

## Article

# Presenting a Framework to Analyze Local Climate Policy and Action in Small and Medium-Sized Cities

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**Abstract:** Academic attention to local climate policy usually focuses on large-sized cities. Given the climate challenges ahead this seems unjustified. Small and medium-sized cities (SMCs) deserve scholarly attention as well. The main question is: What factors influence climate change policy and local climate actions in SMCs? In this article we present an analytical framework to analyze climate change policy and local climate actions of SMCs. The framework addresses different aspects: policy-input, -throughput, -output, -outcome, characteristics of the local environment, local action arenas, influence by higher government levels, and interaction with climate change issue networks. The framework is used to analyze and compare four case studies of SMCs in the Dutch region of Twente (two urban and two rural municipalities, and addresses both adaptation and mitigation). Results show that both ‘localist’, ‘multi-level’ and issue network membership factors influence local climate policy action. Governance modes discerned concern mostly ‘governing by authority’ and ‘self-governing’. When reflecting on the role of SMCs in climate action the study revealed the importance of local capacity building schemes issued by provincial government, inter-municipal network collaboration, and the potential for local governments to mobilize and organize citizen action.

**Keywords:** small and medium-sized cities; climate governance; energy transition; climate change mitigation; climate change adaptation

## 1. Introduction

Climate change has been acknowledged as a grand societal challenge by the majority of countries in the World. In most countries climate change policies have been drafted and implemented [1,2]. Attention to climate change in terms of policy and governance includes both adaptation and mitigation [2]. For both adaptation and mitigation policies and programs have been developed. Next to state level climate programs many countries involve decentralized levels of government as well [3]. As in (the broader) environmental policy it is local governments that have a key role; from all government levels it is the local level that is nearest to citizens, and it is at the local level where climate change related problems manifest, and climate change action is organized [4–7]. Moreover, in cities many greenhouse gases (GHG) are emitted, and cities are increasingly vulnerable to climate change. Examples concern heat waves, the urban heat island effect, declining air quality, hurricanes, increased precipitation, and flooding [2]. With predictions on further growth of cities in terms of inhabitants, economic activities and related consumption of energy and other resources, cities are of

great importance in strategies to mitigate and adapt to climate change [8,9]. For these reasons, local governments—in particular in cities—are important actors regarding governance of climate change. Cities can do this in several ways: as ‘champion’ [8], as initiator of actions, as first mover to adopt clean tech innovations [8], as seedbed of innovation [10], as policy implementing organization [11], as regulator, as facilitator, network manager, as process—or project manager (cf. [12]).

Although many cities have been active to address both adaptation [13–15] and mitigation [7,9] oftentimes there appears to be a lack of integration in strategies. Adaptation and mitigation have been distinguished by scientists, policy makers and practitioners as belonging to different sectoral policy domains (e.g., mitigation in the ‘energy domain’ and adaptation in the ‘water domain’ [11]). Biesbroek et al. [16] refer to this phenomenon as the ‘adaptation-mitigation dichotomy’. Notwithstanding this dichotomy there have been instances of cities that succeed of crossing the chasm, implementing integrated solutions and “no regret options” (e.g., [15]).

While facing these challenges local governments are confronted to design and implement workable climate policies that result in local climate actions (e.g., projects, infrastructure) that lower carbon emissions and make cities more resilient. Given the degree of urban and institutional complexity involved, this is more than—just another—governance challenge. It requires attention to both the nature of climate change related problems that might vary across jurisdictions, the politics of the policy making process, and the commitment and compliance by local parties who are involved in local climate policy implementation [9]. In a key publication Betsill and Bulkeley [17] listed five local conditions they deem necessary to trigger substantial local climate action, viz. (i) the presence of a committed individual in a local-level government that (ii) manifests a solid climate-protection policy (preventing GHG emissions); (iii) has funding available; (iv) has power over related domains; and (v) perhaps most crucially, has the political will to act. If present these factors contribute to local climate capacity building, policy making and -implementation.

Following the signing of the Kyoto protocol many countries have embedded local capacity building in their national strategies. However, support by central government (via inter-governmental capacity building schemes) was of great importance in this process [11]. The latter [11,18,19] compliments factors addressed under the so-called ‘localist’ approach (focusing predominantly on local factors that contribute to local climate policy and related actions). It adds a ‘multi-level’ dimension in that it acknowledges the interplay of cities in climate actions with higher level governments—e.g., the EU, central government, regional government—but also to lower level in which relevant decision-making takes place—e.g., regarding district level infrastructural or housing projects.

Although research into local climate policy is a vast growing academic field (e.g., [8,9,14,19–28]), there appears to be skewed attention that emphasizes the role of frontrunner cities and large (even mega-) sized cities, whereas there seems to be little attention to small and medium-sized cities (SMCs). Although we acknowledge the importance of the former we also want to stress the importance of the latter. First, SMCs is the category in which most urban citizens actually live (e.g., nearly half of all ‘urban’ citizens in Europe live in regions with less than 500,000 inhabitants) [29]. Second, it is widely recognized that SMCs are more constrained in (fiscal) resources, staffing, ‘critical mass’, and organizing and leadership capacities. Third, SMCs have less problems related to agglomeration when compared to large-sized cities, viz.: less traffic congestion, lower property prices, less social segregation, lower crime rates, and less environmental pollution. These issues are considered more controllable and manageable in SMCs. Another advantage of SMCs is that they have more explicit local characteristics and are typically well embedded in economic and institutional structures within (less urbanized, more rural) the regions in which they are situated. This can offer comparative advantages [29].

In this context, we wondered how have SMCs cope with policy and projects concerning climate change mitigation and adaptation. We also want to address local climate policy in an integrative policy framework that addresses both mitigation and adaptation. In addition, we deem it important not to only look to cities as units of analysis but also as loci in regions, in which the dynamics and interplay between urban and rural realms are reflected (i.e., [30,31]). For these reasons the aim of this article is to

create a systematic overview of factors that in some way or another relate to local climate actions, and in the end to lowering of carbon emissions (mitigation) and making cities more resilient to climate change related extreme weather events (adaptation).

In this article the main question is: What factors influence climate change policy and local climate actions in small and medium-sized cities (SMCs)? We apply this research question to four municipalities in the Dutch region of Twente. The question is answered by presenting an integrative analytical framework, which will be used to analyze a set of case studies.

This article is structured as follows. In Section 2 a literature review is presented. The section ends with the presentation of an integrative analytical framework. In Section 3 research design and methodology are presented. The framework presented in Section 2 will be used to analyze four case studies. In Section 4 the results of this analysis are presented. In Section 5 the results are discussed. The paper ends with a conclusion and provides recommendations for future research.

## 2. Literature Review and Synthesis of an Analytical Framework

Ever since Betsill and Bulkeley's landmark publication in 2003 [17] many conceptual and empirical studies have been conducted on factors influencing local climate policy and local climate actions. Also, different research communities came into existence, focusing either on mitigation (e.g., [8,9,11,18,19,21,28]) or on adaptation (e.g., [13–15,22–24,27,32]). Because of the broad variety of concepts that have been developed a literature review was conducted to systematically cluster concepts from these literatures. In order to do this in a systematic way a policy heuristic was used that is often used by economists, scholars and practitioners of public administration, public policy, [33–36], program evaluation [37], and public management (i.e., performance measurement of public organizations) [38,39].

It concerns the process heuristic regarding organizational policy implementation and its effects, which categorizes characteristics of this process into: input, (organizational) throughput, output, and outcome. Input refers to resources that are required like personnel, materials, budget and time. Throughput refers to activities and work processes that are required to 'produce' services and products. Some call these items "process indicators" [40] or "institutional framework conditions" [41]. Output refers to those products and services, and can be viewed as actions or 'performance' of the policy implementing organization (e.g., policy instruments and projects; number of permits or subsidies granted, number of low carbon projects started). Outcome refers to the (intended and non-intended) effects of these services and products. In the realm of climate policy they may, for example, concern (lowering of) GHG emissions. However, they may also concern the trust, experience or satisfaction of citizens vis-à-vis those products and services [38].

Throughput and output indicators are important to indicate implementation intensity. Outcome indicators on the other hand indicate impact and effects [42]. In practice, however, it is often difficult to distinguish output from outcome [43]. Output is viewed by some as indicating impact and effects. Given the complex nature of establishing the effects of local climate change policy viewing output in the form of (low carbon, or extreme weather event protective) projects can also be viewed as an indication of outcome. There are two arguments for this. First, the start of these kind of (often infrastructural) projects already indicates commitment of local actors (also acknowledging that a process of decision-making has already taken place resulting in the approval of plans to start project activities). Second, empirical research has shown that local governments present a decrease in carbon emissions as results of low carbon policy, whereas these figures basically indicate lowering of GHG emissions due to the realization of low carbon projects that are still to be realized in the (near) future. So, in fact these figures present predictions based on calculations (often originating from by engineering companies) accounted for the realization of an infrastructural or construction project in which energy efficiency, renewable energy or lowering of (fossil) energy demand is yet to be realized [44,45].

Policy domains in which the input-throughput-output-outcome process heuristic is used concern environmental policy (in particular those using legal permit systems; e.g., [46]), law enforcement, and policing (e.g., [38,43]). In this article the heuristic is applied to local climate policy and actions.

The conceptual clusters that result from the literature review are: the local government organization, involved with local climate policy (sub-divided into policy input, throughput and output), characteristics of the local environment, the local action arena, external issue networks, higher government levels, intended climate action (in the form of local projects), major external events, and outcome (in the form of GHG emission reduction for mitigation, and resilience for adaptation). They will be presented in more detail in Sections 2.1–2.8.

### *2.1. Cluster I: The Local Government Organization Involved in Local Climate Policy*

Sub-sets of the local government organization cluster are sub-divided into: input, throughput and output categories. Outcome falls outside of the cluster of the local government organization because we deem it a separate cluster.

#### *2.1.1. Input*

Financial resources and fiscal health are mentioned as key resources local governments require to build capacity, develop and local climate policy [17,22,26]. The argument is that sufficient budgets would allow for hiring and training of staff, or allowing current staff members to spend more time on managing climate policy projects. In addition, more budget would also allow for contracting advisors and engineers to work on the planning, scenarios or other technicalities of climate policy, or to host subsidy schemes that support the uptake of ‘no regret’ or low carbon options among local households or local industries [11]. Local government also needs to have a political mandate and the legal authority to prepare and implement climate policy [22]. Another factor is type of municipal council. This was discerned in a U.S. study [25] as to influence decision-making on local climate policy actions [24,27]. However, this indicator is only relevant in countries in which variation in council types is found.

Another important input factor is size which is related to municipal staff volume. Several empirical studies indicate the positive statistical relationship between municipal size and climate policy output or climate actions by local government [23,47,48]. The availability of staff is of great importance regarding the work processes that precede products and service delivery of climate policy instruments and climate action. However, the numerical availability of staff alone is not sufficient, as experience, expertise and (motivational) involvement of staff members and their managers are also of great importance [22,24]. Another input issue concerns the use of technology which can for example be used to monitor policy implementation processes and performance of climate policy instruments and -actions [22]. Although the use of sound knowledge management and technology looks straightforward, this is not always the case as many local governments tend to outsource this to consultancy and engineering companies [49].

#### *2.1.2. Throughput*

A wide set of internal organizational, managerial and process factors discerned in the literature are viewed to have a positive impact on local climate policy endorsed by local government. First of all, a sound policy plan, having ambitious but realistic goals and a clear goals-means action plan, is assumed of imminent importance of municipal climate action. Municipalities having sound climate policy plans were found to have more progressive climate actions than their peers without (e.g., [12]). However, plans only become policies once political support and approval is present. Without the town council’s support this does not happen [17].

Related to policy making and implementation is sound and stable knowledge management (including the use of knowledge management infrastructure and ICT support; [22,24]). This is hard though, since climate (mitigation) matters are very complex and therefore difficult to ‘digest’ for many civil servants (with time restrictions) and local political representatives, who are often not trained as (environmental) engineers. Moreover, continuation of knowledge is at risk when knowledgeable officers retire, and are replaced by others lacking this particular knowledge base [11,48,49].

When it comes to staff working on climate throughput processes the involvement of a “committed individual” [17], “local firebrand” or “local catalyst” [48,50–52] is of great importance; viz. civil servants or public officials who have the power, authority, experience and personal skills to intervene and influence decision-making at a given moment [53] or who make sure to protect or maintain the interest of climate change on local political and policy agendas [48,50–52,54]. We argue that next to being motivated and committed this person also has above average skills in networking, process managing, niche managing and playing the role of ‘policy entrepreneur’ to get climate issues on political and policy agendas (e.g., [12]. As such, the policy entrepreneurs would create the conditions that will in the long term evoke ‘windows of opportunity’ that ‘carpe diem policy entrepreneurs’ can seize as opportunities to get climate change issues on the agenda once they arrive [55]. However, this is only possible if this official has the political will (and position) to act [17]. This is important because he or she has to cope with stakeholders and interest groups (whether or not backed by political support in the City Council) that oppose ideas and proposed climate actions that are essential to the official’s policy agenda (e.g., decision-making on the often contested issue of the siting and construction of a wind energy park; [56]). In practice it is primarily officials having “green activism” beliefs who perceive themselves able to influence agenda-setting and policy-making [57].

Closely related factors of importance to climate policy are leadership, control over processes [22] and power over related domains/inter-departmental coordination [17]. Typically public officials of the environmental department are willing to design and implement progressive climate policy. However, their ambitions are often thwarted by colleagues from other, more traditional sectoral departments (e.g., finance, housing, city planning) who advocate competing policy issues and are seeking for budgets themselves, and hence compete when it comes to allocation [24,27]. Proper leadership and sound inter-departmental coordination can help to overcome these problems [24].

### 2.1.3. Output

Output concerns the instruments, incentives and projects a local government uses to attain policy goals. A first aspect of output is policy instruments. They can have many forms, such as subsidies, levies, building regulations, awareness raising campaigns or even a multilateral agreement with other local actors. Closely related is the governing or governance style the local government uses. Kern and Bulkeley [21] discerned four governing styles used by local governments: (i) governing by authority (using regulations and economic incentives to control other local actors); (ii) self-governing (enacting climate actions themselves; e.g., installing solar panels on the rooftop of the town hall); (iii) governing by provision (e.g., providing low carbon services to local citizenry); and (iv) governing by enabling (actions to empower local citizens and other local actors to undertake climate action themselves or build capacities to do so). Related to both is commitment by the municipal staff to implement the municipal policy instruments, projects and actions properly. Without commitment these can perhaps be viewed more appropriately as an act of ‘symbolic policy’ [58]. A local government can have ambitious an ambitious policy and climate action plan, but if its staff is not motivated nor capable to implement it properly results will be disappointing.

## 2.2. Cluster II: Characteristics of the Local Environment

Local climate policy is implemented in a given local environments which has particular characteristics, which might have effects on the development of local policy and related climate actions. Demographic characteristics of local citizens (like socio-economic status, income and education level) were found to be important factors [23,25–27]. The same holds for environmental group activity. The presence of environmental groups and their involvement in local environmental—a form of ‘civic capacity’—is seen as an important driver in the design and implementation of local climate change policy. Local environmental groups and citizens who have green activist beliefs are apt to mobilize capacity and can give political support to climate change-related issues on local policy agendas. NGOs and citizens can become policy entrepreneurs, creating and harvesting ‘windows of opportunity’ to get climate change issues on the political agenda [25].



Next to social characteristics of the environment physical characteristics are viewed to have impact. Municipalities at locations which are either (or both) vulnerable to climate change extreme weather events or environmental stress (due to some other kind of environmental issue) have been related by researchers to local governments establishing progressive local climate policies, especially in the case of climate change adaptation policy as a response to cope with vulnerability [13,25]. In this sense, 'climate change risk' addresses factors like coastal proximity, ecosystem sensitivity, or proneness to flooding. Since ecological, social and economic risks are not distributed evenly geographically it is municipalities that are the more vulnerable to these particular risks that benefit most from climate change (adaptation) action. Moreover, risk prone areas (already having experienced disasters due to extreme weather events) are found to be more resilient than their (less risk-prone, less experienced) peers [13].

Another important characteristic of the environment is the presence of carbon intensive industry. In this sense 'climate change stress' concerns high levels of energy-intensive, carbon-based employment. When combined with little use of renewable energy sources (which is often the case in energy intensive, industrialized areas) this means that (from an economic perspective on transportation and energy use) carbon emission reduction becomes more costly for local communities [25], which are therefore little motivated to support progressive low carbon policies by local government. In contrast, it can be argued that carbon-intensive municipalities might generate a lot of new jobs in developing an action plan in which local communities can get involved in actions to lower these emissions, for instance in a program targeting local buildings to be thermally insulated, hence lowering fossil energy demand and lowering carbon emissions while at the same time creating more jobs for construction workers to insulate these buildings. For local government this would be beneficial because it helps them to meet two goals: the environmental goal of lowering of carbon emissions and the economic goal of job creation.

Two other important characteristics of the environment concern the availability energy infrastructure (to which renewable energy suppliers can connect), and the availability of space (to construct infrastructure that would help attaining climate goals; e.g., construction of a wind park to generate and supply renewable energy, that would replace fossil energy use locally, and hence lower GHG emissions). Climate policies are sometimes formulated because of the co-benefits they can bring cities in terms of lowering energy bills, generating more business activity and spurring job creation. Sharp et al. [59] refer to this phenomenon as the 'need-based scope'. In this sense, city governments may formulate policies to lower carbon emissions while they are primarily pursuing job creation, business activity, or lowering cost of energy consumption.

### 2.3. Cluster III: The Local Action Arena

Local climate policy is implemented in local action arenas. It is in local actor-networks that local government engages with local actors and tries to persuade them to join in, and coordinate climate actions. Success or failure not only depends on local governments themselves, but to a large extent on collaboration with local citizenry or industries in co-production of public services or in partnerships [11,47,53]. In these action areas (using a concept coined by Elinor Ostrom [60]) decision-making processes take place. Action-arenas are typically characterized by complexity as actors try to pursue their individual interests, each having their own agendas, frames, resources, and forming coalitions with other actors to meet their goals [61]. For example, progressive low carbon plans by a public official focusing on increased energy production from renewable sources (on the siting and construction of wind energy parks) meets heavy opposition from local interest groups [56,62]. In these kind of decision-making rounds there are bound to be winners and losers, which requires making compromises. If collective action is to ensue sound process management is required [22,63]. This requires credibility, leadership and willingness to learn on the side of local government [22].

An important asset in the local action arena is support by local leaders [24,27] for they can mobilize local communities to embrace climate change programs, engage in low carbon actions, or to adopt low carbon technology. For these reasons empowerment of civic capacity and action is of great importance.

Moreover, enhancing civic engagement is considered a key challenge to climate change mitigation in cities [53]. This also applies to local government having good a relationship with local industry. Partnerships with private organizations were found to have a positive impact on local climate policy actions [27].

#### 2.4. Cluster IV: External Issue Networks

Once local governments become members of pro-climate change issue networks this is said to have a positive impact on local climate policy and actions. Kern and Bulkeley [18] found that membership of international climate change issue networks (like ICLEI or Covenant of Mayors) had a positive impact. Local government staff members become better informed about state-of-the-art developments, and increase adaptive capacity to learn from best practices and adopt them in their very own localities. Diffusion-adoption of local climate policies, however, often depends on the roles and positions of certain individuals (civil servants or public officials) in climate change issue networks [7]. The same can roughly be said about local government engaging in regional and inter-municipal climate change issue networks [27,47]. Next to creating better awareness and informing oneself better, collaborative actions can be set up which might lead to more focused, and efficient projects. Local governments can learn from each other, and do not have to “reinvent the wheel” all over again. Hence, network collaboration lowers transaction costs.

#### 2.5. Cluster V: Influence Exercised by Higher Levels of Government

Cities do not stand alone when designing and implementing climate policies. Obviously they have to deal with the local citizenry and local parties like housing corporations/associations and local industry. On the other hand they are also heavily depended on support and framework structures offered by higher levels of government, like the provincial, regional, and central government. Cooperation between cities and higher levels of government is considered of great importance (e.g., [11,41]). Many scholars have acknowledged the importance of inter-governmental support schemes, especially the ones enabling local governments to learn from best practices and being provided the finance to build capacity and establish local climate policies of their own [11,59,64]. In addition, sometimes support schemes in particular areas of climate change (mitigation) are issued, such as renewable energy support policy or competitions organized to stimulate local communities to become low carbon communities (e.g., the ‘Klimakomune Saerbeck’ case in the state of Nordrhein Westfalen, Germany; [12]).

#### 2.6. Cluster VI: Output, viz. Intended Climate Action

This cluster addresses climate actions, viz. local projects leading either to a lowering of GHG emissions (mitigation) or improved resilience to climate change related extreme weather events (adaptation). Actions can be taken by local government (independently; e.g., constructing a solar park in the town hall’s rooftop, improving energy efficiency of municipal owned buildings) or by other local actors (e.g., a housing association thermally insulating its buildings’ stock to lower fossil energy demand and hence GHG emissions). Moreover, these climate actions either address adaptation, mitigation, co-benefits, or both (i.e., no regret option like “green rooftops”). Adaptation actions address infrastructural action to lower local vulnerability to climate change; e.g., creating water drainage and retention areas, or adjusting the sewer planning likewise). Mitigation actions typically address installing energy efficient equipment or renewable energy systems. In addition, awareness raising campaigns among citizens can also be viewed as policy output as they indirectly, might evoke lowering of GHG emissions or increased resilience (i.e., via improved awareness or readiness to act vis-à-vis climate change induced vulnerability to extreme weather events).

### 2.7. Cluster VII: Major External Events

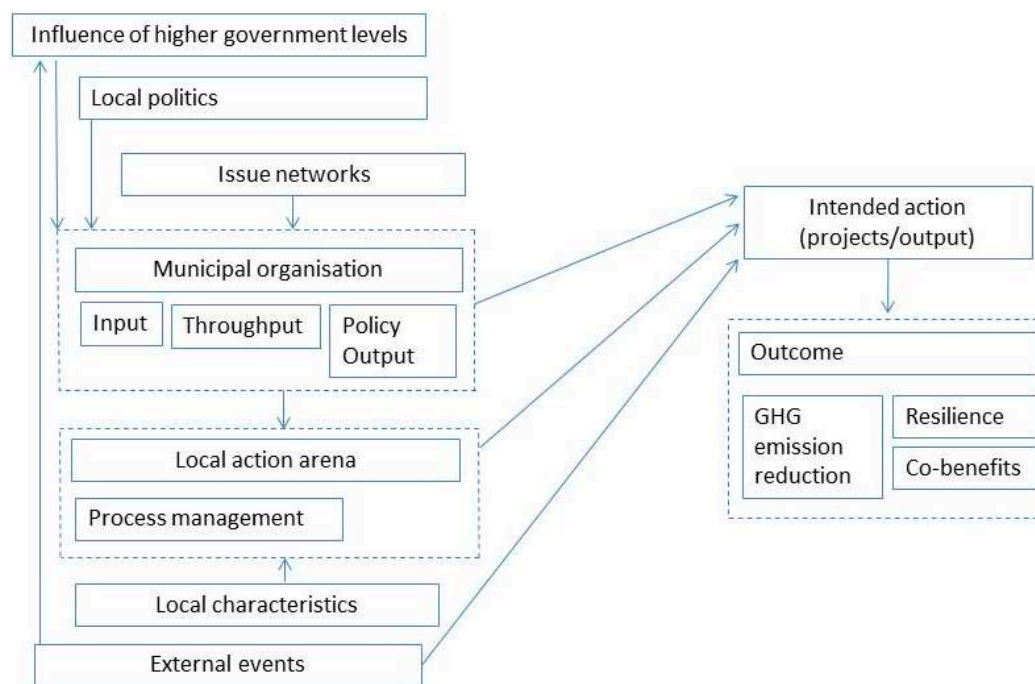
In following insights from theories on agenda setting, policy change (e.g., the Advocacy Coalition Framework; [65]) and transitional change (e.g., the Multi-Level Perspective; [66]) major external events can have a disruptive influence on (entire) societies, localities, actions and efforts by local governments and other actors vis-à-vis climate change [47]. These events can for instance relate to geopolitical events (like elections, but also war), geo-physical events (like natural disasters), or a major economic events (like the 1929 stock market crash or the 2008 economic crisis).

### 2.8. Cluster VIII: Outcome

Outcome is viewed as the impact and effects of climate policy implementation and climate actions (e.g., lowering of GHG emissions, a city becoming more resilient to climate change related extreme weather events). Next to policies and actions deliberately initiated by local government we also adhere to climate action set up by local actors independently, such as citizen-led low carbon initiatives or housing associations. Like with output we differentiate between adaptation and mitigation. For the mitigation the key outcome indicator would be (lowering of) GHG emissions. For adaptation this is more difficult due to the complex nature of adaptation measures (or perhaps an indicator measuring assumed adaptation and—decreased—vulnerability to climate change extreme weather events experienced by local citizens). Another type of outcome is ‘climate co-benefits’ which are added benefits of climate actions in other societal domains; for instance beneficial effects in terms of health (e.g., by improving air quality), job creation, building a stronger economy, or better (more secure) energy supply (e.g., [67–69]).

### 2.9. Synthesis and Presenting a Framework to Analyze Local Climate Action

Figure 1 presents a graphical schematic of the interplay between the conceptual clusters presented in the previous Sections 2.1–2.8. Table 1 presents an overview of the main clusters of the framework including mentioning of the sub-items per cluster.



**Figure 1.** Graphical presentation of the analytical framework on factors influencing local climate action.



**Table 1.** Presentations of key clusters and sub-items of the local climate action framework.

<b>Cluster I: Municipal Organisation</b>	
<i>Input</i>	
-	Financial resources
-	Fiscal health
-	Legal authority
-	Staff (expertise)
-	Technology
-	Size
-	Council type
<i>Throughput</i>	
-	Political support (by council)
-	Solid policy plan (clear goals and sound strategy)
-	Commitment (by staff)
-	Public leadership/presence of a local catalyst
-	Inter-department coordination
-	Knowledge management
-	Monitoring and evaluation
<i>Output</i>	
-	Policy instruments
-	Municipal governing mode (authority, self-governing, provision, enabling)
<b>Cluster II: Characteristics of the Local Environment</b>	
-	Demographic characteristics (SES, income, education)
-	Environmental group activity
-	Vulnerability to climate change
-	Environmental stress
-	Presence of carbon intensive industry
-	Presence of energy infrastructure
-	Available space for deployment of RES
<b>Cluster III: The Local Action Arena</b>	
-	Presence of process manager
-	Support by local leaders
-	Partnerships with private organisations
<b>Cluster IV: External Issue Networks</b>	
-	Collaborative ties with other local governments
-	Involvement in/membership of climate change issue network(s)
<b>Cluster V: Influence Exercised by Higher Government Levels</b>	
-	Alignment with agendas of higher level governments
-	Presence of inter-governmental support schemes
<b>Cluster VI: Major External Events</b>	
-	(Geo-)Political events
-	(Geo-)Physical events/natural disasters
-	Major economic events
<b>Cluster VII: Intended Climate Action (Output/Projects)</b>	
-	Installing energy efficiency and/or RES technology
-	Energy efficient behaviour (by local citizens and organizations)
-	Installing infrastructure to cope with extreme weather events
<b>Cluster VIII: Outcome</b>	
-	GHG emission reduction
-	Resilience
-	Climate co-benefits

### 3. Research Design and Methodology

In this section, the key features of the study's research design, case selection, data collection and data analysis will be presented. This research design of study encompasses case studies of four cities in the Dutch Twente region. Like most case study research designs each case was studied in-depth paying attention to rich description of phenomena relevant to local climate policy and climate actions (e.g., [70]).

#### 3.1. Case Selection

The cases that have been selected are based in The Netherlands, because Dutch municipalities and provinces have proven to have a long tradition setting local carbon emission reduction targets and making efforts to strengthen their capacities concerning local climate policy [11,71]. Within The Netherlands the cases are situated in the region of Twente, which is situated in the Eastern part of the country and is part of the province of Overijssel (see Figure 2). Within this predominantly rural province, the region of Twente is the most urbanized, which allows this study to use cases that vary in terms of rural and urban areas. Urban areas, however, are most often directly linked to rural areas, which creates interesting spatial dynamics between the two. Because the region of Twente has a relatively balanced variation between urbanized and rural municipalities, and therefore also a high variation in size, two urbanized and two rural municipalities were selected. The two urban cases selected are the municipalities of Hengelo and Enschede with respectively around 81,000 and 159,000 residents. The two rural cases are the municipalities of Tubbergen and Hof van Twente with respectively around 21,000 and 35,000 residents [72].

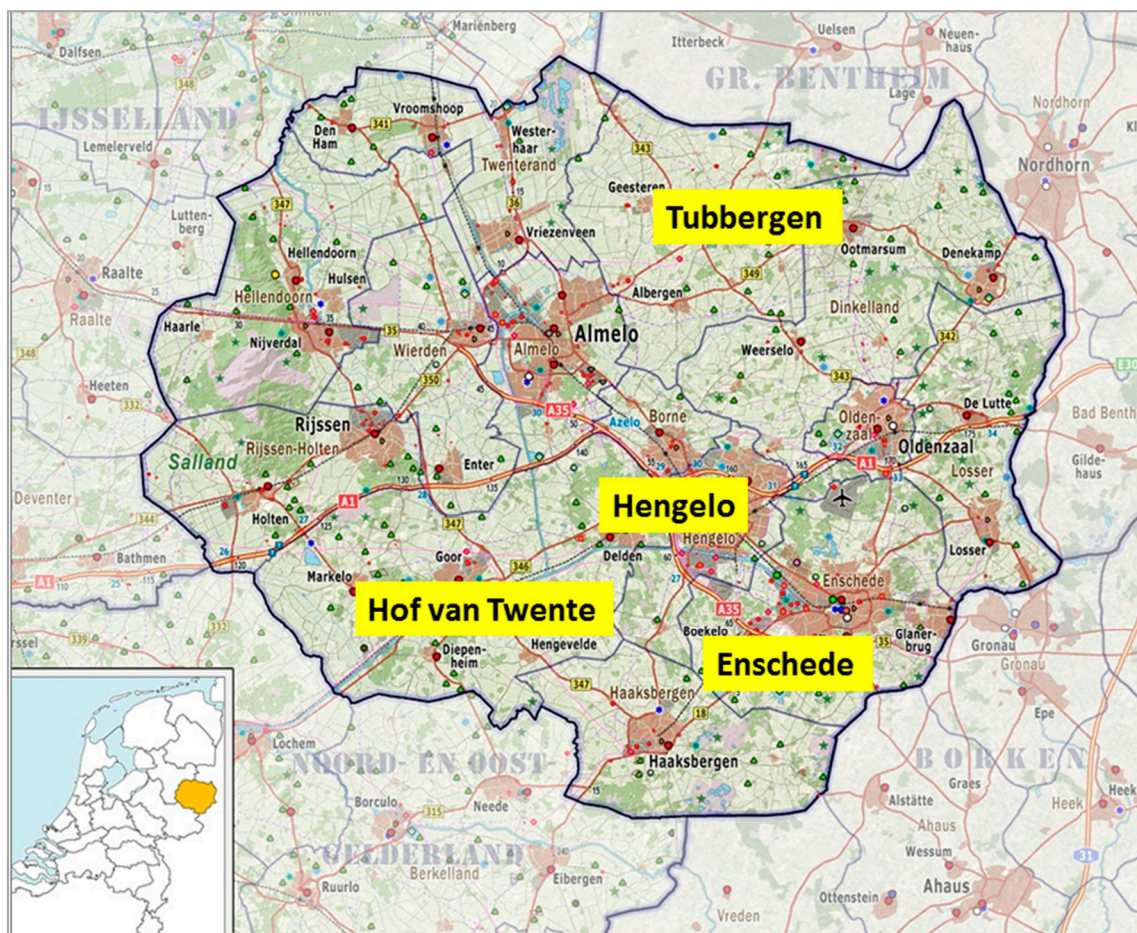


Figure 2. Siting of the Twente region in The Netherlands and the four municipalities within Twente.

### 3.2. Data Collection

Data used in this study concern policy documents, online articles, participant-observation (during meetings) and interviews. For each of the four municipalities, three interviews were conducted, and policy documents were collected. For each municipality a public official, a civil servant, and a citizen (active in a district or community energy initiative) were selected and interviewed. Selection involved the use of criteria on whether the persons could provide informative, inside, in-depth and reliable information on involvement in climate policy or climate actions by their respective organizations. Per case study those persons were selected who were either tasked with climate policy or were most knowledgeable. In the selection the professional expert network of the first author was used. He has been a close observant of local climate policy and -actions in the Twente region since 2005.

By selecting a public official (active in policy making and governing), a civil servant (active in operational administration and bureaucracy of policy implementation) and a local citizens' representative (as a non-government entity, and as those who experience and are at the receiving end of local policy and public service delivery), we tried to cover the set of actors who are most genuinely involved in local climate policy and climate actions. Interviews with citizens involved representatives of citizens' organizations, among which neighborhood associations and low carbon initiatives. Next to interviews with these persons additional interviews with at least twelve other relevant persons (going back to 2006) added useful information for data analysis. This included a larger set of actors including the provincial government, regional government, housing associations, construction companies, a university, and a DSO. For the interviews a semi-structured approach was used reflecting the theoretical concepts of the framework presented in Table 1. Although the questionnaire did embody a list of guiding questions during interviews there was sufficient room for the interviewee wanting to provide additional, detailed information" [73] (p. 135).

In addition to the interviews and collection of written documents, meetings (project meetings, meetings organized by local governments, and meetings by low carbon citizens' initiatives) were attended by the researchers. These included workshops on climate policy organized by local governments, workshops and general meetings organized by low carbon citizens' initiatives, workshops organized by the university (to which the authors were employed at the time of data collection) and the provincial government which involved participation by most of the actors relevant to local climate actions, and excursions to best practice projects. In addition, the authors of this article had Master's students working on assignments that were related to the cases that are presented in this article (e.g., an institutional analysis of district heating in the City of Hengelo, an organizational study of the 'ECHT' low carbon citizens' initiative in the municipality of Hof van Twente, multiple technical studies commissioned by the 'Energiek Vasse' low carbon citizens' initiative in the municipality of Tubbergen, a thesis on local climate policy making in the municipality of Enschede [74] and a thesis on climate policy practices in multiple municipalities in the Twente region [75]).

### 3.3. Data Analysis

In order to judge how the selected local governments approached local climate change capacity and policy—based on the theoretical claims and conceptual notions (see Section 2)—data were critically reflected upon with repeated cycles of data analysis and interpretation. For each four cases case study reports were drafted (see Section 4 for the case histories). In addition, data were analyzed in terms of categories developed or given ones used to produce a set of notions that describe each of the cases. Atlas.ti was used as software tool to code and manage the data and codes.

Based on the analysis, results per theoretical criterion were compared (as mentioned in Section 2, but differentiating criteria 2.1.2 and 2.1.3 into 'mitigation' and 'adaptation' components), in particular between the four case studies (in terms of similarities and dissimilarities). Appendix A offers insights in how the comparison between the four municipalities was established. This occurred in terms of assigning (qualitative) scores per case using five point scales) ranging from '—' for poor conditions, to '++' for strong conditions vis-à-vis pro climate action). The strength or weakness of a given condition was ascribed in a protocol, using clear definitions and operationalization per item used.

For all five values (− −, −, +/−, +, ++), qualitative descriptions were given to support assignment to a condition in one of the four cases. Case comparison was conducted following interpretation of the data matrix established and cross-tabulation of these data (after dichotomization, in which values of ‘+’ or more were coded into ‘1’, and values of less than ‘+’ coded into ‘0’). Cross-tabulation (using the software program fsQCA (University of Arizona: Tucson, Arizona)) was used to analyze the direction and strength of the statistical correlations between theoretically relevant factors (those presented in Section 2) and policy output in terms of climate actions/projects.

### 3.4. Limitations

Despite the careful selection of the four case studies the reader should notice that the results of this study cannot readily be generalized to other regions and countries. The main reasons have to do with the rather unique contextual characteristics of the region under study in terms of geographical factors (proximity to the sea and rivers, type of landscape), demography (rather mono-cultural), regional economy (predominantly rural activities, little industrious), and policy and polity settings (corporatist decision-making tradition, a rather advanced institutional body to support policy transfer and local climate capacity building, and a rather advanced inter-municipal collaboration network).

## 4. Case Study Histories

In this section the case descriptions are presented. Before doing this an introduction to local climate policy in The Netherlands is given in order to present the contextual and institutional setting of the country in which the cases are located.

### 4.1. Local Climate Policy in The Netherlands

The Netherlands is a country situated in river delta that is highly flood prone. It is considered one of the countries in Europe most vulnerable to climate change [76]. Its history is marked by floodings and the country has become increasingly vulnerable to the risks of extreme precipitation. In response the Dutch have developed remarkable skills in water engineering, management and governance to protect themselves against this recurring problem. Having a consensus democracy, a corporatist decision-making tradition, and a high level of institutionalization and organization of the state, the country has many governmental bodies whose tasks and authorities are relevant to the governing of climate change. Moreover, The Netherlands has a rich history in environmental politics and policy.

Since the 1987 Brundlandt report, the country has served as a frontrunner country in advocating governance responses vis-à-vis climate change (although this intensified after 1997 Kyoto protocol). Since the early 1990s programs were set up by national government to support local climate actions, local capacity building, and local climate policy making. First, by means of broader (LA21) support schemes [47], and later in more focused climate change oriented intergovernmental support schemes following the 1997 Kyoto protocol and the nation’s commitment to it [11]. The focus at the time, however, was predominantly on one side of the climate change issue: lowering of carbon emissions, hence the mitigation variant.

Adaptation was considered more as a matter that should be governed at national level, being adopted by the (traditionally well-established) water regime as part of a more integrated water management approach [77]. Implementation of the programs involved the traditional water governance actors (the National water authority ‘Rijkswaterstaat’, the water boards, key actors from water engineering industry, and knowledge institutes). Since 2007 adaptation has received more attention as an independent policy issue when a National Adaptation Strategy (NAS) was formulated. Local governments also participated in the NAS trajectory. In NAS attention to adaptation broadened the scope to other issues than water (e.g., urban heat stress). More national programs were to follow: the ARK program and the Delta Program (the latter having the goal to make The Netherlands “climate proof”). This involved budgets that were made available by governments and public organizations for regional and local vulnerability and adaptation research projects [3]. Under the Delta program



a sub-program was launched aimed at enhancing the level of local climate change adaptation capacity. A few large-sized cities launched programs of their own; for instance, the City of Rotterdam running the “Rotterdam Climate Initiative” wanting to become a frontrunner in climate adaptation governance [32].

By 2016, most Dutch municipalities had local climate change policies of their own. They mostly address mitigation, as attention to adaptation by local governments is still rather limited [11]. The difference in adoption rates between adaptation and mitigation is in part due to the use of central government-led policy support schemes aimed at vertical integration of climate change mitigation policies. As compared to mitigation adaptation was never really prioritized nor supported with properly financed policy support schemes to build capacity among local governments. Moreover, mitigation is still typically framed as an ‘energy’ issue whereas adaptation is more commonly framed as a ‘water’ issue [11]. This has had far-reaching institutional consequences. In the realm of local climate change policies, adaptation is still considered an ‘add on’ to climate change mitigation policy. There is little mainstreaming and policy integration of adaptation with sectoral policy domains to foster adaptation action by local governments [14,15]. Moreover, adaptation is increasingly outsourced by local governments to “water boards”, which are the functional decentralised government bodies tasked with water governance at the regional level. Next to a lack of attention to adaptation local governments have had little attention to “no-regret” options which cover both adaptation and mitigation action [15].

## 4.2. Case Histories

### 4.2.1. The Municipality of Enschede

Enschede is an urban municipality located at the south-eastern part of the Twente region. The municipality has a surface-area of 143 square kilometer [78], counts 158,627 residents that live in the city of Enschede, which makes Enschede the largest city in the Province of Overijssel (and hence, the Twente region) and the 11th Dutch municipality in terms of population [79]. Economically, Enschede used to depend heavily on the textile industry (since the 1860s with a working population of 85%), which collapsed in the 1960s, and led to substantial unemployment rates. The consequences are currently still felt, leading to municipal policies predominantly focusing on strengthening employment levels, hence supporting job creation. In trying to counter the collapse of the textile industry a university (University of Twente), a university of applied sciences (Saxion), a hospital (MST), and state investments in the industry and service sectors were made (Enschede onze Stad, 2014; [80]). In the 1990s, a plan was developed to merge the municipalities Borne, Enschede, and Hengelo into one municipality ‘Twentestad,’ but it was not implemented after results from a referendum in Hengelo (2000) showed a lack of citizens’ support. Following this event, six municipalities (including Almelo and Oldenzaal) did, however, start collaborating at regional in the so-called ‘Netwerkstad Twente’ configuration [81]. Since 2014 the municipality of Enschede and three other municipalities from the Twente region have centralized public service delivery concerning communication, legal affairs, and human resources in a so-called ‘Inter-municipal Management Organisation’ [82].

In 2010, the city of Enschede published a long-term sustainability vision called ‘Nieuwe Energie voor Enschede’ (‘New energy for Enschede’ in English), which formulated a long-term municipal vision aimed at specifying and accelerating climate change mitigations efforts. The vision focused on mitigating climate change impacts with CO<sub>2</sub> emission reduction and using sustainability as an investment to generate economic opportunities to increase employment, improve school buildings, education, and further regional collaboration between municipalities and ambitious local partners (such as the waste incineration company of ‘Twence’, housing associations, the local university and the university of applied sciences). In 2010, a consultancy firm was hired to assess the municipality’s sustainability policy (of which climate change policy was a major part), and to provide suggestions on future policymaking. The assessment found that the municipality of Enschede was in need to further accelerate and sharpen its climate and energy policy to reduce CO<sub>2</sub> emissions in such a way that Enschede could become a ‘carbon neutral’ municipality. Following this advice, a policy goal was set targeting 28% CO<sub>2</sub> reduction (in 2020 as compared to 1990 levels). Moreover, it set out that by 2020



renewable energy sources should account for 17% of local energy demand (and in 2013, after a policy evaluation, these goals were adjusted to a 30% reduction in CO<sub>2</sub> emissions and 20% renewables in local energy demand). In 2014 The Municipality of Enschede signed the Covenant of Mayors, showing commitment to an international treaty to lower carbon emissions.

In line with the Municipality of Enschede's depoliticized, managerial way of designing sustainability policies, the policy-making process mostly drew on expert knowledge by a consultancy firm (which was contracted by the municipality previously), leaving aside local stakeholder and citizen knowledge that could have potentially been used as well [74]. The action plan that followed from the municipal vision mentioned seven key policy areas to which actions have been assigned, regarding sustainable construction, spatial planning, municipal organization, sustainable energy, citizen participation, mobility, industries and companies. Actions mostly targeted the built environment, which can be understood from local city planning in which 30,000 of the local dwellings would be subjected to renovation (and hence, could add to upgrading of energy performance to the list of measures to which these dwellings would be exposed). One reason that the high amount of dwellings were targeted was that the action would lead to an increase in employment rates in the local construction sector. A problem the municipality engaged with regarding projects targeting low carbon dwellings was the poor integration of climate policy actions with spatial, urban development and housing policy, and the low priority actually given to achieving low carbon goals. One civil servant stated during an interview that low carbon goals had to be maintained and defended on local project agendas all the time, as other representatives from incumbent departments would try to get their issues addressed (and hence, budgets allocated), which would lead to abandoning low carbon goals in those projects.

Although the ambitions of the city administration were considerably high, the municipality was facing structural financial problems that would later result in severe budgets cuts. In addition, the municipality was lacking local catalysts, following the replacement of a green-Leftist Alderman and the departure of a respected, experiential civil servant who acted as climate change coordinator. At the time of data collection only one committed individual was found in the organization serving a function as project manager in spatial affairs (an Alderman (in Dutch: wethouder) is a public function in Dutch local government. Together with the mayor Aldermen form the so-called "Council of Mayor and Aldermen". This is the executive council of the municipalities, which is responsible to implement policy. As members of this executive council Aldermen have their own portfolio for which they prepare, coordinate, plan and implement policies).

Although the achievements of previous climate mitigation programs (2000–2010) in terms of policy output and outcome (See Appendix B) can be viewed as remarkable (e.g., in terms of carbon emissions per capita, adoption of renewable energy, passive housing, energy performance improvements in refurbished dwellings, and solar panels installed in public buildings realized as compared to other cities in The Netherlands; [83]) there are several reasons why they can be subjected to criticism. First, in most of the achievements it was housing associations and other local organizations that invested and accomplished low carbon goals, rather than the (contribution by) municipality. Second, in the evaluation report a lack of argumentation in support of achievements was revealed in our analysis. Moreover, a lot of 'phraseology', such as the continuous use of terms as 'frontrunner' was retrieved which led us to question the credibility of these statements. Moreover, there was little evidence that a substantial number of dwellings had factually been refurbished and improved in terms of energy performance.

Whereas the 2010–2014 climate change mitigation policy was ambitious and to some extent successful this could hardly be said about its successor. In the municipality's 2014–2018 coalition agreement, the redundant use of the term 'sustainability' within the various chapters suggested mere framing of general policy in terms environmental policy. Having had a look at the content however revealed only a poor orientation towards realizing climate mitigation goals. The main focus-points of the 'sustainable environment' chapter for instance, did not mention climate change mitigation nor

adaptation. Instead, the chapter merely included a sustainable energy and waste sub-chapter that appeared as minimal in terms of commitment to climate mitigation goals.

Regarding climate change adaptation local government focused mostly on preventing water-related problems (in relation to extreme precipitation events the city experienced a few times in recent years). Although actions to mitigate water problems were mentioned in the municipality's 2014–2018 coalition agreement (e.g., urban citizen agriculture, and green area management by citizens) climate change adaptation was not explicitly mentioned. Moreover, the plans revealed a priority on public budget cuts as a reason to shift responsibilities and action from local government to citizens. Although the municipality's involvement in climate change adaptation was moderate, it joined other cities in the province of Overijssel and the water board to participate in the so-called 'Climate Active Cities' initiative. Despite its inclusive name this initiative solely focused on (water-related) adaptation while neglecting mitigation actions, and 'no regret' options.

#### 4.2.2. The Municipality of Hengelo

Hengelo is located at the central-eastern part of the Twente region, surrounded by the municipalities Enschede, Oldenzaal, Borne, Hof van Twente, and Haaksbergen. Hengelo's surface-area is 61.83 km<sup>2</sup> and has 80,952 residents. It is the second largest municipality in the Twente region. In the 19th and 20th century Hengelo was an important location in the metal industry including big industrial such as the machine factory plant 'Gebr. Stork and Co.'. This led to economic prosperity. Despite the history of Hengelo preventing municipal integration with its municipal neighbours in 2000, the municipality of Hengelo does collaborate with other municipalities in the Twente region (in the so-called 'Netwerkstad Twente' collaboration; [81]). This network also embeds a platform in which climate officers from Twente's municipalities meet, and share best practices. For the last decade the City of Hengelo has held the reputation as the municipality in the Twente region most active in climate change policy [84].

The Municipal coalition agreement for the 2010–2014 term mentioned the need to attain a "resilient, sustainable Hengelo" in terms of social climate, social facilities, and local economy. Climate change policy was embedded in a broader sustainability policy agenda. One of the three focal issues on the sustainability agenda was 'climate and energy', in which short-term goals (<2015), mid-term goals (<2020), and long term goals (<2030) were described. Goals included realization of sustainable constructed houses that supply energy, sustainable mobility, and a 100% carbon neutral industrial park (called 'Twenthekanaal'). Local government focused on improving the local district heating system's sustainability and independence, and implementation of energy efficiency policies. For instance, municipal buildings were set to have a 20% energy consumption reduction, and by 2020 mobility should account for 30% less carbon emissions as compared to 2007. By 2020 40% of energy consumption should come from renewable energy sources. Moreover, 30% of public lighting should be powered by green energy sources. Moreover, 250 self-sufficient energy households were envisaged, to go with 1,000 dwellings that were to be retrofitted with high quality thermal insulation materials. In addition, a citizens' initiative 'Duurzame Energie in de Wijk' ('Sustainable energy in the neighborhood' in English) should be realized, accounting for a 30% reduction in fossil energy use by households (as compared to 2007). Moreover, local government strongly stimulated use of 'green' vehicles. Whereas the municipal policy mentioned a reduction in carbon emissions it did not express commitment to attain specific quantitative targets. Although Hengelo's municipal council was largely committed to deal with climate change, only municipal projects with (assumed) reliable payback-times or large-scale, long-term projects were likely to get approved. One of these projects concerned the sustainable renovation of the town hall, which included installment of 200 solar panels on its rooftop [85].

In realizing low carbon goals Hengelo's main strategy was to focus on collaboration with partners. In order to improve collaboration with other stakeholders, the Municipality of Hengelo supported citizen participation, creating a transparent, dynamic relation with the city council, clear agreements with partners, and effective collaboration with neighboring municipalities, 'Netwerkstad'-partners, 'Regio Twente', and the province of Overijssel. Within these collaborations, projects addressed (amongst

others) sustainable housing, awareness raising, lowering of carbon emissions, and use of renewable energy. Specific arrangements were made with housing associations in order to realize sustainable and near zero energy housing (i.e., 'green deals').

Over the last 20 years Hengelo has had a policy focus on protection against flooding and coping with drought. In the coalition agreement for the 2010–2014 term, the Municipality of Hengelo mentioned the need to cope with the impacts of climate change (adaptation). A budget for adaptation measures was allocated to the water department. One of the measures addressed increasing the city's district water containment with the city's spatial planning agenda in order to re-structure and improve resilience of city districts. In addition, the climate change adaptation strategy focused on green urban areas that contributes to biodiversity, and cope with occasional flooding and urban heat-stress. Concerning the latter it strived play an exemplary role. The City of Hengelo's climate change adaptation policy reflects national policy and appeared to be in good shape. In Appendix C more details can be found on the city's specific policy measures concerning climate change adaptation.

Within the Twente region the City of Hengelo is renowned for having active 'pro-climate' oriented civil servants and on occasion progressive public officials that spur a pioneering role of the municipality in climate change policy. A municipal 'sustainability team' (consisting of civil servants) is responsible for realizing the sustainability agenda, focuses on policy, education, communication, and is specialized in the area of energy and sustainable mobility. The sustainability team also aims to improve citizen involvement in climate themes on behalf of the municipality. Most of the municipal departments that were involved formulating climate change policy (such as water, waste, spatial planning, and nature) have pro-climate oriented officers. However, approaches were oftentimes still fragmented and public officials face problems when translating ambitions into (feasible) policy goals and action plans. When ambitions reached spatial planning matters in concrete projects difficulties to maintain climate goals on the agenda occurred.

Citizen participation in pro-climate networks was viewed by the municipality to be an important way to share information in order to save time and money for other policies. Although Hengelo has been active in stimulating public participation events in recent years it was not considered successful in getting citizens involved in decision making on climate change issues. It neither succeeded in setting up a citizens' low carbon initiative. On a regional level, the municipality of Hengelo participated in an environment and sustainability meeting for public officials to improve a multi-disciplinary sustainability approach. On a provincial and national level, it participated in seminars and workgroups (although prefers participation at the regional level is preferred). European network-meetings organized by ICLEI and Covenant of Mayors were considered as useful by Hengelo officials and are attended by civil servants. In terms of climate change adaptation, regional meetings were held, which led to a water-network project and support was found for the municipal sewer plan due to regional meetings between public officials.

Like most other Dutch municipalities the City of Hengelo was subject to severe budget cuts. This has had a severe impact on (earmarked) budgets for low carbon and energy-related projects (e.g., the large-scale district heating project in the Southern part of Hengelo). Moreover, the City of Hengelo had allocated only little budget for climate change policy. As a response to the lack of budget, the municipality of Hengelo has learned to play an intermediate, multi-sectoral role for companies that are able and willing to invest in, usually mainstream, sustainability projects, which allowed for interesting collaborations that led to new, more efficient solutions. In addition the municipality of Hengelo had become very active in seeking support from other governments. As a consequence most of the low carbon energy projects were actually initiated by provincial government. Accepting a provincial project, however, also meant that the municipality had less control over the project, which increases the risk of becoming unreliable towards local citizens.

#### 4.2.3. The Municipality Hof van Twente

Hof van Twente is a rural municipality located in the south of the Twente region. It has a surface-area of 21,541 hectares, and result from a fusion of five municipalities in 2001. The current

municipality has 34,997 residents registered that live in six villages and thirteen townships. In 2010, a strategic vision document called 'Zicht op 2030' ('View on 2030' in English) was published by local government. It addressed the goal to improve sustainability, which is seen as important factor receiving more attention by decision-making in politics, industries, institutions, and citizens, and has an increasingly solid position in law and regulation, and in several sectoral policies. Within the sustainability agenda most emphasis is with waste management. The main reasons mentioned to invest in sustainability were to improve the environment, social cohesion, and Hof van Twente's local economy [86].

In the sustainability agenda the first prioritized policy item is 'climate and energy'. The goal was to realize a carbon neutral municipal organization within 2011 and 2020, and a carbon neutral town (including the local community at large) in 2035. Local government focused on a broad collaboration between companies, (other) governments, and local citizens, in which local government plays a facilitative role offering room for innovative ideas via participation projects. There is a focus on mitigating carbon emissions (by lowering fossil energy consumption), and to increase the use of sustainable energy. Other key themes concern sustainable construction and living. In terms of goal setting, national blueprints with detailed goals—derived from the 'Climate Treaty' ('Klimaatakkoord' in Dutch) between national government and the Dutch union of municipalities (VNG, 2007)—were actively used for drafting new policy. Commitment from citizens and companies was sought to realize an energy-neutral municipality. Communication was viewed as an important policy instrument to inform citizens and companies on how to lower carbon emissions. In addition spatial planning was viewed an important instrument to achieve a sustainable environment. Policy actions are monitored by the municipality in terms of performance and progress.

Hof van Twente formulated a long-term program called "Meerjaren Uitvoeringsprogramma Duurzaamheid" (multi-year program on sustainability). Indirectly, the document was created by a third party consultancy firm specialized in conducting energy audits for commissioners in rural areas. Different stakeholders were consulted during this process—e.g., local entrepreneurs, energy companies, policy makers, aldermen, council members, housing cooperatives and village councils. The central goal of the program was to encourage citizens and companies to contribute to sustainable developments with a focus on realizing short-term goals. One of these goals concerned a 20% reduction of energy consumption by the municipal organization and a 10% for citizens. Appendix D offers an overview of climate change mitigation policies.

Within the Twente region, Hof van Twente participates in the 'Environmental and Sustainability' network that organizes meetings between 'Twente' municipalities (both civil servants and public officials), which are aimed to share, discuss, and fine-tune local climate policy. Hof van Twente is also a member of the 'Dutch climate treaty' which is a network that consists of more than 150 municipalities, provinces, and water boards that agreed to collaborate in order to realize an carbon neutral society through environmental- and sustainable-oriented projects and lobby activities. As a member of the UN's Millennium network, Hof van Twente also commits itself to the 7th Millennium Development Goal, which focuses on ensuring environmental sustainability with the commitment to reduce carbon emissions. With regards to climate change adaptation networks, Hof van Twente's alderman was a member of the VNG-commission which issued water management.

The municipality of Hof van Twente applied for the SLOK-program (multilevel governance capacity building program on climate change policy targeting municipalities; e.g., [11]), but eventually declined participation for the reason of perceiving the grant application being too complicated. According to a civil servant it would have provided insufficient funding. In addition the accountability was perceived as unclear. In terms of providing subsidy for low carbon initiatives, the municipality played a less prominent role due to a shift in subsidy-allocation from municipality to higher levels of government. Notwithstanding, the municipality participated in 'sustainability program' by the Province of Overijssel in which the province and the municipality jointly financed 1 Million Euros (following a program the Province of Overijssel launched in order to support municipalities to build capacities). The resulting 2 Million Euros were used to run local subsidies that were intended to spur

investments in renewable energy production plants and energy efficiency equipment; for instance to spur solar PV adoption (among citizens) and to replace asbestos rooftops by new rooftops having solar PV panels already installed in them. Other actions were subsidizing of public schools for teaching material, and allocating ‘seed money’ to a local citizens’ energy cooperative ‘ECHT’ (to develop a website of its own, folders, and to organize meetings for its members). ECHT focused on increasing energy efficiency performance levels of dwellings, and installing solar PV and thermal systems. ECHT explored to what extent it could take over tasks and responsibilities from the municipality (e.g., the municipality’s ‘energy panel’), but chances were small because it would take away jobs from civil servants and it was considered as too difficult to ensure reliable service delivery by volunteering citizens. Another initiative from ECHT was to appoint local ambassadors, who would be citizens that were a pioneer for a certain sustainability activity within their local neighborhood and with their experience can help out interested neighbors accomplish the same goal. The focal idea for the ‘local ambassador’ concept was based on experiences in the municipality of Amersfoort and was implemented in a few districts in Hof van Twente to find out whether the approach also works the latter. All in all, the low carbon program resulting from the collaboration between the municipality and the provincial government had achieved a lasting impact, both in terms of built capacity and lowering of carbon emissions in practice [87].

In terms of climate change adaptation, Hof van Twente’s vision document focused on the preservation of drink water, a minimal production of waste water, water for nature and recreation, flood protection and water storage in case extreme droughts occur. Municipal water policy was based on the water act, focuses on having a vital and robust water-system and water-chain and was designed to also cope with climate change impacts such as flood risk, waste water, rain water, and ground water drainage. While the municipality of Hof van Twente had no specific climate change adaptation policy, their environmental policy document did express an ambition to deal with floods and organize water adequately. In addition, a sewer-policy was formulated in order to build sewer-systems that help store, filter, and transport water. In the multiyear program on sustainability, however, climate change adaptation goals were not separately mentioned, though. For many water-related issues the municipality remained depending on the Water board’s policies (‘Vechtstromen’).

#### 4.2.4. The Municipality of Tubbergen

Tubbergen is a rural municipality located in the North of the Twente region. It is located at the border to Germany and has a surface-area of 14,741 hectares. The municipality has 21,215 residents registered that live in one of its ten villages. Although the municipality is home to agricultural economic activity it also host plenty of touristic activities due to esthetic landscaping. Since 2011 the municipality of Tubbergen collaborates intensively with the neighboring municipality of Dinkelland, in public service delivery organization. This collaboration, a partnership called ‘Noaberkracht’ was developed in response to the challenge of demographic decline, governance-related developments, and to cope with lack of capacities and expertise.

The municipality’s coalition-agreement for the 2010–2014 term focuses on stimulating the use and production of sustainability techniques, such as: solar panels, ground heat, and bio-energy. Based on an energy audit conducted by the waste company ‘Twence’ in 2011 potentials for solar energy and bio-energy were identified for Tubbergen. However, this should be balanced against economic and ecological goals. Like many other municipalities in the region Tubbergen (and its neighboring municipality Dinkelland) stress improved waste management (a priori waste separation; the so-called ‘diftar’ method) in sustainability policy. Commitment to sustainable energy is expressed, but does not include specified goals.

While the basic attitude of public officials towards climate change issues was viewed as rather positive, they tend to be conservative and reactionary when it comes to actual dealing with climate change developments. The drive to set up local climate policy was mostly externally driven and topic-specific, in which the policy is not part of an over-arching climate policy document. Also, climate goals had not yet been integrated in other policy domains. The municipality hired a consultancy-firm



to represent the municipality's energy-panel where they share information about energy with citizens and companies (via the so-called 'energy front office; 'energieloket' in Dutch). At the time of data collection local government did not have a clear vision on climate change.

Political priorities in Tubbergen were typically on protection of agri-economic activities given the importance of livestock holders' firms in the local economy. In addition there was poor integration between climate and agricultural policies. Due to a lack of political support, public officials did not have enough time, manpower, or money to focus on other activities than the most necessary climate change goals set by regional, provincial, and national governments. In turn the municipal budget of Tubbergen to deal with climate change issues was rather low. This also reflected in the titles of both the climate-oriented officer and alderman, in which the former had 'environment, sustainability and waste' in his agenda, and the alderman 'healthcare, finance, sustainability, waste, energy, innovation, and social real-estate'. During the 2010–2014 period, the municipality of Tubbergen did not have a public official who took a leading role in committing to the implementation of sustainability policy. From an interview it was retrieved that a sustainability-oriented civil servant believed that he should fulfill this role, but due to a lack of support there was not enough time, manpower, nor budget available to make this happen. Appendix E presents an overview of local climate change adaptation policies.

Because the municipality of Tubbergen had only limited budget available, climate actions were to a large extent depending on subsidies granted by other governments. For instance, the Province of Overijssel, which provides budget for the energy panel, and budgets to local energy initiatives, in particular in the village of Vasse (following the 'Sustainable village' competition in which Vasse and Fleringen won prizes which led to financial support by the Provincial government [88,89]. 'Energiek Vasse' aimed to become carbon neutral with increased energy-savings, local renewable energy production and citizen awareness raising campaigns, that result in reinvesting financial gains in local community projects [90]. Although the citizen-led energy cooperative is ambitious itself (indicated by having realized a solar PV park on the rooftop of the local community center using finance from the local community, without any governmental support), an interviewee stated that actual implementation of the initiative's plans depends to a large extent on the support by local government: this would mean a committed mayor and civil servants who are willing to support citizen-led initiatives. However, these conditions were not met by far. When projects were suggested by the initiative (e.g., construction of wind turbines, and installation of solar panels on schools' rooftops) civil servants and the mayor reacted reserved. Instead of empowering the citizen's cooperative they rather focused on continuation of their own energy actions (e.g., an energy audit and 'vision'; the municipal energy panel). This led to many progressive pro-climate citizens developing skepticism toward the (hardly supportive) role of local government.

Climate change adaptation goals were not specifically addressed by the municipality of Tubbergen. Moreover, climate change was not perceived as an urgent issue that requires adaptive capacity by the municipality. However, it was basically addressed under water policy. In 2013, Tubbergen and its neighboring municipality Dinkelland formulated a legally mandatory, sewer plan in consultation with the water board. One of the sewer plan's goals is to cope with the increasing frequency of rain water, waste water, and soil water surplus in the urban areas due to extreme weather events. In order to realize the sewer plan's goal to deal with extreme weather events, the Municipality of Tubbergen focused on a collaborative approach within the municipal organization and with the water and purification managers within the scope of the current sewer tax. Research was to be conducted to determine what the municipalities and the water board should choose to deal with extreme weather events. A 'water panel' was used to deal with companies' and citizens' questions. The climate adaptation policy actions were mostly coordinated by the water board, not the municipality of Tubbergen itself.

#### 4.3. Overview of Climate Actions and Policy Instruments Used

Overviews of climate actions and policy instruments used by the four municipalities are presented in Tables 2 and 3. Table 2 presents climate actions and policy instruments on adaptation whereas Table 3 presents climate actions and policy instruments on mitigation.

**Table 2.** Climate adaptation actions and policy instruments used per municipality.

Actions	Enschede	Hengelo	Hof van Twente	Tubbergen
Readjusted local spatial plan		✓		
Readjusted local sewer plan		✓	✓	✓
Participates in 'Climate Active Cities' initiative	✓	✓		
CC Adaptation policy is part of water policy	✓	✓	✓	✓
Responsibilities are predominantly with/or shifted to the Water Board	✓		✓	✓
Participates in issue network				
Construction of water infrastructure to cope with extreme weather events		✓		
Research conducted				✓
Water panel to cope with citizens requests				✓
Attention to Urban Heat Stress		✓		
Awareness raising among citizens		✓		
Supporting establishment of sustainable roofs to contain water		✓		

**Table 3.** Climate mitigation actions and policy instruments used per municipality.

Actions	Enschede	Hengelo	Hof van Twente	Tubbergen
Shareholder in renewable energy producing (waste) company ('Twence')	✓	✓	✓	✓
Measures in public buildings (to increase energy efficiency or to use RET; often solar panels)	✓	✓	✓	✓
Energy efficient street lightening (LED)		✓	✓	✓
Participating in central government's SLOK program	✓	✓		
Participating in programs by provincial government		✓	✓	
Monitoring and evaluation actions	✓		✓	
Subsidy to support adoption of RETs by citizens	✓	✓	✓	
Participation in local RET projects (at district level)	✓	✓	✓	
Active in regional issue network	✓	✓	✓	
Signatory of Covenant of Mayors	✓	✓		
Signatory of Millenium Cities			✓	
Signatory of ICLEI		✓		
Supporting low carbon citizens' initiative			✓	
Sustainable municipal car fleet	✓	✓	✓	
Sustainable energy infrastructure (e.g., district heating)		✓		
Arrangements with housing associations vis-à-vis near zero energy housing	✓	✓	✓	
Research	✓	✓	✓	✓
Awareness raising among local citizens		✓	✓	✓
Discouragement of high carbon options (shale gas, etc.)			✓	
Smart metre implementation plan (at district level)			✓	
Low interest loans to citizens			✓	
Energieloket (front office)	✓	✓	✓	✓
Energy audits	✓		✓	✓
Pilot projects	✓	✓	✓	

## 5. Results and Discussion

In this section the results of the analysis are presented two ways. First, an overview is presented on performance of the four case studies on the all items of the eight variable clusters of the analytical framework that was presented in Section 2. Second, the results of the comparative analysis are presented, addressing enabling conditions that co-varyate with (the extent and intensity of) local

climate actions. Third, these results are discussed in a theoretical perspective, emphasizing results of theoretical interest to ongoing academic debates, and especially addressing the results that are most relevant when it comes to the role and position of SMCs (when compared to large-sized cities).

### 5.1. Overview and Comparison of Case Studies

In Table 4 the results of the comparative analysis are presented in qualitative terms ranging from ‘++’ (as present) to ‘--’ (as absent). The comparison shows that the municipalities of Hengelo and Hof van Twente perform relatively well in terms of progressive climate capacity, whereas Enschede, and in particular Tubbergen perform less well. Whereas the municipality of Enschede set ambitious climate goals and policies, and was quite successful in low carbon projects in the past, its recent performance is less impressive, and shows signs of low commitment. As a ‘small’ municipality the city of Hof van Twente appears relatively progressive amongst its peers of small, rural municipalities, having a relatively active, and committed approach to climate change challenges.

**Table 4.** Results of the comparative analysis.

	Enschede	Hengelo	Hof van Twente	Tubbergen
<i>Municipal organisational Input</i>				
Financial resources	+/-	+	+/-	-
Fiscal health	--	+	+/-	+/-
Legal authority	N/A	N/A	N/A	N/A
Staff (expertise)	+	++	+	-
Technology	N/A	N/A	N/A	N/A
Size	++	++	-	-
Council type	N/A	N/A	N/A	N/A
<i>Municipal organisational Throughput</i>				
Political support (by council)	+	+	+/-	-
Public leadership/“political will” to act/local catalyst	+/-	++	+	-
Inter-department coordination/policy integration	+/-	+	+/-	-
Knowledge management	+/-	++	+	-
Policy plan mitigation (goals)	+	++	+	-
Policy plan mitigation (means/action plan)	-	++	+	-
Policy plan adaptation (goals)	+	++	+	-
Policy plan (means/action plan)	+/-	++	+	+/-
Commitment (of staff)	+/-	++	+	-
Monitoring and evaluation	+	+/-	+	-
<i>Municipal organisational Output</i>				
Policy instruments	+/-	+	+	-
Municipal governing by authority	++	++	+	+/-
Municipal self-governing	+	++	++	+/-
Municipal governing by provision	-	+/-	-	-
Municipal governing through enabling	+/-	+/-	++	-
<i>Characteristics of local environment</i>				
Demographic characteristics (SES, education)	--	+/-	+	+
Environmental group activity (RESCOOP)	+/-	+/-	++	+
Vulnerability to climate change/climate change risk	+/-	+/-	+	+
Environmental stress	+	+/-	+	+
Presence of carbon intensive industry	++	+	+/-	-
Presence of energy infrastructure	+	++	+	-
Available space for deployment of RES	+/-	+	++	++
<i>Local action arena</i>				
Presence of process manager	++	+	+/-	-
Support by local leaders/civic capacity	+/-	+/-	++	++
Partnerships with private organisations	++	++	++	-
<i>External issue networks</i>				
Collaboration with other local governments	++	++	+	-
Involvement in/membership of issue networks	++	++	+	-
<i>Influence exercised by higher government levels</i>				
Alignment with agendas of central and regional governments	+	-	+	++
Presence of inter-governmental support schemes	+	+	+	-
<i>Intended climate actions/projects</i>				
Installing energy efficiency and/or RES technology	+	++	+	+
Energy efficient behaviour (by local citizens and organizations)	N/A	N/A	N/A	N/A
Installing infrastructure to cope with extreme weather events	+/-	++	+/-	+/-

All four municipalities were found to have local climate policies of their own. They differ considerably, but also have climate actions in common such as placing solar panels on public buildings (in particular the town hall), replacing inefficient street lightening by LED lightening, implementing an ‘energy front office’ to spur communication with local citizenry and business firms, and being a shareholder of the waste company ‘Twence’ that is also producing renewable energy. However, in general the municipalities lack sufficient budgets for climate change policy (related to general budget cuts in local governments across the nation). This comes not much as a surprise when one understands that climate change was neither prioritized in the four cases (although strongly advocated in Hengelo and Hof van Twente). Nonetheless, policy ambitions have been set relatively high (except for the Tubbergen case), although they are often hardly quantified and do not lend themselves easily to be evaluated (especially when it comes to climate policy in sub-domains like mobility and the built environment). This can perhaps be viewed as policy makers avoiding a potential risk factor by shunning the mentioning of quantitative targets in official documents. In turn, there was little sign of serious monitoring and evaluation of climate policy and capacity building (only in Hof van Twente this was observed). The study also revealed that climate actions undertaken by local governments do not give a complete overview of all climate actions taking place in a given locality. In the city of Enschede, for example, a significant amount of carbon reductions were due to projects done by housing associations, in which the municipality had little involvement (except for getting low carbon issues on the housing associations’ agendas).

The analysis revealed that basically four types of cities coping with climate issues can be discerned: (i) a medium-sized municipality that was already equipped, was considered a frontrunner and has maintained this position (Hengelo); (ii) a medium-sized municipality that was already equipped, had performed well in the past, but regressed in recent years (Enschede); (iii) a small-sized municipality that succeeded in building municipal and civic capacities, and hence succeeded in catching up with progressive municipalities that are active in taking climate change actions (Hof van Twente); and (iv) a small-sized municipality that failed to build municipal capacity, but in which civic capacity was successful built independently (Tubbergen). The cases of the last two of the municipalities mentioned revealed that many actions (and the majority in Tubbergen) were in fact executed by local citizenry, and supported by provincial or central government via grants and related supportive policies. This stresses the importance of organized citizen climate action and ‘governance by enabling’ (although exercising some form of authority via subsidies), although not (only) by local government, but via higher government levels, especially subsidy schemes issued by the provincial government that were designed to build capacities locally.

Regarding the ‘mitigation-adaptation dichotomy’ [16] we found that in recent years there appears to be more attention to adaptation by local governments. However, mitigation was still emphasized in local climate policy agendas (see also Appendix F; which is in line with results from previous research [11]). Moreover, three out of four municipalities left adaptation actions to the water boards, and actually implemented few themselves (besides occasionally re-designing local sewer planning schemes). In addition, little attention to ‘no regret’ options—addressing both adaptation and mitigation actions—was revealed in the four case studies (which is in line with previous studies; [14,15]).

## 5.2. Results of the Comparative Analysis on Factors Enabling Local Climate Action

For both local climate actions and projects of mitigation and adaptation analysis was conducted to discern the factors presenting strong, positive relationships. Results regarding the mitigation dimension on local actions reveal six factors: the municipality having set ambitious policy goals, municipalities having experienced staff members, the municipality engaging in partnership with local business firms, the municipality having collaborative ties with other municipalities, the municipality having memberships of international climate change issue networks, and the municipality using intergovernmental support schemes issued by higher level governments. Whereas the first three of the factors mentioned can be classified as ‘localist’, the other three reveal the importance of efforts local

government makes that goes beyond the local level (concerning the ‘multi-level’ and ‘issue network’ dimensions; which is in line with [18,19,91]).

Next to the six factors having a sound positive correlation to climate change mitigation local climate actions and projects, six other factors were discerned correlating positively, but less strongly. They concern: the municipality having a solid policy action plan at hand, municipal size, the presence of a local catalyst, commitment by the civil servants/staff, the presence of an intensive carbon industry, and a high level of process management in local projects. What the analysis also revealed is that involvement of citizens (or low carbon citizens initiatives) is hardly or not related at all to projects ensued by local government. In other words, citizens are hardly involved in municipal low carbon projects. The one exception is Hof van Twente, in which local government succeeded in empowering the local citizens’ initiative. In the other municipality in which citizens organized themselves (in low carbon energy initiatives) they were not supported by local government, but rather restricted in their activities. Moreover, in the two urban cases the development of citizen-led low carbon initiatives was found to be far less developed than in the rural counterparts. This is in line with Oteman et al. [92] who revealed that low carbon citizens initiatives were pre-dominantly found in the countryside. Strikingly, in one of the rural cases we local government support of community low carbon initiatives was viewed as downright negative (Tubbergen) as the ‘Energiek Vasse’ citizens’ cooperative only experienced heavy resistance by the local government.

When reflecting upon the analytical framework presented in Section 2 four variable clusters seem to matter most: (i) organisational conditions of the local government (emphasizing throughput conditions and to a lower degree input conditions); (ii) the local action arena; (iii) issue networks; and (iv) influence exercised by higher government levels.

When analyzing the different governance models issued by the four municipalities (using the ideal types theorized by Kern and Bulkeley; [21]) the results revealed that two governance types correlate positively to local low carbon actions and projects issued: “governing by authority” and “self-governing”. The “governance by enabling” mode was not found to have a positive relationship with mitigation output (except for the case of Hof van Twente). “Governance by provision” was not analyzed as municipal provision in low carbon (energy) issues for legal authority and ownership reasons is negligible in The Netherlands is compared to other countries (provision services are owned by other organizations like DSOs; greening energy provision goes by applying authority, in other words by using contracts). We also observed forms of non-hierarchical governance via networking and the use of (non-binding) multi-lateral agreements. Given the Dutch corporatist tradition in decision-making and governance style, this does not come as a surprise. However, from a theoretical perspective this could potentially give leeway to discerning a fifth type of (horizontal, networked) local climate change governance to complement the four modes developed by Kern and Bulkeley [21].

Results of the analysis on adaptation climate actions and projects reveal two factors correlating strongly and positively: the municipality has (relatively) strong financial resources available, is financially healthy. Two other factors were discerned correlating positively, but less strongly. They are: municipal size and presence of an intensive carbon industry. As such, only few of the (enabling) conditions theorized in the empirical literature on adaptation policy were present in our study (in line with [24–26]). However, a limitation of our study is that input and throughput indicators of adaptation policy were studied less extensively than their mitigation counterparts. Therefore, for instance some of the claims by Moser and Ekstrom [22] and Bedsworth and Hanak [27] could not be analyzed.

### 5.3. Discussion

In relation to climate governance and -policy the capacity to include considerations of climate change policy on municipal level depends on how and how far actors at the municipal level are both able and ready to either (a) make climate change policy part of existing policy frames or (b) to change policy frames in order to give climate change a chance (e.g., [56]). In theory, using existing



policy frames can mean as much readiness for change (by re-definition or by adding-on new aspects) as rejecting really effective uptake of climate change issues; subscribing to changing policy frames themselves can also be merely symbolic or driven by true will to change; and both can be successful or failing. Let us not forget that the capacity to include considerations of climate change policy can mean to really give up policies and problem perceptions that have been taken for granted since a long time [93]: e.g., the city of Hengelo accepted to some extent to reduce emissions and cease policy that supports greater emissions, while the city of Enschede so far decided to stick to the incumbent policy and implement a form of (rather) symbolic climate policy; the city of Hof van Twente went for emission reduction, embarked on some new governance networks and instruments, adopted a progressive low carbon scheme empowering local citizens issued by the provincial government, but also abandoned the nation-wide progressive climate capacity building program 'SLOK' before finishing the application; and finally, the city of Tubbergen seemed to be lacking most capacities and lacking any ambition to allocate what would build sufficient capacities. At the end of the day, to change policy due to climate change might mean to terminate for long accepted policy [94], and to become innovative in terms of doing different things (new policies, new institutional arrangements, new perceptions for agendas and legitimations for decisions) or things differently (in more sustainable ways) [95], for instance by supporting low carbon citizens' initiatives who deliver services at arms' length of local government [96,97]. We might be talking not just about incremental change, but also about paradigmatic change; not just about climate change, but also about policy change.

Although evidence was found supporting the claim on influence of earmarked subsidies [11,59,64], some counter-evidence was found in this respect as well. In the two rather 'successful' cases (Hengelo and Hof van Twente) local government appeared to be somewhat reluctant towards using higher government subsidies. Hengelo resisted earmarked subsidy schemes for the reason of wanting to maintain local control of its climate agenda. The municipality of Hof van Twente did not partake in the national climate mitigation capacity scheme 'SLOK' because it would take them too much time and resources to request the grant. However, the city did use a climate capacity scheme by the provincial government, which contributed largely to both capacities in the local government organization and civic capacities in society. Without the scheme offered by the province most likely little would have been achieved. The 'SLOK' scheme was only used by two local governments (Hengelo and Enschede) which were large in size, and had already established capacities. For the four cases analyzed the 'SLOK' scheme forms an example of the "Matthew effect", as the most equipped beneficiaries succeeded in receiving the funds while the underprivileged ones (which were arguably most in need of it) did not. Although the role of earmarked support schemes towards municipal climate capacity building appears somewhat ambiguous in the cases analyzed, this is not so when regarding earmarked support scheme that targets civic low carbon actions. Several schemes by the provincial government contributed significantly to build civic low carbon capacities. In the Tubbergen case, a local low carbon civic initiative was greatly supported by a subsidy that was used to set up a professional organisation, which contributed indirectly to the installation of a solar park. In contrast to the Hof van Twente case, local government did not play an intermediary role in this, nor did it offer any substantial form of support toward the citizens' initiative.

When reflecting on the role of SMCs in climate policy and action some of the results revealed by the analysis call for more attention. First, it seems like citizen action is more commonly found in small cities (in line with [92]). It looks like it is easier for local governments in smaller-sized cities to mobilize and organize actions with local citizenry when compared to their counterparts in large cities. This is probably related to the absence of problems related to high levels of agglomeration. Second, it turns out that size (hence municipal capacity) matters. This means that smaller-sized cities are more likely to have problems related to resources, capacity and the presence of - for instance - 'local catalysts'. This calls for policymakers creating or maintaining attention to resources and capacity problems typically found among SMCs. Third, it turns out that inter-municipal networking pays off. This is important for regions with an active history in inter-municipal network collaboration, which

differs from regions with large-sized cities in which those cities mostly collaborate with peers, national government and international partners. Fourth, the results show that the larger—and hence more urbanized—cities were recipients of capacity building subsidies granted by national government, whereas their smaller counterparts were not. One of the smaller ones had a profound reason not to apply for the subsidy. The larger cities, were better prepared having more capacity and ‘critical mass’ to get the subsidy. However, provincial government issued a subsidy scheme targeting both the medium-sized and small-sized local governments that was well tailored to their needs. This shows that provincial governments can be important partners to SMCs when it comes to offering support in building local climate capacity (something previously noted by Späth and Rohrer [41]).

## 6. Conclusions

Many academic publications call for transformative paradigm shifts and radical institutional change, while others argue for mainstreaming climate policies into existing institutions. At the same time, it is widely recognized that cities of all sorts and sizes are very constrained in fiscal, staffing, and leadership capacity. In this context, we wondered how SMCs cope with climate change policy and projects (concerning both mitigation and adaptation)? For this reason, our article started with the following research question: What factors influence climate change policy and local climate actions in SMCs? The research question was answered by presenting an integrative analytical framework on enabling conditions regarding local climate action, and using this framework to analyze and compare a set of four case studies.

The study revealed five key results. First, although local governments enact many local climate actions they are not the primary actors in all of them. The study revealed that citizens’ initiatives, business firms and housing associations were in fact heavily engaged in climate actions. Actions by citizens were strongly empowered by provincial government (via a subsidy scheme and related supportive policies), and not only by local government. Second, governance modes used by local government mostly concerned “governing by authority” and “self-governing”. Except for one case “governance by enabling” was hardly used. However, the provincial government was eager to fill this “gap” in supporting citizen low carbon action. Third, the “localist” model was found to offer only a limited explanation in observed local climate actions. Half of the factors found to influence local mitigation action touched either upon the ‘multi-level’ or the ‘issue network’ dimensions, and can be viewed as complementing the “localist” set of enabling conditions [19]. Fourth, in local climate change agendas attention to mitigation still appeared to outweigh attention to adaptation. Fifth, in relation to policy the capacity to include considerations of climate change policy on municipal level depends on how and how far actors at the municipal level are both able and ready to either (a) make climate change policy part of existing policy frames or (b) to change policy frames in order to give the issue of climate change a chance (e.g., [56]). This related to the use of frames in political and policy debates which reveals a lot about readiness for change (by re-definition or by adding-on new aspects) as rejecting really effective uptake of climate change issues; subscribing to changing policy frames themselves can also be merely symbolic or driven by true will to change; and both can be successful or failing. At the end of the day, to change policy due to climate change might mean to terminate for long accepted policy [94], and to become innovative in terms of doing different things (new policies, new institutional arrangements, new perceptions for agendas and legitimations for decisions) or things differently (in more sustainable ways) [95], for instance by supporting low carbon citizens’ initiatives who deliver services at arms’ length of local government [96,97]. We might be talking not just about incremental change, but also about paradigmatic change; not just about climate change, but also about policy change.

When reflecting on the role that SMCs have in climate action the study revealed the importance of local capacity building schemes issued by higher government levels (in particular those by provincial and regional governments), the importance of inter-municipal network collaboration, and the potential for local governments to mobilize and organize local citizen action (which is more manageable in smaller-sized cities than in larger ones).

Suggestions for further research would be to use the theoretical framework presented in this article to a wider set of SMCs in empirical research. In addition, we suggest further research on the intended and unintended effects of intergovernmental support schemes used in climate change governance, and further research into the role of citizens in low carbon actions and related modes of governance that empower them.

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## Appendix A. Results of the Comparative Analysis with Background Information per Item

**Table A1.** Background information regarding the results of the comparative analysis.

	Enschede	Hengelo	Hof van Twente	Tubbergen
<i>Municipal organisation: Input</i>				
Financial resources	+ / –	+	+ / –	–
Indicator: degree to which the local government has budget available that can be allocated to climate change policy capacity.	Limited capacity financed	Substantial budget allocated	Limited capacity financed	No budget allocated to climate policy
Fiscal health	– –	+	+ / –	–
Indicator: information provided financial debts the municipality has on its annual budget, including information on municipalities being subjected to financial supervision by central government	Used to be on the national ‘Artikel 12’ list of municipalities with financial debts.	Positive balance.	Financial balance regressed but has improved (positive balance).	Budget presented in 2015 scrutinized by Province of Overijssel as risky.
Legal authority	N/A	N/A	N/A	N/A
Indicator: Degree of knowledge, experience and expertise regarding climate policy and running of related projects.	Some internal knowledge and expertise. However, a lot of knowledge is outsourced. No experience at the level of citizens.	High internal knowledge and expertise. Solid knowledge base. Little outsourcing. However, little knowledge at the level of citizens.	Some internal knowledge and expertise with sustainability expert. Experienced on citizen level.	Mandatory, reactive, external knowledge. Limited expertise.
Use of technology (e.g., to monitor)	N/A	N/A	N/A	N/A
Indicator: all municipalities outsources monitoring to other organisations, in particular consultancy agencies and engineering companies.				
Indicator: legal authority municipalities in The Netherlands have. They are the same for the four municipalities analysed for this study.				
Size	++	++	–	–
Indicator: no. of inhabitants (with local government staff mirroring size in terms of inhabitants).	159,000	81,000	35,000	21,000
Council type	N/A	N/A	N/A	N/A
Indicator: They are the same for all municipalities in The Netherlands (hence, for all four municipalities analysed for this study).				

Table A1. Cont.

	Enschede	Hengelo	Hof van Twente	Tubbergen
<i>Municipal organisation: Throughput</i>				
Political support (by City Council)	+	+	+ / –	–
Indicator:	Council supports climate policy by College of Mayor and Aldermen (with minor amendments)	Council supports climate policy by College of Mayor and Aldermen (with minor amendments)	Council supports climate policy by College of Mayor and Aldermen, but opposes some major projects	Climate change is not an issue among the City Council members.
Public leadership/“political will” to act/local catalyst	+ / –	++	+	–
Indicator:	Catalysts in the past, no recent catalysts found. Perhaps a catalyst at project/operational level.	Multiple catalysts present. Sustainability team engaged, waste dep. most catalyst. Creative. Water catalyst.	Potential of catalysing alderman who was catalyst in the past. Former alderman water catalyst.	Absent. Civil servants lack time and resources. No motivation to go beyond.
Inter-department coordination/policy integration	+ / –	+	+ / –	–
Indicator: Degree of inter-department coordination on climate policy and actions.	Sufficiently established coordination organized around projects (at operational level).	Relatively well–established coordination between municipal departments (between sustainability team, waste, water, construction).	Sufficiently established coordination	Little coordination regarding climate change actions, because the latter is hardly considered an issue.
Knowledge management	+ / –	++	+	–
Indicator: Degree of knowledge management. Presence of knowledge management infrastructure.	Some knowledge management, but mostly outsourced.	Strong knowledge base.	Proper knowledge management	Hardly any knowledge management. Knowledge externalised.
Policy plan mitigation (goals)	+	++	+	–
Indicator: clearly defined, ambitious goals	Rather ambitious; municipality wants to become a frontrunner.	Very ambitious. municipality wants to have an exemplary role, and wants to become a frontrunner.	Rather ambitious; municipality wants to have an exemplary role.	Hardly ambitious
Policy plan mitigation (means/action plan)	–	++	+	–
Indicator: sound, feasible action plan which clearly links goals, means and climate actions	Rather poor. Focus on ‘quick wins’.	Very sound	Good	Poor
Policy plan adaptation (goals)	+	++	+	–
Indicator: clearly defined, ambitious goals	Rather ambitious	Very ambitious	Rather ambitious	Hardly ambitious
Policy plan (means/action plan)	+ / –	++	+	+ / –



Table A1. Cont.

	Enschede	Hengelo	Hof van Twente	Tubbergen
Indicator: sound, feasible action plan which clearly links goals, means and climate actions	Relatively sound	Very sound	Good	Relatively sound
Commitment of staff implementing policy instruments	+ / –	++	+	–
Indicator:	Municipality outsources management of projects. Hence, depend a lot on commitment by external market organisations. Committed to projects in built environment and self-governing actions. Achievements not specifically attributed to specific actions. Lack of argumentation in support of how to achieve ambitious goals.	Personal commitment of staff members on broad array of actions among regarding mitigation. Also committed to adaptation actions. Commitment lower among non-climate officers.	High commitment to achieving climate mitigation goals. Trust in empowerment of citizens expressed by financial investments in citizen-led projects. High degree of citizen co-production and participation.  Little commitment to adaptation.	Low commitment to both mitigation and adaptation action. Both or not prioritized.
Monitoring and evaluation	+	+ / –	+	– –
Indicator: Municipality monitors climate policy and performance thereof frequently, and anticipates with feedback loop to policy	Present. Multi year monitoring with reflection in new policies.	Some loosely coupled monitoring efforts	Present. Multi year monitoring with reflection in new policies.	Absent.
<i>Municipal organisation: Output</i>				
Policy instruments	+ / –	+	+	–
Indicator: Total of instruments presented in Tables 2 and 3	Rather limited set of instruments	Large set of instruments	Large set of instruments	Poor set of instruments
Municipal governing by authority	++	++	+	+ / –
Indicator: interpretation of appliance characteristics governing mode to local governments' governing style (using regulatory instruments, economic incentives and contracting parties to govern by hierarchy).	The municipality used a lot of economic incentives, and contracted many parties in climate actions.	The municipality used a lot of economic incentives, and contracted many parties in climate actions. It also sets progressive regulatory standards	The municipality used a lot of economic incentives.	Except for mandatory energy efficiency regulations for buildings (which all Dutch municipalities do) not much.
Municipal self-governing	+	++	++	+ / –
Indicator: interpretation of appliance characteristics governing mode to local governments' governing style.	Local government taking on some projects itself.	A large set of projects executed by local government itself.	A large set of projects executed by local government itself.	A limited set of projects executed by local government (e.g., LED street lighting).

Table A1. Cont.

	Enschede	Hengelo	Hof van Twente	Tubbergen
Municipal governing by provision	–	+ / –	–	N/A
Indicator: interpretation of appliance characteristics governing mode to local governments' governing style.	Little involvement in energy infrastructure projects. This is managed via contracts (hence, governing by authority).	Mun. Hengelo is somewhat involved in management of a local district heating project	Little involvement in energy infrastructure projects. This is managed via contracts (hence, governing by authority).	Not relevant.
Municipal governing through enabling	+ / –	+ / –	++	–
Indicator: interpretation of appliance characteristics governing mode to local governments' governing style.	Developing capacity to support citizens (hiring trainee to develop plan, etc.).	Limited support of citizens' initiatives (but mostly in other domains)	Extensive support of citizens' initiatives.	No support of citizens' initiatives.
<i>Characteristics of the local environment</i>				
Demographic characteristics (SES, education)	– –	+ / –	+	+
Indicator SES: income per capita (in Euros; 2013)	20,600	23,200	25,500	25,100
Indicator education: highly educated (%; 2015)	25%	29%	23%	19%
Environmental group activity	+ / –	+ / –	++	+
Indicator: presence of active citizen-led low carbon initiative.	In development, but hardly organized.	In development, but hardly organized.	Well organized, professional citizens' cooperative having realized multiple projects.	Organized, relatively professional citizens' cooperative having realized one solar project.
Vulnerability to climate change/climate change risk	+ / –	+ / –	+	+
Indicator: degree to which the municipality is vulnerable to climate change related extreme weather events.	The municipality experienced several floodings of infrastructural works (e.g., viaducts) in recent years. Even the city centre was flooded shortly following extreme precipitation. Economic activities were, however, not endangered.	The municipality experienced several floodings of infrastructural works (e.g., viaducts) in recent years. Economic activities were, however, not endangered.	Due to the main economic activities in the municipality being agricultural vulnerability to extreme precipitation and drought in summer is considerable.	Due to the main economic activities in the municipality being agricultural vulnerability to extreme precipitation and drought in summer is considerable.
Environmental stress	+	+ / –	+	+
Indicator: Pollution to the environment due to economic activities.	Recent accidents with factories catching fire and emitting pollutants into environment. e.g., serious pollution of canal.	Potential risks with presence of metal industry, and railway transport carrying toxic substances.	Serious soil pollution due to former presence of factory producing asbestos–holding products. Agri–soil pollution due to manure surplus.	Serious soil pollution due to dumping of toxic wastes ("Teerkuil").

Table A1. Cont.

	Enschede	Hengelo	Hof van Twente	Tubbergen
Presence of carbon intensive industry	++	+	+ / –	–
Indicator: Presence of carbon intensive industry, e.g., in municipal business parks.	Presence of construction sector industry, as well as large-sized factories (e.g., wheel tires).	Presence of chemistry and metal industry. Has decreased in size.	Some industry. Mostly agri-economic activity (live stock holders)	Hardly any industry. Mostly agri-economic activity (live stock holders)
Presence of energy infrastructure	+	++	+	–
Indicator: Presence of district heating infrastructure.	Present, but already used.	Present, but in development and can still be used for EE purposes. In addition, biogas infrastructure in development.	Present, but already used. In addition, biogas infrastructure in development.	Absent.
Available space for deployment of RES	+ / –	+	++	++
Indicator: Space (in ha.'s) available on which RES parks can be established in theory.	Limited space available (in existing business areas).	Substantial space made available for deployment of RES plants in large-sized business area.	Large amount of space available for solar parks, bio-energy generation. Does, however, not apply to wind parks.	Large amount of space available for solar parks, bio-energy generation. Does, however, not apply to wind parks.
<i>Local action arena</i>				
Presence of process manager	++	+	+ / –	–
Indicator: local government has agents available (either tasked or hired) to manage processes in local projects	Multiple process managers available, both in own staff and hired.	Process managers available, both in own staff and hired.	Projects processes are mostly managed external organisation like the local low carbon citizens cooperative	There are no climate projects in which processes can be readily managed.
Support by local leaders/civic capacity	+ / –	+ / –	++	++
Indicator: presence of local leaders and organized citizenry who support climate actions and related projects.	Limited presence substantial civic capacity to run local climate actions.	Limited presence substantial civic capacity to run local climate actions.	Presence substantial civic capacity to run local climate actions (via 'ECHT').	Presence substantial civic capacity to run local climate actions (via 'Energiek Vasse').
Partnerships with private organisations	++	++	++	–
Indicator: collaborative ties with local industry and local business firms to run local climate actions	Multiple collaboration ties with private organisations to run climate actions	Multiple collaboration ties with private organisations to run climate actions	Multiple collaboration ties with private organisations to run climate actions	Rather absent.
<i>External issue networks</i>				
Collaborative ties with other local governments	++	++	+	–

Table A1. Cont.

	Enschede	Hengelo	Hof van Twente	Tubbergen
Indicator: Degree of activity in inter-municipal/regional climate network(s)	Heavily involved in regional and national municipal networks. Hosts regional network.	Heavily involved Heavily involved in regional and national municipal networks.	Involved in regional and national municipal networks.	Somewhat involved in regional network, but hardly on climate issues.
Involvement/membership of climate change issue networks (e.g., ICLEI, CoM, Climate Alliance)	++	++	+	—
Indicator:	Involvement multiple national and international climate networks (i.e., CoM). Also in adaptation issues.	Involvement multiple national and international climate networks (ICLEI). Also in adaptation issues.	Involvement a national climate network. Also in adaptation issues.	Not active.
<i>Influence exercised by higher government levels</i>				
Alignment with agendas of central and regional governments	+	—	+	++
Indicator: Sharing vision, goals, and strategic plans by central and regional governments	Aligns with goals, plans higher governments	Prefers a rather independent positions. Does not align goals and plan necessarily.	Aligns with goals, plans higher governments, especially with those of the provincial government.	Aligns goals and plans well with higher governments, but in other domains than climate change policy.
Presence of inter-governmental support schemes	+	+	+	—
Indicator: Municipality uses intergovernmental support scheme to build climate capacity and/or fund local projects. Financial sum of subsidy.	Municipality uses subsidies by national and provincial government.	Municipality uses subsidies from provincial government, EU. There is even a subsidy for adaptation.	The municipality uses a 1 M euro scheme from provincial government to build local capacity (with citizens).	The Municipality uses a subsidy from provincial government to finance an 'energy front office' so that citizens can get advice.
<i>Major external events</i>				
(geo-)political events	N/A	N/A	N/A	N/A
(geo-)physical events/natural disasters	N/A	N/A	N/A	N/A
Economic events	N/A	N/A	N/A	N/A
<i>Major external events were the same to the municipalities. We have no reason to believe that they had a serious impact on local climate policies and actions of the municipalities investigated.</i>				
<i>Intended climate action (output)</i>				
Installing EE and/or RES plants and infrastructure	+	++	+	+

Table A1. Cont.

	Enschede	Hengelo	Hof van Twente	Tubbergen
Indicator: Indicator: size and intensity of total set of mitigation projects (see Appendix F)				
Energy efficient behaviour (by local citizens and organizations)	N/A	N/A	N/A	N/A
Indicator: Citizens reached by awareness raising campaign who indicate to lower fossil energy consumption.				
Installing infrastructure to cope with extreme weather events	+/-	++	+/-	+/-
Indicator: size and intensity of total set of adaptation projects (see Appendix F).				
Outcome				
GHG emission reduction	N/A	N/A	N/A	N/A
Resilience	N/A	N/A	N/A	N/A
Co-benefits	N/A	N/A	N/A	N/A
No information was found regarding policy outcome in terms of the above mentioned criterions (except for predictions on GHG emissions, etc., which we deem not suitable as a reliable reflection of outcome indicators).				



## Appendix B. Climate Change Mitigation Policies in Enschede

Regarding commitment to its plans—in particular the ‘Nieuwe energie voor Enschede’ vision [98]—(claimed) achievements in a temporary evaluation report (2012) concerned: becoming a frontrunner in terms of energy-saving and a huge increase in green electricity production; having established more than 1200 sustainable houses by 2012; running pilot-projects that stimulate energy-neutral districts, sustainable schools and waste-separation; the municipal organization using renewable energy as energy supply, and is on its way to become energy neutral in 2015; recycling of Twence’s (a waste incineration company producing ‘renewable energy’) residual warmth to green energy has increased sustainable energy supply. In addition, 80 passive houses and near zero energy dwellings were constructed in 2012. Local government also tasked a project developer (‘Reimarkt’) to develop sustainable households and participated in citizen information projects. Local government also managed to install 1500 solar panels on its public buildings. The municipality also explored possibilities to set up a citizen-led energy cooperative in Enschede learning from best practices elsewhere in the Twente region (e.g., Energiek Vasse in Vasse, E.N.D. in Noord-Deurningen, ECHT in Hof van Twente). A trainee was tasked to further this policy action line. In the past municipal budget was used to help citizens set up local sustainability initiatives. Most municipal investments in local initiatives however were small in size and only concerned means for support in terms of information and communication.

## Appendix C. Climate Change Adaptation Policies in Hengelo

In the plans Hengelo’s citizens were mentioned in terms of citizen initiatives who can improve green-structures, increases awareness, increase use of sustainable roofs to contain water (and can serve as roof space for solar PV generated electricity). In addition, a broadened municipal sewer plan for 2013–2017 was formulated in 2012 from the legal obligatory duty to improve sewer and water facilities in order to deal with floods. In the coalition agreement for the 2014–2018 term the ambition is expressed to increase stream space and a more natural environment. A project called ‘the Climate Adaptive City’ aimed to inform citizens about current mitigation or adaptation actions. Hengelo currently participates in a project to find innovative rain water storage solutions. It recently constructed a ‘seasonal Wadi’, which is however a potential risk factor in relation to attracting malaria mosquitos.

## Appendix D. Climate Change Mitigation Policies in Hof van Twente

Local government policy focuses on sustainable construction, energy-saving, sustainable energy, sustainable agriculture, and mobility. In terms of renewable energy, there is a focus on local energy production, also offering co-benefits in terms of job creation. Pilot projects are initiated and investments are done in retrieving subsidy for energy and climate projects. With regard to sustainable construction, arrangements were made with housing associations for energy-efficient, climate-resilient buildings (new) houses. In realizing this, a national construction framework is used to assess each project on EPC-values (energy performance coefficient); performance of newly constructed dwelling should become 10%–20% more efficient than legal prescriptions. To stimulate sustainable mobility, each new municipal vehicle should have an environmental-friendly label, and preferably use renewable fuel. Research was conducted to explore possibilities for constructing a charger to support EV use. In addition, bio-fuels and alternative fuels from local tank stations were stimulated in deliberation with local gas station holders. Livestock holders are encouraged to produce biogas via co-digestion, and to establish wind turbines on their properties. Furthermore, a smart-meter implementation plan was envisaged in the five municipal districts having the highest energy consumption rates. Citizens living in these districts will be motivated with a competition where the district with the most energy-savings after one year, will receive a prize (in the form of a barbeque for the inhabitants which would be financed by local government).

In terms of energy production, renewable energy is stimulated by providing information, local government playing an exemplary role, offering low-interest loans to citizens and local firms,

and a start-subsidy for their local energy corporation. Bioenergy production from firing of wood is stimulated with an explorative business-case, and a facilitative role for citizen and company investment in wood stoves. Bioenergy production from manure processing is stimulated with a facilitative role with possible space in the municipal allocation plan. Wind energy is stimulated for small-windmills on local business terrains, but large-scale exploitation of windmills has insufficient council-support and will therefore not be stimulated. Geothermal energy is stimulated with an exploration of possibilities to formulate soil-warmth policy. Shale gas and coal gas are both discouraged due to uncertainty of profitability and its impact on the environment. Energy crops are neither stimulated, because agricultural land is scarce and prefers production of food, livestock, and fiber or bio-plastic supply. Energy-saving is stimulated with 350 'smart meters' for most energy-demanding five districts in collaboration with energy suppliers and energy cooperative, an awareness increase of energy-saving school material, and a policy plan, initiated from Hof van Twente's citizen panel, is formulated to realize more efficient street-lighting and lighting in municipal buildings for the 2013–2018 term. Thermal insulation of dwellings is stimulated with more focus on house-owner awareness, minimizing most energy-demanding five city districts, and active stimulation to participate in the energy fund that facilitates citizens in realizing sustainable measures. The uncertainty of feasibility, profitability, and affordability that characterizes climate-related projects and initiatives, make it extra important for the municipality to have a municipal council that is committed to implement climate policy. Hof van Twente has a municipal council that continuously supports the sustainability agenda and also initiates ideas, which create fruitful, positive internal dynamics.

#### **Appendix E. On the Role of Local Government in Tubbergen vis-à-vis Climate Change Mitigation**

The municipality of Tubbergen plays several roles to improve climate change mitigation. An informative role is played in which the municipality has set up an energy-panel to increase sustainability living awareness amongst the public. The municipality is also an informant of the impacts and solutions with regards to climate change informs citizens and companies of currently available subsidy-programs, and advises how buildings can be exploited more cost efficiently with the use of sustainable energy. The municipality also plays an intermediate, facilitating role in which the municipality uses its network to help, for example local citizens' energy cooperative 'Energiek Vasse', deal with smart-grid legal obstacles by involving Cogas (DSO) and research institutions in the process. A platform called 'Oans' was established to facilitate citizen participation, which allows citizens to share their climate-oriented ideas with the municipality, which creates more potential for the municipality to implement citizen-supported ideas that help Tubbergen deal with climate change. Furthermore, the municipality of Tubbergen plays an exemplary role with the construction of solar-panels on the municipality building's roof, the decision to make public sport-accommodations climate-neutral, and investments in sustainable living awareness in response to outcomes of an energy audit. The municipality of Tubbergen also plays several roles to improve climate change adaptation. An informative role is played in which a, legally mandatory, water-panel has been set up in response to their published sewer-plan.

## Appendix F. Overview of Projects per Municipality Differentiated between Adaptation and Mitigation

**Table F1.** Climate projects per municipality.

	Enschede	Hengelo	Hof van Twente	Tubbergen
Mitigation	<ul style="list-style-type: none"> <li>- Pilot project energy neutral districts (e.g., “Bothoven-Noord”)</li> <li>- Passive housing</li> <li>- Thermal insulation (social) housing</li> <li>- District heating</li> <li>- Sustainable municipal car fleet</li> <li>- Bio-energy production Twence (indirectly)</li> <li>- Energy efficiency appliances in municipal-owned buildings</li> <li>- Solar PV panels on rooftops local households</li> <li>- 1500 solar PV panels on rooftops municipal-owned buildings</li> <li>- &gt;1200 “sustainable” dwellings</li> <li>- “Sustainable” schools</li> <li>- Installation of charging stations for EVs</li> </ul>	<ul style="list-style-type: none"> <li>- Pilot project smart grids (e.g., “Twenthe kanaal”)</li> <li>- District energy project “Hart van Zuid” with connection of 450 households to district heating.</li> <li>- Solar PV panels on rooftop town hall.</li> <li>- Thermal insulation (social) in 1000 dwellings</li> <li>- Sustainable housing</li> <li>- Pilot project</li> <li>- District heating (including biogas inf.)</li> <li>- Sustainable municipal car fleet</li> <li>- Bio-energy production Twence (indirectly)</li> <li>- Energy efficient street lightening (LED)</li> <li>- Energy efficiency appliances in municipal-owned buildings</li> <li>- Solar PV panels on rooftops local households</li> <li>- 250 self-sufficient energy households</li> <li>- Installation of 16 charging stations for EVs</li> </ul>	<ul style="list-style-type: none"> <li>- Pilot project</li> <li>- Solar PV park business park “Zenkeldamshoek”</li> <li>- Installation of small-sized wind farms in business parks</li> <li>- District heating (including biogas inf.)</li> <li>- Sustainable municipal car fleet</li> <li>- Smart metre installation in 350 households in 5 city districts</li> <li>- Bio-energy production Twence (indirectly)</li> <li>- Energy efficient street lightening (LED)</li> <li>- Energy efficiency appliances in municipal-owned buildings</li> <li>- Solar PV panels on rooftops local households</li> <li>- Construction of sustainable housing.</li> <li>- Biogas production by local livestock holders.</li> <li>- Installation of charging stations for EVs</li> </ul>	<ul style="list-style-type: none"> <li>- Solar PV park on rooftop community building Vasse.</li> <li>- Solar PV panels on rooftop town hall.</li> <li>- Smart metre installation</li> <li>- Bio-energy production Twence (indirectly)</li> <li>- Energy efficient street lightening (LED) Energy efficiency appliances in municipal-owned buildings</li> <li>- Solar PV panels on rooftops local households</li> <li>- Biogas production by local livestock holders.</li> <li>- Installation of charging stations for EVs</li> </ul>
Adaptation	<ul style="list-style-type: none"> <li>- Conservation of nature areas (with retention capacity; e.g., Airport Twente)</li> <li>- City-stream (waterway in city districts)</li> <li>- Adjusted sewer system.</li> </ul>	<ul style="list-style-type: none"> <li>- Conservation of nature areas (with retention capacity)</li> <li>- “Seasonal Wadi” (retention waterway)</li> <li>- Grass rooftops (no-regret option)</li> <li>- Adjusted sewer system</li> <li>- Adjusted spatial issues (like roads, retention areas)</li> <li>- Development of “collective gardens” (for urban farming and retention).</li> <li>- City-stream/urban water projects (waterways in city districts and peripheral areas).</li> </ul>	<ul style="list-style-type: none"> <li>- Conservation and development of of nature areas (with retention capacity)</li> <li>- Adjusted sewer system</li> </ul>	<ul style="list-style-type: none"> <li>- Conservation of nature areas (with retention capacity)</li> <li>- Adjusted sewer system</li> <li>- Re-utilization of old business areas for retention purposes.</li> </ul>

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