg geven over de opbouw en het doel van de focusgroep.*

*Willen jullie, in verband met uw privacy, graag dat ik alleen uw functie noteer, of mag ik ook uw naam vermelden in mijn onderzoek? Deze focusgroep zal waarschijnlijk een uur tot anderhalf uur duren. Ik zal de focusgroep ook opnemen. Na afloop van dit onderzoek zullen de opnames worden verwijderd en zullen ze niet publiekelijk worden gedeeld. Als iemand met de focusgroep wil stoppen dan kan dit op ieder moment en zal ik de opname stopzetten. Gaan jullie hiermee akkoord?*

*Dan zal ik nu de opname starten.*

### **Bestaande eisen**

- *Een korte presentatie geven over de resultaten van het onderzoek.*
1. Wat is jullie eerste reactie op de benoemde krachten en tekortkomingen van de bestaande eisen?
    - a. Hebben jullie hier nog iets aan toe te voegen?
    - b. Waar zijn jullie het wel en niet mee eens?→ Discussie leiden

### **Inhoud van de Klimaattoets**

- *Een korte presentatie geven over de resultaten van het onderzoek.*
2. Wat is jullie eerste reactie op de afwegingen die gemaakt moeten worden voor de inhoud van de Klimaattoets?
    - a. Hebben jullie hier nog iets aan toe te voegen?
    - b. Waar zijn jullie het wel en niet mee eens?→ Discussie leiden

### **Implementatie van de Klimaattoets**

- *Een korte presentatie geven over de resultaten van het onderzoek.*
3. Wat is jullie eerste reactie op de afwegingen die gemaakt moeten worden voor de juridische boring van de Klimaattoets?
    - a. Hebben jullie hier nog iets aan toe te voegen?
    - b. Waar zijn jullie het wel en niet mee eens?→ Discussie leiden

### **Drijfveren en barrières van de Klimaattoets**

- *Een korte presentatie geven over de resultaten van het onderzoek.*
4. Wat is jullie eerste reactie op de benoemde drijfveren en barrières voor de ontwikkeling van een Klimaattoets?
    - a. Hebben jullie hier nog iets aan toe te voegen?
    - b. Waar zijn jullie het wel en niet mee eens?→ Discussie leiden

*Dan wil ik jullie graag bedanken voor het beantwoorden van al mijn vragen en dan zal ik nu de opname stopzetten.*

## Appendix C. Codebook

Sub-question 1	Network	First category	Second category	Code name	Description	Example
Existing standards	Water standards	Disconnecting rainwater pipe		DISCONNECTING RAIN PIPE	The rainwater pipeline has to be disconnected from the sewage system	"We gaan geen regenwater meer afsluiten op het vuilwater rioolsysteem. Dus het regenwater moet ook worden afgekoppeld."
		Don't cause flooding in surrounding area		NO FLOODING SURROUNDING AREA	Developments shouldn't cause flooding in the surrounding area	"Dan moet je eigenlijk aantonen dat een nieuwe ontwikkeling geen overlast veroorzaakt in de omgeving."
		Water assessment		WATER ASSESSMENT	The water assessment (watertoets) is conducted by the water board (waterschappen) when developments are near waterways	"Als je een toename hebt dan eist het Waterschap, als het eigenlijk aangesloten is op, in de directe nabijheid van een watergang."
			Successes	WA TAKEN SERIOUSLY	Because the water assessment is legally required it is taken seriously	"Maar als het verplicht is, zoals je dat nu ziet met die watertoets van het waterschap en met het puntensysteem natuurinclusief bouwen, dan gaan we er ineens over nadenken."
			Shortcomings	WA LARGE DEVELOPMENTS	The water assessment only works well for large developments	"De watertoets, daar wordt nu natuurlijk wel naar gekeken en daar wordt aan de voorkant op gedimensioneerd. Dus in de uitvoering zal dat wel niet heel erg veel afwijken. Dus in die zin, zal het wel grotendeels goed gaan, bij grote ontwikkelingen. Maar bij een particulier die een huis gaat bouwen..."
				WATER DOESN'T FIT IN SPATIAL PLAN	If it is mentioned too late it doesn't fit into the spatial plan anymore and you cannot go back in the process	"Maar, daarbij zie je dus wel eens dat het te laat gebeurt en dan kun je in het proces niet meer terug."
		Rainwater management on own property		RAIN MANAGEMENT OWN PROPERTY	All developments have to manage their rain water on their own property	"Alle nieuwe ontwikkelingen die moeten hun wateropgave op eigen terrein oplossen."
			Successes	NATIONAL REGULATION	It is nationally regulated that rainwater should be managed on own property	"Ontwikkelingen moeten in principe, dus dat is een andere norm, het water bergen op eigen terrein, alleen, dat is volgens mij landelijk geregeld en niet iets unieks voor de gemeente Arnhem."

			Shortcomings	'REASONABLY' TOO LENIENT	Too lenient with requirement to store rainwater 'reasonably'	"Dan kun je op een gegeven moment zeggen dat het redelijkerwijs niet meer mogelijk is om extra maatregelen van ze te verlangen. Alleen nu zijn we, voor zover ik dan heb begrepen, best wel snel coulant daarin, misschien te coulant."
	Heat stress standards	Standards for outdoor heat stress	Temperature in red areas	HS RED AREAS	Policy states that temperatures in red areas should be lowered	"We hebben ook eisen gesteld aan gebiedsontwikkelingen, bijvoorbeeld, dat in die rode gebieden die ontwikkeling eigenlijk moet bijdragen aan het verminderen, verlagen van de gevoelstemperatuur."
			Temperature in yellow areas	HS YELLOW AREAS	Policy states that temperatures in yellow areas should not increase	"Maar in gele gebieden zeggen we bijvoorbeeld: ja die ontwikkeling mag in ieder geval niet zorgen voor een verslechtering."
		Standards for indoor heat stress	TOjuli standard	TOJULI	The TOjuli standard is a national standard for heat stress in and it is not taken into account if there is an active cooling system buildings	"Je hebt dus de TOjuli eis. Ik weet niet of je er ooit van gehoord hebt, ja, de BENG. Maar die geldt niet als je actieve koeling hebt."
			The 'GGD'	GGD	The GGD tests for indoor climate, heat stress and comfort	"Maar de GGD toetst wel mee op, ook juist, veiligheid qua comfort, dus ook op hitte en op leefklimaat."
		General shortcomings		NO HS MEASURING INSTRUMENTS	There are no measuring instruments for heat stress	"Hitte stress, je hebt niet echt concrete normen of meet instrumenten. Waardoor het altijd wat vager blijft."
				NO OBLIGATORY HS STANDARDS	There are no concrete and obligatory standards for heat stress	"Maar ook meer van: ja, het is hier een hitte plek, dus we moeten zorgen voor... Maar niet een concreet iets van: dus, moet je zo veel, of je moet zo veel graden minder, of je moet zorgen voor zo veel.."
		General successes		HS ADVISE	Advise is given by different experts on how to mitigate heat stress	"En voor hitte, ja wat ik zei, wordt er in de projectgroep dan wel aangegeven van joh denk daar over na. Want de hitte die je niet in het gebouw krijgt hoeft je ook niet te koelen, dus dat scheelt ook. Alleen ja, wij hebben daar geen keiharde eisen in. Dus er wordt wel... tips ofzo, van: joh, he, denk aan je zonwering of aan de kleur van de gevel, dat soort zaken."
	Drought standards	General shortcomings		NO OBLIGATORY DROUGHT STANDARDS	There are no obligatory standards for drought	"Voor hitte en droogte hebben we nog op geen enkele manier dingen verplicht gesteld waardoor die thema's dus niet worden opgepakt."
	General climate adaptation standards	Points system nature inclusive building		POINTS SYSTEM NIB	System where points are given for green measures and nesting facilities for birds	"We hebben ook gezegd dat: je moet een combinatie maken tussen groene maatregelen en nestvoorzieningen, want het één kan eigenlijk niet zonder het ander."

			Successes	LEVEL PLAYING FIELD	There is a level playing field if all the developers have to follow the same rules	"Er is ook een level playing field, want iedereen moet er aan voldoen."
				CLEAR REQUIREMENTS DEVELOPER	It is clear to the developers what is asked of them	"Dus ze weten dankzij dat puntensysteem wat ze moeten doen om aan dat natuurinclusief bouwen te voldoen."
				NIB TAKEN SERIOUSLY	People take it seriously because it is legally required	"Maar als het verplicht is, zoals je dat nu ziet met die watertoets van het waterschap en met het puntensysteem natuurinclusief bouwen, dan gaan we er ineens over nadenken."
				FREEDOM AND CREATIVITY	There is freedom for creativity and customization	"Ze behouden wel de vrijheid en creativiteit om zelf de maatregelen te kiezen."
				POSITIVE FEEDBACK DEVELOPERS	The feedback is positive	"Wat ik wel kan zeggen is dat tot nu toe de reacties positief zijn".
			Shortcomings	NIB NOT APPLIED YET	There is no actual house built with the points system yet	"Tot nu toe, er is nog geen huis echt gebouwd met dat puntensysteem, dus ik kan niks zeggen over of het ook inderdaad zo groen en natuurinclusief is als we voor ogen hebben."
		Tree policy		TREE POLICY	Tree policies such as tree compensation or increasing the tree volume.	"Daarnaast hebben we natuurlijk ook, bijvoorbeeld een bomenplan. Daarin staat dat wij willen dat het volume aan boomkronen in Arnhem met 5% toeneemt, en met 10% in de hittegebieden."
		Removing impermeable surfaces		REMOVING IMPERMEABLE SURFACES	Removing as much unnecessary impermeable surfaces as possible	"En zo veel mogelijk onnodige verharding verwijderen."
	Climate adaptation policy in general	Shortcomings	Integral aspect is missing	INTEGRAL ASPECT MISSING	The department of climate adaptation doesn't always take other departments into account very well	"En waar denk ik af en toe het integrale aspect nog ontbreekt, en misschien wel omdat die energieke collega's denken dat het anders veel te traag gaat. En ze willen vooruit en ze willen veranderingen. En dat zal ook een opdracht van de wethouder zijn."
			CA policy is fragmented	CA POLICY FRAGMENTED	The climate adaptation policy is fragmented	"We hebben iets met bomen, iets met biodiversiteit, iets met natuur inclusief en iets met water, maar het is allemaal nog een beetje gefragmenteerd."
			Only CA policy	ONLY POLICY	There is only climate adaptation policy and	"Volgens mij hebben we dus geen eisen. Volgens mij hebben we dus alleen beleid en dat is dus niet geborgd in eisen."

					there are no concrete requirements	
				CANNOT BE MAINTAINED	If there are no concrete requirements measures cannot be maintained or managed	“Een keer is het klaar en dan gaat het eindelijk in een soort beheerfase. Dus op het moment dat jij niks op papier hebt staan om dat ook zo te borgen, kun je dat ook niet voor de langere termijn in stand houden.”
				LOSES FROM CONCRETE REQUIREMENTS	The soft policy always loses from the concrete standards such as for parking	“Want nu gaat het altijd van: oh, er moet die 1,7 parkeerplaats, nou dan halen we daar nog maar wat groen weg. En dan proppen we dat er in. En dan moet je een beetje geluk hebben met wat er overblijft voor de zachte dingen als groen. Want dat is allemaal niet genormeerd.”
	Climate adaptation in projects	Shortcomings	Developers don't take CA into account from beginning	CA NOT FROM BEGINNING	Developers do not take climate adaptation into account from the beginning	“Je gaat het verhaal er naartoe schrijven dat je goed bezig bent. Want, we planten drie bomen aan, dus we zijn goed bezig, omdat er drie bomen in dat plan passen. Maar niet: we gaan kijken wat eigenlijk zou moeten om hier een goede omgeving te maken, en daar gaan we van uit. Dus het is meer daarna het er naartoe schrijven dat het, dat je het kan afvinken, laat maar zeggen.”
				CA DOESN'T FIT IN SPATIAL PLAN	Climate adaptation does not fit into the plan anymore when it is not taken into account from the beginning	“Maar, vanwege de snelheid en de druk, gaan we alvast verder. En dat betekent dat je dingen aan het eind niet meer kunt inpassen, die je aan het begin al wel goed had moeten doen.”
				CA DOESN'T FIT IN BUDGET	Developers do not take climate adaptation into account when making the budget	“Dat op het moment dat we niks zouden benoemen, en er is al een contract gesloten met een ontwikkelaar en die gaat vervolgens, ja gaat in een project, en dan kom je in een keer met die eisen: ja maar, daar kunnen we nou niet meer aan voldoen. Daar hebben we in ons, hoe heet het, in ons business model geen rekening mee gehouden. Dat wordt nu veel te duur, om groene daken aan te leggen, ik noem maar wat.”
			CA not standard in projects	CA NOT STANDARD IN PROJECTS	Climate adaptation is not a standard part of development projects	“De praktijk is vaak, het ligt een beetje aan de projectmanager van de projecten, wie die allemaal in zijn projectteam haalt. En, of er dan genoeg aandacht is voor het thema. Want als er niemand in het projectteam zit die iets met klimaatadaptatie heeft, dan kan het zo maar eens vergeten worden, zal ik maar zeggen.”
			Developers have limited CA knowledge	LIMITED CA KNOWLEDGE DEVELOPERS	You cannot expect developers to have expert knowledge on climate adaptation	“Want uiteindelijk kun je ook maar zoveel, een beperkte expertise uiteindelijk verwachten van de ontwikkelaar. Die heeft niet overal kaas van gegeten.”

			CA requirements are unclear to developers	REQUIREMENTS UNCLEAR DEVELOPERS	It is unclear to developers when they meet the climate adaptation requirements	"Ik kan er wel iets bij bedenken, dat is het punt niet, en een projectontwikkelaar bedenkt er ook wel iets bij. Maar bedenkt hij dan ook wat wij hadden bedacht? Dat is vaak, merk ik vaak lastig: heb je het over hetzelfde?"
<b>Sub-question 2</b>	<b>Network</b>	<b>First category</b>	<b>Second category</b>	<b>Code name</b>	<b>Description</b>	<b>Example</b>
<b>Content design of adaptation instrument</b>	General considerations	Freedom versus strictness	Freedom for exceptions, creativity and innovation	FREEDOM	The developer should have the freedom to give their own suggestions	"Ik vind ook dat een ontwikkelaar ook de vrijheid moet hebben om daar dan zelf een voorstel voor te doen. Het is onze stad, maar uiteindelijk is het niet ons plan. Dus wij zijn niet diegene die tot op de voeg nauwkeurig gaat bepalen wat er gaat gebeuren, want dan hadden we het zelf moeten doen. Dus, maar goed, daar zijn verschillende meningen soms over.
				STANDARDS NOT MEASURABLE	When the standards are not measurable, they cannot be a rule in the 'bestemmingsplan'	"Ja, maar als je een doel gaat voorschrijven, dan kan de ODRA het niet toetsen. Dus als je die onderste doet. Bui die eens in de 100 jaar voorkomt en er mag geen wateroverlast optreden. Ja, dat kan je niet toetsen, dus dan komt het in de toelichting."
				ROOM FOR EXCEPTIONS	There should be room for exceptions in the CT	"Je zou dus wel ruimte laten voor een, voor uitzonderingen?" "Ja, natuurlijk. Dat moet ook. Daarvoor spelen er te veel belangen."
				ROOM FOR CREATIVITY/ INNOVATION	There should be room for creative solutions	"Het jammere aan strakke eisen zou ik vinden dat je de creativiteit van de markt er uit slaat."
			Concrete Standards	CONCRETE STANDARDS	You have to give concrete tools	"Op visie niveau kun je abstracte doelen stellen en naarmate je trechtert naar beneden moeten dat wellicht hele concrete zaken zijn. Die je onderaan de streep gewoon met elkaar kunt aftikken."
				STANDARDS MEASURABLE/ ENFORCEABLE	The standards have to be measurable to be able to be a rule in the 'bestemmingsplan'	"De ODRA die wil alleen dingen in de regels die ze ook goed kunnen toetsen. Dus het moet meetbaar zijn."
				GOING UP AGAINST OTHER STANDARDS	Concrete standards are needed to be able to go up against the concrete standards that already exist.	"Ik weet niet of dat werkbaar is en of dat realistisch is, maar dan heb je wel concrete dingen die je op tafel kan leggen, tegen alle wél vastgelegde normen van: we moeten 1,7 parkeerplaats per woning hebben daar."
	Type of instrument	ECO depot		ECO DEPOT	A developer puts their money in a depot and gets it back when they meet certain standards	"Maar je kunt ook een Eco Depot doen. Dan zeg je gewoon van: nou als jij geen duurzame maatregelen neemt, en dat kan klimaatadaptatie zijn, dat kan energietransitie zijn, dan moet je 15.000 euro in dat depot stoppen en dat krijg je dan niet terug. Maar als je het wel doet, dan krijg je dat geld dus weer terug. Maar dat controleren ze dus, zeg maar, aan het eind. Als je

						huis helemaal klaar staat en je hebt gewoon een heleboel betegeld, ja dan krijg je die 15.000 euro niet terug, zeg maar.”
		Rewarding developers		REWARDING	Receiving a reward when the developer realises more than the minimal requirements	“Van de andere kant: als je veel meer realiseert dan gevraagd is, dan mag je misschien wel een beloning ontvangen.”
		Making the advice of a CA specialist mandatory		MANDATORY ADVICE	Making it mandatory that developments are checked by a specialist (similar to the water assessment procedure)	“En, kijk, in heb altijd gezegd, een Klimaattoets is een, eigenlijk moet de Watertoets opgaan in de Klimaattoets.”
		Making one integral instrument for different sustainability ambitions		ON INTEGRAL INSTRUMENT	Making one instrument where the ambitions for climate adaptation, biodiversity, circularity and the energy transition are combined	“Maar daar kun je ook eens over denken, of je dat soort relaties legt van, zo van, dat je op een gegeven moment kunt zeggen van: oké, klimaatadaptief is die ongeveer neutraal, maar hij doet op zichzelf nog wel veel aan de biodiversiteit, aan circulariteit, misschien de energie-transitie. Dat die daar dan heel veel aan bijdraagt, dan zeg je van: dan mag die als klimaatadaptief neutraal zijn. En anders zou die positief moeten zijn. Dus dat je ook zo'n afweging maakt.”
		Making a points system for CA		POINTS SYSTEM	Making a points system for climate adaptation (similar to the point system for NIB)	“Dus of je moet er inderdaad een puntensysteem aan koppelen, dat ben ik helemaal met je eens.”
			Pro's	FREEDOM/CHOICE	With a points system people are free to choose their own climate adaptation options	“Dat mensen niet helemaal vastgepind worden, ergens op, dus ze kunnen kiezen.”
				FAIRNESS	A points system would be more fair	“En dan is een puntensysteem is wel denk ik eerlijker en rechtvaardiger.”
				INFORMING AND INSPIRING	A points system could inspire people and inform them about different adaptation options	“Maar ze worden ook getriggerd van: hé, dit zou ik eigenlijk ook wel kunnen doen.”
				REQUIREMENTS CLEAR TO DEVELOPER	A points system would make it clear to developers what is expected of them	“Daarin zie ik de parallel met die toets natuurinclusief bouwen. Nou, dat je gewoon een soort handreiking geeft aan die ontwikkelaar van: waar moet je dan aan denken.”
				TESTABLE	A points system is easy to test by the authorities	“Dus daarom is het met natuur inclusief zo fijn, dat er een puntensysteem is. Dat is gewoon heel helder: oké, dit ga ik

						doen, zo veel punten is het. En dat kunnen ze gewoon makkelijk controleren.”
			Con’s	ADMINISTRATION	A points system could cause much administrative work	“Terwijl ik ook wel vrees voor de administratie die er bij alles gaat komen.”
	New standards	New drought standards	Drought is less urgent	DROUGHT LESS URGENT	Drought is less urgent than the other climate adaptation standards	“Ik vind dat ook niet het grootste thema hier.”
			Focus on drought	FOCUS ON DROUGHT	Because there are already many water standards, the focus should lie on drought and heat stress	“Dus dan zou ik zeggen, volgens mij moeten we op hitte en droogte, met name focussen.”
		Fluvial flooding standards	Fluvial flooding is the responsibility of the water board	RESPONSIBILITY WATER BOARD	The standards for fluvial flooding (waterveiligheid) are the responsibility of the water board	“En ja, waterveiligheid is eigenlijk geen issue. Dat mogen de Waterschappen doen. Die gaan er ook over. Die hebben er toch meer verstand van.”
		Pluvial flooding standards	Existing water policy	EXISTING WATER POLICY	Translating the existing water policy into the standards of the ‘climate test’	“Sowieso denk ik dat je dat watergedeelte, zo veel millimeter bergen, dat sowieso. Want dat is vrij makkelijk te kwantificeren, zeg maar. Dus dat zeker.”
			Components from the water assessment	COMPONENTS WATER ASSESSMENT	Taking over most of the components of the water assessment	“Nou, sowieso de onderdelen van de Watertoets. Nou, een groot deel van de onderdelen van de Watertoets. Sommige dingen ook niet.”
				ONLY MAKE NEW STANDARDS IF NOT SUFFICIENT	New water standards only have to be formulated if the current standard are not considered sufficient	“Er hoeft op watergebied, hoeven we alleen iets nieuws te verzinnen als dat wat er nu ligt niet werkt. Als wat nu ligt werkt, dan hoeven we wat mij betreft niet nog iets extra's te gaan eisen.”
		New heat stress standards	Existing heat stress policy	EXISTING HEAT STRESS POLICY	Translating the existing heat stress policy into the standards of the ‘climate test’	“Je hebt in je beleid iets gezegd, bijvoorbeeld in rode gebieden moet een ontwikkeling bijdragen aan een verbetering van de klimaattemperatuur. Nou dan ga je, in je Klimaattoets, moet je dat zien te borgen.”
			There are three heat stress categories	THREE HEAT STRESS CATEGORIES	There are three heat stress categories: the effect if the building on the indoors, the effect of the building on the outdoors and the outdoor heat stress in itself.	“Dus dan heb je eigenlijk al drie aspecten. Het effect van het gebouw op de buitenruimte, het effect van het gebouw op de binnenruimte en de buitenruimte an sich, en het effect daarvan op de gevoelstemperatuur.”
		Effect of the building on	Sun screens, green facades,	SUN SCREENS; GREEN FACADES; GREEN	Sun screens, green facades, green roofs and	“En dan het gebouw, dat zijn hele andere dingen. Dus dan heb je het over luifels, dan heb je het over, nou ja misschien een



		the indoor temperature	green roofs and the colour of the building	ROOFS; COLOUR OF BUILDING	the colour of the building have an effect on the indoor temperature of a building	groen dak voor de bovenste etage, groene balkons, groene gevels, kleur."
			Passive cooling	PASSIVE COOLING	Passive cooling is sustainable as it uses ventilation instead of air conditioners	"Dus, en ik wil niet overal airco's hebben. Want dan maak je het probleem nog groter. Dus, duurzame koeling is een hele belangrijke."
				BEHAVIOURAL ASPECT OF INDOOR HS	Try to take the behavioural aspect of indoor heat stress into account with the 'climate test'	"Maar voor hitte in huis, dat zou dan een soort van derde categorie moeten zijn. En dan zijn het bijna meer open vragen, of ja/nee vragen, van: heeft u er voor gezorgd dat er zo veel mogelijk zonwering aanwezig is? En heeft u de mensen geïnformeerd over nachtventilatie? En dan moet dat gewoon allemaal 'ja' zijn bijvoorbeeld. En dan is dat gewoon niet heel hard, maar dan krijg je wel wat meer dat mensen er over na gaan denken. Dat zou dan misschien kunnen."
			Placement of windows	PLACEMENT OF WINDOWS	Prevent the placement of windows on the south façade of a building	"En je kunt zien: hebben ze hele grote raampartijen op het zuiden? Ja misschien moet je dat dan niet doen, of zo."
		Effect of the building on the outdoor temperature	Shape of the building, the amount of buildings, the orientation of the building, the material of the building	SHAPE OF BUILDING; AMOUNT OF BUILDINGS; ORIENTATION OF BUILDINGS; MATERIAL OF BUILDING	The shape of the building, the amount of buildings, the orientation of the building, the material of the building have an effect on the temperature of the area surrounding the building	"Ja, maar heel belangrijk in een nieuwe ontwikkeling in hoeverre een gebied opwarmt is de vorm van de bebouwing, de mate van bebouwing, de oriëntatie van de bebouwing, materiaalkeuze en schaduw van het gebouw."
				LOCATION OF BUILDING	The location of the building has an effect on the outdoor temperature	"Wat is het effect er van? Denk na over kleuren, denk na over materiaal. Denk na hoe je het positioneert, waar je, überhaupt, waar je gaat ontwikkelen"
				COLOUR OF BUILDING	The colour of the building has an effect on the outdoor temperature	"Daar moet je eens over nadenken, van: materiaalgebruik, kleurstelling, reflecteert het... Ja, dat komt eigenlijk al weer terug in de gevoelswaarde voor hitte, enzovoort."
				WIND	Wind streams have an effect on the outdoor temperature	"Gaat het om, je moet wind, bouwvolume en bouwvorm, die zijn heel bepalend bij hitte."
		Outdoor heat stress	Shadow percentage	SCHADOW PERCENTAGE	Demanding a certain percentage of shadow on the hottest moment of the day	"Maar dan zoiets wat je zegt van: er moet zo veel procent schaduw zijn op het warmste gedeelte van de dag, dat vind ik dan een hele interessante weer."

			Greening	GREEN SURFACE AREA	Demanding a certain amount of square meters of green surface	“Denk ik dat je alleen vierkante meters een soort van groen met een bepaalde definitie wat groen dan is.”
				3-30-300 RULE	The 3-30-300 rule means that every person should be able to see 3 trees from their house, 30% should be covered with tree canopy and within 300 meters there should be a large green area	“Er schijnt zo'n norm te zijn: die 3-30-300. Ik weet niet of je daar van gehoord hebt? Dat heeft iemand bedacht of opgezet, dat je, dat iedereen vanuit zijn woning drie grote bomen zou moeten zien, dat 30% van de omgeving bedekt moet zijn met bladerdak en dat je binnen 300 meter een, bij een park of een groene omgeving zou moeten komen”
				COOL GREEN AREA	Demanding that there should be a cooling green space within a certain amount of meters	“En een groene plek. Zo veel meter hemelsbreed, dan wel wandelroute er naar toe. Dus dan moet je even kijken wat haalbaarder is qua meetbaarheid weer. En een groene plek is dan volgens mij minimaal 200 of 300 vierkante meter, inderdaad met grote bomen.”
				IMPERMEABLE SURFACE PERCENTAGE	Demanding a certain maximum percentage of impermeable surface area	“Dus je zal ook iets met de verharding moeten zeggen.”
				GREEN PERCENTAGE	Demanding a certain percentage of green surfaces	“Ik denk dat je iets moet zeggen over percentage groen en percentage verharding.”
				DON'T MAKE TREES MANDATORY	You cannot demand a certain amount of trees within a planning area	“Ik denk niet dat je kan eisen: zet zo veel bomen neer.”
				TREES DIE	Trees can die or blow over and then a small tree is planted back instead	Ik denk niet dat je kan eisen: zet zo veel bomen neer. Een boom kan ook dood gaan of omwaaien of... Dus ja, dan zet je er weer een mini boompje voor terug. Ik weet niet of dat dan... Dat duurt dan weer 20 jaar voordat dat ding schaduw geeft.
				TREES CAN BLOCK COOLING WIND	Trees can block the cooling wind	“Als je gaat eisen dat er bomen, een bepaald aantal bomen binnen elk project moeten komen, dan gaan mensen die bomen dadelijk precies daar zetten waar dat zomerbriesje doorheen komt. En dan bereik je dus je doel niet.”
				TREES DON'T FIT PLAN	Sometimes trees don't fit within a planning area	“Stel dat je een huis bouwt, nou dan moet je standaard misschien wel drie bomen in je tuin zetten, ja dat is niet altijd de meest passende, soms kan het ook gewoon niet. Dat die boom tegen een gevel aan komt te schuren.”
			Measuring outdoor temperature	MEASURING TEMPERATURE WITH MODEL	Measuring the outdoor temperature with a computer model	“Dat de omgevingstemperatuur dus als koeler ervaren moet worden, en dan zou je een bepaalde modellering, dus moeten inbouwen, want je kan dat niet meten als je alleen maar een

						tekening hebt, zeg maar. Maar je kunt dat wel in een computer modelleren, denk ik, en dan dat uitrekenen wat dat betekent voor de omgeving”
<b>Sub-question 3</b>	<b>Network</b>	<b>First category</b>	<b>Second category</b>	<b>Code name</b>	<b>Description</b>	<b>Example</b>
<b>Implementation of the adaptation instrument</b>	Implementation ‘climate test’	Point out in beginning		POINT OUT BEGINNING	When you point the standards out in the beginning, they will be taken into account each phase	“Ik denk dat als je het aan de voorkant vastlegt, dat je dan gedurende je project er makkelijk op kan sturen.”
		More detailed each phase		MORE DETAILED EACH PHASE	The level of detail depends on which phase you are in	“Ik denk dat die Klimaattoets, die loopt over alle fases heen. In elke fase van het project, van initiatief fase, tot ontwerp fase tot uitvoeringsfase, overall, in al die fases, zul je bepaalde aspecten toetsen aan die Klimaattoets. En elke fase van het project heeft een ander detailniveau. Dus ik zie dat niet als een instrument wat één keer wordt ingezet, en dan klaar. Nee, dat gaat over je hele project, loopt dat door.”
			Voorlopig ontwerp/schetsontwerp	VO/SO	A preliminary design (VO) is the elaboration of the sketch design (SO) made earlier. The feedback from the client is included in this drawing.	“Wat verstaan wij onder een schetsontwerp? Wat verstaan wij onder een voorlopig ontwerp? Kijk, daar zou je hem gewoon tussen kunnen zetten.”
		Enforcing in the end		ENFORCING AT END	Legally you enforce it at the end	“Juridisch borg je hem op het eind, maar dat is ook het enige formele eigenlijk. Want alles kan weer veranderen.”
			Taken into account beginning	TAKEN INTO ACCOUNT BEGINNING	Because you enforce it at the end, it will be taken into account from the beginning	“Kijk, als je het aan het eind goed geregeld hebt, net zoals natuur inclusief, dan is het aan het begin al een gespreksonderwerp.”
	Existing planning instruments	Initiation phase	Nota van Randvoorwaarden en Uitgangspunten	NOTA RANDVOORWAARDEN UITGANGSPUNTEN	The ‘nota van Randvoorwaarden en Uitgangspunten’ are the preconditions of a development described in a vision document	“Nou, de initiatief fase. En de definitiefase ook. Dus zeg maar in het begin. Bij het opstellen van bijvoorbeeld een Nota van Uitgangspunten of een gebiedsvisie. Dat je daar heel helder aangeeft wat je belangrijk vindt. En met name in de ontwerpfase, want dat is natuurlijk waar de keuzes gemaakt gaan worden die ook wel of niet worden vastgelegd in het bestemmingsplan. Dus daar.”
			Omgevingsvisie	OMGEVINGSVISIE	The ‘omgevingsvisie’ is the follow-up of the ‘structuurvisie’ and is a vision document of the municipality	“Maar ik committeer mij ook aan die Omgevingsvisie, dus het gaat er mij veel meer om, om leefbaarheid, en omgevingskwaliteit, en dat is dus veel breder dan alleen maar hoe het er uit ziet.”

			Omgevingskwaliteitsplan	OMGEVINGSKWALITEITPLAN	The 'omgevingskwaliteitsplan' is an initiative of a colleague where the vision on the quality of the living environment is written down	"Ik ben bezig met dat Omgevingskwaliteit Plan en misschien komt het er helemaal niet, maar dat heb ik ook maar geopperd. Omdat ik denk dat omgevingswaarde, en daar valt klimaat ook onder, ook op een juridische manier verankerd moeten worden is ons, als instrument in ons stelsel. Dus niet alleen maar als wens, maar als eis."
		Definition phase	Grondexploitatie	GRONDEXPLOITATIE	The 'grondexploitatie' is a budget of all the expected costs and profits of the development.	"Ik vraag me af van: zou je dan eigenlijk nog een stapje terug moeten? Want uiteindelijk, een ontwikkelaar die grond koopt, dat is natuurlijk ook altijd een rekensommetje. En, misschien een beetje kort door de bocht, maar eigenlijk alle klimaat adaptieve maatregelen die je neemt, dat kost eigenlijk geld. Want het gaat of ten koste van ruimte, of je moet extra investeren, en de ontwikkelaar zal dan altijd zeggen van: ja, maar dat komt niet meer uit. En dat past niet. En dat is te duur. Dus eigenlijk zou je dat eigenlijk in de grondprijs misschien."
			Stedenbouwkundig plan	STEDENBOUWKUNDIG PLAN	The 'stedenbouwkundig plan' is the city plan, which is a document with all the plans and rules for the development.	Eigenlijk, daar hamer ik dus op, dat gelijk op het stedenbouwkundig plan ook het waterplan geschreven wordt."
				HANDBOEK INRICHTING OPENBARE RUIMTE	The 'handboek inrichting openbare ruimte' is a guide for the public space	"En waar ik ook aan zit te denken: wat ik net zei, de gele bundel, dus de randvoorwaarden eigenlijk, die een ontwikkelaar meekrijgt van: als je een openbare ruimte voor ons ontwerpt, want vaak doet de ontwikkelaar dat, toetsen wij de plannen, leggen zij de openbare ruimte aan, en gaat het daarna over naar de gemeente."
			Anterieure overeenkomst (ontwikkelaar grondpositie)	ANTERIEURE OVEREENKOMST	The 'anterieure overeenkomst' is an agreement for when the developer owns the ground	"Maar als je daar in de anterieure overeenkomst al de afspraak vastlegt dat je plan moet voldoen aan de Klimaattoets."
			Aanbesteding (grondpositie gemeente)	AANBESTEDING	The 'aanbesteding' is an agreement when the municipality owns the ground	"Dus als wij een grondpositie hebben, dan kun je privaatrechtelijk dingen regelen. Want een bestemmingsplan is publiek rechtelijk."
		Design phase	Bestemmingsplan	BESTEMMINGSPAN	The zoning plan (bestemmingsplan)	"Ik denk dat je hem vast wil leggen bij het bestemmingsplan, maar dat het voor het proces handig is als je hem in je ontwerp proces al meeneemt."

				EXPLANATION 'BESTEMMINGSPLAN'	The explanation of the 'bestemmingsplan' (toelichting)	"Ja, het moet ergens getoetst worden. Dat is het bestemmingsplan in feite. In feite is, de Waterparagraaf, dus de Klimaatparagraaf straks, hoop ik, is eigenlijk, nou ja eigenlijk, van dat je de vinkjes kunt zetten van: dat hebben we gedaan, dat hebben we goed doorlopen, dat hebben we goed doorlopen, we zijn nu klaar."
				RULE 'BESTEMMINGSPLAN)	The rules of the 'bestemmingsplan'	"Ik denk dat het via het puntensysteem kan. Op diezelfde manier. Dus dat is via een beleidsregel die je toevoegt aan nieuwe bestemmingsplannen."
				ONLY RULES WILL BE ENFORCED	Only the rules of the zoning plan (bestemmingsplan) can be enforced	"Maar alleen wat in de regels staat van het bestemmingsplan, wordt daadwerkelijk, uiteindelijk als de vergunning wordt aangevraagd, want ze moeten dan nog het plan uitwerken en dan moeten ze een vergunning aanvragen, wordt getoetst."
<b>Main question</b>	<b>Network</b>	<b>First category</b>	<b>Second category</b>	<b>Code name</b>	<b>Description</b>	<b>Example</b>
<b>Drivers/barriers</b>	Internal organisation	Leadership and policy entrepreneurs		LEADERSHIP	The leadership of the civil servants to develop a new instrument	"En misschien wel omdat die energieke collega's denken dat het anders veel te traag gaat. En ze willen vooruit en ze willen veranderingen."
		Staff and resources		STAFF AND RESOURCES	The availability of the staff and resources	"Maar waar ik wel een duidelijke belemmering in zie, is gewoon in dit uitrollen. Als je echt een klimaatambitie hebt, dan heb je daar gewoon menskracht, denkkraft voor nodig. Maar we hebben ook mobiliteitsopgaves, we hebben ook woonopgaves. En we komen om in het werk, maar niet in de mensen en de middelen. Dus ik zie de grootste blokkade eigenlijk in gewoon: dat er mensen aangenomen moeten worden die dat werk zouden moeten doen."
		Cooperation between departments		COOPERATION BETWEEN DEPARTMENTS	The cooperation between departments	"Dus op dat soort manieren mag het iets minder snel en iets beter gewoon integraal kijken naar allerlei verschillende disciplines, waar we allemaal goede vakmensen hebben zitten die over dit thema graag meedenken. Ik denk dat we bijna allemaal de intentie hebben om onze klimaatvriendelijk te maken."
			(Spatial) legal department	(SPATIAL) LEGAL DEPARTMENT	The cooperation between the climate adaptation department and the spatial legal affairs department	"[...] kan ons later helpen om precies te bepalen wat de slimste manier is, van juridische zaken."
			Management department	MANAGEMENT DEPARTMENT	The cooperation between the climate adaptation department and the management department	"Dus als je dit veranderen wil, dan moet je beginnen bij die leidinggevende om daar tussen de oren te krijgen dat het ook echt een verandering is. En ik zie dus al, ook bij openbare ruimte, projectleiders, dat dat echt al wel per persoon

						verschillend is, maar soms moet je daar nog wel even voor op de barricade. Dus het zou misschien ook wel helpen dat het ook bij afdelingshoofden of managers, of degene die die mensen aanstuurt, dat het ook helder is dat dit echt een transitie is, en dat het ook een verandering in denken is, en dat het ook iets betekent voor hun werk.”
			Mobility department	MOBILITY DEPARTMENT	The cooperation between the climate adaptation department and the mobility department	“Eh, nou ja, sowieso Beheer altijd meenemen. Het is ook slim om Stedenbouw en Landschap mee te nemen, het is ook slim om Mobiliteit mee te nemen. Erfgoed aan te haken.”
			Urban planning department	URBAN PLANNING DEPARTMENT	The cooperation between the climate adaptation department and the urban planning department	“Het is wel zo van, hoe meer mensen je kunt betrekken bij het klimaatverhaal, hoe makkelijker het is. Want dan ben je niet.. Kijk, ik zit wel vaak aan tafel, maar lang niet altijd. Wie zit altijd aan tafel? Dat zijn de stedenbouwkundigen en de landschapsontwerpers eigenlijk. Nou, als je die mee krijgt, als die daar echt oog voor hebben, dan heb je bij elke schetsessie die er gedaan wordt, wordt het meegenomen.”
			Project management department	PROJECT MANAGEMENT DEPARTMENT	The cooperation between the climate adaptation department and the project management department	“En ook, bijvoorbeeld bij PIM, project managers, dat die daar ook in meegenomen worden. In het belang er van. En in het hoe, en hoe je dingen gaat vastleggen. En implementeren. Dus dat je, nou ja wat is het? De betrokkenheid eigenlijk. Dat je zo veel mogelijk mensen meeneemt er in, in plaats van iets ontwikkelen en dan als het helemaal af is, dan leg je het neer, van: nu moet je zo gaan werken.”
		Conflicting spatial interests between departments		CONFLICTING SPATIAL INTERESTS DEPARTMENTS	The amount of conflicting spatial interests between departments	“En die vierkante meter moet voldoen aan: groen, extra groen, extra woningen.. Die moet voldoen aan ondergrondse infrastructuur: kabels, leidingen en riolering. Die moet voldoen aan: parkeren. Dus die vierkante meter, één vierkante meter, daar zitten misschien wel 20 ambities op.”
		Climate adaptation and circularity		CA AND CIRCULARITY	The amount of conflicting spatial interests between climate adaptation and circularity	“Materialen voor circulair bouwen zijn meestal niet, als je ze gaat hergebruiken, zijn meestal niet klimaatadaptief. Want dat is beton vaak.”
		Climate adaptation and parking		CA AND PARKING	The amount of conflicting spatial interests between climate adaptation and parking	“Maar dat parkeren, het maakt niet uit waar je informatie over hebt, je moet zorgen dat er iemand van mobiliteit bij je hebt, want het gaat altijd over parkeren. Dus op het moment dat je minder parkeerplekken maakt omdat je meer ruimte wil voor iets met klimaat of groen, en dan heb je wel een heel goed verhaal nodig.”

			Climate adaptation and the energy transition	CA AND ENERGY TRANSITION	The amount of conflicting spatial interests between climate adaptation and the energy transition	“Ik ben dan contraproductief bezig voor mijn collega's van NEMIA.”
		Climate adaptation awareness and the structure of the organisation		AWARENESS AND ORGANISATIONAL STRUCTURE	The level of climate adaptation awareness and the behaviour within the organisation	“En ja, dat is meer een cultuur en gedrag iets, denk ik, binnen een organisatie, en hoe je dat veranderd, ja, dat is, dat staat los van de techniek laat maar zeggen.”
			Ambition of the CA policy	AMBITION OF POLICY	The level of ambition of the climate adaptation policy	“En ik heb het idee dat we hier best wel een ambitieuze stad zijn. Want ik bedoel, dat natuur inclusief, daar lopen we toch best wel mee voor. En klimaat-adaptatie ook, al zit het nog niet echt in de eisen. Maar daar, dat hebben we gewoon al best wel heel lang, die richtlijnen, laat ik het maar even zo noemen.”
			Attention for drought standards	WATER ATTENTION	The attention towards water standards (as the climate adaptation department stems from the water and sewage department)	“Klimaatadaptatie, dat weet je misschien ook wel, dat is heel erg ontstaan vanuit de rioleringsgroep binnen de gemeentes. En vanuit de water mensen bij de waterschappen. Maar inmiddels is dat heel erg verbreed, en ik weet niet hoe dat hier in de gemeente Arnhem is, in hoeverre dat al verbreed is, of dat dat nog heel erg zijn basis heeft in die groep, want daardoor zit die focus vaak ook niet op die hitte.”
			Attention for drought standards	DROUGHT ATTENTION	The attention towards drought standards	“Wat ik weet van gesprekken met hen en wat me is opgevallen is dat er wel veel ligt rond water en eigenlijk nagenoeg niet wordt nagedacht over hitte en droogte.”
			Attention for heat stress standards	HEAT STRESS ATTENTION	The attention for heat stress within the organisation	“Wat ik weet van gesprekken met hen en wat me is opgevallen is dat er wel veel ligt rond water en eigenlijk nagenoeg niet wordt nagedacht over hitte en droogte.”
			Filling in the expectation of others	FILLING IN EXPECTATION OTHERS	The level of people filling in other people's expectations	“Wij vullen als ambtenaren wel eens iets in wat de Raad zou kunnen denken.”
			Climate adaptation awareness and structure of the management department	AWARENESS AND STRUCTURE MANAGEMENT DEPARTMENT	How well the structure of management department is adapted to climate adaptation	“Dus de mensen die de straten moeten beheren, maar ook bij mobiliteit de mensen die parkeerplaatsen moeten aanleggen. En dat misschien nu anders moeten doen. En als er een straat opnieuw geasfalteerd moet worden, dan zou je dat misschien niet meer opnieuw asfalteren. Dus ik merk met name dat er nog wel wat missiewerk zit in die laag van de organisatie. Die is ook soms nog wel wat sectoraal georganiseerd.”

				MONEY FOR MANAGEMENT	The amount of money for the management of the climate adaptation measures	"Water en rioolbeheer houden geld over, terwijl groen geld tekort heeft. Omdat zij dingen gaan beheren die... Jongens, het maakt niet uit van wie het is, je stopt alle geld in een pot, per vierkante meter."
		Knowledge and expertise within the organisation		KNOWLEDGE/ EXPERTISE ORGANISATION	The level of knowledge and expertise within the organisation	"Dus de kennis die we, hebben we genoeg kennis in huis om zelf zo'n Klimaattoets in huis, of moeten we die bijvoorbeeld inhuren, extern?"
			Heat stress expertise	HEAT STRESS EXPERTISE	The amount of heat stress expertise	"Bijvoorbeeld al onze stedenbouwkundigen en landschappers zo'n workshop zouden laten volgen bij de [...] en dat er een soort van bepaald kennisniveau ontstaat binnen de organisatie, waardoor die op de juiste manier kunnen adviseren over hitte in projecten. Dat is het denk ik."
				MEASURABILITY OF HEAT STRESS	The level of measurability of heat stress	"Want, ik heb met modellen gewerkt, je kunt manipuleren wat je wil. En niemand ziet het. Dus ik ben altijd wel heel voorzichtig met modellen. Het is namelijk een hulpmiddel te realiteit te benaderen, het is niet de realiteit."
			Drought expertise	DROUGHT EXPERTISE	The amount of drought expertise	"Nou ja, een andere belemmering is dat er wel nog een gebrek aan kennis is, überhaupt, over klimaatadaptief bouwen in de vorm van hitte stress en droogte."
			Water expertise	WATER EXPERTISE	The amount of water expertise	"En hier binnen de gemeente zijn er gewoon echt experts op het gebied van water, dus dat merk ik ook."
			Data of problem areas	PROBLEM AREAS DATA	There is already a lot of data on where flooding and heat islands are the largest problem	"Dat we een hittekaart hebben, dat we een wateroverlast kaart hebben en dat we weten waar de attentie en focusgebieden zitten in de stad. Waar zowel iets met water als hitte speelt bijvoorbeeld. Dus dat we wel al weten wat er speelt."
		Political support		POTICIAL SUPPORT	The support coming from the politics to develop the 'climate test'	"Het is een stukje politiek ook. Als dit bij de politiek ook als iets belangrijks wordt gezien, en uitgedragen. Dat werkt natuurlijk mee."
			Political sensitivity	POLITICAL SENSITIVITY	The political sensitivity of an option	"Welke keuze is het meest politiek gevoelig, soms ook."
			Conflicting political interests	CONFLICTING POLITICAL INTERESTS	The level of conflicting interests between the politics and the civil servants and between the aldermen	"En de Raad zei gewoon: 'ja, toch maar even wat meer woningen er bij'. Ja, maar meer woningen betekent ook meer ruimtebeslag. Ten opzichte van: minder groen."
			Political movement	POLITICAL MOVEMENT	The political movement within the current council	"Dus dat is wel een kans. Dus maak gebruik van de politieke stroming nu de komende vier jaar, om dat dan ook echt..."

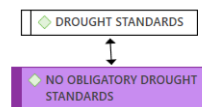
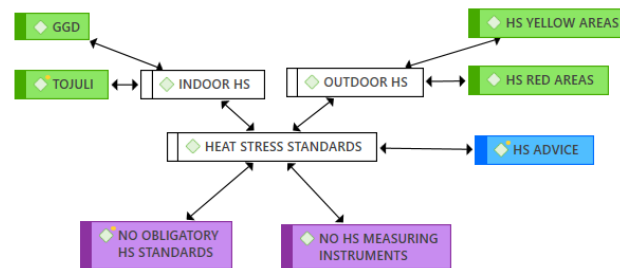
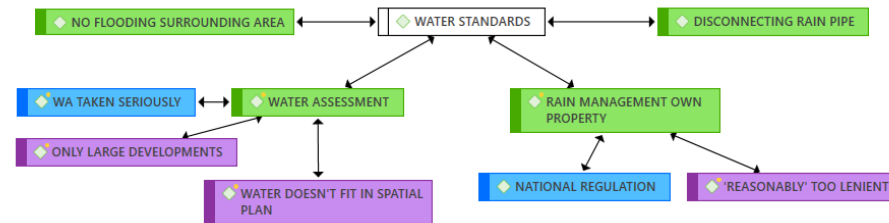


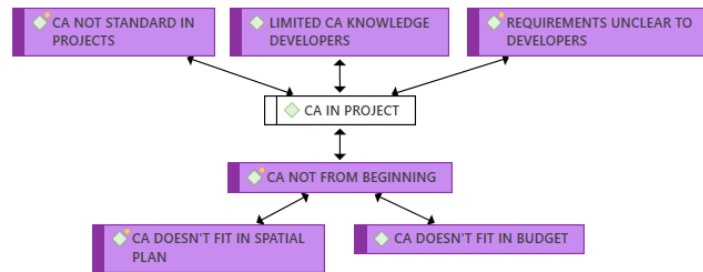
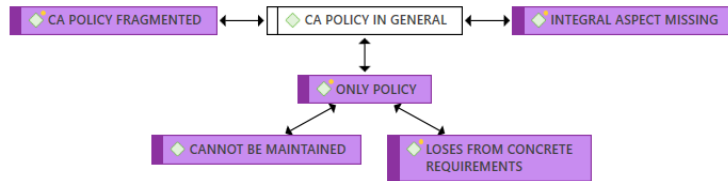
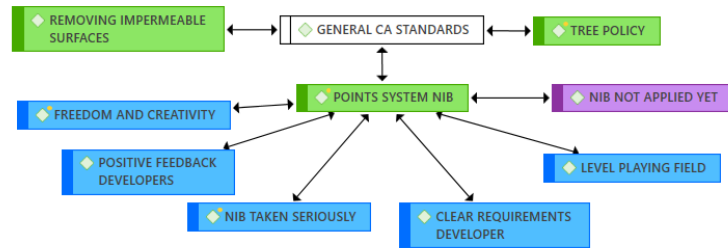
	Private actors	Willingness of the developers		WILLINGNESS DEVELOPER	The level of willingness from the developers to work with climate adaptation	“Want nu zullen alleen de ambitieuzere projectontwikkelaars er echt oog voor hebben. Die gewoon al van zichzelf zoiets hebben van: ‘we willen gewoon iets opleveren waar mensen fijn in wonen’. Maar er zullen er ook wel wat tussen zitten, denk ik, die zoiets hebben van: ‘nou, weet je, we zijn vooral een investeringsmaatschappij en we willen gewoon zo veel mogelijk rendement’.”
			Knowledge resources of the developers	KNOWLEDGE RESOURCES OF THE DEVELOPER	The amount of time, money for climate adaptation measures and expertise that developers have	“En, misschien een beetje kort door de bocht, maar eigenlijk alle klimaat adaptieve maatregelen die je neemt, dat kost eigenlijk geld. Want het gaat of ten koste van ruimte, of je moet extra investeren.”
			The amount of rules	AMOUNT OF RULES	The amount of rules developers have to follow	“Nou, het eerste wat mij te binnen schiet is de opstandigheid van: goh, we moeten al zo veel en we hebben al zo veel regeltjes en dan moet dit er ook nog even tussen gevrot worden, laat maar zeggen. Dus, dat. Ja, en de weerstand die je hebt omdat dit dingen zijn, die kosten geld en ruimte.”
	External organisations	Cooperation with other organisations		COOPERATIONS OTHER ORGANISATIONS	The level of cooperation with other organisations	“Hark bij elkaar wat er al is en giet het in een vorm die voor ons bruikbaar is.”
			Knowledge of the water board	KNOWLEDGE WATER BOARD	The level of climate adaptation knowledge coming from the water board	“Maar ja, zijn ze wel toch bereid om daar ook over mee te denken. En dat ook doen. Dus het is niet dat ze dan afwijzend, zo van: ja maar daar zijn we niet van, dus deze sessie slaan we even over. Dat niet.”
			Knowledge of the ‘GGD’	KNOWLEDGE GGD	The level of climate adaptation knowledge coming from the ‘GGD’	“Ja maar wel een comfortabel binnenklimaat, en dat zou je bijvoorbeeld ook met de GGD kunnen afstemmen, van: wat valt daar dan onder? Want zij zullen daar denk ik iets meer over nagedacht hebben dan wij, omdat zij daar ook op adviseren.”
			Knowledge of other municipalities	KNOWLEDGE OTHER MUNICIPALITIES	The level of climate adaptation knowledge coming from other municipalities	“Dus andere gemeentes, de VNG zou je kunnen raadplegen hierop. Ik kijk zelf wel eens op sites, iets van gebiedsontwikkeling.nu. Dus er is natuurlijk ook al heel veel bedacht.”
			Knowledge and resources coming from the province	KNOWLEDGE AND RESOURCES HIGHER LEVELS GOVERNMENT	The level of climate adaptation knowledge and funding coming from higher levels of government	“Ik vind dat we moeten oppassen om met hele andere eisen te gaan komen, als die straks in Gelderland en Nederland gaan gelden. Tenzij we een hele goeie reden hebben om daar van af te wijken.”
			Knowledge of advising bureaus	KNOWLEDGE ADVISING BUREAUS	The level of climate adaptation knowledge	“Er worden natuurlijk altijd heel veel adviesbureaus ingehuurd hè, om werk te doen voor, nou ja een ontwikkelaar. Als daar de kennis ontbreekt over de thema’s wat wij belangrijk vinden hè.

					coming from advising bureaus	[...]. Dan, dat maakt het makkelijk. Als die er niet is dan wordt het moeilijk want dan moeten wij het gaan vertellen, zou je kunnen zeggen. Maar als de kennis ontbreekt bij die bureaus over hoe je die kennis toepast in een project dan hebben we ook een dik probleem. En ik kan niet goed inschatten of de kennis bij die bureaus er is om wat wij dadelijk gaan vaststellen, om dat in de projecten te gaan doorvoeren."
	Legal framework	Legal barriers		LEGAL BARRIERS	The amount of legal barriers to implement the 'climate test'	"Nou ik zie niet zozeer barrières om het te borgen. Want volgens mij is alles te maken. Maar dat moet de wens zijn."
			The enforcement of the 'climate test'	(OBJECTIVE) ENFORCEMENT CT	The level of enforcement of the 'climate test'	"Je kunt het wel juridisch vasttimmeren, maar handhaving is natuurlijk nergens te bekennen."

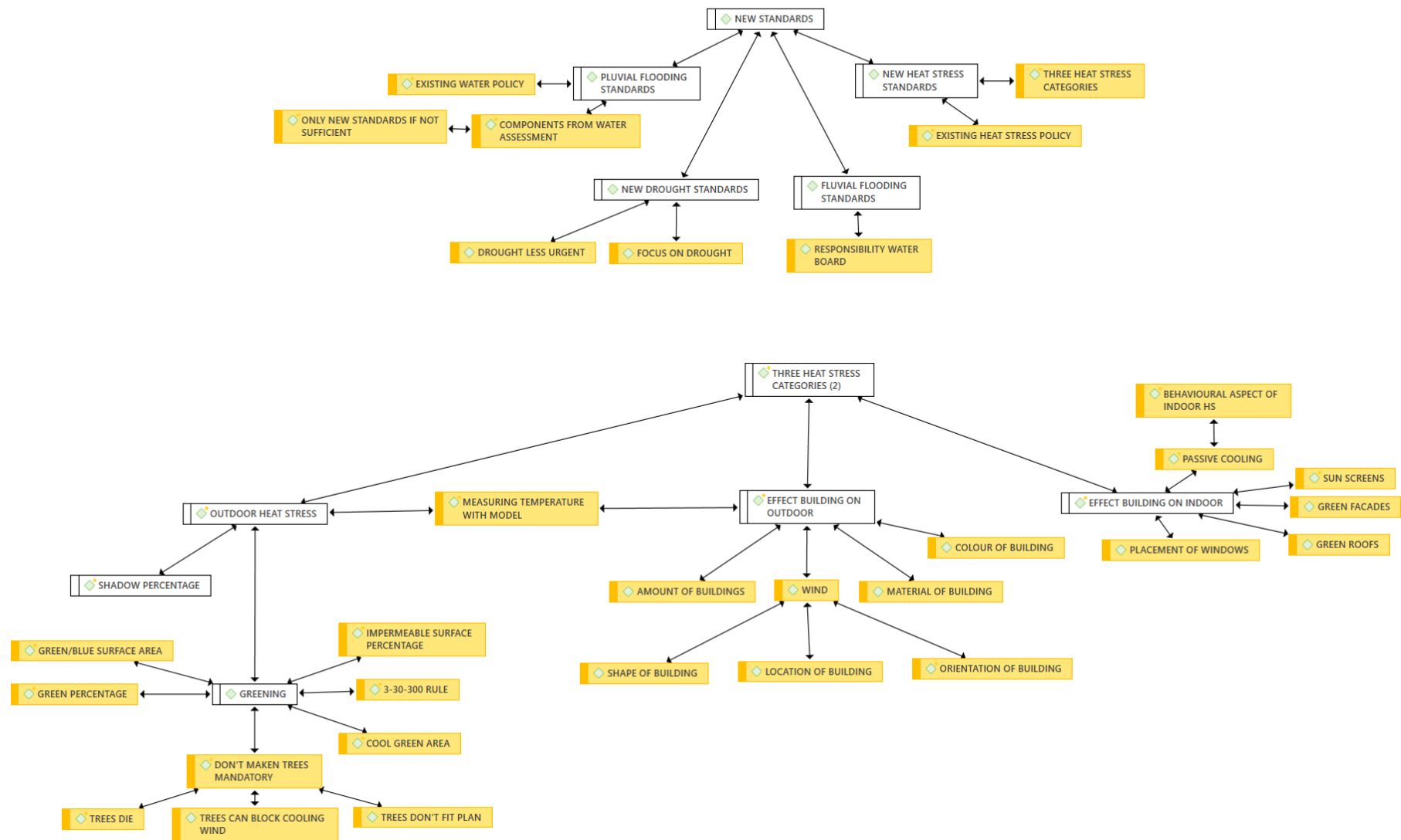
## Appendix D. Networks in Atlas.ti

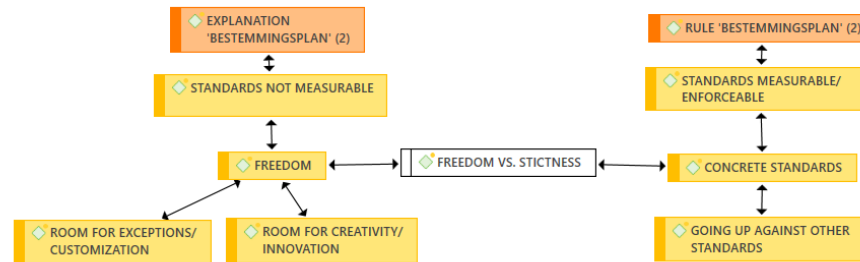
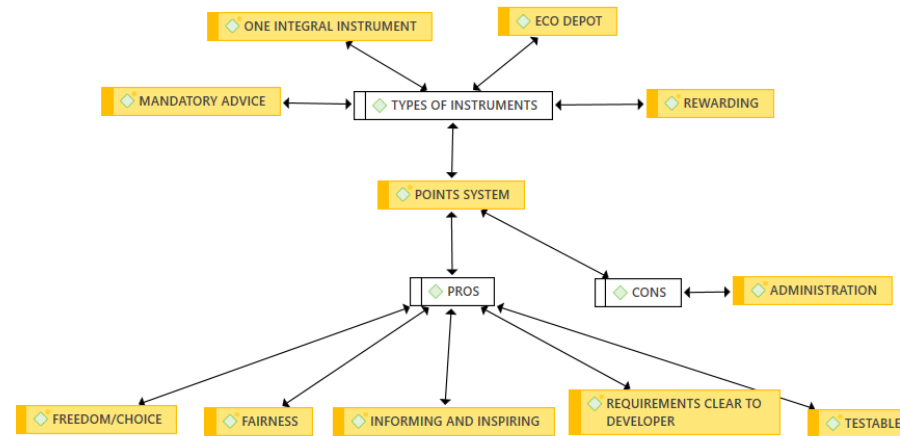
### Networks sub-question 1: existing standards



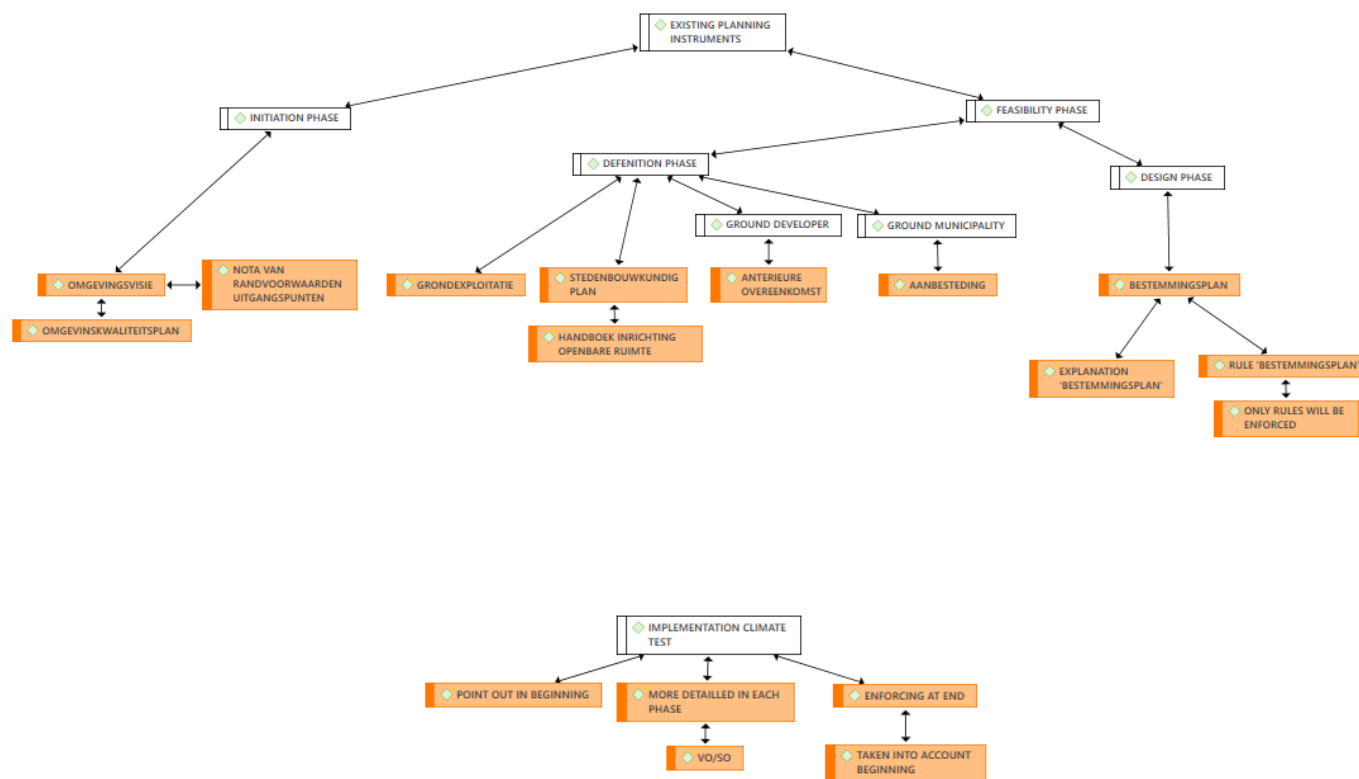


## Networks sub-question 2: design 'climate test'



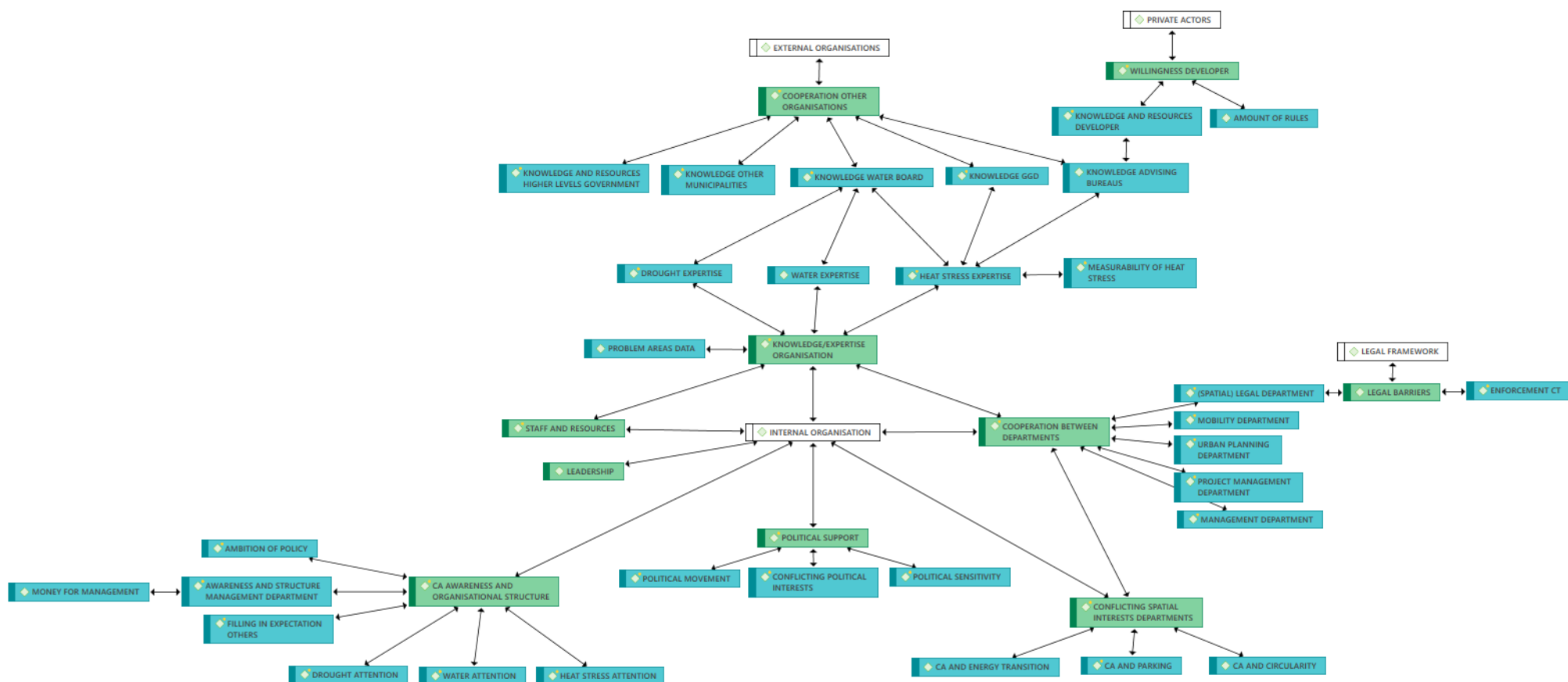


### Networks sub-question 3: implementation 'climate test'





Network main question: drivers/barriers 'climate test'



## Appendix E. Inventory of standards

**Note.** This inventory is based on the policy documents of the municipality of Arnhem (Gemeente Arnhem, 2020, 2021) and the guidebook 'Leidraad klimaat adaptief bouwen 2.0' (Van den Dool & Valkenburg, 2022), which is based on the standards of the metropole region of Amsterdam and the provinces of Zuid-Holland and Utrecht (Metropoolregio Amsterdam Klimaatbestendig, 2021; Provincie Utrecht, 2021; Van den Dool & Valkenburg, 2022).

Theme	Policy municipality of Arnhem		Guidebook 'Guideline climate adaptive building 2.0'	
Flooding	Location	Goal	Basic requirement	Nuance difference regions
Disconnecting rainwater				
	Public space: source areas	Disconnect 90% of the rainwater pipes from the sewage system		
	Public space: well areas	A shower of 40 mm must be able to be processed at the location		
	Renovation: Elden (Arnhem-Zuid)	No longer connecting rainwater to sewage system		
	Renovation: Elden (Arnhem-Zuid)	Assess on a case-by-case basis whether disconnection is feasible		
	New construction	Disconnect all rainwater		
	Renovation	Maximum disconnection from sewage system; process at least 40 mm on site		
Limiting extra pavement/buildings				
	Main infrastructure	Limiting the construction of extra pavements		
	Public space: Arnhem-Zuid	Preventing an increase in pavements/buildings		
	Main infrastructure	Aiming for 10% less pavement: replacing that space with greenery with a function as a storage or infiltration place		
Doorstep heights				
	New construction, renovation	Paying extra attention to for environmental permits		
As little inconvenience as possible				

	Public space: general	Set up in such a way that heavy showers cause as little inconvenience as possible	In the planning area, in the event of extremely heavy precipitation, no damage occurs (at 70 mm in an hour) to buildings, infrastructure and to vital facilities and vital facilities continue to function (at 90 mm per hour).	No
<b>Processing rainwater</b>				
	Public space: transition areas	Infiltrating or buffering rainwater	In the area, natural and superficial drainage is present as much as possible.	MRA specific requirement
	Public space: well areas	Setting up infiltration facilities	The development is water-neutral and does not lead to extra supply/discharge of water. Rainwater is retained as much as possible, brought into the soil and reused in the planning area.	Zuid-Holland does not have this requirement
	Public space: well areas	40 mm shower must be able to be processed on location	A large part of the precipitation (range 40-70 mm) from a heavy shower on the built-up part of private land is processed (infiltrated, collected and/or slowly discharged) on the site itself or in additional (water) facilities in or attributed to the plan area. The facilities drain delayed for the first 24 hours (not extra to sewerage or water system) and are available again in a maximum of 60 hours.	Zuid-Holland: requirement limited to facilities on private property
<b>Floor levels</b>				
	New construction, renovation, renovation	Paying extra attention to for environmental permits		
<b>Water storage</b>				
	Public space: well areas	Setting up a storage location so that greenery can be supplied with water		
<b>Water flows</b>				
	Public space: well areas	Street profile: draining water to (temporary) storage locations	At a water depth of 20 cm on the roadway due to extreme rain and/or flooding, no damage may occur to buildings and electrical installations in public spaces and main roads remain passable.	MRA specific requirement
	Main infrastructure	Layout of roads: allowing water to flow to places where it cannot cause damage or nuisance or where it can be (temporarily) stored		
	Public space: transition areas	Directing water flows to parks and greenery: working as a buffer area		

Theme	Policy municipality of Arnhem		Guidebook 'Guideline climate adaptive building 2.0'	
Heat	Location	Goal	Basic requirement	Nuance difference regions
Rearranging car parking				
	Red areas	E.g. with large shade-giving trees		
Compensating for pavement/buildings				
	Yellow areas: private and/or public	Compensate with extra greenery or less pavement		
Wind				
	Blue areas	Development should not affect cooling winds to orange and red areas		
	Dark blue areas	Protecting vulnerable valley winds: an increase in pavement/buildings where valley winds occur		
Perceived temperature				
	Orange areas	Paving/building must not lead to a deterioration of the perceived temperature: due to shading, choice of materials (albedo) and more greenery and water	At least 40% of all horizontal and vertical surfaces are heated or coolly designed/built to reduce warming of the urban area.	MRA: 50%. South Holland: range 30-80%
	Red areas	Paving/building must lead to an improvement in the perceived temperature: through shading, choice of materials (albedo) and more greenery and water		
Add green and/or blue				
	Red areas	Add green and blue if possible. Trees, façade greenery and water / fountains		
	Orange areas	Add green. In the form of trees and façade greenery		
Shade routes and/or cool spots				
	Red areas: public space	Shade routes and cool spots	Cool shaded places to stay are within walking distance (300 meters) and publicly accessible	Zuid-Holland: no requirement. MRA: minimum 200 m2

	Orange areas: public space	Shadow routes	At least 50% shade in the plan area at the highest solar level (21 June) for places to stay and areas where slow traffic moves	Utrecht: 40% shade in plan area, addition 30% shadow at neighbourhood level. MRA: 40% shade in plan area. South Holland: range 20-60%
<b>Increase in hardening preferably prevent</b>				
	Blue areas	Increase in hardening preferably prevented		
<b>Cooling building</b>				
			Cooling of buildings does not lead to heating of the (residential) space in the immediate vicinity	No
<b>Vital and vulnerable functions</b>				
			Vital and vulnerable functions and green spaces in public spaces must be able to withstand the heat	MRA: limited to "vital and vulnerable functions remain available". Zuid-Holland: no requirement
<b>Theme</b>	<b>Policy municipality of Arnhem</b>		<b>Guidebook 'Guideline climate adaptive building 2.0'</b>	
<b>Floods</b>	<b>Location</b>	<b>Gaol</b>	<b>Basic requirement</b>	<b>Nuance difference regions</b>
<b>Water boards</b>				
	RivierKlimaatpark IJsselpoort	Redevelopment of floodplains		
	Rijnkade	Reconstruction of quay		
	Zuidelijke Rijndijk	Strengthening the dike		
<b>Preventing damage (&lt;0.2 meters)</b>				
			In the event of flooding, no damage to buildings should occur and main roads remain passable	Utrecht addition: "and electrical installations in public space"
<b>Damage limitation (&lt;0,50 meter)</b>				
			Measures should be taken to limit damage in the event of a flood, provided that they are effective.	Zuid-Holland addition: "damage to buildings". MRA: "preventing damage to vital and vulnerable functions"
<b>Protect vital signs (&lt;2.0 meters)</b>				

			In the event of floods, vital functions are protected and continue to function, provided that the measures to do so are effective in view of the regional or national interest	MRA: other functions from 50 cm shelter and evacuation
<b>Shelter and evacuation (&gt;0,50 meters)</b>				
			Measures must be taken to evacuate or to take safe shelter.	Utrecht: shelter and evacuate from 0.50 meters, addition: "if the evacuation time is too short". MRA addition: "no vital and vulnerable functions or adequately protected"
<b>Theme</b>	<b>Policy municipality of Arnhem</b>		<b>Guidebook 'Guideline climate adaptive building 2.0'</b>	
<b>Drought</b>	<b>Location</b>	<b>Goal</b>	<b>Basic requirement</b>	<b>Nuance difference regions</b>
<b>Reducing drinking water use</b>				
		Campaign Vitens	The design and design focuses on drinking water saving, rainwater utilisation and improving water quality.	Specific requirement Utrecht
<b>Infiltration</b>				
			The design of the plan area is infiltration neutral at expansion locations and infiltration positive for redevelopment or redevelopment (at least 50% of the annual precipitation sum), depending on the soil type.	Specific requirement Utrecht
			In the plan area, 50% (450 mm) of the annual precipitation is infiltrated. Range 20-100%	Specific requirement Zuid-Holland
<b>Vital and vulnerable functions</b>				
			Vital and vulnerable functions must be able to withstand prolonged drought	Not included in South Holland
<b>Design of the planning area</b>				
			The (ground) water levels and the freshwater availability in the soil are guiding for the design of the plan area.	Addition Utrecht: "in plan area and environment" appointed, steering in "function choice, system choice and design"
<b>Theme</b>	<b>Policy municipality of Arnhem</b>		<b>Guidebook 'Guideline climate adaptive building 2.0'</b>	

Subsidence	Location	Goal	Basic requirement	Nuance difference regions
			Area-specific, a residual settlement requirement and associated measures against subsidence are chosen that are socially the most cost-effective for public and private land over the lifespan of sixty years.	No
			The natural load-bearing capacity of the soil is the guiding principle in the choice of function, system choice and layout of the planning area.	Specific requirement Utrecht
Theme	Policy municipality of Arnhem		Guidebook 'Guideline climate adaptive building 2.0'	
Greenery and biodiversity	Location	Goal	Basic requirement	Nuance difference regions
			Ecological solutions and solutions based on natural processes of the specific area are always preferable to 'grey' solutions, even with equal social performance and costs (TCO approach)	South Holland: not included
			The horizontal and vertical surface is arranged in conjunction with the green-blue structures and ecosystems in the wider environment (with at least 30% green at neighbourhood level, tree crown area counts)	Zuid-Holland: no % green included
			The plan area creates, depending on the size, a high-quality habitat for one or more species categories	Utrecht and Zuid-Holland: "at least building-related species". South Holland: 1-3 categories.

## Appendix F. Overview of the two types of standards

**Note.** This overview is based on the 'Leidraad Klimaatbestendig bouwen 2.0' (Van den Dool & Valkenburg, 2022).

Pluvial flooding	Example of requirement	Examples of methodology how to assess
Requirements aimed at measures	Each plot must be able to store at least 50 mm of precipitation.	GIS analysis, in which the number of cubic meters of storage on the roof, underground, at ground level, in the soil and in special storage facilities is added together for the area and divided by the area.
Requirements for a desired effect	In the event of a shower that occurs once every 100 years, no flooding may occur. The municipality has defined flooding as: water in homes, roads impassable (30 cm water on the road) and parking facilities poorly accessible (20 cm water in the parking lot).	A calculation of the plan with an integral model, in which for a shower of 70 mm in an hour no flooding occurs according to the definitions.
Heat	Example of requirement	Examples of methodology how to assess
Requirements aimed at measures	There should be ... trees with a crown >10m diameter to be planned within the plan area before completion.	Counting trees in design (possibly with GIS) and control after realization of the plan
	There should be ... m <sup>2</sup> roof/façade light coloured/high reflective albedo of ... after delivery.	Design assessment with the use of Excel or GIS
	Everyone within the planning area must be able to come to a cooling place within ... meters, five years after completion of the project.	GIS analysis, heat label
	It must be demonstrated that there is ... % shade on the public residential and outdoor spaces on 1 July 2020 at .... hours, two years after completion of the project.	GIS analysis
Requirements for a desired effect	The perceived temperature has not risen after realization, compared to the current situation on 1 July 2015 at 15:00 (starting situation PET).	GIS analysis or PET model. Measure in advance and afterwards.
	Vulnerable functions such as schools and retirement homes are always cooler compared to heat hotspots within a radius of 1 km.	PET methodology. Measuring afterwards
	Public outdoor spaces are not hotspots and will never serve above the ... degrees PET.	PET methodology
Fluvial flooding	Example of requirement	Examples of methodology how to assess
Requirements aimed at measures	Schools, hospitals and old people's homes must be built 1.0 meters above ground level.	GIS analysis
	... % of the houses must have a dry floor.	GIS analysis
	Evacuation roads and roads to hospitals are at least on ... meters height to ground level	



Requirements for a desired effect	Evacuation roads and roads to hospitals may not flood more often than 1/... (>10 cm water on road surface).	Network analysis of the vital networks with modelling programs
	The number of victims as a result of flooding must not be increased due to spatial development	Modeling program. HIS-SSM. Water damage estimator.
	Developments in the area outside the dikes may not flood more often than once in ... years.	RAB
	The damage that can occur as a result of a flood once every 100 years should not exceed ... euro.	Modeling program. Water damage estimator.
<b>Drought</b>	<b>Example of requirement</b>	<b>Examples of methodology how to assess</b>
Requirements aimed at measures	Infiltration (mm/year)	GIS analysis. Water balance.
Requirements aimed at desired effect	Sustainable stock: maximum subsidence of the groundwater level under dry conditions.	Groundwater model in which, among other things, groundwater sinking in the summer (GLG) is calculated.
	Sufficient freshwater supply/ freshwater lens	Groundwater model and time series analysis (then in project groundwater monitoring)
	Limited saltwater supply from deeper layers	(Stationary) groundwater model or groundwater monitoring
	No drought damage to planting	Expert judgement, species knowledge
	A maximum stay time of 2 days in e.g. an average situation or in a dry period	Excel calculation (for simple water systems), flow models for complex (branched) water systems
<b>Ground subsidence</b>	<b>Example of requirement</b>	<b>Examples of methodology how to assess</b>
Requirements aimed at measures	Measures that prevent damage caused by subsidence and are cost-effective over the lifetime of 60 years are included in the design.	Geotechnical field research. Cost-benefit analysis.
Requirements aimed at desired effect	Absolute end ground level. For example: End height of area after 30 years is at NAP -1.0 m.	Geotechnical field research. Perform settlement calculations.
	Upper limit absolute size of residual or final setting (initial primary and secondary setting). For example: a maximum of 0.80 m vertical settlement in 30 years after start delivery.	Geotechnical field research. Perform settlement calculations.
	Upper limit of settlement difference (final setting, or residual setting). For example: maximum settlement difference over of 0.05 m over a distance of 25 meters in 30 years.	Geotechnical field research. Perform settlement calculations.
	Maintenance of specific soil layer	Geotechnical field research

## Appendix G. Overview of all the planning instruments

**Note.** This overview is based on the 'Leidraad Klimaatbestendig bouwen 2.0' (Van den Dool & Valkenburg, 2022).

Phase	Planning instruments	Description
Initiation phase	Urbanization strategy (verstedelijkingsstrategie); urbanization agreement (verstedelijkingsakkoord); land policy (grondbeleid)	Municipalities and provinces determine with their <b>urbanization strategy</b> and <b>urbanization agreement</b> how and where the growth of urban areas takes place in the long term. Through the <b>land policy</b> , municipalities and developers determine whether, how and where construction takes place through the purchase of land for new developments. Climate adaptive building and water interests (with water boards) must be part of an assessment framework for the strategic choices in both strategic plans. This takes place in an interactive process in which economic feasibility, spatial planning quality and climate and environmental requirements are weighed up and coordinated.
The definition phase of the feasibility phase	Development vision (ontwikkelstrategie)	A concrete development starts with a <b>development vision</b> . This is an integrated plan product in which the party with a land position (municipality and/or developer) determines the ambitions, the desired functions, the building program, the intended spatial image and an initial financial framework. In a development vision for a municipality, the emphasis is on policy implementation and for a developer on market needs. The process starts with research into the (physical) properties and the relevant themes and goals for sustainability and climate adaptation. This analysis is an important part of climate-adaptive construction, in order to make the best possible use of the physical properties of an area. In this way, climate adaptation will be affordable, adaptive (on the relevant themes) and integrated into the development.
	Environmental impact assessments (milieu effect rapportages)	<b>Environmental impact assessments</b> are part of the planning process for spatial visions, developments and projects with an impact on the environment. The environmental impact assessments are carried out by the initiator. In addition to traditional environmental themes such as air and soil, climate adaptation is increasingly becoming a separate theme in environmental impact assessments.
	Land and real estate exploitation (grond- en vastgoedexploitatie)	In the <b>land and real estate exploitation</b> , the party with a land position (municipality and/or developer) determines the financial frameworks. This includes the costs and revenues for the land and buildings with the aim of profitable and future-proof development. The costs for climate adaptation should be included in this together with the building-related measures.
	Tender (aanbesteding); program of requirements (Programma van Eisen); zoning plan (bestemmingsplan); environmental plan (omgevingsplan); parcel passport (kavelpaspoort); anterior agreement (anterieure overeenkomst)	There are two main options for the public-private partnership. First, the municipality can organize a <b>tender</b> for the development of land owned by the municipality. The development vision is one of the frameworks in this regard. Developers can register for this tender. It is essential that climate-adaptive development is part of a <b>program of requirements, zoning plan, environmental plan or a parcel passport</b> . In addition, measurable award criteria are possible that reward extra ambition or performance in the assessment. Second, a developer can own land himself and concludes an <b>anterior agreement</b> with the municipality about the conditions under which the development may take place. The development vision is one of the frameworks in this regard. Relevant requirements and goals can be included in the agreement.
	Urban development plan (stedenbouwkundig plan); visual quality plan (beeldkwaliteitsplan);	The <b>urban development plan</b> is the integral design for the area development for the party with a land position (municipality and/or developer). It forms the basis for the land development, (anterior) agreements and for the zoning or environmental plan. Together with an <b>visual quality plan</b> for the buildings, it can also serve as a testing framework for designing buildings and public space. The urban development plan lays down the division between public land and private land, the surface water and greenery, the building heights, the number of homes and the layout of the public space. A

	manual for the design of the public space (handboek inrichting openbare ruimte)	<b>manual for the design of the public space</b> of municipalities provides an important basis for this design. It is essential that the manual has a climate-adaptive character or allows climate-adaptive deviations.
	Area recommendation (gebiedsadvies)	An <b>area recommendation</b> for water, greenery and climate ensures that the urban plan is geared to the soil, water and ecosystem in the area and to requirements for climate-adaptive construction. This is not yet standard in a development. In the plan, a developer or municipality, together with the water board, visualizes the space required for water, greenery and climate at the right time, including above and underground space, costs and the added value for the quality of the area. Model analyses can be included in this plan that calculate whether, for example, measures against heat stress or flooding are sufficient for the performance-based requirements for heat stress or flooding.
<b>Design phase of the feasibility phase</b>	Preliminary design (voorlopig ontwerp) of the building	In the <b>preliminary design of the buildings</b> , a developer or corporation elaborates the design of the buildings on the basis of the urban development plan and visual quality plan. This is the planning phase in the design in which building- and plot-related measures and/or facilities are included. For example, to counteract heat in the buildings or to apply nature-inclusive measures to the building.
	Zoning plan (bestemmingsplan); environmental plan (omgevingsplan); water assessment (watertoets); provincial environmental ordinance (provinciale omgevingsverordening)	The <b>zoning plan</b> or <b>environmental plan</b> is the planning framework for the development. This plan can also be drawn up during the earlier definition phase. The municipality decides on the spatial requirements and layout through a public planning procedure, sometimes in consultation with developers and housing associations. It also provides the substantive framework for the later assessment of environmental permits. The goals and requirements for climate adaptation can be selected and included in the plan. The water section in the zoning or environmental plan describes the results of the process of the <b>water assessment</b> . The province checks against its own <b>provincial environmental ordinance</b> .
	Water assessment (watertoets)	The water assessment is an essential part of the procedure for a zoning plan for water and climate adaptation. The water board plays an active role in the planning process through the water assessment process. The test can also take place in the definition phase. All water aspects are involved in this, such as flood risk management and water compensation for extra hardening. This is recorded in the water section in the environmental plan. Both the municipality and the water board test this when drawing up the environmental plan.
	Preliminary design (voorlopig ontwerp) and final design (definitief ontwerp) of the development plan (inrichtingsplan); management test (beheertoets); manual for the design of the public space (handboek inrichting openbare ruimte); management and maintenance report (beheer- en onderhoudsrapport)	In the <b>development plan</b> the street profiles are worked out above ground and underground with cables and pipes, trees, other greenery, exact height levels, pavements and street furniture. The development plan is therefore the technical elaboration of the public space, as delineated in the urban development plan. This is usually provided by the party with a land position (municipality and/or developer). The level of detail is first a <b>preliminary design</b> and then a <b>final design</b> . The connections with private land are also being worked out, such as entrances and front doors. A <b>management test</b> by managers of the municipality is an essential part of a development plan. The municipality's <b>manual for the design of the public space</b> is an important instrument in this respect. The manual must provide space for climate adaptation, as previously mentioned for the urban development plan. The design always has an impact on the use and management phase. It is therefore important to coordinate the consequences for the management and maintenance of the establishment and to record them in a <b>management and maintenance report</b> , so that the transfer during the realization phase to management runs smoothly and functions in the long term.
	Development plan (inrichtingsplan);	The <b>development plan</b> and the <b>urban development plan</b> can be calculated with a predictive <b>climate stress test</b> for optimization of the design. Both the developer and the municipality or water board can take this up or request it. Depending on the size of the plan, the selected goals and requirements, this is quantitative or qualitative. The Delta Plan on Spatial

	urban development plan (stedenbouwkundig plan); climate stress test (klimaatstresstest)	Adaptation describes how the four themes are affected by flooding, flooding, heat and drought a stress test can be done. With regard to limiting subsidence and promoting biodiversity, no standards have been laid down by the DPRA. Methodologies are available for these themes.
<b>Preparation phase of the feasibility phase</b>	Purchase and construction agreement (koop- en aannemingsovereenkomst)	In a <b>purchase and construction agreement</b> , the developer, the builder and the buyer of the building record the legal agreements. This agreement can also include goals and requirements for the climate-adaptive design, such as maximum pavement in the garden, but also options such as rain barrels.
	Final design (definitief ontwerp) of the building	In <b>the final design of the building</b> , the developer or corporation records the design, sizes, layout and architectural design of the building and the surrounding plot (including climate-adaptive, soil-proof and nature-inclusive facilities). The final design is the basis for the application for the environmental permit for the construction of the building and the construction principle of the subsoil (lot/ public area).
	Tenders (aanbestedingen)	Depending on the phasing of the development, the urban development plan and development plan is elaborated by the commissioning party (municipality and/or developer) and <b>tendered</b> in one or more contracts for the construction and housing preparation. The preparation for construction focuses on the earthwork (in areas with subsidence also on raising and pre-loading the site) and the construction of construction roads and sewerage before the start of construction. This is the last moment to incorporate new climate insights into designs or requirements without leading to contract modification. The preparation for living takes place after the completion of the houses and concerns the final design of the public space, such as trees and pavement. The construction and living preparation must be designed in conjunction with each other to prevent mistakes.
	Environmental permit (omgevingsvergunning)	Through an <b>environmental permit</b> , the commissioning or executing party (municipality, corporation, developer, builder or contractor) requests permission for work. Adding pavement and digging water requires a permit from the water board. Building requires a permit from the municipality. This is a final test moment whether the requirements for climate-adaptive construction have been met and whether the effect of the measures and/or facilities is sufficient. Appropriate expertise and sufficient capacity at the authorities is essential in this respect.
<b>Realisation phase</b>		The preparation for construction takes place – before the start of actual construction – in phases by the contractor. It can take more than a year in settlement-sensitive areas, because the pre-loading and elevation take time to limit residual settlement of building land. The construction of water features, sewerage, construction roads and utilities also takes place. The municipality and the water board have the authority to check whether the permit conditions for climate adaptability is met.
		If the permits are irrevocable and the conditions are met, the builder starts. Preparation has taken place in advance, so that the construction site is accessible and equipped with construction water, construction power and connection to the sewerage system.
		The preparation for living also takes place in phases by the contractor. Making it ready for living takes place after completion of the houses and concerns the installation of the final pavement, green areas, sky water supplies and street layout, such as signage. Here too, assessment by the municipality and water board is possible.
<b>Management phase</b>		From the completion of the construction of the public area, the temporary management by the contractor starts. During this phase, residents and other parties are already using the public area.
		The delivery of the building and the plot is the moment when the builder transfers the newly realized building and plot under management to the buyer or corporation. The builder or the municipality can use this opportunity to inform the user

		about the purpose of climate-adaptive measures and/or facilities. For example, about climate-adaptive garden design and sun protection.
		The transfer of the public area is the moment when the commissioning party (municipality and/or developer) and the contractor of the construction and residential preparation transfer the newly realized public area in management and ownership to the municipality. The municipality (or the water board) checks whether the area can be taken into management in accordance with the agreements previously made and incorporates the new areas into the management plans and budgets. The municipality investigates and monitors the functioning of the climate-adaptive measures and/or facilities.

