DELFT UNIVERSITY OF TECHNOLOGY

TOWARDS ENERGY TRANSITION IN THE BUILT ENVIRONMENT

The process towards energy efficient implementations in large urban areas

C.Vlaar

Carolien Vlaar (4007220)
carolien.vlaar@gmail.com
Graduation Thesis
Urban Development Management lab

First mentor: dr. ir. Y. (Yawei) Chen
Second mentor: dr. ir. L.H.M.J.(Louis) Lousberg

Personal Information

Student: Carolien Vlaar
Student number: 4007220
Address: Oosteinde 201E
2611VE, Delft
Cell Phone: +31(0)6 20 102 861
Date 5th proposal: 10/01/2016

University Information

University: Technical University of Delft, the Netherlands
Master: Management in the Built Environment
Graduation Lab.: Urban Development Management
Coordinator: E. Heurkens

ABSTRACT

Cities strive to move towards a more sustainable city. In the process of energy transition in the built environment, moving from usage of fossil fuels towards renewable energy is the process obstructed which results which result in little or no action. This research will focus on several cases in Europe and analyse the cases with a focus on its management, policies and actors. The research will compare theory with practice on the process that tends to go towards the implementation of sustainable solutions in the built environment, focusing on energy efficient solutions in particular. Finally, it will conclude with the found bottlenecks in each theme and each case, which leads through a synthesis to a conclusion that can cover some solutions to overcome these bottlenecks.

KEYWORDS

Sustainable development, large urban areas, energy transition, actors, policies, process, urban development management.

“If you have only four fingers on one hand, that is not a problem; that is a situation.”

(Kingdon, 1984)

PREFACE

This research is conducted as part of a graduation thesis from the master Management in the Built Environment (Technical University of Delft, faculty of Architecture), within the lab of Urban Development Management. This research aims to describe the process towards the implementation of renewable energy in the built environment. It will focus on the power, constraints and the position of actors involved in such a process.

During my studies at the Faculty of Architecture I have always been intrigued on the matter of collaborating, project and process management and the built environment. After being lectured for the first time about sustainability, I have had a critical view on topics related to sustainability. In my opinion, sustainability is a buzzword. The actual practical consequences of being or becoming sustainable are overlooked. By everyone. Naturally, my graduation thesis fits within these topics.

In 2013 and 2014 I have worked on the project "TRANSFORM" as part of my internship at the municipality of Amsterdam. TRANSFORM is about finding the barriers to reach targets, such as 20% more renewable energy in 2020, and enables cities to transform to smart cities. During my internship I have been astonished by the process and progress of the project and the struggles to move as a city, a business, a institute, but also as a person, towards more sustainable solutions.

This all has led to my topic of the process going towards the implementation of sustainable solutions in the built environment.

While writing my graduation thesis I strive to look critically to sustainable development, process management, actor networks in theory and in practice. With this research I try to create new and useful information, which will hopefully influence the current situation on sustainable urban development.

Finally, I would like to thank firstly my tutors Yawei and Louis. They have supported me throughout the whole process, with their knowledge and expertise. I also thank them for pushing me to produce the best. Secondly I would like to thank Ronald for helping me out on so many levels, from knowledge to letting me work on TRANSFORM as an intern. I also appreciated all the help from those from the municipality of Amsterdam, providing me all knowledge and expertise. Finally I would like to thank my friends and family for giving me high motivation and support, while doing my research and writing this thesis.

Carolien Vlaar

Delft | 2016

TABLE OF CONTENTS

PREFACE 4
SUMMARY 9
1. INTRODUCTION 12
2. PROBLEM ANALYSIS 15
2.1 Main Problem 15
2.2 Justification focus main problem 16
2.3 Aim of this research 17
2.4 Relevance of this research 18
Academic relevance 18
Societal relevance 18
2.5 Research questions 18
Main research question 18
Detailed research questions to be answered 18
3. THEORETICAL FRAMEWORK 21
3.1 Introduction to energy transition 21
Transition management 21
Research on energy transition in the built environment in Europe 22
Technologies of energy efficiency 23
Existing stock 24
3.2 Sustainable urban development 25
Policies; movements 25
3.3 Urban area (re-)development 27
Actors 28
Actors and strategies 31
Policy /institutional context 32
Policies 33
Management strategy 33
Phases 34
3.4 Conclusion 34
4. RESEARCH METHOD 37
4.1 Research method 37
4.2 Conceptual model 38
4.3 Qualitative research 39
4.4 Data gatherings methods 40
4.5 Research planning 40

3.6 Research organisation....41
5. CASES....43
5.1 Cases from TRANSFORM....43
5.2 Cases....44
Copenhagen....44
Grand Lyon....46
Amsterdam....48
Hamburg....50
Vienna....52
5.3 Case selection....54
5.4 Copenhagen: Nordhavn....56
Background information....56
Description of the project....57
Political, institutional context....57
Policies, legal framework, financial framework....58
Management, implementation strategy....59
Actors....59
5.5 Grand Lyon; Part-Dieu district....62
Background information....62
Description of the project....62
Political, institutional context....62
Policies, legal framework, financial framework....63
Management, implementation strategy....63
Actors....64
5.6 Amsterdam; Energiek Zuidoost....66
Background information....66
Description of the project....66
Political, institutional context....67
Policies, legal framework, financial framework....67
Management, implementation strategy....67
Actors....67
7. SYNTHESIS....71
7.1 Quick wrap-up....71
Nordhavn, Copenhagen....71
Part Dieu, Grand Lyon....72
Amsterdam Energiek Zuid-Oost, Amsterdam....73
7.2 Phases....73

7.3 Bottlenecks 76
7.4 Political and institutional context 77
Bottlenecks from political and institutional context 78
7.5 Policies, legal and financial framework 78
Bottlenecks: policies 78
Bottlenecks: legal framework 79
Bottlenecks: financial framework 79
7.6 Management, implementation strategy 79
Bottlenecks: management, implementation strategy 80
7.7 Actor 80
Actors in relation to the process and actor information 81
Power and interest grid 83
Support and opposition grid 86
Actor's dependency 87
8. CONCLUSION 90
The process of implementing energy efficient solutions 91
Bottlenecks 93
Actors 94
Actor network diagram 95
8. REFLECTION 98
8.1 Research subject 98
8.2 Research design and methodology 98
8.3 Cases 99
8.4 Synthesis 99
8.5 Conclusion 99
9.6 Theory vs. Practice 100
REFERENCES 101
APPENDIX 105
Categorising actors 105
Copenhagen; Nordhavn 105
Grand Lyon; Part-Dieu district 107
Amsterdam 108

SUMMARY

SUMMARY

Cities strive to move towards a more sustainable city. In the field of urban energy transition, moving from usage of fossil fuels towards renewable energy, a lot of difficulties are found which result in little or no action towards implementing energy efficient solutions.

One can identify the actual process by comparing theory and practice in the process of going towards the implementation of energy efficient solutions. There is a focus on the related fields, which are the content, political and institutional context, policies, management and actors. Within these fields bottlenecks can be identified, that obstruct the whole process.

This leads to the main research question to be answered; how is the process of energy transition in European cities obstructed by its political and institutional context, content, policies and actors, and how can actors influence the process to overcome these bottlenecks?

Five cases are identified and used for research, which are Copenhagen, Grand Lyon, Amsterdam, Hamburg and Vienna. All cases consider the implementation of energy efficient solutions in a large urban area. Amsterdam comes out as a strong counter case, because it did not start with an urban plan or master plan. Vienna, Hamburg and Lyon have similar characteristics, where the political framework and policies have big influence on the process and outcome. Lyon has been chosen because the governmental parties see this process as new and non-traditional. Copenhagen shows a case with a strong base, because of its old systems considering heat supply. As a consequence, governmental parties focus more on other sustainable implementations and new ways of working towards implementing energy efficient solutions.

Different from the process phases from theory has the process identified from the cases a large emphasis on analysing the existing or planned stock. It considers mapping and analysing big data on energy, the physical characteristics of the building, inhabitants and the infrastructure underneath the buildings.

Firstly bottlenecks found in the field of management are highlighted by “we do not know how”. Municipalities or higher governmental bodies that coordinate implementing energy efficient solutions in urban (re-)development do not well how to act differently from their traditional, high hierarchal position. There is also a lack of aligning the objectives of other important actors with the (re-)development of urban areas, considering implementing energy efficient solutions.

Secondly, in the field of political and institutional context, higher governmental bodies need to acknowledge the importance of implementing energy efficient solutions and instigate the movement. The institutional context of municipalities and governmental bodies is rigid and not flexible to the inconstant environment of energy efficient solutions. Finally, the political and institutional context is yet not designed to have implementing energy efficient solutions high on their agendas.

Also, in the field of policies, legal and financial frameworks, not many, or unclear, policies exist on implementing energy efficient solutions, because it is a quite novel movement. Without laws no or little action is taken by actors; implementing energy efficient solutions is not a standard objective of private actors. Also, the business case of implementing energy efficient solutions is not sound. Eventually, with implementing energy efficient solutions, a new financial framework and mind set is necessary. Most actors tend to think traditionally and in the old framework.

After researching the actors, one can conclude that governmental parties contribute to obstructing the process by not knowing how to act from their traditional position. Governmental bodies are not structured to support a new way of coordination or management. Higher governmental bodies do not acknowledge the importance of implementing energy efficient solutions. Laws and stricter policies are needed to activate for example private actors.

The financial bottleneck, having no sound business case, is mostly related to private actors. Most private actors do not want to collaborate, because they tend to think in short term returns. This makes the business case not profitable. The current energy market, with is mostly using fossil fuels, has small margins and not a lot of risk. This is in contradiction to the renewable energy market.

Integrating or using ideas from civilians, bottom-up development instead of top-down, is overlooked by the governmental bodies. Civilians are not actively involved in these types of developments.

All actors should try and align objectives, by thinking more collaborative and less traditional. This could be the possibility of new types of partnerships or companies that combine and align all the different actors that are active in implementing energy efficient solutions. In this way, resources, power and knowledge can be shared and used to create a better living environment for all of us.


INTRODUCTION

1. INTRODUCTION

This chapter covers the introduction to the topic of this thesis, the problems regarding this topic.

Over the past decades governments have created policies for cities to move towards more sustainable cities. In Europe municipalities have agreed upon 20% less CO^2 emission in 2020 compared to the year 1990, in some cases this goal is set on 30% less CO^2 emission. The same agreement states that in the year 2020, 20% of energy comes from renewables in Europe (Europe 2020 in a nutshell, 2009). To achieve these agreements or goals, European countries need to move from energy systems that use fossil resources towards energy systems renewable energy. This movement from fossil to renewable resources, or energy transition, influences all kind of aspects such as the built environment, where new building systems need to be designed to use renewable energy or already existent building systems need to be adapted to use renewable energy.

Different initiatives have shown the possibilities of creating a building which uses renewable energy. One of these initiatives is the Prêt-à-Loger concept, where students have developed a set of sustainable implementations for a typical Dutch row house. The implementation shows that using renewable energy must go hand in hand with reducing energy loss and reusing water. The buildings has become energy positive after the implementation (Prêt-à-Loger Press Release, 2014).

Figure 1 Visual of the Prêt-à-Loger house (Prêt-à-Loger, 2014)

There are many other individual initiatives such as Prêt-à-Loger, but implementations on a larger scale, such as urban areas, are hard to find. Meanwhile urban areas comprise the largest concentrated source of greenhouse gas emission and will increase from 66% to 75% of total emission by 2030 (IEA, 2008).

Though, some cities have an already existing system in the built environment that does not use fossil fuels. The Copenhagen district heating system is one of the world's largest, oldest and most successful, supplying 97% of the city with clean, reliable and affordable heating. This means that little fossil fuels are used for city heating, which is highly sustainable. Unfortunately this does not mean that there is little fossil fuel used for other usages of energy. Governmental bodies want to change towards renewable energy, but there is little movement noticeable in the built environment, while movement is necessary. Why are cities not implementing initiatives of using renewable energy on a large scale in urban areas?

"Why are cities not implementing initiatives of using renewable energy on a large scale in urban areas?"

Current city problems are bound to become tangled and very complex, due to its quick changing context, interconnected content and necessary collaboration. This means that the involved actors in the process of (re-)developing an area that uses renewable energy are bound to recognise this interconnected nature. All actors need to understand they cannot operate without the other. An example to explain this nature.

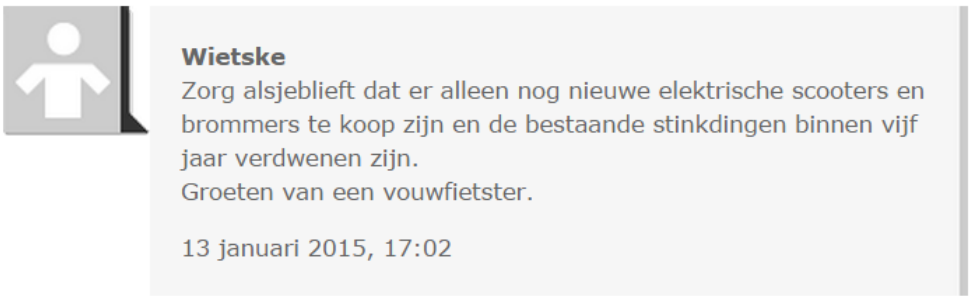


Figure 2 Comment on the policy of the municipality of Amsterdam on sustainable energy (Agenda duurzaamheid "Duurzaam Amsterdam", 2015) Translation: Please make sure that stores only sell electric scooters and that those other smelly things are gone within 5 years. Yours sincerely, a folding bike user.

In this example Wietske (civilian) tries to emphasise the problem of the usage of fossil fuel energy in mobility. Please change to electric vehicles instead that do not smell and could function on sustainable energy. In her opinion she expects that the municipality of Amsterdam has the power to dictate the type of scooters stores should sell, while the municipality actually has not the power that can cause such a movement without the willingness and cooperation of private parties and buyers.

This report will first cover deepening onproblem field and its analysis. It follows by the main question that is raised in this report and the related sub-questions. So the solution of the raised problem will be reflected in the answer to those questions. Then the theoretical framework is presented, that come from the problem field and the raised questions. The theoretical framework is followed by the cases and a thorough analysis of those cases. This analysis is the base and input for the synthesis and conclusion of the report. In the reflection, the process, result, research methods and other related topics are reflected upon. This is done in relation to possible further research.

PROBLEM ANALYSIS

2. PROBLEM ANALYSIS

This chapter will cover the main problem and a justification why it is important to focus on this problem, the aim and relevance of this research and the questions that are related to answering the main problem.

2.1 Main Problem

To go from the old systems in buildings towards new systems which use renewable energy, new developments and redevelopments in urban areas are necessary. Urban area development is connected to a social and policy context, actors and management which each have its own complexity and problems. City problems become tangled and wicked.

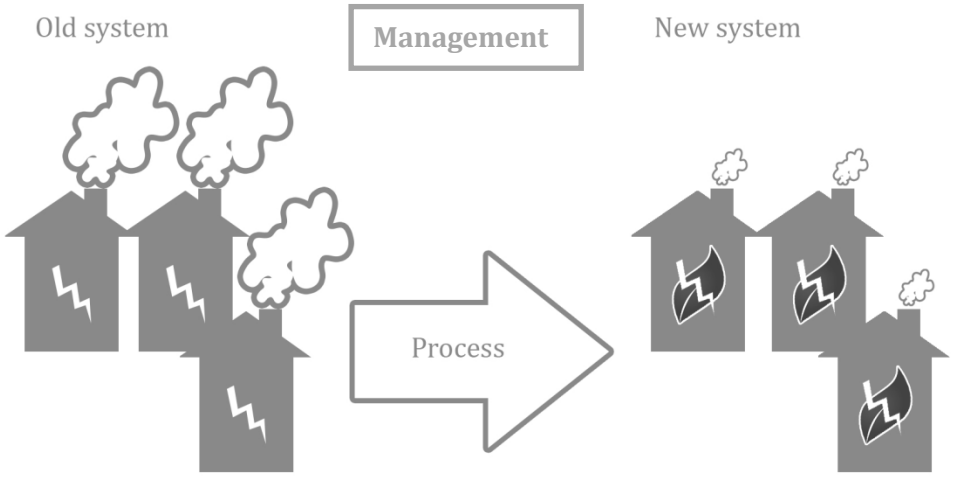


Figure 3 By a process an area should be developed from an old system which uses fossil fuels towards a new system that uses renewable energy (own ill.)

Figure 3 shows that by a certain process one can towards a new system in the built environment that can use renewable energy. This is the underlying understanding of energy transition. This research aims to focus on this process and encounter problems in each step of this process.

Cities strive to move towards a more sustainable city by setting ambitious goals. In the field of urban energy transition, from fossil fuels towards renewable energy, different difficulties are found, which result in no action or movement towards renewable energy. General problems found in the field of energy transition are categorized in 6 topics: context, content, policies/ legal framework / financial framework, management, political / institutional context and actors.

Table 1 Categorisation of problems in energy transition in the built environment (Energy Cities, 2014).

Problem	Category
In the decision making process of energy transition, most **decisions are made in the hand of national administrations and large energy companies**, who have vested interests in maintaining a status quo, that is, in privileging a centralised-supply approach.	Political framework
There is more action needed on a larger scale in energy transition, to meet set goals by governments and governmental bodies. There is **little known on how to instigate this movement.**	Management
Energy transition in the built environment means dealing with a lot of uncertainty in the most effective solution. This results in an **unstable market**.	Financial framework
In the decision making process of energy transition, most decisions are made in the hand of national administrations and large energy companies, who have vested interests in maintaining a status quo, that is, in privileging a **centralised-supply approach**.	Political framework, actor
Urban energy transition takes place in a **multi-actor network,** where actors deal with variety, mutual dependencies and a dynamic environment.	Actor
One of the main difficulties of the energy transition is to **align short, medium and long-term objectives**.	Management
Local authorities' administrations are **not organised to co-ordinate territorial dynamics and local actor networks**. They lack expertise and practice when it comes to working with the civil society instead of just providing top-down information.	Management, actor
Interaction between areas and the relations between actors are important and necessary, because current city problems cannot be solved without **collaboration.**	Actor
It is hard to impossible to **experiment with new solutions** in practice to move the transition.	Management

In table 1 it is possible to see that most problems in energy transition have problems in the field of actors. It relates to coordinating and aligning interests of the actors involved, where large energy companies or national administrations tend to keep the status quo. There is also a lack of expertise and information on the best implementation or management of these kinds of projects.

2.2 Justification focus main problem

This research will focus on the movement of energy transition, because it is related to one of the five goals set by the European Commission: in 2020, 20% more renewable

energy compared to 1990. This is the main driving force from high governmental bodies to instigate energy transition.

Secondly, the amount of fossil fuel available will eventually decrease, where new sources or instigation of energy are necessary. Urban areas and its buildings must adapt to be able to use these new sources of energy. An example is new underground infrastructures, such as heat grids. Because the technology of using renewable energy is of the past decades, there is not much research conducted on this process.

Thirdly, there is a lot of uncertainty in the European electricity sector. This is the result of uncertainty about the most profitable energy efficient technology (Richting van de energietransitie nog niet bekend, 2015). This uncertainty could result in hesitation of actors to move towards energy transition and questions the right measures of adapting the built environment.

Nowadays little action is taken in the field of energy transition. Ruud Koornstra (sustainable entrepreneur) thinks that big steps are necessary to use renewable energy on a larger scale. This could mean instigate energy transition on a larger scale, in urban areas. How to instigate energy transition on such a scale is vague and not clear.

Moreover is the problem of aligning short, medium and long-term objectives, which is necessary for energy transition, still unsolved. This problem is one of the main difficulties of energy transition (Energy Cities, 2014).

Finally, energy transition on a larger scale is linked to cooperation and decision making with multiple actors. This is also known as a multi-actor network. Governments or municipalities (public sector) cannot individually steer and control these processes (Koppenjan & Klijn, 2004; p.1), as owners of buildings (developers, residents, civic societies), energy providers (businesses), knowledge institutes (technology providers) and contractors (businesses) must be invited to the decision making process towards energy transition (Energy Cities, 2014). All actors influence the process and will be influenced by the outcome.

2.3 Aim of this research

This research aims to fill in knowledge gap on the process of energy transition in large urban areas, with a focus on the actors involved. The process of going from usage of fossil fuels towards renewable energy must be researched. Also the bottlenecks that obstruct this process must be identified. Why are we not moving towards energy efficient urban areas? By researching the actors who are involved, one can draw conclusion on how the anticipate on the bottlenecks and moreover how to contribute to the process of moving towards more implemention of energy efficient solutions.

Moreover will this research try to stimulate sustainable urban development and more in particular energy transition and create more information and understanding on the topic of energy transition. Thirdly, this research will create a better understanding of the network of actors in the process of energy transition in the built environment. This research also aims to create an insight on the complex and difficult state of the art, which can be used to understand and work towards implementing more energy efficient solutions.. Eventually, this research aims to stimulate action towards a better environment, by creating new knowledge on actors' their position and possibilities.

By outlining the pitch, actors can have a better understanding of one another's position.

2.4 Relevance of this research

This paragraph describes the academic and societal relevance of this research.

Academic relevance

In the field of Urban Development Management little is known about the process towards implementing sustainable solutions in the field of energy transition and the influence of all actors and actors together in the field of sustainable urban development.

This research will also combine theory from multi-actor decision making, process management, urban area development and collaboration. This could lead to new models incorporating different theories.

Lastly, this research tries to unfold new theories and insights on the field of transition and more particular the field of energy transition in relation to the built environment.

Societal relevance

This research strives to create new useful information on the process of energy transition in the built environment. Currently little action is taken towards renewable energy and this research tries to find the barriers why and stir up more action on a larger scale. This will eventually could benefit the environment in which we all live.

Everyone on this planet could participate in moving towards the usage of energy efficient solutions in the built environment, whether you are the owner of a building, the planner or the investor. This research tries to indicate what is possible for each and everyone of us and overcome the bottlenecks towards more renewable energy.

2.5 Research questions

This research aims to understand and find the obstructions in the process of energy transition in the built environment with a focus on the related actors and its position, powers and constraints.

Main research question

"How is the process of energy transition, in several European cities, obstructed by its political and institutional context, policies, management and actors, and how can actors influence the process to overcome these bottlenecks?"

Detailed research questions to be answered

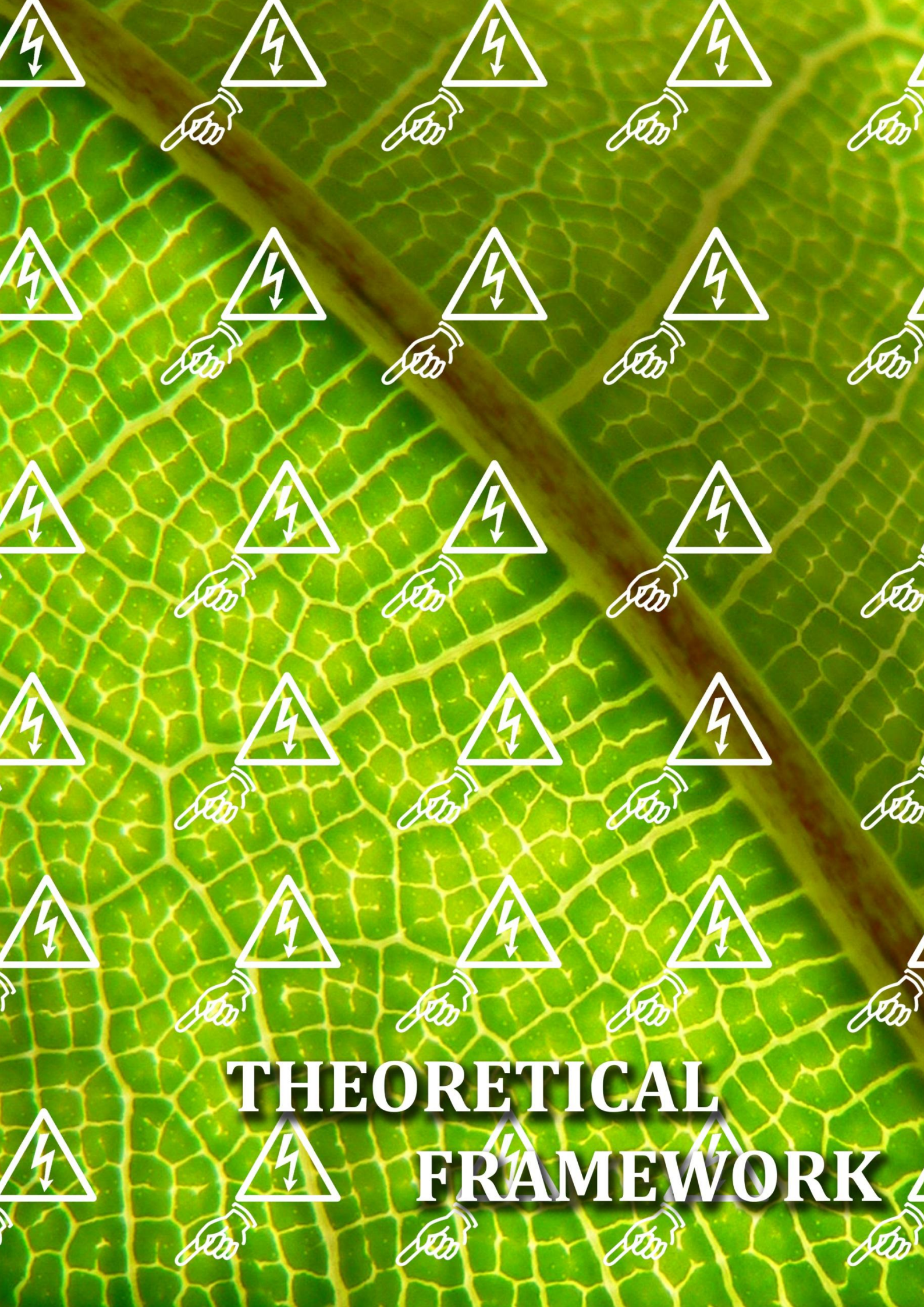
To answer the main research question more detailed research questions are formulated. These more detailed questions lead to a detailed answer to the main question raised. These sub-questions are:

THEORETICAL

1. What is sustainable urban development and how is it related to energy transition?
2. How can you analyse the process and the process's bottlenecks of energy transition in the built environment?
3. Who are the actors in energy transition in the built environment and how can you analyse their involvement?

PRACTICAL

4. What are the characteristics of the process of energy transition in large urban areas in different European cities? Why is energy transition a challenge in large urban areas?
5. What are the characteristics of the phases of implementing energy efficient solutions?
6. What are the characteristics of the political and institutional context in the process of energy transition?
7. How does the political and institutional context contribute to the bottlenecks in the process of energy transition in large urban areas?
8. What are the characteristics of the policies in the process of energy transition?
9. How do policies contribute to the bottlenecks in the process of energy transition in large urban areas?
10. What are the characteristics of the management in the process of energy transition?
11. How does the management contribute to the bottlenecks in the process of energy transition in large urban areas?
12. What are the characteristics of the actors in the process of energy transition?
13. How can the actors contribute to the bottlenecks in the process of energy transition in large urban areas?



THEORETICAL FRAMEWORK

3. THEORETICAL FRAMEWORK

This chapter considers the theoretical framework which is used for this research. The theoretical framework is an exploration of all found theory in related literature. This chapter will eventually elaborate in depth on definitions of terms, its relation and methodology. In this chapter the following questions will be answered:

- What is sustainable urban development and how is it related to energy transition?
- How can you analyse the process and the process's bottlenecks of energy transition in the built environment?
- Who are the actors in energy transition in the built environment and how can you analyse their involvement?

3.1 Introduction to energy transition

As described in chapter 2, this research will focus on energy transition. This because energy transition plays a big role in goals set by Europe, European countries and European cities: 20% more renewable energy compared to 1990. Also, the availability of fossil fuels will decrease, which means that new sources or instigation of energy are necessary. Thirdly, there is a lot of uncertainty in the European electricity sector. Moreover, little action is taken nowadays in the field of energy, where it is unclear how to take big steps on instigating energy transition on a larger scale. Finally, the public sector cannot steer processes individually. But it is unclear how the relation between actors can be and what the phases are of the process of implementing energy efficient solution.

Energy transition is a transition of fossil fuel towards renewable energy. This could happen in different fields, such as mobilty and urban areas. When moving towards renewable energy, old energy systems must be transformed, renewed or re-formed. This results in a process which is new or not studied well yet.

A proposal from Energy Cities (2014), signed by the Covenant of Mayors, state that in Europe the need for a transition towards a new energy paradigm is establishing in the minds. However the decision-making process is mainly in the hand of national administrations and large energy companies, who have vested interests in maintaining a status quo, that is, in privileging a centralised-supply approach.

Whereas climate and energy goals are set on long term, it forces to think in long term. The world we live in however is dominated by short term timeframes and time constraints. One of the main difficulties of the energy transition is to align short, medium and long-term objectives (Energy Cities, 2014).

Transition management

A transition is the result of developments in different domains. In other words, a transition can be described as a set of connected changes, which reinforce each other but take place in several different areas, such as technology, the economy, institutions, and behaviour, culture, ecology and belief systems.

"A transition can be seen as a spiral that reinforces itself; there is multiple causality and co-evolution caused by independent developments." ***Rotmans et. al. (2011)***

Transitions are transformation processes in which society changes in a fundamental way over a generation or more. Although the goals of a transition are ultimately chosen by society, governments can play a role in bringing about structural change in a stepwise manner. Their management involves sensitivity to existing dynamics and regular adjustment of goals to overcome the conflict between long-term ambition and short-term concerns (Rotmans et. al., 2011).

Transition management is based on a different, more process-orientated philosophy that balances coherence with uncertainty and complexity. It can be summarized in terms of the following characteristics:

- Long-term thinking (at least 25 years) as a framework for shaping short-term policy.
- Thinking in terms of more than one domain (multi-domain) and different actors (multi-actor) at different scale levels (multi-level)
- A focus on learning and a special learning philosophy (learning-by-doing and doing by-learning)
- Trying to bring about system innovation alongside system improvement
- Keeping a large number of options option (wide playing field).

The aim of transition management is not so much the realization of a specific transition: it may be enough to improve existing systems, or the problems may turn out to be less severe than at first thought. It is about working towards a transition that offers collective benefits in an open, exploratory manner (Rotmans et. al., 2011).

Research on energy transition in the built environment in Europe

Not a lot of research is found on energy transition in the built environment. Research on the different topics, such as energy efficiency or sustainable development in the built environment and transition management can be found. Research on the combination of these topics is still novel.

However, the European Commission started in 2014 one of the biggest EU Research and Innovation programme with nearly €80 billion of funding available over 7 years (2014-2020) – in addition to the private investment that this money will attract. It is expected that this programme promises breakthroughs, discoveries and world-first by taking great ideas from the lab to the market. Science and innovation are key factors that will help Europe to move towards smart, sustainable, inclusive growth and along the way to tackle its pressing societal challenges (FP7: the future of European Union research policy, 2012). In 2014 has the European Commission started a new programme for co-funding research, which is called "Horizon2020".

In 2012 a project, co-funded by the European Commission, took off under the name of "TRANSFORM". The projects aims to find the barriers that cities experience trying to become a low carbon city. The project consists of nineteen partners, from knowledge institutes, municipalities to business parties (such as energy and grid companies and consultancies).

Technologies of energy efficiency

The definition of energy transition is the movement from fossil fuels towards renewable energy. The built environment must adjust to use this renewable energy effectively. Different solutions and possibilities can be found in literature and practice. Important to underline, is the coherence of the different technologies: energy efficiency lies in applying several technologies to create a more energy efficient building. For example, when using solar thermal power as a additional or replacing power resource, it is important to also make the building more isolated, so that a minimum of energy is required in that particular building. This relative context applies on many technological solutions.

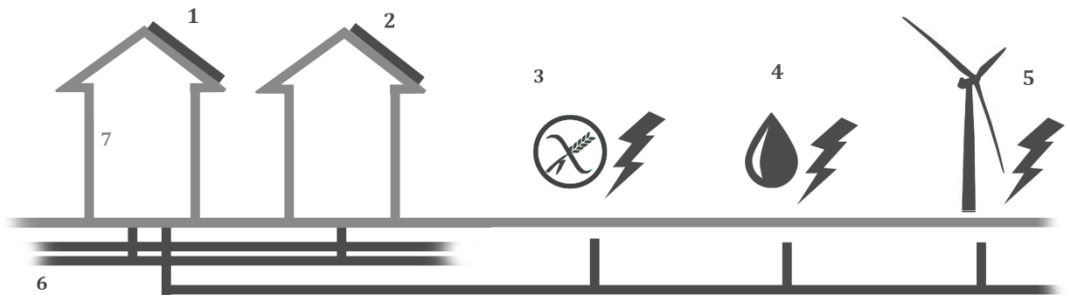


Figure 4 Schedule of current technologies that can be used to create a more energy efficient building or urban area (own ill.)

1. Solar thermal heating and cooling

A solar collector attached to roof of a building uses solar energy to heat and cool water, used for warming and cooling the building. This technology requires a suitable roof, insulated pipes through the building, a controller, solar tank, pump, conventional water heater and cold water supply. Important is that this technology can be implemented above ground and is most effective in sunny climates (Marken & Sanchez, 2008).

2. Solar thermal energy

This technology is viewed in the figure as a technology that can only be implemented on the roof of the building, but it can also be implemented in a field with more than one solar panel, a solar tower or a solar dish. This is called a Solar Energy Generating System (Solar Electric Generating Systems, 2008). Nowadays, curved solar panels, non-imaging optical panels and moving panels are created to create optimal use of solar energy in not only a sunny climate, but also a less sunny climate. This technology be implemented above ground and only needs measures in or on the building.

3. Biomass

Biomass is biological material derived from living, or recently living organisms. In the context of biomass for energy this is often used to mean plant based material, but biomass can equally apply to both animal and vegetable derived material. Biomass takes carbon out of the atmosphere while it is growing, and returns it as it is burned. If it is managed on a sustainable basis, biomass is harvested as part of a constantly replenished crop. This is either during woodland or arboricultural management or coppicing or as part of a continuous programme of replanting with the new growth

taking up CO_2 from the atmosphere at the same time as it is released by combustion of the previous harvest. This maintains a closed carbon cycle with no net increase in atmospheric CO_2 levels (Biomass Energy Center, 2011).

4. ***Hydropower/ ocean energy***

This energy is created by the use of falling or running water or ocean water. Many types of hydropower can be identified, but most common is conventional hydroelectric, referring to hydroelectric dams. This uses the pressure of the water in the dam, by a penstock, turbine and generator working in a powerhouse connected with long distance power lines (Hydro Electricity Explained).

5. ***Wind energy***

Wind power is extracted from using wind turbines or sails to produce mechanical or electrical power. Windmills are used for their mechanical power, wind pumps for water pumping, and sails to propel ships. Wind power as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, and uses little land (Fthenakis & Kim, 2009).

6. ***Geothermal heat and energy***

In regions without any high temperature geothermal resources, a ground-source heat pump (GSHP) can provide space heating and space cooling. Like a refrigerator or air conditioner, these systems use a heat pump to force the transfer of heat from the ground to the building. Heat can be extracted from any source, no matter how cold, but a warmer source allows higher efficiency. A ground-source heat pump uses the shallow ground or ground water (typically starting at 10–12 °C or 50–54 °F) as a source of heat, thus taking advantage of its seasonally moderate temperatures (Goswami & Kreith, 2008). There are yearly some periods, where using geothermal heat and energy is not efficient enough to supply heat and cold in a building. This is during the coldest period of winter and warmest period in summer. A different resource is then necessary. When there is no infrastructure underneath the ground yet, there can be difficulties found in implementing this technology because of the complex infrastructures underground. There are already many infrastructures created underground in most parts of Europe, with all different owners.

7. ***Adjustment building***

While using a different resource for energy, it is important to realise that also the building should be designed or adjusted to become more energy efficient. This relates to a more isolated skin of the building, new uses of light (natural light and LED) and a more (on distance) controlled use of energy. This means that also the user of the building should become more aware of their energy use and should be able to make adjustments to become a more energy efficient user.

Existing stock

Most interesting cases are those that consider a transformation of an already existing urban area. Because it nurtures a far more complex content than when it considers a new built area.

This research tries to find a case or cases considering the adjusting or transforming the existing stock, because this will be the problem of the future. Because the existing

stock is not designed to use renewable energy, where new urban areas can be designed and built to use energy efficient solutions. Many problems have also been found in re-developing areas with respect to energy, because many interests come together and need to find a way towards implementation.

3.2 Sustainable urban development

The aspect of sustainability becomes more and more an issue of the past decades, where cities strive to move towards a more sustainable city. By reducing the use of sources of energy, integrate resource systems, become more energy efficient and engage and activate users. Still, a lot of uncertainties are found and is urban sustainability an under-exposed topic in the field of urban development.

Research on sustainability is still experimental and still very fragmented since it requires joint effort, collaboration and continuous implementation and monitoring, involving many different disciplines and many different people working together over a long period of time (Brandon & Lombardi, 2011; p. 148).

"Research on sustainability is still experimental and still very fragmented." ***Brandon & Lombardi (2011)***

Policies; movements

Many terms and different movements can be found in literature and practice on sustainable urban development. Below a summation of the movements which occurred most in literature. Noticeable is that most movements are defined with other movements or terms. Therefore understanding the ideas behind all movements is difficult and cannot be thought about without one and the other.

Table 2 Movements in Sustainable Urban Development (Chourabi et. al., 2012; Zhilin et. al., 2009)

Sustainable Urban Development	Characteristics
Energy Transition	• Transition from fossil fuel towards renewable energy
Smart City Development	• Uses digital technologies to enhance performance and wellbeing, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens.
Low Carbon City	• Integrates both elements of low-carbon economy and low-carbon society.
Circular Economy	• Industrial economy that is, by design or intention, restorative.

It is significant that the aspect of all movements being connected with each other and have an integrated in sustainable urban development. Sustainable solutions do not lay in only one of these movements.

Energy transition

Energy transition is a transition of fossil fuel towards renewable energy. This could happen in different fields, such as mobility and urban areas. When moving towards renewable energy, old energy systems must be transformed, renewed or re-formed. This results in a process which is new or not studied well yet.

"One of the main difficulties of the energy transition is to align short, medium and long-term objectives"
Energy Cities, 2014

A proposal from Energy Cities (2014), signed by the Covenant of Mayors, state that in Europe the need for a transition towards a new energy paradigm is establishing in the minds. However the decision-making process is mainly in the hand of national administrations and large energy companies, who have vested interests in maintaining a status quo, that is, in privileging a centralised-supply approach.

Whereas climate and energy goals are set on long term, it forces to think in long term. The world we live in however is dominated by short term timeframes and time constraints. One of the main difficulties of the energy transition is to align short, medium and long-term objectives (Energy Cities, 2014).

Smart City

A smart city (also smarter city) uses digital technologies to enhance performance and wellbeing, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens.

Currently cities, megacities, are generating new kinds of problems. First, problems are related to waste, scarcity of resources, pollution, health concerns and inadequate, deteriorating and aging infrastructures. Second, problems can be found on a basic technical, physical and material level. Lastly problems are more social and organizational in nature (Chourabi et. al., 2012).

Only a few studies in the academic literature on smart city initiatives address issues related to managerial and organizational factors (Chourabi et. al., 2012). On an organisational level there are several challenges of using technologies in smart cities.

Table 3 Challenges of using technologies in smart cities (Ebrahim & Irani, 2005)

Dimension	Challenges
Organisational	• Lack of cross-sectoral cooperation • Lack of inter-departmental coordination • Unclear vision of IT management • Politics • Culture issues

Low carbon city

The term low carbon city is most found in Asian literature. Low-carbon city, which integrates both elements of low-carbon economy and low-carbon society, provides a

new model of sustainable urbanization towards ecological civilization and scientific development (Zhilin et. al., 2009).

Circular economy

The circular economy is a generic term for an industrial economy that is, by design or intention, restorative and in which material flows are of two types, biological nutrients, designed to re-enter the biosphere safely, and technical nutrients, which are designed to circulate at high quality without entering the biosphere.

3.3 Urban area (re-)development

To understand the difficulties that apply on the matter of energy transition, it is important to understand the theory of urban area development. This paragraph describes all important underlying topics related to urban area development. These fields are important factors that also eventually influence energy transition in the built environment.

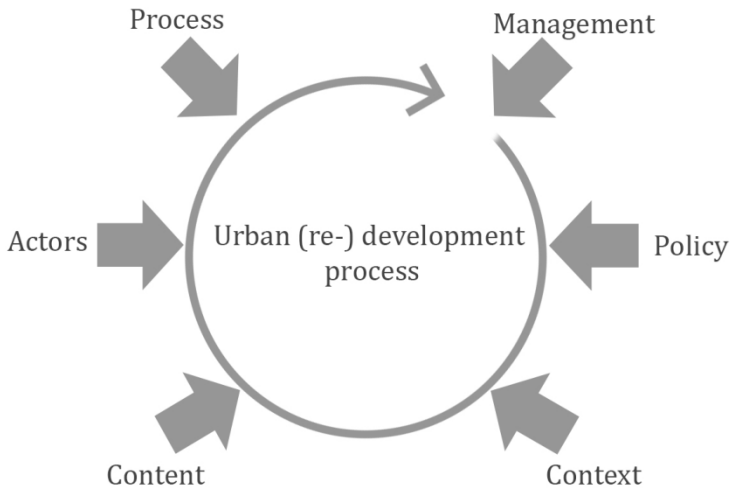


Figure 5 Influences on urban area development process (Franzen et. al., 2011, Van 't Verlaat, 2008)

Figure 5 describes all identified aspects that can influence the urban (re-) development process by literature. These aspects will be described more in detailed in the following subparagraphs. Eventually this will also relate to the energy transition process, whereas it is defined as part of urban (re-) development processes.

In general, urban area development has become increasingly complex in recent times. This is not only because of the number of actors involved and the complexity of social developments; it is also because the implications of urban area development often reach far beyond its physical boundaries. Urban area development is increasingly about the redevelopment of existing urban areas, which is far more complex than more traditional developments where agrarian areas were transformed into urban areas (Franzen et. al., 2011). City problems have become wicked and tangled, which mean that these problems are associated with multiple and diverse actors, high levels of interdependence, competing objectives and values, and social and political complexity (Dawes, 2009).

Franzen states that the content of urban area development is primarily determined by the context. The shape of the content is then influenced by the actors involved and the management methods. How the various actors deal with or respond to the process management also influences the outcome. They each have very diverse interests and roles and this adds significantly to the complexity of urban area development.

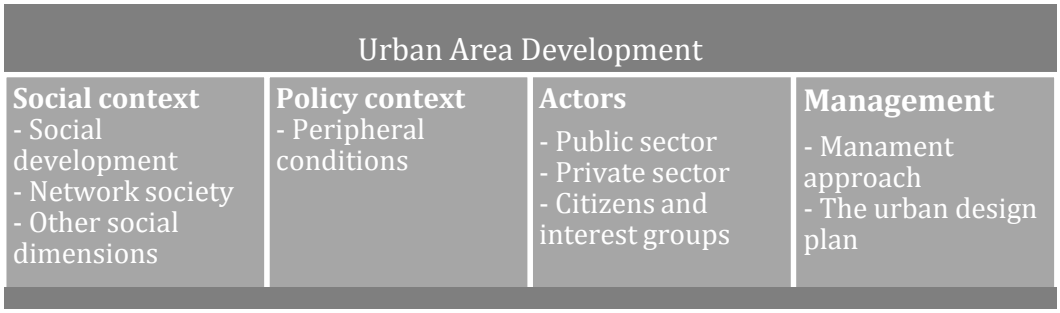


Figure 6 Relation between urban area development, social context, policy context, actors and management (own figure).

Actors

This research makes a distinction between stakeholder and actor, where an actor takes action, acts, in such a way that fits within the actor its role where it could benefit (or not) policies of a project. An actor is, literally, a beneficiary, which reflects in a more passive role (Hermans & Telli, 2012). In this way it also stresses on the fact that an actor influences the policy of the project, where it could be negative or positive.

Franzen et. al. (2011) state that a distinction is made between actors in public and private sector and local citizens and other parties involved in an area should be taken into account. The social conditions under which area development takes place have changed drastically over the past decades.

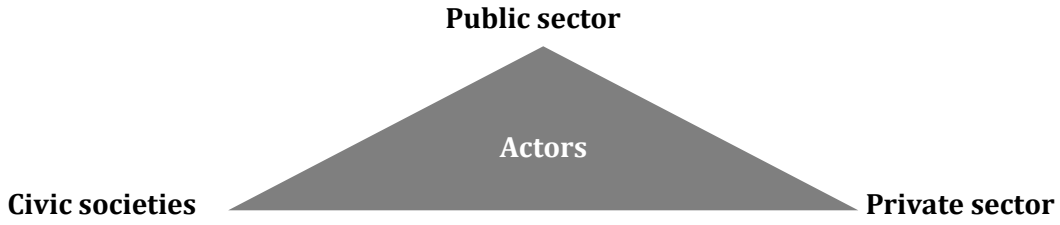


Figure 7 Triangle of actors in urban area development

Traditional planning tends to be centralized, predictable and dominated by one actor in a hierarchal structure. Urban development tends to move more towards a network, which is decentralized, deals with uncertainty and where the structure is a network. This shift affects the roles of the three players in urban development and makes collaboration necessary.

The relationship between actors in urban development is translated to a multi-actor network or network society. Characteristics of such a network are interdependencies, variety, closedness to hierarchical signals and is dynamic (de Bruijn & ten Heuvelhof, 2008; p.10). In these networks actors produce and strive to coordinate their decisions and actions (Teisman & Klijn, 2002; Teisman, 2005). When actors from different

networks interact with each other in relation to a specific project or policy issue, they can be perceived to do so in an 'arena' (Koppenjan & Klijn, 2004). Inside such an arena, actors can thus be perceived as to influence each other's orientations by defending their own perceptions and preferences in relation to the urban development project (Daamen, 2010). This research will use the concept of the arena to understand the relationship between different actors in urban development projects.

First, to have a better understanding of these actors, one should conduct a whole actor analysis. An actor analysis will cover the position of the actors, their power and interest, norms, their source dependency and views and interaction (Daamen, 2010; de Bruijn & ten Heuvelhof, 2009).

As mentioned earlier have the roles and positions of the actors in urban development changed and have created a more dependent relation. But in the field of energy transition, which is part of urban development, this dependent relation is unclear and undefined. Below an overview of the steps is shown to analyse the actors thoroughly.

The main issue remains with fact that other actors may not have the same problem perception or the same sense of urgency to start a competition dialogue for priorities (de Bruijn, Heuvelhof, 2008, p61).

Table 4 Step by step plan to analyse actors in a process (Koppenjan & Klijn, 2004; de Bruijn & ten Heuvelhof, 2009; Daamen, 2010)

Step	Description
1. Actors in relation to the phases	Identify all actors that will be or were active in the process
2. Actor information	An indication of each actor's problem perception, individual goals and available resources
3. General interests and norms	Identify the general interest and norm of concerning actors in each phase.
4. Create network structure	Make a schematic overview of the relation of each actor by their common interest
5. Create a power interest grid	Place actors in the grid by their interest and power and identify their position (subject, players, context setters or crowd)
6. Create support and opposition grid	Place actors in the grid by their attitude towards the problem; support or oppose, compared to their power.
7. Identify actor's dependency	Place actors in the grid by their replace ability and importance.

Before it is possible to generate a network structure, one must identify of each case the actor information (problem perception, individual goals and available resources) , then identify the interests and norms of each actorThis identification is done by

interpretating the actor's characteristics with all available information. This leads to the third step: the network structure, which indicates each actor their common interest and thus their relation.

Table 5 Power interest grid (de Bruin & ten Heuvelhof, 2009)

HIGH INTEREST	SUBJECTS	PLAYERS
LOW INTEREST	CROWD	CONTEXT SETTLERS
	LOW POWER	**HIGH POWER**

Fifth step is to generate a grid that indicates the interest of the actors by their power. This will also be done by their support and opposition, to give an indication on how actors may act in the process: as a player, subject, context setter, crowd or a weak/strong support or weak/strong opponent (de Bruijn & ten Heuvelhof, 2009).

Table 6 Actors supporters and opponents (de Bruijn & ten Heuvelhof, 2009)

SUPPORT	WEAK SUPPORTERS	STRONG SUPPORTERS
OPPOSITION	WEAK OPPONENTS	STRONG OPPONENTS
	LOW POWER	**HIGH POWER**

Lastly each actor's dependency is identified by their replace ability and importance. This indicates if the process taken place is dependent on the resources of each actor (de Bruijn & ten Heuvelhof, 2009).

Table 7 Actor's dependency by importance and replaceability (de Bruijn & ten Heuvelhof, 2009).

HIGH REPLACE-ABILITY	LOW DEPENDENCY	MODERATE DEPENDENCY
LOW REPLACE-ABILITY	MODERATE DEPENDENCY	HIGH DEPENDENCY
	LOW IMPORTANCE	**HIGH IMPORTANCE**

After analysing the actors thoroughly from a process management point of view, one could interpret how actors could contribute to a better process. This is done by analysing which actor should change position. Solutions are related to broadening the problem and trade-offs with the related actors (de Bruijn & ten Heuvelhof, 2009).

Actors and strategies

More in depth methodologies must be described. The methodology described above is also a tool which is suitable for a process manager to map its actors, by own knowledge. This research strives to approach the analysis of all actors more scientific and more precise focusing on the actor's characteristics, instead of only how to deal with the actors. This will be done by means of the strategies of actors.

Many theories on strategy and strategy management are described in theory, where this research mostly focuses on the findings of Mintzberg. Mintzberg's forms of strategy are useful for this research on strategies for urban development projects, because urban development projects are surrounded by the intention to intervene in the existing development trajectory of an existing urban area.

"Mintzberg's concepts allow for the interpretation of strategy as a collective effort emerging between a plurality of actors which will more likely follow the model of a political 'arena' rather than that of a single, rule-adhering actor" ***Daamen, 2010***

Secondly, Mintzberg's concepts allow for the interpretation of strategy as a collective effort emerging between a plurality of actors which will more likely follow the model of a political 'arena' rather than that of a single, rule-adhering actor. Also, thinking of strategy as an ongoing process that is both deliberate and emergent reflects the obvious reality of change (Daamen, 2010).

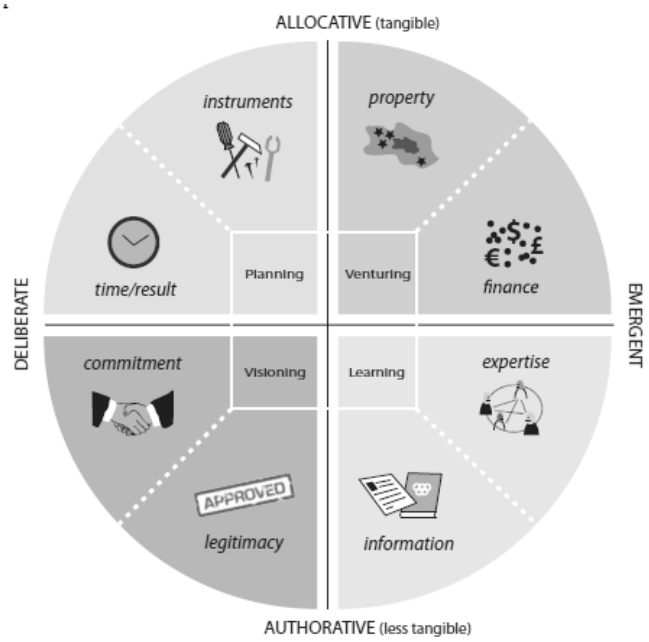


Figure 8 Categorisation in processes of strategy formation (Daamen, 2010)

Figure 8 shows the deliberate and emergent processes of strategy formation defined by Mintzberg (2007) with the allocative and authoritative dimensions of power defined by Giddens (1984). It depicts four pairs of 'urban development resources', each consisting of an inalienable category – property, expertise, legitimacy, and instruments – and a substitutable category – finance, information, commitment, and time/result (Daamen, 2010).

This figure will be used in the cases as a reflection on the stream of decisions and action aimed at mobilizing these eight categories of urban development resources, resources, and that these decisions and actions can be interpreted in terms of strategic planning, venturing, learning and visioning (Daamen, 2010).

For further exploration of the cases other topics, apart from the actor's interest, power, interdependency and replace ability, must be researched. These topics are related to the processes of strategy formation of the actors, which are found in the literature of Daamen. In the case study one must cover the position of the actor to their resources and information.

To have a better understanding between the positions of the actors regarding the process of strategy formation, one must reflect each actor on the four pairs of 'urban development resources'. This is done by a simple categorisation of + (high), +/- (moderate) and – (low). Putting the actor into this categorisation is done by analysing all information gathered. A full analysis of the selected cases can be found in the appendix.

Policy /institutional context

The urban area is connected to various levels of policy authorities. At a municipal level policies are directed to area developments, policies at higher levels, including regional or provincial levels, the national level, increasingly the European level, and the global and abstract level, are all equally pertinent (Franzen et. al., 2011).

Complex ecological and environmental problems are characterized by (scientific) uncertainties, and a diversity of (conflicting) values at stake. Actors often disagree on the question what the goal of policy should be, as well as what the relevant means are for attaining that goal (e.g. which policy measures). This type of policy problems has also been referred to as 'wicked' (Rittel and Webber, 1973), 'illstructured'(Dunn, 1988; Mitroff and Sagasti, 1973; Simon, 1973),'messy' (Ackhoff, 1974) and 'unstructured' (Hisschemöller, 1993; Hisschemöller and Hoppe, 2001) (Franzteskaki et. al., 2013).

Policies

Policy at the municipal level is the principal point of departure for urban area development in a specific area. Ideally, the municipality would create an 'integrated development vision' for the future of the city, wherein clear priorities are set out concerning the actions to be taken and the areas to be developed within the city (Franzen et. Al., 2011). The various policy levels are intrinsically linked. They are no longer branches of a single governmental hierarchy but act relatively independently yet also necessarily interact. Policy at higher levels can be amended by experience that is, for instance, gained during urban area development. Policy directives that are imposed from above are not always accepted unquestioningly at lower levels. The reason for this is, of course, the different interests of the parties involved (Franzen et. al., 2011). The relationship between cities and the central government is far more complex than a situation where the central government acts unilaterally and stipulates policies that must be implemented by municipalities.

Management strategy

In urban area development are various types of networks and alliances. The type of alliance depends on the nature of the task and on the phase in which the process occurs. The process of inclusion of these alliances, responsibilities and tasks need to be managed. Different parties, with interests in an area, jointly arrive at a way of integrating planning and spatial investment, which will ultimately lead to the implementation of an urban area development project. The involvement of such a variety of organisations and actors result in complex processes (Franzen et. al., 2011).

A management approach towards these complex processes could be process management. Franzen sees process management as a connection between strategic level and operational level.

Table 7 Positioning of the process manager as connecting agent between the strategic and operational level (Franzen, 2011).

Actors	Project organisation	Level
• Housing association • Province • Developers	Political/ Managerial	Strategic
	↑	
	Process management	Tactical
	↓	
• Housing association • Province • Developers	Working groups	Operational

• Households	End user	Operational

Phases

The phases of urban area development can be roughly divided in four phases, initiation, planning, realisation and maintenance. In the first phase becomes organisational talent an important factor. During the planning phase, the many interests and professional lines of approach must be incorporated in a way that advances the process and results ultimately in a plan that can be realised.

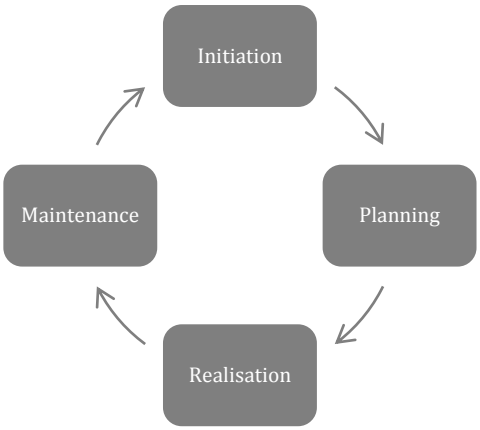


Figure 9 Overview of the phases of urban area development

3.4 Conclusion

By analysing all relating topics of the problem; why are energy efficient solutions not implemented on a large scale in urban areas, we can relate several topics with each other. This relation is conceptualised in figure 10.

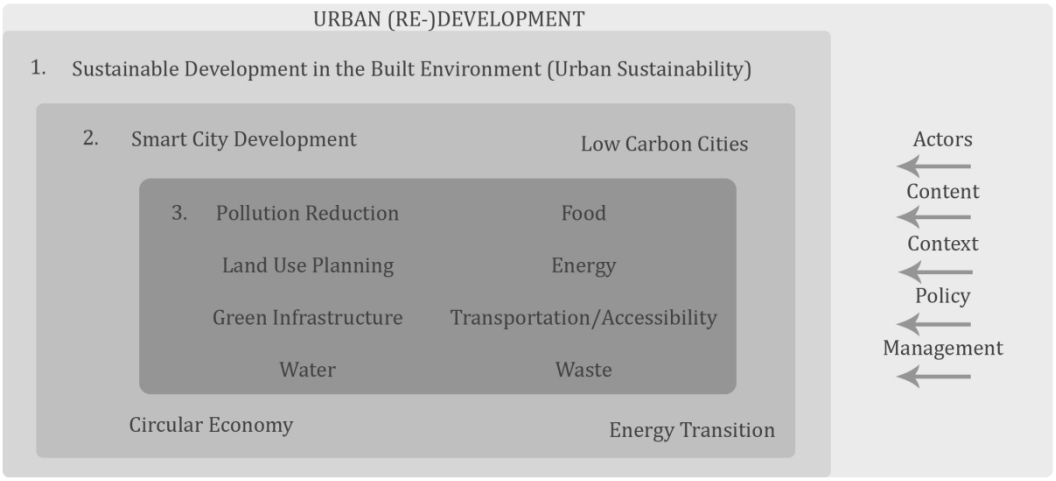


Figure 10 Conceptual model explaining the relation between the relations of urban (re-) development sustainable development in the built environment and eventually energy transition (Stern, 2011; Chourabi et. al., 2012; Zhilin et. al., 2009; Franzen et. al., 2011).

Energy transition is a transition of fossil fuel towards renewable energy. This could happen in different fields, such as transportation and urban areas. Energy transition, but also for example smart city development, is part of urban development, which is called in literature sustainable urban development. Sustainable urban development are several movements with one goal; creating a better quality of living by implementing and planning sustainable solutions in the built environment. It can be considered part of urban development. Urban development identifies several general phases which are called, initiation, planning, realisation and maintenance. These phases may have to be adjusted to be more applicable to energy transition.

When researching (re-)urban development management several related topics are found to research urban development management and its process. These topics are: actors, content, context, policy and management. These topics are slightly adjusted to apply better to the management and process of energy transition. A greater emphasis must lay on the context, which is divided into political / institutional context. The topic of policies goes paired with the legal and financial framework. Management is divided in management strategy and implementation strategy. To have a better understanding of the content, it is referred as by background information and description of the project. This information relates to the general information of the intention of the urban development, such as size of the project and idea.

To research the actors, a thorough analysis must be made. In these analysis's topics as interest, power, information and resources are covered. These topics can reveal the position of each actor and also relate to bottlenecks.

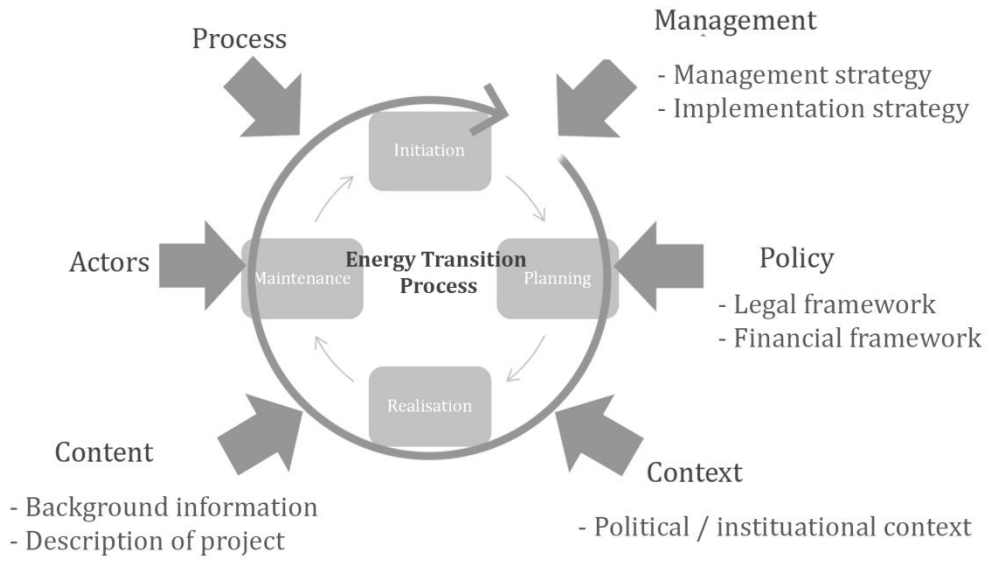


Figure 11 Relation between the energy transition process and its influential aspects identified from literature (own ill.)

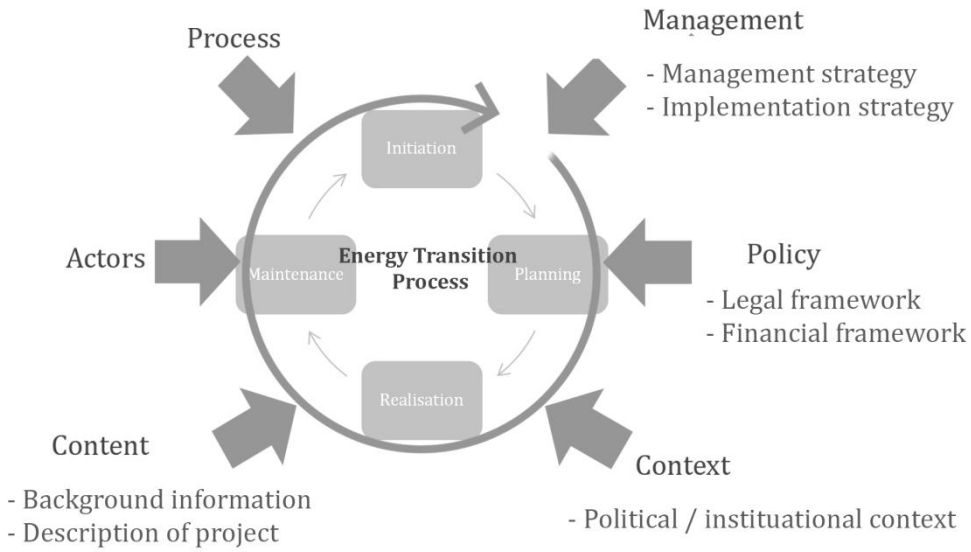
RESEARCH METHODS

4. RESEARCH METHOD

4.1 Research method

As seen in the conclusion of the theoretical framework, there is more information needed to make a statement of the management of energy efficiency. This will be done by doing research on several cases which concern implementing energy efficient solutions on a larger scale.

As described before, is the energy transition process influenced by different aspects that are identified from literature. These themes are the foundation of the methodology, which cover the aspects to be research upon in several cases.



As can be seen in the figure above more background information is necessary to be more precise about the process and its aspects.

First, a conceptual model is provided that conceptualises the steps of the research, how the main research (and sub-questions) will be answered. Finally a paragraph is dedicated to the data gathering methods that will be used to provide the information that is necessary to answer the research questions and eventually draw a conclusion on the problems in the field of energy transition in the built environment.

Secondly, a process design is made from literature and articles from governmental bodies. This process relates to the different steps that are made in the energy transition on a large scale. This process design will be the base on which the cases will

be reflected. This research will mostly focus on the initiation, planning en realisation (implementation). This research focuses on these phases, because they have most information on these phases, or are not realised yet.

Then, general actors are identified in the process of energy transition. These actors are also identified with literature from theory and practice. Then a section is written about the policy context in energy transition in the built environment.

A section is provided with an elaboration on the case selection, with a brief description of the chosen cases.

This will be done by a qualitative research, where it will describe a phenomemom, will be conducted. It will be exploratory, observational an describes feelings and perceptions. This will also cover the process and actors of energy transition.

The qualitative research can be done by a case study on several projects from the FP7 project "TRANSFORM". Data will be collected through in-depth analyses of documents written on these projects and small interviews.

4.2 Conceptual model

A conceptual model is made that indicates the steps that will be taken in the research. Each step focuses on the related questions to the main question: "How is the process of energy transition, in several European cities, obstructed by its political and institutional context, policies and actors, and how can actors influence the process to overcome these bottlenecks?"

First it focuses on only the process of energy transition in large urban areas in European cities. It covers a description of the process by the identified themes from literature; management, content, context, policy and actors. Next step is to identify the bottlenecks in the process. Then, the actors concerning the process will be researched more in depth. This considers also their options on contributing to the energy transition process. Finally, the different cases are compared to eventually draw conclusions. This is all shown in the figure below.

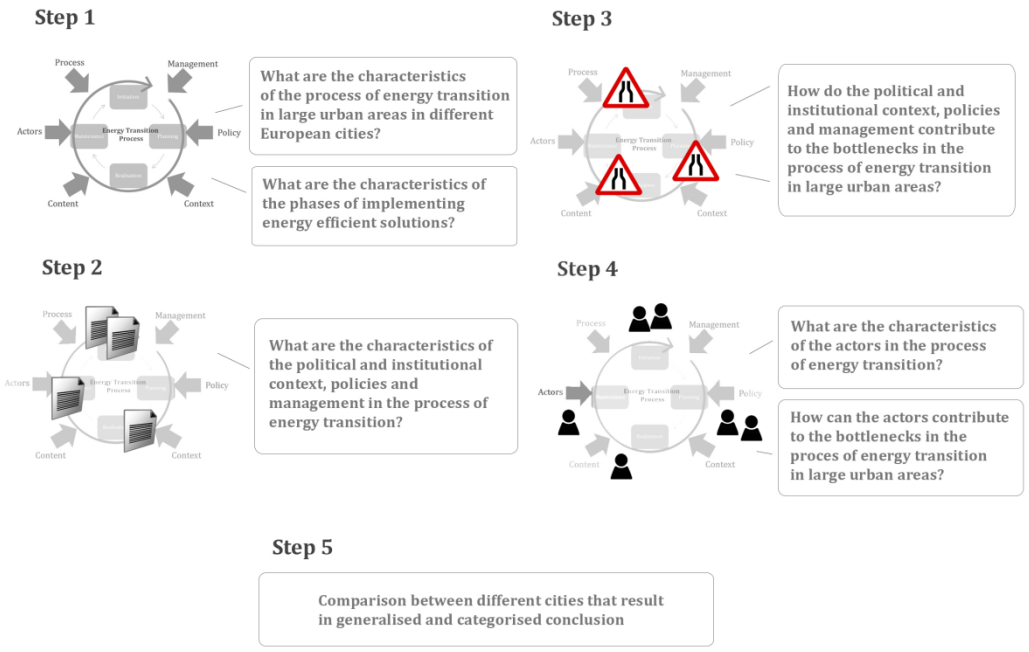


Figure 12 Conceptual model, own illustration.

4.3 Qualitative research

The research consists of several steps that lead towards the conclusion. First literature is reviewed and a theoretical framework is created. This relates to the specific topics that cover the answer to the predefined research questions. Eventually it leads to a comparative nature, where cases are compared with each other to draw conclusions.

Because of the nature of the research, which is describing a phenomenon and a description about the process of the cases, cases will be studied. Through a qualitative research the topics of this research can be explored more in-depth. To create new information on the complex problem, one uses case studies to have an intensive analysis. Crucial point is how well the theory is generated from the findings. To do so, several cases are selected which are representative for the problem.

The qualitative research will be combined with an in-depth analysis of documents created by the actors involved with the cases. This will be the base of the case study. Qualitative research predominantly emphasizes an inductive approach to the relationship between theory and research, in which the emphasis is placed on the generation of theories. With qualitative research theories are mostly generated and not tested (Bryman, 2012).

Other elements necessary for this research will be generated through interviews with the actors. In this way different viewpoints can give a more broad description of the themes from the process. It could also be a starting point for solutions and ideas that lead to the conclusion.

4.4 Data gatherings methods

The gathering method focuses on two parts; the first is the process of energy transition and the bottleneckss, the second on the actors and policies and their influence on the process. Both parts are plentiful described in documents created by the "TRANSFORM" project, but this research tries to go beyond the cases and create an overview of conclusions and focus more on the involved actors and policies.

This will be done by interviews with actors involved in the specific cases. The decision on interviews lies in its flexibility and it focuses more on the point of the interviewee. When needed, more interviews with one interviewee could be planned, to get more detailed and aligned results (Bryman, 2012).

The process will be researched, with a focus on each phase. The process is categorised by its phases and main themes that influence the process. Focus lies on barriers and found solutions in practice.

In the documents created by "TRANSFORM" participants, most actors are covered, but could be not as in depth as required from the methodologies in the theoretical framework. More information is needed for comparison and to draw conclusions. This information can be retrieved by interviews, if necessary, with related actors and let them explain their view on how the concepts appeared during the energy transition process.

4.5 Research planning

The table below explains all phases of the research and when what will be done. As all parts have a deadline, the process will mostly be iterative. Parts need to be adjusted after completion, due to the progress made or new information that is been found.

Table 8 Overview of the planning

Phase	Aspect	Date Finished
P1	Subject	March
	Problem statement	March
	Research questions	March
	Literature study	April
P2	Theoretical frame/Literature study	June
	Rephrase research proposal	June
	Expert meeting	May
P3	Interviews / Oberservations	September t/m December
	Data analysis	September t/m December
	Data evaluation	November t/m January
P4	Conclusion	January

	Recommendations	January
	Completion thesis	February
P5	Presentation	Beginning April

3.6 Research organisation

Table 9 Overview research organisation (own ill.)

Organisation	
Scientific domains	Urban Development Management Design and Construction Management
Mentors	1. dr. ir. Y. (Yawei) Chen 2. dr. ir. L.H.M.J. (Louis) Lousberg
Company	In depth cases from "TRANSFORM". ProjectManagement Bureau, Ruimte en Planning (Gemeente Amsterdam).


CASES

5. CASES

This chapter will cover a thorough exploration of the cases that are used for this research. First an overview is given that describes all cases and shortly describes the barriers found. Then a more detailed description of the selected cases is given. All information used come from the documents produced by all TRANSFORM partners.

5.1 Cases from TRANSFORM

The cases are selected through some criteria. A first selection criterion is that all cases come from the implementation work package of the "TRANSFORM" project. This because much information is already gathered which cover the discussed topics from the theoretical framework. The cases that are used are in leading cities in Europe in sustainable development of urban areas. In this particular case, these cities are Copenhagen, Amsterdam, Grand Lyon, Vienna and Hamburg. The city of Genoa was also part of the TRANSFORM project, but its implementation plan does not meet the same size as the other projects. These results have been eliminated for the case study of this research. To process this information as objective as possible, one must strictly use and maintain the given framework from theory. This is done in order to be comprehensive and objective.

Then a selection is made, mainly because of the diverse nature of those cases. These cases have a different context and political framework, combined with different techniques used to use renewable energy compared to the other cases. This leads to different outcomes and found barriers. These cases are described more in detail in order to make a valuable synthesis. For the selection Amsterdam comes out as a strong counter case, where it did not start with an urban plan or master plan. Vienna, Hamburg and Lyon have similar characteristics, because the political framework and policies have a big influence on the outcome. Lyon has been chosen because of its newness towards the private parties. Finally Copenhagen is chosen, due to the historical background of the city. Copenhagen already upholds a law that restricts new built building to be connected to its old heat supply system. As a consequence, the governmental parties focus more on other sustainable implementation besides heat supply.

Table 10 All cases and its characteristics

Cases	Characteristics
Copenhagen	Sustainable development beyond heat supply, such as the quality of the buildings.
Grand Lyon	Different role governmental bodies, compared to the antecendent traditional role.
Amsterdam	Start-up not from a master plan or urban plan, but the starting point was setting up collaboration.

Hamburg	Strong position governmental parties. Upper hand of traditional planning.
Vienna	Complex network, with multiple different departments in governmental bodies. Upper hand of traditional planning.

5.2 Cases

Below the overview of all cases, where it describes its background, content, context, technology used, policies and political framework, implementation strategies, management and a short analysis of all actors involved.

Copenhagen

	Description	Bottlenecks to process
Image of area		n/a
Background information	Nordhavn is a formal industrial port, with a development plan until 2040. Area is 2.5 km^2, with 490 businesses considering logistic, harbour and office functions.	
Description of the project	Development of new area with 40,000 dwellings and 40,000 working places. Function as real-life energy laboratory and showroom. Buildings must be certified according the Danish adaption of the DGNB standard, with extra quality requirements from municipality. This means there is a low energy need and low-temperature systems can be used. It is unclear what the implementation will be specifically, but it will be a combination of district heat generated by wood-fired combined heat and power (CHP) plants.	• Higher standard for new built buildings than legally necessary.

Political, institutional context

Copenhagen is a growing city, where it increases around 1,000 citizens every month. The municipality of Copenhagen is part of the Region Hovedstaden. Above the municipality there is the Greater Copenhagen authority. In 2009 the Copenhagen Municipal Council decided that Copenhagen will become the world's first carbon neutral capital by 2025.

The municipality of Copenhagen has the formal responsibility for energy planning based on project-by-project proposals elaborated by HOFOR (Greater Copenhagen utility). The municipality could in principle force the utility company to offer any kind of heat supply.

- Quick growing city in combination with ambitious goal of being a CO2 neutral city in 2025.

Policies
Legal framework
Financial Framework

New ownership structure for CCPD, where the city of Copenhagen owns 95% of the metro lines and the road tunnel. More budget for social housing and investment on sustainable housing. Voluntary agreement between municipality and CCPD to work for higher levels of sustainability. Heat supply is planned on basis of a national Heat Supply Act. The district heating in Denmark must be operated on a non-profit basis. Buildings must follow the national Building Regulation, which already require very low energy consumption. No clear business case for developing high sustainable buildings.

- High prizes of land combined with the financial crisis in Denmark.
- Change in ownership infrastructure area.
- Lack of a clear business case for developing sustainable buildings.

Management, implementation strategy

Master plan is set up by higher governmental bodies, where municipality of Copenhagen tries to get other actors aligned with the higher plan of sustainable development by early dialogues with the actors and arranging workshops. Early dialogue with developers. Workshops are facilitated by the municipality of Copenhagen for citizens, to discuss the quality of the new built area.

Area divided in several phases, where it will experiment with different used technologies.

- Municipality of Copenhagen lacks internal alignment.
- Experimental implementation.

Actors

Actor	Responsibility
City of Copenhagen	Municipality plan, regulation plan, building permits authority on heat, waste and water
CCPD (Copenhagen City & Port Development)	Develop and sell land
HOFOR, Greater Utility of Copenhagen	Supply of water, district heating, gas and district cooling

- Developers have no incentive on achieving a high score in the DGNG certification scheme.
- There is no clear business case for higher levels of sustainable buildings, which leads to a lack of interest from the developers.

DONG	Owner electricity grid and power
Developers	Build dwellings and offices
Citizen	Ideas and qualifying zoning plan

Energy Partnership, which found that early discussion on vision and understanding of each partner's strategy, is positive.

Difficulty on aligning plans municipality to developers, where they do not have an intention to invest in an even higher quality. And the business case is still unclear.

Grand Lyon

	Description	Bottlenecks to process
Image of area		n/a
Background information	Area considers main business district of Lyon and its region of 1.35 km^2. Lyon Part-Dieu was meant to be a decision-making business centre to counterbalance the importance of Paris. The aim was to design an entire urban development scheme including a business, administrative, cultural, commercial and residential centre.	
Description of the project	Double the net floor area, where the area must be economically attractive. While double the net floor area, maintain same overall energy consumption. Increase of dwellings from 3,500 to 5,000 dwellings.	

Political, institutional context	More emphasis on the role of the development department of the municipality of Grand Lyon (Greater Lyon), where they make themselves responsible for the management for the ambition of the project. Parliament is still discussing law on energy transition, but does not influence this project.	• No support yet from higher governmental bodies with law on energy transition.
Policies Legal framework Financial Framework	MAPAM law aims to clarify the competences of local authorities, by particularly reorganising the legal system of the most integrated French inter-municipal communities, the metropolises. Eco-loan provides financing for energy saving initiatives. Several grants and funding programmes that help financing projects on a local level.	• Only financial support on local level. • MAPAM law and law on energy transition are not yet applicable in greater Lyon.
Management, implementation strategy	Intense priority on gathering and analysing data for decision making. More emphasis on the role of the development department of the municipality of Grand Lyon (Greater Lyon), where they make themselves responsible for the management for the ambition of the project. Greater Lyon controls and organises all meetings, dialogues and workshops. Implementation follows the urban project Part-Dieu 2030. As initiator and leading party will Greater Lyon firstly make an energy diagnosis of the district, then make a scenario of the energy 'evolution' with regard to the urban project, thirdly accompanying the program of the urban project and actors of the district and finally work towards an energy planning of the urban area.	• Difficulties on finding and creating data for decision making process. • More project approach, than process management approach. • Small department of municipality responsible for implementing energy efficiency, where whole development is coordinated by great governmental body.
Actors	**Actor** / **Responsibility** **Part-Dieu Commission**: Provide impetus and coordination between Greater Lyon and the institutions affected by the project, the economic partners, real-estate operators, private clients and residents. Mobilizing resources. **The Energy Commission**: Information provider on sustainable energy development. **ERDF**: Managing the public electricity distribution network for 95% of	• Change of position municipality; where it must collaborate with non-traditional actors. • Difficulty on reaching developers and owners to persuade them that substantial intervention was worthwhile.

	continental France.
The City of Lyon	A number of departments are involved by monitoring the electricity and gas concessions for the territory of the city of Lyon.
Heating and cooling network operator	Providing heating and cooling.
Real Estate Developers	Investing in sustainable implementations on new built buildings.
Owners/Occupiers of the office buildings Part-Dieu (Club Part-Dieu)	Actually investing in redevelopment of their buildings and sustainable implementations.

Novelty in working with other actors such as private, para-public and public landowners.

Amsterdam

	Description	Bottlenecks to process
Image of area		n/a
Background information	Amsterdam South East is a mixed area of housing, offices, retail and industry. The energy consumption is relatively high (10% of the city's consumption) and the size of the area is 2,3% of the city surface. There was no existing higher plan on redeveloping the area. The Amsterdam structural vision 2040 states that Amsterdam should become "Economically strong and sustainable". The area is 22 km^2, but the implementation area is much smaller.	

Description of the project	New programme will be connected to the city heating system. The municipality of Amsterdam wants to set up a project organisation that will result in a public private partnership. Creating an energy atlas as basis for decisions and definition of goals of the implementation.	• No physical goal; but a project organisation.
Political, institutional context	The ambitions to implement more sustainable and energy efficient solutions come from the EU 202020 goals and the Amsterdam structural vision 2040. No action was undertaken if municipality did not participate in TRANSFORM. Change from local district governmental bodies, where the political committee per city district is smaller and has less formal power than in 2013.	• Driving force from participation EC funded program. • Less local formal power.
Policies Legal framework Financial Framework	Possibility of funding through investment funds of 60-100 million for which sustainable projects can apple and compete, which is a loan with an interest rate of 2%. The city of Amsterdam has a subsidy on retrofitting social housing and there is an energy loan. On a national level there is a subsidy for sustainable energy. The Law on the environmental maintenance states that big energy users must have a return of investment of at least five years.	
Management, implementation strategy	More focus on process management, instead of project management. Very open discussion with actors on the future outcome. Developing data on energy use, which can be used in decision making. No physical implementation plan is identified, but several small implementations on building level, not area level.	• Focus on gathering and analysis data on energy for decision making, which can only support investors, but made by municipality. • No implementation plan is yet defined.
Actors	**Actor** — **Responsibility** **The Amsterdam Energy and Climate Office** — Accelerator of the process, defining the process interventions that build up the network and the knowledge base. Organising workshops, working groups, bilateral contacts and setting up the energy atlas. **Amsterdam ArenA** — Owner stadium , invest in sustainable implementation	• Small part of addressed building owners and companies continued in the dialogue and collaboration. • Who will take the leadership after setting up partnership is unclear. • No clear business case.

AMC Hospital	Owner hospital building, invest in sustainable implementation
Other building owners (ING, ABN AMRO, ROC, IKEA, Equinix)	Owners of other buildings in area, invest in sustainable implementation
Nuon	Producer of heat and cold and distributor
Real Estate Developer	Investor in sustainable implementation of new buildings.

Actors are aware that collaboration is the way to success. During a dinner ("Captians Dinner") the main actors in the area committed themselves to continue together to create a more sustainable area.

Hamburg

	Description	Bottlenecks to process
Image of area		n/a
Background information	The area considers the largest inhabited river island in Europe with a surface of 35 km2 and a population of 55,000 inhabitants. It is a mixed area from high-rise residential areas to commercial areas. Wilhemsburg has been for a long time not on the agenda of the city council and the other inhabitants of Hamburg, where it can be considered as a socially deprived district. In 2003 the development concept "Leap across the Elbe" was planned by the Ministry of Urban Development and Environment.	
Description of the project	Become 100% renewable until 2050. Meet the "Climate Protection Concept Renewable Wilhelmsburg" target. Existing building were retrofitted to meet the New Building energy standard and the new buildings have the Passive house standard. Creating scenarios with Energy Atlas that could incorporate with the IBA projects.	
Political, institution	IBA Hamburg (International Building Exhibition) has its own budget of 90 million Euros, given by the Hamburg Ministry of	• Project organisation (IBA Hamburg) is

	Urban Development and Environment, its own organisation and its own departments. It is a project organisation that is specially set up to work on the Elbe islands.	bound to given budget and the Ministry of Hamburg.
Policies Legal framework Financial Framework	In 2012 a proposal was made in the Hamburg parliament, which asked for a heat concept for Hamburg. The renewable energy act (EEG/Erneuerbare Energien Gesetz) law objectifies sustainable development of the energy supply and boost development of technology for the electricity production with renewable energy sources. Aiming to increase the share of renewable energy sources. There is no regulation in any law to regulate the connection and use of a district heating grid in a local plan. On building level it should follow EnEV 2009 (Energie Einsparverordnung), which aims to reach the energy related goals set. This is to have a climate neutral building stock in 2050. A method is created for tendering, where sustainability and energetic criteria can count in the overall evaluation.	• The current housing policy does not tighten any legal requirements for insulation or energy status of dwellings on municipal level. • There should be a better funding scheme for retrofitting buildings. • City of Hamburg failed to update EnEV law.
Management, implementation strategy	IBA Hamburg is initiator and coordinator of the whole project. Large focus on monitoring the building through data collection, but still exists on a small scale. Action goes through political decisions. On a small level different sustainable solutions are implemented.	• Lack of milestones • Pressure of realising projects in a short time. • High costs delay the implementation. • Sceptical view on implementing a decentralised network.
Actors	**Actor** / **Responsibility** **IBA Hamburg GmbH** — Acquire, coordinate and steer the implementation of private investment or in some cases public funding **Hamburg Ministry of Urban Development and the Environment** — Financier and relevant consultant **Working groups (JHJ Bleicherode and egs Netzwerk Nordhausen)** — Conducting Experts **Hamburg Energie** — Investor of the main energy	• Developers, architects and investors only go for the minimum solution. • Collaboration worked well when local associations and organisations were involved. • IBA Hamburg could back out of project once it is out of budget.

GmbH (municipal utility company)	installations
SAGA GWG	City owned housing company
Several investors	Investors of the single projects

IBA is a company that is owned by the city of Hamburg and was given its own budget and thus has a certain amount of independence.

Vienna

	Description	Bottlenecks to process
Image of area		n/a
Background information	Area considers a former airfield of Aspern, with no dwellings or other buildings so far. Area is 2.4 km^2.	
Description of the project	Area development of Seestadt North for a high quality of life for future 7,000 dwellings and 14,000 work places. Buildings must have higher thermal building standards and are obliged to be prepared for solar use and monitoring. Letting aspern_Seestadt become a model for 'smart city' development and leave enough openness and flexibility for new framework conditions and technologies in the coming 15 years of implementation. All buildings, except industrial/commercial buildings must be connected to the district heating network.	• Because of new area, lack of knowledge on future energy use and opportunities.
Political, institutional context	First an international master plan competition was conducted, where Aspern was a target area for new development. In 2007 the master plan was adopted by the Vienna City Council. Wien 3420 is founded to promote and develop Aspern Seestadt.	• No legal instrument to assure access to information as for example capacities

	Different departments of the municipality of Vienna are responsible for the coordination of the whole area.	of district heating networks and heat plans.
Policies Legal framework Financial Framework	Environmental Impact assessment is obligatory. The EIA contains specifications on the thermal quality of the buildings. EIA lacks more precise terms of the planned energy system, which could result in re-opening the EIA-approval process. Buildings must meet the defined standard of nearly zero-energy buildings in 2020. Numbers of aid schemes are in Vienna on a building level.	• Developers do not want to re-open the EIA approval process. • Lack of information to define energy system for long period that is obliged in EIA.
Management, implementation strategy	Project is divided in different phases, where the municipality of Vienna is responsible for coordination and was initiator. Elaboration on "smart city scenario" with key actors. High priority on integrated planning and the need of agreements between actors. In depth analysis and comparison of finance and business models. Wien 3420, owned by GELUP GmbH (subcontractor of the Vienna Business Agency Group) and the Federal Real Estate Society is responsible for the development of the area and for the definition of the Implementation Plan. Wien 3420 has its own equity of 55 million Euros. The different departments of the municipality functions as the coordination of all implementation.	• Challenge in taking the step from research on innovative systems to implementation. • More integrated development approach is missing. • Implementation is dependent on a large number of actors with conflicting aims and a fundamental (political) commitment is missing. • Official quantitative targets were missing
Actors	**Actor** / **Responsibility** Wien 3420 Aspern Development AG (Stock corporation)(73,4% GELUP GmbH, 26,6% Federal Real Estate Society) / Develop and promote aspern Seestadt as an urban centre within the City of Vienna. Developing concepts and defining guidelines, providing property and offering consultancy for development projects. Responsible for the development of the area and the definition for the Implementation Plan. The City of Vienna / Coordination unit aspern Seestadt Municipal Department / Urban development concepts and	• Binding agreements between actors are missing. • Hesitating on decision making because of unknown framework conditions, technological changes and innovative opportunities. • Need of agreements between involved actors in order to achieve higher liability of planning

18 (Urban Development Planning)	strategic urban planning	when developing new urban quarters in respect to energy and climate protection targets.
Municipal Department 21 (District Planning and Land Use)	Land and use planning Vienna	
Municipal Department 20 (Energy Planning)	Area related, integrated spatial and energy planning in Vienna. Coordinating energy related city concepts.	
Municipal Department 28 (Road management and construction)	Final planning activities, commissions the mobility concept	
Municipal Department 42 (Park and gardens)	Maintenance of green areas	
Wiener Stadtwerke Group (Wien Energie, Wiener Linien)	Infrastructure service provider.	
Aspern Smart City Research (Siemens, Wien Energie GmbH, Wiener Netze Gmbh, Wirtschaftagentur Wien, Wien 3420 Aspern Development AG)	Examine new buildings in terms of technology, environment and energy in Aspern Seestadt.	

5.3 Case selection

After the general overview, it is possible to make a selection of the cases, because firstly some projects cover or the same implementation or have a similar context. Secondly it is not possible to go in depth into all cases, because of the timeframe of the research.

Table 11 Different characteristics per case.

Field	CPH	LYON	AMS	HAM	VIE
Description project	New development industrial port.	Double net floor area, maintain same overy consumption.	Setting up public private partnership along with Energy Atlas.	Retrofitting buildings to meet the New Building energy standard.	New development former airfield.
Political, institutional context	Goal to become first carbon neutral capital by 2025.	Greater Lyon coordinates master plan, small energy department	Change from local to central municipality.	IBA Hamburg is bound to budget given by the Hamburg	Many departments of the municipality of Vienn are responsible for

		responsible realising energy target.		Ministry.	coordination. Energy planning is one of the eight.
Policies Legal framework Financial Framework	Heat Supply Act and national Building Regulation.	Small financing possibilities.	Small financing possibilities. Big energy users must have a return of at least 5 years.	No regulation on the use of a district heating grid in a local plan.	Building standard with nearly zero energy in 2020. Small financial possibilities.
Management, Implementation strategy	City of Copenhagen set up master plan. Early dialogues.	Very governmental based planning. Focus on gathering information.	Focus on open discussion with building owners along with developing Energy Atlas.	IBA Hamburg is initiator and coordinator, Very governmental based. Emphasis on data collection.	Focus on researching "smart city scenario". Step from research to implementation is big.
Actors	Only case where citizens are involved.	Traditional, novelty in working with private actors: building owners.	Non-traditional, small part of building owners continued in the process.	Traditional, mostly public actors.	Traditional, lot of department of the municipality involved.

The selection should be representative to the research question, which is: "How is the process of energy transition, in several European cities, obstructed by its political and institutional context, policies, management and actors, and how can actors influence the process to overcome these bottlenecks?"

So the next step is to compare and categorise the cases how they influence or represent the research question, to make a deliberated selection.

Table 12 Cases v.s. the main research question.

Cases	Representation main research question
Copenhagen	Because Copenhagen has a further developed political and legal framework on implementing heat grids and building quality, bottlenecks on a less traditional process are found. This case is also the only case that uses citizen involvement to improve the master plan.
Grand Lyon	Case reflects a more tradional planning. This case will give an insight on what bottlenecks in the process will occur when

	governmental bodies have a high position in the process. Interesting is the position of the Energy department, that is responsible for the implementation of the energy target. The Energy department tried to act less traditional, by an early dialogue with the building owners.
Amsterdam	Different process was intended: the municipality of Amsterdam was focusing on collaboration and setting up a public private partnership. Different bottlenecks are to be found, because of the different intended process.
Hamburg	Bottlenecks to be found reflect the strong position governmental parties. This case reflects traditional planning with a high position of the municipality. They coordinate but also finance the whole development.
Vienna	This case reflects a complex institutional framework of the governmental actor, with multiple different departments in governmental bodies. The case also reflects traditional planning.

The selection will select those cases that have a different context, where there is a clear distinction between control from the higher governmental bodies and more local governmental bodies. A distinction can be seen between Copenhagen and Amsterdam on the one side and Grand Lyon, Hamburg and Vienna on the other hand. Because Grand Lyon, Hamburg and Vienna have in some sort of way the same implementation a selection must be made. Grand Lyon is than the most appealing one, because of the more powerful position of a higher central governmental body and the inclusion and cooperation between the municipality and the energy distribution network party (ERDF). Furthermore, Grand Lyon tried to act non-traditionally. This is not the case in Hamburg and Vienna.

Because the actual implementation of Amsterdam is completely different from all the other cases, Amsterdam is also selected for further exploration. Copenhagen is selected because Copenhagen has a rich history on implementing sustainable solutions, where they have a Heat Act and focus on different implementations and have a further developed legal framework than the other cases.

5.4 Copenhagen: Nordhavn

This paragraph will describe the case in Copenhagen which is in the Nordhavn area. The case considers the transformation large harbour area. The municipality of Copenhagen has a vision to create a new sustainable and vibrant city for everyone. The development should follow the city-wide overall goals, which are defined in the Copenhagen 2025 Climate Plan, CPH 2025.

Background information

Nordhavn is a formal industrial port, with a development plan until 2040. Area is 2.5 km^2, with 490 businesses considering logistic, harbour and office functions. On three

sides of Nordhavn is water and on the fourth side, there is a short stretch that borders a heavily trafficked regional road and railway area.

Description of the project

Nordhavn is Scandinavia's largest city development area with expected 40,000 new residents and 40,000 new working places. The municipality visualises the area as a real-life energy laboratory and **be a showroom for future energy solutions**. The development is necessary, because of growing number of inhabitants of Copenhagen. For Nordhavn there are no specific measures that must be met for the energy supply system as it is a part of Copenhagen and hence a **part of the overall goals from the Copenhagen Climate Plan, CHP2025 as well as the overall National energy requirements and goals**.

The development process consists of five phases, where the Master Plan focuses on a time horizon to 2040. The first phase concerns the first district of the peninsula with 3000 inhabitants and 7000 work places.

Nordhavn will be supplied by district heat generated by wood-fired combines heat and power (CHP) plants. Electricity will become the main source for heating; primarily through heat pumps using sea water as heat source.

The buildings most be certified according the Danish adaptation of the DGNB standard.

Political, institutional context

The municipality of Copenhagen is focused on the use of renewable energy and become world leader in the usage of this technology. Further, the municipality of Copenhagen is focused on developing more bicycle lanes. Their ambition is not only **becoming a low carbon city, but also a carbon neutral city in 2025**.

Nordhavn was an industrial port, owned by Københavns Havn A/S, which now are part of the City Port Development department. The CCPD (Copenhagen City Port Development) is also the owner of land in Nordhavn. The selling of the land in Nordhavn is used by CCPD to reduce the debt of creating metro lines in Copenhagen and create additional metro lines.

In June 2014 a new agreement between the municipality of Copenhagen and the state was signed. The agreement includes the establishment of additional metro lines and a road tunnel to Nordhavn, but **also a new ownership structure for CCPD**. Henceforth, the City of Copenhagen now owns 95% and the state 5% of CCPD. This reflects a stronger role and greater responsibility of the municipality for the development of the capital, but also the national government's expectations that the City of Copenhagen functions as a growth motor for Denmark.

Copenhagen is a growing city, where it increases around 1,000 citizens every month. The municipality of Copenhagen is part of the Region Hovedstaden. Above the municipality there is the Greater Copenhagen authority. In 2009 the Copenhagen Municipal Council decided that Copenhagen will become the world's first carbon neutral capital by 2025.

The municipality of Copenhagen has the formal responsibility for energy planning based on project-by-project proposals elaborated by HOFOR (Greater Copenhagen utility). The municipality could in principle force the utility company to offer any kind of heat supply.

In 2009 the Energy Partnership was formed by the municipality of Copenhagen, CCPD (landowner), the energy suppliers HOFOR , DONG, the Ministry of Climate and Energy on very high level (CEO). The vision was at this very early state to talk about a new sustainable energy supply and development of the Nordhavn area.

Policies, legal framework, financial framework

The municipality of Copenhagen is obliged to make regulation plans for areas that are to be developed. The plan is usually made in cooperation between the municipality of Copenhagen, the landowner and private developers, who would like to realise specific projects.

The heat supply is planned on basis of a national Heat Supply Act, stating that the municipality is responsible for making heat plans. This is done in co-operation with the utility company, which is in Copenhagen HOFOR.

The heating demand of each building has been assumed in compliance with the national Building Regulation (BR 2020). According to this, space heating demand must be zero in buildings built from 2015 onwards. Also the buildings must all comply with the BR2020 regulation requiring a very low energy consumption stating a maximum external energy supply of 20 kWh/m2/year for dwellings and 25 kWh/m2/year for businesses.

The 2015 fiscal budget for Denmark included an amendment to the law on planning according to social housing, which allows the municipality to prioritize land for social housing to a lower price. The new law on planning prescribes that the municipality to prioritize land for social housing to a lower price. At the same time the municipality is given an option to offer social housing companies long-term loans (up to 50 years) with zero interest and zero repayment.

The main barrier for sustainable development is the high prizes on land combined with the financial crisis in Denmark.

Management, implementation strategy

The municipality of Copenhagen and CCPD have made a development agreement. This development agreement enables the two parties to implement some of the elements in planning and development of the area which will help meet the level of ambition on the original Master Plan. In the agreement the two parties commit to different parts of the project that cannot be regulated in the zoning and land use plan or detailed plan for the different parts of Nordhavn. **This agreement is a voluntary agreement, whereby the parties agree to work for higher levels of sustainability.** The development agreement underpins the specifics of the area and makes it easier to promote the area to investors and citizens.

The municipality has great expectations towards the early dialogue with developers. **Normally the municipality does not communicate with the developers** until they have drawn their building and works for a permit to build it. This idea of the dialogue is from a project in Malmö, where twice as many developers reached level A (Swedish norm) when they participated in an early dialogue about sustainability.

The municipality of Copenhagen facilitated workshops for the citizens to discuss the quality of the new built area. They included actors such as developers, architects, the cyclist union and local city government representatives.

In Nordhavn, the municipality of Copenhagen aims to test initiatives on top of the conventional planning tools. The conventional tools include municipal and local plans, local plan supplements and urban development agreements. Later "early dialogue with developers" are to be tested. This means that Nordhaven is a test lab on how to improve dialogue with developers and landowners on sustainable development. Question is how the municipality can achieve this.

Actors

Below a table that shows the actors that are involved in de development and their responsibility concerning the development.

Table 13 Actors and responsibilities (TRANSFORM, 2014)

Actor	Responsibility
City of Copenhagen	Municipality plan, regulation plan, building permits authority on heat, waste and water
CCPD (Copenhagen City & Port Development)	Develop and sell land
HOFOR, Greater Utility of Copenhagen	Supply of water, district heating, gas and district cooling
DONG	Electricity grid and power
Developers	Build dwellings and offices

Citizen	Ideas and qualifying zoning plan

CCPD is cautious in making demands on developers that could further increase development costs, such as through strengthened sustainability goals suggested in local regulations plans or development agreements between CCPD and the municipality of Copenhagen.

The municipality of Copenhagen and CCPD hosted a big workshop for citizens and other actors to discuss ideas for the new part of the city. The citizens participated together with other actors such as developers, architects, the cyclist union and local city government representatives.

The municipality controls only a minor part of energy consumption in the city. It controls energy consumption in public buildings and some infrastructure. This results also in no ownership of data considering energy consumption. The municipality only owns the data that concern their own part. **This results in a lack of information to make decisions on the development process.**

The greatest activity is that of the land owner negotiating with developers to sell land, and the City of Copenhagen seeking to influence the process to enhance sustainable priorities in the development of the area.

HOFOR is asked by the municipality to make an analysis of the best possible heat supply for Nordhavn. The municipality takes the decision, allowing the utility company to make the district heating or not. If district heating is not the best solution, the municipality could in principle force the utility company to offer heat supply in another way.

There was a Energy Partnership formed by the municipality of Copenhagen, CCPD (landowner), the energy suppliers HOFOR , DONG, the Ministry of Climate and Energy on very high level (CEO). **The expectations were high, but the results from this partnership have not been very innovative.** The partners state that it has been very positive to meet early in the planning process to get an understanding of each partner's strategy, discuss the vision for the area and solve some of the problems together. **But, the business cases concluded that the return on investments was too low.**

A key message from actors was that **the municipality of Copenhagen lacks internal alignment**. Another key message was a **question of finance and the lack of a clear business case for building sustainable buildings** as seen from a pure business perspective. **More challenges are found in persuading developers to aim for a high score in the DGNB certifications**.

The city cannot require the owners of the existing building stock to renovate their buildings. However, it still needs to be done.

Table 14 Interpretation information actors Copenhagen on energy efficient implementations (own table)[1]

[1] See appendix for full analysis

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Interdependence (+, +/-, -)
City of Copenhagen	+/-	+	-	+/-	+
CCPD (Copenhagen City & Port Development)	+/-	+	-	+/-	+
HOFOR, Greater Utility of Copenhagen	+/-	+	+/-	+	+
DONG	+/-	+/-	+/-	+/-	+
Developers	+	-	+	-	-
Citizen	-	+/-	+/-	-	-

The table is constructed from the theory on analysing actors from the theoretical framework. Topics that are to be researched are power, interest, resources, information and interdependence. To give actors a different position on these topics one has used + for high, +/- for moderate and – for low. This information is also used for the actor analysis in chapter 6 and the whole analysis can be found in the appendixes.

What can be seen in the table above is that the municipality of Copenhagen, the CCPD, HOFOR and DONG share an interest for the project. This is because they are bound by its legal context to work on sustainable implementations; however HOFOR and DONG have also the interest to make a profit on the implementations.

What also can be seen is that **the actual initiators and governmental bodies of the project have fewer resources to invest in the whole project**. This results in being dependent on other actors, such as developers. Eventually this results in the bottleneck **of few investments, because the return on the investment is too low**.

Most actors seem to have enough information and expertise to implement the solution, but what could be found in the information is that there is a lack of information which solution is best suitable for the area. **This results in a lack of data, which also need to be integrated.**

Finally, a bottleneck was found by the other actors by stating that the municipality of Copenhagen lacks integral planning. **This is also reflected in the interest of the actors, where developers and citizens have fewer interests in implementing energy efficient solutions.**

5.5 Grand Lyon; Part-Dieu district

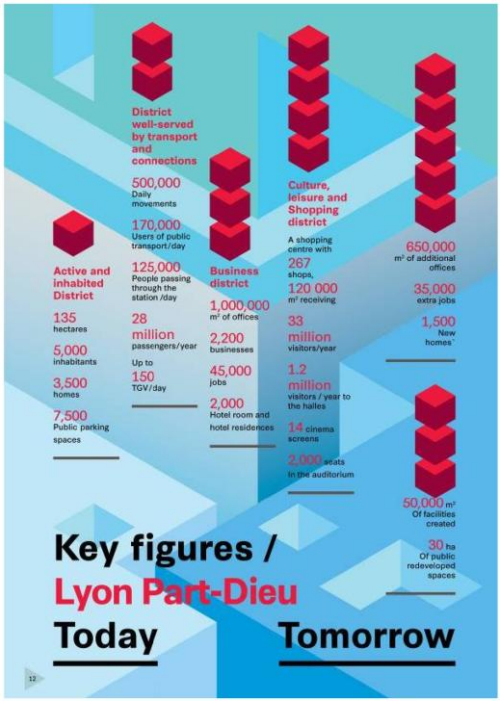
This paragraph will describe the case in Grand Lyon in the Part-Dieu district. The implementation considers the densification of the area by doubling its net floor area, but maintain the energy balance if the district.

Background information

Lyon Part-Dieu was meant to be a decision-making centre to counterbalance the importance of Paris. The aim was to design an entire urban development scheme including a business, administrative, cultural, commercial and residential centre.

Description of the project

The new objective of the area is to double the net floor area, where the area must be economically attractive. Also the energy balance of the district should be maintained, by combining highly energy efficient buildings together with a strong reduction of the specific electricity consumption. The number of dwellings should increase from 3500 dwellings to 5000 dwellings.



The Part-Dieu district is served by one heating and cooling network for Lyon/Villeurbanne/Bron.

Political, institutional context

The implementation is intended to follow the context of the urban project Part-Dieu 2030.

The Territorial Climate and Energy Plan (PCET) is a territorial sustainable development project, the main purpose of which is to combat climate change. Instituted by the National Climate Plan and subsequently enshrined in the Grenelle I and Grenelle II laws, it is a framework of commitment for the territory. Grand Lyon's PCET is based on a partnership approach involving, in 2013, 74 public and private partners (businesses, public establishments, research institutes etc.). Grand Lyon's PCET has two objectives in its sights: - Mitigation of / reduction in Greenhouse Gas

emissions. The aim is to restrict the territory's impact on the climate by reducing greenhouse gas emissions; - Adaptation to climate change. The aim is to reduce the territory's vulnerability to the impact of climate change which cannot be entirely avoided.

The law on the modernisation of territorial public action and affirmation of metropolises, called "MAPAM law" aims to clarify the competences of local authorities, by particularly reorganising the legal system of the most integrated French inter-municipal communities, the metropolises. The new Lyon Metropolis will therefore have a wider energy mandate, which will enable the new Lyon Metropolis to build a forward-looking vision, translated in the form of an energy master plan, and directly manage investment policies and operational action programmes.

Articles 64 of the draft " Law on energy transition for green growth" makes provision for a series of measures aimed at greater sobriety and better energy efficiency, as well the promotion of renewable fields "void of any nuclear activity". The law mainly covers the construction sector, which alone accounts for nearly half of the energy consumption in France. The roadmap makes provision for the thermal renovation of 500,000 houses per year, a goal stated since 2012, but still a long way from achieved. Furthermore, the entire housing stock should be renovated according to "low energy buildings" standards by 2050.

These laws do not apply to the implementation plans of Lyon, but do influence its process where it will be applicable in the future.

Policies, legal framework, financial framework

National level

The national energy regulatory environment has changed over the past five years. The future law on energy transition is still discussed in parliament.

The eco-loan provides financing for energy saving initiatives and potential costs resulting from these initiatives in order to make the house more energy-efficient, more comfortable and emitting less greenhouse gasses.

Local level

Within the framework of the implementation of its Climate Plan, Grand Lyon is experimenting with an eco-renovation grant for social landlords to attain the BBC-renovation standards.

In addition to this experimental approach, Grand Lyon and the National agency for the Improvement of Habitat (ANAH) are also funding works geared at improving the quality and energy performance of houses and condominiums, especially within the framework for the "live better" programme for homeowners or private rental houses.

From 2004, Grand Lyon, with the help of the local energy agency, designed and implemented an environmental quality reference for new houses.

Management, implementation strategy

The project management approach is quite novel as, in this district, the public authority only owns public installations and very few sites, and so has to work with numerous other private, para-public and public landowners. "Greater Lyon takes on the project management for the ambition of the project".

The implementation strategy is highly dependent on the information and data that the initiators want to use to make decisions on which implementation will be most suitable. In the process there is a high emphasis on gathering data, adjusting data to the right format, analysing data and monitoring data. What can be seen is due to a lack on the right data, a bottleneck is found.

Actors

The Part-Dieu urban project is steered by Greater Lyon in the context of a novel arrangement: the creation of a dedicated ad hoc commission followed by the conversion of this commission into a local public corporation in June 2014.

Table 15 Actors and responsibilities (TRANSFORM, 2014)

Actor	Responsibility
Part-Dieu Commission	Provide impetus and coordination between Greater Lyon and the institutions affected by the project, the economic partners, real-estate operators, private clients and residents. Mobilizing resources.
The Energy Commission	Information provider on sustainable energy development.
ERDF	Managing the public electricity distribution network for 95% of continental France.
The City of Lyon	A number of departments are involved by monitoring the electricity and gas concessions for the territory of the city of Lyon.
Heating and cooling network operator	Providing heating and cooling.
Real Estate Developers	Investing in sustainable solutions.
Owners/Occupiers of the office buildings Part-Dieu (Club Part-Dieu)	Actually investing in redevelopment of existing buildings.

The Part-Dieu Commission is the leader of the project, has a limited lifespan and reports to the General Directorate of Greater Lyon. It is organised to coordinate between Greater Lyon and the other actors and mobilises the resources of the many departments of Greater Lyon and coordinates their actions without representing them.

However, the actual responsibility of the implementation plan lies with the conurbation strategy department of Greater Lyon, within the prospective and conurbation policies department (DPPA).

ERDF carries out its task of Network Distribution Operator within the framework of a concession contract signed with the Organising Authority for the Distribution of Electricity, the Lyon metropolis as from 1 January 2015.

Club Part-Dieu, the district's economic actors and 60 largest businesses present in the Part-Dieu district, are involved by workshops and a partnership. The main objectives of the club are sharing experiences, expressing the business' expectations and upgrading and promoting the district.

The impact of different scenarios on the electricity distribution network is carried out in partnership with ERDF, Part-Dieu Commission, Hespul and Elioth.

Table 16 Interpretation information actors Grand Lyon on energy efficient implementations (own table)[2]

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Inter-dependence (+, +/-, -)
Greater Lyon	+	+/-	+/-	-	+
Part-Dieu Commission	+	+/-	+/-	-	+
The Energy Commission	+/-	+	-	+/-	+
ERDF	+/-	+/-	+/-	+/-	+
Heating and cooling network operator	+	+/-	+	-	-
Real Estate Developers	+/-	+/-	+	-	-
Owners/Occupiers of the office buildings Part-Dieu (Club Part-Dieu)	+	+/-	+	-	-

The table is constructed from the theory on analysing actors from the theoretical framework. Topics that are to be researched are power, interest, resources, information and interdependence. To give actors a different position on these topics one has used + for high, +/- for moderate and – for low. This information is also used for the actor analysis in chapter 6 and the whole analysis can be found in the appendixes.

What can be seen in the table above is firstly the lack of information with almost all actors, which is stressed in the fact that in the process there is currently a high focus on making, gathering, analysing and monitoring data that can cover the argumentation in the decision making process. All actors are not willing to decide on an implementation solution without this data.

[2] See appendix for full analysis

The Part-Dieu Commission has a strong position in the project, where it is part of Greater Lyon and is only focused on this area and its development. When looking closer into the information it is **just a department of Greater Lyon that is responsible for the implementation of the energy efficient solutions**.

What also can be seen in the table is that all governmental bodies, Part-Dieu Commission, the municipality of Lyon and ERDF are interdependent on other actors. **These other actors are not interdependent which gives them a solitude attitude**. However they are in some way interested in the project, which makes them more committed.

An interesting position is found in the building owners, where they are not involved with the urban development of the area (Part-Dieu Commission), but **are involved with thinking into more energy efficient implementations** (conurbation strategy department Greater Lyon).

5.6 Amsterdam; Energiek Zuidoost

This paragraph describes the case in Amsterdam in the South-Eastern area. In this case no urban development plan was served as a base, but the municipality of Amsterdam steered towards cooperation between building owners and the municipality.

Background information

Amsterdam South East is a mixed area of housing, offices, retail and industry. The energy consumption is relatively high (10% of the city's consumption) and the size of the area is 2,3% of the city surface. There was no existing higher plan on redeveloping the area. The Amsterdam structural vision 2040 states that Amsterdam should become "Economically strong and sustainable". The area is 22 km^2, but the implementation area is much smaller.

Description of the project

New programme will be connected to the city heating system. The municipality of Amsterdam wants to set up a project organisation that will result in a public private

partnership. Secondly, the municipality created an energy atlas as basis for decisions and definition of goals of the implementation.

Political, institutional context

The list that describes the vision of the municipality of Amsterdam in 2040, states that Amsterdam should be more energy efficient and should start using renewable energy. In this same document states the municipality of Amsterdam that Amsterdam should have more clean air and should produce and consume according the circular economy movement (Stam, 2011).

The ambitions to implement more sustainable and energy efficient solutions come from the EU 202020 goals and the Amsterdam structural vision 2040.

No action was undertaken if municipality did not participate in TRANSFORM.

Change from local district governmental bodies, where the **political committee per city district is smaller and has less formal power than in 2013.**

Policies, legal framework, financial framework

Possibility of funding through investment funds of 60-100 million for which sustainable projects can apple and compete, which is a loan with an interest rate of 2%. The city of Amsterdam has a subsidy on retrofitting social housing and there is an energy loan. On a national level there is a subsidy for sustainable energy.

The Law on the environmental maintenance states that big energy users must have a return of investment of at least five years. When calculating returns of investment of sustainable solutions it is not possible to have a return of at least five years, but more twenty years or longer.

Management, implementation strategy

In this case the emphasis lies more on a process management strategy, with a goal to create a partnership with building owners and businesses in the area. This results in keeping the dialogue between the municipality and the building owners and businesses through workshops and meetings.

The approach is bottom-up, where the municipality starts dialogues with local actors in the area, instead of top-down.

After the early dialogue with all building owners in the area, only two stayed in the process. **After intentions are set to more clear plans, it is very unclear who should lead the implementation.**

On the other hand, the development of an energy atlas is managed that supports the decision making process and the building owners with potential opportunities in the area.

Because of the lack of any commitment of the building owners and businesses, **no actual action towards an implementation plan is taken.**

Scenarios can be however calculated or analysed through the Energy Atlas.

Actors

The initiator of the process is identified in the Amsterdam Energy and Climate Office of the municipality of Amsterdam.

Table 17 Actors and responsibilities (TRANSFORM, 2014)[3]

Actor	Responsibility
The Amsterdam Energy and Climate Office	Accelerator of the process, defining the process interventions that build up the network and the knowledge base. Organising workshops, working groups, bilateral contacts and setting up the energy atlas.
Amsterdam ArenA	Owner stadium , invest in sustainable implementation
AMC Hospital	Owner hospital building, invest in sustainable implementation
Other building owners (ING, ABN AMRO, ROC, IKEA, Equinix)	Owners of other buildings in area, invest in sustainable implementation
Nuon	Producer of heat and cold and distributor

However, the municipality can only be involved in this process with human resources, **they have no budget on implementing whatsoever**.

In the beginning of the process, the companies like the ArenA soccer stadium, the hospital (AMC) and IKEA took initiatives from their own perspectives. They follow their own energy efficient agenda and were involved and responsible for separate projects in the area.

The NUON had more interest, when they moved their headquarters to the area and triggered them to be more involved in formulating an ambition for the area and invest in new partnerships.

Table 18 Interpretation information actors Amsterdam on energy efficient implementations (own table)

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Inter-dependence (+, +/-, -)
The Amsterdam Energy and Climate Office	+/-	+	-	+	+
Amsterdam ArenA	+	+/-	+	-	+/-
AMC Hospital	+	+/-	+	-	+/-
Other building owners (ING, ABN AMRO, ROC, IKEA, Equinix)	+	-	+	-	+/-

[3] See appendix for full analysis

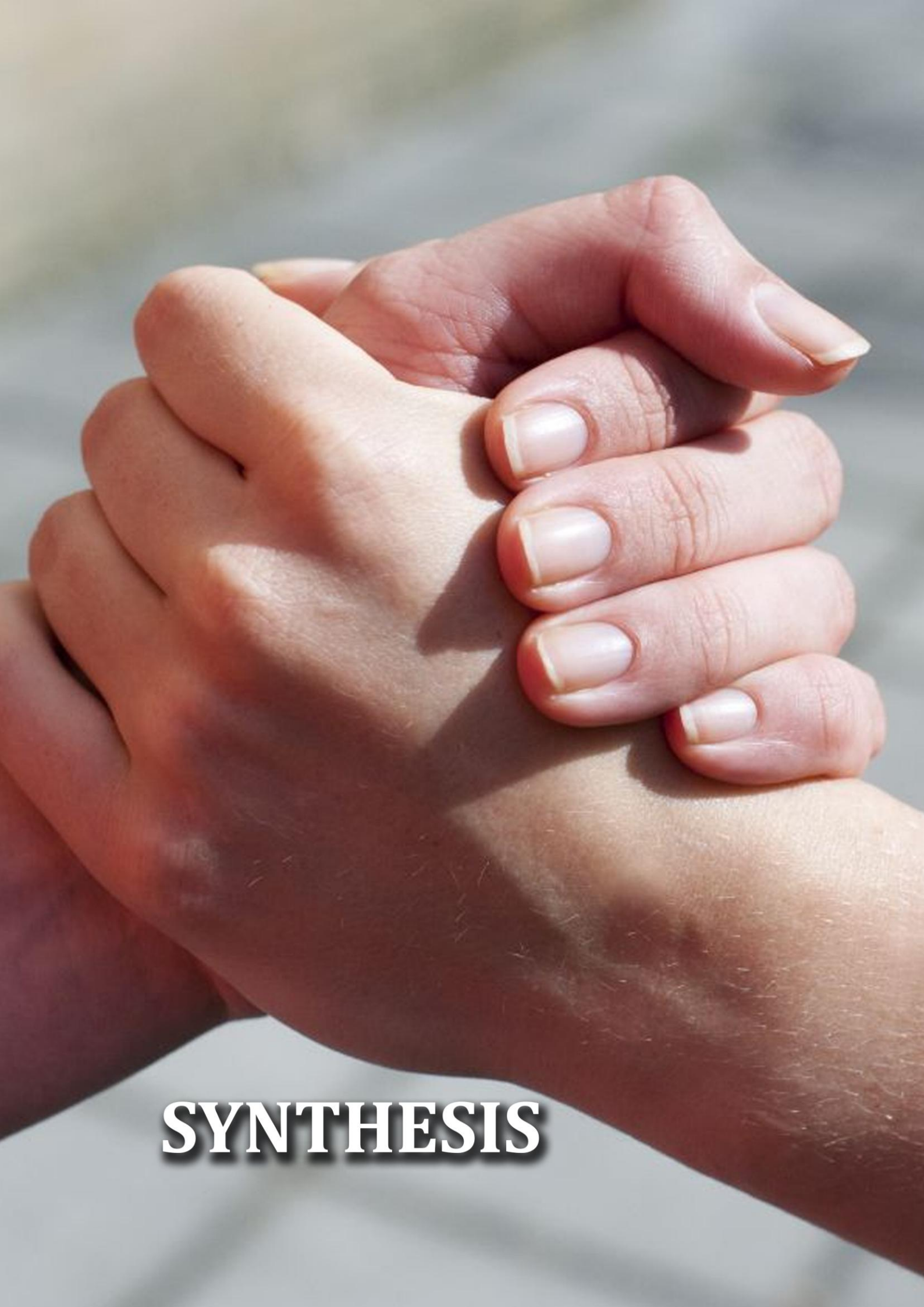
Nuon	+	+/-	+	+/-	-

The table is constructed from the theory on analysing actors from the theoretical framework. Topics that are to be researched are power, interest, resources, information and interdependence. To give actors a different position on these topics one has used + for high, +/- for moderate and – for low. This information is also used for the actor analysis in chapter 6 and the whole analysis can be found in the appendixes.

What is most noticeable in the table above is the position of the energy and climate department of the municipality of Amsterdam. Where they have a lot of interest, information through the energy atlas, **they lack power and resources**. This power lies in the hands of the building owners, because it is them that invest in the implementations on their buildings. The municipality **can only function as an initiator and accelerator of the process.** The municipality's power lies in the information they gathered that can support the decision making process of the other actors.

Secondly, the municipality **is highly dependent on all the other actors**, where the other actors are only dependent on the information from the municipality for deciding on the best energy efficient solution. Aligning and making the implementation plan together could lead to less costs and more quality, which most of the owners recognised from the beginning of the process.

Also the other building owners could play a role in the public-private partnership, **but backed out of the process due to a lack of interest and sound business case**.



SYNTHESIS

7. SYNTHESIS

7.1 Quick wrap-up

This paragraph summarises all the cases, pinpointing on the most important bottlenecks from the first analysis of the cases. In a simple way it also reflects on the relation between all actors involved.

Nordhavn, Copenhagen

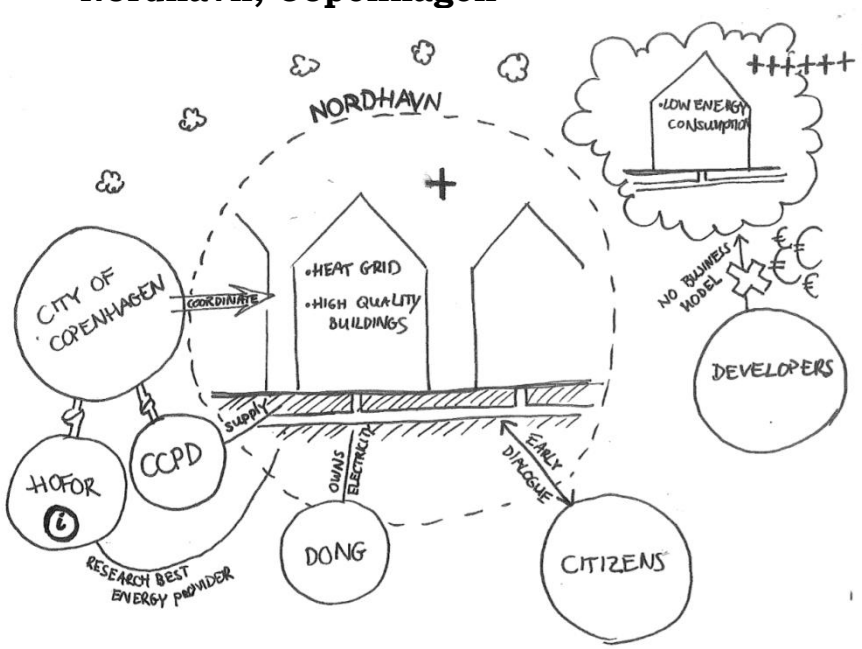


Figure 13 Quick wrap-up of Nordhavn (own ill.)

The City of Copenhagen coordinates the development process, where the CCPD owns 95% of the infrastructure of the area. HOFOR collaborates with the city of Copenhagen by researching the best implementation for energy. HOFOR also provides this energy supply for the whole city of Copenhagen.

The precise energy efficient implementations are still unclear, because there is a lack of information on what implementation will be the best solution. The area must be connected to the heat grid, because of the Heat Supple Act. The City of Copenhagen would like to have a high quality of the buildings (highly energy efficient).

Developers are involved through early dialogues, but are not interested in the project due to unclear business case and no incentive to invest in a higher quality of the buildings in the area

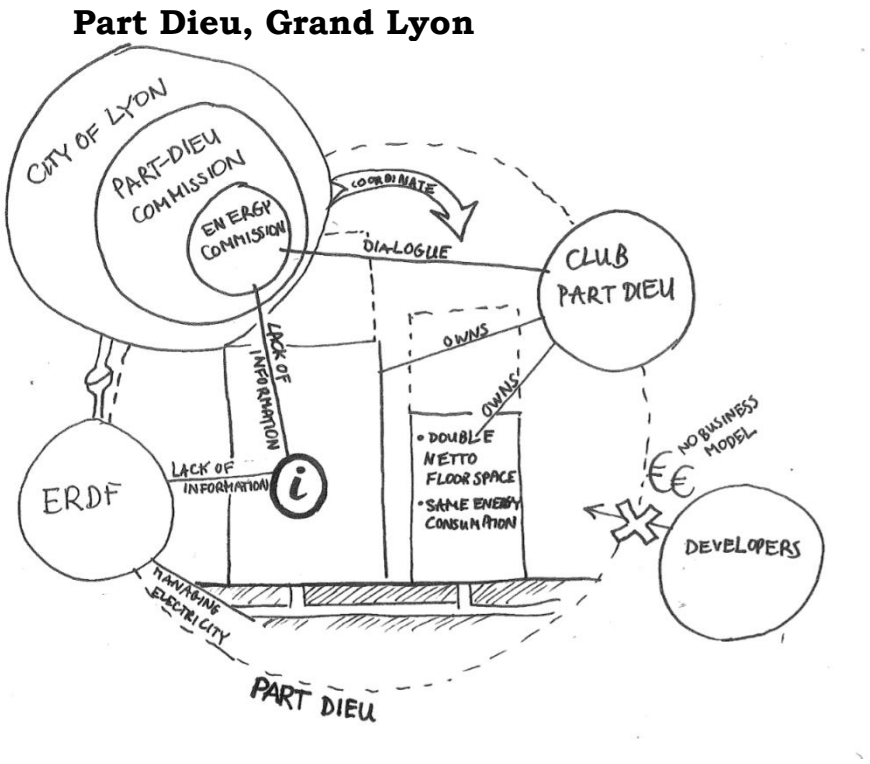


Figure 14 Quick wrap-up Part Dieu (own ill.)

Part Dieu is an outdated business district, where the City of Lyon decided to double the net flour area and have the same amount of energy that is used for the area.

The Part Dieu Commission is assigned to coordinate the whole development, whereas the Energy Commission is later on assigned to coordinate the energy efficient implementations. The Energy Commission is a small group, part of the Part Dieu Commission, and has tried to start the process with early dialogues with the owners of the buildings: Club Part Dieu. This is novel to the municipal body of Grand Lyon.

Biggest problem to overcome is the lack of information that is needed to find the right implementation for the buildings in the area. ERDF, electricity owner and supplier, encounters the same problem and has no or little information on, for example, the energy use of the area.

Amsterdam Energiek Zuid-Oost, Amsterdam

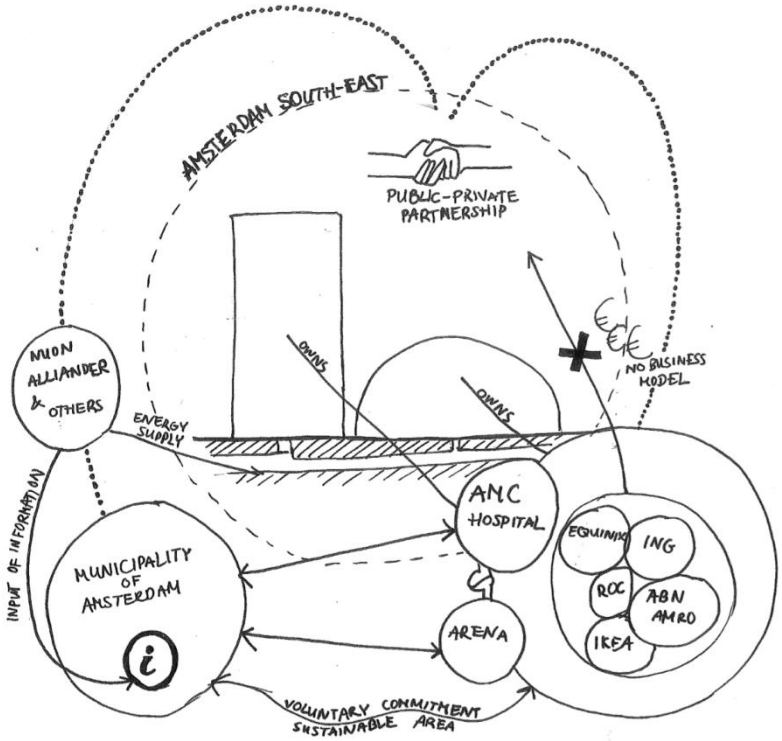


Figure 15 Quick wrap-up Amsterdam South-East (own ill.)

Energiek Zuid-Oost has a different objective, which is not physical. The objective is to create a public-private partnership.

The idea is received positive by the building owners, but only two owners stay in the process. Other are not interested anymore because of an unclear business case.

The municipality of Amsterdam creates a stronger position by creating and bundling information in their so-called "Energy Atlas". This is done in collaboration with the energy suppliers, which were hesitant to share their information.

7.2 Phases

From the theoretical frame a simple and general differentiation is made in the phasing, these phases are initiation, planning, realisation and maintenance. After researching the cases a more detailed phasing can be identified (Franzen et. al., 2011; Copenhagen climate adaption plan, 2011; TRANSFORM, 2014). The result can be found in figure 16.

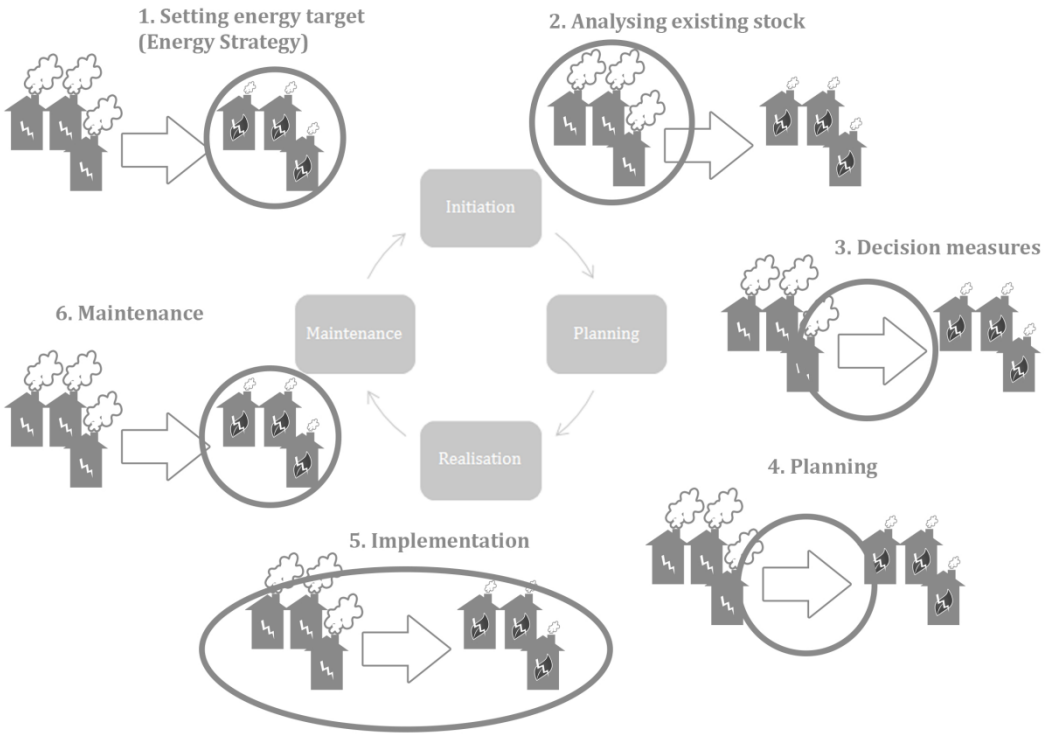
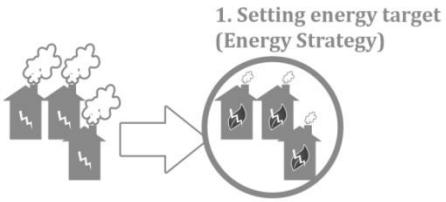


Figure 16 Phases in transforming existing stock towards usage of renewable energy and energy efficiency (own ill.)

1. Setting energy target (Energy Strategy)



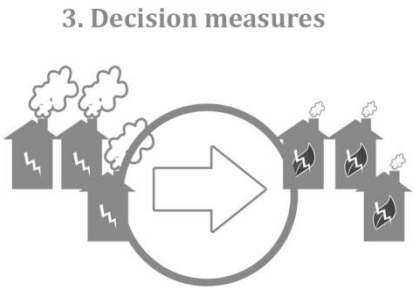
The first step taken towards energy transition is stating the energy target or objective. This statement consists of the goals set by (mostly) governmental bodies and is the starting point of this process. Nowadays most strategies are secured by governmental actors, where energy transition also can take place between parties of the private sector, without intervention of the government. During this phase one indicates their desired end result after implementation. What can be seen in the strategies of many governmental bodies is that they have set ambitious and drastic goals for their country, city and district in the field of energy. This also without including many other parties that have influence on the desired outcome and are by means a actor in the network of this process.

2. Analysing existing stock

After pinpointing the end result of the whole process with the most important actors, it is important to analyse the existing stock of the area in question. A big component of this analysis is data. In large areas different buildings are built, with different

characteristics. Due to current technology, data gets collected on several components of the building. These could be for example energy use, physical characteristics, inhabitants and data on the infrastructure underneath the building. This data can be used for decision making with related actors, but also for further calculations on the best solution. Currently different decision models are created by knowledge institutes, municipalities and companies, but all are still freshly developed and still need further development for optimal use. Nowadays limited data is available about the energy use of the buildings, the characteristics and infrastructure. This means that or actors are not willing to share their gathered data or that the data simply does not exist. Data has become more important due to the complexity of the (re-) development and provides more inside on usable solutions (TRANSFORM, 2014).

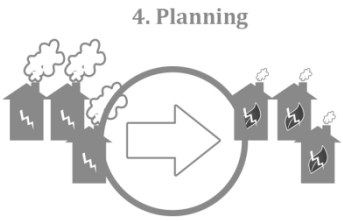
3. Decision measures



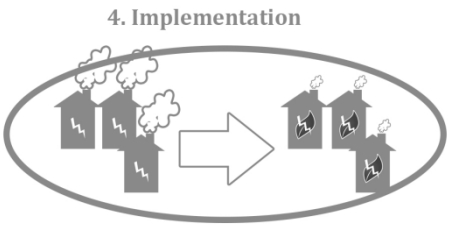
During this phase actors come around the table and negotiate, with or without a decision making model that can calculate the outcomes of the measures, the possible solutions. The decisions are related to the desired end result, which can change during this process.

4. Planning

During this phase decisions will be made in relation to the planning in time and costs. This means that the decision making is influenced by many factors such as the actors, costs or financial resources, the strategy and the outcome.. Importance lies in keeping all actors interested in the end result, where they all put effort in meeting each other's interests and create a so-called win-win situation (de Bruin & ten Heuvelhof, 2009).

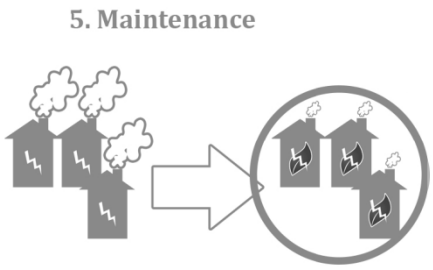


5. Implementation



During this phase implementation of the found solutions will take place. This means that all planned projects will take place, to meet the end result. Overall this relates to preparing public and private space for implementation. Most of this phase is characterised by taking action. This phase influences the end user, the contractor and the governmental body as a controlling actor.

6. Maintenance



Last phase consists of maintaining the status of the building stock. This relates to the effect of the measures and the possibilities of eventually upgrading systems. While planning in the third phase, one should keep in mind the adaptability of the system and its future use. Nowadays a lot of controlling and checking on the effectiveness is done by repeatedly measuring the building performance. This can be a cause to start again with this process and set a new energy target for the area in question.

7.3 Bottlenecks

This paragraph summarises all found bottlenecks from the cases that have been researched in the case study.

Table 19 Bottlenecks found from each field from the case study

Field	Bottleneck
Political and institutional context	• Driving force to work on implementing energy efficient solutions comes from high governmental body (EU), which is not (always) shared on municipal level. • Setting a too ambitious goal by governmental bodies. • No support from higher governmental bodies with law on energy transition. • Change in institutional context causes less local formal power, leading to no action.
Policies, legal and financial framework	• No support from higher governmental bodies with law on energy transition. • Lack of or no policies on implementing energy efficient solutions. • High prizes of land combined with the financial crisis, make it hard to find financial means for investing in energy efficiency. • Change of ownership, resulting in higher expectations from the national government on the developments. • Municipality has no budget on implementing, only human resources to invest in the process. • Only financial support on local level. • Lack of a clear business case for implementing energy efficient solutions.
Management, implementation strategy	• Difficulties on finding and creating data for decision making process. Lack of information to make decisions on the development process. • Coordinator focuses on gathering data, which can support investors and gives the coordinator stronger position.

	Because it is difficult to gather data, no further steps are taken. • Small departments of municipality are responsible for implementing energy efficiency, where the whole development is coordinated by great governmental body. • Project management approach is quite novel, public authority owns public installations and a few sites and has to work with private, para-public and public actors. • Lack of internal alignment. • Integrating early dialogues into the project is found difficult. • Very experimental on implementing energy efficient solutions.
Actors	• Municipality can only function as an initiator and accelerator of the process. The municipality is highly dependent on all the other actors. • Unclear role of who will lead after setting up a partnership. • Because of lack of any commitment of the building owners and businesses, no actual action towards an implementation plan is taken. • Normally the municipality does not communicate with the developers. • The actual initiators and governmental bodies of the project have fewer resources to invest in the whole project. • The municipality controls only a minor part of energy consumption in the city. • Developers have no incentive on developing high quality buildings, with a high score on sustainable certifications. • Municipality has to act non-traditional; collaborating with building owners. • Developers and building owners are not convinced investing in implementing energy efficient solution is worthwhile.

7.4 Political and institutional context

In the case study it was found that in each European city a different political or institutional context is present. These different contexts also result in a different effect on the process of implementing energy efficient solutions. From the case study it is possible to extract different institutional contexts, which influence the process of implementing energy efficient solutions.

Institutional context: clustered governmental parties

As could be seen in the case of Grand Lyon, Vienna and Hamburg, the coordinating governmental body was clustered containing different departments in different levels

within the organisation. All governmental departments are related to each other and have different specific areas where they exceed in. In this way governmental bodies are less dependent on other actors that are necessary for data or investments for example. Because of their institutional context they have greater power and can steer more towards energy efficient solutions.

Institutional context: large gap between central and local

In the case of Grand Lyon and Amsterdam there is a large difference between the position and power of the central government, such as city ministries or administrations and local governments such as district administrations. This results in a more difficult context where higher governmental bodies set goals which are in practice on local level very laborious to execute. This also results in less action on local level.

Bottlenecks from political and institutional context

Firstly it is noticeable that the driving force to implement energy efficient solutions flows from higher governmental bodies all the way to local level. If this driving force from higher governmental bodies is missing, one could state that no or little action is taken to move towards energy transition.

Also, it was found hard to act different from the traditional institutional context, because of its rigid nature. Not following certain procedures, collaborating with non-traditional actors and finding new ways to fund the process are found hard by the governmental actors.

Finally, when the political and institutional context changes it creates a bottleneck to the process of implementing energy efficient solutions. This is related to the Amsterdam and Vienna case, where in Amsterdam the institutional context changed by a reorganisation. This resulted in a change from a more local focused organisation to a more central organisation. In Vienna new members of the parliament or city council were chosen and new goals were set and old goals were putted aside instantly. Contributing to energy transition is not a common goal of all politicians or all governments in Europe.

7.5 Policies, legal and financial framework

Not many policies or laws exist, because of the novelty of the problem of working on energy use in urban areas. In the case of Copenhagen this is different, because Copenhagen already has policies and laws on heat grids and the energy use of buildings. This also reflects in the much more ambitious goal of Copenhagen: becoming carbon neutral in 2025.

The financial framework is one of the biggest aspects of realising energy efficient areas that is uncertain. The coordinating and initiating actor has no or little resources to invest in energy efficiency. On the other hand is the business case not sound. Private parties with short returns are not interested in investing, because the investment in energy efficient solutions is not profitable.

Bottlenecks: policies

On the topic of policies it is marked that not many policies exist on implementing energy efficient solutions. Cities with old policies on energy efficient solutions, such as Copenhagen, are much further in the process of energy transition. This means that

other cities should also put sustainability higher on the agenda and be more forceful on creating policies on implementing sustainable solutions. Reason for this can be found in the novelty of this problem and lack of information on what is the right thing to do.

Bottlenecks: legal framework

There is a lack of laws on implementing energy efficient solutions, which results in hesitation of taking action from, for example, private actors. Also legal support from higher governmental bodies is missing.

It is noticed that all actors act upon stated laws that for example state the quality of the buildings or the usage of heat grids. This was the case in Copenhagen, with the Heat Supply Act. Without laws from above no or little action is taken by actors, which could be seen in the Amsterdam case. It is possible to say that actors are not willingly to move towards energy efficiency only from their interest in creating a more sustainable urban area.

Bottlenecks: financial framework

Most private actors are driven by making profit, so this bottleneck exceedingly affects the process: no sound business case. So far there is no profit or even loss for these actors when it comes to implementing energy efficient solutions. This results in private actors not willing to contribute to the process of energy transition. Why contribute when it results in a loss?

What also contributes to this bottleneck is the fact that the initiator, in all cases the municipality or city district, has no budget or a lack of budget to implement energy efficient solutions. In the Amsterdam case they only have human resources to activate or help out with initiating the process. After initiation no actor takes over and goes further in the process.

Also actors tend not to think in a different financial framework and prefer short term investments with short term returns. This is not the case for implementing energy efficient solutions. This leads into difficulties on persuading investors and developers to invest in energy efficient solutions.

7.6 Management, implementation strategy

What the cases demonstrate is a strong focus on gathering data. This means that the coordinator of the implementation first gathers data to use for decision making. Because the data is very complex and mostly distributed among other actors, such as private actors, the strategy has a high focus on first convincing actors to share data.

In the case of Amsterdam, one could state that the municipality used the data for having a stronger position in the network. This means that building owners need to involve the municipality for their knowledge.

In all the cases, except the Amsterdam case, the municipality has the role of coordinator. This means that they initiated the Master plan. In all cases the municipality also designed the Master plan, where in the Copenhagen case it could be noticed that other actors were not satisfied by the plan because they got involved after the plan was designed.

In the Grand Lyon case there was a strong division between the city district coordinating the development and a small department responsible for implementing energy efficient solutions. This led to a lack of alignment and a diffuse management strategy.

In two cases, Amsterdam and Copenhagen, a voluntary agreement is made to work towards higher levels of sustainability. In the case of Amsterdam it became unclear who will lead the development after one designed or thought about the desired solutions for the area.

Bottlenecks: management, implementation strategy

Aligning interests and ideas from other actors was mentioned as a great problem. Having early dialogues with actors was experienced as a good step, but had a wrong timing. Most actors felt like they could not influence the Master plan with their ideas.

In most cases the municipality had the role of coordinator, but did not have the means or resources to invest in the project. This gives the municipality a weak position and questions whether private parties should not take the lead in implementing energy efficient solutions.

What could be seen in the Grand Lyon case is the novelty of working with private, para-public or public actors. This is paired with uncertainty on the success of this new management strategy.

Because implementing energy efficient solutions is rather new in urban development, there is uncertainty on its success. This also resulted in doubting actors and less implementation. There is a big need of confirming data or models that show that the chosen technology will result in a successful implementation.

In most cases it was difficult to steer and coordinate on energy efficiency, because it was added to the program of the Master plan after it got designed.

7.7 Actor

This paragraph contains an analysis of the bottlenecks found on actors in the case study and a thorough analysis of all the actors with the concepts of the theoretical framework. It considers the following steps from the table below:

Table 20 Step by step plan to analyse actors in a process (Koppenjan & Klijn, 2004; de Bruijn & ten Heuvelhof, 2009)

1.	Actors in relation to the phases	Identify all actors that will be or were active in the process.
2.	Actor information	An indication of each actor's problem perception, individual goals and available resources.
3.	General interests and norms	Identify the general interest and norm of concerning actors.

4.	Create network structure	Make a schematic overview of the relation of each actor by their common interest.
5.	Create a power interest grid	Place actors in the grid by their interest and power and identify their position (subject, players, context setters or crowd).
6.	Create support and opposition grid	Place actors in the grid by their attitude towards the problem; support or oppose, compared to their power.
7.	Identify actor's dependency	Place actors in the grid by their replace ability and importance.

The actor analysis is based on the case study, and tries to make a more general answer to the question that are raised in the research method.

Actors in relation to the process and actor information

From all cases several actors can be identified from the public sector, private sector or the civic societies (Franzen et. al., 2011). These actors have different responsibilities and are involved in a different matter in each case.

Public actors

From the case studies different public actors are identified. In all cases the municipality of the city is involved in de development or project. Noticeable are the different positions of each municipality.

Table 21 Identified public actors from case study

Public sector	General description and role in process
1. Higher governmental bodies	Central government, city ministry, investor, policy maker and initiator
2. Municipalities	Executer, coordinator, designer, (sometimes) investor
3. Departments of municipalities	(Sometimes) executer or coordinator, informer
4. Governmental owned utility companies	Energy provider
5. Housing associations	Social housing provider

Higher governmental bodies have the ambition to go towards energy transition but do not have enough resources to do so. The problem of moving towards implementing energy efficient solutions is seen as a big problem, which results in setting big goals worldwide.
These higher governmental bodies impose municipalities to coordinate and execute

action towards implementing energy efficient solutions, by the higher governmental bodies' ambitions and policies. Municipalities do not have enough resources to implement. Municipalities have a general goal of creating a liveable environment for its inhabitants, which has common ground with using renewable energy and creating a low carbon city.

In some cases departments within municipalities have the same role as municipalities in general, where they act as coordinator and executer of the high ambition of higher governmental bodies. Further, in some cases different departments have to collaborate to create an integral plan of the whole implementation plan. Housing associations are not greatly mentioned in the cases, but also play a role in the implementation of energy efficient solutions. In most of the municipal structure there is also a department for research and investments.

As described in the case study, some governments own or partly own the utility company. This gives them a stronger position compared to the situation when the utility company is from the private sector and do not have a strong connection to the municipality but are more solely focused on making profit.

Housing associations are bound to a specific financial framework (for example, the housing must be affordable for a low income households) and some policies (for example, certain amount of tenants must agree to redevelopment plan). This makes this actors more restricted than for example building owners.

Private actors

Other actors that can be identified are from the private sector. These actors are in most cases are investors or owners of what needs to be adjusted for the implementation of energy efficient solutions, such as the heating network or the building itself.

Table 22 Identified private actors from case study

Private sector	General description and role in process
6. Investors	Financer
7. Developers	Builder, developer
8. Network owners	Owner network, investor
9. Utility companies	Energy provider
10. Researchers	Informer, researcher, innovator
11. Building owners	Owner building, investor

Financers and developers have no means or interest to work on energy efficient solutions, because of several reasons. First, the business case of implementing energy efficient solutions is not sound. Their system to calculate the return is based on short term investments with a return within five or ten years. This is no match to energy efficient solutions, such as heat grids, where it considers a long term investment with

a payback time around thirty years. This is nowadays too deceptive for private parties, which results in a lack of interest in investing on such solutions.

Also network owners or utility companies seem to act based on making profit, where energy efficient solutions result in less profit compared to the current energy system. Their position is a little different when these parties are part of the government, in the case of Grand Lyon and Copenhagen. The government can dictate these private parties to move towards energy efficiency in the urban areas that need to be developed.

In all cases researchers are involved, especially on the topic of big data. In all cases there is a lack of information, necessary to calculate different scenarios and make a thorough decision. This big data comes from municipalities and energy providers. Researchers are then asked to create models or calculate the best solution for the area in question.

Building owners are, at times, interested in making their building more energy efficient, but do not have the information on which solution could be the best. Likewise they have a lack of interest due to no sound business case.

Civic societies

In most of the cases users are not mentioned or active in the process towards implementation of energy efficient solutions. In most cases the project considers a newly built area, where no users are yet in the picture. In some cases building owners have been reached to discuss and elaborate on the different solutions. In some cases this way of working is unusual and very new.

Table 23 Identified civic actors from case study

Civic sector	General description and role in process
12. Civilians	Inhabitant, renter or owner building

Civilians want to live in a dwelling that uses as less energy as possible, but with the minimal investments or interference on the building and surrounding. Not always it is clear to them what they can do and how they can move to a more energy efficient dwelling.

Involving citizens can be seen as a more bottom-up approach. In all cases the coordinating or managing actor uses a top-down approach.

Informing or activating citizens is also very under exposed in each case. Activating citizens on the usage of the energy efficient solutions is very important, because the user also influence the amount of energy used in each building.

Power and interest grid

Before a power and interest grid can be made, all actors are listed and numbered that match the numbers in the power and interest grid, the support and opposition grid and the actor's dependency grid.

Table 24 Numbering of actors identified from case study

Number	Actor
1.	Higher governmental bodies
2.	Municipalities
3.	Departments of municipalities
4.	Governmental owned utility companies
5.	Housing associations
6.	Investors
7.	Developers
8.	Network owners
9.	Utility companies
10.	Researchers
11.	Building owners
12.	Civilians

From all case studies a general categorisation can be made. An explanation of the whole table can be found in the appendix.

Table 25 Generalisation of the positions of actors (own table)[4]

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Inter-dependence (+, +/-, -)
1. Higher governmental bodies	+	+	+/-	-	+
2. Municipalities	+/-	+	+/-	+/-	+
3. Departments of municipalities	+/-	+	-	+/-	+
4. Governmental owned utility companies	+/-	+	+/-	+/-	+

[4] See appendix for full explanation of analysis

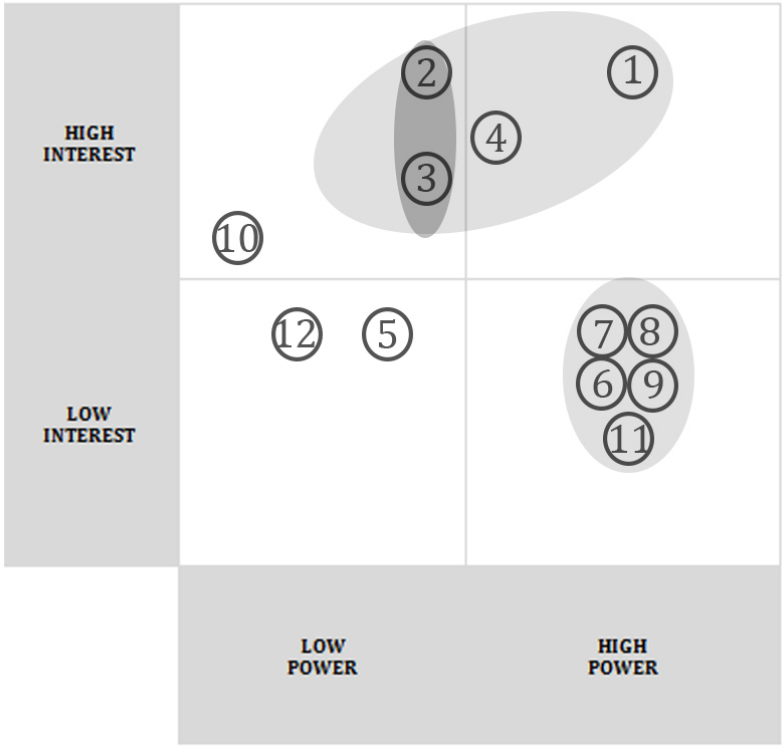
5. Housing associations	-	+/-	+/-	-	+/-
6. Investors	+	-	+	-	-
7. Developers	+	+/-	+	-	-
8. Network owners	+	+/-	+	+/-	+/-
9. Utility companies	+	-	+	+/-	+/-
10. Researchers	-	+/-	-	+	-
11. Building owners	+	-	+/-	-	+/-
12. Civilians	-	+/-	-	-	-

Legend table: (+ = high, +/- = moderate, -=low)

This table is input for the follow products, the power and interest grid, power and support/opposition grid and actor's dependency grid. An explanation of the whole table can be found in the appendix.

Power interest grid

Table 26 Power and interest grid created from information of the case study



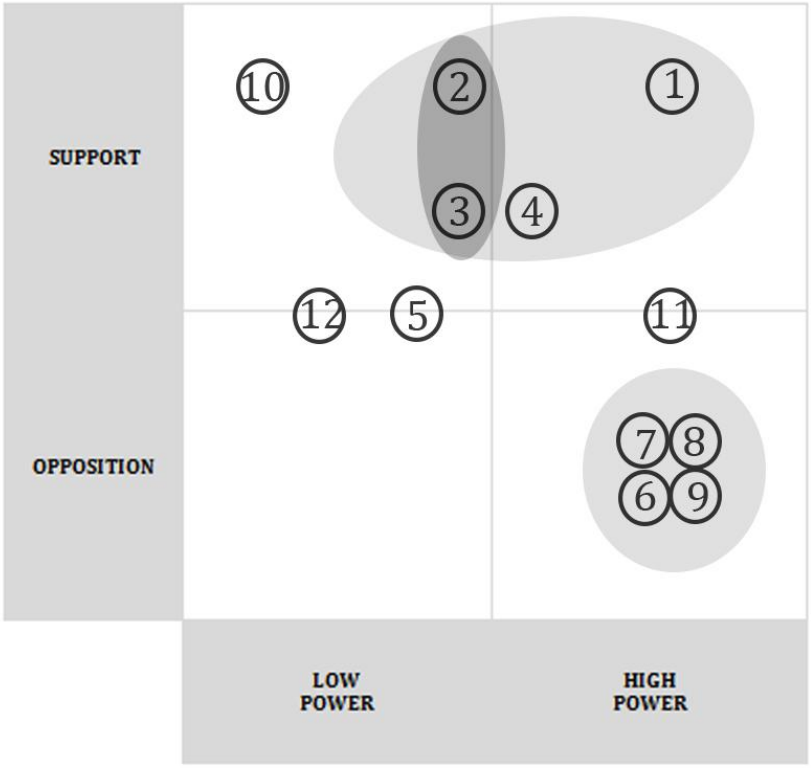
What can be seen in the interest power grid is that the governmental actors all have the most interest in implementing energy efficient solutions. Municipalities and their departments have less power than the central government. In all cases municipalities share the goal of working on energy efficiency by the imposition of central governments.

Researchers, civilians and housing associations stay on a low profile, where they are a little interested but also have little power.

Important is to notice the position of all private sector actors which have power by resources, but have a lack of interest due to unclear business cases and no integral planning.

Support and opposition grid

Table 27 Support and opposition grid created from information of the case study



The grid is comparable to the power and interest grid, because the Y-unit stays the same: power.

In the grid above you can clearly see three different clusters of actors. First the governmental is the biggest supporter of implementing energy efficient solutions in the built environment. Within the governmental bodies there is a differentiation between the municipalities and departments and central government. The central government has more power.

Actors with a neutral attitude are housing associations, building owners and civilians, where it is not clear to them how they could contribute to implementing energy efficient solutions.

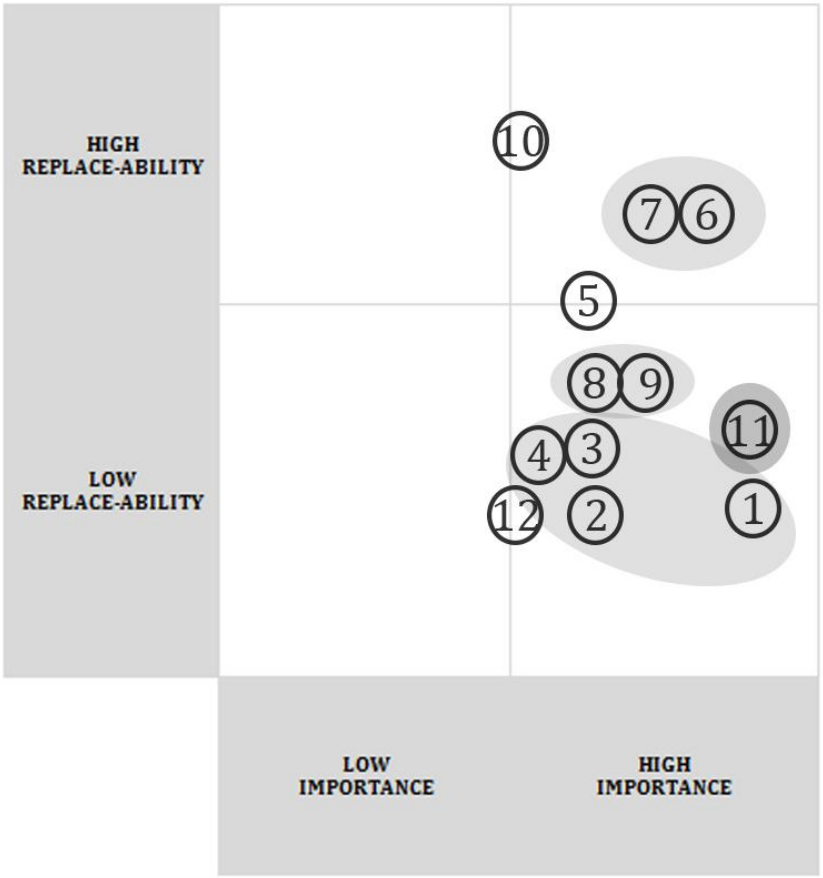
A clear distinction is seen at the cluster of private actors, who are opposing the process because it could cut in the current profits they are making. They are also opposing because they no means whatsoever to invest in higher quality buildings, as it had no benefits for them.

Change position

From the diagram it is clear that the private actors should change position, because their importance in the process; you cannot implement without them. This means that the manager or coordinator of the process should find a way of aligning the private parties. This could mean trade-offs or giving those actors something in another problem, which they are dealing with. On the other hand there is the solution of not collaborating with the actors and finding new ways of financing.

Actor's dependency grid

Table 28 Actor's dependency grid created from information of the case study



In table 28 you see that all identified actors are important to the process. Again the governmental bodies have a high dependency, because they are important and irreplaceable.

Interesting is the position of the building owners, which have also a high dependency, because they are the ones that need to allow the implementations on their building. If you do not have the owners on board, the process is going nowhere.

Finally the investors and developers have an interesting position, where they are replaceable. Interesting is that even though they are replaceable, the attitude of those actors is to act within the policies set by the government. This means that not many investors and developers are willing to act out of the boundaries set by the policies. So even though investors and developers are replaceable, they are not many with the right attitude.

CONCLUSION

8. CONCLUSION

The process of implementing energy efficient solutions, or energy transition, is established. Then all bottlenecks are identified from the cases, categorised in the different fields. Below a table is provided with the overview from chapter 7.

Table 29 dentified bottlenecks from the cases

Field	Bottleneck
Political and institutional context	• Driving force to work on implementing energy efficient solutions comes from high governmental body (EU), which is not (always) shared on municipal level. • Setting a too ambitious goal by governmental bodies. • No support from higher governmental bodies with law on energy transition. • Change in institutional context causes less local formal power, leading to no action.
Policies, legal and financial framework	• No support from higher governmental bodies with law on energy transition. • Lack of or no policies on implementing energy efficient solutions. • High prizes of land combined with the financial crisis, make it hard to find financial means for investing in energy efficiency. • Change of ownership, resulting in higher expectations from the national government on the developments. • Municipality has no budget on implementing, only human resources to invest in the process. • Only financial support on local level. • Lack of a clear business case for implementing energy efficient solutions.
Management, implementation strategy	• Difficulties on finding and creating data for decision making process. Lack of information to make decisions on the development process. • Coordinator focuses on gathering data, which can support investors and gives the coordinator stronger position. Because it is difficult to gather data, no further steps are taken. • Small departments of municipality are responsible for implementing energy efficiency, where the whole development is coordinated by great governmental body. • Project management approach is quite novel, public authority owns public installations and a few sites and has to work with private, para-public and public actors.

	• Lack of internal alignment. • Integrating early dialogues into the project is found difficult. • Very experimental on implementing energy efficient solutions.
Actors	• Municipality can only function as an initiator and accelerator of the process. The municipality is highly dependent on all the other actors. • Unclear role of who will lead after setting up a partnership. • Because of lack of any commitment of the building owners and businesses, no actual action towards an implementation plan is taken. • Normally the municipality does not communicate with the developers. • The actual initiators and governmental bodies of the project have fewer resources to invest in the whole project. • The municipality controls only a minor part of energy consumption in the city. • Developers have no incentive on developing high quality buildings, with a high score on sustainable certifications. • Municipality has to act non-traditional; collaborating with building owners. • Developers and building owners are not convinced investing in implementing energy efficient solution is worthwhile.

It is then possible to answer the main question of this research:

"How is the process of energy transition in European cities, obstructed by its political and institutional context, policies, management and actors, and how can actors influence the process to overcome these bottlenecks?"

This will be done by first describing the general phases of the process. This research will then generalise on the different bottlenecks that are identified from the cases. This will lead to several bottlenecks that are identified as bottlenecks that influence the process the most. Because they or have occurred in all cases or because most of the actors are involved with the bottleneck. These bottlenecks will be used for a network analysis.

The process of implementing energy efficient solutions

Energy transition is a transition of fossil fuel towards renewable energy. Sustainable urban development are several movements with one goal; creating a better quality of living by implementing and planning sustainable solutions in the built environment.

These sustainable solutions could be energy efficient solutions, such as the use of renewable energy. Because of the complexity of current innovative solutions, cities tend to research the most suitable solutions to implement in the area. This will result in a different process compared to the urban area development process in general: first gathering big data and then analysing it with, for example a decision model, consumes a lot of the process to implementing energy efficient solutions.

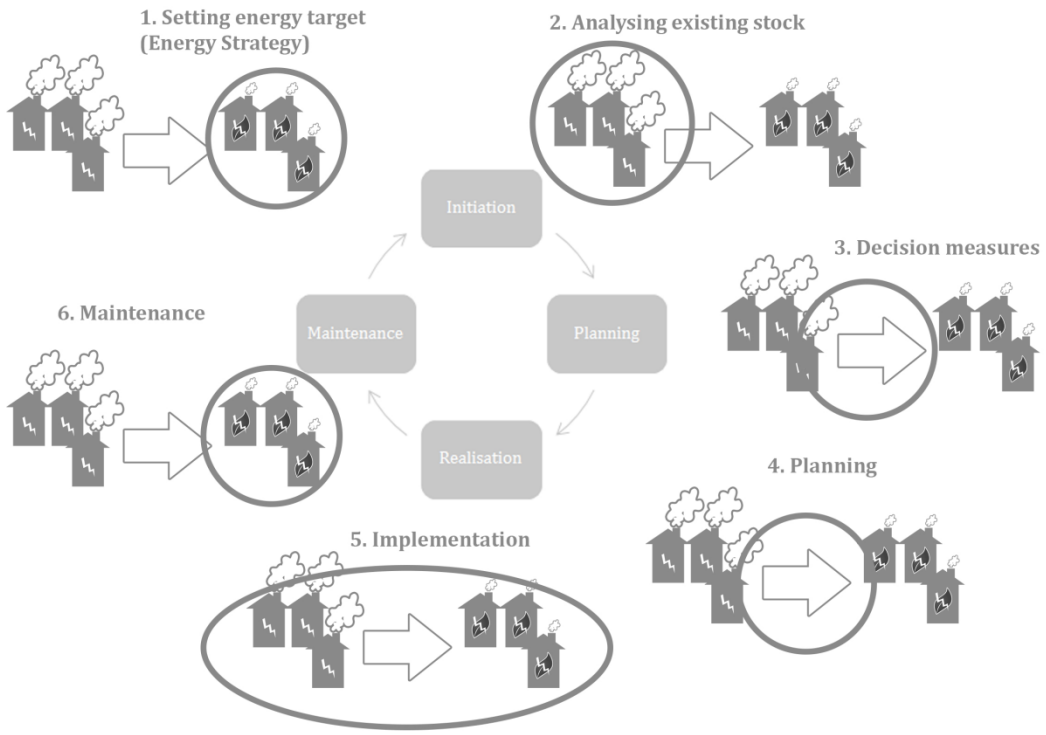


Figure 17 Phases in transforming existing stock towards usage of renewable energy and energy efficiency (own ill.)

The process starts with the ambition or plan from the higher governmental bodies that sets a new energy target. This could be using 20% more renewable energy compared to a certain time, but also doubling the netto floor area in combination with preserving the total use of energy in that area.

Then data is gathered or created of the specific area, with numbers that indicate for example the energy use, or date of construction. This big data is used as input to make a decision on the best applicable energy efficient solutions. Most actors think this step is most important, since it results in specific and elaborated result. This is also why some actors design and create a decision support tool, which calculates scenarios with different trends and current trends. This data gathering and analysing can be seen as part of the planning phase.

This will eventually result in deciding what to implement. That follows with the phase of planning the implementation. The development is planned in phases with different sub-projects that can be for example the implementation of a heat grid or building certain buildings in certain areas.

After building the area there is a phase of maintenance. Because in all cases this phase has not been reached, not many information in found on the characteristics of this phase.

Bottlenecks

In the research many bottlenecks have been identified. From literature several overall, general bottlenecks have been identified. In the case study bottlenecks have been filtered can be compared to the bottlenecks in literature. Eventually this will lead to the bottlenecks that influence the process the most, because or they occur in all cases or most of actors are involved in the bottleneck.

Political, institutional context

Firstly it is noticeable that the driving force to implement energy efficient solutions flows from higher governmental bodies all the way to local level. If this driving force from above is missing, one could state that no or little action is taken to move towards energy transition.

Also, it was found hard to act different from the 'normal' institutional context, because of its rigid nature. Not following certain procedures, collaborating with non-traditional actors and finding new ways to fund the process are found hard by the governmental actors.

Finally, when the political and institutional context changes it creates a bottleneck to the process of implementing energy efficient solutions. When new members of the parliament or city council are chosen new goals are set and old goals can be put aside instantly. Contributing to energy transition is not a common goal of all politicians or all governments in Europe.

- **Higher governmental bodies need to acknowledge the importance of implementing energy efficient solutions and instigate the movement.**
- **The institutional context of municipalities and governmental bodies is rigid and not flexible to the inconstant environment of energy efficient solutions.**
- **The political and institutional context yet is not designed to always have implementing energy efficient solutions on the agenda.**

Policies, legal and financial framework

On the topic of policies it is marked that not many policies exist on implementing energy efficient solutions. Cities with old policies on energy efficient solutions, such as Copenhagen, are much further in the process of energy transition. This means that other cities should also put sustainability higher on the agenda and be more forceful on creating policies on implementing sustainable solutions. In the cases it was noteworthy there was a lack of policies on sustainability in the built environment. Reason for this can be found in the novelty of this problem and lack of information on what is the right thing to do.

There is a lack of laws on implementing energy efficient solutions, which results in hesitation of taking action from, for example, private actors. Also support from higher governmental bodies is missing.

Secondly, all actors, minimally, act upon stated laws that for example state the quality of the buildings or the usage of heat grids. Without laws from above no or little action

is taken by actors. It is possible to say that actors are not willingly to move towards energy efficiency only from their interest in creating a more sustainable urban area.

Because most private sector actors are driven by making profit, this bottleneck is one of the biggest: no sound business case. So far there is no profit or even loss for these actors when it comes to implementing energy efficient solutions. This results in private actors not willing to contribute to the process of energy transition. Why contribute when it results in a loss?

Also actors tend not to think in a different financial framework and prefer short term investments with quick returns. This is not the case for implementing energy efficient solutions. This leads into difficulties on persuading investors and developers to invest in energy efficient solutions.

- **Not many, or unclear, policies exist on implementing energy efficient solutions, because it is a quite novel movement.**
- **Without laws no or little action is taken by actors: implementing energy solutions is not a standard objective of private actors.**
- **The business case of implementing energy efficient solutions is not sound.**
- **With implementing energy efficient solutions, also a new financial framework and mind set is necessary. Most actors tend to think traditionally and in the old framework.**

Management

Bottlenecks in management are highlighted by "we do not know how". The actors that are assigned the task to coordinating implementing energy efficient solutions tend to tackle the problems from their traditional position in the network of actors. In all cases the task of coordination laid in the hands of governmental bodies, and in most cases they had to work differently compared to their central, traditional role in the process as coordinator, informer, but also investor. In the case of Amsterdam the management tried to accomplish their goals by setting a different goal: collaboration. What can be noticed is that because of these new ways of working, the management strategy is characterised with trial and error. This eventually results in less or a lack of action towards energy transition in the built environment.

What can also be noticed is the lack of alignment. Early dialogues as management strategy have been found effective, but still many objectives of other actors are not incorporated with the redevelopment plans of cities. This leads to a lack of commitment to the process and eventually less action towards implementing energy efficient solutions.

- **Municipalities or higher governmental bodies that coordinate implementing energy efficient solutions in urban (re-)development do not know well how to act differently from their traditional, high hierarchal position.**
- **There is a lack of aligning the objectives of other, important, actors with the (re-)development of urban areas, considering implementing energy efficient solutions.**

Actors

Various actors have been identified in the process and have been analysed through a thorough actor analysis and strategy analyses. This resulted in their position within the process and how they are related to the bottlenecks.

From the grids one could conclude that private actors should be more aligned in the process of implementing energy efficient solutions. This does not only mean involving them more in the process but also give them a different position in the process. Below the main findings:

Change position; private parties more interested

Obviously it is important to change the position of the private actor cluster, where they should become more interested in the problem. This could be done by changing or broadening the problem statement of implementing energy efficient solutions, so that they could be interested in solving the problem. Also new types or ways of financing could be thought of and have a more collaborative approach.

Change position; opposing private parties

From the diagram it is clear that the private actors should change position, because their importance in the process; you cannot implement without them. This means that the manager or coordinator of the process should find a way of aligning the private parties. This could mean trade-offs or giving those actors something in another problem, which they are dealing with. On the other hand there is the solution of not collaborating with the actors and finding new ways of financing.

Actor network diagram

Below an actor network diagram that shows the relation between actors, based on the information found in the case study. The relations are shown to the most common bottlenecks from all the six cases in the case study. This is done to show the complex and interdependent nature of the whole process of moving towards implementing more energy efficient solutions.

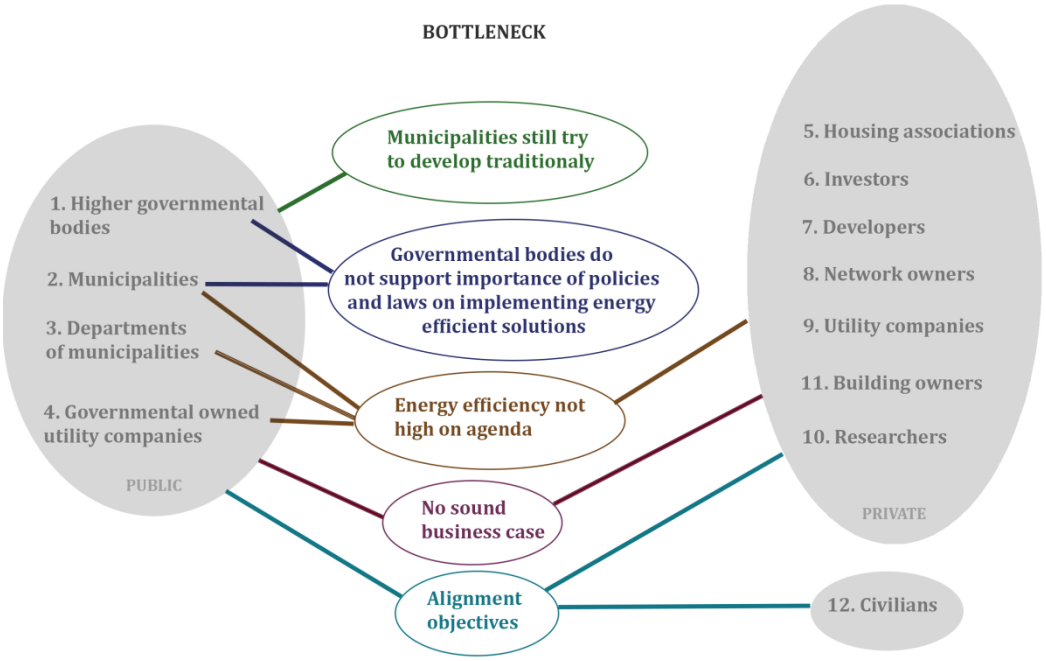


Figure 18 Network diagram in relation to bottlenecks (own ill.)

The figure above shows the relation between the bottlenecks and the actors. From a process managerial point of view, this could also be the starting point of aligning problems or bottlenecks to each other. This means that by aligning and combining bottlenecks together, one actor, the municipality for example, could help out the other actor, building owners for example. In another case it could be the other way around. The whole idea behind process management is to get as much actors around the table by stating a problem, in which all of them are interested and feel motivated to solve.

Municipalities still try to coordinate and plan traditionally

Public bodies try to have a very high hierarchal position in urban development, where this position changed into a network diagram. From the cases it is seen that all the municipalities are still searching for a new way of managing or coordinating. This means that they have to have a different attitude towards the process and be less directing which they were. This could eventually also mean leaving implementing energy efficient solutions to private parties, instead of trying to implement it themselves or a combination of them both where one could think of a public- private partnership.

Governmental bodies do not support importance of policies and laws on implementing energy efficient solutions

To give the market a harder push, higher governmental bodies need to understand the importance of implementing energy efficient solutions and start working towards endorsing laws on building energy efficient. In order to achieve their ambitious goals they need to develop regulations and laws. Private parties tend to move only within political context and do not think outside of this context in all the cases. Doing something on energy efficiency is considered something extra and not something by default. Higher governmental bodies have this power by stating laws, but before it is possible to establish a law, these bodies need to acknowledge the importance of implementing energy efficient solutions in the built environment. And the influence it will have on our world and human mankind.

Energy efficiency is not high on agenda

When higher governmental bodies do acknowledge the importance of implementing energy efficient solutions, also the other public bodies should act upon taking action. This means that created policies from municipalities and departments of municipalities should consider new ways of coordinating and managing and give more emphasis on the importance of energy efficiency by putting it high on the agenda. This will give more movement, because it is a movement through the whole public body that is involved with implementing energy efficient solutions in large urban areas.

Energy efficiency is also not high on the agenda of private actors. Mostly because the objective of private parties is not putted in the plan, it is most of the times added after designing the plan. Citizens have energy low on the agenda, because they are not optimally involved and have little knowledge on what to do or how.

No sound business case

The private actors should change their attitude towards financing the implementation of energy efficient solutions. Currently they think in short term investments with

short pay-back times, which is not the case with energy efficient solutions. These solutions require a long term investment and result in a long pay-back time. This is also related to the current energy market with small margins and not a lot of risks. It is simply too expensive to invest in other energy markets than the fossil fuel market. Ones the context of the fossil fuel market changes, for example less import of fossil fuels from abroad, the market of renewable energy become more attractive. So if the old market dies to change, the new market is able to get born. Unfortunately is the old market that rigid, constant and steady that not much can be done by all the actors.

Align objectives

All actors should try and align objectives, by thinking more collaborative and less traditional. This could be the possibility of new types of partnerships or companies that combine and align all the different actors that are active in implementing energy efficient solutions. In this way resources, power and information or knowledge can be shared and used to create a better living environment for all of us.

8. REFLECTION

This chapter will cover a detailed reflection on the research subject, research design and methodology, the cases, the synthesis and the conclusion.

8.1 Research subject

As this research developed over a year, the topic of sustainable development, implementing energy efficient solutions in large areas is still a very current topic and still moving slowly towards more progress. What is noticeable is a larger stress on the subject of circular economy, which is the process of re-using materials. In some theories energy efficiency or re-using energy is also considered circular economy, where this thesis considered it as a different movement.

Still, little action is taken towards implementing energy efficient solutions on a large scale. It is visible that more and more individual projects on implementing energy efficient solutions are taking place and more implementations occur on the scale of one or a few buildings. This means that new information is created on implementing those solutions. If this information can be used on a larger scale is difficult to tell, because the process is far more complex compared to the individual scale.

Interesting would be further research on the idea of the creation of a company or partnership that is specifically founded with the purpose of accelerating the process of implementing energy efficient solutions. This could be the design of the partnership or the company and the tasks and positions of the actors. Also, one could research more the way of collaborating and how actors should act upon each other.

8.2 Research design and methodology

This research has been designed as a qualitative research because the subject is new and not well founded in literature. Eventually a qualitative research was best, as it becomes very complex, difficult and almost impossible to quantify topics such processes, actor involvement and bottlenecks in processes.

The methodology was mostly focused on urban (re-)development and process management. Eventually it led to a very broad elaborated research, but other methodologies needed to be used could be more detailed. Again this also refers to wanting to state something about different cities in Europe, and a more broad methodology focusing on policies for example is logical. Deepening the research by more coverage on transition management or energy management or systems, could contribute to the result of this research.

The research could have had more interviews, where more detailed information on each actor could be covered. This would have also meant more time in the thesis and processing all these interviews.

8.3 Cases

The research was designed to cover European cities, where the cases of the project "TRANSFORM" have been used.

Firstly, the cities that participated in the project and also cover the case study have been selected because of their innovative and sustainable character. This means that all cities have in some sort of way the objective to do something with sustainable development. This attitude was typical of these cities, but not for all the other cities of Europe. This means that found bottlenecks only apply on those cities in Europe that are far in sustainable development and find sustainable development important.

Secondly the case study only used information provided from the project. This means that maybe other actors could have had important information that could be used as input for the research.

Also, because I was involved with TRANSFORM it was very difficult to keep my own personal view on the matter out of sight. Difficulties had been found on keeping the case study as objective and professional as possible, while have been involved with all the processes.

Finally, a cut was made from the original cases from five cases to three. This cut was made, because of the amount of time in relation to the amount of information that was needed for this research. If there was more time, all five cases could have been used for this research. Information would have been more detailed, but because the cases were included in broad outline, no information was missed to give a full and well elaborated broad conclusion.

8.4 Synthesis

The synthesis was combining the concepts from the theoretical framework with the case study and find results.

Combining one and another was difficult because not much theory could be found on energy transition in the built environment. When theory was found, it was mostly written from the view of public actors.

The results from the synthesis are very broad and widely statements on the information found from the literature study and the case study. It was very difficult to be very specific, because the information used on the case study and literature review was also very broad not extremely specific. Eventually this does not mean a lack of quality of the result, but a lack of preciseness of the result.

8.5 Conclusion

This research was concluded by answering the main research question. At first, the main research question was specific and would tackle the problem of not enough movement towards energy transition. Now after the research one could say the research question is not as specific enough to really contribute to accelerating the process of implementing energy efficient solutions. Eventually the answer or solution is more a very thorough statement on the state of the art and describes the relation of the actors towards the state of the art. This means that no practical steps or models are provided by this research that can actually be used by actors. This is in

contradiction with my personal interests, where I am more motivated by doing instead of elaborating a phenomenon. This means that more action towards implementing energy efficient solutions can be instigated by actively confronting the actors on the results of my research.

Again, also the conclusion reflects an interpretation of the theory from the perspective of the reader and analyst of the case studies. This means that to be more precise or revise these conclusions one should conduct a research with more depth. This could be done by letting all actors make the actor analysis themselves and compare the results with one and another.

Finally, the field of implementing energy transition is changing, slowly, but this also means that the context has changed. Of course this changeable behaviour is taken into account in this research, but it does mean that some conclusion could be out-dated. For example, higher governmental bodies could already have established new laws on energy efficiency. Or partnerships have been already established.

8.6 Theory vs. Practice

Finding the right theory that matches the main research question was very difficult. The topic is quite novel and theories are not that well developed yet. Also the topic is very complex, because different fields are brought together in the problem. This means that many theories were found on the individual topics, but bringing fields like urban development management, transition management and process management together in literature is novel and not easy to find. I noticed this while working on the theoretical framework and found it very difficult to related one to another.

Gathering practical information was not difficult, but how to process that information was very difficult. It means you have to define, with theory and common sense, how to deal with all the information from the cases. To my opinion it was very difficult to define what information should and what information should not be part of this research.

It is difficult to compare theory with practice, because the bottlenecks found in practice reflect a state of the art of this decennium. Theory is broader and more timeless.

8.7 Further research

Research on the process of energy transition in the built environment is as described in this chapter very novel. Topics as sustainability are becoming more and more important, and also literature on sustainability is growing.

Further research should focus on the bottlenecks that are found in this research. What can actors do more specifically to overcome these bottlenecks and are there cases that provide solutions. During this research more development has taken place on implementing energy efficient solutions.

Most interesting and important bottleneck to research further is the business model of implementing energy efficient solutions. How can you make the business model sound or what do actors need to agree upon to make the business model sound?

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APPENDIX

Categorising actors

This text explains how the actors are categorised and positioned regarding their power, interest, resources, information and interdependence.

Copenhagen; Nordhavn

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Interdependence (+, +/-, -)
City of Copenhagen	+/-	+	-	+/-	+
CCPD (Copenhagen City & Port Development)	+/-	+	-	+/-	+
HOFOR, Greater Utility of Copenhagen	+/-	+	+/-	+	+
DONG	+/-	+/-	+/-	+/-	+
Developers	+	-	+	-	-
Citizen	-	+/-	+/-	-	-

The City of Copenhagen or the municipality of Copenhagen has a moderate power, because the financial means of the municipality are low, due to high prizes on land combined with the financial crisis in Denmark. Also, they have decision power. The municipality is highly interested in the development, because of the general goal of creating a better environment for its citizens. The municipality is also interested because they are assigned with the task from higher governmental bodies to invest and work on energy efficiency. This is related to the goal of 2020, but also the goal of the city itself of becoming energy neutral in 2050. The municipality has moderate resources, because of high land prizes and the financial crisis. The municipality of Copenhagen is categorised with moderate information, because they are the owner of all the information of the design and master plan, but lack information on data on energy efficient implementation. That is imposed to HOFOR in combination with

DONG. The municipality has become dependent to other actors, because of its lack in information and resources.

Because the CCPD is part of the municipality they share the same power, interests, resources, information and interdependence. The CCPD has moderate power in the implementation, because they own parts of the area (mostly underground). The CCPD has high interest on developing the area, because the CCPD owns it. Interests in developing it with sustainable aspects, comes from the higher goal assigned by higher governmental bodies. Also, just as the municipality of Copenhagen, the CCPD is dependent on other actors. It is impossible to act and develop without other actors.

HOFOR has moderate power, because HOFOR has the responsibility of proposing a plan for energy supply. Though, the municipality has the power to overthrow their ideas. HOFOR has high interest in implementing energy efficient solutions, because HOFOR proposes for the supply of energy. Because of laws and the goals set by the municipality, HOFOR has interest in sustainable development; they must meet the goal of the municipality. With moderate resources, HOFOR is responsible for the supply for water, district heating, gas and district cooling. HOFOR has high information, because HOFOR is the supplier and therefore owns the data. HOFOR also owns their own decision making model, that calculates scenarios and gives output on the best possible solution. Because HOFOR is part of Greater Copenhagen, HOFOR is dependent on other actors, such as the municipality.

DONG is the owner and supplier of electricity, and has moderate power. The municipalities proposed a Master plan based on the use of electricity, which gives DONG power. But, it is HOFOR and the municipality that design and decide on the type of energy used in the development. DONG has moderate resources and information, but is dependent on other actors. The municipality decides on which implementation is used for the area.

Potential developers of the area have a high power, because an area does not get developed without developers. But, developers are not interested in investing in sustainable solutions, because it has no benefits to their opinion. Developers have resources to invest, but are not interested because the development requires a longer payback time. Developers have a lack of information on the best solution, but also the financial business model. Developers are not dependent on other actors; they have the opportunity to invest in traditional developments that not require a long pay-back time.

Citizens are the underdog in this network. Citizens have no or little power. They are involved in an early dialogue, but this is not done with future residents. Citizens do have moderate interest in energy efficiency, because it relates to how much they have to pay for energy. Citizens do not know well what the best option is for energy efficiency or how they can influence the process. Citizens are not dependent on other actors.

Grand Lyon; Part-Dieu district

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Inter-dependence (+, +/-, -)
Greater Lyon	+	+/-	+/-	-	+
Part-Dieu Commission	+	+/-	+/-	-	+
The Energy Commission	+/-	+	-	+/-	+
ERDF	+/-	+/-	+/-	+/-	+
Heating and cooling network operator	+	+/-	+	-	-
Real Estate Developers	+/-	+/-	+	-	-
Owners/Occupiers of the office buildings Part-Dieu (Club Part-Dieu)	+	+/-	+	-	-

Greater Lyon is the higher governmental body in this urban development, which gives them high power. They have moderate interest in the development of this area, because they first wanted to redevelop Part-Dieu. Later they added the energy target, because they want to meet the 2020 goals. As Greater Lyon they have large decision power. The Part-Dieu Commission is required to report directly to Greater Lyon. Greater Lyon has limited resources on energy efficiency though, because investing in energy efficient buildings is something novel. Greater Lyon has a lack of information; it has no or little data on its building and energy use. Greater Lyon is dependent on its departments and investors.

The Part-Dieu Commission shares the same categorisation as Great Lyon, as it is set up by Greater Lyon and is part of Great Lyon.

The Energy Commission is then a part of the Part-Dieu Commission. Because it is a sub-department, they have less power. The Energy Commission is responsible for reaching the energy target and working on the actual implementation of energy efficient solutions. This makes them highly interested. Because it is a department, they have limited resources. The Energy Commission focuses on gathering data to find the best solutions to implement, but have limited or no data. It was simply never created. The commission is highly dependent on all actors involved. They cannot implement without financers, political power or information.

ERDF, the electricity distribution network manager of 95% of France, has moderate power because it has monopoly on distributing electricity. But electricity is not the only energy source regarding energy efficiency. ERDF is used to think traditionally, where investing and using renewable energy is new. So ERDF is moderate interested in developing the area with renewable energy. ERDF has moderate resources. ERDF owns the electricity grid, so ERDF has all data on energy use. Unfortunately, because a lack of information on the buildings it is impossible to visually link the energy use to the buildings. ERDF is dependent on the decision of the Part-Dieu Commission on the type of energy that will be used in the area.

The heating and cooling network operator have moderate power. When needed, they will provide use of heat and cooling to heat and cool the area. But Greater Lyon decides. This means that the operators are moderately interested. These operators have high resources, but because of the unclear business case they are not interested to invest. They also have a lack of information on the systems that already exist in the area, because it was simply never mapped. Operators are not dependent.

The same can be said about real estate developers. They have moderate power, because they do not decide on the target of the buildings. Real estate developers are not interested in energy efficiency; it is impossible to make profit in a short term. They have high resources though, to invest in the buildings. Real estate developer have little or a lack of information on investing in energy efficiency. Real estate developers are not dependent; they can choose whether to invest in this area or another.

Club Part-Dieu has high power. They are the owners of the building and decide whether they want to invest and take action on making their buildings energy efficient. They are moderate interested, because energy efficiency gives the buildings a higher quality but it means a long-term investment. The building owners do own individual information, but lack in information on the possible implementations and techniques for energy efficiency. Club Part-Dieu is not dependent on other actors, they can choose themselves if they want to invest or not in their buildings.

Amsterdam

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Inter-dependence (+, +/-, -)
The Amsterdam Energy and Climate Office	+/-	+	-	+	+
Amsterdam ArenA	+	+/-	+	-	+/-
AMC Hospital	+	+/-	+	-	+/-
Other building owners (ING, ABN AMRO, ROC,	+	-	+	-	+/-

IKEA, Equinix)

Nuon	+	+/-	+	+/-	-

Working on energy efficiency is initiated by a department of the municipality of Amsterdam. This gives them moderate power; they still need the higher governmental body to approve. The Amsterdam Energy and Climate Office has high interests in implementing energy efficient solution, because they want to meet the 2020 goals. This goal is also shared with the municipality. The office or department has only human resources, so that gives the office low resources. Because they developed the Energy Atlas, the office has high information. They can calculate scenarios with a decision support tool. The office is highly dependent, as it can only initiate collaboration and has no means to actually invest in energy efficiency.

Both building owners, the Amsterdam Arena and the AMC Hospital have high power. They are the building owners and decided on what will happen with their property. Both owners have moderate interest. They have agreed, in the voluntary agreement, to work for a more sustainable area. But both also doubt the added value of investing in energy efficiency. Both actors do have the resources to invest. The owners do not have the right information to make a decision on what is the best possible implementation. They are moderate dependent on other actors, such as the office because their lack of information.

The other building owners have also a high power, because they own the actual buildings. They lack interest because the lack of a sound business case. They are not willing to make a long-term investment. They lack the right information on the best possible implementation and are because of this dependent on other actors.

Nuon, the energy provider and heat and cold supplier has a high power in this project. If the building owners decide to implement a heat grid, they need Nuon. Nuon is moderately interested in investing, because of no sound business case. But because the headquarters is located in the area they are more willingly to collaborate. Nuon has the resources to invest in energy efficiency. Nuon owns a part, other data is partly owned by Alliander and other utility companies. Nuon is not dependent to produce or work on energy efficiency; other actors are dependent on them to collaborate.

Overall categorisation actors

This table is a result of combining the categorisations and positions of actors from the three cases. Below the table an explanation per actor on their position is written.

Actor	Power (+, +/-, -)	Interest (+, +/-, -)	Resources (+, +/-, -)	Information (+, +/-, -)	Inter-dependence (+, +/-, -)
13. Higher governmental bodies	+	+	+/-	-	+
14. Municipalities	+/-	+	+/-	+/-	+
15. Departments of municipalities	+/-	+	-	+/-	+
16. Governmental owned utility companies	+/-	+	+/-	+/-	+
17. Housing associations	-	+/-	+/-	-	+/-
18. Investors	+	-	+	-	-
19. Developers	+	+/-	+	-	-
20. Network owners	+	+/-	+	+/-	+/-
21. Utility companies	+	-	+	+/-	+/-
22. Researchers	-	+/-	-	+	-
23. Building owners	+	-	+/-	-	+/-
24. Civilians	-	+/-	-	-	-

Higher governmental bodies have high power and interests. These actors want to reach their set goals regarding energy efficiency and low carbon cities. They have moderate resources, because investing in energy efficiency is still considered novel. So there are not standard budgets available for energy efficiency. The higher governmental body have a lack in information and they are very dependent on other actors. They need them to achieve their goals.

Municipalities have moderate power, because they have a lack in resources. This is due to high prizes and the financial crisis. Municipalities have a high interest in developing energy efficient, because they also want to achieve their goals. They share the goal with the higher governmental bodies, plus they have also local goals. Municipalities have moderate budget as stated before. Budgets are available, but mostly on local level. Some information is available to municipalities, but information on energy consumption is always missing, unless the municipality own the utility

company. Some data is not useable or never mapped. The municipality is high dependent on other actors.

Departments of municipalities share the same position as municipalities, but they have one difference: departments of municipalities have no or little resources. Mostly they are a novel department with a small budget.

Governmental owned utility companies have moderate power. In most cases these companies not have the power to make the final decision on the type of energy. These utility companies have moderate interest, because investing in implementing energy efficient solutions is not feasible yet. But because they collaborate with the municipality they also want to achieve the municipality's goal. The utility companies have moderate resources to invest. They have moderate information, because data for the decision making process is scattered between different actors. One of these actors can be the governmental owned utility companies. The utility company is dependent on other actors.

Housing associations are little mentioned in the case study, but are mentioned in the theory. Traditionally, housing associations are in a later phase involved. Housing associations have little power, even when the implementation considers a redevelopment. In most cities, residents of the social housing have a high power. Housing associations have moderate interest, because implementing could mean a higher quality of the building which results in a higher rent. But because residents are not that charmed by all the construction work and because of high costs, housing associations are less interested. Housing associations have moderate resources, when they invest everything is calculated back to the renters. Housing associations have little information on the best implementation. Housing associations are dependent on the public actors, because they decide on the type of dwellings in the development plan. They have the final decision on whether to develop or not social housing.

Investors have high power, as they can decided to invest or not in the development. Investors are little interested in the developments, because investing in energy efficiency is not feasible and the objective of investors is to make profit. Investors have high means to invest in sustainable development, but simply do not see the beneficial aspects. Investors have a lack of information on a sound business case or best energy efficient implementation. Investors are not dependent on other actors, they are replaceable.

Developers share the same position as investors, but are a little more interested because they can develop new techniques and create buildings that have a high quality.

Network owners have high power in the development. They have contracts with building owners when it considers a development of an already existing area and have a part of the data for the decision making process. Network owners are moderate interested, because the development could consider a new investment. Though, the investment is not feasible yet. Network owners have the resources to invest. Furthermore, network owners have moderate information and are moderate dependent.

Utility companies share the same position as network owner, but are less interested. The objective of utility companies is to make profit and investing in energy efficiency is not feasible.

Researchers are or companies, universities or departments of the municipality. Researchers have no or little power. They are simply hired or assigned the task to research the implementation and data to give argumentation for other actors in the decision making process. Researchers have moderate interest. Researchers have little resources; they simply analyse and research the development and advice on possible solutions. Researchers have most information. Researchers are not dependent, because it is possible to hire any company or department to research.

Building owners are an overlooked actor. These building owners can be compared to housing associations, but have much more power. They decide on the future of their owned real estate (portfolio). They have low interest, because investing in energy efficiency is not beneficial to them, except for increasing the quality and life span of their building. They also lower their expanses on energy, but this is only long-term. Nowadays most business or financial models are based on short-term investments. Building owners have partly data that is necessary. Building owners have moderate resources. Building owners have little or no information, information on the financial structure is missing. Also information on the best technology to implement is missing. Building owners are moderate dependent, as the municipality has the power to decide against or in favour of the redevelopments of the buildings.

Civilians or citizens are the underdog in these developments. They are considered actors with little power, little resources, information and are not dependent. If citizens have interest in the development, they have minimal means to get involved in the development. In all cases, except Copenhagen, there are no efforts made to involve citizens.