Developing a framework for the municipality of Alkmaar to translate the findings of POCITYF in an effective climate vision for 2050.

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ETT	Energy Transition Track
EU	European Union
EV	Electric Vehicle
IS	Integrated Solution
P2P	Peer to Peer
PEB	Positive Energy Building
PED	Positive Energy District
SDG	Social Development Goal
V2G	Vehicle to Grid

Abstract

Clear targets have been set by the Paris Climate Agreement to limit global warming by a maximum of 2 degrees celsius. The European Union aims to be the first climate neutral continent. In order to achieve climate neutrality an energy transition needs to take place from the current fossil-fuel based system towards an energy system based on renewable energy sources. Since the majority of European citizens live in cities, these are logical places to focus on during this transition, however many European cities have a historical character, especially in city centres. Making these areas with historical heritage sustainable and CO2 neutral without losing the cultural values will be a challenge. Providing smart energy solutions for these historical city centres is exactly what the European pilot project POCITYF is aiming to do. Various energy solutions will be tested in two Lighthouse Cities in Evora, Portugal and Alkmaar, the Netherlands. Six Fellow Cities will closely monitor the progress in order to learn from the developments and eventually implement the successful solutions as well. This study conducts a case study on Alkmaar to find out how the solutions currently being carried out in the demonstration area can be used and translated to being used in the replication areas, both within Alkmaar as in the Fellow cities. A literature study has been conducted to learn about the use of pilot projects, but also about the challenges that come with retrofitting historical buildings and long-term planning. Furthermore, various policy documents from a variety of dutch governments have been analysed to learn about the current long-term planning policy of Alkmaar. Additionally available documents from similar pilot projects have been analysed to learn from other pilot projects that are currently in progress across Europe. Eventually a recommendation will be given to the municipality of Alkmaar, this recommendation will be based on the conclusions of the combined literature and policy research on how to translate the lessons from pilot project to effective long-term planning.

Keywords: Pilot projects, energy transition, replication, smart cities, positive energy districts, long-term planning, policy transfer

Chapter 1: Introduction

Chapter 1.1: Introduction to the energy transition

One of the main challenges for the upcoming decades is the climate crises that our society is facing. Increased greenhouse gas emissions in the atmosphere cause global warming, increasing the occurrence of all sorts of natural phenomenons such as heat waves, droughts, floodings, rising sea levels and storms. It has been established that humans have an influence in the occurrence of the enhanced greenhouse effect (Huang et al., 2013), causing global warming. In order to limit the effects of climate change 197 countries signed the Paris Climate agreement in 2015, in which they collectively aim to limit climate change by 2 degrees celsius and aim for a reduction below 1.5 degrees (Angelakoglou, 2020; Rogelj et al., 2016). In order to collectively achieve these goals a drastic reduction of greenhouse gas emissions is needed. As a result the European Union has set goals and policies to become the first climate neutral continent (Leitão et al., 2021; European Commission, 2019). Since the majority of Europeans are living in cities it is important to focus on making these cities climate neutral.

According to the UN, in 2018 around 55% of the global population lived in cities, while this is expected to reach 70% in 2050 (United Nations, 2018; Lampropoulos et al.,2020). For the European Union it is even expected that 80% of all Europeans will live in cities by 2050 (Eurostat, 2016). Currently cities account for two-thirds of the global energy-use and energy related CO2 emissions (REN21, 2021). Among other things, energy is being used for the heating and cooling of the built environment, mobility, electricity production and the production of nearly all goods. As a result the built environment is where most of the energy is used, therefore they receive great focus to make these places more sustainable. In order to achieve this reduction a systematic shift is needed from a fossil fuel based energy system towards one based on renewable energies. This shift is better known as the Energy Transition. According to Rotmans et al. (2007) a transition is a nonlinear shift from one state to another. In order to be able to reach this shift in a relatively short amount of time a lot of new techniques and innovations are needed, these need to be developed, tested, replicated and scaled up. Often these innovations are being tested through pilot projects.

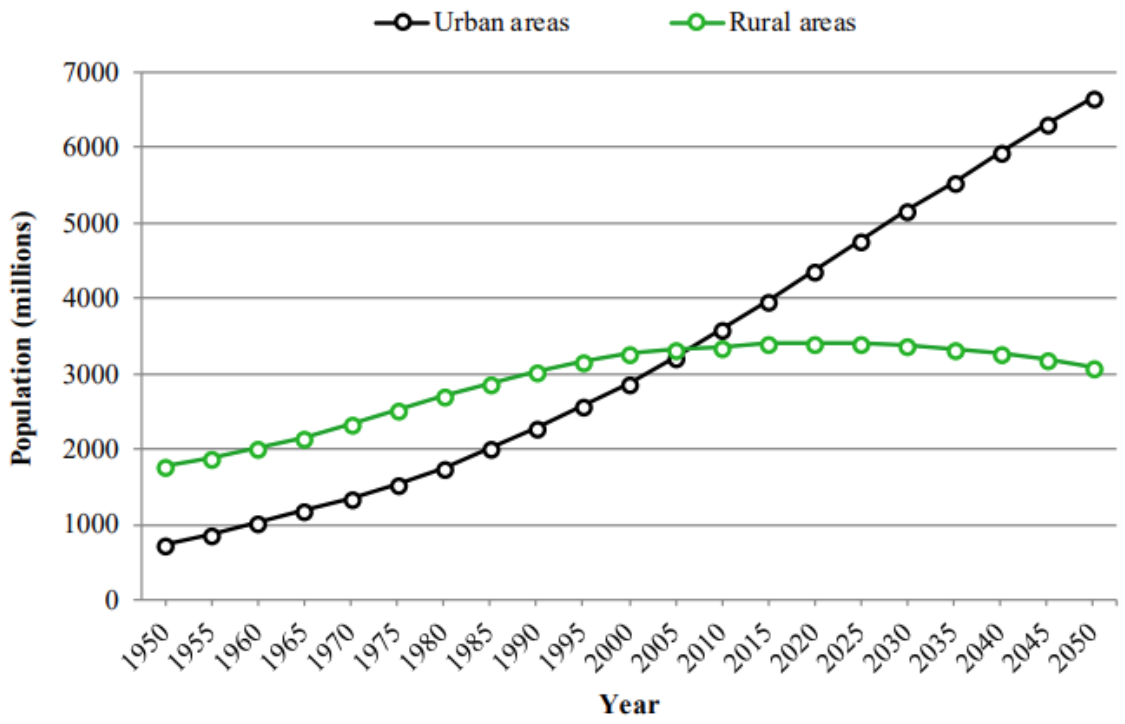

Figure 1. World population (in millions) living in rural and urban areas. Based on historical data and projects of the United Nations (2017). Figure derived from Lampropoulos et al. (2020), based on data from the UN.

Buildings in the European Union are responsible for around 40% of the energy consumption (IEA, 2016). Residents in the EU spend 57% of their energy on space heating, 25% on hot water and 11% on electricity (Chwieduk, 2002). Kelly and Pollitt (2011) and Evola et al. (2016) express that the local context and geography are important for the decentralised production of energy, therefore local planners and policymakers should be in the lead since they have more knowledge about the area than higher levels of government. Hughes et al. (2018) add that local city governments have a large influence on the emissions emitted in their jurisdiction due to their large role in land use planning, energy use and transportation. Therefore local planners play a crucial role in the development of environmental policy.

An important part of making cities climate neutral is the concept of Positive Energy Districts, these are neighbourhoods or districts with a net positive energy balance. Often achieved through reduced energy demand through insulation and smart networks, and the production of energy through solar, wind and other means of carbon-neutral energy sources. These PED's will compensate for areas that do not have a positive energy balance, through a combination of energy intensive uses, challenges in energy production or insulation.

Chapter 1.2: Introduction to POCITYF

In order to stimulate the development of Positive Energy Districts the European Union has initiated various pilot projects which seek to test and demonstrate smart solutions that contribute to the Positive Energy District concept. One of these pilot projects is POCITYF,

which stands for Positive energy CITY transformation Framework. POCITYF is a Horizon Smart City project. It aims to support sustainable innovations and technologies in cities with historical and cultural heritage districts (Leitão et al., 2021; POCITYF, 2020). Two Lighthouse cities will seek to test ten integrated solutions, part of four Energy Transition Tracks. The Integrated solutions are a combination of technical and non-technical solutions on various themes. The Energy Transition Tracks are focussing on Positive Energy Districts, Energy Management, Mobility and Citizen engagement. An overview of the Energy Transition Tracks and Integrated Solutions can be found in figure 2.

	ETT#1: Innovative Solutions for Positive Energy (CH) Buildings and Districts		ETT#2: P2P Energy Management and Storage Solutions for Grid Flexibility		ETT#3: e-Mobility Integration into Smart Grid and City Planning		ETT#4: Citizen-Driven Innovation in Co-creating Smart City Solutions	
Integrated Solutions	IS 1.1	Positive Energy (stand-alone) Buildings	IS 2.1	Flexible and Sustainable Electricity Grid Networks with Innovative Storage Solutions	IS 3.1	Smart V2G EVs Charging	IS 4.1	Social innovation mechanisms towards citizens engagement
	IS 1.2	Positive Energy Districts Retrofitting					IS 4.2	Open innovation for policy makers and managers
	IS 1.3	Feeding PEDs with Waste Streams Promoting Symbiosis and Circular Economy	IS 2.2	Flexible and sustainable district heating/cooling with innovative heat storage solutions	IS 3.2	E-mobility services for citizens and auxiliary EV technologies	IS 4.3	Interoperable, modular and interconnected city ecosystem

Figure 2. Overview of the Integrated Solutions within the Energy Transition Tracks. Table derived from Leitão et al. (2021).

The Lighthouse cities are the city of Alkmaar in the Netherlands and Evora in Portugal. A selection of 6 Fellow Cities will monitor the developments in the Lighthouse Cities during the project and benefit from the gained knowledge. Eventually the knowledge will be used to replicate the integrated solutions in their own urban fabric. These Fellow Cities are: Bari (Italy), Celje (Slovenia), Granada (Spain), Hvidovre (Denmark), Ioannina (Greece) and Ujpest (Hungary), all with their own unique historical centre.

POCITYF is a pilot project under the Horizon 2020 programme, which is a European subsidy programme of roughly €80 billion for clean energy, green transport and climate actions (van Winden & van den Buuse, 2017). The subsidy programme ran from 2014 until 2020 (European Commission, n.d.). The programme focused on research and innovation that produced smart, sustainable and inclusive growth of jobs. Next to POCITYF there are multiple European Horizon 2020 projects with a comparable framework, these projects are collected under the Smart Cities Community. This community aims to engage cities, industries, SMEs, investors and researchers to design and deliver smart and sustainable solutions (Tatar et al. (2020), mainly with the concept of Positive Energy Districts (Urrutia-Azcona et al., 2019). Examples of these projects under the Smart Cities Community with a Lighthouse city in the Netherlands are Making-City (Groningen), Triangulum (Eindhoven), IRIS (Utrecht), Atelier (Amsterdam), and RUGGEDISED (Rotterdam). Additionally there are projects part of the Smart Cities Community, without the involvement of Dutch Lighthouse cities. An overview of all Lighthouse and Fellow cities is given in figure 3.

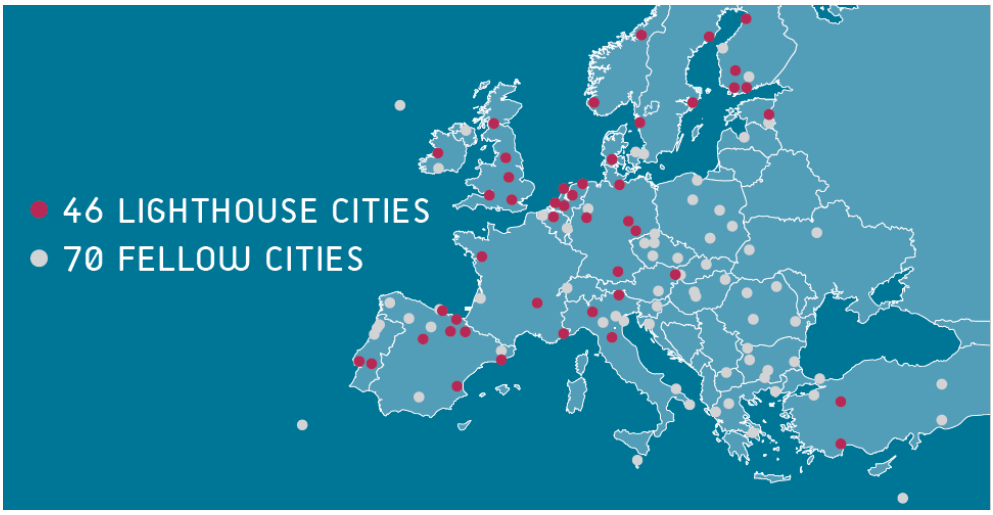

Figure 3. Map showing all Lighthouse and Fellow cities under the Smart Cities Community of the Horizon 2020 subsidy program. Source: Smart Cities Marketplace

The Framework for Bold City Vision is an important deliverable part of most Horizon 2020 programmes. The Bold City Vision will be a projection for the city to the future. It is a vision for sustainable development that includes urban, technical, financial and social aspects (+CityxChange, 2020). The Framework is based on the pilot project and highlights the key opportunities and actions that are needed to become more sustainable and accomplish the proposed vision and goals.

An important aspect of the Smart City Community projects is the concept of Positive Energy Districts. According to JPI Urban Europe (2020) a PED is an energy efficient urban area of connected buildings which produce net zero greenhouse gas emissions and manages to generate a surplus production of renewable energy. The PED plays a crucial role in the vision of climate-neutral cities, which are needed to reach the European Climate goals (European Commission, 2019). The demonstration of these districts is an important development in the scalability and replicability of this solution (Giourka et al., 2020). According to Gouveia et al. (2021) there is an important connection between PEDs and energy poverty, a topic which is often not being considered in most studies and European Projects. However, Making-City and POCITYF included energy poverty in their project. According to Pye et al. (2015) energy poverty is a critical socioeconomic problem in historical cities. In these older neighbourhoods the energy prices are high, income is low, and energy efficiency is low (Dobbins et al., 2019). Silverman (2015) adds to this that improving energy efficiency in houses creates additional benefits besides the reduced use of energy and greenhouse gas emissions, being reduced energy costs and improved living conditions, which contribute to the improvement of social inequalities and energy poverty.

Chapter 1.3: Problem statement and research question

The main goal of POCITYF is to integrate and test new developments in the field of sustainable solutions. The findings will be used to further develop the solutions and learn from the process. Additionally, these findings will be used to develop a 2050 Bold City Vision for both of the Lighthouse Cities. However, at this point it is unclear how the project findings of POCITYF in

Alkmaar can actually be implemented in the wider framework of the long-term city planning vision. This uncertainty about the implementation is partly due to what extent the findings of the current test area in Alkmaar are representable for the rest of the city, due to the large differences in characteristics, building styles, regulations and building age. This difficulty to translate findings from pilot projects into policy is acknowledged by the Climate Proof Cities consortium (2014), which state that many cities in the Netherlands have high ambitions with regards to climate adaptation policies, however the realisation remains often limited to pilot and demonstration projects.

The aim of this research is to discover how pilot projects, such as POCITYF, can contribute to the long-term sustainability goals of a city, hence the research questions is:

"How can pilot projects in cities contribute to the local long-term planning goals, in order to reach the sustainability targets of 2050?"

In order to answer this main question, the following secondary research questions have been formulated:

- To what extent can the findings of the current Alkmaar test site be used to replicate the old city centre of Alkmaar?
- To what extent can the findings of the POCITYF pilot projects be applied to historical buildings, including cultural heritage?
- To what extent can long term strategic plans be made on the Dutch municipal level, while considering the futility of political, regulatory, economic, and social aspects?

Chapter 1.4: Scientific and social relevance

This study will conceptualise how pilot projects impact long-term urban planning, while focussing on the POCITYF project in Alkmaar. This is scientifically relevant since it will provide insights in how lessons drawn from pilot projects can impact long-term city planning. The network of smart cities from the European Horizon 2020 subsidy framework will be analysed. Additionally this study will provide recommendations for efficient long-term planning with regards to the energy transition and sustainability. This study will use literature on pilot projects, policy transfer and long-term planning and see how these subjects are addressed in the POCITYF project. This study will conceptualise how pilot projects impact long-term urban planning, while focussing on the POCITYF project in Alkmaar. The social relevance of this thesis is related to the importance of the research topic, transforming the urban environments into positive energy districts is essential for the energy transition and combating climate change since cities are the main users of energy (IEA, 2016).

Chapter 2: Theoretical Framework

The theoretical framework starts with explaining pilot projects and presenting the main findings about them in chapter 2.3. After this the literature about policy transfer is discussed in chapter 2.2. In chapter 2.3 the theoretical findings about energy measures in historical buildings is presented, in order to find out the possibilities with regards to this. Chapter 2.4 will give additional background information about the planning procedures in the Netherlands, which is needed to gain an understanding about the planning context that

POCITYF is positioned in as a pilot project in the Netherlands. Chapter 2.5 will elaborate on the theory about long-term planning with regards to city planning. Lastly all concepts will be brought together and presented in the conceptual model in chapter 2.6.

Chapter 2.1: Pilot projects

Pilot projects are set up in many cities in order to test new technologies that address sustainability issues (van Winden & van den Buuse, 2017). Often they are supported by the municipality, funded by subsidies and run in partnerships (van Winden & van den Buuse, 2017). Pilot projects are small scale projects, usually only active in a few streets (Kummitha, 2018), that aim to test the viability of a solution, develop knowledge about the technology and create insight about how the technology can fit into society (Markusson et al., 2011). Cities can act as living laboratories for climate change policy innovations that can eventually scale up to other cities (Hughes et al., 2018). However scaling up from a small pilot project to a city-wide solution is a complex process, with many pilot projects never being able to scale up their solutions (Bundgaard & Borras, 2021). Therefore pilot projects are not always considered as innovative ways contributing to knowledge and policy generation (Vreugdenhil et al., 2010). Sanderson (2002) did not even find that any policy learnings took place in the pilot projects he studied.

Bundgaard & Borras (2021) have identified five governance conditions that are key in the process of scaling up small pilot projects to the scale of a city. These conditions are: collaboration intensity, a capable municipality, the articulation of public needs, social legitimacy, and the perception of technological uncertainty.

Chapter 2.2: Policy Transfer

Pilot projects often have the important goal of acting as a test case. The findings of the pilot will need to be documented and made available for other users. It is important to know under what circumstances the pilot took place and how these circumstances impacted the pilot. This is necessary in order to be able to replicate the pilot in another city or even country with different circumstances. Knowledge sharing is one of the justifications of granting subsidies to pilot projects, however it remains unclear to what extent knowledge sharing is actually happening (Evers & Chappin, 2020).

Policy transfer is the process in which knowledge from one place is used in the development of policies in another place (Dolowitz & Marsh, 1996). However the concept of knowledge sharing is complex due to the dynamics (Evers & Chappin, 2020). The lack of knowledge can be a bottleneck for further development, while knowledge sharing can enable further large-scale implementation of pilots (Evers & Chappin, 2020). It is therefore important that knowledge sharing is understood and an important part of pilot projects.

Successful pilots are so called best-practices, they show how implementation and replication processes work and publish the information about the processes. Best practices are often used by European policy makers in the process of coming up with new policies (Stead, 2012). Van Assche et al. (2020) distinguishes four modes of learning in governance and planning systems, these are; learning from the past; learning from other places; learning from experts, and

learning through discussion. When policy makers are learning from pilot projects in other places this can be distinguished as learning from other places. However, there are so many best-practices available that policy makers can be confronted with too much information when looking at best-practices (Stead, 2012).
Additionally some components are more suitable for policy exchange than others. Table 1 shows the various components for exchange for local development practices and their visibility and transferability according to the OECD (2001). The first category has low visibility and low transferability, because they are difficult for outsiders to understand, and difficult to adapt to a different context (OECD, 2001). The second category has medium visibility and high transferability, these components make most sense for exchange. The components in the third category are most visible for the outside world, however they are very difficult to transfer to another context, because these components are often tailor made for particular areas (OECD, 2001).

Visibility	**Components for exchange**	**Transferability**
Low	Ideas Principles for action Philosophy	Low
Medium	Methods Techniques Know-how Operating rules	High
High	Programmes Institutions Modes of organisation Practitioners Joint projects	Low

Table 1. Components of local development practices and their transferability. (Source: OECD, 2001)

The OECD (2001), has identified the following conditions which need to be met for a successful exchange of components:

- The recipients must be clearly identified
- The recipient must be motivated and be willing and able to innovate
- There needs to be accessible communication and a mechanisms for coordination and brokerage
- The component must be compatible with the context of the recipient area.
- There need to be mutual benefits from the process of transfer between the areas involved.

Chapter 2.3: Energy retrofitting of historical buildings

Positive Energy Districts have mainly been tested in newly built districts, where the implementation is relatively easy and cost-effective (Gouveia et al., 2021). However, in order to reach the sustainability targets, existing neighbourhoods, including historic districts need to be transformed as well. However, various barriers arise while aiming to implement energy efficiency measures in historical buildings. These barriers are mainly based on architectural conservation, cultural barriers and a country's regulations (Tsoumanis et al., 2021).

Blumberga et al. (2020) have analysed the challenges that come with implementing energy efficiency measures in densely populated historic urban centres, they came up with four main restrictions:

1. Historic structure needs to be preserved
2. Historical landscape needs to be preserved
3. Technical obstacles with outdated infrastructure
4. Legal restrictions

There are only few studies with regards to the application of innovative energy solutions in cultural heritage, due to the barriers that prevent them from implementation (Tsoumanis et al., 2021).

The Climate Change and Cultural Heritage Working Group International (2019) recognizes the threat of climate change for historical heritage. They stress the importance cultural heritage has on the benefits and quality of life it provides to communities. Cultural heritage should be protected, and where possible, contribute to the solution of climate change. However, Blumberga et al. (2020) concluded that the most efficient decarbonization methods for historic buildings also have the highest impact on the historic heritage values themselves with the risk of losing these values. The total overview of types of energy efficiency measures and the impact on the historic values are presented in table 2.

Type of energy efficiency measure	**Energy efficiency measure**	**Loss of historic heritage values**	**Effectiveness of Decarbonization**
Building	Building thermal envelope	High	High
	Building services energy efficiency	High	High
	Intensification	Medium	Medium
Smart Energy Systems	Smart grid, ICT	Low	Medium
	Waste heat, energy cycle	Low	Medium
	Renewables	Medium	High
	Energy storage	Low	Medium
Social energy savings	Energy community	Low	Medium
	Behavioural energy savings	Low	Medium

Table 2. Impact of energy efficiency measures on historic heritage values and effectiveness of decarbonization. Source: Blumberga et al. (2020), edited by the author.

The interest of conserving the characteristics of historical buildings need to be balanced with the interest and need of the energy transition (Nieuwenhout & Oliveira Evangelista, 2020). Two international institutions have set up programmes to share knowledge regarding sustainable development in cultural heritage, these institutions are UNESCO and ICOMOS (Nieuwenhout & Oliveira Evangelista, 2020). In the Netherlands, the Rijksdienst voor Cultureel Erfgoed (RCE) is responsible for archeology, art and the preservation of landscapes and buildings with heritage. One of their assignments is to advise municipalities how to make their monumental buildings more sustainable (RCE, n.d. b)

In the Netherlands there are about 237.000 houses that are 'beschermd stadsgezicht' (Pointer, 2022), which are houses that are subject to strict regulations with regards everything that changes the appearance of the house (RCE, n.d. c). The RCE has relaxed its policy with regards to pv-panels on the roofs of monumental and protected townscapes (RCE, 2020), however Pointer (2022) found out that many homeowners of these protected homes in the Netherlands do not get approval from the municipality to place pv-panels on their roofs.

Chapter 2.4: Planning in the Netherlands

The Netherlands is a relatively small country, however it is also one of the most densely populated countries on earth (Alpkokin, 2012). Therefore space is scarce in the Netherlands and spatial planning is needed to carefully plan for housing, infrastructure, industry, agriculture and more (Rijksoverheid, n.d.). The governing structure in the Netherlands with regards to spatial planning is based on collaboration, transparency and consensus building (Alpkokin, 2012). Planning is very much decentralised, regional and local have authority and responsibility (Alpkokin, 2012; Rijksoverheid, n.d.), with the national government taking mainly responsibility when it comes to large scale infrastructure projects and strategic policies (Louw et al., 2003). Lower levels of government are now responsible for policy that used to be the responsibility of the national government, among others these policy subjects are youth healthcare, housing of refugees and the energy transition. Since the energy transition is a long-term issue it is deemed politically less important by the local governments, since the other subjects are more pressing (Koelman et al. 2018). As a response responsibility is transferred to the market, however where the government is responsible for energy security and availability, the market is more focused on the profitability of renewable energy (Koelman et al. 2018).

The energy transition means a shift from centralised energy production, towards the decentralised production of renewable energy, which comes from sources such as wind turbines and solar plants, requiring land to be built on (Wüstenhagen et al., 2007). This puts an extra pressure on the scarcity of available space in the Netherlands.

For the built environment, in the Climate Agreement the Dutch government has ruled that by 2050 all 7 million homes and 1 million buildings need to be heated by sustainable heat and use clean electricity (Klimaatakkoord, 2019). According to Natuur & Milieu (2021) the current housing stock in the Netherlands has a poor energy performance, and the rate of isolation is too low, at the current rate it takes until 2101 in order to improve the energy labels of all housing stock until at least a C. Improvements in energy efficiency are the most cost-effective way to reduce the greenhouse gas emissions in cities (Mills, 2012). Many of the houses are either owned by housing corporations or private owners, the government is therefore dependent on the willingness of these owners to improve the energy efficiency of the houses Tambach et al. (2010).

The planning of renewable energy in neighbourhoods should be applied at the neighbourhood level (Delastro et al., 2016), solutions can better be implemented on this scale, as various sources such as geothermal and waste heat are only viable on this scale. Tatar et al. (2020) adds to this that it is important to gather relevant stakeholders at the local level to design a

variety of potential futures together, in order to develop a common vision and sufficient local support. Distributed energy infrastructure should be designed whilst taking technological and economic limitations in consideration, also attention to environmental and social effects needs to be given (Bracco et al., 2018).

Chapter 2.5: Long-term planning of cities

In Europe cities are seen as the motor of sustainable development, due to the increasing importance of social, economic, ecological and institutional development city management has become more complex (Rotmans & van Asselt, 2000). For this city management long-term city visions are needed to plan and manage for future opportunities and investments (Dixon et al., 2018). The idea of having a long term vision for a city emerged in the 80s and 90s to plan a desirable or preferred set of outcomes (Dixon et al., 2018). In the 20th century the sustainability agenda led governments to think about visions for a sustainable and desirable future (Dixon et al., 2018). Creating sustainable visions is important for research, planning and decision-making, as it provides a reference point for developing strategies to transition from the present to the future (Wiek & Iwaniec, 2014). However setting ambitions does not necessarily mean they will be followed up, Hughes et al. (2018) found a persistent gap between ambitions and the actual progress of cities on climate change mitigation.

Within literature there are two models dominant for long-term planning (Peter & Jarratt, 2015), the first one being the prescriptive, planning approach, or the linear model where the long-term plans are based on analysis, performance and environment (Chaffee, 1985). The alternative approach is an adaptive form, where organisations are refining their strategies as soon as new information becomes available (Chaffee, 1985). Shorter planning cycles allow for more adaptability along the way, but sometimes fail to anticipate relevant innovations that are required (Peter & Jarratt, 2015). Whatever the model being used, long-term planning requires at least a vision. In order to create this long-term city vision a well-structured participatory process is needed in order to create social support from stakeholders (Rotmans & van Asselt, 2000). Dixon et al. (2018) confirms this by arguing for the Quadruple Helix instead of Triple Helix model when it comes to the design of co-created city vision, this model adds civil society to the helix of university, government and businesses. Alongside citizens a strong government structure, inclusion of emerging technologies, business models and innovations needs to be included whilst planning for long-term energy strategies (Carvajal et al. 2022). For a strong governance structure there needs to be good participation with all stakeholders and a strong coordination among the different government institutions (Carvajal et al. 2022).

Chapter 2.6: Conceptual Model

This research looks at the influence of pilot projects on long-term strategic planning of cities. Therefore literature on pilot projects, policy transfer and long term planning will be used. The conceptual model illustrates the potential impact that pilot projects have on long and short term planning policies.

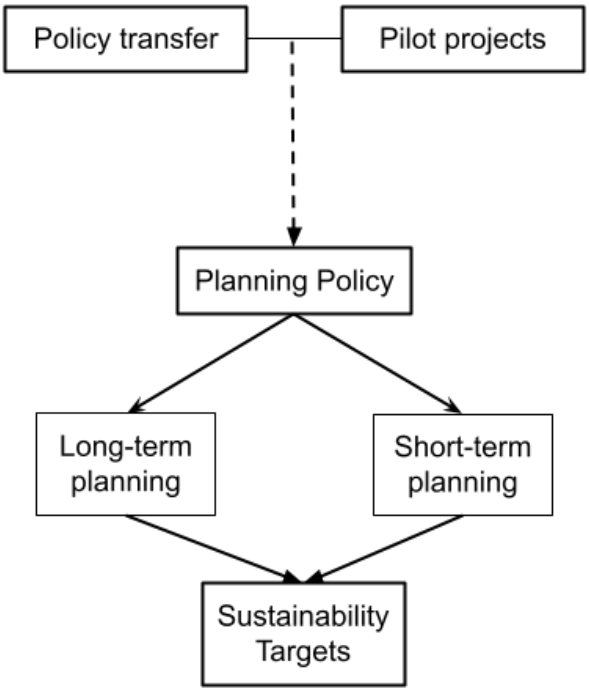

Figure 4. Conceptual model. Created by the author.

Chapter 3: Methodology

Chapter 3.1: Research Design

This research aims to discover how the findings of pilot projects can be used in the long-term planning of cities. This research will focus on a specific case, being the POCITYF project in Alkmaar. An interview with the program manager of POCITYF has been conducted in order to find out the bottlenecks of the project and establish the research questions. To understand the scope of the POCITYF project in Alkmaar internal and external documents about the projects have been reviewed. In order to position the project in the local context a policy analysis has been conducted, analysing various long-term planning documents from the municipality of Alkmaar, the province of Noord-Holland and various other institutions. By analysing POCITYF and the policy documents related to Alkmaar the potential impact of the pilot project can be identified. Furthermore similar Horizon 2020 projects will be analysed to learn about their replication and implementation potential.

Chapter 3.2: Case study research

The case study research is a commonly used research strategy in many fields of science (Yin 2009). However, there is no consensus about the methodological status of a case study as a type of empirical research (Verschuren, 2003). This research will use the definition given by Creswell and Yin. According to Creswell (1994) a case study is where the researcher explores

a single entity or phenomenon (the case), bounded by time and activity, and collects detailed information by a variety of procedures. Yin (1989, p. 23) defines a case study as '*an empirical inquiry that investigates a contemporary phenomenon within its real-life context*'. In a later edition Yin (2003) rephrases this definition into: A case study method allows one to study the characteristics of real-life events. In this research the pilot project POCITYF in Alkmaar will be the single entity or phenomenon (the case), of which detailed information has been gathered via various procedures. This aligns with the case study definition of Creswell (1994) and Yin (1989).

Chapter 3.3: POCITYF Alkmaar as selected case

It is important for a case study that the case is selected with care, so that it can be representative for the larger population. Alkmaar is a medium-sized city in the Netherlands with a historical city centre, of which there are many in the Netherlands. Also in the European context Alkmaar this case is representative for the study of pilot projects and long-term planning, both in context of this research as for the context of the POCITYF programme. Although results will not be exactly applicable for all similar cities due to the unique characteristics and context of each city, the results can help other municipalities when carrying out pilot projects and drawing their own long-term city visions.

Chapter 3.4: Data collection

For this research a combination of a literature review, case study analysis and a policy review has been used. A literature review has been conducted in order to identify the key concepts related to this research. The literature provided insights into the effectiveness of pilot projects and the process of upscaling. These findings contribute to understanding the position of POCITYF as a pilot project in the context of Alkmaar aiming to reach its sustainability targets. In order to discover the potential impact of POCITYF on the climate goals of Alkmaar, the current sustainability targets of the Municipality had to be analysed, therefore a policy review has been conducted.

For this research participating observations, site visits and a semi-structured interview with the programme manager of Alkmaar has been conducted. Additionally many internal documents of POCITYF were made available to provide context and in-detail information about the project. Additionally, publicly available documents from POCITYF and other smart city projects were derived from the project's websites. Policy documents from the various government institutions were gathered online. The variety of data sources makes the results of the research stronger (Clifford et al., 2016).

With regards to the data collection ethical considerations are taken into account. It is important to include ethical considerations whilst doing research (Clifford et al., 2016). The main data of this thesis is derived from public sources, not containing any personal, restrictive or other sensitive data. The main ethical consideration is to reference all data sources correctly in order to keep the research transparent. Although the thesis topic was chosen in collaboration with parties involved in the POCITYF project, the research has been carried out independently, with no conflicts of interest.

Chapter 3.4.1: Policy documents

In order to be able to analyse the potential impact of POCITYF on the climate plans of Alkmaar, first these climate plans had to be established. Various policy documents have been reviewed for this. The policy documents can be found in table 3, and are displayed in chronological order. The documents are mainly from government agencies, being the municipality of Alkmaar and Province of Noord-Holland. The Regional Energy Strategy is also considered an important document, as it establishes the ambition for local renewable energy in the region. Three of the documents are focused on the city level, while two others aim at the larger area, being Noord-Holland Noord and the whole province of Noord-Holland.

Author	**Dutch title**	**English title**	**Publishing date**
Municipality of Alkmaar	Omgevingsvisie Alkmaar 2040	Environmental Vision Alkmaar 2040	October 5, 2017
Province of Noord-Holland	Omgevingsvisie NH 2050	Environmental Vision NH 2050	November 19, 2018
Municipality of Alkmaar	Programma Duurzaam Alkmaar 2020-2024	Programme Sustainable Alkmaar 2020-2024	June 10, 2020
Energieregio Noord-Holland Noord	Regional Energy Strategy 1.0 Noord-Holland Noord	RES 1.0 Noord-Holland Noord	April 21, 2021
Municipality of Alkmaar	Alkmaarse Warmtevisie	Heat vision Alkmaar	2019

Table 3. Overview of the policy documents that have been analysed.

The 'Omgevingsvisie Alkmaar 2040' serves to understand the current long-term vision of the municipality of Alkmaar for the city. The 'Omgevingsvisie NH 2050' is used for the same reason, describing the long-term vision for the province of North-Holland. The 'Programma Duurzaam Alkmaar 2020-2024' is the short-term programme of the municipality Alkmaar with concrete steps for a 4-year period. The 'Regional Energy Strategy 1.0 Noord-Holland Noord' is a policy document drafted by the Energy Region. It serves as an exploratory document on how the region will deal with renewable energy production. Lastly the 'Alkmaarse Warmtevisie' shows the heat vision and its transition formulated by the municipality of Alkmaar.

Chapter 3.4.2: Horizon 2020 Pilot projects

In order to position and compare the POCITYF project in Alkmaar, all fellow projects have been identified. These projects are all Horizon 2020 projects which aim to integrate and test solutions in the urban environment with regards to smart cities. The fellow projects are structured roughly all in the same manner and include a variation of the Bold City Vision Framework. Various of these projects started before POCITYF or are already finished. This means that more documents are already published and open for analysis. All Fellow projects, including their Lighthouse Cities and project duration can be found in table 4.

Project	Lighthouse Cities	Project duration
POCITYF	Alkmaar, The Netherlands Evora, Portugal	01/10/2019 - 30/09/2024
+CityxChange	Trondheim, Norway Limerick, Ireland	01/11/2018 - 31/10/2023
Atelier	Amsterdam, The Netherlands Bilbao, Spain	01/11/2019 - 31/10/2024
GrowSmarter	Stockholm, Sweden Cologne, Germany Barcelona, Spain	01/01/2015 - 31/12/2019
IRIS	Utrecht, The Netherlands Nice, France Gothenburg, Sweden	01/10/2017 - 31/03/2023
Making-City	Groningen, The Netherlands Oulu, Finland	01/12/2018 - 30/11/2023
MATCHUP	Valencia, Spain Dresden, Germany Antalya, Turkey	01/10/2017 - 30/09/2022
MySMARTLife	Nantes, France Hamburg, Germany Helsinki, Finland	01/09/2018 - 30/09/2022
Remo Urban	Valladolid, Spain Nottingham, UK Tepebasi/Eskiseh, Turkey	01/01/2015 - 30/06/2020
Replicate	Bristol, UK San Sebastian, Spain Florence, Italy	01/02/2016 - 31/01/2021
RUGGEDISED	Rotterdam, The Netherlands Umea, Sweden Glasgow, UK	01/11/2016 - 31/10/2022
SmartEnCity	Vitorio-Gasteiz, Spain Tartu, Estonia Sonderborg, Denmark	01/02/2016 - 31/07/2021
SharingCities	London, UK Milan, Italy Lisbon, Portugal	01/01/2016 - 31/12/2021
SmarterTogether	Vienna, Austria Lyon, France Munich, Germany	01/02/2016 - 31/07/2021
Sparcs	Leipzig, Germany Espoo, Finland	01/10/2019 - 30/09/2024
Stardust	Pamplona, Spain Tampere, Finland Trento, Italy	01/10/2017 - 31/03/2024

Triangulum	Eindhoven, The Netherlands Stavanger, Norway Manchester, UK	01/02/2015 - 31/01/2020

Table 4: Overview of the Smart City projects under the Horizon 2020 research and innovation programme. Information derived from project's websites and Cordis.eu.

As seen in table 4, these projects are in various stages of completion. The available documents with regards to the long-term city planning of these projects have been analysed and compared. Special attention was given to the projects that are already finished, or are close to completion. Many projects are already further in the process compared to POCITYF, therefore their publications and deliverables can serve as guidelines for POCITYF. These documents have been analysed in order to find out how the pilot project potentially could impact the long term planning of the Lighthouse City. These results can then be compared to Alkmaar in order to predict the potential impact of POCITYF on Alkmaar.

Chapter 4: Policy analysis

In this chapter the results of the analysis will be presented. First, in chapter 4.1 an analysis of POCITYF will be carried out, in order to find out to what extent the findings of POCITYF in the current demonstration area can be replicated to the replication areas. In chapter 4.2 a comparison between the (preliminary) results of POCITYF in Alkmaar will be compared with the transferability conditions. In chapter 4.3 the results of the desk research of the available deliverables of comparable Horizon 2020 projects will be given, and compared to the situation in POCITYF, in order to draw valuable lessons for Alkmaar. In chapter 4.4 the results of the policy analysis will be presented. In this chapter the key findings from the relevant policy documents from several government agencies are shortly summarised and presented, in order to discover the policy targets and visions from these government agencies. In chapter 4.5 there will be a comparison between the relevant policy documents presented in chapter 4.4, and the findings about POCITYF, in order to analyse to what extent POCITYF can contribute towards the long-term policy of the region.

Chapter 4.1: Analysis POCITYF

Comparison between PoCityF and literature on pilot studies

POCITYF is a subsidy project from the European Horizon 2020 subsidy programme. The municipality of Alkmaar plays an important role in the project and is leader in some of the workpackeges, additionally many local partners are involved in the project. This organisational structure fits the description of pilot projects according to van Winden & van den Buuse (2017). As part of the Grant Agreement, Alkmaar and Evora will have to deliver 'Replication Plans' and a 'City Bold Vision Plan'. Within the replication plans the potential of replication in the other areas of the city will need to be presented, based on feasibility studies. For the Bold Vision a feasibility study of all activities for the Energy Transition Tracks combined with the political recommendations needs to be presented. Table 5 shows an overview of the Energy Transition Tracks with the Integrated Solutions and their descriptions. Table 6 shows the demonstration locations of POCITYF in Alkmaar, with the implementations and the Energy Transition Track and Integrated Solution they belong to.

Energy Transition Track	**IS**	**Description**
ETT 1. Positive Energy Buildings and Districts, to create energy-efficient urban areas able to actively manage surplus renewable energy.	1.1	Positive Energy (stand-alone) Buildings
	1.2	Positive Energy Districts retrofitting
	1.3	Feeding PED's with waste streams promoting symbiosis and circular economy
ETT 2. P2P energy storage and management, to maximise self-consumption, reducing grid stress and avoiding load and generation curtailment.	2.1	Flexible and sustainable electricity grid networks with innovative storage solutions
	2.2	Flexible and sustainable district heating/cooling with innovative heat solutions
ETT 3. E-mobility integration into smart grid,	3.1	Smart V2G EV's charging

to increase the penetration of electric vehicles powered by renewable energy sources and use them to support grid flexibility, while reducing curtailment.	3.2	E-mobility services for citizens and auxiliary EV technologies
ETT 4. Citizen-driven innovation in co-creating smart city solutions, to improve citizens' quality of life by involving them directly in the development, design and evaluation phases of smart city solutions.	4.1	Social innovation mechanisms towards citizens engagement
	4.2	Open innovation for policy makers
	4.3	Interoperable, modular and interconnected city ecosystem

Table 5. Overview of the Energy Transition Tracks and Integrated Solutions of POCITYF. Source: POCITYF, 2020.

Location	Implementation	Integrated Solution
Sports Complex de Meent	PV's on roof	ETT 1, IS 1.1
	PV's above parking	ETT 1, IS 1.1
	Battery station connected to lampposts, charging points and heat pumps	ETT 2, IS 2.1
	Heating and cooling	ETT 2, IS 2.2
	Low temperature grid to neighbouring buildings	ETT 2, IS 2.2
Woonwaard Highrise building	Powernest	ETT 1, IS 1.1
	Vertical solar panels	ETT 1, IS 1.1
	Roof insulation of circulair materials	ETT 1, IS 1.1
Woonwaard Dillenburgstraat	Connection with nearby heat network	ETT 2, IS 2.2
Bloemwijk	Triple glazing and circular insulation	ETT 1, IS 1.1
	PV panels connected to batteries	ETT 1, IS 1.1
	Vehicle-to-Grid with two bidirectional chargers	ETT 3, IS 3.2
InVesta foundation	Integrated PV panels	ETT 1, IS 1.1
	Nickel hydride battery	ETT 2, IS 2.1
	Hydrogen fuel cell	ETT 2, IS 2.1

Miscellaneous	100 smart lampposts	ETT 3, IS 3.1
	Charging lamp post for e-cars and boats	ETT 3, IS 3.1
	Vehicle to Grid bus charger	ETT 3, IS 3.1
	Electricity charging noise barrier	ETT 3, IS 3.2
	Reverse waste collection	ETT 1, IS 1.3
	Hydrogen garbage truck	ETT 3, IS 3.2
	City Energy Management	ETT 2, IS 2.1
	P2P energy trading platform	ETT 2, IS 2.1

Table 6. Location and description of the planned Integrated Solutions in Alkmaar, Source: POCITYF, 2020 & POCTYF, n.d.

As can be seen in table 6 most of the implementations carried out in Alkmaar are either part of Energy Transition Track 1 or 2. ETT 4 is entirely focussed on citizen driven co-creation, and therefore not solely linked to one implementation.

Demonstration and replication areas

In order to answer the first subquestion, a comparison between the demonstration and replication areas will be made. In figure 4, a map with the demonstration and replication areas of POCITYF in Alkmaar is presented. The PEB-Westrand is the demonstration area of POCITYF in Alkmaar, showcasted in blue. The canal zone, city centre and Boekelermeer, shown in red, have been appointed as replication areas. Within these replication areas the successful innovative elements of the PEB-Westrand will be replicated.

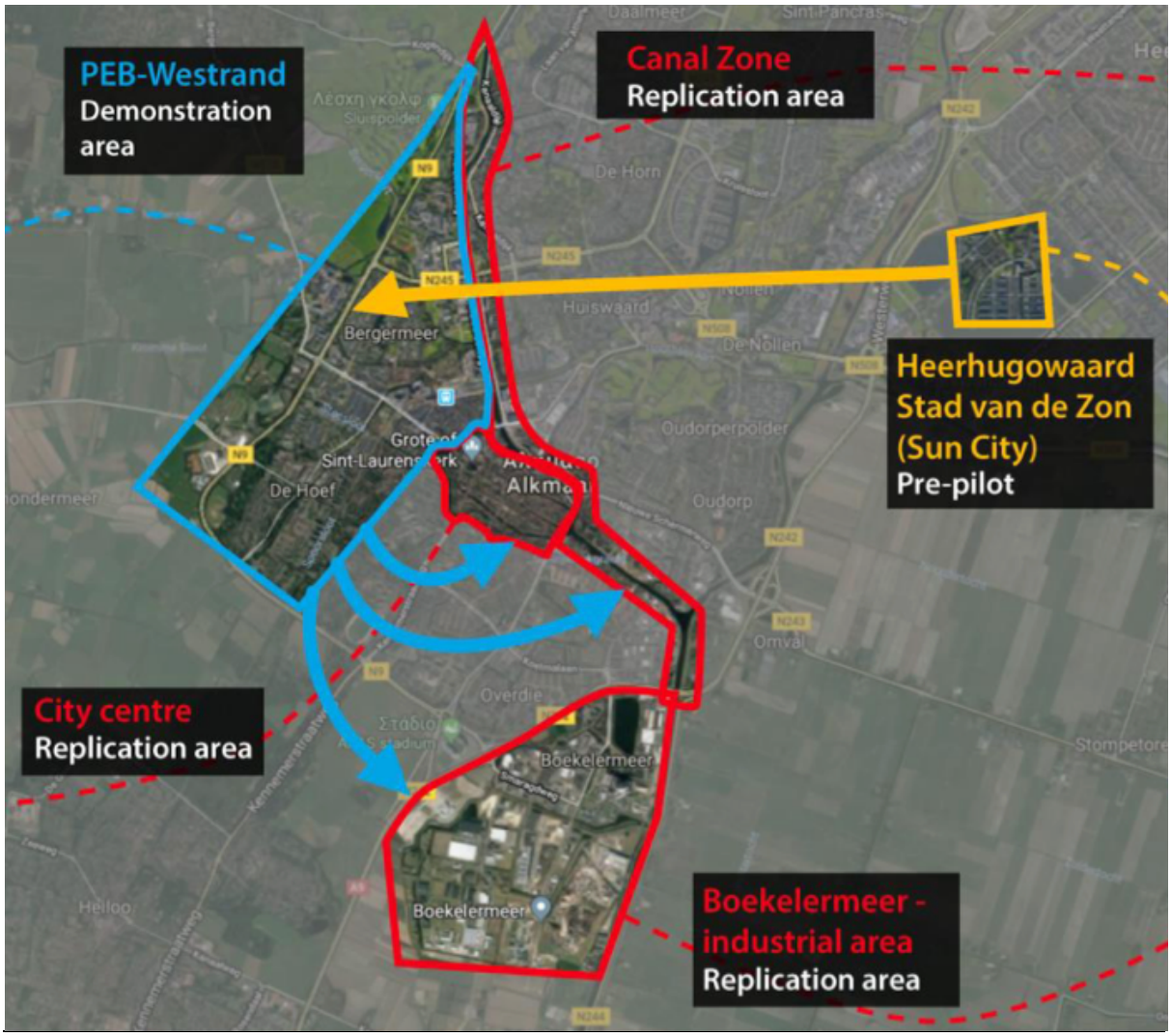

Figure 5. Demonstration (blue) and replication (red) areas of POCITYF in Alkmaar. Source: POCITYF, n.d.

PEB-Westrand - Demonstration area

The area 'PEB-Westrand' is located on the west of Alkmaar. Within the PEB-Westrand the locations of 'De Meent', 'Bloemwijk', 'Woonwaard' and 'Oranjebuurt' are located. Only the demonstration location of InVesta and some miscellaneous are located outside this area. There will be many important transformations in the neighbourhood with regards to rebuilding or retrofitting many houses, buildings and public spaces, therefore creating the ultimate opportunity of using this transformation for some positive changes with regards to energy (POCITYF, n.d.).

Canal Zone - Replication area

The canal zone runs through Alkmaar along the Noordhollandsch Kanaal, connecting the North Sea through Den Helder & Alkmaar with Amsterdam. Alkmaar will redevelop the area around the canal, and include sustainable and climate adaptive developments (Municipality of Alkmaar, 2017, p. 21). The main use of this area will shift from industrial towards residential and public spaces.

City centre - Replication area

The city centre is the most historic part of Alkmaar with many mediaeval buildings still intact. Alkmaar has 380 buildings registered in the Dutch National Monument register, many of them located in the City Centre (RCE, n.d. a).

Boekelermeer - Replication area
Boekelermeer is an industrial area located southeast of Alkmaar. It is connected to the aforementioned Canal Zone. The industry area is home to many companies, among others the HVC waste-to-energy plant, and POCITYF partner InVesta. The HVC energy plant provides heat for a local heat grid, which heats houses and companies (Engelen, 2018).

However the boekelermeer is a bottleneck with regards to the energy grid, currently the energy distribution station is at the maximum capacity, the upgrade of the grid capacity has been delayed until 2026 (Liander, 2022; Alkmaar Centraal 2022). Until then companies located at Boekelermeer are having trouble becoming more sustainable (Bleeker, 2022).

Comparison demonstration and replication areas
Based on the analysis conducted on the implementations in the demonstration area and the characteristics of the demonstration and replication areas we can conclude that there are large differences in the varying areas, as can be seen in table 7.

	Main use	**Main challenges**
PEB-Westrand	Residential	
Canal Zone	Industrial -> residential	Transition from industrial to residential, how to do this transition in a sustainable manner.
City centre	Commercial/residential	Historic buildings, regulations on energy production and retrofitting of buildings.
Boekelermeer	Industrial	Grid congestion

Table 7. Characteristics of demonstration and replication areas of POCITYF Alkmaar

Many of the integrated solutions are tailor made to the demonstration location/building they are intended for, however valuable lessons can be drawn from the technical application, implementation and licensing of the solution. These lessons can be used for the implementation of these techniques in the replication areas. However due to the different characteristics of the buildings, owners and challenges among the areas it is likely some of the gained knowledge is irrelevant. According to the OECD (2001) methods, techniques, know-how and operating rules are the components most suitable to transfer between two areas. When we zoom into the specific areas each area could learn from different aspects of the solutions being tested in the demonstration area. Within the Canal Zone, many new developments will take place in the near future, being mainly newly-built residential areas and public spaces (Municipality of Alkmaar, 2017, p. 21). The Canal Zone could learn from the integrated solutions of Bloemwijk, which will be mainly new constructed housing with excellent insulation, PV-panels connected to batteries and Vehicle-to-Grid technologies. The lessons drawn from these solutions could be valuable for the future development of the Canal Zone.

For the city centre it would be tougher to replicate some of the Integrated Solutions due to the stricter regulations with regards to retrofitting historic buildings. This limits the possibilities with regards to PV-panels to historical roofs (Pointer, 2022). However other measures such as related to energy storage, smart grids and behavioural savings have a low impact on historical values whilst having medium effectiveness of decarbonization (Blumberga et al., 2020). With regards to energy storage and smart grids the Integrated Solutions in ETT 2 could provide valuable lessons for the city centre of Alkmaar.

The Boekelermeer, being an industrial area, is a great consumer of energy. However due to its large buildings it has plenty of roofs available for solar panels, for which it could draw valuable lessons from the implementation of solar panels on the roof and parking places of De Meent. Additionally the POCITYF partner InVesta, located at Boekelermeer can contribute to the sustainability targets of this area.

Chapter 4.2: Analysis replication to the Fellow Cities

In this chapter the potential replication to the Fellow Cities will be analysed, thus answering the second research question: *To what extent can the findings of the current Alkmaar test site be replicated in the six Fellow Cities?*. The Fellow cities are: Bari (Italy), Celje (Slovenia), Granada (Spain), Hvidovre (Denmark), Ioannina (Greece) and Ujpest (Hungary). Each Fellow city will also have to deliver a replication plan, which entails how the city will replicate elements from the Lighthouse cities into their own. The Fellow cities will replicate and learn from the methods, techniques, know-how and operating rules that have been tested out by the Lighthouse cities; these components have a high transferability according to the OECD (2001). In order to successfully transfer these components there are five conditions which need to be met.

Condition	**POCITYF Framework**
The recipients must be clearly identified	Within the POCITYF context the recipients are clearly defined, being the Fellow Cities.
The recipient must be motivated and be willing and able to innovate	The Fellow Cities are committed to be involved in the project, to monitor the developments in the Lighthouse Cities and to come up with replication plans for how to integrate the solutions based on the findings so far in their own city.
There needs to be accessible communication and a mechanisms for coordination and brokerage	Within the POCITYF framework there will be plenty of information available through the deliverables, information sessions and physical exchanges.
The component(s) must be compatible with the context of the recipient area.	While the aim of POCITYF is to integrate energy solutions in the context of historical cities, many of the solutions are not being implemented in this historical context. Additionally there are differences in regulations, culture and governance among the Lighthouse and Fellow Cities. These differences should be taken into account while executing the transfer. Solutions

	should be translated to the local context.
There need to be mutual benefits from the process of transfer between the areas involved.	With policy transfer the recipient is the most beneficial, however with the POCITYF context mutual collaboration is encouraged and an obligation for the various partners and Lighthouse Cities.

Table 8. Comparison of policy transfer conditions set by the OECD and the POCITYF framework.

As shown in table 8, most of the conditions for successful exchange of components are being met in the POCITYF framework with Lighthouse and Fellow Cities. Sharing the knowledge about the implementation of the integrated solutions is an integral part of the project. Both the sender(s) and recipient(s) of the knowledge transfer are clearly defined within the project through the Grant Agreement. Additionally the availability of the necessary data is secured through the mandatory deliverables for both the Lighthouse and Fellow Cities. The main challenge will however be to transfer the knowledge from one context to the other, since there are variations in culture, regulations and governance among the various cities. In the end we can conclude that the POCITYF framework meets all conditions set by the OECD (2001) that are needed for a successful policy transfer, therefore the knowledge gained in Alkmaar can be valuable for the affiliated Fellow Cities.

Chapter 4.3: POCITYF and fellow projects comparison

In this chapter the available deliverables of the comparable Smart City Community projects will be analysed, in order to find relevant information with regards to long-term planning and the impact of the pilot project on this strategic planning. All 16 fellow projects besides POCITYF mentioned in table 3 have been analysed to see if there are already strategic long term visions available. The results of this analysis can be found in table 9 below.

Project	**Strategic documents**
+CityxChange	D3.1 Framework for Bold City Vision, Guidelines, and Incentive Schemes
Atelier	D2.3: Common methodological Framework for vision development
GrowSmarter	Road to replication – guiding cities on smart urban development
IRIS	D5.8 Preliminary report on Utrecht lighthouse demonstration activities D7.8 Preliminary report on Gothenburg lighthouse demonstration activities D8.1 A Roadmap for replication of activities D8.3 Replication tool box
Making-City	No relevant documents
MATCHUP	No relevant documents
MySMARTLife	No relevant documents
Remo Urban	Best Practices and lessons learned Model for replication potential
Replicate	No relevant documents

RUGGEDISED	No relevant documents
SharingCities	No relevant documents
SmarterTogether	No relevant documents
Sparcs	D1.11 City Vision 2050 - Draft
Stardust	No relevant documents
Triangulum	No relevant documents

Table 9. Strategic documents from the fellow projects that have been found and analysed.

Since not all projects are already finished, or published their Bold City Vision or similar strategic documents yet, only the relevant documents will further be analysed. This analysis is presented in table 10.

Project	Findings
+CityxChange	***Framework for Bold City Vision, Guidelines and Incentive Schemes*** - The purpose of a Bold City Vision is to develop politically approved city vision, roadmaps and actions plans. And to present existing policies, show what works and does not work, and to create policies and solutions that contribute to sustainable development. (+CityxChange, 2020, p. 33). - The framework will be a roadmap for smart and sustainable transitions, that is integrated in the governance systems of the city. (+CityxChange, 2020, p. 9).
Atelier	***Common methodological framework for Vision development*** - The City Vision 2050 is a framework, which cities, politicians and planners can use as a reference while defining policies, action or plans towards the 2050 targets (Atelier, 2021, p. 35). - The City Vision 2050 will be complemented with a roadmap or pathway, which sets milestones in order to create political commitments, in order to reach the goals set for 2050 (Atelier, 2021, p. 35).
GrowSmarter	***Road to Replication - Guiding cities on Smart Urban Development*** - The replication report concludes with recommendations for local and regional governments, so they can increase the application and upscaling rate of sustainability measures (GrowSmarter, 2019, p. 52-56). The main recommendations to local governments are: continue building on existing city targets and plans; align with national and regional energy policies and; determine scalability based on past experience of demonstration projects.
IRIS	***A Roadmap for replication of activities*** - The roadmap is created by all lighthouse and follower cities together. It serves as a roadmap for the follower cities to create their own replication plan, based on the best practices of the lighthouse cities (Iris, 2020a, p. 5). - One of the most important requirements for solutions is that they should be replicable, any solution which contains technical innovation, working business model and a proven impact will be interesting for any city, if they are able to replicate the solution (Iris, 2020a, p. 63). ***Replication tool box*** - This replication tool box supports cities in the creation of a replication plan. (Iris,

	2020b, p. 8). In order to successfully replicate a solution the needs, challenges and prioritisation of the follower city need to be identified, consequently the IRIS integrated solution(s) that fit the identified needs can be chosen (Iris, 2020b, p. 16-17). Consequently a working group with regards to the integrated solution(s) should be created, similar solutions in other projects need to be analysed and the knowledge exchange actions need to be planned (Iris, 2020b, p.21-23).
Remo Urban	***Best Practices and lessons learned*** - Remo Urban has created a 'Best Practices Factsheet', in which each best practice has been rated for its replicability potential on a 4-point scale. Each best practice is presented with the lessons learned, advice, caution, stakeholders and replicability.
Sparcs	***City Vision 2050 - Draft*** - The City Vision 2050 will be a vision for what the city wants to be and look like in the future. It will include technical, urban, financial and social aspects, as well as a roadmap for the implementation, replication and upscaling of the successful solutions from the Lighthouse and Fellow cities (Sparcs, 2021, p. 2). - The final City Vision 2050 will be based on the outcomes of various workshops for policymakers, stakeholders, citizens and communities (Sparcs, 2021, p.2). - The developed methodology can act as a participatory framework, manual for designing a City Vision and a set of actions to transfer the methodology and learnings (Sparcs, 2021, p. 11). - In order to create an effective City Vision 2050 a methodology has been developed, which sets participation at the centre stage of attention, whilst making sure to come up with many statements about the desired future in 2050 (Sparcs, 2021, p. 16).

Table 10. Key findings from the analysed documents

Participation

Based on the analysis of the available documents for the Horizon 2020 projects under the Smart Cities and Communities we can draw various conclusions which are valuable for POCITYF. First of all, the available long-term visions claim that the vision is a representation of the desired situation in 2050, which can be used in future (policy) developments as a reference point. This aligns with Dixon et al. (2018) who state that city visions are needed for city management, in order to manage future opportunities and investments.

An important aspect mentioned in the literature is the participation of stakeholders, including residents, in the formation of long-term city vision (Dixon et al., 2018; Rotmans & van Asselt, 2000). The participation of these stakeholders is mentioned in the policy documents of *Sparcs* and *IRIS*. *Sparcs* has developed a methodology for the City Vision 2050 which is being used by all the participating cities, this methodology is centred around participation of the relevant stakeholders (Sparcs, 2021). However each city was able to design their participatory activities and strategies, the input of the public in some cities was collected via other methods such as surveys (Sparcs, 2021). This implies that the public was not always directly involved in the design of the city vision documents, but rather has delivered input in the form of questionnaires, which has been taken into consideration in the design of the city vision. It can be argued that this does not count as active participation or co-creation. *Iris* has citizen engagement and co-creation as a separate ETT, just like POCITYF has. Various engagement and co-creation tools are being carried out in various cities. However it should be the participation activities that vary between each participating city (IRIS, 2020). Citizen

participation is also an important aspect of POCITYF, being the main thematics of the fourth ETT.

Chapter 4.4: Policy analysis

The following chapter analyses policy documents regarding the energy transition of Alkmaar. These policy documents are policy plans with various time frames between 2020 and 2050. Documents from the municipality of Alkmaar will be considered as the main documents, since the municipality is responsible for the design and implementation of energy transition measures and the heat vision. Additionally documents from the province of Noord-Holland are analysed to discover the main targets of the province. The documents will be presented in chronological order. This chapter will mainly answer the 3rd and 4th subquestions.

Chapter 4.4.1: Environmental Vision Alkmaar 2040

Publication date: October 5, 2017
Goal: Create an environmental vision for the city of Alkmaar for 2040
Author: Municipality of Alkmaar

Key findings:
The environmental vision is a strategic policy document concerning the physical living environment of Alkmaar. In this vision strategic choices for future developments of the municipality will be made (Municipality of Alkmaar, 2017, p. 7). One of the key aspects in this environmental vision is sustainability, the municipality has set the goal of 20% CO_2 reduction in 2020 and energy neutrality in 2040 (Municipality of Alkmaar, 2017, p. 17).

Within the vision three main focus areas have been formulated; Create an attractive and liveable Kanaalzone; maintain a high-quality compact city; make the rural areas future proof and innovative. With regards to sustainability Alkmaar will create a sustainable agenda, based on the separate themes of: housing, transport & mobility, companies and public real estate (Municipality of Alkmaar, 2017, p. 17).

Alkmaar already has a lot of knowledge with regards to sustainable energy (Municipality of Alkmaar, 2017, p. 25). It will expand this position by stimulating experiments in the field of biogasification and residual heat (Municipality of Alkmaar, 2017, p. 29).

Existing buildings will need to be adjusted in order to be more energy efficient. New buildings will need to be energy neutral, and potentially energy positive in the future (Municipality of Alkmaar, 2017, p. 29). In the Kanaalzone a smart city for the future will be realised (Municipality of Alkmaar, 2017, p. 19).

Neighbourhoods in Alkmaar Noord need to be more sustainable and future proof, the municipality will support initiatives from the residents and the market. With regards to the energy transition the municipality will connect with regional developments to stimulate this transition (Municipality of Alkmaar, 2017, p. 27).

Chapter 4.4.2: Environmental Vision NH 2050

Publication date: November 19, 2018
Goal: Create a vision for the Province of North-Holland for 2050
Author: Province of Noord-Holland

Key findings:

The environmental vision of the Province of North-Holland aims to balance economic growth with liveability, in order to maintain the existing high levels of welfare in the province (Province of Noord-Holland, 2018, p. 17). The energy transition is mentioned as one of five key movements, in which economic chances arise in the energy and circular economy sector (Province of Noord-Holland, 2018, p. 17).

The province aims to be climate neutral in 2050, it will offer space for the required infrastructure with regards to the production of renewable energy (Province of Noord-Holland, 2018, p. 10). One of the mentioned areas which could become a circular economy hub is the Boekelermeer (Province of Noord-Holland, 2018, p. 44).

According to the Province of Noord-Holland (2018, p. 46), there are a few critical conditions for reaching the target of climate neutrality in 2050. The critical conditions that are needed are; Future proof energy infrastructure; Utilisation of energy saving measures; Experimenting with knowledge exchange about innovative solutions; Regulations.

The creation of the Environmental Vision NH 2050 has been co-created with over 500 representatives of various levels of government, additionally three panels with the input of around 4.500 inhabitants of the province have been organised (Province of Noord-Holland, 2018, p. 72). The Environment Vision is thus not only a representation from the Vision of the province itself, but it is a co-creation of many stakeholders.

Chapter 4.4.3: Heat Vision Alkmaar

Publication date: 2019
Goal: Design a vision for Alkmaar based on alternatives for natural gas
Author: Municipality of Alkmaar

Key findings:
The Netherlands wants to get rid of natural gas, all municipalities need to have a heat vision in order to show which alternative solutions will be used in what areas. Ultimately Alkmaar needs to be free of the use of natural gas in 2050 (Municipality of Alkmaar, 2019, p. 4). For the realisation of this transition nine agreement points have been formulated in coherence with residents:

1. The municipality will actively work together with the residents
2. Together with the municipality each neighbourhood/village can choose its own cooperation partners
3. The municipality will research, together with the residents, what alternatives for natural gas are most suitable
4. The municipality will make a seperate plan for each neighbourhood/village, together with the residents
5. House owners and landlords have the freedom to choose their alternative for natural gas
6. The municipality will stimulate residents to use energy saving measures
7. The municipality will start in the neighbourhoods with the greatest potential
8. The municipality will combine drastic construction works to limit nuisance
9. The municipality strives to make the heat transition at least budget neutral for residents

For the replacement of natural gas there are three main alternatives that can be used as a replacement of natural gas, these techniques are: (sustainable) Gas, (sustainable) Heat and Electric (Municipality of Alkmaar, 2019, p. 6). With these techniques gas provides the highest potential temperature for heating, All-electric provides the lowest temperatures. A mix of these techniques will be required in order to replace natural gas in the built environment. Each technique has its own pro's and con's, which have been presented in table 11.

	Gas	**Heat**	**All-electric**
Insulation	Not required, but desired	Not required, but desired	Excellent insulation required
Indoor adjustments	Potential adjustments to boiler and pipes	Installation heat delivery set	Underfloor heating or big radiators
Investment in network	Keep current network up-to date, potentially needs replacement	New infrastructure and heat source	Expansion electricity network and storage
Energy costs	Average to high	Average	High
Availability of source	Sustainable gas sources are scarce	Depending on the location	Potential sufficient ways of production

Table 11. Implications of the three natural gas alternatives. Source: (Municipality of Alkmaar, 2019, p. 8), Edited and translated by author.

Not all solutions are possible for each neighbourhood, theoretically a distributed heat network is the most cost-effective, however it requires a high density of buildings in order to reach this competitive price level. The all-electric solution would be an alternative for low-density neighbourhoods, however this solution requires relatively large investments such as isolation, pv-panels and a heat pump (Municipality of Alkmaar, 2019, p. 9). The municipality has made an analysis, based on six criteria, to discover the best neighbourhoods to start with. These criteria are based on the support from citizens, planned renovations for housing and public space, state of the gas network, proximity to the heat network and the cost-effectiveness of the operation. Five neighbourhoods have been selected: Oudorperpoder-Zuid, Overdie-Oost, De Hoef, Kooimeer, and Huiswaard. Additionally Bloemwijk-Zocherbuurt is mentioned as a promising neighbourhood, however since housing corporation Van Alckmaer is currently executing large construction works in this neighbourhood it will be considered at a later stage (Municipality of Alkmaar, 2019, p. 12).

The municipality understands the importance of first aiming to reduce the use of energy and energy losses, it will therefore start an energy savings campaign targeting residents in 2019. The next step after energy savings is to use renewable energy sources, the last step is where the use of fossil energy sources are unavoidable, they need to be used as efficiently as possible with solutions such as residual heat and heat pumps (Municipality of Alkmaar, 2019, p. 16).

Chapter 4.4.4: Programme Sustainable Alkmaar 2020-2024

Publication date: June 10, 2020
Goal: Create a framework in order to meet national climate goals of CO2 reductions and local Energy production.
Author: Municipality of Alkmaar

Key findings:
Since 2018 the municipality of Alkmaar is a 'Global Goals Municipality' in which it underlines the importance of the SDG's, these goals have been included in the programme (Municipality of Alkmaar, 2020, p. 5). The municipality has set the definition for 'sustainable Alkmaar', which the municipality will become once it is climate neutral by 2050 and meets the SDG's. The current programme will run for 4 years and has set targets for seven important themes. These targets have been displayed in table 12.

Sector	**Goal for 2024**
Electricity	16% of the total energy use will be locally generated in a renewable manner
Built environment	Reduction of 25% CO2 emissions in the residential and commercial sector, compared to 2010
Mobility	Reduction of 11% of CO2 emissions, compared to 2010
Industry, business parks and circular economy	Reduction of 53% of CO2 emissions, compared to 2010
Agriculture	Reduction of 53% of CO2 emissions, compared to 2010
Municipality Alkmaar	Reduction of 28% of CO2 emissions, compared to 2010
Climate adaptation and greening	Alkmaar 2050 will be prepared for the effects of climate change

Table 12. Alkmaars' 2024 ambitions. Source: Municipality of Alkmaar, 2020. Created by the author.

For this research the sectors Electricity, Built environment and Mobility will be most relevant, therefore only these sectors will be described shortly:

Electricity
The municipality has set the goal for 16% of renewable energy production in 2024. This target is in line with the 'energieakkoord'. In 2017 Alkmaar already produced 13% of its energy from renewable energy sources. The exact amount of renewable energy that Alkmaar will need to produce will be established in the Regional Energy Strategy (Municipality of Alkmaar, 2020, p. 10).

Built environment
In order to reach a climate neutral built environment in 2050, Alkmaar will need to reach the target of a 27% reduction in 2024 to stay on track. The heat vision will help the municipality in reaching this target. Alkmaar has around 50.000 houses, this means that on average 1.600 will need to become CO2 neutral annually in order to reach climate neutrality in 2050 (Municipality of Alkmaar, 2020, p 14).

The municipality will stimulate households and businesses to produce their own energy, it therefore wants to place 10.000 solar panels on houses and 10.000 solar panels on businesses. This measure will quickly bring down energy costs and CO2 emissions (Municipality of Alkmaar, 2020, p 15).

Within the build environment the European H2020 project POCITYF will contribute to increased sustainability at sportcomplex De Meent and various residential areas. The goal of the pilot is to share innovations and knowledge between EU member states in the field of sustainability (Municipality of Alkmaar, 2020, p. 16). At the end of the pilot Alkmaar will have a positive energy district and a leading example as a Smart City (Municipality of Alkmaar, 2020, p. 17).

Mobility
As part of the reduction of CO2 emissions of the mobility sector, the municipality will expand the network of EV charging infrastructure. Until 2024 another 180 new charging stations will be realised in the municipality, double the current amount. This expansion should realise each house in Alkmaar should have a charging station within walking distance in 2024 (Municipality of Alkmaar, 2020, p. 19).

Chapter 4.4.5: Regional Energy Strategy 1.0 Noord-Holland Noord

Publication date: April 21, 2021
Goal: Create a Regional Energy Strategy for Noord-Holland Noord
Author: Energieregio Noord-Holland Noord (NHN)

Key findings:
The region of Noord-Holland Noord aims to generate 3,6 TWh of sun and wind energy on land in 2030, this is a combination between existing and new energy projects (Energieregio NHN, 2021, p. 10). Within the province, the Alkmaar region will be the most difficult one to produce plenty of renewable energy, due to the scarcity of space and existing nature protection, nevertheless the ambition of 0,62 TWh has been set for this region (Energieregio NHN, 2021, p. 98). The industry area Boekelermeer is a potential production area for various sources of renewable energy (Energieregio NHN, 2021, p. 101).

The electricity grid in the region is already used quite heavily, therefore the grid operator is working on the expansion of the grid (NHN, 2021, p. 111). The realisation of a new grid station takes between 5 and 7 years, therefore it is important to plan ahead if new stations are needed (Energieregio NHN, 2021, p.111)

The region aims to produce renewable energy by solar panels on roofs, parking lots, businesses and noise screens as much as possible (Energieregio NHN, 2021, p. 103).

There is already an existing heat grid in Alkmaar, where heat is coming from the HVC bio-energy plant (Energieregio NHN, 2021, p. 109).

There are various energy-saving campaigns for home owners ongoing in the various municipalities of the region, some municipalities also offer financial aid or subsidies (Energieregio NHN, 2021, p. 125). Additionally municipalities have made agreements with housing corporations to make the social houses in their portfolio more energy efficient (Energieregio NHN, 2021, p. 126).

In the Regional Energy Strategy (Energieregio NHN, 2021) the Boekelermeer is mentioned as a potential energy supplier for Alkmaar, via various energy sources. Currently there are already some wind turbines located, however potentially a few more could be added, alongside the

addition of solar fields and solar on roofs within the industry area (Energieregio NHN, 2021, p. 108).

Chapter 4.5: Analysis between policy and POCITYF

Something that the policy documents have in common is setting a clear target(s) for the city or region. The timeline and region for the targets highly depends on the type of policy document. While the sustainability target is often clearly described in policy, a roadmap, timeline or necessary steps reaching these goals are lacking in these documents.

Creating clear visions with targets are important for decision making and planning since it provides a reference point for developing strategies (Wiek & Iwaniec, 2014), therefore it is a good development that various goals with regards to sustainability have been set by the municipality, province and national government. However, only setting ambitions does not mean that these are actually followed, as there remains a large gap between ambitions and actual progress (Hughes et al., 2018). It is therefore important for Alkmaar to develop a roadmap in which the strategies for reaching the goals will be set. The Bold City Vision of Alkmaar might play a role in the development of such a roadmap.

Year	Target	Document
2020	- 20% CO2 reduction	Environmental vision Alkmaar 2040
2024	- 25 CO2 reduction, compared to 1990 levels - 16% of own energy consumption produced sustainable	Programme sustainable Alkmaar 2020-2024
2030	- 0,62 TWh renewable energy production in Alkmaar region	Regional Energy Strategy
2040	- Energy neutral	Environmental vision Alkmaar 2040
2050	- Alkmaar free of natural gas	Heat Vision Alkmaar

Table 13. Policy targets and their deadline, derived from the analysed policy documents. Figure created by author.

Based on the key findings of the policy documents, several targets with regards to the energy and heat transition become clear. The main targets have been visualised in table 13. The table shows the various targets set by various layers of government.

The ambition of the region to use as much solar on roofs and parking spaces (Energieregio NHN, 2021) fits with the realisation of solar panels on the roof and parking spaces at sportcomplex 'De Meent'.

Critical condition:	Aligns with:
Future proof energy infrastructure	Energy Transition Track 1. Focused on Positive Energy Buildings and Districts, both through maximised energy production as energy efficiency measures. Various solutions such as PV-panels and smart grids are in this Energy Trach, which contributed to an sustainable and reliable energy infrastructure

Utilisation of energy saving measures	Energy Transition Track 1. Focused on Positive Energy Buildings and Districts, both through maximised energy production as energy efficiency measures. Various innovative and circulair energy saving measures are included in this Energy Track, such as triple glazing and roof insulation from circulair materials.
Experimenting with knowledge exchange about innovative solutions	Knowledge exchange is an integrated part of the POCITYF framework, through collaboration, deliverables and exchanges there is knowledge exchange between companies, institutions and cities. Within cities several partners work together to develop and implement innovative solutions, the lessons drawn from this are made available to the Fellow Cities to allow them to learn from and implement the solution themselves.
Regulations	Theoretical findings of Nieuwenhout & Oliveira Evangelista (2020), which claim that a regulatory framework is necessary for the success of implementing energy measures.

Table 14. Comparison between critical conditions and POCITYF.

The critical conditions that the province of North Holland (2018) has set for climate neutrality in 2050 aligns with the theoretical and practical findings of this research. The critical conditions are displayed in table 14, and compared with the findings.

The creation process of the Environmental Vision NH 2050 shows that the input of inhabitants is an important input for the environmental vision. The Integrated Solution of POCITYF part of ETT 4, citizen-driven innovation in co-creating smart city solutions, shows that citizen participation is an integrated part of POCITYF. This is in line with Dixon et al. (2018) and Rotmans & van Asselt (2000) that argue that participation is very important in the design of city visions. Additionally it is very important to have the support of citizens, since many houses in the Netherlands are privately owned (Tambach et al., 2010), therefore home owners need to be involved and engaged in the process of making houses and neighbourhoods part of the energy transition.

In all policy documents it is clear that Alkmaar will have to become more sustainable, with the help of clear targets to the sustainability goals. However a clear roadmap towards this sustainability often lacks. There is little notion about the historical city centre and the challenges that come with making city centres sustainable.

<u>Legal regulations for POCITYF Alkmaar</u>

One of the objectives of POCITYF with regards to replication and upscaling is to identify regulatory barriers and legal aspects while implementing integrated solutions, and come up with recommendations on how to overcome these. While POCITYF aims to develop knowledge about the implementation of Integrated Energy Solutions in historical districts, many of the demo-sites do not meet these characteristics. It should be noted that there are currently no demo sites included which fall under the Dutch Heritage Law, however this law is applicable for the Alkmaar city centre (Nieuwenhout & Oliveira Evangelista, 2020). Therefore it is highly relevant for POCITYF to consider this during the implementation of the integrated solutions and the creation of replication and strategic vision documents. Many buildings in Alkmaar have to deal with '*beeldbepalend pand*' (building with a significant appearance); '*beschermd stadsgezicht*' (protected city area)'; '*Erfgoedverordening Alkmaar*' (Heritage Regulation of

Alkmaar) or '*Wet Algemene Bepalingen Omgevingsrecht*' (General Provisions of Physical Environment Law) (Nieuwenhout & Oliveira Evangelista, 2020).
Nieuwenhout & Oliveira Evangelista (2020) argue that many of the laws that are currently applicable for the historical buildings in Alkmaar, or the Netherlands as a whole, will be revised in the upcoming years, therefore it is currently impossible to analyse the exact legal framework.

Chapter 5: Conclusion & reflection

This chapter presents the conclusion of the thesis, including a reflection on the research carried out. Additionally a recommendation will be given for the project team of POCITYF on how to design a long-term city vision for Alkmaar, based on the findings of this thesis.

Chapter 5.1: Conclusion

A case study has been used to analyse the pilot project POCITYF in Alkmaar. This case served as a single case in order to answer the main question: *"How can pilot projects in cities contribute to the local long-term planning goals, in order to reach the sustainability targets of 2050?*. At first, the importance and need for making cities sustainable was established in the first chapter which served as an introduction. Based on this chapter we can conclude that drastic interventions are needed in all sectors to drastically reduce greenhouse gas emissions. In Europe citizens and emissions are concentrated in urban areas (REN21, 2021). Therefore it is important to make cities more sustainable. However most European cities have cultural heritage, therefore they are in general badly isolated, and harder to retrofit, due to technical and legal restrictions (Blumberga et al., 2020). The pilot project POCITYF aims to test energy solutions that can be used in historical buildings. However a discrepancy can be noted between the characteristics of demosites and the historical buildings it is aiming for. In order to implement energy efficiency measures in historical buildings various restrictions such as legal restrictions and technical obstacles are present (Blumberga et al., 2020). The most effective energy efficiency measures also have the most drastic loss of historic heritage values (Blumberga et al., 2020).

Pilot projects such as POCITYF are often used by cities to test new technologies (van Winden & van den Buuse, 2017), however many never scale up the tested solutions (Bundgaard & Borras, 2021). While the potential of replication and upscaling is present, it remains a challenge to actually achieve this. An instrument to stimulate this potential is the Bold City Vision document, a required deliverable part of the program structure. In this document each participant will have to come up with a vision for their city in 2050, based on the characteristics of their city and the developments from the program. Based on the theory we can conclude that long-term planning documents can act as a reference point for the development of new policy (Wiek & Iwaniec, 2014), however having a vision does not necessarily mean that it will be followed (Hughes et al., 2018).

The sub questions have been answered in the research, based on these answers and the theoretical framework we can now discuss the main research question: *"How can the findings of the POCITYF project in Alkmaar contribute to the long-term planning goals, in order to reach the sustainability goals of 2050?"*. Based on the policy analysis of Alkmaar we found that the municipality has set several sustainability targets within the coming years until 2050. However while the targets were clear, the steps towards these goals remained rather incomplete and still need to be decided. POCITYF could potentially fill this gap by developing a Bold City Vision 2050. The main condition for creating a successful long-term planning document is to include active participation with all stakeholders (Dixon et al., 2018; Rotmans & van Asselt, 2000). POCITYF has included participation in the project by Energy Transition Track 4, where citizen driven co-creation the main topic is. Analysis of similar projects showed that participation is also part of their approach, however there is no standard framework to

include participation. All in all we can conclude that pilot projects such as POCITYF have the potential to contribute to long-term planning goals, both by testing innovative solutions and driving technology forwards, as by engaging and activating all relevant stakeholders and uniting them by creating a common vision for the future.

Chapter 5.2: Reflection

This research started off with the intention to compare all Horizon 2020 projects from the Smart Cities Framework, however during the research it became clear that there were far less relevant documents publicly available, even though a large share of the projects are already finished, or close to finishing. Based on the progress of these projects, it was expected that more documents were already publicly available. Additionally the documents that were available were less useful that the titles were suggesting, therefore only a few documents have been taken into consideration, making the research a lot weaker than intended. It could be recommended to analyse all Horizon 2020 projects from the Smart Cities Community, once all projects are finalised and all documents are publicly available, in order to do a full analysis of the impact of the subsidy program, and analyse the pilot projects that have run in all Lighthouse Cities.

Chapter 5.3: Recommendation

The recommendation towards the municipality of Alkmaar is twofold: Participation and replicability. Based on the literature and comparison of similar Horizon 2020 projects we can conclude that participation is very important when coming up with long-term city visions. Therefore it is important to include all relevant stakeholders in this process. There seems to be no common method for engaging with the stakeholders for this process, therefore it would be advised to monitor and document the chosen method, so other projects can learn from the engagement. Even though there were little documents from other projects available for this research, almost all projects have common goals, and projects can still learn from each other through other channels than public deliverables. Reaching out to project managers from projects that are already finished or close to finishing could give insight about their methods. However it should be reminded that these methods would have taken place in another context and culture.

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