Mitigating Climate Change at a local level

A study to allocate national sustainability targets into feasible and measurable local targets

Master Thesis
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Colophon

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Abstract

In order to mitigate climate change, measures at all levels of governance are required. The Netherlands has formulated the Energy agreement in order to reduce the carbon emissions. This is subsequently implemented by provinces and municipalities. As a couple important national objectives are probably not achieved. This study therefore identifies how the targets to reduce CO_2 emissions at a local level can be improved in order to contribute to the national targets.

This research first identifies which measures are currently described by the executive agreements of municipalities. Afterwards, additional climate programs are used to determine how these targets are implemented, measured and monitored. Following from these results a general overview of the current contribution of municipalities has been given. These steps of the analysis reveal that there is a general commitment for sustainable development and CO_2 emission reductions. Nevertheless, the way in which actual measures will be implemented is often unclear due to a lack of quantified targets. This research therefore proposes adaptations to create feasible and measurable targets at a local scale which subsequently has resulted in a framework with improved steps.

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Executive Summary

Climate change, which is mainly caused by the continued emissions of greenhouse gasses, is a major issue at all levels of governance. The Netherlands responses to the climate change risks by drafting the Energy agreement wherein the government aims to reduce CO_2 emissions with 20% in 2020, supported by a share of 14% sustainable energy sources and an annual reduction of the final energy use with 1.5%. In order to achieve these goals, provinces and local authorities are required to set measures. Nevertheless it seems that a couple main goals of the government will not be achieved by 2020. A cause for this might be the barriers experienced by local authorities to actually define and implement measures.

This study seeks to provide steps to improve the feasibility and thereby the measurability of local targets for the municipalities in the Netherlands. With the use of executive agreements it has first been determined which targets regarding the reduction of CO_2 emission are currently formulated by the municipalities. This resulted in a set of targets including the categories energy savings & energy efficiency, renewable energy, sustainable transport and waste heat. These categories are further examined on the differences and similarities for all municipalities which mainly shows in general a high commitment regarding sustainable development, accompanied with an decreasing interest in more detailed and quantified measures. As the executive agreements did not provide enough detailed information, additional climate programs of the 50 largest municipalities regarding citizen and area were collected and analyzed.

The research continued with identifying how the quantified targets are implemented, measured and monitored. To be able to implement the measures, the municipalities in general cooperate with citizens and entrepreneurs, housing corporations and several businesses. Another detected aspect are the relatively low amount of quantified targets. Notwithstanding, it has been noticed that municipalities with a high amount of citizen have more often a quantified target compared to municipalities with a large area. With the use of the obtained quantified targets this study furthermore provides insight in the contribution of municipalities to the national objectives. Although most of the quantified formulations were not suitable, the municipality Arnhem proved to be useful in order to determine the contribution to the energy saving and wind energy target. Wind energy has additionally been elaborated which revealed that the current targets are not enough to achieve the national target.

This study subsequently builds upon the existing framework by Reed et al. (2006) in order to propose adaptations to improve local targets in way that does contribute to the national objectives. This resulted in a framework with several steps including: define the system boundaries and stakeholders, establish cooperations with stakeholders, specify goals at national and local scales, establish quantitative targets and establish a monitoring system. In order to create quantitative targets it has been recommended to define requirements to implement sustainable measures. Subsequently, these requirements should be linked with the system boundaries of the municipality. Afterwards the monitoring system can be applied to monitor the progress of a measure and to adjust the strategies if necessary. The created framework is therefore established in an iterative way.

By reflecting the research some shortcoming were detected. These limitations are mainly related with the available information and the way of interpreting the targets. This study therefore recommends future research to obtain more quantitative information regarding the formulated targets, to expand the categories and to apply more relevant variables that could influence the implementation of sustainable measures. With this study it can thus be concluded that adaptations at a local level are required to achieve the national targets which is highly recommended towards a more sustainable future.

Table of Contents

List of abbreviations

GDP	=	Gross Domestic Product		
GWh	=	Gigawatthour	=	10^6 Kilowatthour (KWh)
Kton	=	kiloton	=	10^3 ton
MW	=	Megawatt	=	10^6 Watt
PJ	=	Petajoule	=	10^{15} Joule
TJ	=	Terajoule	=	10^{12} Joule

1. Introduction

1.1. Societal Background

Heat waves, heavy rainfall and sea-level rises are a couple impacts on future ecosystems and people that will occur more often as a consequence of climate change. Underlying causes for this climate change are the ongoing emissions of greenhouse gasses due to an increasing population size, welfare growth and [1]energy and [2]carbon intensity (Andrews & Jelley, 2013). In this context, limiting the risks of climate change asks for a reduction of carbon emissions which can be achieved by reducing the carbon intensity and by improving the energy intensity. In order to achieve these measures adaptation strategies at all levels of governance are requires (IPCC, 2014).

In response to the risks of climate change the European Union has established an overarching framework to encourage a smart, sustainable and inclusive growth of the economy towards 2020. This so-called "Europe 2020" strategy entails a reduction of greenhouse gas emissions by at least 20% compared to 1990 which is supported by an increased share of renewable energy up to 20% and an increase of the energy efficiency by 20%. In order to realize these goals the Member States are responsible to implement corresponding targets into their national legislation (European Commission, 2010). The Netherlands for example have responded to the Europe 2020 strategy with the implementation of the 'Energy agreement for sustainable growth' (i.e. Energieakkoord) (SER, 2013). The main target of this energy agreement is a reduction of CO_2 emissions with 20% compared to 1990 which is supported by a share of 14% sustainable energy sources and a reduction of the final energy use with 1.5% annually (resulting in 100 PJ additional energy savings by 2020) (SER, 2013).

Although this reduction of greenhouse gas emissions and climate adaptations is encouraged by global agreements and national climate policies, the actions taken are mainly local efforts by local institutions, municipalities and individuals (Lindseth, 2004). One of the reasons for these local efforts is the responsibility of municipalities regarding local activities with potential emissions of greenhouse gasses, ranging from public lighting to energy consumption in public buildings. Another reason is that local authorities have a close relation with citizens which is favourable to establish a degree of support. Furthermore, local authorities are responsible for many other areas of climate policies, such as town and country planning, the construction of buildings and transport related aspects. The approach of local authorities towards climate policies is subsequently dependent on the national, political and institutional context of the country (Coenen & Menkveld, 2002). Additional support to implement sustainable energy policies at a local level has been provided by several programs, for example the Covenant of Mayors, which was launched by the European Commission in response to the 2020 strategy (Covenant of Mayors, 2016).

1.2. Scientific Background & Knowledge gab

Before dividing the European targets in a fair manner among countries, several aspects should be considered. For example, the European Commission has divided the 20% renewable energy target by taking the starting point, the renewable energy potential and the energy mix of each Member State into account (European Council & Parliament, 2009). This has resulted in a 14% renewable energy target for the Netherlands, which will be further implemented by the provinces and municipalities (SER, 2013). Subsequently, the allocation of national targets into local targets has resulted in general formulations associated with CO_2 reductions defined in the executive agreements and additional

[1] Energy intensity involves the energy per unit of GDP (Andrews & Jelley, 2013)
[2] Carbon intensity is related to the CO_2 emissions per energy consumed (Andrews & Jelley, 2013)

climate policies of municipalities. These local targets should therefore contain feasible measures in order to contribute to the targets at a national scale.

Although a number of previous studies recognise the emerging importance of locally implement climate change measures, these studies also indicate barriers and limitations experienced by local authorities to implement the national targets at a local scale (Davies, 2005; Bulkeley & Kern, 2006; Wilson, 2006). One of these barriers is the lack of professional, technical and political support. Another barrier which has been noticed is the dominance of other conventional policy objectives and the lack of local power and resources to implement measures (Wilson, 2006). A more fundamental limitation, which has been described by Lindseth (2004), is that framing climate change as a local issue might pose the impression that the problem could be 'solved' at a local level. Notwithstanding, measures to reduce greenhouse gas emissions are often beyond the ability of local authorities, for example the municipality has not the ability to change the electricity mix of the municipality, implement energy efficient devices in households, change the emitted greenhouse gas emissions by vehicles and to implement CO_2 reduction measures at large energy consuming industries (SER, 2013).

Moreover, not all national targets equally relevant for municipalities. Each municipality has several characteristics that should be considered while composing a target e.g. available area, amount of residents, house types and the presence of various types of industry. As a result of the barriers and limitations, the coherence in which the local targets are currently derived from the national targets is often unclear. A shortcoming of this lack in coherence is that it has become more difficult to determine the contribution of each municipality to the national objectives. Furthermore, despite the national, provincial and local efforts, the national targets of the Netherlands to raise renewable energy up to 14% and to obtain 100 PJ of energy savings will probably not be met (ECN, 2015). On the other hand, the targets to reduce greenhouse gasses and to raise the energy efficiency are likely to be achieved (ECN, 2015). These aspects indicate that additional tools to establish feasible local targets with practical measures and projects within the possibilities of local authorities are required to contribute to the national sustainability targets.

Previous research, such as the IPO report, has already formulated a tool for the Netherlands by drawing policy deployment for provinces regarding sustainable energy. This has resulted in a sustainable energy matrix wherein the national sustainable energy targets are divided per province (IPO, 2010). However, this previous research has only provided tools for national and provincial governments and has not considered tools at a municipality level. Thereby has this report only focussed on sustainable energy, whereas the Dutch energy agreement also provides targets on energy efficiency and other CO_2 reduction measures.

1.3. Research Objectives

Following from the societal and scientific background, this thesis will focus on the municipality level of the Netherlands regarding the main target to reduce CO_2 emissions, including the associated targets to raise renewable energy and to improve energy efficiency and energy savings. This leads to the following research question:

> *How can the national targets for CO_2 reductions, renewable energy and energy efficiency & energy savings be implemented in order to create feasible and measurable targets for municipalities in the Netherlands?*

To answer this research question the next sub-questions will be applied:

1. **Which targets regarding CO_2 reduction measures are formulated by the all municipalities?**
   As there are many measures to reduce the CO_2 emissions e.g. renewable energy sources, energy efficiency and energy savings, the first sub-question will identify which measures are most often applied. This will be determined with the use of a selection of municipalities in order to determine the exact scope of the thesis. Defining this for all municipalities will subsequently provide a structured overview of all proposed targets. This results in a database which will be applied in the next parts of this thesis.

2. **Which differences and similarities with regard to the selected targets can be defined between the municipalities?**
   To be able to compare the municipalities and provinces with each other, the previous obtained data will be used to define similarities and differences. It furthermore shows which national targets are most often allocated into local targets. These aspects will be determined for all municipalities.

3. **How are the selected targets currently implemented, measured and monitored?**
   After identifying the differences and similarities, this sub-question will examine the formulation of the proposed targets in more detail. This part elaborates on 50 selected municipalities to show in what way the targets are quantified and how these CO_2 reduction measures are implemented. Hereby it should be taken into account that not all municipalities formulated or quantified a target. Afterwards it will be determined how the municipalities monitor the progress of implemented measures.

4. **How do the proposed targets of municipalities in general contribute to the national targets?**
   Following from the previous sub-questions it can be determined if it is possible to derive the contribution of a municipality to the national targets. A quantified target does not directly imply that it is possible to determine this contribution. This sub-question therefore examines how much the municipality contributes in general and which municipal targets are feasible.

5. **What adaptations can be proposed to improve the targets of municipalities?**
   A subsequent step is to apply the obtained knowledge to achieve more feasible and measurable targets regarding the selected CO_2 reductions. The theory by Reed, Fraser & Dougill (2006) will be applied to establish improved steps regarding local sustainability targets. These feasible and measurable steps contribute to allocate the national targets into useful local targets. This might result in an improved implementation of CO_2 reduction measures which supports the societal problem of mitigating climate change.

1.4. Research Outline

In order to answer the research question as well as the related sub-questions, this report is structured as follows:

The next section of this thesis provides the background information about the Netherlands. This part furthermore provides an overview of the power and tasks of the municipalities and presents an outline of existing frameworks to improve sustainability targets. The third section of this thesis is the method in which the methods used to answer the sub-questions will be discussed. The results will be presented from Chapter Four, this chapter will identify which targets are currently proposed by all municipalities. This information will be elaborated in Chapter Five in order to determine how the targets of 50 municipalities are implemented, measured and monitored. In Chapter Six, it will be strived to determine the contribution of the municipalities to the national targets. These results will subsequently be used to identify improvements for the sustainable targets of the municipalities. This part will be followed with a discussion about the method, where limitations will be discussed and recommendations for future research will be suggested. The final chapter of this thesis is a conclusion that contains the answer to the main research question.

2. Theoretical Background

In order to provide information about the current situation in the Netherlands, this chapter will first give a general overview of relevant aspects with regard to the Netherlands and the municipalities. Afterwards, the power and tasks of the municipality regarding the reduction of CO_2 emissions will be defined. This will be followed by an outline of existing frameworks to improve sustainability targets.

2.1. Topographical information of the Netherlands

The Netherlands is a relatively small country in Western Europe, located between Germany at the east, Belgium in the south and the North-Sea at the west. With a total area of 41,543 km^2 and approximately 16,9 million residents, the country is one of the most densely populated countries in the world ([2]CBS, 2016). The country is divided in 12 provinces which are in turn sub-divided into 390 municipalities as shown in figure1. The population of the Netherlands is not equally distributed over the 12 provinces in. Most highly populated areas can be found in the western provinces Zuid-Holland, Noord-Holland and Utrecht which is featured by figure 2a. This figure furthermore reveals that the municipality Amsterdam, which also contains the capital of the country, is the largest municipality in the Netherlands with 821,752 citizens. Other municipalities with a rather high amount of citizens are Rotterdam, Den-Haag and Utrecht ([2]CBS, 2016). In contrast, the high amount of residents in these municipalities does not correlate with the amount of area. The largest municipalities with respect to area can be found in the provinces Drenthe, Flevoland, Friesland and Zeeland which is indicated by figure 2b. The average amount of area in these municipalities is 250 km^2, whereas the average municipality in the Netherlands has an area of 106 km^2 ([2]CBS, 2016).

Figure 1 - The distribution of the Netherlands in provinces and municipalities. Source: (Ketelaars, 2015)

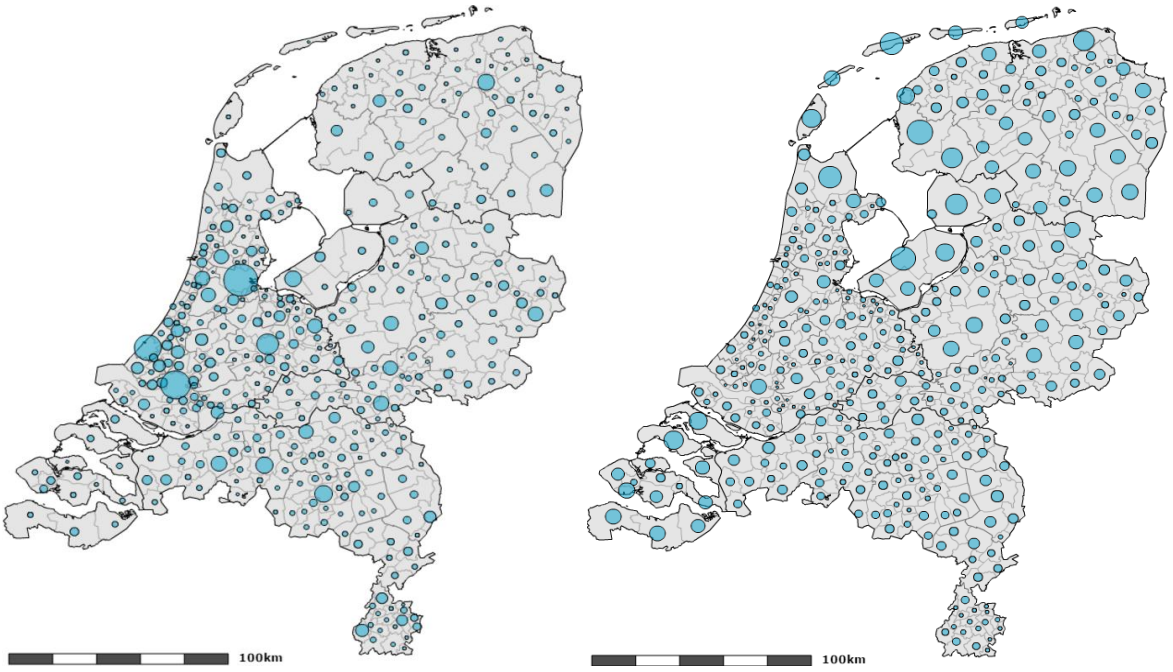

Figure 2a. (left) - The distribution of the amount of citizen for each municipality in the Netherlands in 2015. 2b. (right) - The distribution of the amount of area for each municipality in the Netherlands in 2015. Source: [2]CBS, (2016).

2.2. Energy consumption of the Netherlands

The Netherlands has a developed economy with a relatively large GDP compared to other countries in Europe (Eurostat, 2016). Almost 69% of this GDP is retrieved with the value of export products and services ([6]CBS, 2016). The economic recession of 2008 reduced the size of the economy and also influenced other related factors such as the energy consumption (ECN, 2015). The first signs of economic recovery appeared in 2014 and this trend of economic growth continues gradually. This in contrast with the [3]final and [4]primary energy consumption of the Netherlands which has slightly reduced over the last years. It is thereby expected that this reducing trend continues towards 2020 (ECN, 2015). A main cause for this lower energy consumption is the reduced demand for energy in industrial, agricultural and transport sectors. The residential area on the other hand remained fairly constant due an increased electricity consumption and a lower heat demand (ECN, 2015). This resulted in an electricity consumption of 3050 kWh in 2015 and a gas consumption of 1200 m^3 which subsequently turns into a final energy consumption of 1806 PJ ([5]CBS, 2016).

This consumption of electricity and gas is relatively constant between the municipalities of the Netherlands, although private owned buildings consume on average more electricity compared with rental buildings ([3]CBS, 2016). This energy is mainly generated with the use of fossil fuels, although a small transition in primary energy fuels might be expected. Figure 3 reveals that the amount of fossil fuels, represented by the gray and black colours in the figure, slightly reduce towards 2030. In contrast, the green colour in the figure indicates that the amount of renewable energy sources will slightly increase (ECN, 2015). This implies that the carbon intensity (CO_2 emissions per energy consumed) in the Netherlands will slightly improve. Nonetheless, the current amount of renewable energy in the Netherlands is approximately 6% which is quite low compared to other European countries (ECN, 2015). As indicated by table I, this amount of renewable energy is mainly generated

[3] *Final energy* use refers to all energy supplied to the final consumer for all energy uses such as electricity, natural gas and heat (IEA, 2016).
[4] *Primary energy* implies the direct use of energy at the source, or supplying users with crude energy which has not been subjected to any conversion like crude coal, oil and gas (IEA, 2016).

with the use of biomass and wind energy. Hereby it should be noted that there are several options for applying biomass for example as an auxiliary in power plants, companies and households or as liquid bio-based transport fuels and biogas, whereas wind energy is mostly obtained with on-shore wind farms ([4]CBS, 2016).

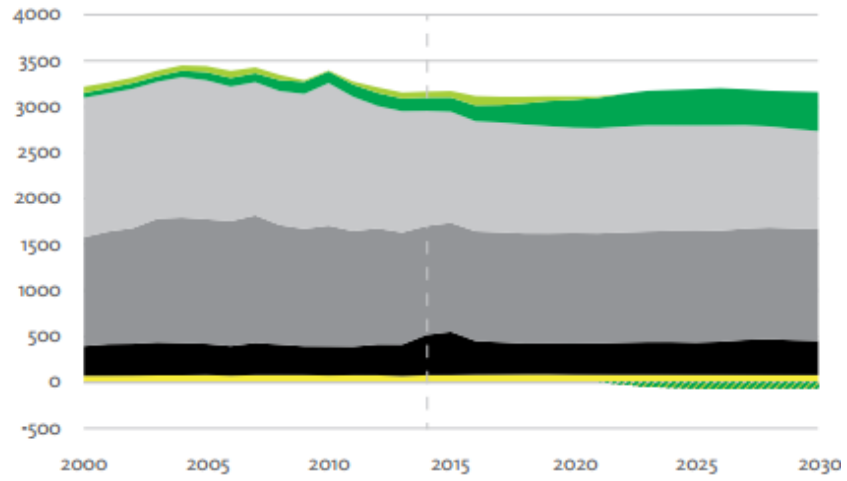

Figure 3 - The current and expected primary energy consumption per energy source in PJ in the Netherlands. Source: ECN, 2015.

Table I - Renewable energy in PJ avoided primary energy in the Netherlands. Source: [4]CBS, (2016).

Renewable energy source	Percentage renewable energy
Hydropower	0,6%
On-shore wind energy	28,6%
Off-shore wind energy	4,3%
Solar power	4,5%
Solar heat	0,8%
Geothermal heat	1,0%
Total geothermal warmth (heat/cold storage)	2,1%
Outdoor air heat	0,2%
Total Biomass energy	57,9%

Wind energy is therefore seen by the government as an important source to reduce the CO_2 emissions. However, although wind energy is a suitable source of generating renewable energy, the municipalities have to deal with controversies about environmental impacts and public acceptance (Andrews & Jelley, 2013). Similar to wind energy is also solar energy, generated with the use of photovoltaic (PV) cells, seen as a desired fossil free option. (Andrews & Jelley, 2013). In order to implement both renewable energy options, a couple aspects that can influence the potential energy generation need to be taken into account. For example resource characteristics (solar/wind regime), geographical characteristics (land use, land cover, citizen or residential density) and other aspects such as techno-economic (scale, costs) and institutional factors (policy regime, legislation) (de Vries, van Vuuren & Hoogwijk, 2007). It is important that such characteristics are considered during the analysis of this thesis in order to identify if a municipality is suitable to implement a renewable energy measure. Moreover, as shown in figure 4 the contribution of renewable energy sources currently fluctuates per municipality. Despite of the fact that there are municipalities with more than 400 TJ renewable energy, most municipalities in the Netherlands generate lower amounts of renewable energy (Rijkswaterstaat, 2016). This indicates that efforts are required to raise the amount of renewable energy in order to comply with the national target.

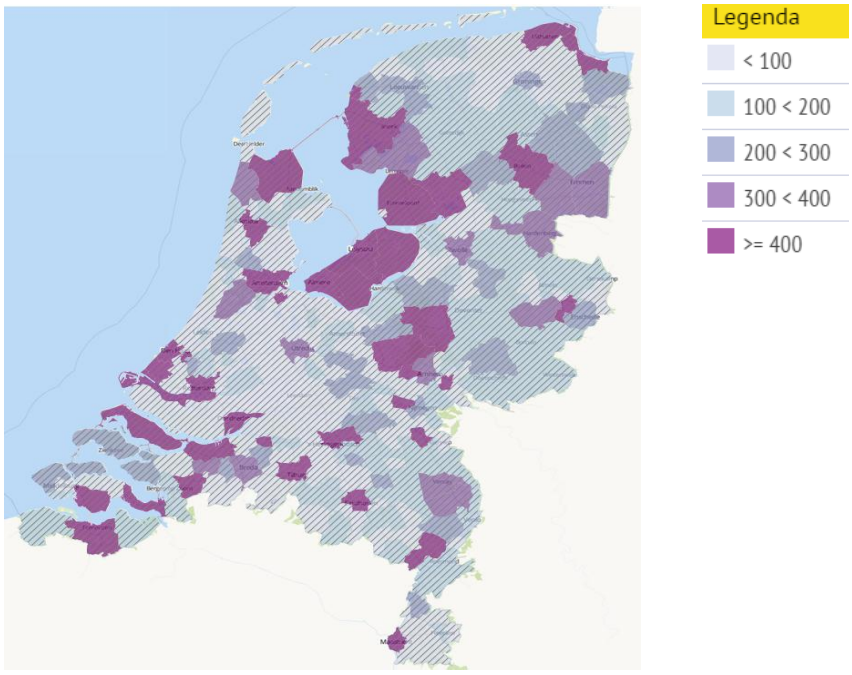

Figure 4 - Total renewable allocated energy options in TJ per municipality in 2013. Source: Rijkswaterstaat, (2016)

Although, the energy exploration of the ECN (2015) expects that the amount of renewable energy increases and the energy consumption slightly decreases, it cannot be concluded that this results in a more energy efficient economy. In order to become more energy efficient, the energy intensity (energy per unit of GDP) should be taken into account. This can be improved with the use of energy efficiency and energy saving measures. Energy efficiency measures are attempted to fulfil human needs with a minimum amount of energy. Such efficiency measures can be obtained through improvements in technology, for example replacing incandescent light bulbs by LED lights, reducing heat losses through surfaces and implementing efficient boilers (Blok, 2007).

Energy savings on the other hand are applied to reduce the consumed amount of energy and to reduce the amount of greenhouse gasses as a consequence of generated electricity. Most energy savings can be obtained in the industry, building and transport sectors. An example to achieve these savings is by stimulating lifestyle changes such as using public transport instead of driving a car (Andrews & Jelley, 2013). Another example is by improving the energy label of buildings. An energy label is an indicator of the energy performance of a house, although it might also be applied for electric appliances and cars. This performance is expressed in classes from A (efficient) to G (inefficient) which might be improved with adaptations like isolation measures, double glass and solar panels (Rijksoverheid, 2015).

2.3. The power and tasks of municipalities

The Netherlands currently accounts for 4% to the total carbon emissions of the European Union ([7]CBS, 2016). In order to comply with the European 2020 strategy, the main target of the Netherlands is to reduce the CO_2 emissions with 20% compared to 1990. This is supported by a share of 14% renewable energy and an improvement of the final energy use by 1.5% annually which results in 100 PJ additional energy savings by 2020 (SER, 2013). In order to achieve the national goals and to implement measures, the government cooperates with other parties including provinces and municipalities, electricity and housing corporations (SER, 2013). Each of these actors have different powers and tasks in order to implement sustainable measures. This study will further examine the measures at a local level and therefore this paragraph elaborates on the power and tasks of the municipalities.

The context of the Dutch constitutional system can be labelled as a decentralized unitary state. This implies that there is a certain agreement between the national government, provinces and municipalities. In this system, the 390 municipalities have a constitutional power with a certain amount of freedom. This enables municipalities to deal with matters of local concern along the legislation of higher authorities (Coenen & Menkveld, 2002). The municipality is mainly responsible for tasks with a direct importance for citizens such as public administration, health, education and waste management (Bulkeley & Kern, 2006; [1]Rijksoverheid, 2016). Besides these areas the municipality is responsible for the construction and maintenance of roads, the regulation of municipal estate, the accommodation of schools and regulating the 'Wet milieubeheer' which obliges provinces and municipalities to adopt energy saving measures with a payback time of five years or less (SER, 2013).

The municipality is assumed to derive local targets from the national objectives. In order to implement these targets, the municipality has to collaborate and cooperate with various departments in the local administration such as building and infrastructural management, mobility and transport, land use and spatial planning and economic and social affairs (Covenant of Mayors, 2016). Moreover, the municipalities can receive support from several transnational municipal networks for climate protection that endorse local authorities to implement sustainable policies (Bulkeley & Kern, 2006). One of these programs is the Covenant of Mayors for Climate & Energy. This program was launched by the European Commission and has created a network of local and regional authorities to develop action plans and to provide direct investments towards climate change mitigation measures (Covenant of mayors, 2016). Participating in such a program creates benefits for local authorities, for instance through practical support with guidance material and tools, financial opportunities, innovative ways to network and a high international recognition (Covenant of mayors, 2016). Nevertheless, there are currently only 17 municipalities in the Netherlands participating in this program (Covenant of mayors, 2016). Besides this Covenant of Mayors program, there are other international projects that stimulate climate adaptations for instance the ICLEA, Energy Cities and Euro Cities (ICLEA, 2016; Energy Cities, 2016; Euro Cities, 2016).

2.3.1. Modes of governance

The power of municipalities to reduce carbon emissions can be combined within several modes of governance including governing the own activities, providing resources and services, applying regulations and directions or facilitating, coordinating and encouraging initiatives of citizens and local energy cooperations (Bulkeley & Kern, 2006). These forms of governance contain a certain scale of direct and indirect measures regarding energy and transport which is presented by table II. On the one hand, governing the own activities is mainly achieved with directly implemented measures with the purpose to abate carbon emissions. For instance the municipality can directly influence the energy consumption of the municipal estate by enhancing energy saving and energy efficiency measures. This in contrast with measures that facilitate or encourage businesses and citizen to implement carbon reduction measures. In this context the municipality has no influence on the actual implementation of these measures which makes it harder to determine how much energy savings are actually achieved.

Moreover, there are several ways in which the municipality can act to facilitate or encourage these measures. For instance the municipality can act as a coach, facilitator, provider of services, participant or co-producer. These roles are not static, but may evolve over time (Rijkswaterstaat, 2013). As a coach, the responsible official of the municipality will have conversations with the initiators and critically looks into the plans and success rate of the project. If the initiative got enough potential, the municipality can act as a facilitator by providing resources such as conference rooms or relevant contacts (Rijkswaterstaat, 2013). According to SER (2013), municipalities mainly act as a facilitator regarding the design and implementation of energy savings and regarding energy generation at a local and regional scale. This requires an integrated approach, for example by providing facilities for local heat networks, heat and cold storage, decentralized generation of energy and cooperation with companies.

The municipality can also deploy its power by providing services during licence procedures, stimulating communication with citizens and by actively searching for sufficient locations for solar or wind energy (Rijkswaterstaat, 2013). If the cooperation continues, a municipality can become involved in the project as a participant. This implies that a municipality becomes a member of the organization in order to contribute and encourage the project. Being a co-producer is the most intensive cooperation between a municipality and a particular initiative. In this case the municipality commits itself to the initiative in order to realize the municipal targets. During this co-operation a clear division of tasks is established. Examples of such co-operations are: establishing a sustainable energy company with significant power and tasks for the company, creating a joint venture to realize a wind farm or to develop a stakeholder approach for energy efficient renovations of buildings in the municipality (Rijkswaterstaat, 2013).

Table II - Carbon reduction measures within the different modes of governance. Partly based on Bulkeley & Kern 2006

Governing own activities	Applying regulations and directions	Providing Resources & Services	Facilitate, coordinate & encourage
Energy			
Energy efficiency schemes within municipal buildings (e.g. schools) & improve energy labels	Strategic planning to enhance energy conservation	Energy efficiency measures in council housing	Campaigns for energy efficiency
Purchasing green energy	Supplementary planning guidance on energy efficiency design and renewable energy		Provide advice on energy efficiency to businesses and citizens
Procurement of energy efficient appliances	Assign locations & supply permits for on-shore wind energy projects		Promote the use of solar energy among citizen
Exemplary role regarding renewable energy projects			Cooperate with housing corporation to improve the energy labels
Transport			
Green travel plans	Reduce the need to travel through planning policies	Public Transport Service	Education campaigns on renewable energy and energy efficiency
Mobility management for employees	provide infrastructure for alternative forms of transport	Improve cycling facilities	Quality partnerships with public transport providers
Sustain the municipal car fleet			
Planning			
High energy efficiency standards in new buildings			Provide guidance for architects and developers on energy efficiency
Use of renewable energy in new council buildings			Provide guidance for architects and developers on renewable energy

2.3.2. Specific power of Dutch municipalities

The climate action programs can contain several aspects to reduce CO_2 emissions. For example, the municipality can formulate a target to become climate neutral. Climate neutrality in this case implies that the municipality compensates all emissions in order to emit net zero CO_2 emissions over a year. This can for example directly be achieved with the use of energy savings in municipal building, the procurement of energy efficient appliances and higher energy efficiency standards in public buildings. But it could also be achieved with indirect measures for instance by facilitating services regarding energy savings and renewable energy (Bulkeley & Kern, 2006). As described in the previous chapter, most energy savings can be obtained in the industry, transport and building sectors. The municipality has barely influence on the industry sector as the energy and industry sectors are covered by the European Emission Trading Scheme (EU-ETS). This is in contrast with the transport, building, service and agricultural sectors, which have to comply with the Effort Sharing Decision. The Member States are responsible to set policies and create measures to reduce the required amount of emissions for these sectors (EC, 2008).

These created measures will be further allocated among regional and local authorities and therefore the municipality has influence on the transport and building sectors. To realize energy savings in the transport sector the municipality can for instance stimulate sustainable transport. One can think about measures to improve cycling facilities and electric charging points or to sustain the municipal car fleet to reduce emissions by fossil fuels (SER, 2013). The municipality furthermore acts as an advisor for the building and installation sector. This can result in more energy efficient houses and in an increase of decentralized renewable energy options e.g. solar energy (SER, 2013). With these measures the energy labels of households will be improved which is necessary to comply with the national objective. This national objective involves an annual improvement of two label steps at 300.000 existing buildings and an average label B at corporation houses in 2020. Furthermore, 80% of the buildings rented by private landlords are expected to have energy label C in 2020. Additionally, new buildings should almost be energy neutral in 2020 and municipal buildings are expected to be energy neutral at 2018 (SER, 2013).

The municipalities also have some specific power concerning wind energy. The national government is in first place responsible for granting regulations and legislations regarding large scale wind farms (>100MW). The aim of the government is to facilitate 8 million households with on -and off-shore wind energy by 2020. Together with provinces the government assigns locations for large scale wind projects of at least 100 MW. Locations for projects with less than 100 MW are determined by provinces and municipalities ([2]Rijksoverheid, 2016). Locations for projects with less than 100 MW are determined by provinces and municipalities ([2]Rijksoverheid, 2016). The province and municipalities can stimulate wind energy by providing and maintaining permits to particular projects. Every province has its own wind energy policy and this has resulted in the spatial regional plans of municipalities. The municipality plays an important role regarding the realization of wind energy. Their main tasks are assigning locations for wind energy, supplying permits and evaluation criteria and maintain existing wind farms. The municipality is furthermore provides information to raise support among citizen (RVO, 2016).

Solar energy is also stimulated by the national government. For example energy tax reductions are in place for citizens that generate solar energy and the SDE+ regulation is accessible for large scale solar energy projects. Households are furthermore allowed to redeliver the generated energy into the energy grid and can expect a compensation when there is more energy generated than consumed. Licenses for solar panels are provided by municipalities if the installation of solar panels does not fit within the

zoning plans of the municipality ([3]Rijksoverheid, 2016). The municipality is furthermore able to stimulate solar energy among citizen by providing information (SER, 2013).

2.4. Previous research on targets setting frameworks

The last part of this research will consider which steps are required to improve the feasibility and measurability of the formulated targets by the municipalities. It is therefore relevant to determine which previous steps are already taken to improve sustainable targets at a local level. Although, there is currently not an existing framework with direct improved feasible and measurable steps, there are already previous studies that putted effort in the design of a stepwise approach that measures and facilitates the progress towards sustainability aspects.

For instance, Reed, Fraser & Dougill (2006,) Quaid (2002) and the United Nations (2010) all describe theories that provide guidelines on setting targets regarding sustainability. The United Nations (2010) provides guidelines on setting targets related to water and health issues. Nevertheless, the framework is quite general and might therefore also be applied to other areas of governance. Most important aspects that are highlighted by this framework are to identify of stakeholders, provide a baseline analysis and identify problems, agree on draft and final targets, implement measures and review and asses the progress. In contrast with the framework of the United Nations, Quaid (2002) specifically looks into municipal processes towards sustainability. This resulted in a couples steps including establish an effective and participatory process, conduct a sustainability inventory, set a community sustainability vision, develop and implement a sustainability action strategy, and monitor and evaluate the progress.

The most elaborated framework that guides the identification potential adaptations at a local level is provided by Reed et al. (2006). This research applies sustainability indicators based on local data to propose a method that measures and monitors progress towards sustainable development. The first part of this paper consists of a critical analysis about previous literature regarding sustainability indicators at a local scale. This is subsequently used to develop a methodological framework that summarizes best practices. Especially the differences between top-down and bottom-up approaches are herein highlighted. These best practices are subsequently combined in a learning process that integrates these studies from a stakeholder point of view to assess local sustainability targets. This resulted in a holistic approach (figure 5) to guide any local sustainability assessment around four basic steps: establish a human and environmental context, provide guidance on how to set management goals for sustainable development, derive methods to identify, evaluate and select indicators and collect data that can be used to monitor changes in sustainable development over time and space. These four basic aspects are subsequently supported by 12 steps (Reed et al., 2006). Comparing the framework of Reed et al. (2006) with the steps of the United Nations (2010) and Quaid (2002) reveals that there are several similarities between these studies. Following these steps might therefore be a relevant guidance to improve the target setting of local sustainable measures.

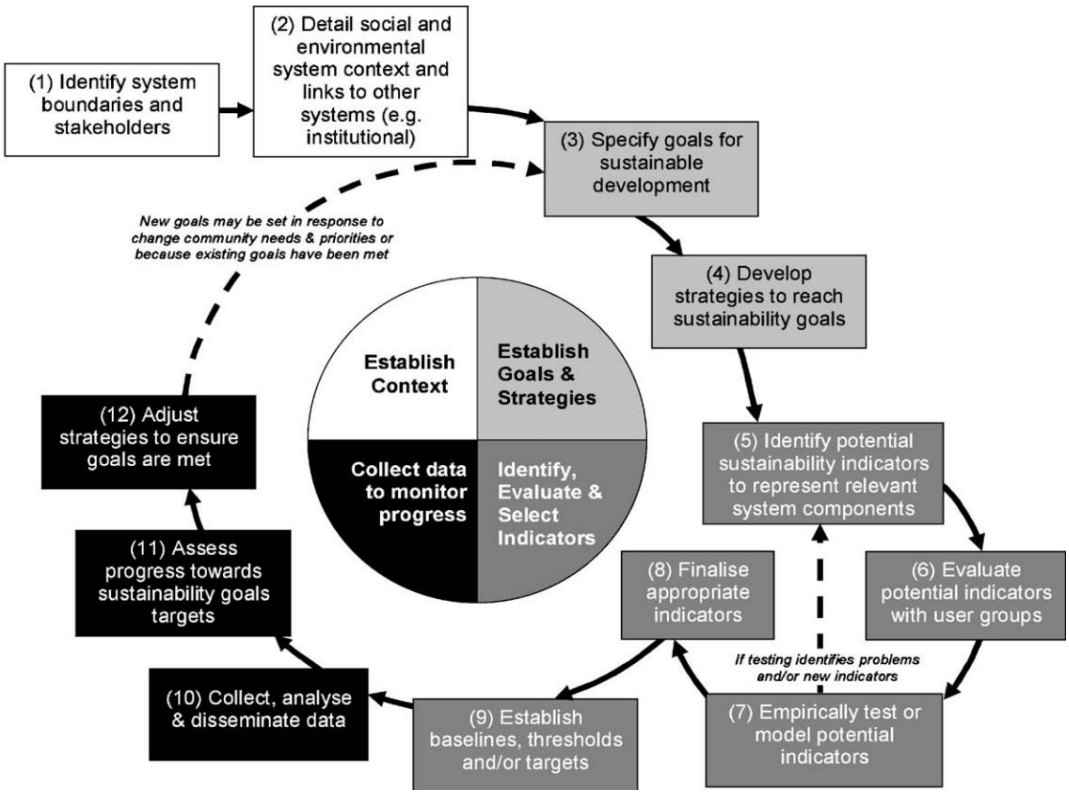

Figure 5 - Framework to define the adaptive learning process for sustainability indictor development and application Source: Reed et al. (2006).

3. Method

Research had to be conducted in order to improve the local targets in a feasible and measurable way in which it becomes a contribution to the national objectives. In this third chapter, the method used to conduct this research will be elaborated per chapter, each representing one sub-question.

3.1. Selecting the currently described targets

Before it was possible to perform the analysis of this research, several initial steps had to be taken. The first step was to determine the actual scope of the analysis. Therefore, a set of targets was created with the use of information regarding the governmental plans and policies of a municipality for this period of governance (2014-2018). This information has been derived from the executive agreements and could be found on the municipal websites by searching for the words 'Coalitieakkoord', 'Collegeakkoord' or 'Bestuursprogramma'.

The next step was to draw a realistic overview of the available information provided by the executive agreements. Therefore, a smaller selection of municipalities has been determined. This selection consisted of 50 municipalities defined along two requirements. The first requirement was that the selected municipalities represented a sufficient overview of the Dutch municipalities. Therefore, the 25 largest municipalities with regard to area and the 25 biggest municipalities regarding residents were determined with the use of demographic core values ([1]CBS, 2015). A second requirement was that all provinces were represented in the selection. It appeared that the municipalities Apeldoorn and Ede belonged to both categories. To cope with this duplication, two municipalities that corresponded to the requirements were added to the selection. This resulted in 26 selected municipalities per group and a final selection of 50 different municipalities.

A subsequent step was to examine which targets, related to CO_2 reductions, were described in the executive agreements. This analysis has been started by searching for described formulations related to the national objective to reduce CO_2 emissions. An additional focus has been paid on formulations regarding renewable energy and energy efficiency. To take the differences between formulated targets into account, the formulations that had been found were structured in groups regarding CO_2 reductions, renewable energy and energy savings and energy efficiency. In this case, the differences between quantified targets, open-ended targets without a quantification and no specific targets were covered. The structured information was subsequently applied to determine which targets were frequently mentioned. The most frequently mentioned targets were considered to be the final set of targets. Moreover, important targets form the Energy agreement that were less often referred by the municipalities were also taken into account. This resulted eventually in categories and sub-categories which will be analysed in the next steps of the research.

A final step was to establish requirements in order to analyse all executive agreements on the created set of targets. This step was taken to avoid confusion about when a formulation was assigned to one or more of the categories. These requirements are composed with the use of the formulations from the executive agreements. Additional requirements were added during the analysis if a municipality provided a formulation which suited the category.

3.2. Identifying differences and similarities between municipalities and provinces

The next step in the method was to analyse the collected executive agreements of all 390 municipalities. This step has been taken in order to provide an overview of the formulated targets and to identify differences and similarities between municipalities and provinces. To have this analysis, a municipality received a green colour if the formulation of the municipality correlated with the specified requirements. In the case that there were no targets described or if the description did not met the requirements the municipality received a red colour.

Afterwards, the green and red colours were quantified with one's and two's to calculate the percentage of municipalities with and without a target. Bar charts were subsequently developed in order to visualize the results and to be able to determine the differences and similarities between the municipalities and provinces. Additionally, several groups were established regarding municipalities with a combination of sub-categories. These groups were used to calculate the percentage of municipalities with more than one target in a category. For example, the amount of municipalities that provided both analysed renewable energy options i.e. solar and wind energy. Moreover, the percentage of municipalities that that did not further specify a category was examined in a similar way.

The feasibility of a proposed target could be influenced by several characteristics. For this research it was assumed that the techno-economic factors and institutional factors are similar for all municipalities and that the resource characteristics are more relevant at a regional scale. Therefore, the geographical characteristics including the average amount of citizen, the average amount of households and the average amount of residential density in municipalities was further examined. The data regarding these characteristics was derived from Statline. To determine the variation and to improve the validity of the data, the standard deviation has been calculated for the averages.

3.3. Identifying how the targets are implemented, measured and monitored

The executive agreements were not sufficient to establish a more detailed analysis and thereby to determine how municipalities implemented, measured and monitored their formulated targets. It was therefore chosen to obtain additional climate programs with more detailed formulations regarding environmental policies. This detailed analysis has been executed for the 50 municipalities selected in paragraph 3.1. If there was an uncertainty about the validity of the document, personal contact was sought with that municipality. This has been done for the municipalities Coevorden, Den-Haag, Eindhoven, Haarlemmermeer, 's-Hertogenbosch, Midden-Drenthe, Nijmegen, Oostellingwerf and Zaanstad. Additionally, more information about the development of sustainable policy documents was obtained through a telephone conversation with Jan Schreuder, the program manager energy and climate of the municipality Zaanstad.

The previous created set of targets was again applied to analyse the climate programs. Before identifying which targets were measurable, requirements for each category had to be established. Therefore, the term measurability needed to be defined for all categories and sub-categories. The Cambridge dictionary defines "measurable" as: "*To discover the exact size or amount of something*" (Cambridge Dictionary, 2016). In this research, a target was considered to be measurable if the municipality formulated a specific quantity to determine directly or indirectly the reduction of CO_2 emissions. This could either be done with absolute numbers (expected % CO_2 reduced compared with base year y, x amount of kton CO_2 reduced, % renewable energy in year y, x amount of buildings with

an energy label in year y) or with qualitative formulations (e.g. becoming energy neutral or climate neutral in year y).

After identifying which municipalities formulated a measurable target, corresponding to the requirements, the percentage of municipalities with and without a measurable target was calculated. With this data the differences between the 50 municipalities as well as the differences between the 26 largest municipalities regarding citizen and area was determined. Afterwards, the qualitative aspect of the formulation has been interpreted to identify how the targets are implemented, including the involved stakeholders, the role and responsibility of the municipality and the expected target year in which the target has to be achieved. A final step was to determine the applied monitoring systems by the municipalities. Monitoring a target implies that a municipality evaluates the progress of a target. The climate programs were examined in order to determine if a municipality did or did not indicated to monitor progress.

3.4. Determine the general contribution of municipalities to the national objectives

After identifying which municipalities formulated a measurable target, it was strived to provide an overview with the contribution of the municipalities to the national objectives. This has been done for the categories renewable energy and energy savings. To calculate the contribution of the municipality it was necessary that the formulated target of the municipality corresponded with the formulation of the national objective. Therefore, one municipality with measurable targets in all categories has been chosen to provide a general overview with respect to the elaborated options.

The Energy agreement has described the aim to realize 100 PJ of energy savings in 2020. This amount was subsequently compared with the target of the chosen municipality. A condition in order to be able to calculate the contribution of this municipality, it was required that the municipality described how much energy (in Joule) has to be reduced in 2020. In contrast, it was not possible to calculate the contribution if the municipality only mentioned the percentage of energy saved without formulating the current energy consumption. Aside from energy savings, renewable energy has been examined for the two options i.e. solar and wind energy. The Energy agreement has no direct target regarding solar energy, but it has formulated a combination of decentralized options, including solar energy, solar heat, heat pumps and heat and cold storage. This decentralized target has therefore been considered to be the objective for solar energy, although this consumption should be taken with care. The wind energy objective has subsequently been analysed for several municipalities, because the Dutch government has assigned wind energy as an important measure to raise the amount of renewable energy. As a result, the national objective to realize 6000 MW in 2020 has been specified per province (RVO, 2016).

A first step to analyse the wind energy target was to collect data regarding the provincial targets and the current amount of wind energy in the provinces in order to determine which part of the provincial target has already been achieved. The results of this calculation has been used to assign two outstanding provinces, including one province with a high amount of wind energy and one province with a low amount of wind energy. With this information the municipalities within these provinces were analysed on their perception about wind energy. Therefore, the executive agreements and the additional climate programs were analysed on formulations regarding wind energy. A second step was to identify which of these formulations were quantified and how this contributed to the national and provincial targets. Only municipalities with quantified wind energy targets for 2020 were implemented in this analysis. This second step was subsequently repeated for the selected 50 municipalities (pg. 3.1). Afterwards, the expected amount of wind energy generated per citizen was calculated by dividing

the expected amount of wind energy with the amount of citizen living in the municipality. The information with regard to the amount of citizen living in a municipality has been derived from the statistical data base Statline.

3.5. Identifying steps to improve local targets

The analysis of the targets revealed to what extend the municipalities set measurable and suitable targets for their municipality to implement CO_2 reduction measures. It thereby showed the current shortcomings of the defined policies and thereby which aspects has to be improved to obtain a better allocation of local measures. In order to identify and structure improved steps this study builds upon the framework by Reed et al. (2006) (figure 5).

A first step was to list the current shortcomings retrieved from of the analysis. The four basic steps of the framework by Reed et al. (2006) were subsequently applied to structure the identified shortcoming. Afterwards, the steps in the outer circle were adapted to actually convert the shortcomings into improvements and adaptations for the municipalities. Therefore, not all steps were equally relevant which was no problem as the method by Reed et al. (2006) has to be flexible and needs to be adapted to the dynamic and heterogeneous local conditions. In this case the first two steps regarding system boundaries and stakeholders were applied to improve the context of the formulated targets. The specification of goals and strategies for sustainable development in step 3 and 4 were assumed to be relevant at a national and local scale. The steps 5 to 9 in the framework have regard to evaluate and select indicators. For these steps it has been taken into account that the targets should become more likely to be implemented or achieved. In this context the proposed adaptations are assumed to improve the feasibility of a target. Aside from feasibility it also has been assumed that the targets have to become more measurable. This contributes to the last parts of the framework which implies that targets should be measured in order to determine the progress. For this reason the last three final steps in the framework of Reed et al. (2006) were adopted to improve the monitoring and potential adjustments of the targets.

4. Selecting the currently described targets

The first step in the method is to determine the scope for the next analysis of this research. This chapter will therefore first explain which measures, regarding the reduction of carbon emissions, are mostly formulated by the municipalities and with these measures a set of targets will be established. Afterwards the requirements corresponding to each target will be presented.

4.1. The scope of the research

In order to identify which targets are mostly formulated by the municipalities, the relevant governmental plans and policies are derived from the executive agreements. Therefore, the 50 largest municipalities regarding area or citizens are selected to obtain a sufficient overview of the formulated targets. This selected group of municipalities is shown in annex A. The executive agreements of these selected 50 municipalities were subsequently retrieved and analyzed. This analysis primarily focused on the main national objective to reduce CO_2 emissions, but an additional focus has been paid on the supportive measures regarding renewable energy and energy savings as well as the power and tasks of municipalities. Following from this analysis the measures found in the executive agreements were structured in tables, whereof one is shown in table III and a template is shown in Annex B.

Table III - The measures proposed by the municipality Rotterdam in order to reduce carbon emissions and to improve Sustainable Development. Source: Municipality Rotterdam, 2014.

Rotterdam: - The focus on sustainability leads to lower energy bills, jobs, cleaner air and a better environment. Sustainability is more than climate, it is a catalyser for chance and dynamics.		
How: - 'Programma Duurzaam' and revise the 'Rotterdam Climate Initiative'		
Cooperations with other parties: - Citizen, - Entrepreneurs and companies, - Research institutions, - Housing corporations		
Targets	**Description**	**How**
Renewable energy	- Put effort in *renewable energy* generation	
Energy Efficiency & Energy savings	- Implement *energy savings* in order to lower the energy bills - Intensify the 'Energy Saving' program	*Role of the Municipality:* - Stimulate energy efficient buildings - Invest in energy saving measures
Other CO_2 reduction measures	*Sustainable Transport:* - Cleaner public transport - Search for possibilities to reduce emissions for shipping and logistic sectors by stimulating cleaner fuels and engines - Cycling is an alternative for cars, therefore cycling lanes will be improved *Waste heat:* - Improve the usage of waste heat, sustain the sources and expand the heat network	*Role of the Municipality:* - Stimulate cleaner traffic by providing electric charging points, sustain own car fleet and cleaner shipping
Financing	- Sustainability: €2 million (2015), 3 million (2016), 4 million (2016-2018)	

Concluding from this table, four groups main groups of measures can be detected, namely renewable energy, energy efficiency & energy savings, transport and waste heat. This result was also found for most of the other municipalities and therefore these four categories are chosen as main categories that contribute to the reduction of carbon emissions. However, within these categories a couple aspects returned regularly. By combining these aspects with each other a couple sub-categories could be establish. These categories and sub-categories are subsequently considered to be the final set of targets which will be further analysed in the next parts of this research. Figure 6 provides an overview of these targets.

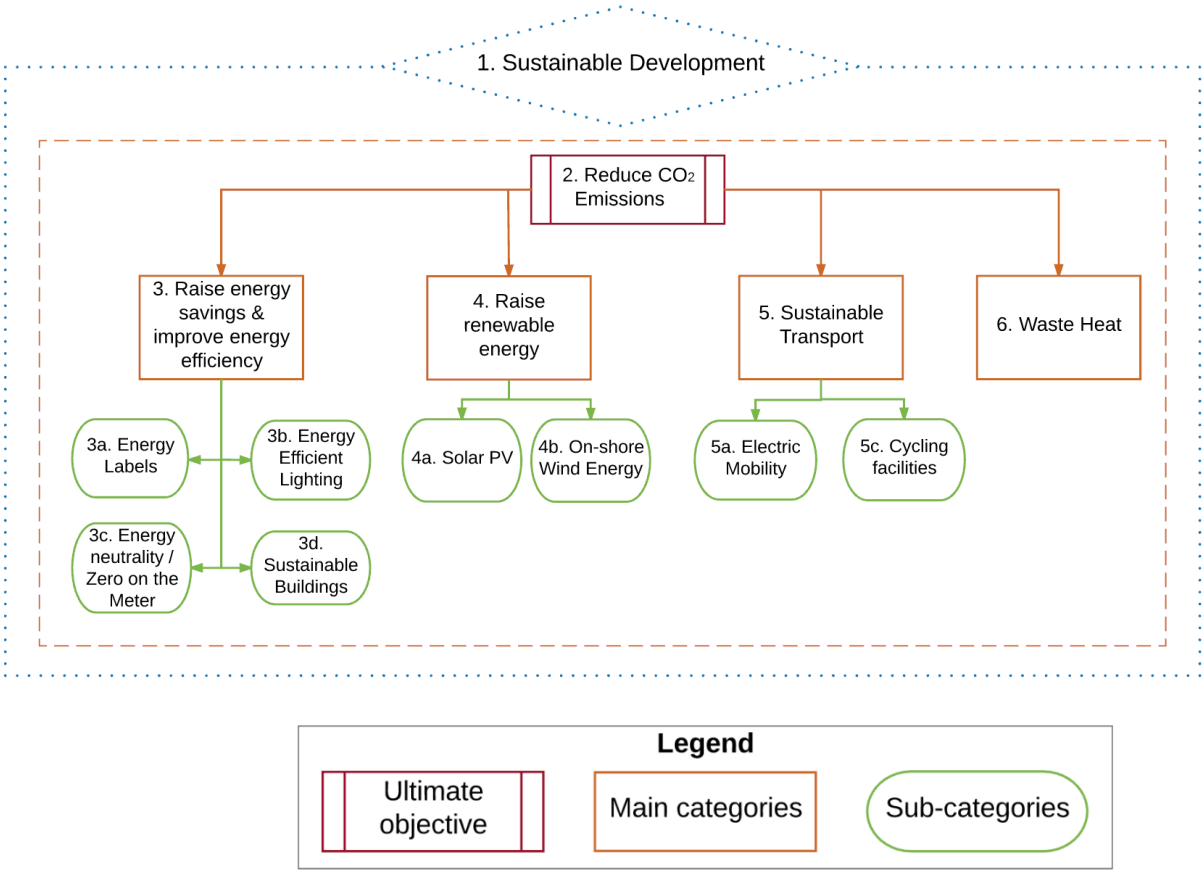

Figure 6 - The relation between the sustainable categories applied in this research to obtain sustainable development and to reduce CO_2 emissions.

4.2. The defined requirements for each of the categories

After identifying which targets are formulated by the 50 selected municipalities, a set of requirements has been defined for each of the categories. This has been done to assign the targets of municipalities in a constant manner along the categories and sub-categories. Following from these requirements, a municipality is assumed to not have a target if the formulation does not fit with the requirement. The first target in figure 6 involves the recognition of municipalities to adapt and mitigate climate change with the use of "Sustainable Development". This is the most general target as many of the selected municipalities only stated to adapt climate change or to improve the environment without providing a particular measure to achieve this. Therefore, the "Sustainable Development target" will be assigned to municipalities with a specific formulation to adapt and mitigate climate change and to municipalities that only mentioned the importance of climate change adaptations without describing specific measures.

Most important objective, represented by target 2 in figure 6, is associated with the reduction of carbon dioxide emissions. There are basically three options detected to formulate this target. Most common option is to formulate one of the categories e.g. energy savings as a measure to reduce carbon emission. These municipalities often have no specific formulation in the executive agreements to reduce the CO_2 emissions. In contrast, the second detected option to formulate this ultimate category is to describe an expected amount of reduced CO_2 emissions. A final third option includes municipalities that formulate to become climate neutral municipality or to build climate neutral buildings. As all three options contribute to the reduction of carbon emissions, municipalities with one or more of these formulations are assumed to have a target regarding the reduction of CO_2 emissions.

The Energy agreement furthermore defines measures to reduce carbon emissions with the use of energy savings and energy efficiency , target 3 in figure 6. Most of the selected executive agreements did not divide energy savings and energy efficiency measures as two separate aspects and therefore both options are analysed in the same category. This category is subsequently divided in sub-categories regarding energy neutrality (3a), energy efficient lighting (3b), energy labels (3c) and sustainable buildings (3d). The sub-category "Energy neutrality" is assigned to the municipalities with a formulation that specifically states or stimulates to become an energy neutral municipality. It furthermore includes targets that aim to build energy neutral or zero on the meter buildings. The sub-category "energy efficient lighting" includes targets with regard to raise the amount of energy efficient lights at buildings and in public areas. Thereby are also the formulations to replace existing lights for energy efficient (LED) lights, innovations regarding efficient lighting and smart lights assumed to be measures within this sub-category.

Although measures to improve the energy labels at houses were not often mentioned in the executive agreements it will be further elaborate as a sub-category. This because the national government describes some specific goals to improve energy labels. In this analysis energy labels are considered to be a target if the municipality mentions or stimulates the improvement of energy labels. This includes energy label improvements in municipal and public buildings as well as label improvements in rental or private owned houses. The final sub-category entails "sustainable buildings". This category is included in the research as the municipalities have different powers and tasks to obtain energy saving and energy efficiency measures. It is therefore attempted to divide the energy savings and energy efficiency in measures regarding municipal buildings, rental buildings and private owned buildings.

CO_2 emissions can furthermore be achieved with the use of renewable energy options. As there are many renewable energy options possible, the first aspect involves a general "renewable energy" target including all types of renewable energy with the purpose to generate electricity (4). The analysis of the

executive agreements subsequently revealed that most municipalities formulate on-shore wind (4a) energy and solar PV (4b) as renewable energy options. Hereby it should be noted that these formulations were often lacking a quantified formulation on the generated amount of solar and wind energy. For this reason, the municipalities are considered to have a target in the sub-category "on-shore wind energy", when on-shore wind energy is formulated as a renewable energy option, if the municipality stimulates on-shore wind energy or when it is intended to install wind turbines after investigating locations. Aside from wind energy, "Solar PV" is assumed to be a target if the municipality formulates solar PV as a renewable energy option, if solar PV is stimulated among citizen or when a municipality investigates or installs solar panels on roofs or at solar farms. When there is no formulation regarding solar PV or on-shore wind energy it will be assumed that the municipality does not have a target. Additionally, a separate column will indicate if a municipality specifically describes to be against wind energy.

The sustainable transport category (5) is the next category which will be examined in this research. There are several formulations found to sustain transport and it will therefore be assumed that municipalities with a formulation related to sustain the car fleet, stimulate or improve public transport, raise the amount of bicycles and to stimulate electric transport have a target regarding sustainable transport. However, the sustainable transport is not considered as a target when the municipality describes to improve the infrastructure for traffic safety. Not only the executive agreements describe sustainable transport measures. Also the Energy agreement formulated goals regarding sustainable transport. One of these goals is to establish regional plans in order to increase the amount of bicycles with 35% in 2030, whereas another goal is to obtain more energy efficient transport (SER, 2013). As these aspects are also in some cases reflected by the executive agreements, the category will be divide in the sub-categories cycling facilities (5a) and electric mobility (5b). "Cycling facilities" are considered to be a target when a municipality improves or stimulates the usage of bicycles for example with more bicycle storage or improved cycling lanes. Municipalities are furthermore able to stimulate sustainable transport options. The sub-category "Electric mobility" is therefore assumed to be target when the municipality formulates measures related to raise the amount of electric charging points, stimulates electric vehicles or sustains the municipal car fleet.

The final category which will be examined is "waste heat" (6). This category is the least formulated by the 50 municipalities. Nevertheless, it might be interesting to examine if the usage of waste heat for district heating becomes more common in the Netherlands. Several formulations have been considered to be a target regarding waste heat including municipalities that formulate to stimulate, install or expand district heating networks. In contrast, the target regarding waste heat will not include other options for household heating such as heat and cold storage and geothermal heat.

5. Identifying the differences and similarities between municipalities and provinces

In line with the formulated requirements, this chapter will provide an overview of the formulated targets by identifying the differences and similarities between municipalities and provinces. In the first part of this chapter will focus on the sustainability target which will be followed with the differences and similarities regarding CO_2 reduction measures including the categories renewable energy, energy savings and energy efficiency, sustainable transport and waste heat will be identified.

5.1. Identified targets regarding sustainable development & CO_2

The importance of sustainability and climate change is recognized by most of the municipalities (figure 7). Although many of the municipalities did mention sustainable development in their executive agreements, either with or without specified carbon reduction measures, still 6% of the municipalities did not provide any formulation on sustainability.

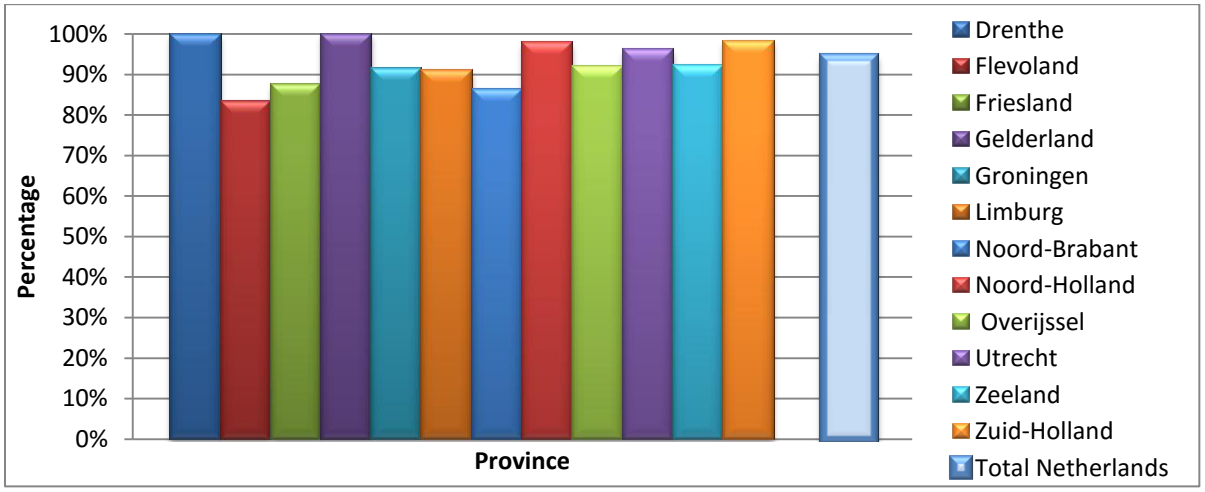

Figure 7 - The percentage of municipalities that described a target regarding sustainability in their executive agreement. This is visualized for each province and for the Netherlands as a whole.

Aside from the fact that there are not large differences between the provinces detected, the review of the executive agreements revealed a great variety in the way municipalities formulated their sustainable targets. For example Meppel described to "*continue with the current policies regarding sustainability*", whereas Zeewolde explains that "*the quality of living, life, work and recreation is high in Zeewolde*' and that '*Sustainability is an obvious part of this quality*" (Municipality Meppel, 2014, p.17; Municipality Zeewolde, 2014, p.3). A corresponding aspect between these types of formulations is that the municipalities draw the intention to improve sustainable development in the municipality. This in contrast with the definition of sustainable development by the municipality Achterkarspelen "*development that meets the needs of current generations without compromising the ability of future generations to meet their needs*" (Municipality Achterkarspelen, 2014, p.14). This formulation is more related with a global definition of sustainable development and is for this reason more difficult to achieve at a local level. Although the various types of definitions indicate that the municipalities take sustainable development into account, the definitions do not provide an explanation of how the targets are achieved and how the greenhouse gasses will be reduced.

However, reducing greenhouse gas emissions is one of the most important aspects in order to limit the impacts of climate change. It might therefore be expected that the ambition to reduce CO_2 emissions is reflected in many executive agreements. Figure 8 reveals that this expectation is valid as approximately 4 out of the 5 municipalities in the Netherlands presented one or more measures to reduce carbon emissions. Especially the categories renewable energy and energy savings are frequently defined, whereas the categories sustainable transport and waste heat are barely mentioned. In addition, it should be noted that the formulated measures to reduce carbon emissions are in most cases not quantified. Haaksbergen for instance only stated to provide an exemplary role regarding the reduction of the CO_2 emissions (Municipality Haaksbergen, 2014). A reason for the low amount of municipalities that explicitly stated to abate carbon emissions, might be the fact that this is a higher level of abstraction which is not included in the executive agreements. The next paragraphs will therefore elaborate on the categories regarding energy savings & energy efficiency, renewable energy, sustainable transport and waste heat.

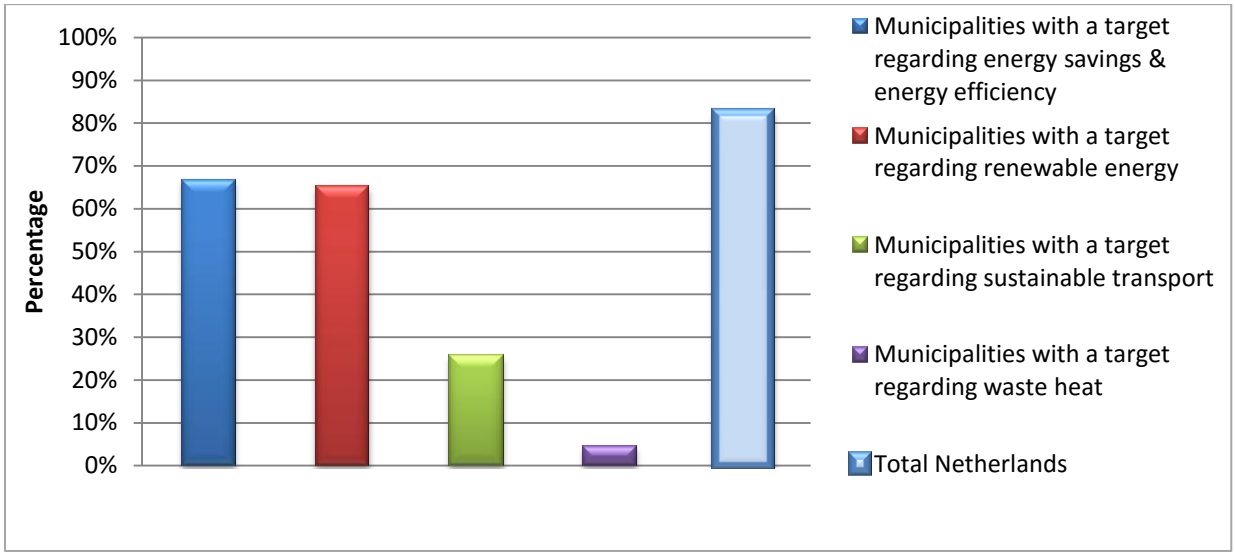

Figure 8 - The total percentage of municipalities in the Netherlands with a target in one of the categories to reduce CO_2 emissions.

5.2. Differences and similarities within the category energy savings & energy efficiency

The first category which has been examined in this research involves the category energy savings and energy efficiency measures. There are several ways detected in which these measures are formulated. A first step was therefore to identify the differences and similarities regarding the category energy savings & energy efficiency including includes municipalities within one of the sub-categories as well as municipalities that only formulate to save energy. This resulted in figure 9 which features the amount of municipalities per province with energy efficiency & energy saving measures. Especially the municipalities in the provinces Drenthe and Gelderland formulate aims regarding energy savings, also the provinces Zeeland, Overijssel, Zuid-Holland, Groningen and Utrecht are above the national average of 67%. This in contrast with Flevoland where only 33% of the municipalities formulated measures to obtain energy savings.

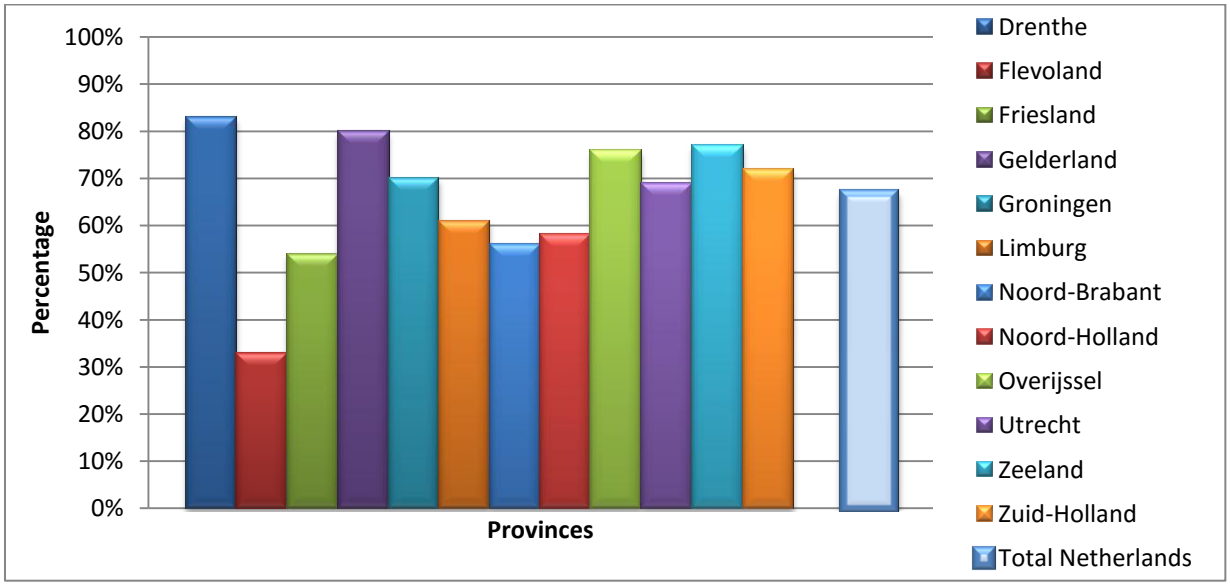

Figure 9 - The percentage of municipalities that formulate a target regarding energy savings or energy efficiency. This is visualized per province and for the Netherlands as a whole.

Furthermore, a small selection of formulations already reveals a large difference in the way municipalities describe to realize energy savings & efficiency measures. The formulation of Aa en Hunze for example is to "*stimulate and support the construction and renovation of energy efficient and energy neutral buildings by translating the national guidance into local situations*". This in contrast with the municipality De Friese Meren who aims to "*facilitate and stimulate energy efficiency at businesses*", whereas Lelystad has the intention to "*reduce the energy consumption of households, companies and institutions and generate the remaining energy demand with renewable energy*" (Municipality Aa en Hunze, 2014, p.4; [2]Municipality De Friese Meren, 2014, p.11; Municipality Lelystad, 2014, p.11).

A next step was to elaborate the differences and similarities for each of the sub-categories. For this purpose, all municipalities with one or more targets in a category are visualized in figure 10 This figure shows that there exists a large difference between the examined sub-categories. For instance, the municipalities most often formulate to sustain buildings with the use of energy savings and energy efficiency measures. This is mainly caused by the general requirements for this category. However, at first it was attempted for this sub-category to create a distinction between municipalities that sustain municipal buildings, rental buildings or private owned buildings. On the one hand, there were

municipalities that explicitly stated to have energy savings in municipal buildings or to have energy agreements with housing corporations. On the other hand, in many cases it was not clear whether the energy savings were implemented at municipal, rental or private owned buildings. For example, the municipality Hoorn formulated to "*build sustainably*" as an aspect which has to be incorporated in their sustainability agenda (Municipality Hoorn, 2014).

It can therefore be concluded that the executive agreements did not provide enough information to identify which types of building are sustained by the municipalities. As a consequence of this lack in clarity, the sub-category sustainable building has become more general and includes all types of energy savings and energy efficiency measures at buildings. For this reason, the target will not be further examined in the next parts of this chapter.

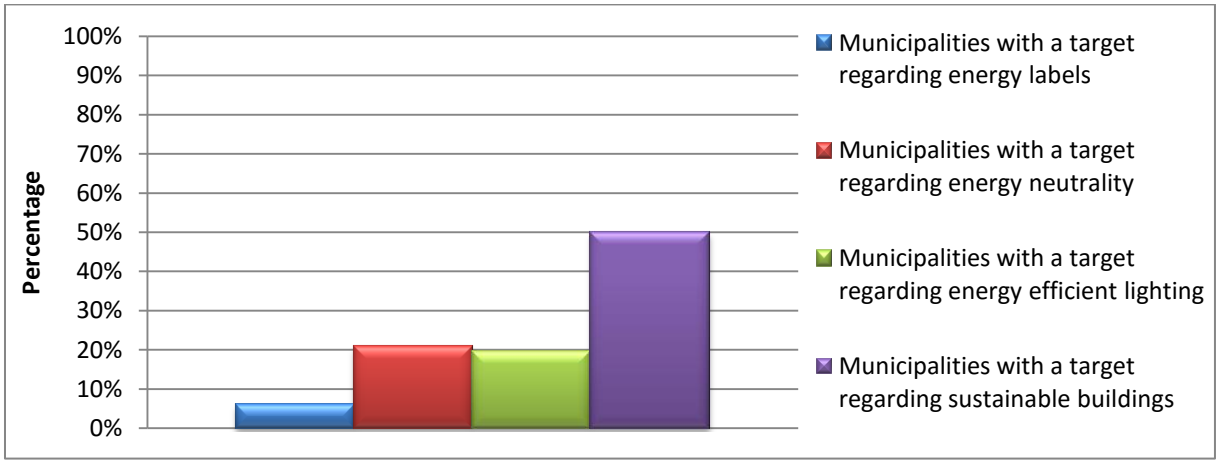

Figure 10 - The total amount of municipalities in the Netherlands with a target regarding energy labels, energy neutrality, energy efficient lighting and sustainable buildings.

Nevertheless, it was possible to make a clear distinction between the other sub-categories energy labels, energy efficient lighting and energy neutrality. Focusing on these sub-categories, figure 11 divided the sub-categories in groups of municipalities with only one energy saving measure, municipalities that formulate a combination of two or three measures and municipalities that did formulate energy savings without specifying which measures.

It appears that roughly half of the municipalities in the Netherlands did not further specify their energy savings target in one of the sub-categories. This trend is visible in almost all provinces, except for the province Noord-Holland. In contrast, the amount of municipalities with a combination of two or three categories is relatively low (NL: 11%). This implies that it is more common for municipalities to develop one of the categories, instead of applying more than one option. In addition, the amount of municipalities within the sub-category energy neutral is similar for all provinces. An exception to this trend is the province Flevoland where 100% of the energy saving measures are specified in the category energy neutral. However, it should be noted that only 2 out of 6 municipalities in Flevoland described an energy savings target. The category which is the least formulated by the municipalities is the sub-category to improve the energy labels. This is remarkable because the Dutch energy agreement provides specific objectives to improve energy labels in existing buildings and rental buildings (SER, 2013).

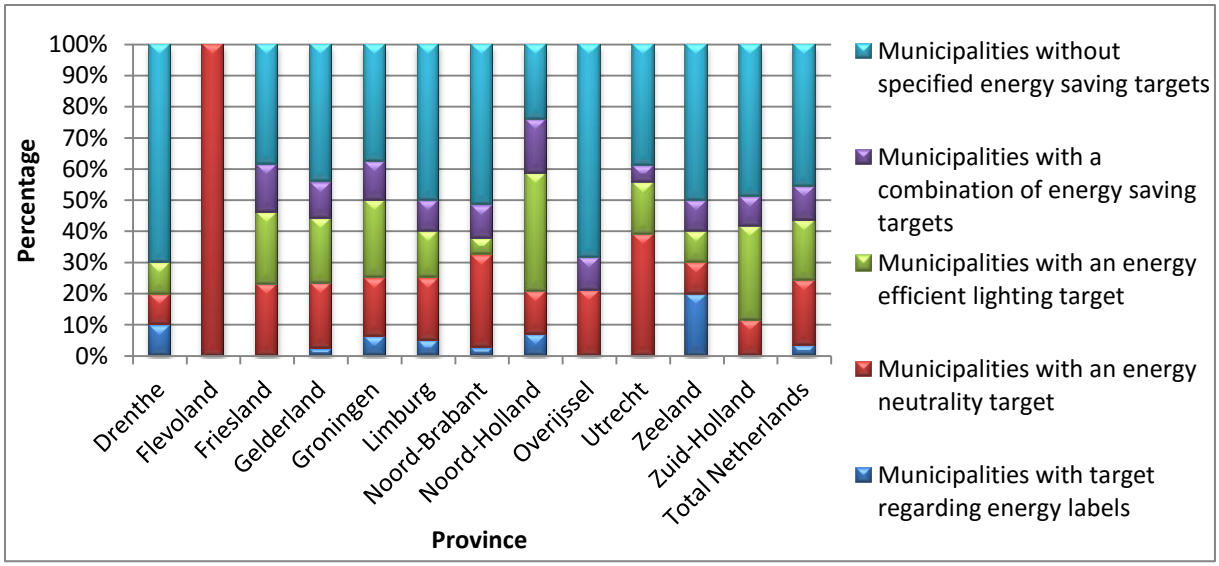

Figure 11 - The percentage of municipalities that specified their energy saving/energy efficiency target in one of the categories; efficient lighting, energy neutral, energy labels. In more than one category or not further specified the target. This is visualized per province and for the Netherlands as a whole.

5.2.1. Sub-category Energy Labels

As already indicated by figure 10, the amount municipalities with an energy label is relatively low. Following on this, figure 12 shows that less than 10% of the municipalities in the Netherlands can be assigned to the sub-category energy labels. This trend is similar for all the other provinces, except for the province Zeeland where 23% of the municipalities formulated to improve the energy labels of buildings which is still relatively low. Although there were not many formulations found, the most formulations retrieved from the executive agreements corresponded with the national objectives regarding energy savings. For example Hulst describes that "*the municipality stimulates housing corporations to improve their housing stock by at least energy label B for new and renovated buildings*" and also Utrecht has a comparable objective as "*all buildings rented by housing corporations have at least energy label B in 2020 and private rental buildings have energy label C or better*" (Municipality Hulst, 2014, p.14; Municipality Utrecht, 2014, p.19).

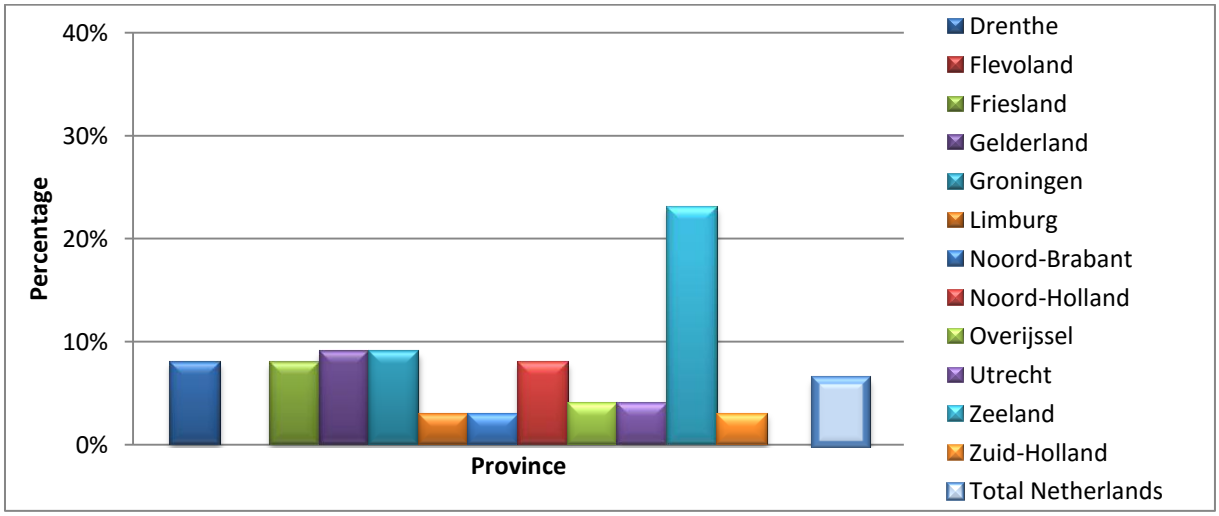

Figure 12 - The percentage of municipalities that provided a target regarding energy labels in their executive agreement. This is visualized per province and for the Netherlands a whole.

5.2.2. Sub-category energy neutrality

Next to the sub-category energy labels, the analysis of the executive agreements revealed that slightly more municipalities in the Netherlands reported to become energy neutral (21%). Comparing the different formulations with each other showed basically two ways of formulation energy neutrality. In the first formulation the municipalities stated to become an energy neutral municipality, whereas the other formulation has regard to municipalities that formulate the intention to build energy neutral or zero on the meter houses. Nonetheless, these formulations do not specifically mention the intended amount of zero on the meter houses, neither is estimated how much CO_2 emissions are reduced. This lack in quantified targets can be revealed with couple examples: "*support the construction of sustainable and energy neutral buildings*" and "*remove limitations towards an energy neutral living and strive for zero on the meter during the construction of, or renovating from municipal buildings*" (Municipality Bunschoten, 2014, p.12; Municipality Baarn, 2014, p.4).

Aside of these different formulations figure 13 also shows differences between provinces. The largest amount of municipalities that strive to become energy neutral can be found in the provinces Flevoland and Utrecht. Drenthe and Gelderland on the other hand are the only provinces where more than 90% of the municipalities did not provide a formulation that suited the requirements of this sub-category. A reason for this relatively low amount of municipalities that have the aim to become energy neutral could be explained by the fact that the national objective only describes to establish 111.000 zero on the meter houses in 2020 (SER, 2013). It is therefore not required that all municipalities formulate a target to build zero on the meter houses. In accordance to this national objective it is even more notable that this sub-category is more often formulated than the sub-category energy labels.

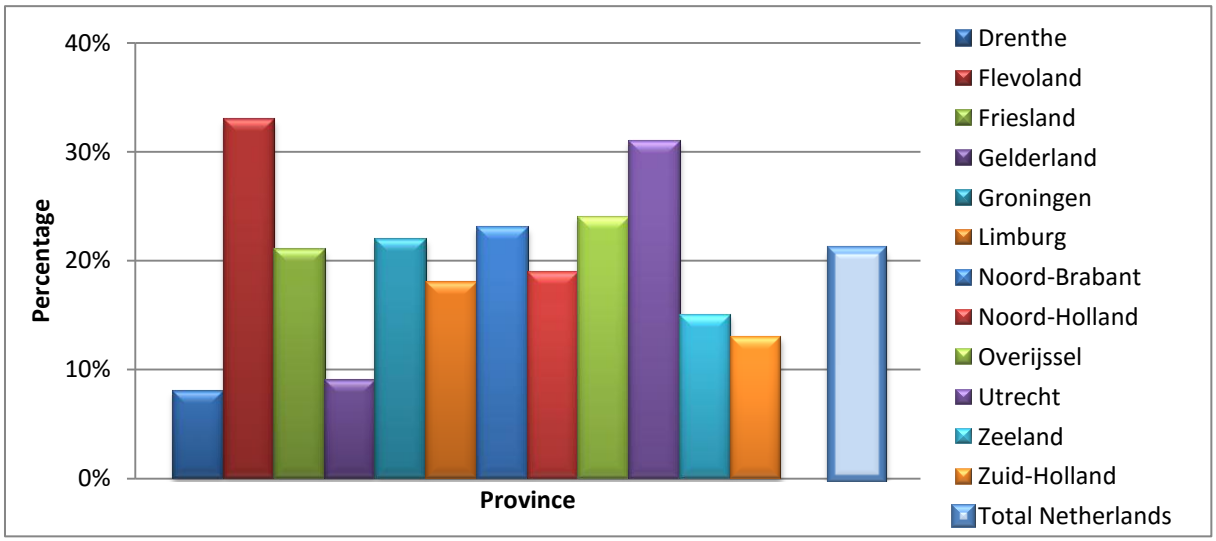

Figure 13 - The percentage of municipalities with a target in their executive agreement to become energy neutral or raise the amount of zero on the meter buildings per province and for the Netherlands as a whole.

5.2.3. Sub-category energy efficient lighting

Moreover, the analysis implies that the amount of municipalities within the sub-category energy efficient lighting is comparable with the sub-category energy neutral. There are several formulations found to improve lighting systems. For example Hendrik-ido-Ambach describes to "*apply lights that save energy for municipal buildings and public lighting*" and also other formulations are reported by Langedijk "*streetlights will be applied with LED lights and smart regulations*" and Opmeer "*municipal buildings and street lights will be equipped with LED lights, when it is possible and economically responsible*" (Municipality Hendrik-ido-Ambach, 2014, p.19; Municipality Langedijk, 2014, p11; Municipality Opmeer, 2014, p.11). These formulations show that the municipalities do take energy efficient lighting systems into account, however the expected amount of savings and the corresponding carbon reductions are not added to the formulation.

Comparing the different provinces with each other (figure14) shows that the municipalities in Noord-Holland (33%), Zuid-Holland (28%) and Gelderland (26%) most often formulate to replace existing lights for energy efficient lights. This in contrast with the province Flevoland, Overijssel , Drenthe and Noord-Brabant where more than 91% of the municipalities did not formulated aims to improve lighting systems. This low amount of municipalities with this sub-category might be caused by the lower amount of residential area in these provinces compared to Zuid-Holland and Noord-Holland which results in a lower the potential for replacing lights (Statline, 2016).

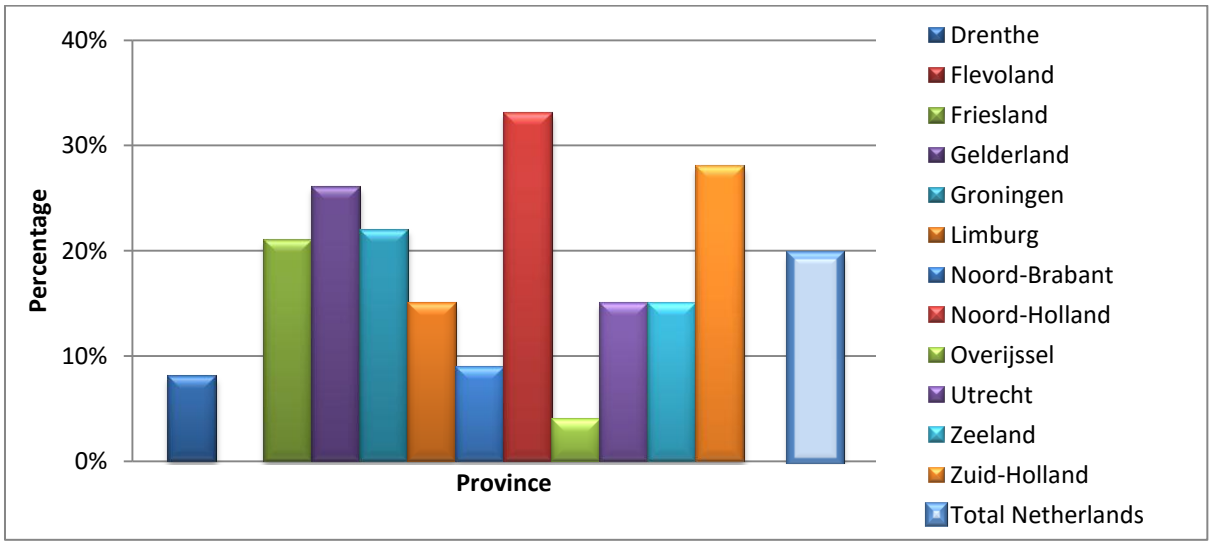

Figure 14 - The percentage of municipalities with a target regarding energy efficient lighting. This is visualized per province and for the Netherlands as a whole.

5.3. Difference and similarities within the category renewable energy

The second category on which the CO_2 reduction target is analysed contains the renewable energy options. Renewable energy sources can save a considerable amount of CO_2 emissions as they generate energy in a carbon -and pollution free way (Andrews and Jelley, 2013). There are several forms of renewable energy, but as indicated in Chapter 4 this research will focus on wind and solar energy. Before these options are examined in more detail, figure 15 provides a broader overview of all renewable energy measures described in the executive agreements of municipalities. This broader overview considers the municipalities to have a renewable energy target if it is specifically described, if it is stated as an example or if the municipality stimulates renewable energy. It can be concluded from this figure that there are currently large differences between the provinces. Where 83% of the municipalities in the provinces Drenthe, Flevoland and Friesland formulate renewable energy measures, less than 55% of the municipalities in Limburg, Noord-Brabant and Zeeland show commitment to renewable energy.

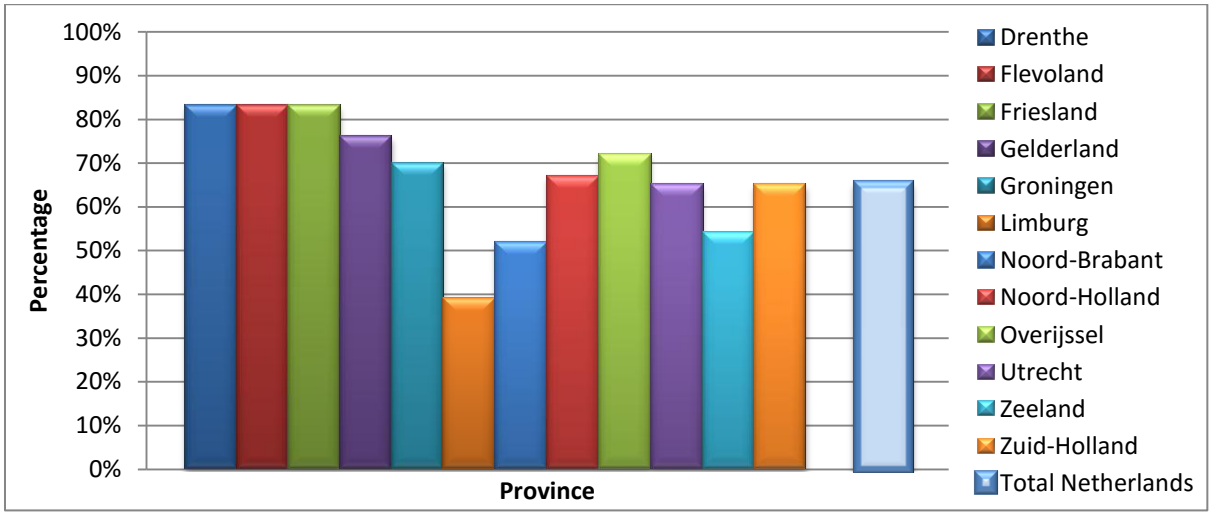

Figure 15 - The percentage of municipalities with a renewable energy target, visualized per province and for the Netherlands as a whole.

Following from this first step, the next step is to divide the general renewable energy target per sub-category (figure 16). It turns out that the amount of municipalities with only the intention to install wind energy is much lower than the amount of municipalities that only stated to implement solar energy. A cause for this difference might be relatively low support for wind energy among citizen living nearby a wind farm (Cunningham and Cunningham, 2012). An exception to this trend is the province Flevoland, where 60% of the municipalities provided wind energy as a measure for renewable energy generation. Aside from municipalities with only one of the renewable energy options, figure 16 also shows the amount of municipalities with a combination of both sub-categories. This combination is often applied by the municipalities in Flevoland (40%), Gelderland (38%) and Groningen (38%). Formulating both targets might be a benefit for the municipality, because they can decide later between one of the options. Nevertheless, there is also a vast amount of municipalities that did not specify renewable energy in one of the sub-categories. This can partially be explained by the fact that other renewable energy sources might be applied e.g. biomass energy. However, a consequence of not specifying the renewable energy target is that there is no incentive to actually implement renewable energy measures.

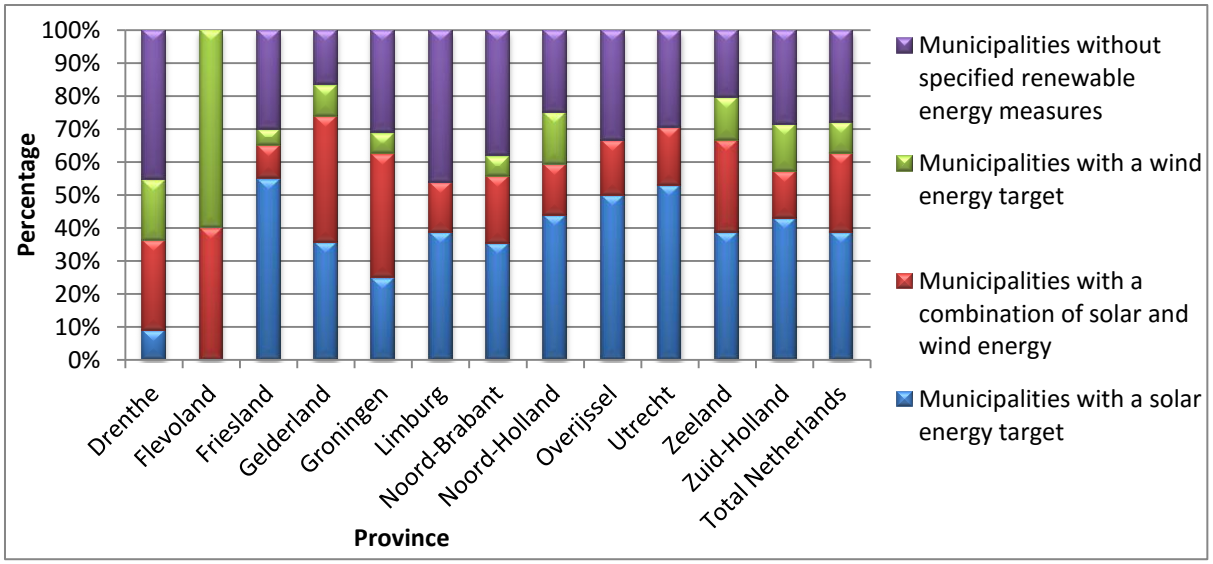

Figure 16 - The percentage of municipalities that divided its renewable energy target in the categories solar or wind energy, a combination of both categories or without specifying the renewable energy target. This is visualized per province and for the Netherlands as a whole.

5.3.1. Sub-category solar PV

Approximately 40% of the municipalities in the Netherlands formulate the aim to raise the amount of solar PV. There are basically two options to apply this solar energy i.e. decentralized with the use of solar panels on buildings or centralized with photovoltaic solar farms (Andrews & Jelley, 2013). Nevertheless, there is a great variety found between the formulations regarding the generation of solar PV. On the one hand, there are many municipalities with a direct target to install solar panels on buildings like the municipality Best (Municipality Best, 2014). However, there are also municipalities that have the aim to investigate locations for solar PV, for example Aalsmeer stated to "*investigate the possibilities for a large scale solar park at Greenpark*", while Heemstede describes to "*investigate where solar panels can be applied on municipal buildings*" (Aalsmeer, 2014, p.18; Heemstede, 2014, p.11). Another formulation which has been found in the executive agreements is to provide solar energy as an example for renewable energy, for instance Bergen op Zoom reports *"invest in the environmental infrastructure e.g. solar panels on bare grounds*" (Bergen op Zoom, 2014, p.10).

Although these formulations present the ambition to increase the amount of solar PV, it does not clarify the amount of solar panels to be installed neither does it estimate the potential amount of generated electricity. Nevertheless, the various formulations are taken into account to indicate the amount of municipalities with and without solar energy targets. This resulted in figure 17 which indicates that the provinces Friesland and Gelderland have the most municipalities with targets regarding solar energy. This in contrast with the provinces Limburg (18%), Noord-Brabant (29%) and Zeeland (31%) where the least targets regarding solar energy are described.

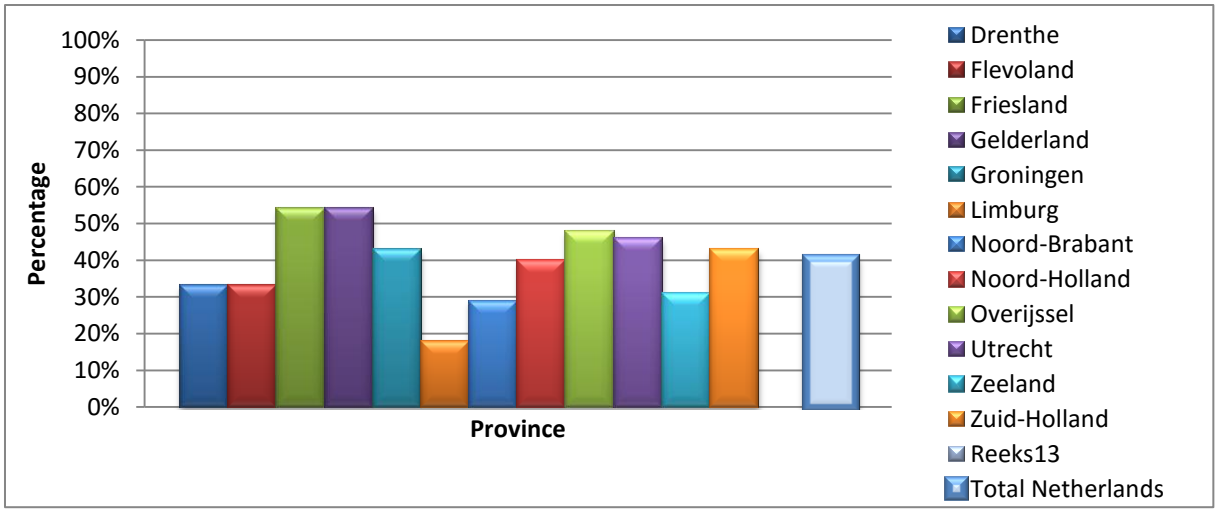

Figure 17 - The percentage of all municipalities that described a target regarding solar energy in their executive agreement. This is visualized for the provinces and for the Netherlands as a whole.

Additionally, it has been examined whether the geographical characteristics of a municipality correspond with the formulated targets. As explained in the background information (Ch. 2), solar energy is dependent on several aspects e.g. solar insolation, the available area and the characteristics of a solar panel (Andrews & Jelley, 2103). To deal with these aspects, this research applies the housing stock as an indicator for the available area of solar panels. For this purpose, the average amount of households per municipality with and without a target is calculated for each province.

It might be expected that municipalities with a higher amount of houses have more roofs available which makes them more suitable to install solar panels. Figure 18 illustrates that indeed the average amount of households in Zuid-Holland is higher in municipalities with a solar energy target. This trend is also observed for almost all municipalities, except for Friesland and Noord-Holland. Furthermore, the horizontal bars in the figure indicate that the standard deviation is quite large regarding the average amount of households in municipalities with a solar energy target. This in contrast with the deviation regarding the average amount of households in municipalities without a solar energy target. The large variation between the amount of houses in municipalities with a solar energy target indicates that most larger cities have a solar energy target.

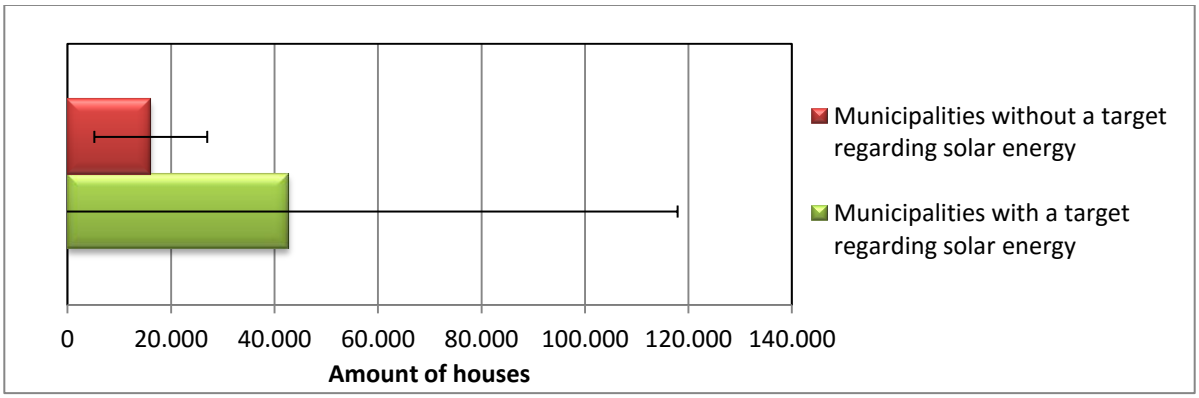

Figure 18 - The average amount of houses in municipalities with and without a target regarding solar energy for the province Zuid-Holland.

5.3.2. Sub-category wind energy

Wind energy has the second highest potential with respect to renewable energy generation in the Netherlands (PBL, 2013). Although the largest potential for wind is located at the North-Sea, this thesis does only focus on on-shore wind energy. This because municipalities are mainly involved in on-shore wind energy projects and thereby the municipalities have relatively little power with regard to off-shore wind energy projects. Analyzing the executive agreements shows that there are several possibilities for municipalities to be involved in wind energy projects. An objective given by Bunschoten is for example to "*enable the possibility to install wind turbines in a way that the landscape is not harmed*" (Municipality Bunschoten, 2014, p11). Another goal which has been provided by the municipality Houten is to "*evaluate the current wind farm Houten in order to apply this information to assign future locations"*. This in contrast with Sluis who states to "*facilitate wind turbines with a shaft height up until 15 meter*" (Municipality Houten, 2014, p.3; Municipality Sluis, 2013, p.17).

As formulated by the requirements, this research considers the municipality to have a target regarding wind energy if there is an incentive to install wind energy, if wind energy projects are stimulated or if the municipality investigates locations for wind turbines. Despite the high potential of wind energy in the Netherlands, the analysis reveals a relatively low 22% amount of the municipalities in the Netherlands with the intention to increase wind energy. By comparing the different provinces with each other (Figure 19) it turns out that the least targets are described in the province Limburg (6%), followed by Overijssel (12%), Utrecht (12%), Noord-Brabant (14%) and Zeeland (15%). This in contrast with municipalities in the provinces Flevoland and Drenthe where respectively 50% and 42% of the municipalities formulated a wind energy target.

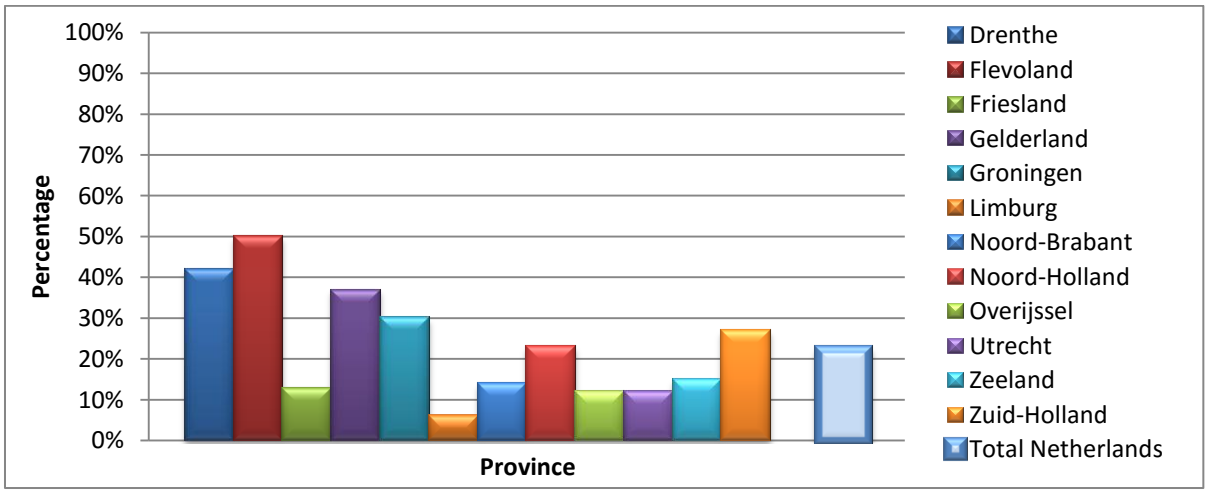

Figure 19 - The percentage of all municipalities that described a target regarding wind energy in their executive agreement. This is visualized for the provinces and for the Netherlands as a whole.

Similar to the solar energy targets, also by targets regarding wind energy several characteristic should be considered to be able to determine if a municipality is suitable to implement wind energy. An important factor before wind turbines could be installed is to define the available amount of area. It might be expected that municipalities with a wind energy target have more area available and thus a lower residential density per km^2. In order to test this hypothesis, the average residential density for municipalities with a target and the average residential density for municipalities without a wind energy target is calculated per province. The results in figure 20 show that this hypothesis is valid for the province Friesland. Moreover, the analysis detected similar trends for the provinces Flevoland, Noord-Brabant, Noord-Holland and Zeeland. However, the opposite is true for the provinces Drenthe,

Gelderland, Groningen, Limburg, Overijssel and Utrecht. As shown in figure 20 Groningen has a high residential density in municipalities with a target regarding wind energy. These differences might imply that the municipalities are not always considering whether their areas are suitable to install wind turbines. Nonetheless, it should be noted that also factors might influence these findings, for example the amount of agricultural and forest area, the infrastructure or the available amount of wind at the location.

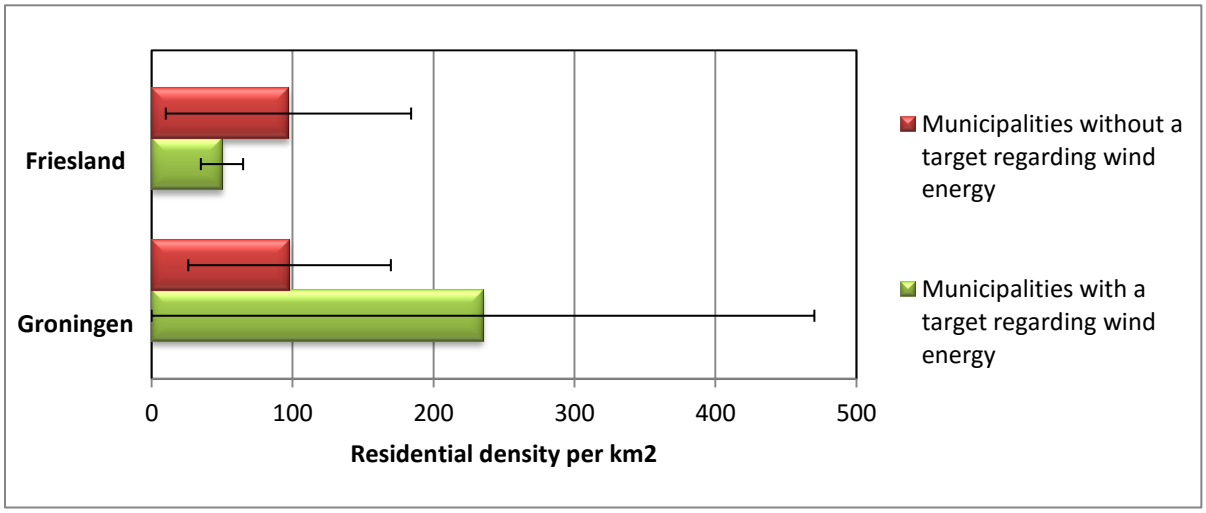

Figure 20 - The average residential density in municipalities with and without a target regarding wind energy for the province Friesland and Groningen.

5.4. Differences and similarities within the category sustainable transport

The third category to reduce CO_2 emissions involves sustainable transport options. As there are many possible measures to sustain transport, the two sub-categories electric vehicles and cycling facilities will be further elaborated in this research. As already shown in the first part of this chapter, 26% of the municipalities in the Netherlands have formulated a target regarding sustainable transport either with or without a specified sub-category. Figure 21 implies that most of the municipalities in the Netherlands have further specified sustainable transport in one of the sub-categories. Additionally, the amount of municipalities that describe one of the sub-categories is equally distributed in the Netherlands. Nevertheless, there are large differences between the provinces. Main outliers are Drenthe, Flevoland and Groningen as the municipalities in these provinces only examine one of the sub-categories. A cause for these outliers might be the fact that only one or two municipalities in these provinces provided a target regarding the category sustainable transport.

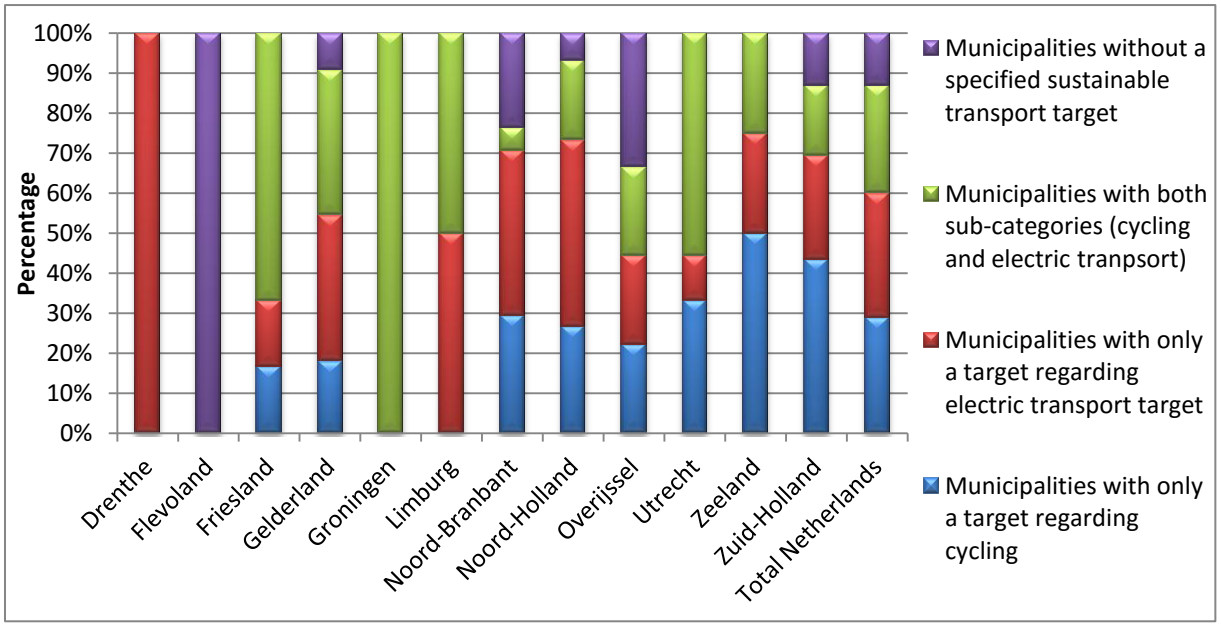

Figure 21 - The percentage of municipalities that divided sustainable transport into targets only regarding cycling facilities, only regarding electric vehicles, a combination of targets for cycling and electric vehicles or not further specify the sustainable transport target.

Although the analysis reveals that many municipalities specify sustainable transport in one of the sub-categories, the formulations are quite general. For example, the municipality Pijnacker points out that "*sustainable solutions are necessary in the transport sector'* which requires *'cleaner traffic and behavioural changes*" and Heerde expressed to stimulate cleaner transport by "*expanding the amount of electric charging points for cars and bicycles*" (Municipality Pijnacker, 2014, p.4; Municipality Heerde, 2014, p16). These formulations indicate that the municipalities have the intention to sustain transport, although it is not indicated how much vehicles are sustained neither does it show how much CO_2 emissions are expected to be reduced. As a consequence of these general formulations it is difficult to determine how much the municipality contributes to the reduction of carbon emissions in the transport sector.

5.5. Difference and similarities within the category waste heat

The fourth and last category which is examined in this research entails the utilization of waste heat in district heating networks. There are currently 24 municipalities in the Netherlands with a district heating network, whereof the municipalities Nieuwegein and Duiven have currently the largest amount of households connected (59.1% and 50.8%) ([3]CBS, 2016). Nonetheless, the analysis regarding the amount of municipalities with a waste heat target reveals that there are only 18 municipalities (table IV) in the Netherlands that are attempted to develop or expand their heating network. These municipalities are distributed among the country, though the province Zuid-Holland has the most municipalities with a formulated waste heat target. The analysis further shows that many of the municipalities with a formulated waste heat target belonged to the 26 largest municipalities in the Netherlands regarding citizen. This trend can be explained by the larger amount of households in municipalities with a high amount of citizen which subsequently creates a greater potential to connect houses to the heating network. Thus, eight of these municipalities already have an existing waste heat network which makes it more easily for these municipalities to expand the heating network.

Table IV - The municipalities with a target to expand or establish a district heating network. The corresponding housing stock of these municipalities and the percentage of households that are currently connected with a network (*). (Based on: [3]CBS, 2016)

Municipalities with a target to expand or establish waste heat	Housing stock of the municipalities	Current amount of waste heat in % of houses connected
Alkmaar	44,884	-
*Almere	78,330	58%
*Amsterdam	413,697	7%
*Arnhem	71,114	6%
Delft	48,438	-
*Den-Haag	249,994	7.4%
*Leiden	55,202	14.1%
Goirle	9,843	-
Groningen	97,905	-
Heerenveen	23,134	-
Hengelo	37,625	-
Nijmegen	27,068	-
*Rotterdam	308,291	15.9%
Ten Boer	3,033	-
*Utrecht	146,329	26.8%
Zaanstad	66,585	-
Zevenaar	14,541	-
*Zoetermeer	54,809	5.1%
Average housing stock	97,268	

6. Identifying how the targets are implemented, measured and monitored

Now the differences and similarities are identified, this chapter will further examine the formulation of the created set of targets by analysing the 50 largest municipalities in the Netherlands with regard to area and citizen. The first part of this chapter will focus on the implementation of the targets. After this, it will be determined how the targets are quantified and how often quantified targets are formulated. The last part of this chapter will discuss the way in which the formulated targets are monitored.

6.1. Identifying how the targets are implemented

The assessed executive agreements of the previous chapter are often lacking quantitative formulations. This is mainly caused by the fact that the executive agreements provide the main headlines for all areas of governance. It is therefore uncertain if all measures to reduce CO_2 emissions are included and to what extend these measures are implemented. During the analysis it appeared that many municipalities adopted additional climate policies wherein targets to improve the climate or environment within a municipality are elaborated (Schreuder, 2016, pc). These additional climate programs also include measures that contribute to the reduction of carbon emissions. Nevertheless, the implementation of these measures may evolve over time due to changing policies and the development of technologies (Municipality Zaanstad, 2013). The municipality Zaanstad for example evaluates and adapts its climate program every year which subsequently results in changes regarding the formulated measures to reduce CO_2 emissions. The associated financial aspects of implementing carbon reduction measures are neither mentioned in the executive agreements or in the additional climate programs. Though the financial aspects can be retrieved from several budgetary documents (Schreuder, 2016, pc).

In order to obtain more information on how the targets are implemented, measured and monitored, the most recent climate programs are derived for the selected 50 municipalities. In accordance, table V shows for which municipalities it was possible to obtain these additional climate policies.

Table V - The retrieved additional climate programs per municipality, wherein green represents municipalities with an additional program and red without an additional climate program.

Amsterdam		Amersfoort		Noordoostpolder		Aa en Hunze	
Rotterdam		Zaandstad		Súdwest-Frieslân		Borger-Odoorn	
Den Haag		s-Hertogenbosch		Hollands Kroon		Goeree-Overflakkee	
Utrecht		Tilburg		De Friese Meren		Berkelland	
Eindhoven		Haarlemmermeer		Midden Drenthe		Terneuzen	
Groningen		Zwolle		Emmen		Zeewolde	
Almere		Zoetermeer		Dronten		Lelystad	
Breda		Leiden		Hardenberg		Schouwen-Duiveland	
Nijmegen		Maastricht		Coevorden		Opsterland	
Apeldoorn		Dordrecht		Steenwijkerland		De Wolden	
Enschede		Ede		Bronckhorst		Oostellingwerf	
Haarlem		Leeuwarden		Sluis			
Arnhem		Alphen a/d Rijn		Westerveld			

Following from the above text it can be concluded that municipalities often provide additional programs to further elaborate on the implementation of their measures. By analyzing these additional climate programmes it turned out that many municipalities apply scenarios or roadmaps to describe measures that contribute to the reduction of CO_2 emissions. In order to implement these measures municipalities need help from several parties. Although there were many municipalities that did not describe cooperations with these parties, overall three general groups of cooperative partners could be identified. The first group includes citizen and entrepreneurs. On the one hand, many municipalities are aiming to stimulate the generation of renewable energy or the implementation of energy saving measures among citizens. On the other hand, entrepreneurs are stimulated for their innovative ideas regarding sustainability. The municipality Castricum for example describes to "*stimulate initiatives of citizen, entrepreneurs and institutions to improve the sustainability in the municipality*" (Municipality Castricum, 2014, p.19).

The second group which is often mentioned as cooperative partner includes the housing corporations. These housing corporations are important partners to improve the energy performance and energy labels of rental houses. In order to stimulate these housing corporations, the municipality needs to establish energy agreements with the housing corporations. A final group can be categorized as companies, organizations and institutions. Although this group is mentioned by many municipalities a specification of the type of company or type of organization is usually not provided. Hellendoorn for example describes to "*establish a sustainability agenda, together with citizen, nature and environmental organizations and companies*", whereas Westland formulates to "*stimulate and facilitate sustainable initiatives of citizen and companies*" (Municipality Hellendoorn, 2014, p.3; Municipality Westland, 2014, p.2).

Another important aspect to implement the formulated measures is the target year wherein a target has to be achieved. By analysing the additional climate programs it turns out that most of the municipalities formulate a target year. Though there are large differences between the mentioned target years. On the one hand, municipalities regularly mention targets on a short time scale, including 2018 which the end of this period of governance or 2020 which corresponds with the main targets from the Energy agreement. These targets years on a shorter time scale are mainly applied for energy saving measures and renewable energy options. On the other hand, long term targets for 2030 or 2040 are sometimes applied for the measures regarding wind energy and for targets to become climate or energy neutral as these aspects are often not achieved on a short time scale.

An additional aspect which has been examined is the difference between formulations regarding final and primary energy. The Dutch Energy agreement attempts to reduce the final energy consumption with 100 PJ in 2020. It was therefore expected that the municipalities also describe implemented measures to reduce final energy instead of primary energy. However, this distinction has not been found in the executive agreements and the additional climate policies.

6.2. Identifying how the targets are measured

The created set of targets (Chapter 3) has been applied in order to identify which of these targets are measurable. For this analysis it has been considered that a target is measurable if a specific quantity is formulated to determine directly or indirectly the reduction of CO_2 emissions. In figure22 is an overview of the amount of municipalities with a quantified target in one of the categories given. It turns out that 70% of the selected 50 municipalities formulate a quantified measure to reduce carbon emissions. Nevertheless, there is a clear distinction visible between the measurable two examined groups. Where almost all municipalities with a high amount of citizen provide a quantified measure, only 46% of the municipalities with a large amount of area formulate quantified measures.

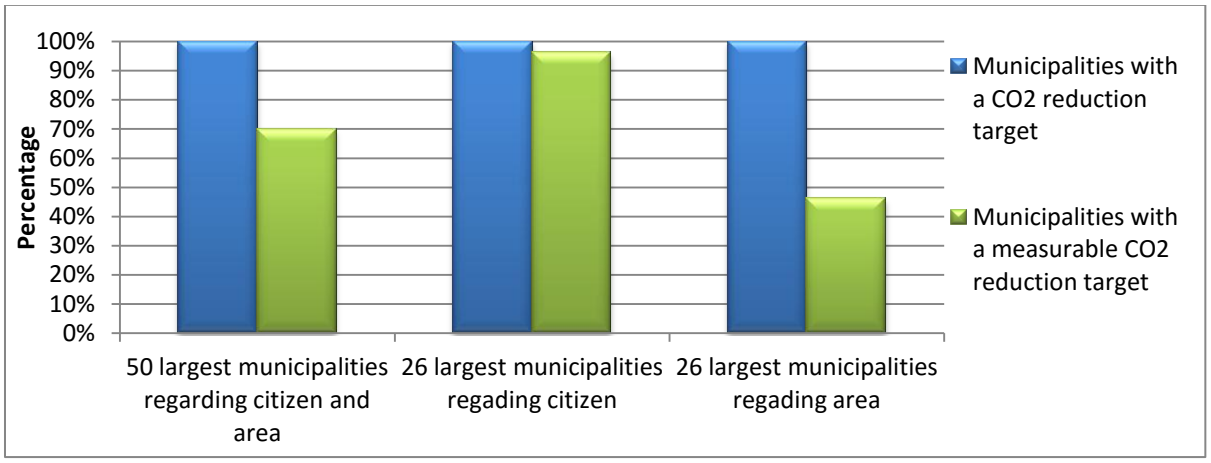

Figure 22 - The percentage of municipalities with a quantified target regarding CO_2 reduction measures, including energy savings & energy efficiency, renewable energy, sustainable transport, waste heat. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

Moreover, it has been determined how often each sub-category is quantified (figure23). This figure illustrates that the category energy saving and energy efficiency measures are regularly quantified, this is followed by the categories renewable energy and sustainable transport. The category waste heat is in the end the least quantified target. Similar to figure 22, the municipalities with a higher amount of citizen have in all sub-categories more quantified formulations compared to municipalities with a large amount of area.

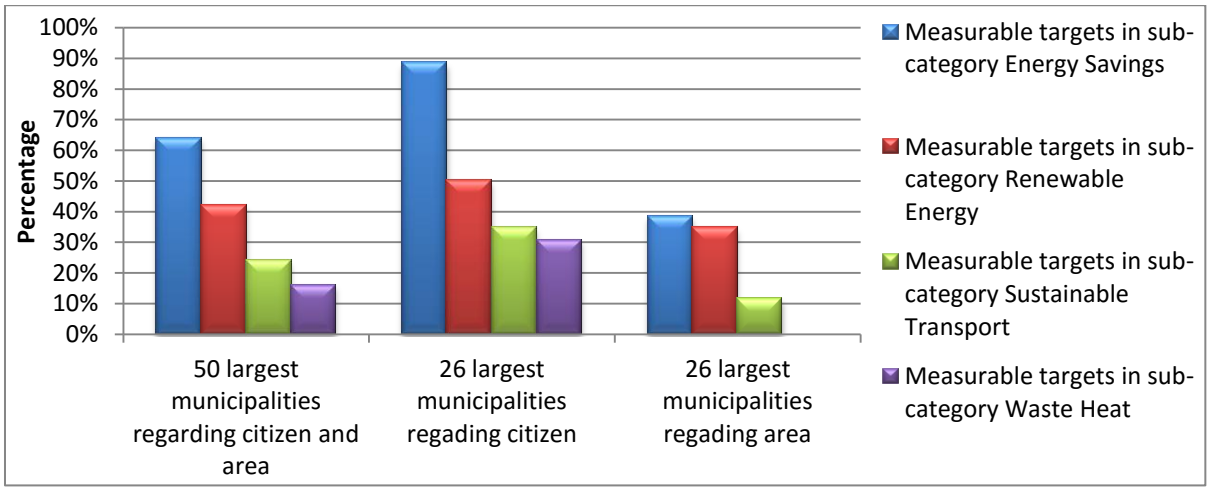

Figure 23 - The percentage of municipalities with a quantified target regarding energy savings & energy efficiency divided per category. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

6.2.1. Quantified CO_2 reduction measures

An important aspect for the chapter regarding the comparison with the national objectives is to determine the way in which these measurable targets are formulated. One detected way of formulating the quantified targets entails municipalities with a direct aim to reduce carbon emissions, for example by formulating to become climate or CO_2 neutral. This aspect is mentioned by 34% of the 50 municipalities. It is notable that all municipalities with this target also formulated a target year which varies between 2030 and 2050. In addition, Berkelland has the ambition to become for one third energy neutral which corresponds to a reduction of 75 kton CO_2 emissions in 2019 (Municipality Berkelland, 2016).

Another way to reduce the CO_2 emissions is with the use of renewable energy and energy saving, although as earlier described in the previous chapter this was often not stated. Nonetheless, the analysis of the 50 municipalities reveals that the additional climate documents do pay attention to the aspect of reducing CO_2 emissions with the use of renewable energy or energy efficiency measures. It appeared that 48% municipalities at least mentioned this aspect, though there is a great difference between the two groups, 65% of municipalities with a high amount of citizen described CO_2 reductions as a consequence of renewable energy and energy savings, whereas only 27% of the municipalities with a large amount of area formulated these CO_2 reductions. Moreover, there are not many differences between the formulations of both groups. In case the municipality quantified these CO_2 measures it is either be formulated with a specific amount or an expected percentage of reduced CO_2 emissions. For instance, the municipality Amsterdam describes measures to diminish the (fossil) energy consumption and to increase renewable energy generation, whereby the municipality expects to reduce the carbon emissions with 40% in 2025 and 75% in 2040 compared to 1990 (Municipality Amsterdam, 2015).

6.2.2. Quantified energy saving & energy efficiency measures

Following from these general formulations of reducing carbon emissions, the other categories can be elaborated in more detail. The first category on which the measurable targets are examined entails energy savings and energy efficiency. As presented by figure 24 most of the 50 municipalities formulate a target within this category and that also 72% of these municipalities provided a quantified formulation. The figure additionally indicates the difference between the municipalities with a high amount of citizen and a large area. It turns out that there are much more quantitative energy saving measures formulated by municipalities with a high amount of citizen compared with the municipalities with a large area. The quantified energy savings target is subsequently divided in the sub-categories energy neutral, energy labels, zero on the meter houses and energy efficient lightening which is shown in figure 25. This figure shows that there are no large differences, although the sub-category energy labels is most often quantified by the municipalities. Another remarkable trend is that the four sub-categories are equally quantified between municipalities with a high amount of citizen and with a large amount of area.

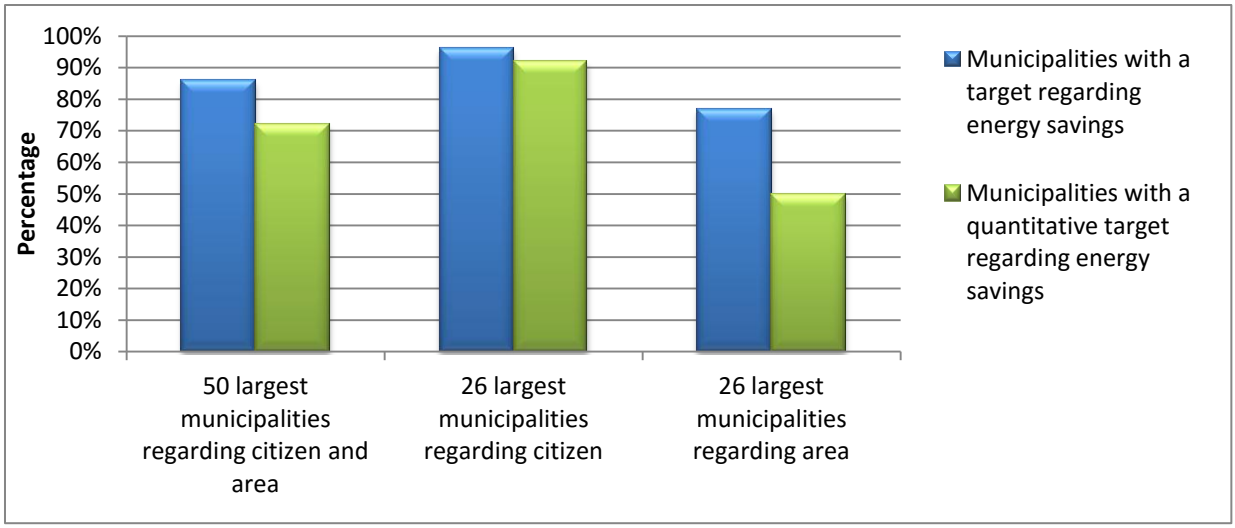

Figure 24 - The percentage of municipalities with a target regarding energy savings & energy efficiency and the percentage of municipalities with a quantified energy savings target. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

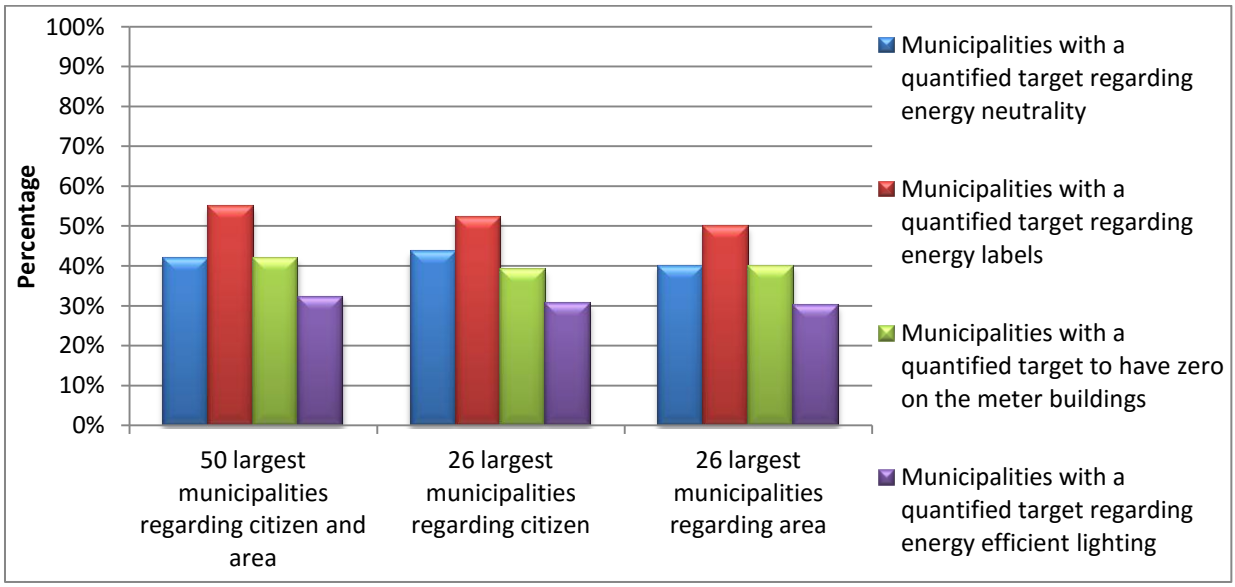

Figure 25 - The percentage of municipalities with a quantified energy savings target divided per sub-categories. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

It is furthermore examined how the measurable energy savings target is formulated for each sub-category. The analysis of the additional climate programs revealed one general formulation regarding the sub-category energy neutrality. This general formulation entails the formulation to become energy neutral in a particular target year. Moreover, most of the municipalities describe to accomplish this quantified target with the use of renewable energy or energy savings. Nevertheless, the formulation does not exactly show the potential amount of reduced CO_2 emissions. Additionally, it has been examined which municipalities formulated to build energy neutral or zero on the meter houses. It appears that this aspect is quantified by 42% of the 50 municipalities, either by describing a specific amount of zero on the meter houses or an expected amount of energy neutral houses. As a result, the municipalities Amsterdam, Groningen and Amersfoort the aim to establish 1000 zero on the meter houses, whereas Berkelland expects to build 30 zero on the meter houses (Municipality Amsterdam,

2015; Municipality Groningen, 2014; Municipality Amersfoort, 2014; Municipality Berkelland, 2016). This in contrast with the municipality Utrecht who has the objective to build annually 2000 energy neutral buildings (Municipality Utrecht, 2015).

Moreover, the sub-category energy efficient lighting is quantified by 32% of the 50 municipalities. Although energy efficient lighting can be achieved with energy savings in households and public areas, the municipality Utrecht is the only municipality that aims to improve energy efficient lighting within households (Municipality Utrecht, 2015). Energy efficient lighting is by most municipalities quantified with an expected amount of energy savings in a particular target year. Nijmegen for instance strives to reduce the energy consumption of public lights with 15% (Municipality Nijmegen, 2011). Additionally, the municipalities Arnhem, Sluis and Berkelland formulate the expected amount of lights to be replaced (Municipality Arnhem, 2015, Municipality; Berkelland, 2016). Sluis for example expects that replacing 1.494 poles and ~2.918 fixtures can save 18% of the consumed energy in public lighting (Municipality Sluis, 2013).

The final sub-category involves the quantified formulations regarding energy labels. This sub-category is with 55% of the municipalities more often formulated than the sub-category energy efficient lighting. Moreover, this amount of municipalities is also much higher compared to the 6% of municipalities that formulated energy labels in the executive agreements. This confirms the assumption that a target regarding energy labels is too detailed for the executive agreements which implies that it is likely that more municipalities in the Netherlands have targets regarding energy labels. The analysis of 50 municipalities furthermore reveals that the provided formulations often correspond with the first part of the national objective i.e. obtain average energy label B for corporation houses (SER, 2013). However, it varies per municipality if a particular amount of households is indicated. The second part of the objective that strives to realize energy label C at 80% of the private rental houses is only mentioned by a few municipalities including Utrecht, Groningen, Zwolle, Alphen aan den Rijn, De Friese Meren and Emmen. Moreover, the formulation to improve 2 label step improvements in buildings is only used by the municipalities Ooststellingwerf, Midden-Drenthe and Zaanstad.

6.2.3. Quantified renewable energy measures

The second category entails renewable energy measures. This target is similar to the previous analysis of the executive agreements divided in the sub-categories solar energy and wind energy. Figure 26 shows that all 50 municipalities provide a target regarding renewable energy. However only 44% of these municipalities also have a quantitative formulation. Besides, the figure shows the comparison between municipalities with a high amount of citizen or area. It turns out that half of the municipalities with a high amount of citizen formulated their renewable target with a measurable quantity, whereas only 35% of the municipalities with a large amount of area quantified their target.

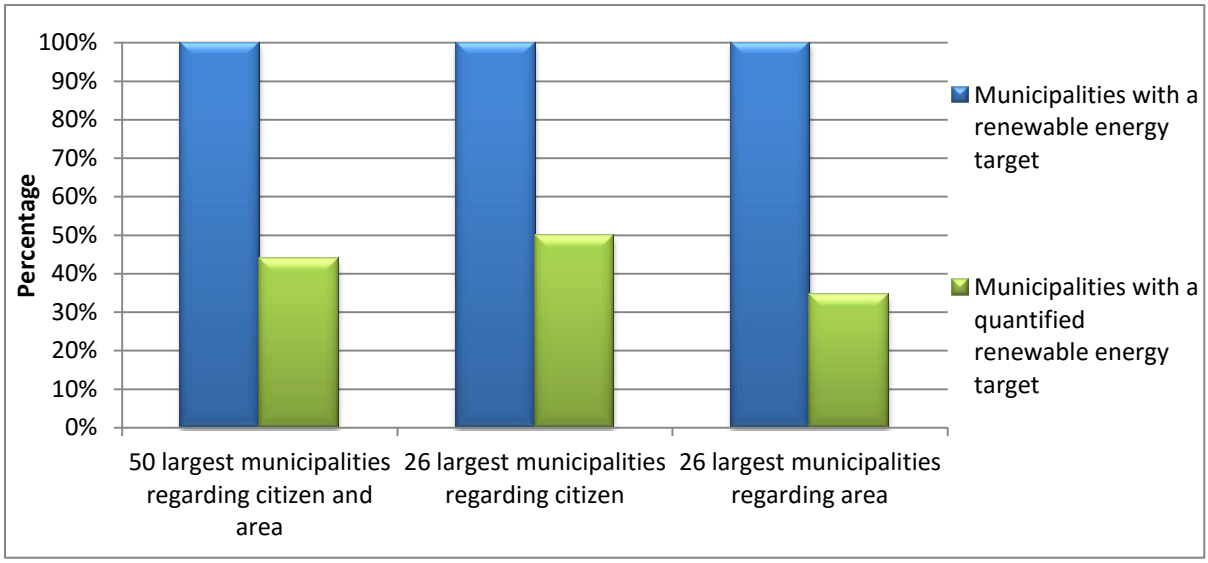

Figure 26 - The percentage of municipalities with a target regarding renewable energy and the amount of these municipalities with a quantified target. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

The analysis furthermore revealed a large difference between the division of quantitative renewable energy options among the 26 largest municipalities regarding citizen and area. On the one hand, figure 27 presents a relatively equal distribution between the renewable energy options among all 50 municipalities. However, where the 26 largest municipalities regarding citizen mostly apply a combination of quantitative solar and wind energy measures (69%), this combination is not formulated by one of the municipalities with a large amount of area. In contrast, municipalities with a large amount of area describe more often or a quantitative measure for solar energy or a quantitative measure regarding wind energy.

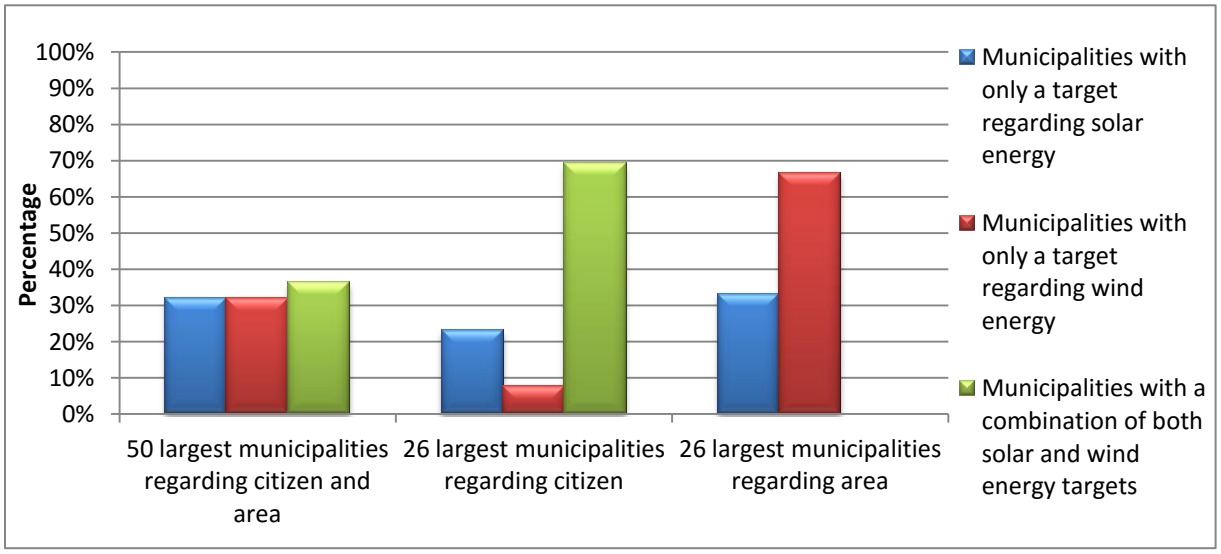

Figure 27 - The percentage of municipalities with a quantified renewable energy target divided in the sub-categories. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

Moreover, the analysis revealed several ways in which the quantitative targets are formulated. For solar energy are two different formulations identified. The first formulation involves a quantitative description wherein the expected amount of solar panels is defined for a particular target year. For instance Amsterdam formulates to have "*630.000 solar panels (100 ha) in 2020 in order to generate 160 MW of solar energy which is enough for the energy consumption of 80.000 households*" (Municipality Amsterdam, 2015, p.11). Similar formulations are also found for the municipalities Rotterdam, Arnhem, Groningen and Terneuzen. The second formulation which has been identified does not indicate an actual amount of solar panels, but only provides an expected potential amount of solar energy which has to be achieved in a particular target year. This formulation is for example reported by the municipality Almere *"from the required 436 MWp, 20 to 40 MWp will be realized in 2018"* (Municipaltiy Almere, 2015, p.36). Similar for both formulations is that most municipalities describe a potential amount of solar energy in MW, GWh or PJ.

Also the wind energy target is formulated along two ways. Most municipalities with a quantitative target indicate an intended amount of turbines for a particular target year. For example the municipality Enschede aims to install 7 wind turbines in 2020 (Municipality Enschede, 2010). The second possibility is for example applied by Amsterdam. This municipality formulates to strive for 85 MW wind energy in 2020 (Municipality Amsterdam, 2015). When the municipalities describe to have a potential amount of energy this is either be formulated in MW or PJ. All formulations regarding solar and wind energy are furthermore accompanied with a particular target year. These target years differ between the municipalities although most targets for solar and wind energy are described on a shorter timescale as 2018 or 2020. Nevertheless, some municipalities also took longer time periods into account, like Rotterdam (2030) and Amsterdam (2040) (Municipality Rotterdam, 2015; Municipality Amsterdam, 2015).

6.2.4. Quantitative sustainable transport measures

The third category involves sustainable transport options. This category is described by 24% of the 50 municipalities. Similar to the previous categories, figure 28 indicates that municipalities with a high amount of citizen formulate more often a measurable target regarding sustainable transport compared with municipalities with a high amount of area. The category is additionally divided in the sub-categories bicycling and electric vehicles. This division is visualized in figure 29. It appears that 42% municipalities quantified the sub-category electric vehicles, whereas only 25% of the municipalities formulated a measurable target regarding bicycles. The municipalities that quantified both the sub-categories is 17% and also a similar amount of municipalities did not further quantify their sustainable transport target.

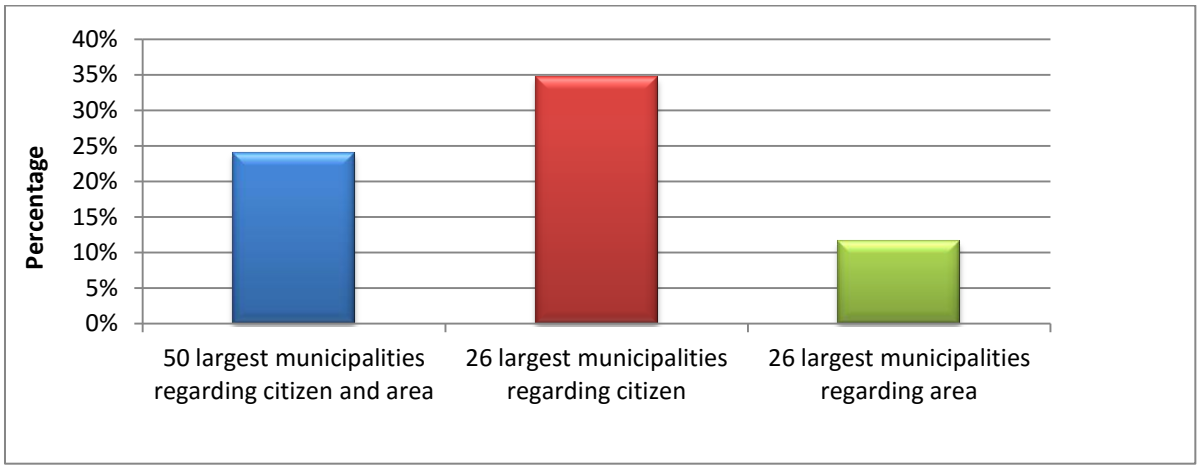

Figure 28 - The percentage of municipalities with a quantified target regarding sustainable transport. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

Although the amount of municipalities that quantified sustainable transport target is approximately similar for the 26 largest municipalities regarding citizens and area, figure 22 shows that the division of this target differs between these two groups. In municipalities with a high amount of citizen is the sustainable transport target equally divided in the categories regarding electric vehicles, bicycling and the combination of both targets. This in contrast with the municipalities with a large amount of area. These municipalities only formulate the sub-category bicycling in combination with electric vehicles.

In addition, the analysis of the measurable targets reveals a great variety in quantified formulations. One way to describe the sustainable transport is by formulating a particular amount of electric charging points. For example, Amsterdam has a target to establish 2500 electric charging points in 2016 and 4000 electric charging points in 2018 (Municipality Amsterdam, 2015). Another, formulation is to directly describe the expected amount of electric vehicles in a target year. The municipality Flevoland for instance aims to reduce the mobility with 10%, raise the usage of (electric) bicycles by 35%, create a full electric public transport system and an emission free city centre in 2025. Additionally, the municipality expects to reduce the CO_2 emissions with 20% compared to 1990 (Municipality Lelystad, 2015). Nonetheless, most municipalities with a measurable sustainable transport target did not indicate the predicted amount of CO_2 reductions.

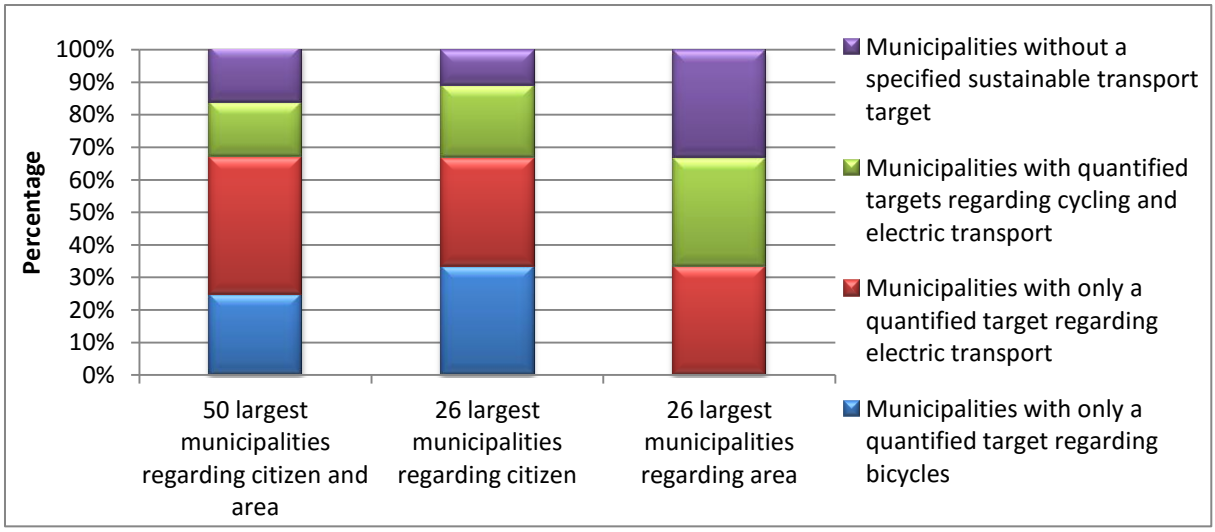

Figure 29 – The percentage of municipalities with a quantified sustainable transport target divided in the categories bicycling, electric transport, a combination of targets or not further specified their target. This is visualized for the selection of 50 municipalities and divided in the 26 largest municipalities regarding citizen and area.

6.2.5. Quantified waste heat measures

The last category to reduce the CO_2 emissions is waste heat. The analysis of the differences and similarities in Chapter 4 already presented that only 18 municipalities in the Netherlands provide a formulation regarding waste heat. The analysis of the 50 municipalities shows that 10 of these municipalities belong to the 26 biggest municipalities regarding citizen. Thereby, 8 of these municipalities also quantified their target. This formulation is often given as a quantitative amount of connections or households which will be connected to the waste heat network in a particular target year. Some of the municipalities also added a potential amount of CO_2 reductions that could be achieved if all connections are installed. For example, Rotterdam has a target to connect 150.000 houses and buildings to the heat network in 2030 and Groningen describes to have 40.000 house equivalents connected to the heat network in 2025. Groningen thereby predicts a reduction of 102 kton CO_2 if the connections are accomplished (Municipality Rotterdam, 2015; Municipality Groningen, 2014).

6.3. Identifying how the targets are monitored

Monitoring the implemented measures is important in order to determine the proceeding of a target. Therefore, the last aspects on which this chapter will focus is which targets are monitored, how are these targets monitored and when this monitoring takes place.

The analysis of the additional climate programs revealed that most municipalities recognize the importance of monitoring their programs which is mainly not specified per target, but only elaborated in single paragraph regarding monitoring. It is therefore often not possible to determine which targets are actually monitored. However, the municipalities do indicate how and when the targets are monitored. The municipality Sluis for example points out that their sustainability policy is monitored every two years. The results of this monitoring process will subsequently be applied to evaluate the policy and to signal if adaptations are required. One of the aspects which are monitored in this municipality is the energy consumption in municipal buildings (Municipality Sluis, 2013).

Another example is provided by the municipality Zoetermeer. This municipality monitors the climate program every year with the use of several indicators. One of these monitored indicators involves the abatement of CO_2 emissions as a consequence of the implemented projects. Other applied indicators are for instance air quality, biodiversity and sustainable procurement (municipality Zoetermeer, 2015). Also the municipality Haarlem measures the CO_2 emissions. In this context the municipality applies a CO_2 monitor to determine which industries and companies emit most CO_2 emissions. This information is subsequently applied to assign areas with a high potential for carbon reductions. The municipality on the other hand, stimulates sustainability measures at those companies and is able to measure the progress with the CO_2 monitor (municipality Haarlem, 2015).

The municipality Amsterdam has the most elaborated description on the monitoring process compared with other municipalities in the analysis. This municipality monitors the proceedings of several indicators, but also has a mandatory paragraph regarding sustainability adopted in the financial statements. In this paragraph, the progress of the CO_2 roadmap and the targets for sustainable procurement are reported and also aspects with regard to the generated amount of energy and the amount of energy saved are taken into account. Indicators to measure these aspects are for example the yearly renewable energy per citizen (GJ/citizen), yearly amount of energy saved (GJ/ citizen), the carbon dioxide emission per citizen and the share of bicycles in the total movements of bicycles and cars at 15 measure points in the city centre. The results are furthermore communicated with citizen and other organizations. Therefore, a quantitative sustainability index with the trends and developments, facts and figures, an overview of the results obtained by sustainable initiatives and questions, new chances and developments are formulated (Municipaltiy Amsterdam, 2015)

7. Determine the general contribution of municipalities to the national objectives

The previous analysis revealed which municipalities formulated a measurable quantity to their targets regarding the reduction of carbon emissions. However, providing a measurable target does not directly imply that the formulated target is applicable to determine its contribution to the national objectives from the Energy agreement. Hence, this chapter will strive to give a general overview regarding the contribution to the national objectives. The first part of this chapter examines the contribution of the municipality Arnhem to the national objectives regarding the main categories. The second part of this chapter will subsequently focus on the contribution of several municipalities to the national and provincial objectives regarding wind energy.

7.1. The national objectives from the Energy agreement compared with the municipality Arnhem

The Energy agreement describes a couple main objectives in order to reduce the CO_2 emissions in 2020. A first aim is to reduce the annual final energy consumption with 1.5%. This will subsequently result in 100PJ energy savings in 2020. The second aim is to raise the share of the renewable energy generation up to 14%. This has to be achieved with several renewable energy options including 6000 MW of on-shore wind energy and 40 PJ decentralised renewable energy. In order to derive the general contribution of the municipalities to these national objectives, it is preferred that a municipality formulated measures in a similar way. However the previous analysis revealed that there are not many municipalities with a quantitative formulation which is directly comparable with the national objectives. The municipality Arnhem is one of the exceptions with quantitative sustainability targets regarding all the main categories examined in this research. This municipality has therefore been chosen to assess their targets to the national objectives.

Besides the executive agreement, Arnhem provided an additional climate program wherein sustainable targets for 2020 are described. This program was established with the use of 117 partners who pointed out that the municipality needed more focus, realistic targets, a clear vision and actions programs on the short and long term regarding sustainability. The first part of this additional climate program describes the context of the program including the current local and national policies, the key partners of the municipality and the most important sustainable options for the municipality (Municipality Arnhem, 2015). The program defines the ambitions and potentials with regard to sustainable measures for 2020 and 2050. The main target of the municipality corresponds with the national objective, namely to obtain 14% renewable energy in 2020 and an annual energy reduction of 1.5% (Municipality Arnhem, 2015).

The municipality aims to achieve this target with the use of energy savings, wind energy, solar PV energy, sustainable heat and sustainable transport (Municipality Arnhem, 2015). As these ambitions are accompanied with a quantitative formulation they can be applied in order to determine the contribution to the national objectives. Regarding energy savings, Arnhem formulated to reduce the total energy consumption from 9.7 PJ to 9.0 PJ in 2020. The municipality expects to obtain these energy savings by influencing the behaviour of citizen, installing efficient devices, applying smart meters and monitoring systems and with measures such as isolation, LED lights and double glazed glasses in buildings. In addition, it is preferred to combine these measures with the concept of zero on the meter (Municipality Arnhem, 2015). The 0.7 PJ reduction of energy consumption in 2020 is

subsequently compared with the Dutch target to reduce the final energy consumption of 100 PJ in 2020. This implies that Arnhem contributes for 0.7% to the national objective[5].

Another measure of Arnhem is to install 4 wind turbines in 2020. Moreover, the municipality investigates in potential locations for wind energy, develops a spatial policy and provides an active role regarding the feasibility of wind turbines. Assuming that the intended 4 wind turbines are able to generate 3 MW wind energy, the contribution of Arnhem to the national objective will be 0.2%[6]. Additionally, the municipality contributes for 4.2% to the provincial target of Gelderland which is 230.5 MW in 2020 (RVO, 2016). Besides wind energy, the municipality also formulates the target to obtain 31.25 MW solar energy. This has to be accomplished with the realization of 105,000 extra solar panels in 2020, whereas the current amount of solar panels in the municipality 20,000. Besides the decentralized solar panels on roofs, the municipality aims to establish a solar farm with 8,000 solar panels. It is expected that this solar farm can generate 2 MW of solar energy in 2020 (Municipality Arnhem, 2015). However, the Dutch Energy agreement only describes a solar PV target in combination with other decentralized options as solar heat, heat cold storage and heat pumps. This should eventually generate 40 PJ energy in 2020. Assuming that this is a target for solar energy, it can be compared with the decentralized target of Arnhem. In this case, the 31.25 MW needs to be converted into PJ which results in ~0.98 PJ solar energy. This subsequently corresponds with a contribution of 2% to the national objective[7]. As a consequence of this assumption this result should be taken with care.

Moreover, Arnhem has formulated the intention to improve its district heating network. In this context, the heat network will be expanded with 2,000 household equivalents each years. This requires 475,000 GJ extra heat to the network in 2020. Another option for the municipality to sustain household heating is with the use of heat and cold storage or solar collectors. The municipality formulates the ambition to generate 50,000 GJ extra renewable heat in order to obtain a total of 325,000 GJ in 2020. Although the Energy agreement describes to improve the usage of waste heat, it does not provide a particular target which could be applied for the comparison with Arnhem. A final aim of Arnhem is to sustain the transport and mobility. This sustainable mobility target includes at least 85,000 GJ sustainable fuels, the realization of 1000 extra bicycle storage places, new trolley 2.0 busses and a test to recharge electric cars on the trolley lines. These aspects are in line with the Energy agreement wherein targets regarding sustainable mobility are formulated. The national government aims to realize with short and long term goals, a reduction of 25 Mton CO_2 in 2030 and 60% less CO_2 emission in 2050 compared with 1990 (SER, 2013).

[5] Calculation Energy Savings: $\frac{0.7\ PJ}{100\ PJ} * 100\% = 0.7\%$

[6] Calculation Wind Energy: $\frac{4 * 3\ MW}{6000 MW} * 100\% = 0.2\%$

[7] Calculation Decentralised Solar Energy: $31.25\text{MW} * 8760\ \text{h} * 3.6 * 10^{-6}$ PJ and $\frac{0.98 PJ}{40 PJ} * 100\% = 2\%$

7.2. The contribution of municipalities to the national wind energy objective

Raising the amount of wind energy is seen as an important measure to obtain 14% renewable energy and therefore the wind energy objective is formulated in more detail. In order to realize this increase, the Dutch government and the provinces established agreements about the realization of 6000 MW wind energy in 2020. The agreed amount of wind energy per province is together with the current amount of wind energy visualized in table VI (RVO, 2016). This data is subsequently applied to calculate which part of the provincial target has been fulfilled. It appears that the provinces Flevoland and Zeeland have currently the largest part of their wind energy target accomplished. This in contrast with Drenthe where only 8% of the provincial wind energy target is achieved (RVO, 2016). The second part of this paragraph will further elaborate on these two outstanding provinces Drenthe and Zeeland, but first the contribution to the wind energy objective of a couple selected municipalities will be further examined.

Table VI - The agreed amount of wind energy per province, the already achieved amount of wind energy and the calculated percentage of wind energy which has already been achieved. Source: RVO (2016).

Province	IPO agreement wind energy in 2020 (MW)	Amount of wind energy on Dec 31, 2015 (MW)	Percentage of wind energy already achieved
Flevoland	1,390.5	963	69%
Groningen	855.5	442	52%
Zuid-Holland	735.5	332	45%
Noord-Holland	685.5	358	52%
Zeeland	570.5	351	62%
Friesland	530.5	168	32%
Noord-Brabant	470.5	170	36%
Drenthe	285.5	22	8%
Gelderland	230.5	59	26%
Limburg	95.5	18	19%
Overijssel	85.5	43	50%
Utrecht	65.5	25	38%
Total	**6001**	**2951**	

The previous analysis of Chapters 5 and 6 revealed that only 19% of all municipalities in the Netherlands formulated wind energy in their executive agreements. Moreover, only 30% of the 50 selected municipalities provided a quantified target. This paragraph compares these formulated quantitative targets with the national objective for 2020. Only the municipalities with a wind energy targets for 2020 are considered in this comparison, because it has been assumed that municipalities with the ambition to realize wind energy in 2030 or 2040 are not contributing to the wind energy objective in 2020. Eventually, 10 municipalities could be assigned with a quantitative target regarding wind energy. These municipalities and their corresponding contribution to the national and provincial target are shown in table VII. Additionally, the table shows the weighted contribution of the target by providing the generated amount of wind energy per citizen.

It appears that the municipalities Lelystad, Dronten & Zeewolde have the highest contribution to the national objective compared with the other municipalities. These three municipalities are combined with each other as they cooperate in a regional plan (Municipality Lelystad, 2015). Another municipality which stands out in the table is Goerree-Overvlakkee. Similar to the municipalities in the regional plan of the province Flevoland, this municipality contributes for large part to the national and

provincial objective. Thus, the amount of wind energy per citizen is in this municipality is relatively high compared to the other municipalities. This might be explained by the low residential density of this municipality, whereas the other municipalities belong to the 26 largest municipalities in the Netherlands regarding citizens. Moreover, table VII reveals that only 23% of the national objective will be fulfilled with the formulated targets by these municipalities. Considering that currently only half of the national objective is fulfilled and that there are not many other municipalities with an ambition regarding wind energy, more effort to raise the amount of wind energy is required. Otherwise, it is likely that the wind energy objective will not be accomplished in 2020.

Table VII - The contribution of municipalities to the national and provincial objective regarding wind energy. Source: Municipality Nijmegen (2013), Municipality Arnhem (2015), Municipality Enschede (2010), Municipality Almere (2015), Municipality Lelystad (2015), Municipality Amsterdam (2015), CE Delft & Motivication (2016) & Municipality Goerree-Overvlakkee (2016).

Municipality	Target of municipality for 2020 (MW)	Contribution national target (6.000 MW)	Contribution to provincial target	The amount of KW wind energy per citizen
Nijmegen (Gl)	29.2	0.5%	12.7%	0.17
Arnhem (Gl)	12	0.7%	4.2%	0.08
Enschede (Ov)	16.1	0.3%	18.8%	0.10
Almere (Fl)	12.6	0.2%	0.9%	0.06
Lelystad, Dronten & Zeewolde (Fl)	304.4	5.1%	21.9%	2.20
Amsterdam (NH)	85	1.4%	12.4%	0.10
Zaanstad (NH)	15	0.3%	2.2%	0.10
Goeree-Overflakkee (ZH)	225	3.8%	30.6%	4.67
Total	1335	23%		

7.3. The contribution of the provinces Drenthe and Zeeland to the national wind energy objective

As already shown in table VI, the province Drenthe has currently the least amount of its wind energy target fulfilled. As a consequence, Drenthe needs to increase the amount of wind energy with 92% in the next four years. Despite of this low amount of wind energy, the province expresses the objective to become energy neutral in 2020. To accomplish this goal, the province describes a transition of fossil fuels towards renewable energy. This implies that efforts in solar energy, biomass energy, geothermal heat and the agreed 285.5 MW wind energy are required. To comply with the wind energy objective, the province has assigned new locations for wind farms in the municipalities Aa en Hunze, Borger-Odoorn Coevorden and Emmen (Province Drenthe, 2014).

Comparing this information with the analyzed targets of municipalities reveals that all the assigned municipalities adopted wind energy in their executive agreements. However, a more detailed analysis of the executive agreements shows that the municipalities are not completely in favour of wind energy. The municipality Aa en Hunze for example only mentioned wind energy as a politically relevant aspect, whereas Borger-Odoorn describes that the wind energy plans are assigned by the province and that they want to perform an independent research regarding the support among citizen (Municipality Aa en Hunze, 2014; Municipality Borger-Odoorn, 2014). A similar point of view is found by the municipalities Emmen and Coevorden. These municipalities acknowledge the provincial plans, but also put a high value on the opinion of citizen. In addition, the municipality Emmen provides requirements for wind energy in the potential locations. This implies that future wind projects should cause the least possible nuisance for citizen and that wind turbines within 1.500 meter from houses are not allowed. Another requirement is that possible revenues of the wind project should be added to a development fund for the area (Municipality Coevorden, 2014; Municipality Emmen, 2014).

Moreover, the assigned municipalities were included in the selected 26 largest municipalities regarding area. The analysis revealed that only the municipality Emmen provided a quantitative aim to raise the amount of wind energy. In this case, Emmen formulated that the municipality "*experiments with the participation of citizen and companies in a process of integrated area development in order to realize 60 MW of wind energy*" (Municipality Emmen, 2013, p. 6). However, a year later the province decided that Emmen has to generate 95.5 MW wind energy by 2020. Likewise, the province Drenthe has the intention to realize 40 MW of wind energy in the municipality Coevorden 150 MW in the municipalities Aa en Hunze and Borger-Odoorn (Province Drenthe, 2014). However, the latter two municipalities were not pleased with the locations for wind energy and started a lawsuit. Nonetheless, the court recently decided that the province is allowed to assign the location and that the planned wind turbines should be build (Municipality Aa en Hunze, 2016)

Although the resistance of some municipalities, the wind energy target of the province Drenthe could be achieved if the above projects are fulfilled. Table VII reveals that in this case the municipalities Aa en Hunze and Borger-Odoorn contribute for 53% to the provincial objective, Emmen for 33.5% and Coevorden for 14%. This results in a total contribution of 4.8% to the national target of 6000 MW. The table additionally shows that the combined project in the municipalities Aa en Hunze and Borger-Odoorn delivers a significantly higher amount of energy per citizen compared with Emmen and Coevorden, which might be a cause for the resistance against wind energy in these municipalities.

Table VIII - The wind energy targets of 3 assigned municipalities in the province Drenthe and their contribution to the national and provincial target. Additionally, the table shows the contribution of the target per citizen. Source: Province Drenthe (2015) & Municipality Coevorden (2014).

Municipality	Target of municipality for 2020 (MW)	Contribution national target (6.000 MW)	Contribution to provincial target	The amount of KW wind energy per citizen
Emmen (Dr)	95.5	1.6%	33.5%	2.01
Aa en Hunze & Borger Odoorn (Dr)	150	2.5%	52.5%	6.86
Coevorden (Dr)	40	0.7%	14.0%	2.62

Zeeland on the other hand is a province that already achieved a large part of its national wind energy objective. In order to realize this amount of wind energy the province has assigned centred areas for wind farms to avoid that large wind turbines arise at random locations. These locations are mainly located within the municipalities Vlissingen, Terneuzen, Reimerswaal, Veere, Noord-Beveland and Schouwen-Duiveland (Provincie Zeeland, 2016). Although the province Zeeland already realized a large part of its wind energy target, the analysis of the executive agreements shows that in this period of governance only 15% of the municipalities described a target regarding wind energy. It is not possible to derive the contribution of these municipalities to the national objective as the targets are not quantified. Nonetheless, the formulation of several municipalities in this province indicate that the incentive to expand on-shore wind energy is relatively low as 5 of the 13 municipalities formulated to be against on-shore wind farms or large wind turbines. This involves Reimerswaal, Schouwen-Duiveland, Sluis, Terneuzen and Veere.

On the one hand, Reimerswaal (77.50 MW) and Terneuzen (44 MW) already deliver a large part of the wind energy target, followed by Veere (24 MW) and Schouwen-Duiveland (10.20 MW) (Bosch & Van Rijn, 2016). In this case, a possibility in order to contribute to the provincial an national wind energy target is to upgrade the existing wind farms in these municipalities. On the other hand, the municipality Sluis is against large wind turbines and explains that only wind turbines with a shaft height up until 15m are allowed (Municipality Sluis, 2013). However, contribution of Sluis to Zeeland's wind energy target is with 10 MW low compared with the municipalities Reimerswaal and Terneuzen (Municipality Sluis, 2014; Bosch & Van Rijn, 2016). Nevertheless, this municipality seems most suitable to expand wind energy in Zeeland as the residential area in this municipality is low and the total amount of area is high (CBS, 2015). Moreover, it should be noticed that the province Zeeland also has a potential regarding off-shore wind energy. The province has thus several possibilities to continue with the expansion of wind energy.

8. Adaptations to improve the formulated local targets

Now it has been identified which targets are formulated by the municipalities, how these targets are measured and implemented and to what extend the targets contribute to the national objectives, this chapter seeks to provide adaptations for the improvement of local targets. These steps will be build upon the framework by Reed et al. (2006).

As described earlier, binding agreements for reducing greenhouse gas emissions are established at national and international scales. In response to these agreements the Netherlands has created the Energy agreement with measures for the reduction of carbon emissions which has to be implemented by provincial and local authorities (SER, 2013). The analysis in the previous chapters has revealed that currently a vast majority of the municipalities show commitment regarding sustainable development. In response to this commitment several municipalities have proposed measures to reduce carbon emissions. However, most of these measures are formulated in a general way with open-ended targets. These targets are often lacking detailed and quantified measures. This makes it harder to determine whether and to what extend the proposed measures are currently implemented.

On the one hand, one could question whether targets at a local level should be formulated in a more quantitative way. On the other hand, it seems that several important goals of the Energy agreement are not met in 2020 and that the commitment of the municipalities does not result in measures that actually contribute to the national objectives. This implies that it is necessary to put effort in achieving the targets at all levels of governance. In order to ensure that more of the proposed measures at a local scale become implemented and that it is possible to define the contribution of these measures to the national objectives, this study will recommend several adaptations. These adaptations will either improve the feasibility or measurability of a formulated target. These adaptations are supported by a couple steps that are shown in figure 30.

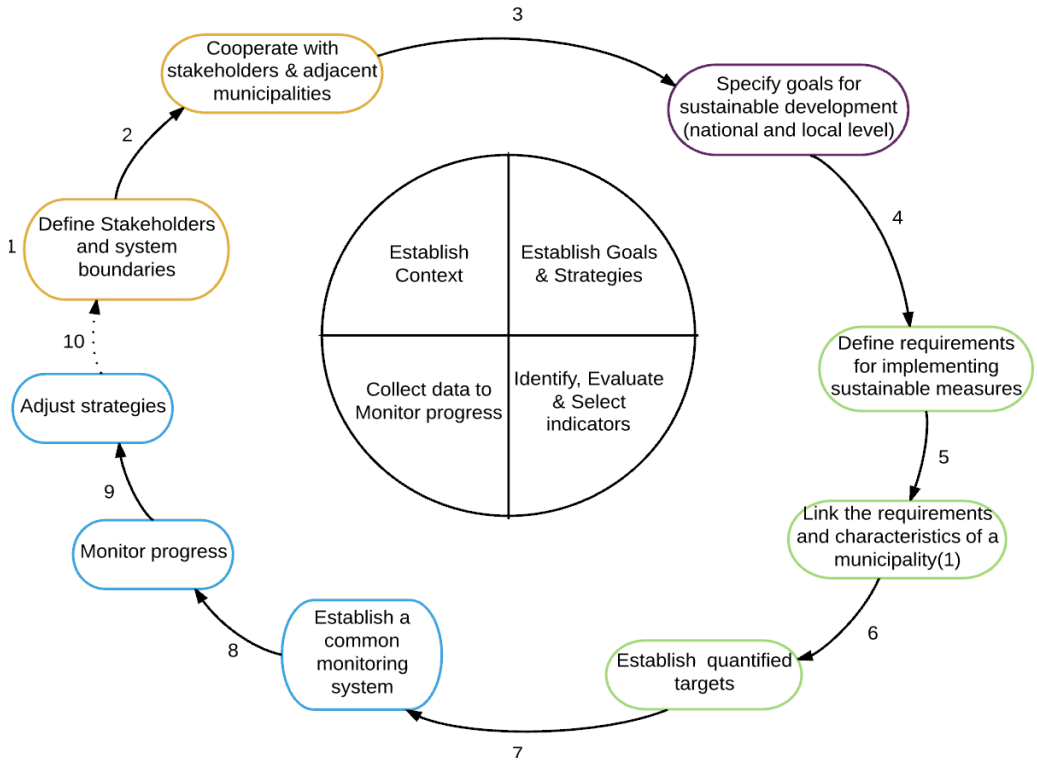

Figure 30 - Proposed adaptations to improve the feasibility and measurability of local sustainability targets.

8.1. Define stakeholders & system boundaries and establish cooperations

Identifying the system boundaries and the stakeholders is the first recommended step in figure 30. With the use of these two aspects one can draft a relevant context which contributes to improve the feasibility of a target. In order to be able to identify the system boundaries municipalities have to determine their own current situation. With this information one can detect which aspects could be improved within the power and tasks of a municipality. This could for example include the current energy performance of buildings, the energy labels of buildings, the generated amount of renewable energy and the available area for wind turbines or solar panels. Besides these system boundaries it is furthermore recommended to set up a rigorous stakeholder analysis. This is an important aspect because each of the following steps in the framework requires an active involvement of local stakeholders (Reed et al., 2006). It is crucial for municipalities to gain knowledge about stakeholders in order to perform their role as a connector and facilitator regarding (Municipality Arnhem, 2015). It is therefore necessary to identify which sustainable initiatives and projects are currently running in the municipality and which groups of stakeholders should be involved to implement sustainable measures.

When a municipality has identified the stakeholders, it is also important that the municipality cooperates with these actors. Besides cooperating with stakeholders, it might be beneficially for a municipality to cooperate with adjacent municipalities (J. Schreuder, pc, 2016). For this reason, Step 2 in figure 30 recommends to cooperate with stakeholders and other municipalities. One of the advantages of these cooperations is that municipalities can share knowledge and costs. Moreover, cooperation between municipalities can stimulate to adapt and match the targets with each other which is important because CO_2 emissions and the related reduction measures are often crossing the borders of municipalities.

The Dutch government has currently formulated several groups of important stakeholders including consumers, the traffic and transport sectors, agriculture, industry, retail, the building sector and other additional groups like energy companies or research institutions (Milieuloket, 2016). Although many municipalities have not indicated the involved stakeholders, three groups of stakeholders could be assigned by analysing the executive agreements and the additional climate programs, namely citizen, housing corporations and a combination companies and organizations. A comparison of the defined stakeholder groups of municipalities with the stakeholders formulated by the government reveals that one group in particular has not been taken into account by the municipalities i.e. the industrial sector. This group of stakeholders has often a high energy consumption which results in large amounts of CO_2 emissions (Rijksoverheid, 2014). Even though the municipality has limited power to influence the industrial sector, it might be an important stakeholder to take into account.

8.2. Establish quantitative local targets

After identifying the system boundaries and the stakeholders, the second part of the framework entails steps to establish goals and strategies for a more sustainable future (Reed et al., 2006). Such goals and strategies (step 3) have already been formulated in the Energy agreement which implies that it is also important that the national and provincial governments formulate feasible and measurable measures. The municipalities in turn have converted these national targets into local measures that are formulated their executive agreements and additional climate programs. However, these targets are often not quantified in a way that contributes to determine the contribution to the national objectives. It might therefore be important that a municipality provides a quantified plan when they are aiming to implement a measure. In this case one could identify whether a measure is implemented and to what extend it contributes to the national objectives. Following from this the formulated goals of municipalities should fit within the power and tasks of the municipalities as it has been described in Chapter Two. This should thus be determined with the use of step 3.

Defining quantified measures is also related to the third part of the adaptive learning process which prescribes to identify, evaluate and select indicators (Reed et al., 2006). In this context the requirements for possible sustainability measures should fit with the previously defined characteristics of the municipality (step 1). Step 4 therefore recommends to define relevant requirements for implementing a sustainable measure. The next step (step 5) links these requirements with the previously defined current situation of the municipality. Identifying the characteristics and the requirements in advance shows if the municipality is suitable to implement a measure and it thereby contributes to establish feasible targets. In this analysis it was possible to analyse some of the required characteristics. For example solar panels were compared with the amount of houses and wind energy related to the available area. Following from this it could be concluded that the municipalities are currently not always taking the available are for wind energy into account which shows the relevance to link the requirements for a sustainable measure with the characteristics of the municipality.

Moreover, when a municipality has determined which sustainable measures fit with the characteristics of the municipality, step 6 recommends to be quantify the measures. This could for example be achieved by identifying an x percentage or an x amount of energy savings, renewable energy or electric charging points. Additionally, the municipalities could formulate the expected percentage or expected amount of reduced CO_2 emissions. A corresponding aspect which should be considered in order to define quantitative targets is the formulation of short and long term goals. The analysis of the additional climate programs has revealed a large variation in described target years. It appears that many municipalities already guide their target with a particular target year. However, to be able to compare the measures with the Dutch energy agreement and to obtain a better overview of the progress, it would be preferred if all municipalities formulate targets for 2020. The IPO (2010) report has already recommended the national government to establish long term goals. This research therefore recommends to incorporate long term visions with potentials for 2030, 2040 or 2050 in the quantified measures. Moreover, an appropriate tool to visualise these long term visions and quantified targets is by creating roadmaps (IPO, 2010).

8.3. Monitor the progress of the quantified targets

The final step of the framework is associated with the collection of data to monitor the progress. According to Reed et al. (2006) the following steps are necessary: collect, analyse and disseminate data, assess the progress towards sustainability targets and adjust strategies to ensure the goals are met. The analysis of the 50 municipalities has revealed that there are several municipalities that have formulated a monitoring process. Beside the municipalities that have formulated monitoring systems, there were also many municipalities that did not provide the way in which they monitor their targets.

For this purpose it is recommended to assure that monitoring takes place, because it gives insights in the progress of a target and enables the possibility to respond on changing needs and priorities of the stakeholders (Reed et al., 2006). The municipality Groningen for example initially described a target to increase wind energy within the municipality. However, due to the provincial policy the municipality was forced to stop with this target in 2015 (Municipality Groningen, 2015). In such cases adjustments are necessary if the corresponding target to obtain a particular amount of renewable energy remains constant. As monitoring the progress improves the likelihood to achieve a target, it is suggested that a common monitoring system for all sustainable options will be established (step 7). This should subsequently be applied by all municipalities (step 8). In addition, if it turns out that it is required to change the municipal policy, the previous steps should be repeated (step 9, 10). Therefore, the framework is iterative which is represented by the feedback loop (Reed et al., 2006).

9. Discussion

A couple of limitations are inherent to data collection and research design. During this research some uncertainties and limitations appeared as a result of limited data availability and interpretation. This chapter will first elaborate on these shortcomings and provides afterwards an outlook for future research.

9.1. Reflection on the data availability

The information being used to determine the differences and similarities of formulated targets were mainly derived from the executive agreements. Although it was expected that the executive agreements would provide enough information, during the analysis it turned out that the executive agreements primarily focus on the main headlines of the governmental plans. This resulted in very general and short formulations regarding the selected categories that are analysed in this research. For this purpose, it was more difficult to assign which of the municipalities have actual plans to implement sustainability measures. In response to this limited data availability, the defined requirements were taking more general formulations into account which makes the analysis less accurate. Nevertheless, this way of formulating the categories was more convenient to be assure that most of the formulated targets were included in the category, keeping in mind that municipalities might have additional climate programs, with more accurate targets.

Moreover, the additional climate programs were retrieved for 50 municipalities in order to determine how the formulated targets are implemented, measured and monitored. Nonetheless, also the available data in these programs varied per municipality. As a consequence of this variety in data, a couple uncertainties arise and thus the results should be treated with care. At first, some of the additional programs were already outdated. Oostellingwerf and ‘s Hertogenbosch for example provided documents that were valid up until 2015, whereas their websites indicated that new policies should already be in place. After personal contact with these municipalities it turned out that the municipalities are working on new policies and that the current policies are still applied. A second shortcoming of using additional climate programs is that many municipalities provide several additional documents. For this reason, it was sometimes unclear if all documents were retrieved. To avoid this uncertainty, again personal contact was sought with the concerned municipalities. Nevertheless, some municipalities did not give a response and therefore it has been considered that the additional document were valid if targets regarding 2020 were described. A final shortcoming is caused by the fact that not all of the municipalities provide an additional climate program. The executive agreement were used in this case, although it has to be noted that the executive agreements have less information on quantified measures which creates an imbalance between the available amount of data and the assigned targets.

9.2. Reflection on the interpretation of the local targets

Another uncertainty emerges due to the interpretation of the various formulated targets. Every municipality with a target regarding one of the sustainable options formulates this in its own words. For each of these formulation it has been determined if the formulation fits within one of the categories. To be able to make the best possible consideration and thereby limit the uncertainty, a document with requirements has been created. Nevertheless, assigning if a municipality met the requirements remains a matter of interpretation. In order to deal with this uncertainty, the additional climate programs are applied for the analysis of the 50 municipalities. These additional climate programs provide a more complete overview of the targets which simplifies the way to assign the municipality to a target. A result of these requirements is that the analysis becomes more detailed which is a benefit in order to determine the similarities and differences as well to further analyse the

implementation and quantification of the targets. Applying these additional climate programs is therefore preferred over the executive agreements.

A related aspect, to the interpretation and the various formulations by the municipality, is that it has become more difficult to order a formulated target in one of the defined categories. As a result, some of the formulated targets could be interpreted in more than one category. For example it was attempted to assign energy savings in buildings in several groups, including rental buildings, private owned buildings and municipal buildings. However, the formulations were too diverse and therefore this division was not incorporated in the analysis (Municipality Achterkarspelen, 2014).

9.3. Recommendations for future research

Following from the previous limitations on available information and the uncertainty due to interpretation, it is in first place recommended to collect and analyse all additional climate programs of the municipalities instead of the executive agreements. As described in the previous section, the additional climate programs explain the targets regarding sustainable options with more detail which extends the available information and reduces the uncertainty. Obtaining all additional climate programs might furthermore be useful in order to determine if the policies are still valid and if the targets from the executive agreements are further elaborated.

Moreover, it is recommended to extent the analysis with other topics. For example obtaining more information regarding the financial aspects might be a contribution to determine if the municipality has enough budget to implement the measures. An additional aspect which might be interesting for future research, is to obtain more knowledge about the varies definitions regarding sustainable measures. This could for instance be achieved by interviewing municipalities about what they specifically mean with the formulated measures. For example when a municipality only formulated to become climate or energy neutral, a question might be ‘what does the municipality understand with becoming climate neutral or energy neutral?’ and ‘how is this supposed to be achieved?’. Subsequently, questions regarding quantitative measures or the amount of reduced CO_2 emissions could be valuable to determine in what way the municipality contribute to the national objectives. Asking these questions in a survey or an interview will therefore be useful to get a better overview of the formulated targets which contributes to the reduce the uncertainty due to interpretation.

Another recommendation for future research is to broaden the analysis by adding new categories or sub-categories in order to provide a more complete overview of the proposed measures. For example, the renewable energy target is in this research only divided in solar and wind energy which could be extended with other options such as biomass energy, solar heat, and geothermal heat or heat cold storage could. Another aspect to expand the analysis of the renewable energy targets is by comparing the target with more variables. Solar energy for example is in this research compared with the amount of houses, but might also be influenced by variables such as the type of house. Likewise, this research only considered the residential density as a variable for wind energy. However, wind energy is also influenced by other types of land use. One can for instance consider variables as forest area, agriculture, infrastructure or industries. Adding these aspects to the analysis can contribute to show if the municipality has potential to deploy solar or wind energy.

Moreover, this research compared the provincial objective for wind energy with the current amount of wind energy in the province and the subsequent targets of municipalities. This comparison was only established for the provinces Drenthe and Zeeland, but could be investigated for all provinces in future research. This comparison supports to determine to what extend the municipalities contribute to the provincial targets regarding wind energy. Likewise, the energy savings target could be further elaborated in future research by taking extra energy saving or energy efficiency categories into account. More specific requirements regarding these targets could contribute to divide both categories in two separate categories.

Obtaining more information regarding the targets and expanding the categories, will give more insights in local measures and target setting. A final recommendation is therefore to adapt the created framework with future knowledge in order to improve the steps.

10. Conclusion

This thesis has been conducted in order to identify how the national targets to reduce carbon emissions can be implemented to create feasible and measureable targets for municipalities in the Netherlands. With the use of executive agreements it first has been determined which measures are currently defined by the municipalities. This has resulted in a set of targets, including the categories of renewable energy, energy savings & energy efficiency, sustainable transport and waste heat. These targets have been further analysed to determine the differences and similarities of the categories among municipalities and provinces. It turned out that a vast amount of municipalities showed commitment to sustainable development and the reduction of carbon emissions. Although the analysis has revealed a large variety in formulations, detailed and quantified measures were often lacking.

The way in which these measures were implemented, measured and monitored could not be assessed with the use of the executive agreements. For this purpose, additional climate programs were derived for the 50 largest municipalities regarding area and citizens. A more detailed analysis of these programs has revealed that still a relatively low amount of municipalities has quantified their target in one of the categories. It is moreover noticeable that municipalities with a high amount of citizen more often formulate quantitative measures compared to the municipalities with a large amount of area. One aspect which was formulated in almost all quantified measures was the target year wherein the measure has to be achieved. Nevertheless, these quantified targets were in many cases not suitable in order to determine the contribution to the national targets. This was mainly caused by the fact that the quantified targets lacked formulations on the particular amount of energy saved, energy generated or CO_2 emissions reduced. The targets regarding wind energy were an exception to this rule and therefore it was possible to elaborate on the formulated wind energy measures.

Following from the research one can conclude that the commitment of many municipalities regarding carbon emission reductions does not result in quantified measures that contribute to the national objectives. This lack in quantified targets indicates that adaptations are required to improve the feasibility and measurability of municipalities in order to contribute to the national objectives. Therefore, this research recommends a couple steps to improve the targets, including determine the system boundaries and execute a rigorous stakeholder analysis, specify goals within the ability of the municipality, establish quantified targets and create a monitoring system to monitor the progress and adjust measures if needed. Additionally, some shortcomings were detected in the research related to the data availability and interpretations. For this reason, future research is recommended to obtain more quantitative data and to expand the research with more categories and relevant variables. These created adaptations and the proposed recommendations for further research can subsequently contribute to achieve the national objectives which is necessary for a reduction of carbon emission and will be beneficially in order to achieve a more sustainable future.

11. References

Andrews, J. & Jelley, N., (2013). *Energy science: principles, technologies, and impacts*. Oxford University Press.

Blok, K. (2007). *Introduction to Energy Analysis.* Amsterdam: Techne Press

Bosch & Van Rijn (2016). *Windstats.nl Statistieken over windenergie in Nederland.* Retrieved on July 15, 2016. Available on: <http://www.windstats.nl/turbines.php?&pagenum=1&sortcol=total_power&sortdir=DESC&provincie=Zeeland>

Bulkeley, H., & Kern, K. (2006). Local government and the governing of climate change in Germany and the UK. *Urban studies*, *43*(12), 2237-2259.

Cambridge Dictionary (2016). *Measure – The English definition of measure from the Cambridge dictionary.* Retrieved on August 17, 2016. Available on: <http://dictionary.cambridge.org/dictionary/english/measure>

Centraal Bureau voor de Statistiek (2014). *Nederland op weg naar 8 miljoen auto's.* Retrieved on June 2, 2016. Available on: <https://www.cbs.nl/nl-nl/nieuws/2014/34/nederland-op-weg-naar-8-miljoen-auto-s>

[1]CBS (2015). *Demografische kerncijfers per gemeente 2015.* Retrieved on February 8, 2016. Available on: <http://www.cbs.nl/NR/rdonlyres/CD5C3DC8-8DED-48CC-BC30-FDFE8AE0B372/0/2015A414demografischekerncijferspergemeente2015_WEB.pdf >

CBS (2016). *Gemeenten alfabethisch 2016.* Retrieved on April 6, 2016. Available on: <https://www.cbs.nl/nl-nl/onze-diensten/methoden/classificaties/overig/gemeentelijke-indelingen/gemeentelijke%20indelingen%20alfabetisch%20en%20numeriek/gemeenten-alfabetisch-2016>

[2]CBS (2016). *Regionale kerncijfers Nederland.* Retrieved on August 17, 2016. Available on: < http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=70072NED&D1=260-261&D2=>

[3]CBS (2016). *Energieverbruik particuliere woningen; woningtype en regio's.* Retrieved on August 17, 2016. Available on: <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=81528ned&D1=a&D2=0,4-7&D3=>

[4]CBS (2016). *Hernieuwbare energie; verbruik naar energiebron, techniek en toepassing.* Retrieved on August 17, 2016. Available on: <http://statline.cbs.nl/Statweb/publication/?VW=T&DM=SLNL&PA=83109ned&D1=a&D2=0-2,5,11,18-19&D3=a&D4=0,10,20-25&HD=160713-1430&HDR=T&STB=G1,G2,G3>

[5]CBS (2016). *Energiebalans; Kerncijfers.* Retrieved on August 17, 2016. Available on: <http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=37281&D1=19-20&D2=0-1,4,7-12&D3=l&VW=T>

[6]CBS (2016). *Export draagt 29% bij aan Nederlandse economie.* Retrieved on August 27, 2016. Available on: <https://www.cbs.nl/nl-nl/nieuws/2012/06/export-draagt-29-procent-bij-aan-nederlandse-economie>

[7]CBS (2016). *Nederland langs de Europese Meetlat 2016.* Retrieved on August 27, 2016. Available on: <http://download.cbs.nl/pdf/2016-nederland-langs-de-europese-meetlat-2016.pdf>

CE Delft, Motivication (2016). *Zaans Groen. Ingrediënten voor de Zaanse Energie Agenda 2.0.* Retrieved on June 2, 2016. Available on: <http://www.ce.nl/?go=home.downloadPub&id=1773&file=CE_Delft_3I15_Zaans_groen_DEF.pdf>

Coenen, F. M. & Menkveld, M. (2002). *The role of local authorities in a transition towards a climate-neutral society*, in: M. T. J. Kok, W. J. W. Vermeulen, A. P. C. Faaij & D. de Jager (Eds) Global Warming & Social Innovation. The Challenge of a Climate-Neutral Society (London, Earthscan).

Covenant of Mayors (2016). *As a local authority.* Retrieved on August 23, 2016. Available on: <http://www.covenantofmayors.eu/participation/as-a-local-authority_en.html>

Cunningham, W.P. & Cunningham, M.A. (2012). *Environmental science: A global concern.* New York: McGraw-Hill

Davies, A. R. (2005). Local action for climate change: transnational networks and the Irish experience. *Local Environment*, *10*(1), 21-40.

ICLEI (2016). *Who are we.* Retrieved on August 23, 2016. Available on: <http://www.iclei.org/about/who-is-iclei.html>

ECN (2015). *Nationale Energieverkenning 2015.* Retrieved on March 14, 2016. Available on: <https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-O--15-033 >

Energy Cities (2016). *Association*. Retrieved on August 23, 2016. Available on: <http://www.energy-cities.eu/-Association,8->

Euro Cities (2016). *About Euro Cities.* Retrieved on August 23, 2016. Available on: <http://www.eurocities.eu/eurocities/about_us>

European Comission (2008). *Het voorstel van de Commissie over de verdeling van de inspanning op het gebied van emissiereductie: vragen en antwoorden.* Retrieved on April 21, 2016. Available on the World Wide Web: <http://europa.eu/rapid/press-release_MEMO-08-34_nl.htm>

European Commission (2010). *Europe 2020: the European Union strategy for growth and employment.* Retrieved on February 8, 2016. Available on the World Wide Web: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=uriserv:em0028>

European Council and Parliament (2009). *The promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.* Retrieved on March 14, 2016. Available on: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN>

Eurostat (2016). *Gross domestic product at market prices.* Retrieved on August 23, 2016. Available on: <http://ec.europa.eu/eurostat/tgm/graph.do;jsessionid=Tm4EYMZINmROnoLIpBP5NaM2p4FCcLbm0bwwLKsMKYO0Uvolja!125362223?tab=graph&plugin=1&language=en&pcode=tec00001&toolbox=type>

Interprovinciaal Overleg (IPO) (2010). *Uitwerking en actualisering duurzame energie ambities Klimaat-en Energieakkoord.* 288. Den Haag: RS Drukkerij

International Energy Agency (IEA) (2016). *Energy Efficiency.* Retrieved on March 26, 2016. Available on: <http://www.ipcc.ch/pdf/assessmentreport/ar5/syr/AR5_SYR_FINAL_SPM.pdf>

IPCC (2014). *Climate Change 2014, Synthesis Report. Summary for Policymakers.* Retrieved on February 8, 2016. Available on the World Wide Web: <https://www.iea.org/aboutus/faqs/energyefficiency/>

Ketelaars (2015). Gemeentelijke Experimenten Nederland. Retrieved on April 27, 2016. Available on: <http://basisinkomen.net/obi/testimonial/gemeentelijke-experimenten/>

Lindseth, G. (2004). The Cities for Climate Protection Campaign (CCPC) and the framing of local climate policy. *Local environment*, *9*(4), 325-336.

Milieuloket (2016). *Doelgroepen milieubeleid.* Retrieved on July 27, 2016. Available on: <http://www.milieuloket.nl/9353000/1/j9vvhurbs7rzkq9/vhurdyxq2n7k>

PBL (2013). *Potentieel van bekende hernieuwbare energiesoorten in 2050.* Retrieved on June, 29. Available on: <http://www.pbl.nl/infographic/potentieel-van-bekende-hernieuwbare-energiesoorten-in-2050>

Province Drenthe (2014). *Regieplan Windenergie Drenthe.* Retrieved on July 20, 2016. Available on: <https://www.aaenhunze.nl/Inwoners_verenigingen/Wonen_en_ver_bouwen/Windenergie/Regieplan_Windenergie_Drenthe_Definitief.org>

Province Zeeland (2016). *Windenergie.* Retrieved on July 20, 2016. Available on: <https://www.zeeland.nl/energie-en-klimaat/windenergie>

Quaid, A. (2002). The sustainability inventory: A tool to assist US municipalities advance towards sustainability. *Local Environment*, *7*(4), 447-452.

Reed, M. S., Fraser, E. D., & Dougill, A. J. (2006). An adaptive learning process for developing and applying sustainability indicators with local communities. *Ecological economics*, *59*(4), 406-418.

Rijksoverheid (2014). *Energieverbruik per sector, 1990-2013.* Retrieved on July 27, 2016. Available on: <http://www.clo.nl/indicatoren/nl0052-energieverbruik-per-sector?i=6-40>

Rijksoverheid (2015). *5 miljoen huiseigenaren krijgen energielabel.* Retrieved on March 26, 2016. Available on: <https://www.rijksoverheid.nl/actueel/nieuws/2015/01/06/vijf-miljoen-huiseigenaren-krijgen- energielabel>

[1]Rijksoverheid (2016). *Taken van een gemeente.* Retrieved on April 18, 2016. Available on: <https://www.rijksoverheid.nl/onderwerpen/gemeenten/inhoud/taken-gemeente>

[2]Rijksoverheid (2016). *Windenergie.* Retrieved on April 18, 2016. Available on: <https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/inhoud/windenergie>

[3]Rijksoverheid (2016). *Zonne-energie.* Retrieved on April 18, 2016. Available on: <https://www.rijksoverheid.nl/onderwerpen/duurzame-energie/inhoud/zonne-energie>

RVO (2016). *Provinciaal beleid windenergie.* Retrieved on June, 29. Available on: <http:// www.rvo.nl/onderwerpen/duurzaam-ondernemen/duurzame-energie-opwekken/ windenergie-op-land/beleid/provinciaal-beleid>

Rijkswaterstaat (2013). *De rol van locale overheden bij locale duurzame energie-initiatieven.* Retrieved on Mai 2, 2016. Available on: <http://www.rwsleefomgeving.nl/onderwerpen/ lokaal_klimaatbeleid/publicaties/downloads/ha ndreiking-rol/>

Rijkswaterstaat (2016). *Totaal hernieuwbare energie alloceerbare opties 2013- gemeenten.* Retrieved on August 17, 2016. Available on: <https://klimaatmonitor.databank.nl/Jive/>

Sociaal Economische Raad (SER) (2013). *Energieakkoord voor duurzame groei*. Retrieved on February 8, 2016. Available on: <http://www.energieakkoordser.nl/energieakkoord.aspx>

United Nations (2010). *Guidelines on the setting of targets, evaluation of progress and reporting*. Retrieved on March 8, 2016. Available on the World Wide Web: <https://www.unece.org/fileadmin/DAM/env/water/publications/documents/guidelines_target _setting.pdf>

Vries, B.J.M. de, Vuren, D.P. van, Hoogwijk, M.M. (2007). Renewable energy sources: Their global potential for the First-halve of the 21st century at a global level: An integrated approach. *Energy Policy*. *35*(4), 2590-2610.

Wilson, E. (2006). Adapting to Climate Change at the Local Level: The Spatial Planning Response. *Local Environment*, *11*(6), 609–625.

Cover page illustration:

Ways to reduce your carbon footprint. Retrieved from: <http://www.dailysabah.com/life/2014/07/09/ways-to-reduce-your-carbon-footprint>

Applied Executive agreements and additional climate programs

Municipality Aa en Hunze (2014). *Buitengewoon, verbindend,levendig en zorgzaam. Executive agreement 2014-2018 Gemeentebelangen, GL, CDA.* Retrieved on April 4, 2016. Available on: <https://www.aaenhunze.nl/Bestuur/College_van_ burgemeester_en_wethouders/ Coalitieakkoord_2014_2018>

Municipality Aa en Hunze (2016). *Uitspraak kort geding windpark 3 februari 2016.* Retrieved on July 20, 2016. Available on: <https://www.aaenhunze.nl/Inwoners_verenigingen/Wonen_en_ ver_bouwen/Windenergie/Uit spraak_kort_geding_windpark_3_februari_2016>

Municipality Aalsmeer (2014). *Samen voor Aalsmeer: ondernemend en zorgzaam. Executive agreement 2014-2018 CDA, Aalsmeerse Belangen.* Retrieved on April 4, 2016. Available on: <https://www.aalsmeer.nl/web/Bestuur-en-organisatie/College-van-B-en-W/Collegeprogramma-20142018-3.htm>

Municipality Achterkarspelen (2014). *In sosjaal, lokaal en belutsen mienskip*. Executive program 2014-2018 FNP, GBA en PvdA. Retrieved on April 4, 2016. Available on: <http://www.achtkarspelen.nl/organisatie-bestuur-achtkarspelen/coalitieprogramma_43971/>

Municipality Almere (2015). *Energie werkt!* Retrieved on June 10, 2016. Available on <http://www.binnenlandsbestuur.nl/Uploads/2015/4/Energie-Werkt.pdf>

Municipality Amsterdam (2015). *Duurzaam Amsterdam.* Retrieved on June 10, 2016. Available on: <https://www.amsterdam.nl/gemeente/volg-beleid/agenda-duurzaamheid/>

Municipality Amersfoort (2014). *Toekomstagenda Milieu 2014-2020.* Retrieved on June 8, 2016. Available on <https://amersfoort.notudoc.nl/cgi-bin/showdoc.cgi/env=help/action= view/id=835231/type=pdf/Toekomstagenda_Milieu_2014-2020.pdf>

Municipality Arnhem (2015). New Energy made in [Arnhem]. Retrieved on June 8, 2016. Available on: <https://www.arnhem.nl/stad_en_wijken/projecten/energie_made_in_ arnhem/new_energy_made_in_arnhem/Programma_New_energy_made_in_Arnhem.pdf>

Municipality Baarn (2014). *Nieuwe energie voor Baarn. Executive agreement 2014-2018 BOP, D66, GL, PvdA.* Retrieved on April 4, 2016. Available on: <http://www.baarn.nl/portal/nieuwsberichten_41899/item/coalitieakkoord-nieuwe-energie-voor-baarn_40121.html>

Municipality Best (2014). *Verbinden met Daadkracht. Policy agreement 2014-2018*. Retrieved on: April 4, 2016. Available on: <https://www.gemeentebest.nl/beleidsakkoord-2014-2018>

Municipality Bergen op Zoom (2014). *Merk toch hoe Sterk. Executive agreement 2014-2018 GBWP, Lijst Linssen, VVD, D66.* Retrieved on April 4, 2016. Available on: <http://www.bergenopzoom.nl/Bestuur/College_van_B_W/Coalitieakkoord_Merck_toch_hoe _Sterck_2014_2018.org>

Municipality Berkelland (2016). *Energie Uitvoeringsprogramma 2015 t/m 2018.* Retrieved on June 10, 2016. Available on: <http://www.gemeenteberkelland.nl/bis/dsresource? objectid=6b5195cd-d677-4e06-9b09-e1b462b1b77b&type=PDF>

Municipality Borger-Odoorn (2014). *Verbindend besturen naar een nieuw evenwicht.* Executive agreement 2014-2018 Gemeentebelangen, D66, CDA. Retrieved on April 4, 2016. Available on: <https://www.borger-odoorn.nl/bestuur-en-organisatie/burgemeester-en-wethouders/coalitieakkoord.html>

Municipality Bunschoten (2014). *Samen kunnen we meer. Executive agreement 2014-2018 CDA, CU.* Retrieved on April 4, 2016. Available on: <http://www.bunschoten.nl/bestuur/documenten-bestuur_42620/item/coalitie-akkoord-2014-2018_28459.html>

Municipality Castricum (2014). *Ondernemend en Sociaal vooruit 2014-2018.* Stadspartij Den Helder, Behoorlijk Bestuur, Fractie Vermooten, Vrije socialisten, GL, CU. Retrieved on April 4, 2016. Available on: <https://castricum-preproductie.sim-otap.nl/portal-home>

Municipality Coevorden (2014). *De verbindende kracht van Coevorden.* Executive agreement 2014-2018 BBC 2014, CDA, PvdA. Retrieved on April 4, 2016. Available on: <https://www. coevorden.nl/bestuur-en-organisatie/burgemeester-en-wethouders/bestuursprogramma.html>

Municipality De Friese Meren (2014). *De Friese Meren: Een dynamische en vitale gemeenschap. Exective agreement 2014-2018 FNP, CDA.* Retrieved on April 4, 2016. Available on: <http://www.defryskemarren.nl/bestuur-en-organisatie/collegeprogramma_42885/>

Municipality Emmen (2013). *Milieuagenda 2013 – 2016.* Retrieved on June 10, 2016. Available on: <https://gemeente.emmen.nl/sites/default/files/milieuagenda_2013-2016.pdf>

Municipality Emmen (2014). *Aanpakken en Doen! Policy agreement 2014-2018* Wakker Emmen, PvdA, CDA. Retrieved on April 4, 2016. Available on: <https://gemeente.emmen.nl/sites/default/files/bestuursakkoord_2014-2018_aanpakken_en_doen.pdf>

Municipality Enschede (2010). Nieuwe *Energie voor Enschede.* Retrieved on June 8, 2016. Available on: <http://enschede.doegroendatscheelt.nl/algemeen/Nota/>

Municipality Groningen (2014). *Masterplan Groningen Energieneutraal.* Retrieved on June 8, 2016. Available on: <https://gemeente.groningen.nl/sites/default/files/masterplan-groningen-energieneutraal.pdf>

Municipality Goerree-Overvlakkee (2016). *Energieneutraal.* Retrieved on June 10, 2016. Available on: <http://www.goeree-overflakkee.nl/duurzaamheid/energieneutraal_44273/>

Municipality Haaksbergen (2014). *Krachtig, Energie, Verbindend. Executive agreement 2014-2018 LH, D66, PvdA.* Retrieved on April 4, 2016. Available on: <https://www.haaksbergen.nl/Beleidscyclus.html>

Municipality Haarlem (2015). *Duurzaamheidsprogramma.* Retrieved on June 8, 2016. Available on <http://www.degroenemug.nl/media/Duurzaamheidsprogramma2015-2019.pdf>

Municipality Heemstede (2014). *Collegeakkoord. Executive agreement 2014-2018 HBB, VVD, CDA.* Retrieved on April 4, 2016. Available on: <https://www.heemstede.nl/fileadmin/files/heemstede/documenten/Politiek_en_organisatie/Beleidsstukken/Collegeakkoord_2014.pdf>

Municipality Heerde (2014). *De kracht van samen leven, wonen en werken. Executive program 2014-2018 DGH, PvdA/GL.* Retrieved on April 4, 2016. Available on: <https://www.heerde.nl/dsresource?objectid=33fa6152-315e-4cda-96b8-fd8b6d1f2de5&type=org&&>

Municipality Hellendoorn (2014). *Samen aan zet. Executive agreement 2014-2018 CDA,CU, D66, PvdA, VVD.* Retrieved on April 4, 2016. Available on: <*https://www.hellendoorn.nl/politiek-gemeente/beleidsbibliotheek/collegeprogramma/00001/*>

Municipality Hendrik-Ido-Ambacht (2014). *Voor elkaar in Ambacht. Executive agreement 2014-2018 CDA, SGP, CU, PvdA.* Retrieved on April 4, 2016. Available on: <https://www.h-i-ambacht.nl/ik-woon/bestuur-en-organisatie/college/coalitieprogramma-2014-2018>

Municipality Hoorn (2014). *De kracht van verbinding.* Executive agreement 2014-2018 PvdA, SP, D66, CDA, GL. Retrieved on April 4, 2016. Available on: <https://www.hoorn.nl/Documenten/Internet/Gemeentebestuur/Beleidsdocumenten/2014/Coalitieakkoord%202014.pdf>

Municipality Houten (2014). *Beleidsakkoord of coalitieakkoord. Executive agreement 2014-2018 D66, VVD, CDA, PvdA.* Retrieved on April 4, 2016. Available on: <https://www.houten.nl/uploads/tx_pagefiles/Beleidsakkoord_2014-2018.pdf>

Municipality Hulst (2014). *Samen voor Hulst. Executive agreement 2014-2018 Algemeen Belang Groot Hulst, CDA, Groot Hontenisse, PvdA.* Retrieved on April 4, 2016. Available on: <https://www.gemeentehulst.nl/de_Gemeente/College_van_B_W/Coalitieprogramma.org>

Municipality Langedijk (2014). *Samen Verantwoordelijk. Executive agreement Dorpsbelang, VVD, CDA.* Retrieved on April 4, 2016. Available on: <http://www.gemeentelangedijk.nl/dsresource?objectid=6ed135ec-76fb-40f9-a9bf- c6b3bed4db60&type=org>

Municipality Lelystad (2014). *Lelystad transformeert! Executive agreement 2014-2018 VVD, InwonersPartij, PvdA, SP, CU.* Retrieved on April 4, 2016. Available on: <http://www.lelystad.nl/Documenten/Gemeente/Coalitieakkoord%202014-2018.pdf>

Municipality Lelystad (2015). *Kadernota Duurzaam.* Retrieved on June 10, 2016. Available on: <https://www.lelystad.nl/Documenten/WonenLeven/Kadernota%20duurzaamheid.pdf>

Municipality Meppel (2014). *Met de Samenleving. Executive agreement 2014-2018 VVD, PvdA, CDA, CU* Retrieved on June 8, 2016. Available on: <https://www.meppel.nl/Bestuur_organisatie#item_tab>

Municipality Nijmegen (2011). *Duurzaanheidsagenda 2011-2015.* Retrieved on June 8, 2016. Available on: <http://www2.nijmegen.nl/mmbase/attachments/1112677/Duurzaamheidsagenda_Gemeente_Nijmegen_2011-2015_def.pdf>

Municipality Nijmegen (2013). *Power 2 Nijmegen.* Retrieved on June 8, 2016. Available on: <http://www2.nijmegen.nl/wonen/milieuenafval/klimaat/Power2Nijmegen>

Municipality Opmeer (2014). *Samen werken aan duurzame zorg, werk en welzijn. Executive agreement 2014-2018* Gemeentebelangen, VVD en PvdA. Retrieved on April 4, 2016. Available on: <http://www.opmeer.nl/bestuur-organisatie/coalitieakkoord_44618/>

Municipality Pijnacker (2014). *Collegeprogramma. Executive agreement 2014-2018* . Retrieved on April 4, 2016. Available on: <http://www.pijnacker-nootdorp.nl/web/file?uuid=0fb98ff7-5f7d-4243-b5a9-3fa18d358caf&owner=06df2d6e-b001-4f56-82f8-72c1ccdc169c&contentid=10176>

[2]Municipality Rotterdam (2015). *Duurzaam dichter bij de Rotterdammer.* Retrieved on June 10, 2016. Available on: <http://www.rotterdam.nl/Clusters/Stadsontwikkeling/Document%202015/Duurzaam/Rotterdam_Duurzaam_2015-2018_spreads.pdf>

Municipality Sluis (2013). *Visie Duurzaam Sluis 2013-2019.* Retrieved on June 10, 2016. Available on: <https://www.gemeentesluis.nl/Leven_Wonen_en_Werken/Ruimte_wonen_milieu/Milieu>

Municipality Sluis (2014). *Sluis verbindt Het geheel is meer dan de som der delen. Executive agreement 2014-2018 CDA, Nieuw Gemeentebelang, VVD, D66.* Retrieved on April 4, 2016. Available on: <https://www.gemeentesluis.nl/Bestuur_en_Organisatie/College_ B_W/College_B_W>

Municipality Utrecht (2014). *Utecht maken we samen. Executive agreement 2014-2018 D66, GL, VVD, SP.* Retrieved on April 4, 2016. Available on: <https://www.utrecht.nl/college-van-b-en-w/coalitieakkoord-2014-2018/>

Municipality Utrecht (2015). *Utrecht: energiek middelpunt van het land Duiding van het College bij het Energieplan.* Retrieved on June 10, 2016. Available on: <https://www.utrecht.nl/fileadmin/uploads/documenten/3.ruimtelijk-ontwikkeling/Milieu/Energie/Duiding-van-het-College-bij-het-Energieplan.pdf>

Municipality Westland (2014). *Nieuwe realiteit, Westlandse oplossingen Collegeworkingprogram 2014-2018 CDA, Gemeentebelang, VVD, Progressief Westland.* Retrieved on April 4, 2016. Available on: <https://www.gemeentewestland.nl/fileadmin/documenten/organistatie_en_bestuur/Collegewerkprogramma_2014-2018.pdf>

Municipality Zoetermeer (2015). *Programma 'Duurzaam Zoetermeer 2030'.* Retrieved on June 8, 2016. Available on: <http://www.zoetermeer.nl/inwoners/duurzaam-zoetermeer_46746/item/het-programma-duurzaam-zoetermeer_34769.html>

Municipality Zeewolde (2014). *Duurzaam zelfbewust. Executive program 2014-2018 Leefbaar Zeewolde, CU, CDA, VVD* Retrieved on April 4, 2016. Available on: <http://www.zeewolde.nl/bestuur/collegeprogramma-2014-2018_41391/>

Municipality Zaanstad (2013). *Evaluatie integraal klimaatprogramma Zaanstad Een herijking van de routekaart naar klimaatneutraliteit in 2020.* Retrieved on June 2, 2016. Available on: <https://zaanstad.notudoc.nl/cgi-bin/showdoc.cgi/action=view/id=781919/type=pdf/Rapportage_m.b.t._evaluatie_klimaatprogramma_21.05.13.pdfEvaluatie>

12. Annex

A. Selected municipalities

The list with selected municipalities applied in the analysis regarding the measurable targets.

26 biggest municipalities regarding area			26 largest municipalities regarding residents	
Municipality	**Province**		**Municipality**	**Province**
Noordoostpolder	Flevoland		Amsterdam	Noord-Holland
Súdwest-Fryslân	Friesland		Rotterdam	Zuid-Holland
Hollands Kroon	Noord-Holland		Den-Haag	Zuid-Holland
De Friese Meren	Friesland		Utrecht	Utrecht
Midden-Drenthe	Drenthe		Eindhoven	Noord-Brabant
Apeldoorn	Gelderland		Tilburg	Noord-Brabant
Emmen	Drenthe		Groningen	Groningen
Dronten	Flevoland		Almere	Flevoland
Ede	Gelderland		Breda	Noord-Brabant
Hardenberg	Overijssel		Nijmegen	Gelderland
Coevorden	Drenthe		Apeldoorn	Gelderland
Steenwijkerland	Overijssel		Enschede	Overijssel
Bronkhorst	Gelderland		Haarlem	Noord-Holland
Sluis	Zeeland		Arnhem	Gelderland
Westerveld	Drenthe		Amersfoort	Utrecht
Aa en Hunze	Drenthe		Zaandstad	Noord-Holland
Borger-Odoorn	Drenthe		s-Hertogenbosch	Noord-Brabant
Goeree-Overflakkee	Zuid-Holland		Haarlemmermeer	Noord-Holland
Berkelland	Gelderland		Zwolle	Overijssel
Terneuzen	Zeeland		Zoetermeer	Zuid-Holland
Zeewolde	Flevoland		Leiden	Zuid-Holland
Lelystad	Flevoland		Maastricht	Limburg
Schouwen-Duiveland	Zeeland		Dordrecht	Zuid-Holland
Opsterland	Friesland		Ede	Gelderland
De Wolden	Drenthe		Alphen a/d Rijn	Zuid-Holland
Oostellingerwerf	Friesland		Leeuwarden	Friesland

B. Table to structure the data from the executive agreements and additional climate programs

<table>
<tr><td colspan="3">Name of municipality:
- What is the main target of the municipality regarding sustainability
- Has the municipality a target to become climate or energy neutral</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">How:
- Which measures does the municipality take to achieve the main targets (not included in the division below).</td></tr>
<tr><td colspan="3">Cooperation’s with other parties:</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Targets</td><td>Description:
What is the target of the municipality divided per sub-category below.</td><td>How:
How is the target specified:
- Scope:
- Potential/Percentage:
- Year:
- Final/primary energy:
- Measurable aspects

- Role of municipality:
(Coach, facilitator, provider of services, participant or co-producer Providing information)</td></tr>
<tr><td>Renewable Energy</td><td>Solar:

Wind:</td><td>Solar:

Wind:</td></tr>
<tr><td>Energy Savings or Energy efficiency</td><td>Energy savings measures:

Zero on the Meter:

Energy efficiency measures:

Energy labels:

Lighting:</td><td>Energy savings measures:

Zero on the Meter:

Energy efficiency measures

Energy labels:

Lighting:</td></tr>
<tr><td>CO_2 reduction</td><td>Transport:
Waste heat:
Climate neutral:

Circular economy:
Cradle to Cradle:
Natural step (Sustainable future):</td><td>Transport:
Waste heat:
Climate neutral:

Circular economy:
Cradle to Cradle:
Natural step (Sustainable future):</td></tr>
<tr><td>Financing</td><td colspan="2">Descriptions about financing the targets</td></tr>
<tr><td>Source:</td><td colspan="2"></td></tr>
</table>