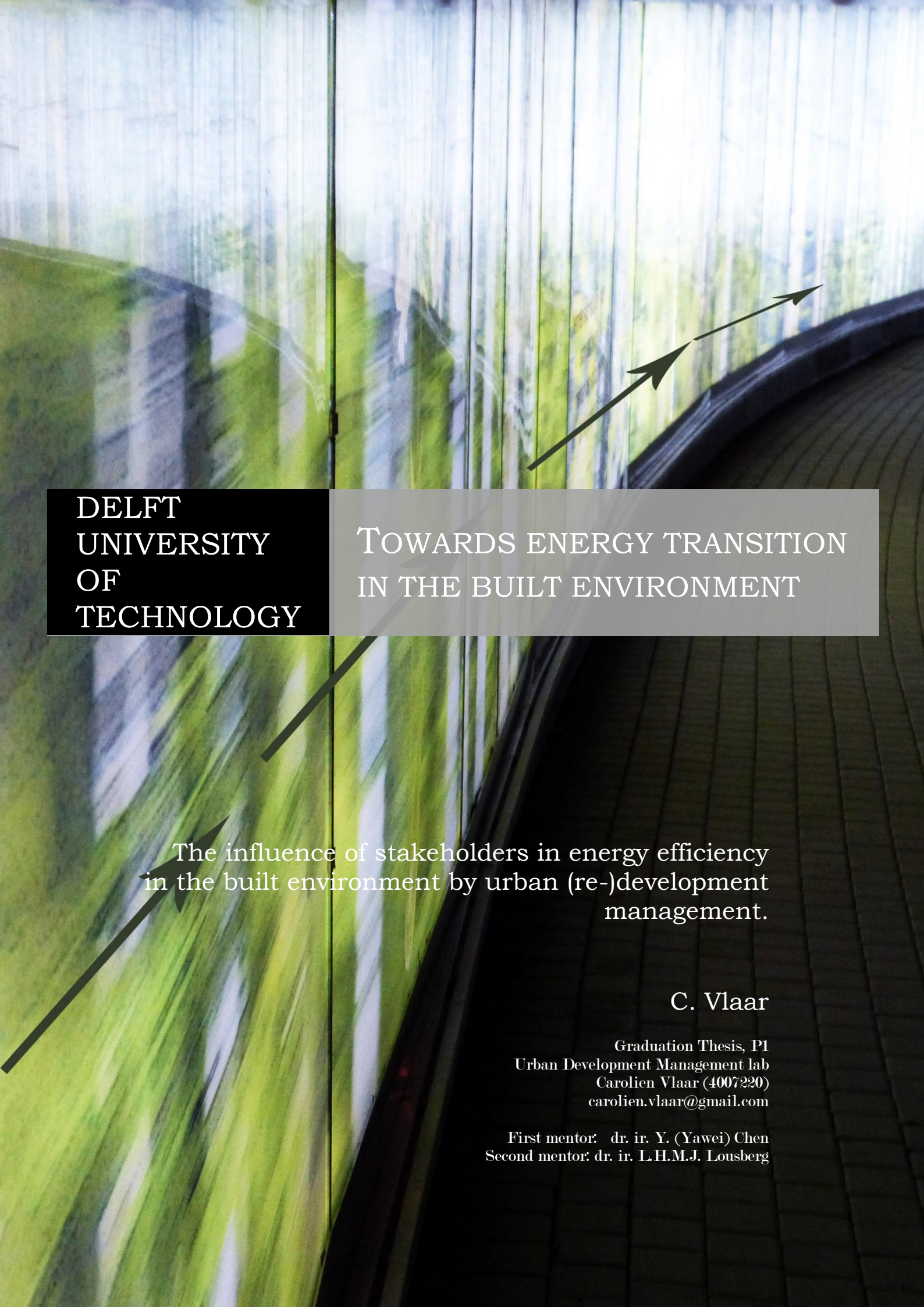

DELFT UNIVERSITY OF TECHNOLOGY

TOWARDS ENERGY TRANSITION IN THE BUILT ENVIRONMENT

The influence of stakeholders in energy efficiency in the built environment by urban (re-)development management.

C. Vlaar

Graduation Thesis, P1
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ABSTRACT

Cities strive to move towards a more sustainable city. In the field of urban energy transition, from fossil fuels towards renewable energy, a lot of difficulties are found, which result in little or no action towards renewable energy. This 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 transition in particular. Focus of this comparison and the solution will also lay on the stakeholders involved. This will be done by qualitative research that includes interviews and observations of the process and actors that took place in cases in European cities.

KEYWORDS

Sutainable development, urban areas, energy transition, stakeholders, process management.

PREFACE

This research is conducted as part of a graduation thesis from the master Real Estate and Housing (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 stakeholders involved in such a process.

During my studies at the Faculty of Architecture I have always been intrigued on the matter of collaborating together, project and process management and the built environment. Naturally, my graduation thesis fits within these fields.

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, management, collaboration in theory and in practice. With this research I try to create new and useful information, which will hopefully influence the current situation in sustainable urban development.

Finally, I would like to thank all those who have helped and supported me while working on this graduation thesis.

Carolien Vlaar

Delft | 2015

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OVERVIEW

Step 1	
GOAL	Comparing theory with practice on the process that tends to go towards the implementation of sustainable solutions in the built environment, focusing on energy transition in particular. Focus of this comparison and the solution will also lay on the stakeholders involved.
PROBLEM	Cities strive to move towards a more sustainable city. In the field of urban energy transition, from fossil fuels towards renewable energy, a lot of difficulties are found, which result in little or no action/ movement towards renewable energy.
Step 2	
MAIN QUESTION	What are the barriers of the process of energy transition in urban areas and how can actors influence this process in theory and in practice?
RELATED QUESTIONS	What are the characteristics of the process of energy transition in the built environment? What are the problems in the process of energy transition in the built environment? How can you overcome these problems regarding to similar processes in urban area development and energy efficiency in theory? Which stakeholders or actors should be involved in energy transition in the built environment and how would they placed in a network (position, power, interests, constraints, resources,)? How should stakeholder intervene with the process of energy transition in the built environment by process management? What are the difference between theory and practice? What are the lessons learned on which practice can benefit?
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RESEARCH	Practice/expert involvement Case studies Qualitative; interviews; observations See conceptual model on page 16.

PROBLEM DEFINITION

1. PROBLEM DEFINITION

1.1 Introduction

Over the past decades have governments 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, which used to be in some cases 30%. 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, 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 buildings need to be designed for using renewable energy or already existent buildings need to adapt 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 sustainable implementation for a typical Dutch row house. The implementation shows that using renewable energy must go hand in hand with reducing energy loss and reusing for example water. After the implementation has the building become energy positive (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 the Prêt-à-Loger, but implementations on a larger scale are hard to find. This while 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 mean 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.

Governments 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?

While (re-)developing areas are several stakeholders or actors involved in an iterative process which starts with an initiative and ends with maintenance. 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 stakeholders in the process of (re-)developing an area that uses renewable energy are bound to collaboration. Collaboration can also bring miscommunication, conflicts and misunderstandings, such as the example below.

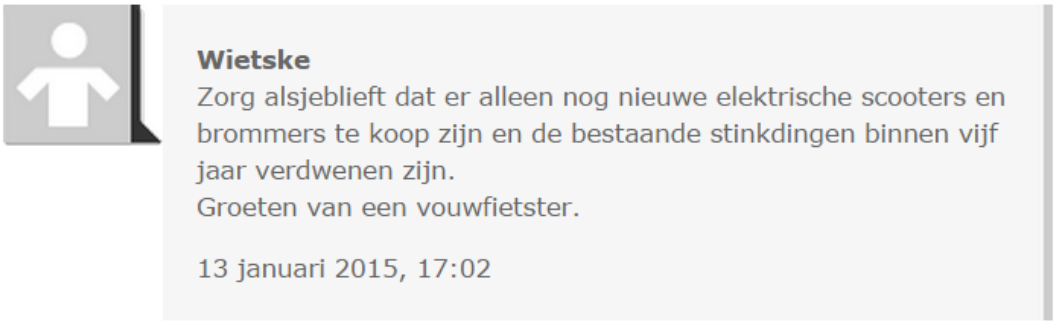


Figure 2 Comment on the policy of the municipality of Amsterdam on sustainable energy (Agenda duurzaamheid "Duurzaam Amsterdam", 2015) Translation: Please make sure that stores only sell electric scooters and that those other smelly things are gone within 5 years. Yours sincerely, a folding bike user.

In this example Wietske (civilian) tries to emphasise the problem of the transition of usage of energy in mobility. Please change to electric vehicles instead of those that use fossil fuel. In her opinion she expects that the municipality of Amsterdam can bring forth the type of products stores should sell, while the municipality is not the actor that can cause such a movement in energy efficiency. Naturally, will these misunderstandings between stakeholders also take place in the process of energy transition in the built environment. Could collaboration be key to the use of more renewable energy in urban areas?

1.2 Aim of this research

This research aims to fill in knowledge gap on the process of energy transition, with a focus on the stakeholders involved. It will answer questions such as: what is the position of the stakeholders involved in the energy transition in the built environment during the initiation and planning phase? How can stakeholders benefit from each other throughout the process? The answers could be used in practice, to influence the process.

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, will this research 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 a model which can be applied in practice to initiate and maintain collaboration towards energy transition in the built environment

Eventually, aims this research to stimulate action towards a better environment, by creating new knowledge on stakeholders' their position and possibilities. By outlining the pitch, stakeholders can have a better understanding of one another's position.

1.3 Relevance of this research

Below a description of 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 stakeholders and stakeholders 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 energy transition 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 barriers towards more renewable energy.

1.4 Main Problem

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

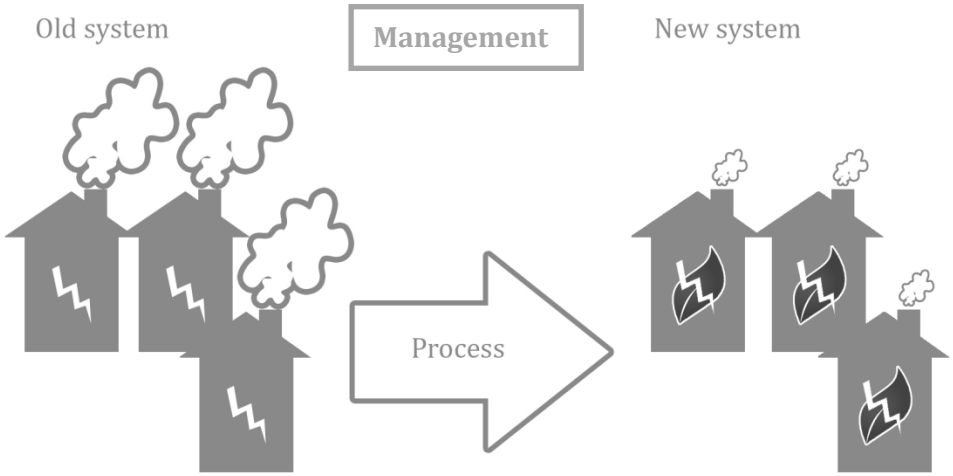


Figure 3 By a certain process should an area be developed from an old system which uses fossil fuels towards a new system that uses renewable energy (own ill.)

Figure 6 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 six topics: political, economic, social, technological, legal and environmental (PESTLE).

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/Social
• 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.	Political/Social/Legal
• Energy transition in the built environment means dealing with a lot of uncertainty in the most effective solution. This results in an unstable market.	Economic
• 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

• Urban energy transition takes place in a multi-actor network, where actors deal with variety, mutual dependencies and a dynamic environment.	Social
• One of the main difficulties of the energy transition is to align short, medium and long-term objectives.	Political
• 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.	Political
• Interaction between areas and the relations between stakeholders are important and necessary, because current city problems cannot be solved without collaboration.	Social
• It is hard to impossible to experiment with new solutions in practice to move the transition.	Technological

In table 5 it is possible to see that most problems in energy transition have a political or social nature.

During the process of going from the old to the new system, stakeholders are involved. By focussing on these stakeholders, one can understand this network of stakeholders and its relation to the final result.

Justification focus on energy transition

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 cause for energy transition.

Secondly, the amount of fossil fuel available will decrease, where new sources of energy are necessary. Urban areas and its buildings must adapt to be able to use these new sources of energy. For example 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 stakeholders 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). This because all stakeholders have influence on the process and will be influenced by the outcome.

1.5 Research questions

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

Main research question

"How can stakeholders influence, together, the barriers of the process of moving towards energy transition in the built environment in theory and in practice?"

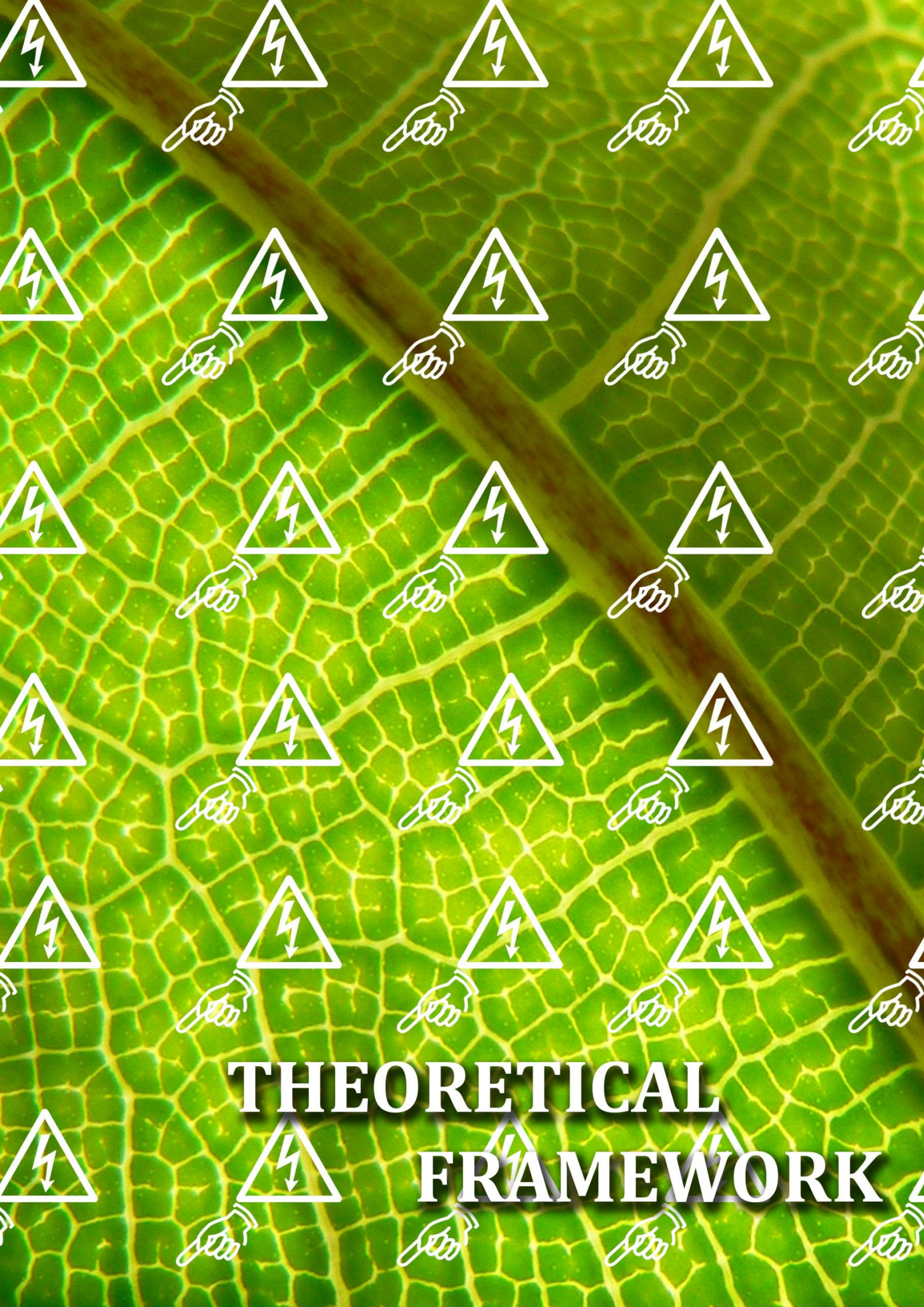
Detailed research questions to be answered

To answer the main research question more detailed research questions are formulated. These questions are:

1. What are the barriers in the process of energy transition in the built environment?
2. How can you overcome these barriers regarding to similar processes in urban area development and energy efficiency?
3. Which stakeholders or actors should be involved in energy transition in the built environment and how would they placed in a network (position, power, interests, constraints, resources)?
4. How should stakeholder intervene with or influence the process of energy transition in the built environment?

5. How does the current process of energy transition in the built environment look like?
6. Which stakeholders or actors are involved in energy transition in the built environment and how are they placed in a network (position, power, interests, constraints, resources)?
7. How do stakeholders intervene with or influencethe process of energy transition in practice?

8. What are the difference between theory and practice?
9. What are the lessons learned on which practice can benefit?



THEORETICAL FRAMEWORK

2. THEORETICAL FRAMEWORK

2.1 Exploration relations terminology sustainable development

Before describing and exploring all definitions, movements and statements in the field of energy transition and the built environment, it is important to unravel the relation between one and another.

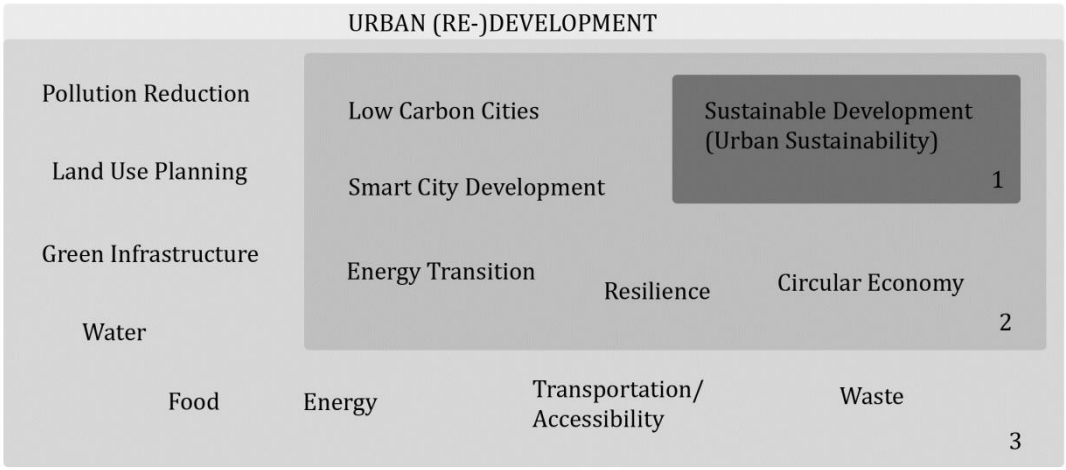


Figure 4 Relations in sustainable development in the built environment (Stern, 2011; Chourabi et. al., 2012; Zhilin et. al., 2009)

As seen in figure 4, this research identifies three different levels, with all a link to urban (re-)development. This is the case because all movements can be part of a urban (re-)development strategy. In the first level, the core of this diagram, is urban sustainability or sustainable development in the built environment. This term consist of several movements, described in literature mostly by governmental bodies, which are low carbon cities, smart city development, circular economy and energy transition. Last can also be seen as part of the smart city development, only smart city development more focused on the integration of all terms of the third layer. This means that smart city development is connected to all fields in the third layer. When it comes to low carbon cities, it is more connected to pollution reduction and energy. Circular economy is more focused on waste. Finally energy transition is mostly linked to energy and eventually pollution and reduction.

A fourth layer can be identified in more specific strategies or programs. Below a table with further descriptions according to Stephanie Stern (2011).

Table 2 Further exploration of terminology of sustainable development (Stern, 2011)

Third Layer (Strategy themes)	Fourth Layer (Programs)
Energy	• Efficiency • Conservation • Clean generation/ renewables

Water	• Conservation • Storm water • Waste water
Land use planning	• Smart growth • Ecologically sensitive zoning
Pollution reduction	• Air pollution prevention • Pesticide reduction • Removal of lead, asbestos etc.
Food	• Local agriculture • Farmer markets • Community gardens
Waste	• Recycling • Composting • E-waste recycling • Solid waste reduction
Green infrastructure	• Tree planting • Green roofs • Land/habitat conservation
Transportation/Accessibility	• Bicycle programs • Pedestrians programs • Reducing car use • Public transit

Below an in more depth exploration of all described layers.

2.2 Urban area (re-)development

To understand the difficulties that apply on the matter of energy transition, it is important to understand the difficulties and development of urban area development. These topics will be linked back to energy transition, to fully describe all elements of the movement.

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 stakeholders, high levels of interdependence, competing objectives and values, and social and political complexity (Dawes, 2009).

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).

Figure 5 Schematic overview urban area development (Van 't Verlaat, 2008)

Franzen et. al. (2011) state that the content of urban area development is primarily determined by the context, where 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.

Urban Area Development			
Social context	**Policy context**	**Actors**	**Management**
- Social development - Network society - Other social dimensions	- Peripheral conditions	- Public sector - Private sector - Citizens and interest groups	- Manament approach - The urban design plan

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

Social and city context

Economies all over the world have become dependent on each other and consequently have introduced a new scale in the relationship between economy state and society (Sassen, 2000).

This relationship 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) .

Actors

Franzen et. al. (2011) also 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.

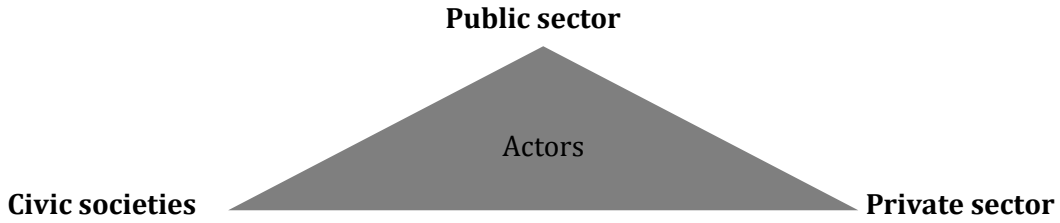


Figure 7 Triangle of actors in urban area development

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 effects the roles of the three players in urban development and makes collaboration necessary .

Policy 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).

Management

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 3 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.

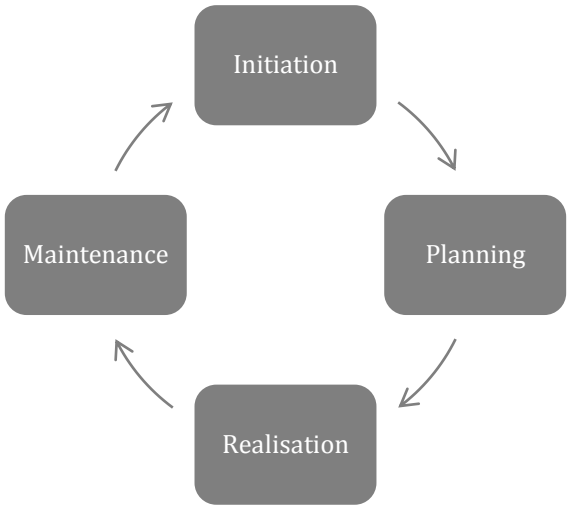


Figure 8 Overview of the phases of urban area development

2.3 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. This by use less and different sources of energy, integrate resource systems, become more energy efficient and engage and activate users. Still there are a lot of uncertainties 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).

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 4 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.

Importance lays in 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 transportation 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).

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 are cities, megacities, 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 5 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 (Wikipedia).

Movements in Europe

Different movements can be found in the strategies and policies of cities in Europe, but of course all depend on sustainable development. This could make communication on sustainable development and its solutions difficult, because the terminology differs all around the globe.

Amsterdam

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).

Copenhagen

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

Grand Lyon

Grand Lyon's policy is created from a high governmental body, named the Higher Energy Council put in place by the Ministry of Energy. Soon will the city release an energy master plan, concerning a framework to carry out different projects of energy efficiency on a large scale. Their strategy is mostly focused on transforming/retrofitting a large amount of buildings from their stock. Grand Lyon aims to become a leader in smart energy and roll out the electricity grid and network of tomorrow, collecting and distributing a decentralised and intermittent renewable energy production (TRANSFORM, 2014).

Hamburg

Hamburg is taking up the challenge of climate-friendly energy policy, by for example supplying carbon-free or at least low-carbon electricity and heating. Most striking is the use of wind energy as a renewable energy source, with at an output of at least 100 megawatts, in particular by the replacement of old wind turbines by new, more powerful ones. The strategy is also focused on increasing the competitiveness of Hamburg's economy in the long term, which is different from most other strategies. Lastly is Hamburg strategy focus on becoming a low carbon city and aims to reduce in 80% carbon emissions by 2050.

3.4 Energy transition

As described in paragraph 1.4, will this research 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 will the availability of fossil fuels decrease, which means that new resources 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.

Research on energy transition in Europe

In 2014, the European Commission started 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).

Technology 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 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.

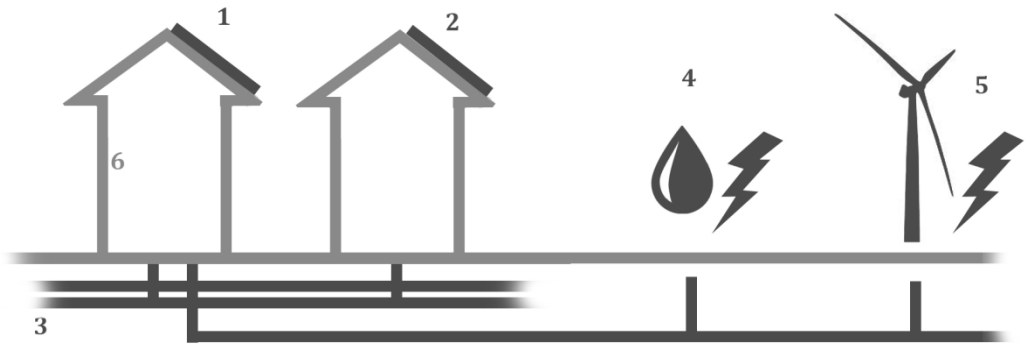


Figure 9 Schedule of current technologies that can be used to create a more energy efficient building (own ill.)

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 are also curved solar panels, nonimaging optical panels and moving panels created to create optimal use of solar energy in not only a sunny climate, but also less sunny climate. Again can this technology be implemented above ground and only needs measures in or on the building.

3. 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.

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 air flow 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. ***Adjustment building***

While using a different resource for energy, it is important to realise that also the building should be transformed 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

Because most of the new transformations in areas that take place in Europe concerns the existing stock, will this research only focus on urban area development of the existing stock. 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. Most new built areas already take in account some level of awareness on energy efficiency and using renewable energy.

Phases/Process of energy transition

This paragraph is allocated to describe the process of energy transition. This is done by combining the general phases from urban area development management with found phases in literature (Franzen et. al., 2011; Copenhagen climate adaption plan, 2011; TRANSFORM, 2014).

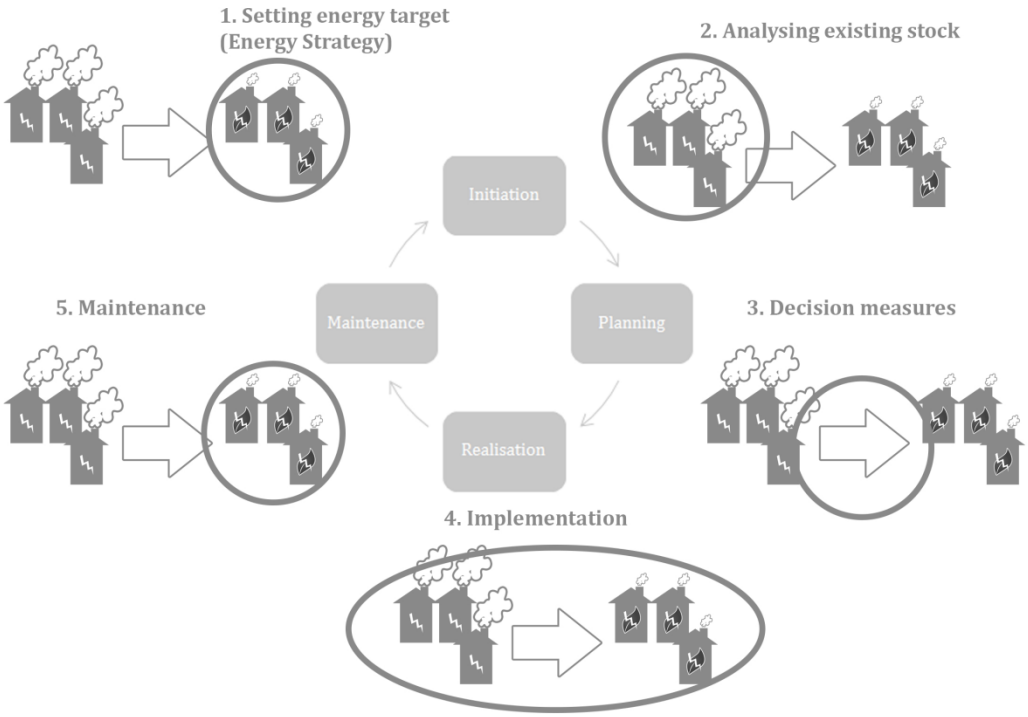
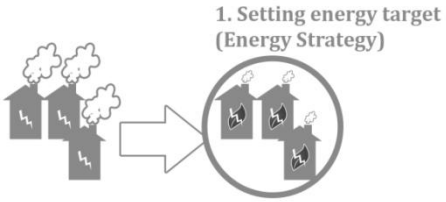


Figure 10 Phases in transforming existing stock towards usage of renewable energy and energy efficiency (own ill.)

1. Setting energy target (Energy Strategy)



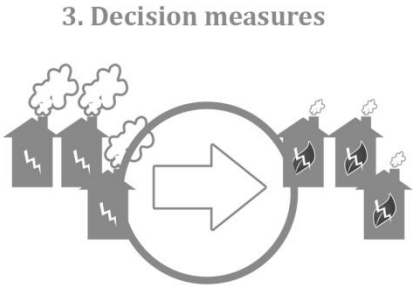
The first step taken towards energy transition is stating the energy target or objective. This statement consists of the goals set by (mostly) governmental bodies and is the starting point of this process. Nowadays most strategies are secured by governmental actors, where energy transition also can take 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 stakeholder in the network of this process.

2. Analysing existing stock

After pinpointing the end result of the whole process with the most important stakeholders, 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

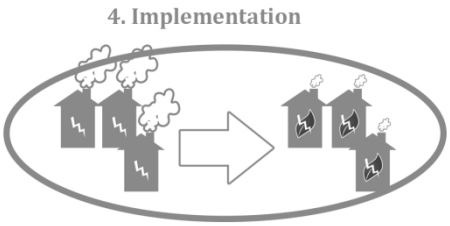
components of the building. Its energy use, physical characteristics and data on the infrastructure underneath the building. This data can be used for decision making with related stakeholders, but also for further calculations on the best solution. Currently different decision models are created by 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 stakeholders 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 and planning



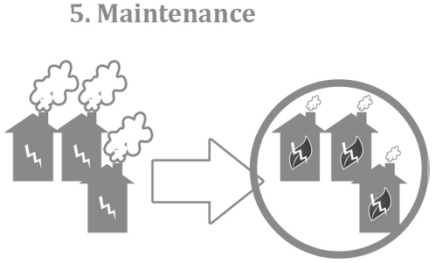
During this phase stakeholders come around the table and negotiate, with or without a decision making model that can calculate the outcomes of the measures, the possible solutions. This in relation to the desired end result, which can change during this process. During this phase decisions will be made in relation to the planning in time and costs. This means that the decision making is influenced by many factors such as the stakeholders, the strategy, the outcome, the planning in time and costs. Importance lies in keeping all stakeholders 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).

4. 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.

5. Maintenance



Last phase consists of maintaining the status of the building stock. This relates to the effectivity 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.

Policy context of energy efficiency

From different levels many goals are set within the field of energy efficiency and sustainable development. Below an overview of goals related to CO_2 emission and renewable energy that are found on the websites with official statements of different continents and countries.

Table 6 Goals per different levels (Tempo van de energietransitie, 2014) (Europe 2020 in a nutshell, 2009)(Department of Climate Change UK, 2013) (EERE Gov, 2009) (IEA/OECD, 2013)

Who?	Goals
Europe	• A 20% reduction in EU greenhouse gas emissions from 1990 levels; • Raising the share of EU energy consumption produced from renewable resources to 20%; • A 20% improvement in the EU's energy efficiency.
The Netherlands	• In 2050 reduce CO_2 emission to 80-95% • In 2050 70% renewable energy.
Denmark	• Reduce Denmark's GHG emissions by 40% by 2020 compared with 1990.
Germany	• By 2050 80 to 95% less GHG emissions, compared to 1990.
United Kingdom	• Reduce the UK's greenhouse gas emissions by at least 80% (from the 1990 baseline) by 2050.
China	• 40-45% reduction in CO_2 emissions per unit of gross domestic product (GDP) from 2005 level by 2020.
United States of America	• Reducing greenhouse gas (GHG) emissions in the range of 17% below 2005 levels by 2020.

In the table it is possible to see the diversity in goals. Statements are also made by cities that uphold the covering statements made on a national level.

In 2011, the Kyoto parties have changed to 12,1% less CO_2 emission compared to the year 1990 (IEA/OECD, 2013). EU28 has reached 17,8% less CO_2 emission compared to the year 1990 (Eurostat, 2013).

Notable is, that not many specific statements are made on goals towards renewable energy. This while the solution to less CO_2 emission lies in the energy transition towards renewable energy.

Institutions driving the process per city

Below a table that describes the competences of the institutions that drive the process per city. This table is a result of implementing an energy efficient strategy on different scales, on building level and on area level.

Table 7 Initiators that drive the implementation process of energy efficiency and their competences (TRANSFORM, 2014)

City	Institution driving the process	Competences
Amsterdam	The Amsterdam Energy and Climate Office, part of the urban planning department of the municipality.	Decision on the input of human resources only (no own assets or resources to invest, no competency to enforce e.g. the environmental act). It supports projects to make use of the Amsterdam investment funds (60 million Euro, funding to support projects throughout the city in the first phase of the development with loans, guarantees and shares).
Copenhagen	The Finance Administration and the Technical and Environmental Administration (TEA), municipal administration City of Copenhagen	Respective tasks as a municipal authorities. Main resource to support the development are men hours.
Hamburg	IBA, GmbH (municipality), limited liability company	IBA has no sovereign rights and administrative tasks, but it does have a remit defined by the parliament (called Bürgerschaft in Hamburg) and is legitimated by democratic process.
Lyon	Department for Urban development Grand Lyon Administration	Responsible for the elaboration of land use and zoning plans (PLU), housing and social housing policy, shared urban infrastructures on the level of the agglomeration and the operation of urban development projects such as Part-Dieu. Grand Lyon remains a key institutional actor, both in connection to the Part-Dieu project (competences in terms of urban planning)
Vienna	Municipal department MA21 (land use planning and zoning), Municipal administration	Municipal department responsible for land use planning and zoning permissions, which is also coordinating the development of the target area Liesing Mitte (larger than Groß Erlaa).

Actors of energy transition

The decision making process towards energy transition is marked by a multi-actor network (Koppenjan & Klijn, 2004). A network can be defined as (1) a number of actors with (2) different goals and interests and (3) different resources, (4) who

depend on each other for the realization of their goals (de Bruijn & ten Heuvelhof, 2009; p.1).

If this process could take place in an hierarchical model, it would be characterized as uniform, unilateral dependencies and stability (de Bruijn & ten Heuvelhof, 2009; p.12). The process of energy transition in the built environment is, in contrary to these characterisations, unstable, uncertain and deal with mutual dependencies.

By identifying the actors in the energy transition process one can steer, manage and control towards a better decision making process, which is needed to begin this energy transition on a larger scale.

One of the most principle questions in research efforts focusing on the processes behind urban development projects are about 'who' is involved (from Dahl, 1961/2005 to Flyvbjerg, 1998b to Majoor, 2008).

In the field of energy transition different actors or stakeholders can be identified. In this table main actors are identified.

Table 8 Different actors in different sectors, concerning energy transition (Franzen et. al., 2011)

Sector	Specific actors
• Public	European Union National Government Local governments Municipalities
• Private	Energy providers Gas providers Renewable energy developers Real estate developers Housing associations Knowledge institutes Energy efficiency consultancies Contractors
• Civic society	Residents Owner building Public organisations Environmental groups Energy transition organisations or foundations

To have a better understanding of these stakeholders, one should conduct a whole stakeholder analysis. A stakeholder analysis will cover the position of the stakeholders, 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 has 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 to analyse the actors thoroughly.

The main issue remains with fact that other actors may not have the same problem perception nor the same sense of urgency to start a competition dialogue for priorities (de Bruijn, Heuvelhof, 2008, p61).

Table 9 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.

Firstly are different actors important in different phases. This means that in each phase different actors are active and participate in the five phase, earlier defined. Important is that the relationship between each actor can be different in because of its context.

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) an then identify the interests and norms of each stakeholder per phase. This leads then to the third step: the network structure, which indicates each actor their common interest and thus their relation.

Table 10 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 11 Stakeholders 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 12 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**

3.5 Conclusion

A differentiation is made between sustainable development, sustainable movements , strategy themes that relate to sustainability and sustainable strategies. Different contexts are identified for different cities in Europe. The process of energy transition is defined and related problems are identified. Also the technologies that can lead towards energy efficiency in the built environment are identified.

Below an explanatory image of the relation between the strategy, area, outcome and actors. Overall four are connected to the management of the area in relation to its context.

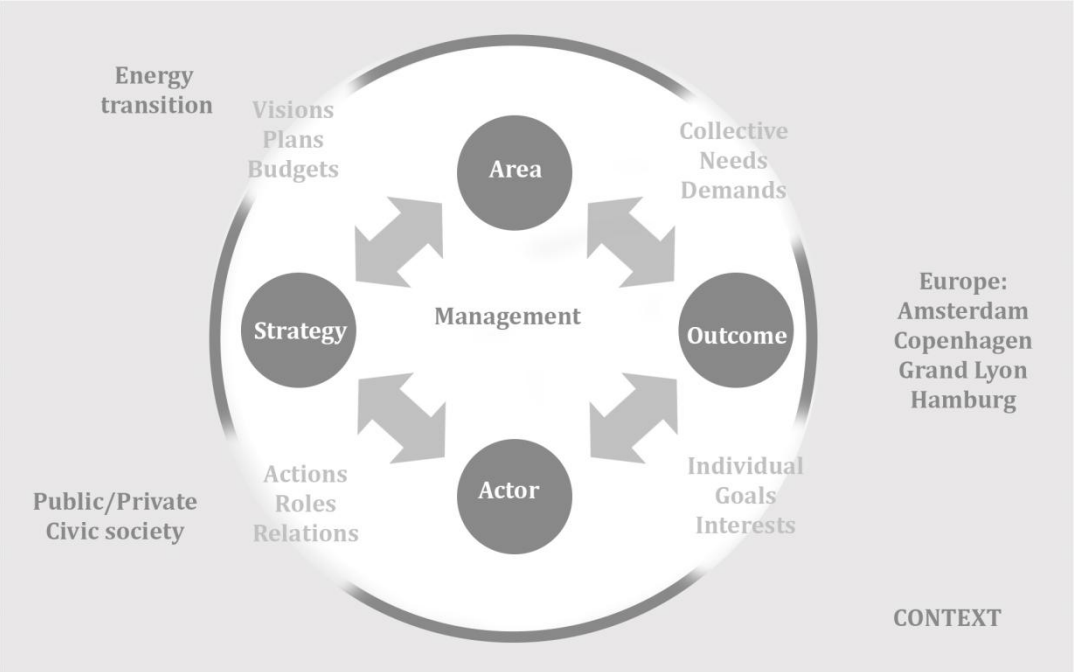


Figure 11 Relation between strategy, area, outcome and actor (Chen, 2015)

On different levels are different strategies identified in the field of sustainable development and energy transition or energy efficiency in particular. These strategies apply in a certain area, where in particular in this research a focus lays in Europe. The area also consist of a building stock with mostly existing buildings. Actors are influenced and can influence the strategy, which is in this context energy transition. The outcome is mostly dominated by the needs of governmental bodies that try to create a better living environment for its citizens. By analyzing and identifying all parts of these four aspects, one can make statements about suitable management of the area. Currently are some aspects still unknown, to make a statement about the management and the process of energy transition on a large scale in the built environment.

RESEARCH METHODS

3. RESEARCH METHOD

3.1 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.

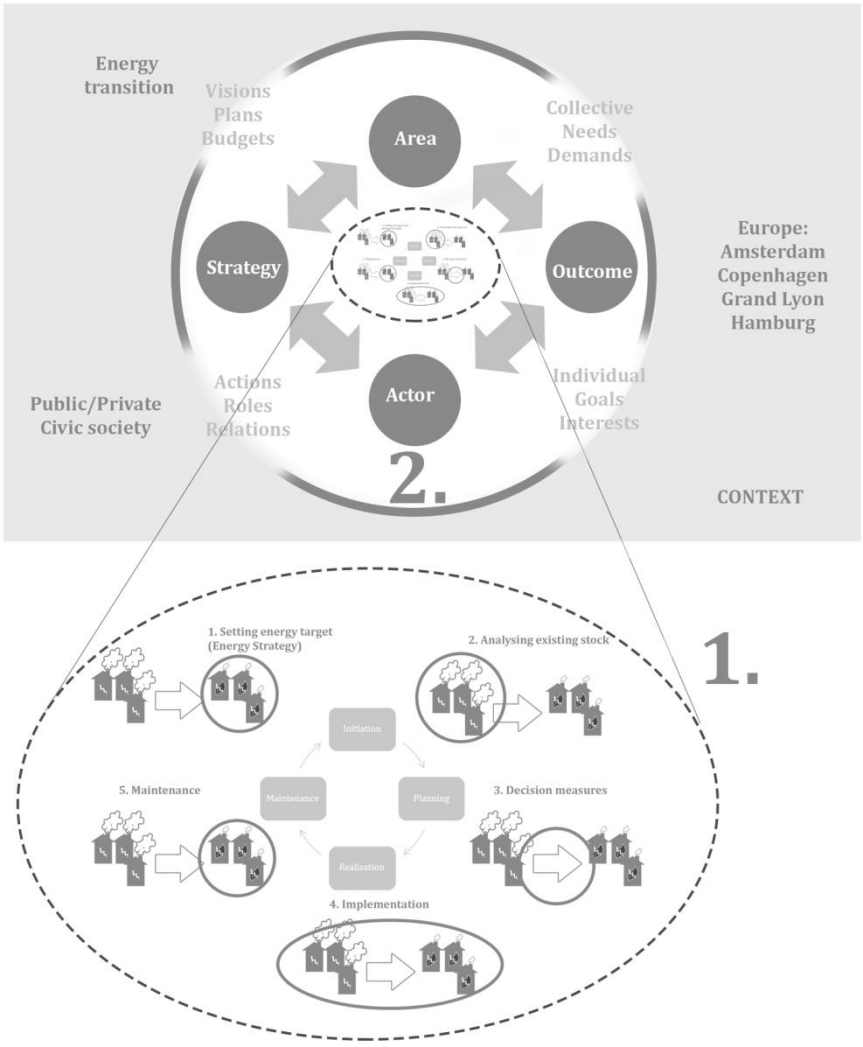


Figure 12 Fields of research on each case (own ill.)

Firstly, the research conduct an empirical part, where the process and stakeholders of energy transition in the built environment will be researched. This research will answer the subquestions considering the process of energy transition on large scale in the built environment and its barriers. This is done by research from literature and from practice, to eventually create a rightful overview of the process and its aspects (1). The process of implementing energy efficiency solution gives indications on the proper management of these processes. This research will also focus on stakeholders or actors, because of a lack of information, to draw conclusions on the proper management (2).

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

The qualitative research can be done by a case study on several projects from the FP7 project "TRANSFORM" and maybe other projects. Data will be collected through in-depth interviews and observations.

3.2 Conceptual model

Below an explanation of the steps of this research. On each case study the following steps are followed by. Most focus lays in describing and analysing the process of energy transition in a large scale area. Conclusions of the process and its barriers can lead to new insights on new management strategies.

In relation to this management statement, is research with regards to the strategy (more specific than on a city level), area (more characteristics), the outcome (which technological solutions) and the actors (who was involved and how, etc.).

This research will than focus more on what each actor can do to intervene on the process. This means that it will focus on all stakeholders involved, in each sector, but will mostly focus on the initiating or managing party and its management.

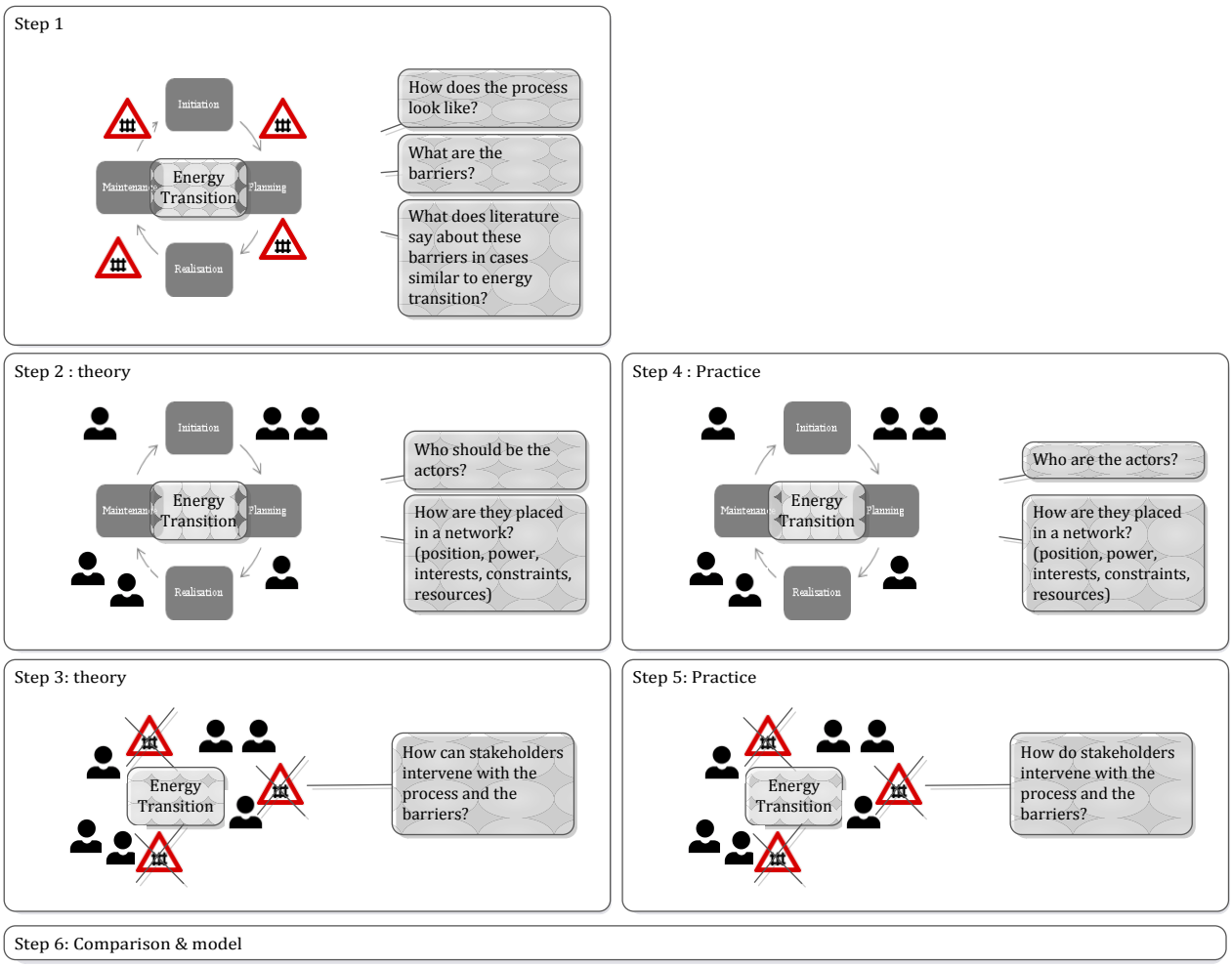


Figure 13 Rough conceptual model, own illustration.

3.3 Cases

Below a description of several cases which are suitable for this research. Most of them are part of the project called "TRANSFORM" (TRANSFORM, 2014).

Amsterdam

Amsterdam Zuidoost: Transformation of a mixed-use area (300 ha), incl. Ajax stadium, offices, leisure and shopping, a city hospital, large datacenters and an energy plant. Focus areas: transforming energy grids (thermal and electric) into smart grids, energy efficiency, waste and new mobility concepts.

Hamburg

Hamburg IBA Wilhelmsburg: Transformation of a partly industrial zone into a mixed-use urban area, combining housing, industry, port, water, green and open space. Focus areas: stakeholder process, 100% renewable energy by 2025, heating and cooling.

Copenhagen

Copenhagen Nordhavn: Redevelopment of a port area towards a CO2 neutral, mixed-use lively new neighborhood for living and working. Nordhavn will be a lab for new solutions in energy and building construction. Focus areas: integration of smart energy grids and low energy buildings.

Grand Lyon

Lyon Part Dieu: Transformation of a 1960 central district into a mixed-use area. Large building program, including offices and residential and commercial areas. Focus area: heating and cooling and renovation schemes.

Vienna

Vienna Seestadt and Liesing: Seestadt is a greenfield & brownfield development, incl. 20.000 apts., 20.000 work places; new public transport, social & smart technical infrastructure. Liesing is a transformation area, including residential, industrial and service functions.

Karlsruhe, Salzburg and Winterthur

As part of the DACH cooperation project "Energy-efficient city", the potential for energy efficiency projects will be explored in Karlsruhe, Salzburg and Winterthur by early 2015, and the conditions for their implementation will be put in place. The research project is based on two strategies: CO2-reducing power use and supply structures can be reached far more cost efficiently and faster at the municipal organisation level, if as many players as possible face up to the challenges of climate-friendly development of energy structures at the same time (multi-level governance). Plus: by networking the three municipalities at a national political level and in international sharing of experience, learning and synergy effects will be achieved. It will accelerate the learning process, leading to faster and more cost-efficient implementation of innovative investments, organisational innovations and finally faster increases in energy efficiency (Germany, Austria and Switzerland (DACH) – A tri-national cooperation of energy-efficient cities, 2013).

3.4 Data gatherings methods

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

Process

The process will be researched, with a focus on each phase, through interviews and observations with related stakeholders of each case. The process is categorised by its phases and actors can explain their experience in each phase. Focus lies on barriers and found solutions in practice. The phases of the process can also be changed according to the actor, with fair argumentation.

The interview will include questions that reveal the characteristics of the process of energy transition. It will also include questions that let the actor focus on the barriers and solutions during those phases.

Actors

In this same document created by "TRANSFORM" participants, most stakeholders or actors are covered, but not as in depth as required from the proposed stakeholder analysis. This information can be retrieved by interviews with related stakeholders and let themselves create a comprehensive stakeholder analysis.

3.5 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.

Secondly, there will be a explorative chats with some experts to give the research more focus on the right angle of the topics.

Thirdly will be the document written about all cases be thoroughly analysed and information will be used for further development of this thesis.

Then, the research will be conducted with an open character and thus will hold open interviews with the key-persons with an open/ semi-structured character. Most topics are pre-defined, but because of the open character there is opportunity to contribute new topics or field to explore for the research by each key person.

The interview will cover the process, its barriers and related stakeholders.

Topic	Related questions
Energy efficiency	• What is your view on energy efficiency? • How is your role related to energy efficiency?
Process of energy transition	• Can you describe the process you have undertaken to create a more energy efficient building stock? • What are the characteristics of the process? • Which problems/barriers have you undertaken? • How have you solved these problems?
Stakeholders/actors	• Can you identify all actors working on this energy transition? • How would you describe your own position in the network of actors? • How do you describe the position of the other stakeholders? • Have you influenced the process? (Yes: how?) • Did other actors influenced the process? (Yes: how?)

These interviews lead eventually to new information from practice, which can be compared with the findings from literature and documents.

This all will lead to several statements on how an actor can influence the process of energy transition in the built environment.

3.6 Research planning

The table below explains all phases of the research and when what will be done. As all part 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 13 Overview of the planning (own ill.)

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	July t/m October
	Data analysis	July t/m October
	Data evaluation	October/ November
P4	Conclusion	November
	Recommendations	November
	Completion thesis	December
P5	Presentation	January

3.7 Research organisation

Table 14 Overview research organisation (own ill.)

Organisation	
Scientific domains	Urban Development Management Design and Construction Management
Mentors	1. dr. ir. Yawei Chen 2. dr. ir. Louis Lousberg
Company	Project Management Bureau Gemeente Amsterdam / Dienst Ruimtelijke Ordening In depth cases from “TRANSFORM” and other.

FURTHER STEPS

4. FURTHER STEPS

After completion of my P2 milestone, I will continue by contacting related actors to the cases which suit my desired research. My contacts are mostly from my internship while working on "TRANSFORM" at the municipality of Amsterdam. Contacting those participant will hopefully result in fruitful contacts and continue into interviews with several stakeholders of all cases.

Complications lie in the choice of different European cities, instead of only Dutch cities. I must realise it is important to make appointments as soon as possible, because distance can also create a delay in communication. Also can different countries interpret the questions differently, so I should keep in account the sort of language I will use towards different actors and be as comprehensive as possible to prevent miscommunication.

Hopefully are cities enthusiastic on collaborating with me to gain information for my research, but it may be very difficult because not all actors have the time to have an interview.

My theoretical framework can be more comprehensive by adding more literature about strategies in relation to the actor. This could lead to an inclusion of figure 14;

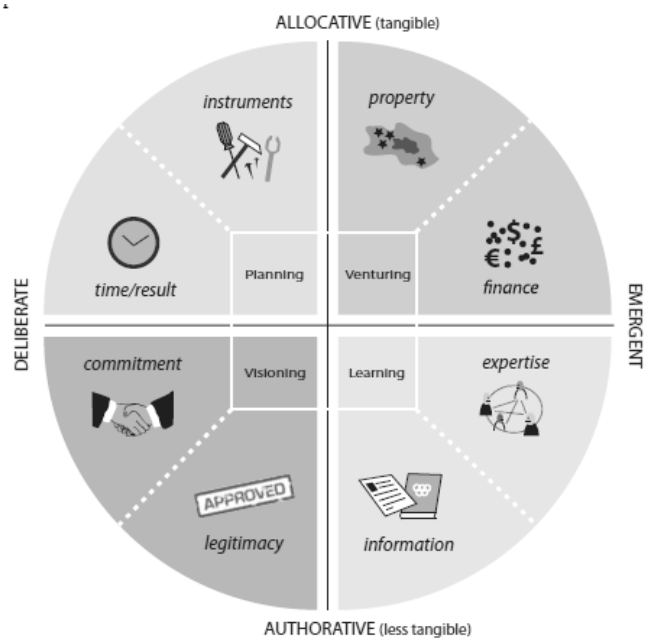


Figure 14 Strategy as force model (Daamen, 2010).

What also misses in the theoretical framework are the possibilities and exploration of process management in theory and the solutions it offers to overcome barriers in process.

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