Urban policies to bring heritage building energy retrofit projects to scale: Fostering the run towards low-carbon cities in the Netherlands

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Foreword

This thesis has been written as completion to the research master programme in Sustainable Development, at the University of Utrecht. The subject of this thesis, "Urban policies to bring energy retrofitting of heritage buildings to scale", goes beyond my academic borders on Environmental Governance, to additionally incorporate interests from the Energy Sciences track. I officially started working on this Master's thesis in November 2014, feeling excited for entering an unknown field. But I also felt distressed, for entering an unknown field entails a lot of reading, puzzling, writing and deleting. Still, looking back, the past 8 months have been a lively journey. I had the opportunity to acquire abundant knowledge from a very peculiar field: cultural heritage. I have had many interesting interviews and long discussions with numerous inspired actors and I have myself grown a big passion for the subject sustainable cultural heritage.

Writing this Master's thesis has not been a particularly easy undertaking, yet a lot of people have helped me along the way. I remain immensely grateful to my supervisors who guided me through the process of conceptualising, researching, organising, polishing, and submitting my research project.

Firstly, I would like to thank my second supervisor Dr. Jesús Rosales Carreón, who welcomed me with open arms in his academic realm but ensured that I was challenged thorough the eight months of research work. I thank him for reminding me the importance to write a consistent and coherent story, for his critical judgment, for asking me the right questions and for all the hours that we spent on discussions. Finally, I thank him for his friendship and sympathy when I most needed.

Secondly, I would like to thank my first supervisor Dr. Mendel Giezen, who not only provided me with valuable insights and directions but also challenged me to be creative in my research and to go the "extra mile". I thank him for giving me needful guidance to complete the research and write this thesis. I also thank him for his friendship and sympathy throughout this process.

Furthermore, I would like to show my gratitude to PhD Didi van Doren for her helpful insights, rousing ideas, readiness and availability.

Many thanks go out to all the respondents, who gave me their valuable time and input, and have been very hospitable, honest and open in the interviews.

Lastly, I would also like to thank my classmates from the Environmental Governance track, with whom I could openly discuss about my ideas and anxieties throughout this period of my life.

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Summary

Buildings are amongst the major energy consumers in the European Union (EU), accounting for 40% of the total primary energy consumption and consequently offering space for energy and carbon savings. More than 10% of the pre 1945 building stock in the EU is considered as heritage buildings, making the upgrading of their energy performance an attractive task.

Energy retrofitting heritage buildings (ERHB) aims at increasing building energy performance while maintaining satisfactory service levels and indoor thermal comfort conditions. So far, ERHB efforts have been gradual and are oftentimes not applied on a large scale, or in additional cities. This study looks into the challenges of undertaking and bringing ERHB projects to scale. It follows the central research question:

How can urban policies contribute to the scaling-up of energy retrofitting of heritage buildings in the Netherlands?

An in-depth comparative case study was employed to identify factors that are influencing the uptake of ERHB projects and urban policies that can boost the up-scaling potential of ERHB. The scope of this study is delimited to analysing two contrasting ERHB projects. By incorporating expert elicitation, semi-structured interviews and a comparative case approach, the research systematically investigated the relative importance of scaling-up ERHB and how urban policies can contribute to its successful realisation.

The study disclosed that a significant reduction of the energy consumption of heritage buildings is desirable as energy costs and lack of comfort form the bottlenecks for a healthy exploitation and accordingly sustainable management and preservation of these buildings. However, the possibilities for interventions are limited and require customised solutions as heritage buildings bear unique physical attributes and building use. Tensions between the monument and sustainability disciplines are inevitable, but it is acknowledged. Nonetheless, urban policy can facilitate the realisation and scaling-up of ERHB projects by:

- ✓ Urban policy: integrate energy and sustainability issues in cultural heritage legislation; ensure consistent and well justified legislation on cultural heritage conservation; institute a national portal to afford accurate and transparent information in a coherent framework; alleviate the legal and administrative license procedure; trigger the discussion on the adjustment on the Dutch labelling scheme methodology and on the enforcement of a conditional energy performance baseline for historic buildings.
- ✓ Local governance capacity: improve the quality of information on ERHB provided to the public and to experts; institute a knowledge portal or entity where experiences in the field of ERHB are exchanged; develop a reference book in which the possibilities to make sustainable interventions in

historic buildings are structurally presented; encourage experiment and demonstration of ERHB projects; encourage follow-up mechanisms; communicate about developments to the public; and ensure cooperation between historic building owners and the municipality, monument and sustainability officials, and generally between all the different disciplines in the field of ERHB.

- ✓ Economic policy: mobilise long-term financial programmes to stimulate sustainable interventions in existing buildings; provide subsidies (e.g. by means of reinvesting money from building permits) that are guaranteed on a long-term basis and also for segments other than the commercial one; concentrate the provision of financial resources for the historic housing market; offer further incentives in the form of higher mortgage and loan allowances as a reward for investments in energy efficiency measures; introduce green tax reductions; mobilise financial resources for advisory; and provide loans under the precondition of maintaining cultural heritage values and integrating sustainable interventions in undertaking renovation in historic buildings.

Keywords: urban policy; scaling-up; low-carbon urban initiatives; heritage buildings; energy retrofit.

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Chapter 1: Introduction and Research Objectives

1.1 Problem description

The abatement of carbon emissions in the building sector is considered a pivotal strategy in promoting low-carbon cities (Yung and Chan, 2012; Levine et al., 2007). Buildings are major energy end users, accounting for approximately 20-40% of the final energy consumption (Lapillonne et al., 2012), generating one third of the global greenhouse gas (GHG) emissions (UNEP, 2009). In Europe, buildings have a share of 40% in the total energy demand (Balaras et al., 2005; Pérez-Lombard et al., 2008). Further, in the construction of new buildings, nearly 136 million tonnes of waste are annually produced, of which approximately half is from the demolition process (HUD, 2003). Through the reduction of energy consumption in construction processes, maintenance and refurbishment of buildings, contemporary cities can greatly support efforts to mitigate climate effects. As buildings are the largest energy-consuming sector in the European Union (EU), they also offer the largest cost-effective opportunity for savings and to significantly decrease carbon emissions (Kamal-Chaoui, 2009; Newton, 2010; UNEP, 2009).

The EU has been reactive to climate change concerns and has set goals for reducing GHG emissions. The *Europe 2020: A European strategy for smart, sustainable and inclusive growth* report urges member states to reduce 20% of its GHG emissions comparatively to 1990 levels and increase the employment of renewable sources to achieve 20% of total energy production and level up energy efficiency by 20% (EC, 2014). To reach these climate targets, alterations have been made in the European regulation. One alteration comprises the revision of the EU Energy Performance of Buildings Directive, which subsequent to 2010 stimulates the development of energy performance of new and existing buildings through retrofitting (EPBD, 2010). Yet, heritage buildings are not included in the Directive (EPBD, 2010). In the Netherlands, a policy was enacted to maintain heritage in its original state due to cultural, social, aesthetic and scientific value (Monuments and Historical Buildings Act, 1988). While much research has been done to optimise the energy performance of new and existing buildings, this has not been the case for heritage buildings.

Heritage buildings are described as buildings built before 1945, holding a historic, monumental or iconic importance for the city (Heritage Canada Foundation, 2003). Representing 10% of the EU's built stock, heritage buildings form an integral part of European's cultural capital. In the Netherlands, approximately 20% of all buildings fall under the heritage classification (Troi, 2011). Heritage buildings provide significant cultural, social, environmental and economic benefits (Bullen and Love, 2010) and therefore a valuable glimpse of the past and lend character to communities, and should be thus conserved for future generations (DEH, 2004). The integration of historic conservation with environmental concerns has become an inherited feature on the sustainability agenda (Bullen and Love, 2010; Stubbs, 2004). However, their preservation demonstrates unsustainability as the energy performance of heritage buildings is significantly lower than of recently constructed buildings (Troi,

2011). Renovating heritage buildings implies a careful study on retrofitting possibilities to concurrently increase energy performances and retain cultural and patrimonial values.

The idea of *adapting heritage buildings for the future* or *climate-proofing heritage buildings* is a growing trend that has been appreciated by many authors (Kohler and Hassler, 2002; Gallant and Blickle, 2005; Ball, 2002; ReFoMo, 2014; Climate-KIC, 2014). Retrofitting heritage buildings aims at increasing energy performances while maintaining satisfactory service levels and indoor thermal comfort conditions that are applicable in contemporary lifestyles (Moran et al., 2013; Ma et al., 2012). Retrofit frequently refers to the installation of new systems (i.e. heating systems) as well as to the fabric of a building such as retrofitting insulation, walls or windows. Energy retrofitting (henceforth "retrofitting") provides attractive opportunities to reduce energy consumption of heritage buildings. Through energy retrofit, an energy reduction of factor 4 should be practical for heritage buildings (75% reduction of the initial demand), representing a 2.25% reduction of the total energy consumption (Climate-KIC, 2014; ReFoMo, 2014). In addition to the energy performance aspect of retrofitting, it also boosts the whole condition of the building. Examples include noise insulation conditions and exploitation opportunities, which extends the building life cycle and increase their value (Mickaityté et al., 2008). In spite of the considerable advantages energy retrofitting of heritage buildings (ERHB) bring about, efforts have been gradual (Bulkeley et al., 2009). Successful experiences are oftentimes not applied on a large scale, or in additional cities (Fabbri et al., 2012; Bullen and Love, 2010; Lewis, 2013).

ReFoMo (Reduced Footprints of Monumental Structures, Landscapes and Buildings) is a project that has been responsive to the omission of heritage buildings in the EPBD. Their objective is "to reduce the footprint of unique heritage buildings by bridging the gap between the energy performance of heritage buildings and the potential energy savings" (ReFoMo, 2014). ReFoMo has been exploring *technical* solutions that can be put in place to advancing the implementation of ERHB. This study in turn aims at exploring what exactly is impeding ERHB to be applied on a larger scale, put differently, what is impeding ERHB of *scaling-up*. This research also aims at studying how *urban policies* could contribute to the minimisation of these impeding factors and to bolster the realisation and scaling-up of EHRB projects in the Netherlands.

The subsequent sections briefly elaborate on the aspects of urban climate governance, the increasingly important role of cities to mitigating climate effects, consecutively on low-carbon urban development and on the concept of scaling-up, so as to substantiate the rationale of this research.

1.1.1 Urbanising the governance of climate mitigation

Governance is an essential component in the accomplishment of effective climate planning and action (Betsill and Bulkeley, 2003, 2006; Bulkeley and Broto, 2013). Addressing climate change effects requires an "unprecedented level of cooperation, not only between countries, but also between different level of governments and the private sector" (de Boer, 2009, p.1). Urban climate governance refers to the means with which the civil society, private and public actors and institutions articulate climate change ambitious, exercise authority and influence, and manage urban climate planning and

implementation processes (Betsill and Bulkeley, 2006; Holgate, 2007). Urban climate governance is rather recent, thus local actors must improve their policy agendas with rules, norms and best practices to direct them in their efforts towards carbon-proof futures.

While the international community has been struggling to consent on common targets and objectives to mitigate climate change impacts, a growing number of cities and regions have taken initiatives to diminish their CO_2 emissions and energy use. As observed by Bulkeley and Betsill (2003), successful mitigation and adaptation measures are oftentimes required to be taken by international and national actors; yet, numerous initiatives are designed and implemented at the local level. Faced with a two-way relationship between urban development and climate change, most local governments have advanced its climate policy initiatives through, for instance, the introduction of building codes and regulation, GHG reduction targets and establishment of energy-saving programs (Bulkeley and Broto, 2013; OECD, 2008). City governments have thus an increasingly important role in creating opportunities for climate change action and for fostering the run towards *low-carbon urban development* (Bulkeley and Broto, 2013; Schreurs, 2008).

1.1.2 Low-carbon urban development

In response to the debate around GHGs, climate change and the need for greener urban development, the concept of *low-carbon urban developmen*t (LCUD) was developed. Presently, there is no internationally agreed definition of LCUD strategies; nevertheless the concept of "using less carbon for growth" is commonly applied (Mulugetta and Urban, 2010). In this study the concept refers to the reconciliation between climate mitigation efforts and urban development (van Tilburg et al., 2011). *Low carbon cities* refer to the growing concern to integrate carbon emission reduction strategies in urban development planning (Yung and Chan, 2012). In this paper, both concepts overlap.

1.1.3 Up-scaling of low-carbon urban initiatives

Innovative low-carbon urban initiatives (LCUIs) demonstrate that urban development can meet societal demands with little or no CO_2 (Mulugetta and Urban, 2010). To support the run towards low-carbon cities, LCUIs necessitate going beyond "islands of excellence" [1](WB, 2003; Bulkeley and Broto, 2013; van Doren et al., forthcoming). A potential approach for doing so is that of *scaling-up*. The concept of scaling-up varies in the literature and oftentimes refers to activities related to the spread, replication or adaptation of practices (WB, 2003). A consistent understanding of the concept is that of going from a small to a large impact. Blackburn and Holland (1998) apply scaling-up in close association to the dissemination of ideas and concept of participatory action and reflection. In this study, scaling-up refers to advancing LCUIs from small to larger scale of coverage at the municipal level. The identification of appropriate strategies to accelerate the uptake of LCUIs is imperative for its success.

Scaling-up is further conceptualised in hierarchical progression that facilitates goal attainment (Gillespie, 2004) by means of two approaches*: horizontal* and *vertical scaling-up* (Hancock, 2013). The horizontal scaling-up, "diffusion" (Rogers, 1995) or "broadening" (Rotmans and Loorbach, 2006), implies

[1] LCUIs initiatives should not be restricted to a few stand-alone projects.

the quantitative (partial) growth of a given initiative (e.g. hardware, software and operational orgware) (Hancock, 2013). It can also be the outcome of an initiative's replication to other geographical regions ("scaling out") (Douthwaite et al., 2003). Vertical scaling-up, "political scaling" (Gillespie, 2004), "institutionalization" or "mainstreaming" (Hancock, 2003), refers to structural learning and institutional adjustments favouring LCUDS. Formal and informal institutions embody the visions and interpretations, governance and procedures, and policies of competent actors and policy-makers at the policy and sector level (Van Doren et al., forthcoming). In general, it is argued that the empirical evaluation of initiatives and codification of lessons have the potential to incentivise horizontal and vertical scaling-up (*Idem*). For the purpose of this study, the horizontal approach to scaling-up ERHB will be emphasised, as the interest lies in looking at the replication and advancement of ERHB experiences.

Scaling-up LCUIs is a promising approach to guaranteeing climate-proof futures, however, successful initiatives are frequently not implemented at a larger scale or in other cities. Although the necessary technical adaptations for LCUIs might be accomplished, the ambition to lower $C0_2$ emissions entails a unique policy challenge as "any process of social change is dependent on and restricted by different institutional contexts" (Söderholm et al., 2011, p. 1106). Further, it is "unlikely … that public policy of any significance could result from the choice process of any single unified actor" (Scharpf, 1978, p.347). Governance, conversely, benefits from its participatory nature of governing, which enables a thorough understanding of problems, conflicting values and beliefs and creates social support for policy measures (Driessen et al., 2001). Localised action and support is essential to supporting efforts of national governments in mitigating climate effects (UN-Habitat, 2011).

Taken together, the above indications suggest that any strategy aimed at governing the transition to low-carbon future has to address both technical structures and practices and political-institutional and socio-economic aspects. The fundamental challenge is to provide the enabling conditions for "system transformations and to stimulate, coordinate and steer the transitions in certain, desired directions while taking into account various interests and perspectives" (Söderholm, et al., 2011, p. 1107). This research project therefore looks into the challenges of undertaking and bringing LCUIs to scale. It also looks into urban policies that can be put in place by local governments to overcome barriers, create drivers and encourage state and non-state actors to advance LCUIs. ERHB is the LCUI under analysis in this study.

1.2 Knowledge gap

There is compelling need to advance the research on ERHB. Studies on the technical aspects regarding the construction design and retrofitting (e.g. ReFoMo, 2014; URBACT Programme, 2014; 3ENCULT Project, 2010; EFFESUS, 2012; New4Old, 2008) are being carried out with the aim to bridge the gap between the conservation of heritage buildings and climate protection, by means of furthering innovative solutions for conservation and energy-efficient refurbishment (van Rompaey, 2013). However, governing factors that influence this transition have not been thoroughly studied. The

platform between current technical studies on retrofitting and the necessary urban policies to boost its implementation is still absent.

Also, as previously mentioned, successful ERHB initiatives are oftentimes not applied at a large scale and do not lend themselves readily to climate mitigation policy launches. Thus, the question here is how to go from such incremental intervention to systemic and large-scale change (Bulkeley and Broto, 2013). Previous studies have investigated the transformation to low-carbon cities from contrasting scientific perspectives; however, these do not afford an all-inclusive overview of key drivers and barriers that are influencing the advancement of the initiatives (van Doren et al., forthcoming). A comprehensive theoretical framework on ERHB to enhancing the run towards low carbon cities is accordingly missing (Yung and Chan, 2012), which further complicates its scaling-up.

The research aspires to fill in the existing gap between current technical studies on ERHB and urban policies that are needed to be enacted to support the advancement of these developments – scaling-up. It specifically aims at affording recommendations to advance the initiative in the Netherlands, and optimistically on a European level. Further, it aims to contribute to the research conducted by ReFoMo by shedding light on the governance aspects of ERHB. An ultimate aspiration of this study is to build up to the LCUI literature, through the provision of a comprehensive overview of the underlying barriers and incentives that influence the advancement of ERHB.

1.3 Research objectives, questions and framework

If it has been demonstrated that ERHB offers great potential to mitigating CO_2 emissions, why has the approach not reached a large-scale implementation? If there are successful examples, what is exactly impeding the approach of scaling-up at the urban level? What urban policies can be applied by local governments to minimise these impeding factors and to boost the scaling-up of ERHB projects? This study attempts to provide answers to these rising interests. The objective of this research is threefold:

1. To explore the barriers and incentives related to the realisation of ERHB projects.
2. To identify prominent urban policies and its influence on the realisation of ERHB projects.
3. Based on these, to afford urban policies recommendations to bolster the scaling-up potential of ERHB projects.

The central research question of this study reads as follows:

How can urban policies contribute to the scaling-up of energy retrofitting of heritage buildings in the Netherlands?

The following sub-questions were elaborated to provide guidance throughout the research trajectory:

- What are the barriers and incentives in undertaking ERHB projects?

- What are the prominent urban policies applicable to ERHB?
- How do urban policies influence the realisation and scaling-up potential of ERHB projects?
- What are the differences and similarities in undertaking ERHB projects and in urban policies in place that address ERHB?

To provide answers to these questions, a conceptual framework based on the appropriate empirical and theoretical literature on ERHB, LCUIs and urban climate policies has been derived. The conceptual framework will provide a range of factors that are hypothesised to have an influence on the outcome of interest. These factors will be operationalised by means of singular or multiple indicators, which will allow observations on how each case performs with regards to the framework.

The structure of this paper is depicted in the Research Framework (figure 1). Chapter two provides a more thorough background on LCUIs, ERHB scaling-up and urban climate policies and delineates the framework of analysis for urban policy to scale-up ERHB projects. Chapter three introduces a list of explanatory variables identified from the literature review, which gives shape to the conceptual model. The theoretical framework is then applied to two contrasting studies in order to draw attention to differences and develop robust claims with respect to factors that influence the realisation and scaling-up of ERHB projects. More specific information regarding the case selection, data collection and analysis will follow in the methodology chapter four. Chapter five lays down detailed descriptions of the two selected contrasting cases. This is performed because an accurate descriptive analysis of each case study is necessary before the comparison can take place (Pickvance, 2001). Following, in chapter six a comparative analysis is performed, which will enable a thorough identification of similar and contrasting findings so that patterns can be discerned. Chapter seven answers the central research question and discusses the basic assumptions underlying this research. Finally, chapter eight provides a discussion around the limitation of the conclusions and recommendations for further research.

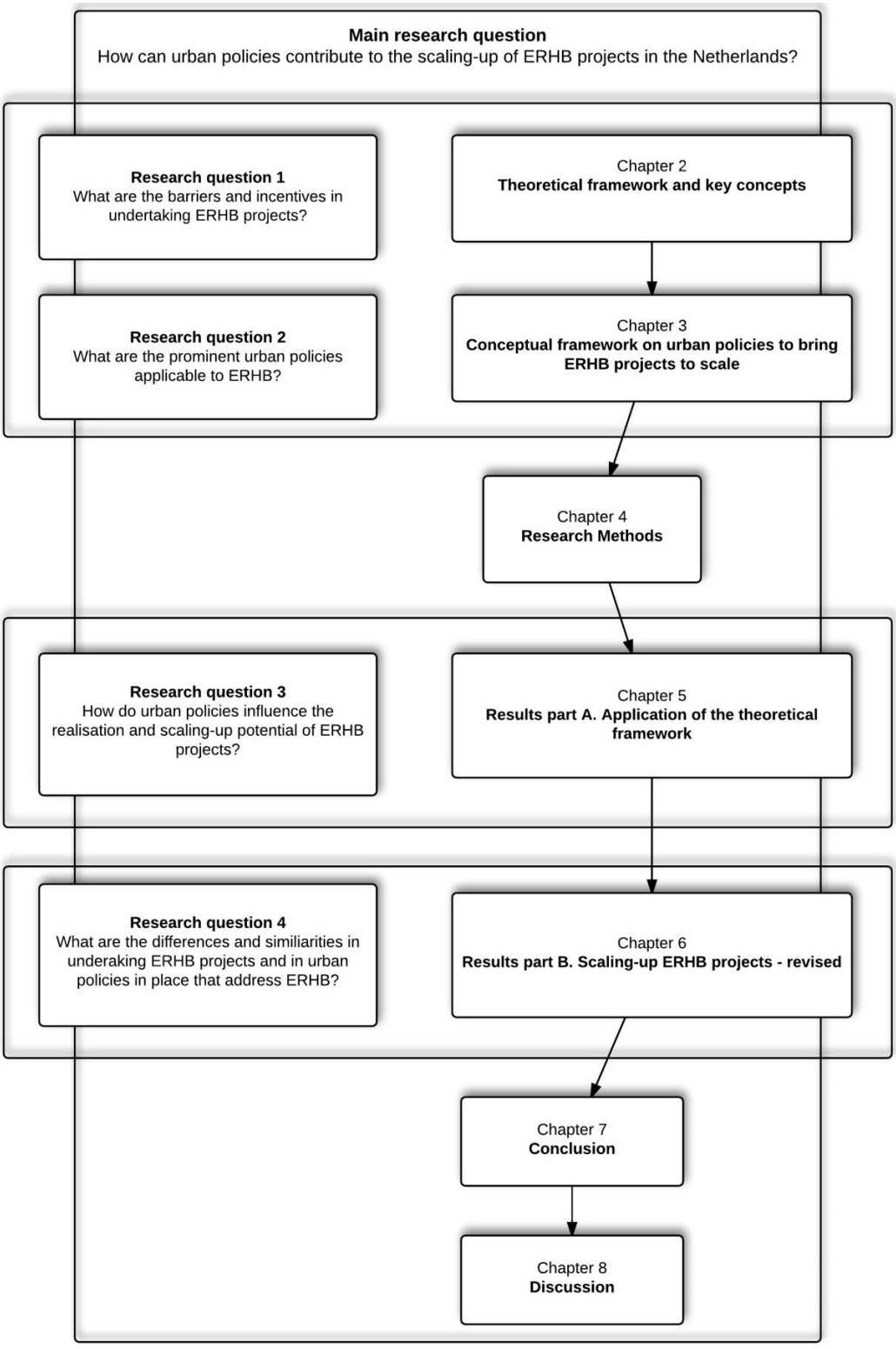

Figure 1: Schematic representation of the research framework and research questions.

Chapter 2: Theoretical Background and Key Concepts

This research is founded in two hypotheses. First, it is assumed that LCUIs necessitate going beyond "islands of excellence" to support efforts in bringing about climate-proof cities. Second, it is hypothesised that urban policies can influence the scaling-up process of LCUIs. The overall assumption is that urban policies can overcome barriers, create drivers and encourage state and non-state actors to bring about and scale-up LCUIs (see figure 2). In this study, ERHB is the LCUI under analysis. To support the investigation on how urban policies can contribute to bringing ERHB projects to scale, a conceptual framework has been assembled.

The theoretical basis for this framework stems from LCUIs, scaling-up and urban climate policy literature, and is supplemented with existing principles and themes from the literature and practice specific of ERHB projects. Particular steps were taken to assemble the theoretical framework, namely:

1. To identify factors that influence the realisation of ERHB projects, the conceptual framework of "low-carbon initiatives" by van Doren et al. (forthcoming) is applied. The LCUIs conceptual framework will undergo adjustments to accommodate the research objective.
2. To investigate how LCUIs can reach greater impact, the concept of scaling-up is introduced and delineated (Gonsalves, 2001; Hancock, 2003; Gillepsie, 2004; Douthwaite et al., 2013; Uvin et al., 2000).
3. To study how urban policies can facilitate the realisation and instigate the scaling-up of ERHB projects, literature on urban climate governance is reviewed (Betsill & Bulkeley, 2007; Bulkeley & Betsill, 2003; Bulkeley & Kern, 2006; Alber & Kern, 2003; Schreurs, 2008; Bai, 2007; Romero Lankao, 2007; Betsill, 2001).
4. To refine the framework, empirical papers reporting specifically on ERHB projects are reviewed (Kohler and Hassler, 2002; Gallant and Blickle, 2005; Ball, 2002; Godwin, 2011; Bullen and Love, 2010; Stubbs, 2004; Douglas, 2002; Van Beuren de Jong, 2007; ReFoMo, 2014; Climate-KIC, 2014).

The ensuing sections lay down the theoretical claims and concepts to assemble a framework on urban policies to scale-up ERHB projects. Figure 2 depicts the current research rationale. Following the incorporation of the theoretical claims, a conceptual model is introduced (Chapter 3) with an all-inclusive overview of influential factors. The conceptual model guides the analysis of the case studies and the dissemination of findings. It also supports the pursuit to conceive recommendations on urban policies that should be instituted by local authorities to incentivise the horizontal scaling-up of ERHB projects.

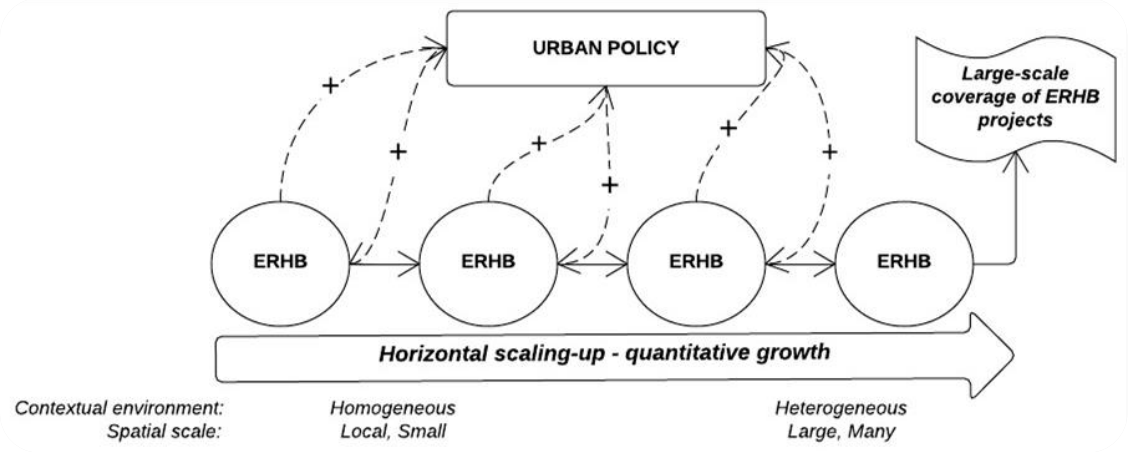

Figure 2: Illustrative representation of the underlying line of reasoning on urban policies to scale-up ERHB projects.

2.1 Low-carbon urban initiatives

The first phase to developing the theoretical framework comprises the identification of factors that are contributing to, or impeding, the scaling-up of ERHB projects. As ERHB is the LCUI under analysis in this project, it seems reasonable to clarify the concept of LCUIs for a thorough understanding of the issue in hand. This exercise is done closely in line with the study conducted by van Doren et al. (forthcoming), who structurally evaluate and explain the success and influence of LCUIs.

2.1.1 What does the concept of LCUIs mean?

There is currently no internationally agreed definition of the LCUIs concept, yet development through economy-wide decarbonisation certainly seems the common feature in all LCUIs. In this study, LCUIs are defined as initiatives at the municipal level that focus on the reconciliation between urban development and the mitigation of anthropogenic climate change. There are practically five *fields of activity* (see figure 3) in spatial planning in which LCUIs can be incorporated (Corfee-Morlot et al., 2009). These fields of activity stipulate the strategies in which LCUI could aim to alleviate CO_2 emissions. First, new approaches to energy policy have become prominent in local migration efforts to advance energy efficiency or promote renewable energy solutions. Second, efforts to improve public transportation systems or to promote alternative forms of transportation are identified. Third, waste and water management address mitigation through prevention, reuse and recycling. Lastly, efforts in urban land use and spatial structure sectors range from new standards for building to strategic planning of new neighbourhoods. ERHB, as an illustration of LCUI, is incorporated under the energy field of activity in spatial planning, suggesting that ERHB, at least ideally, should be addressed in the urban building regulations and energy policies, and more generally in urban climate mitigation strategies.

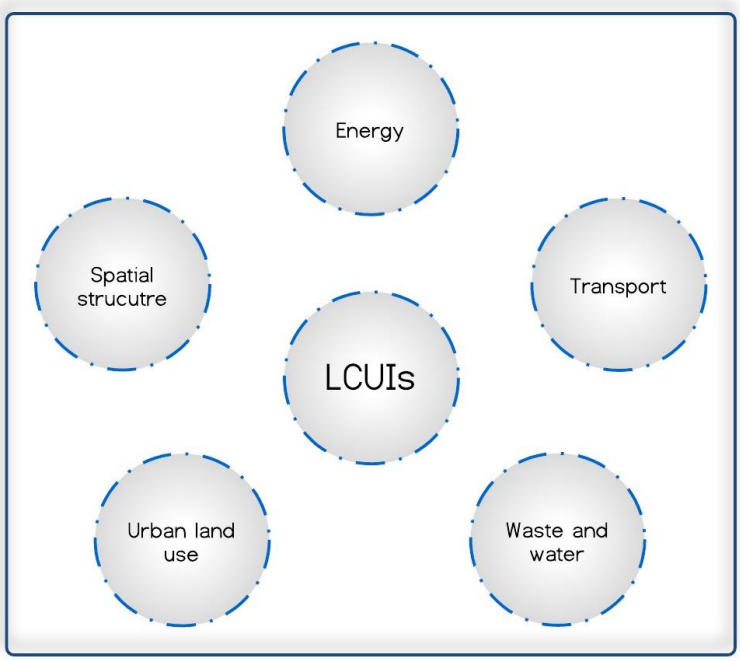

Figure 3: LCUIs fields of activity.

LCUIs can be characterised as interrelated systems of hardware (technologies contributing to climate mitigation); software (skills, instructions and knowledge to operate and maintain the project hardware and/or alter the behaviour to contribute to climate mitigation); and operational orgware (organisational structure of the initiative) (van Doren et al., forthcoming). Hardware represents the physical objects that are incorporated in technologies to mitigate climate impacts. Software encapsulates the information foundation of initiatives, including the required skills, knowledge or instructions to operate and maintain the project hardware (Dobrov, 1979; Rogers Everett, 1995). It also relates to behavioural changes to contribute to climate mitigation. It is argued that the hardware and software components jointly establish reactive strategies particular to LCUIs and can directly result in CO_2 mitigation, such as energy consumption reduction through energy efficiency and energy conservation, renewable energy and improved natural sinks (Lemos and Agrawal, 2006). Successful implementation of the hardware and software is dependent on the operational orgware system (Dobrov, 1979), as well as on the urban climate policy in place. The operational orgware refers to the relations and practices at the organisational level of the initiative (Dobrov, 1979). Urban climate policy refers to the external local governance capacity and formal and informal institutional environment at the sector and macro level (see Chapter 4). External trends refer to processes at the societal level, and together with the macro orgware, these can indirectly influence the successful realisation of LCUIs. For a visual illustration of LCUIs and its context, see figure 4.

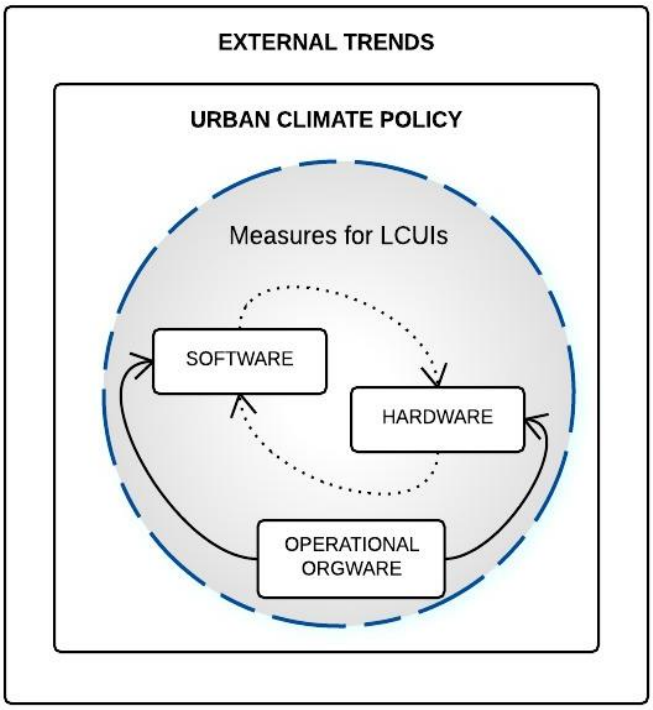

Figure 4: LCUIs and its interrelated systems adapted from: Van Doren, D., Driessen, P.J., Runhaar, A.C.H. & Giezen, M. (forthcoming). Identifying the factors that influence the scaling-up potential of low-carbon urban initiatives: towards a conceptual framework. Utrecht University, Faculty of Geosciences, Copernicus Institute of Sustainable Development. The Netherlands

LCUIs demonstrate that urban development can meet societal demands with little or no CO_2 (Mulugetta and Urban, 2010). Thus, a growing number of local governments have incorporated LCUIs in their agendas to diminish carbon emissions and energy use at the city level, which accordingly supports the realisation on their common climate targets. An example of LCUIs that is gaining increasing eminence for its attractive opportunities in alleviating CO_2 emissions is energy retrofitting of buildings, in particular, of heritage buildings.

The subsequent section introduces and elaborates upon the concept of scaling-up, which is one of the cornerstones of the analytical framework.

2.2 Scaling-up LCUIs

The second step to assemble the theoretical framework encompasses introducing and delineating the concept of scaling-up. Whereas ERHB is a representation of LCUIs, studying the initiative in the light of scaling-up is well-founded. The scaling-up framework is adjusted for the purposes of this study and is also expected to undergo further refinement during empirical data collection. The following sections are devoted to understanding the premises of scaling-up and to adapting the concept to this research.

2.2.1 What does the concept scaling-up mean?

The term scaling-up has been widely employed in the literature to explore how initiatives related – but not limited – to agricultural practices (Douthwaite et al., 2003), rural development (WB, 2003), community driven development (Uvin, 1995; Uvin et al., 2000; Gillespie, 2004) and energy transitions (Rotmans and Loorbach, 20060) can deliver greater impacts. There is, however, limited understanding of what the precise meaning of scaling-up is and more efforts are needed to further clarify the boundaries.

Scaling-up can entail the delivery of "more quality benefits to more people over a wider geographical area, more equitably, more quickly, and more lastingly" (Gonsalves, 2001). Oftentimes, scaling-up and related concepts (e.g. scaling-out, going to scale) are employed with reference to the replication, spread or adaption of processes, policies and systems (e.g. means). Scaling-up is also employed with reference to increasing the scale of environmental, socio-economic, or other impacts (e.g. ends). One acknowledged and coherent understanding of the scaling-up concept is going from a small to a large impact – even implied when referring to scaling up as means (Hancock, 2003). Small impact indicates that, regardless how effective a scattering of small-scale LCUIs are, wide-reaching action and realisation of ultimate objectives are not attained. Small-scale LCUIs necessitate going beyond "islands of excellence" to deliver its full potential and accordingly to advance their conclusive goal of furthering the run towards low-carbon cities. In this study, impact corresponds to the achievement of large-scale and institutional systemic coverage of ERHB at the municipal level.

2.2.2 Multiple dimensions and contexts: horizontal and vertical scaling-up

As observed, the scaling-up definitions are not free of ambiguity. In the literature, there is a high degree of controversy with respect to the terminology and concepts of scaling-up. Whereas some employ the concept of scaling-up as a synonym for dissemination, others understand it as the impact that interventions could have at a higher scale. So as to guide the study on scaling-up, this paper employs two main typologies to describe the concept: vertical and horizontal scaling-up.

Scaling-up can be conceptualized in hierarchical progression that facilitates goal attainment in two distinct ways: vertically and horizontally (Gonsalves, 2001; Hancock, 2003; Gillepsie, 2004) – both of which encompass direct and indirect pathways (Uvin et al., 2000). Vertical scaling-up refers to institutional and policy change approaches (Gonsalves, 2001) Horizontal scaling-up, in turn, refers to organizational growth approaches (e.g. expanding and implementing successful systems elsewhere) (Ibid).

For the purpose of this study, the horizontal approach to scaling-up ERHB will be emphasised, as the interest lies in looking at the replication and advancement of ERHB experiences. In the following, a more comprehensive overview of the horizontal scaling-up is elaborate upon.

Horizontal scaling-up

The horizontal scaling-up concerns the integrative or partial quantitative growth of an initiative (e.g. hardware and software) (Uvin, 1995; Hancock, 2003). Terms such as "diffusion" (Rogers, 1995) or

"broadening" (Rotmans and Loorbach, 2006), "organizational growth" (Hancock, 2003) and "spatial scaling" (Douthwaite et al., 2013) are used in relation to horizontal scaling-up. Horizontal scaling-up can culminate from spatial expansion of scale and growth of an initiative. It can also be the outcome of an initiative's replication to other geographical regions ("scaling out") (Douthwaite et al., 2003). Indirectly, horizontal scaling-up can result in the formation of joint venturing, partnerships, and integration of innovative "breakthrough" strategies and ultimately programmes (Uvin et al., 2000). It is in horizontal scaling-up process that the systems of hard- and software and operational orgware become apparent.

2.2.3 Synergies between urban climate policies and horizontal scaling-up

There is great potential for synergies between urban climate policies and horizontal scaling-up pathways (Douthwaite et al., 2003). As initiatives spread spatially, the greater are the chances that the initiative will influence those at the higher levels, and likewise, as an initiative goes to higher institutional levels, the greater are the chances for horizontal scaling-up. In other words, the more horizontal scaling up takes place, the greater are the chances that the initiative will captivate urban climate policies. Urban climate policies in turn transforms into a facilitative urban institutional context, thereby incentivizing horizontal scaling-up and the instigation of new initiatives. Both urban climate policy and the horizontal scaling-up process are therefore necessary to boost the development of LCUIs. As Lobo (1996) pointed out, urban policy and horizontal scaling-up have to be in harmony if these are to bring about a sustainable impact. Logo argued that:

"Up-scaling individual success stories to a larger scale calls for a perspective of macro management which at the same time has to be rooted in and be responsive to the micro level. Unless there is a continuous and enabling co-operation between the key sectors and actors such a process would be bound to get unstuck, thus seriously jeopardizing sustainability as well as replicability." (Lobo, 1996, pp.5)

In this study attention is devoted to the horizontal scaling-up of ERHB, considering no large ERHB implementation has been yet observed. The interest lies in looking at the expansion and advancement of ERHB experiences and to explore for factors that are influencing the achievement of large-scale coverage of ERHB at the municipal level. This process consists of analysing the hardware, software and operational orgware systems of the LCUI under scrutiny, which are assumed to influence the successful realisation of ERHB. The next step follows the identification of enabling conditions at the macro level to overcome barriers and incentivize the horizontal scaling-up of ERHB. As heretofore mentioned, initiatives remain little more than "boutiques" in an institutional environment that is not responsive to LCUIs (see Uvin et al., 2000).

2.2.4 What is exactly being scaled-up?

Hitherto, much scrutiny has been given to understanding the roots of the scaling-up concept and the different approaches it entails, yet little attention has been devoted to understanding what this study actually aims to horizontally scale-up. The problem that this research envisages to undertake concerns the small-scale implementation and impact of ERHB projects. But what exactly is being scaled-

up to achieve large-scale coverage of ERHB projects - processes, innovations, technologies, methodologies?

As heretofore mentioned, ERHB is an example of LCUIs (see 2.1). ERHB falls within the energy field of activity of LCUIs, which aims to improve energy efficiency or promote renewable energy solutions to ultimately boost local efforts to mitigating CO_2 emissions. Increasingly, innovative technologies are enabling the successful realisation of ERHB projects. These technologies could be regarded as the "spark" for the scaling-up debate; however, technologies alone cannot engender the scaling-up of ERHB projects. Previously, it was discussed that ERHB, as a representation of LCUIs, can be characterised by interrelated systems of hardware, software and operational orgware, which are essential for the success of ERHB projects. It is these interrelated systems of ERHB that this study aims to horizontally scale-up.

Nevertheless, scaling-up demonstrates to be a multidimensional process and can therefore not be scale-up in isolation (Gonsalves, 2000). As observed, urban policy and horizontal scaling-up should go hand in hand if LCUIs are to bring about sustainable impacts. The study therefore takes on this integrative approach to studying efforts in scaling-up ERHB: one that focuses on the processes, institutional modifications, policy innovations, as well as technologies. This positioning is consistent with the rationale that scaling-up is not only about replication, but about adaptation and learning (Gonsalves, 2000). In this research, it is therefore argued that the empirical assessment of ERHB projects and deduction of learned lessons have the potential to boost the horizontal scaling-up of the ERHB initiative.

The third step to developing the theoretical framework amounts to introducing and deliberating on the concept of urban climate policy, which is deemed crucial for the horizontal scaling-up of ERHB projects.

2.3 Urban policy for scaling-up ERHB projects

The third phase to developing the theoretical framework consists of the identification of the urban policy with which local authorities have sought to govern ERHB for its scaling-up. Urban policies are part of the urban contextual environment that can influence the success and the scaling-up of LCUIs. Urban policies in this study emerge in the form of local governance capacity and formal and informal institutions (these are described in detail in the following sections). Depending on the urban policies in place, these can act as barriers or drivers to the scaling-up of LCUIs. As ERHB is the LCUI under analysis in this project, it seems reasonable to study ERHB within the urban climate governance literature.

In this study, it is assumed that the overall climate mitigation interventions taken by the municipality at a strategic, policy and regulatory level can address the problematic of ad hoc retrofitting projects of many historic buildings. Urban policy can boost the implementation of ERHB on a wider scale, support the maintenance of local cultural heritage and change energy use to more efficient and sustainable approaches (3ENCULT, 2014). Thus, in this study it is argued that urban policies can overcome obstructions and create incentives for the scaling-up of ERHB. Yet, it is also expected that

these can emerge as barriers to the advancement of ERHB projects. It is therefore important to analyse what are the predominant urban policies in place and how these are influencing the implementation of LCUIs so as to designate best urban policies to sustain the scaling-up of ERHB. Hence, this research aims at the identification of urban policies that are most suitable for the successful realisation and scaling-up of ERHB projects.

In order to identify urban policies that can contribute to the scaling-up of ERHB at the municipal level, it is important to understand how successful ERHB experiences were brought about, and vice-versa. To undertake this exercise, it is necessary to explore how local governments address the uptake of ERHB projects: what policy instruments are in place to stimulate the urban up-scaling of ERHB projects, or the lack thereof; and whether local authorities have the capacity to govern ERHB.

The following sections discuss the realms of urban climate policy literature. Firstly, the domain of urban policy and climate mitigation is presented. Secondly, the domain of urban governance and climate mitigation is discussed. Thirdly and fourthly, urban policy is introduced in the form of local governance capacity and formal and informal institutions for ERHB are introduced. Finally, the different aspects of the identified urban policies are examined.

2.3.1 Urban policy and climate mitigation

Research on urban policy with respect to climate change has focused on the issue of climate change mitigation. Cities represent a conglomeration of economic and social activities that produce GHG emissions, particularly CO_2. As estimates suggest that cities account for 78% of carbon emissions from anthropogenic activities (Stern, 2006), a growing number of urban policy-makers and analysts highlight the significant role that cities have in addressing climate mitigation challenges. Indeed, in an increasingly urbanizing world in which cities are home of growing carbon emissions, it is important to scrutinize how local authorities and other stakeholder might best intervene so as to reduce their environmental impact. Cities are also appreciated for offering distinct set of governance opportunities and potential advantages. As cities advance in density, they become more energy efficient and socially productive (Glaeser, 2011).

Local governments have a level of influence over GHG emissions through their competencies in energy supply and management, transport, land-use planning, and waste management – LCUIs (see 2.1). In the energy sector, for instance, there is growing evidence that local governments are developing and extending their enabling role in the arena of energy retrofits. Cities are emerging as sites for growing innovative and governance capacity and are regarded central to scaling-up existing ad-hoc and intermittent retrofit initiatives (Eames, Dixon et al., 2013). In fact, local governments started to cooperate in transnational networks to strengthen GHG reduction efforts and learning, by means of combining their purchasing power to realize common goals such as enhanced energy performance of public buildings (e.g. C-40, 2008; Betsill and Bulkeley, 2007). In the land-use sector, planning has been used to promote the inclusion of energy efficiency measures and renewable energy in new buildings, and in some cases to mandate particular standards for domestic and commercial buildings, while

exceptions remain for heritage buildings. In general, research discloses that a growing number of cities have initiated more strategic bottom-up initiatives to add GHG reduction to city policy objectives (Bulkeley and Betsill, 2005; Betsill and Bulkeley, 2007; Shaw and Theobald, 2011).

It is important to underline that, as in every governance level, the urban level of action has its strengths and weaknesses. While some local governments have succeeded in elaborating a systematic approach to climate policy by means of undertaking GHG emissions inventories, determining emissions reduction targets, climate action and implementation plans, others have failed to pursue a systematic and structured approach, and implemented no-regret measures on a case by case basis instead (Kern and Alber, 2008). Further, in spite of the potential in alleviating GHG emissions in other fields of activities, research discloses that "attention remains fixed on issues of energy demand reduction" (Betsill & Bulkeley, 2007, p.450). In general, while the rescaling of climate change to the urban level presents numerous opportunities, it does however also suffer from critical limitations: urban innovative initiatives must be scaled-up, linked to one another and coordinated in a particular fashion so as to achieve meaningful aggregate effects (Gordon, 2013).

The following section elaborates on the debate of climate governance at the urban level and examines the factors are influencing the development and implementation of urban policy and planning for climate change mitigation.

2.3.2 Urban climate governance

Governance is an essential component in the achievement of effective climate planning and action (Anguelovski and Carmin, 2011). The concept of governance refers to the emergence of new styles of governing, in which the traditional boundaries between the public and the private sectors, and the national and international levels have blurred. As observed by Scharpf (1978) "It is unlikely […] that public policy of any significance could result from the choice process of any single unified actor" (p.347). Indeed, public policy is increasingly elaborated and implemented in "dynamic contexts where multiple actors interact at multiple levels" (Driessen et al., 2012, p.143; Scharpf, 1978). At any given time in contemporary policy elaboration processes, one can easily observe the presence of certain actor configurations, institutional and policy content components (Reen et al., 2011). It is this assemblage of actors, institutions and content what we generally refer to as *governance.*

While successful mitigation and adaptation call for measures to be taken by international and national actors, numerous initiatives are designed and implemented at the local level (Betsill and Bulkeley, 2003). *Urban climate governance* refers to the ways in which public, private and civil society actors and institutions articulate climate goals, exercise influence and authority, and manage urban climate planning and implementation processes (Birkmann et al., 2010; Betsill and Bulkeley, 2006; Holgate, 2007). It is through these processes that climate institutions, in the form of rules and norms, are instituted and maintained (Lemos and Agrawal, 2006). However, local governments are oftentimes constrained by certain institutional boundary conditions, including national energy and climate policies and legal authority and financial independence, which incur certain caveats (Azevedo et al., 2013).

There is, therefore, a paradox at the heart of this new-found conviction on the potentiality of urban responses to climate change.

On the one hand, concerns remain over the effectiveness of the local response. As highlighted by Betsill and Bulkeley (2007), the "gap" between the rhetoric and the reality of local interventions "remains stubbornly resistant to change" (p. 448). Some question whether the local government has the "jurisdictional scope" to effectively contribute to efforts in CO_2 reduction, while others point to the lack of collaborative frameworks necessary to integrate local, sub-regional and regional responses to climate change (Pearce and Cooper, 2009). The capacity of local authorities in ensuring the co-operation and involvement of a wide range of stakeholders to achieving CO_2 reductions is as well questioned (Shaw & Theobald, 2011). Research discloses that many carbon and climate-relevant decision-making processes and institution-building are fragmented, poorly coordinated and ineffective in handling complex mitigation and adaptation challenges and in escalating speed at the urban level (Biermann et al., 2009). Further, responses are seen to be shaped by a number of enabling and restraining external and internal factors such as leadership, competition and political time tables (Anguelovsky and Carmin, 2011). In essence, municipalities that have pursued a comprehensive, planned approach to climate governance are limited and far between and most have encountered significant barriers related to institutional capacity and political economy (Bulkeley, 2010; Kern and Alber, 2008).

On the other hand, the number of initiatives and interventions at the city level that seek to address climate change demonstrates to be rapidly proliferating (Romero-Lankao, 2012). Here, the increasing participation of agents such as international organisations, NGOs and individuals in climate-change responses might be influential. Scholarship demonstrates that these responses are increasingly occurring in a context of multilevel governance ranging from local to sub-national, national and international actors through the redistribution of state-functions upwards to international and transnational organizations and institutions; downwards to states, regions, urban areas and cities; and outwards to NGOs, civil organizations and other non-state actors (de Oliveira, 2009). Yet, this has been resulting in fragmented climate governance affecting the scaling-up of LCUIs. Recent analysis suggest that numerous cities, which have adopted CO_2 reduction targets, have failed to pursue a systematic and structured approach, and implement no-regret measures on a case by case basis instead (Kern and Alber, 2008). Indeed, local authorities who engage with an issue that lays outside their core competences turn to an enabling mode of governance that depends on discrete pots of financial assistance and on re-framing climate change as an issue related to core agendas, resulting in fragmented, case-by-case approaches to the development of LCU measures and initiatives (Bulkeley and Kern, 2006; Sanchez-Rodriguez, 2009).

Altogether, the literature reveals that numerous cities encounter governance challenges as they seek to initiative and sustain urban climate mitigation programs. Cities oftentimes fall short on political support, financial and human resources, and other forms of local capacity in their attempt to pursue climate mitigation (Romero-Lankao, 2007; Betsill, 2001; Burch, 2010; Robinson and Gore, 2005). The oscillating capacity of local authorities in governing climate change evidently influences the achievement

of effective climate mitigation at the urban level, and thus the advancement of LCUIs. The identification of the factors that are shaping the local capacity in addressing climate mitigation is an important exercise, if local governments are to upgrade their ability and create an enabling governing environment for the up-scaling of LCUIs, specifically of ERHB.

2.3.3 Local governance capacity for scaling-up ERHB

Despite the challenges, patterns related to successful urban climate governance are emerging. The factors that shape urban governance of climate change mitigation have been reported by a number of authors (Bulkeley, 2010; Kern et al., 2008; Betsill and Bulkeley, 2007; Bulkeley and Betsill, 2003; Bulkeley and Kern, 2006; Schreurs, 2008; Bai, 2007; Romero Lankao, 2012; Betsill, 2001). The work suggests that urban climate mitigation responses can be regarded primarily in terms of the development of new forms of policy and planning, thus processes of change are mainly driven by political and institutional processes. Within this work, LCUD have been understood substantially in terms of "policy change", which is facilitated or hindered by different factors, such as leadership, resources and capacity (Bulkeley et al., 2009). The identification of these factors is significant for it enables one to derive lessons on how best to stimulate the local capacity for scaling-up ERHB. Here, it is expected that once the governing capacity of local authorities is in place, the likelihood for scaling-up LCUIs is greater. This section reviews each in turn.

Political leadership

Leadership has been identified as a crucial factor shaping local capacity to act on climate change in two distinct ways. First, in terms of the role of individuals as leaders within a municipality, research has pointed to the roles of policy entrepreneurs and political champions in establishing climate change as an issue on urban agendas and in boosting innovative action (Bulkeley and Bestill, 2003; Bulkeley and Kern, 2006; Schreurs, 2008). The assumption suggests that the degree to which policy entrepreneurs and political champions can institutionalise the urban climate change agenda is critical to local governance capacity. The second relates to the available opportunities for municipalities to perform leadership roles with respect to their peer communities. It is argued that opportunities and means of recognition afford both incentives and reward for municipalities to react, and can enclose responses to climate change within the municipal culture, reinforcing trust. Leadership can be a central bridge between the LCUI and the external context. Having leaders who can govern the realisation of LCUIs is important for the success and scaling-up of ERHB, as they can motivate and coordinate stakeholders, create common visions, promote commitments, mobilize resources and enhance trust to invest in ERHB.

Trust in the policy framework

Another important factor identified from the literature is associated with trust. A stable political climate that supports climate mitigation action is more likely to encourage stakeholders to invest in LCUIs (Sullivan et al., 2013). Complex, changing or inconsistent policy instruments demonstrate to undermine trust in the policy framework (Hwang and Tan, 2012). Thus, trust by actors in the building sector is a relevant driver for the realisation and scaling-up of ERHB.

Resources mobilisation

Resources are another factor that is influencing the municipal capacity to govern ERHB. Here, resources incorporate the mobilisation of human financial assets with which local governments can deploy in relation to addressing and scaling-up LCUIs (Bulkeley et al., 2009; Bullen & Love, 2011a,b; Betsill, 2011; Hoffman & Henn, 2008). For instance, limited human resources can make a substantial difference to the extent and efficacy of measures to address climate change (Holgate, 2007). Likewise, inadequate financial resources can limit the provision of services. Cities have therefore the crucial role of securing additional funding to provide impetus for climate action (Bulkeley & Betsill, 2003; Bulkeley & Kern, 2006). Securing both external (e.g. national governments, EU) and internal (e.g. revolving energy funds or energy performance contracting) funding sources are determining (see Bulkeley and Kern, 2006). With respect to securing internal funds, the presence and ability of individual political leaders is significant, as these individuals are oftentimes responsible for establishing innovative financial mechanisms within municipalities (Bulkeley et al., 2009). Such schemes are priceless in overcoming the "inflexible budgetary structures" (Jollands, 2008: 5) for which local governments are generally renowned. As ERHB is considered to be a delicate topic and complex and costly process, the mobilisation of resources by local authorities is crucial for its scaling-up.

2.3.4 Formal and Informal Institutions to scale-up ERHB

In addition to the general issues of local governance capacity for scaling-up ERHB, specific challenges arise for LCUIs with regards to formal and informal institutions. Formal institutions are legally introduced and enforced by state institutions (e.g. laws and binding agreements). In turn, informal institutions depend on enforcement methods not supported by the state (e.g. rules of conduct, awareness raising campaigns, networks, etc.). Within the energy domain, governments have initiated policies to reduce energy consumption in buildings, which can be grouped into one of the following categories: regulatory instruments (e.g. codes or standards); economic instruments (e.g. taxes, energy pricing); and informative policy instruments (e.g. energy awareness campaigns, energy audits). Together, formal and informal institutions can either instigate or hinder the implementation and advancement of ERHB. These are reviewed in detail below.

Informative policy instruments

As local authorities conceive climate policies, they customarily formalise and institutionalise their work to facilitate implementation and invigorate legitimacy, coordination, and support for such policies across sectors and departments (Carmin, Anguelovski and Roberts, 2012; Romero Lankao, 2007). One facet of formalisation entails the institution of dedicated climate units within an important department or as individual and crosscutting office. These institutions can be seen as informative policy instruments, which are in place to facilitate information sharing and communication. Informative policy instruments make use of information and communication strategies to minimise existent perceived uncertainties and complexity of ERHB. For instance, the presence of dedicated climate units can support stakeholders with concise information on the different guidelines, regulations and policies in place that influence the implementation of ERHB. Informational devices such as eco-labels – provision of moral suasion through the provision of information about the environmental impact of particular products and

services to consumers, also demonstrate to be gaining increasing influence (Jordan et al., 2003). These instruments can induce demand for ERHB if well employed (Azevedo et al., 2013; Hofman and Henn, 2008; Hwang and Tan, 2012; Williams, 2013).

Regulatory policy instruments

Essential to the institutionalisation of urban climate action is the materialization of regulations, policies, codes and support programs. These institutions are in place to provide both the informal behavioural norms and formal guidelines that increase predictability, establish order and promote cooperation (Ostrom, 1990). Regulatory instruments are a straightforward driver that creates certainty for investors and lead directly to the attainment of climate mitigation goals, hence are important drivers for the realisation and scaling-up of LCUIs (Azevedo et al., 2013; Betsill, 2001; Schreurs, 2008; Williams, 2013; Yao et al., 2005). Regulatory instruments are emerging in the form of building codes, standards for minimum energy performance (e.g. European Standards Body), directives, binding legislative acts, etc. For instance, building retrofitting is a domain where mitigation institutions are increasingly emerging. Local governments are shaping energy efficiency through the establishment of building codes, offering financial incentives to builders and developers, and development of training programs to support contractors in learning about energy-efficient materials and new construction techniques (Mairie de Paris, 2010). Yet, the presence of building codes oftentimes also obstructs the realisation of ERHB projects due to stringent ruling. Thus, policy instruments should be employed to *incentivize* stakeholders in carrying out ERHB and its scaling-up.

Economic policy instruments

Economic policy instruments are the "myriad techniques at the disposal of governments to implement their policy objectives" (Howlett, 1991: 2). A full arsenal of (new) economic instruments need to be employed to mitigate climate change, adapt to the irreversible impacts, and minimize unequal distribution of benefits and costs, while maintaining city competitiveness and economic security. The deployment of "new" environmental economic instruments (Jordan et al., 2010) has grown in recent years, namely: eco-taxes and market-based instruments (MBIs) - taxes, subsidies, tradable emission permits, deposit-refund schemes (OECD, 1998). Similar to the regulatory instruments, economic policy instruments can also be restraining to the up-scaling of ERHB (e.g. carbon taxes). As effectuating ERHB is frequently perceived to be costly, economic instruments should be strategically employed to positively influence the financial advantage of the realisation and scaling-up of ERHB (Azevedo et al., 2013; Williams, 2013; Bullen and Love, 2010; Bullen and Love, 2011a,b; Yao et al, 2005).

Voluntary agreements

Voluntary agreements (VAs) are commitments undertaken by businesses and sector associations as the aftereffect of negotiations with public authorities (EEA, 1997). VAs emerge in the form of codes of conduct, covenants or negotiated agreements (OECD, 1998), and have the potential to reduce uncertainty and thus encourage professional actors to carry out ERHB, accordingly promoting its up-scaling (Jordan et al., 2013; Chmutina et al., 2014; Yao et al., 2005).

2.3.5 Synthesis

In sum, the literature review discloses that critical challenges for contemporary urban climate governance rest notably on developing knowledge and capacity for public agencies, the private sectors and multiple users in city regions to systematically re-engineer their built environment. Cities still face considerable barriers in co-ordinating policy action, accessing sufficient resources, operating in the context of regulatory frameworks that tend not to facilitate local action, and in often conflicting political timetables. Yet, there are a range of policy means with which local authorities can address the problematic of ad hoc LCUIs, particularly of ERHB projects. These can emerge in the form of local governance capacity and formal and informal institutions, and should be accommodated to incentivize the uptake and scaling-up of ERHB. As previously stressed, in an institutional environment that is not responsive to LCUIs, initiatives remain little more than "boutiques" (see Uvin et al., 2000). Thus, the identification of urban policies to overcome barriers related to the hardware, software and operational orgware of ERHB projects is a fundamental step towards its scaling-up.

Finally, in the following section the concept of ERHB is further deliberated upon so as to refine the analytical framework of urban policies to bring ERHB projects to scale.

2.4 Energy retrofitting of heritage buildings – ERHB

The following sections are devoted to comprehending the ERHB domain. Firstly, it gives an introduction to the European built heritage, delineating the definition and characteristics of heritage buildings. Components of the software and hardware systems of ERHB are disclosed in this section. Secondly, it stresses the necessity of retrofitting for heritage buildings and introduces other contemporary concepts that further accentuate impetus for retrofitting heritage buildings. Lastly, it presents the identified hindrances that are affecting the implementation and advancement of ERHB.

2.4.1 The built heritage

The European building stock is characterized by a unique heritage consolidation, providing significant opportunities but also posing numerous challenges. According to UNESCO, there are three principal heritage classifications: cultural, natural and heritage in the event of armed conflict. Cultural heritage encompasses both tangible (e.g. paintings, monuments or shipwrecks) and intangible (e.g. oral traditions or rituals) aspects. The cultural heritage sector is among the most attractive European economic drivers. It creates millions of jobs and is essential to the three economic sectors that contribute most to EU GDP; to the Cultural and Creative industries, the Real Estate activities and the Tourism industry (Nypan, 2009). Natural heritage comprises natural sites with cultural aspects, such as landscapes, physical, biological or geological formations. The concept of heritage in the event of armed conflict emerged from The Convention for the Protection of Cultural Property in the Event of Armed Conflict as a consequence of the massive destruction of the cultural heritage in the Second World War. The classification covers movable and immovable cultural heritage, constituting monuments of architecture, art or history, archaeological sites, works of art. Heritage is thus the legacy of the society

that is constitutional from past generations, cultivated in the present and given for the prosperity of future generations.

The value of a heritage building – also referred to as *historic building* in this study - lies in its architectural value, and in all the distinct aspects that together form its cultural significance or cultural heritage values. Alois Riegl (1929) developed a systematic categorization of the divergent monumental attributes, in which he incorporated historic value, artistic value, age value, commemorative value, use value and newness value. More recently, the Burra Charter (The Australia ICOMOS Charter for Places of Cultural Significance, 1999), which has been widely adopted as standard guidelines for heritage preservation practices, describes cultural significance as follows: "Cultural significance means aesthetic, historic, scientific, social or spiritual value for past, present or future generations." The simplest definition of a heritage building is related to three peculiarities (Georgia Department of Natural Resources, 2014): to be regarded as heritage, "a property must have sufficient age, a relatively high degree of physical integrity, and historical significance". In this paper, heritage buildings are defined as buildings built before 1945, holding a historic, monumental or iconic importance for the city.

Historic buildings are thus not only embodied energy and carbon, as many perceive. Historic buildings are a finite resource and their existence is integral to the identity and spirit of a country. Hence, there is a need to explore the possibilities of transforming our heritage building to ensure their sustainability and prolong their life expectancy, whilst contributing to CO_2 neutrality (LivingGreen.eu, 2010). The strategy should entail more than just "after-insulation". It should be the basis of an integral approach that contributes to the sustainable preservation of architectural heritage and local distinctiveness. Much thoughtfulness must be injected to achieve a balance between adapting historic buildings to modern performance standards and sustainability requirements (Godwin, 2011). Yet, finding this balance demonstrates to be a demanding exercise.

2.4.2 The characteristics of heritage buildings

Historic and traditional buildings have different behaviour characteristics when compared to modern construction, and every alteration must be undertaken with great sensitivity to the preservation of the unique qualities of the individual building and with thorough understanding of the building physics implications. This suggests that some characteristics of historic buildings can be "hard to treat" (ChangeWorks, 2008). Usually, a building of historic interest normally holds an exemplary stance of a building type, construction style or bears some historic or architectural significance that benefits the character of an area and provides society with an overall feeling of foundation. It may as well exhibit examples of building techniques, materials or design that remain instructive for ongoing and future developments. A crucial consideration with respect to building conservation is the retention of the original fabric[2] and the integrity of historic buildings. In spite of the fact that the greatest effort in

[2] Fabric comprises building interiors and subsurface remains as well as excavated material. Fabric may characterise spaces and these may be relevant elements of the significance of the place. ICOMOS Australia, The Burra charter: *http://australia.icomos.org/wp-content/uploads/BURRA-CHARTER-1999_charter-only.pdf*

enhancing ERHB can come from the way people use it, alterations in the fabric of buildings is anticipated to have the biggest effect on a historic building's appearance and character (Godwin, 2011). Windows, walls, roof, floors and doors, materials, and cleaner and greener technology are among the most contentious issues in the conservation of historic buildings (for thorough overview, see Almeida *forthcoming*).

In general, the conservation of historic buildings, either comprehensively or by simply re-using elements in-situ and enabling their thermal upgrading in benign ways, can afford optimal results that are in line with the principles of building conservation and sustainability. Substituting existing buildings for new ones demands a substantial investment of "embodied energy"[3], generally equivalent to five or ten years of building (Godwin, 2011). The retention of the existent building stock, particularly when energy consumption performances can be improved, is unequivocally favoured in alleviating environmental impacts. Heritage buildings are under increasingly pressure to minimize carbon emissions, which essentially resolves around energy efficiency and conservation (Godwin, 2011; Tomás, Carvalho and Coelho, 2010).[4] Heritage buildings require retrofitting processes, yet a balance needs to be drawn between modifications to facilitate and advance energy efficiency and efforts to protect the special architectural and historic features of a building (Kohler and Hassler, 2002; Gallant and Blickle, 2005; Ball, 2002; Godwin, 2011; Bullen and Love, 2010; Stubbs, 2004; Douglas, 2002; ReFoMo, 2014).

2.4.3 Energy retrofitting and heritage buildings

The idea of *adapting heritage buildings for the future*, or ERHB, is a growing trend that has been appreciated by many authors (Kohler and Hassler, 2002; Gallant and Blickle, 2005; Ball, 2002; Van Beuren de Jong, 2007; ReFoMo, 2014; Climate-KIC, 2014). This trend is appealing for it prolongs the useful life of existing buildings and boosts sustainable urban development by means of lowering energy consumption, pollution and material use (e.g. Cooper, 2001; Douglas, 2002; Gregory, 2004; Balaras et al., 2004; Kurul, 2007). These environmental benefits, integrated with the economic and social advantages of increasing energy efficiency of heritage buildings, make adaptive reuse of an imperative element of sustainable development (DEH, 2004).

Adaptive reuse can be broadly described as "any building work and intervention to change its capacity, function or performance to adjust, reuse or upgrade a building to suit new conditions or requirements" (Douglas, 2006). It involves transforming a building for a particular use and this transformation may require the complete renovation and/or refurbishment of existing buildings and structure (Latham, 2000). Alterations to buildings may include major internal space reorganisation and service replacement or upgrades. It also may simply require minor restoration works, where nothing is modified expect the functional use of the building use. When applied to heritage buildings, adaptive

[3] Embodied energy is the energy consumed in extracting, processing, manufacturing, transporting and installing building materials or equipment, which when considering between refurbishing or repairing an existing building and re-development, requires much scrutiny.

[4] Tomás, N,, Carvalho, A., Coelho, D., Renewable Energy Integration in Buildings: A Case Study in Portugal, International Conference on Renewable Energies and Power Quality (ICREPQ'10), 23th to 25th March, Granada (Spain), 2010

reuse does not only maintain the building but conserves the skill, effort and dedication of the original builders (Love and Bullen, 2009). The approach also protects the architectural, cultural, historical and social values (Latham, 2000). As Cooper (2001) asserts, the outcomes of adaptive reuse comprise advancements in resource and material efficiency (environmental sustainability), retention (social sustainability) and cost contractions (economic sustainability). In general, adaptive reuse has various aspects, one of which is the central focus of this study: energy efficiency retrofitting.

Many terms are used in the literature to refer to the work needed to upgrade energy efficiency and the environmental performance of heritage buildings. Commonly used terms are – but not limited to – "retrofitting", "refurbishment", "adaptation", "upgrading", and "reconstruction" (see Almeida, *forthcoming*). In this paper, retrofitting is the term utilised. To retrofit literally indicates providing an element or feature not fitted during manufacture or adding something that did not exist when first constructed (Eames et al., 2013). It is usually associated to the installation of new systems but may as well refer to the fabric of a building, such as retrofitting insulation, windows and walls. Retrofit is regarded necessary to upgrade buildings to new requirements, that is, to improve their energy and environmental performance.

Retrofitting is being increasingly acknowledged as an effective strategy to improve the sustainability of existing buildings (Kohler and Hassler, 2002; Douglas, 2002; Ball, 1999). One underlying motives for the increased interest in adaptation is the perception that old buildings are oftentimes more economically advantageous to convert to new uses than to rebuild or demolish (Douglas, 2002; Ball, 2002; Gregory, 2004). The conservation of the historic building stock has demonstrated effectiveness in reassuring sustainability of the built environment, principally as a result of performance upgrading (Kohler et al., 2013; Bromley et al., 2005). Myers and Wyatt (2004) accentuate the value of sustainability for building stocks in augmenting its economic, social and cultural capital, stressing therefore that corresponding opportunities should not be missed out.

Overall, the objective of retrofitting a particular building rests on reducing energy consumption by means of upgrading its energy performance, minimizing carbon emissions of its operations and extending the building life cycle. The strategy is thus to decrease the energy demand through thermal improvements of the building envelope, curtailment of heat losses in heat distribution systems and sources, and partial or total replacement of heat sources. Through the improvement of indoor thermal comfort of the building and its air quality, and the reduction of energy demand and dependency on fossil fuels in a cost-effective fashion, delivering climate-proof heritage buildings while satisfying the needs of contemporary societies is very likely attainable.

In the case of heritage buildings, retrofitting envisages the achievement of enhanced energy performances while maintaining satisfactory services levels and indoor thermal comfort that are suitable for contemporary lifestyles (Moran et al., 2013; Ma et al., 2012). According to Aikivuori (2006), historic buildings should undergo retrofitting when: i) building deterioration has been resulting in a building failure; ii) building usage has changed; iii) improved energy efficiency is to result in economic

optimization; iv) the subjective features of the decision maker are in place; and/or v) circumstances have changed. In sum, ERHB is a compelling strategy to not only reduce their carbon emissions and improve cost efficiency, to extend their life cycle and tailor buildings to new applications, but also preserve fundamental heritage values (Yung & Chan, 2012).

2.4.4 Barriers to ERHB

In spite of the acknowledged potential ERHB have in climate mitigation, efforts have been piecemeal (Bulkeley et al., 2009) and successful experiences are oftentimes not applied at a larger scale, or in additional cities. This drawback is mainly owed to the complex nature of ERHB processes. Numerous technical barriers concerning ERHB have been identified. ERHB requires a minimal impact on the heritage prestige of the building and its setting, as well as the introduction of a contemporary layer that adds value for the future (DEH, 2004). Thus, its employment should be a compatible use (ICOMOS, 1999) in which interventions with the fabric are lessened. Building owners and practitioners are further reluctant to ERHB due to problems associated with health and safety, increase maintenance and rental returns, inefficiencies in spatial layout and commercial uncertainty and risk (Shipley et al., 2006; Remøy and van der Voordt, 2007; Kurul, 2007; Bullen, 2007; Bullen and Love, 2010). All these aspects are influential to the hard- and software systems of ERHB.

At the European Union level, rules and standards that address ERHB are lacking, regardless of the great potential the building market offers in supporting LCUD endeavours. Historic buildings are not taken into account in the EU Energy Performance of Buildings Directive (EPDB, 2010), and Member States are delegated the responsibility to set adequate energy efficiency levels. This resolution is based on the contrasting features historic and traditional buildings have (*hardware*), which sets forward the question of how realistic it would be to deliberate about standards and certificates, considered that there are no "one-size-fits-all" solutions. Consequently, systematic knowledge, certificates and standards on ERHB do not yet exist (*software*), resulting in millions of Euros spend on restoration of historic buildings without (or unsuccessful) any implementation of climate solutions (ReFoMo, 2014).

Another major identified drawback concerns the predominant urban climate policy in place. Many building developers and owners still regard ERHB as an impractical option due to planning and building rules and regulations, which oftentimes restrict its functioning (Bullen and Love, 2010). Further, the possibilities for ERHB are not acknowledged by owners and heritage experts, and sometimes not even welcomed. The integrity and historic values of buildings continuously play a crucial role in determining the retrofitting of historic buildings (ReFoMo, 2014). Lastly, actor configuration features, e.g. mobilising networks of economic stakeholders, assisting the identification of opportunities for the local economy, participating in structuring the local market for eco-restoration and stimulating demand are main challenges for partners in encouraging future-proof historic buildings (Lewis et al., 2013).

Altogether, the review discloses that ERHB is not a straightforward process. Although successful ERHB experiences are in place, the literature reveals that numerous barriers in implementing and furthering ERHB prevail. These barriers necessitate to be overcome if ERHB is to be more than just little

"boutiques" (see Uvin et al., 2000) and accordingly bring about its reassuring benefits. In the following chapter, the conceptual framework on urban policies to bring ERHB projects to scale is introduced.

Chapter 3: Conceptual framework - Urban policy to scale-up ERHB projects

To investigate factors that can bring about the horizontal scaling-up potential of ERHB projects, it is firstly important to examine what factors in the soft- and hardware, and operational orgware systems of the LCUIs have enabled the successful realisation of former ERHB projects. It is anticipated that these success factors should be in place when replicating or spreading the initiative at the municipal level. Here, "success" corresponds to improved energy performances in heritage buildings. In this study, it is assumed that a determining factor that can support the success and enhance the likelihood of horizontal scaling-up of ERHB projects amounts to urban policy.

The potential for horizontal up-scaling of ERHB projects is highly dependent on the urban policy in place. Thus, to explore how the scaling-up of ERHB can be realised, it is important to study how local governments are undertaking ERHB projects. Put differently, it is necessary to study what urban policies are in place. In this study, it is argued that urban policies can overcome obstructions related to the systems of software, hardware and operational orgware of ERHB projects and create incentives its scaling-up, but these might as well emerge as barriers. Hence, the analysis of predominant urban policies and their respective influence on the implementation of ERHB is essential if one is to single out best policies that can boost the horizontal scaling-up of ERHB projects.

Built on the knowledge from the previous chapters, the conceptual framework is in the following conclusively compiled and introduced.

3.1 Conceptual framework: explanatory factors

Building on the literature review of the previous chapters, this chapter provides a summary of the identified factors that are contributing to, or impeding the realisation of ERHB, and their respective operationalization in the form of a conceptual framework. The conceptual framework consists of four sets of explanatory systems that correspond to the distinctive dimensions of LCUIs (van Doren et al., *forthcoming*), which in this study are adjusted to the specific case of ERHB: hardware and software; operational orgware; urban policy, which emerges in the form of: local governance capacity and informal and informal institutions; and external trends.

In the following, the identified explanatory factors from the literature review and their underlying presupposed influence on the scaling-up ERHB initiatives are disclosed. The identified explanatory factors are categorised in correspondence with the four interrelated LCUIs systems. It is important to accentuate that this exercise is a mere attempt to develop a typology exclusive to ERHB.

3.1.1 Hardware and Software Systems

The first set of factors that are assumed to influence the successful realisation and the scaling-up of LCUIs relate to the hard- and software characteristics of the ERHB.

Cost efficiency

The decision to retrofit a heritage building is highly driven by economic considerations: the relative costs, related benefits and constraints of investing in retrofitting versus demolition are pondered. Project developers and end-users mainly regard the construction and whole cycle costs of the project. Investment returns in short-term periods are mostly desired. The economic sustainability can act as a driver or barrier for the realisation and horizontal scaling-up of ERHB (Hall, 1998; Douglas, 2006; Kohler and Yang, 2007; Nasser, 2003; Steinberg, 1996; Hunt and Rogers, 2005; Hoffman and Hen, 2008; Zhang et al., 2011; Holyoake and Watt, 2002; Ball, 2002; Shipley et al., 2006).

Environmental performance of the building

Environmental upgrading of existing buildings is a critical part of in-situ reuse, as it supports the reduction of GHG emissions and carbon footprint (e.g. energy efficiency, waste management, water conservation, reuse of materials). The importance of ERHB is being increasingly accentuated, and its environmental performance demonstrates to determining in the realisation of ERHB (Balaras et al., 2004; Langston, 2010; USGBC, 2000; Getty Conservation Institute, 2011).

Physical attributes

Physical compatibility relates to the building design. The physical attributes of a building were found to be an influential factor in the decision to undertake ERHB. Considerations that needed to be taken into account are dimensional characteristics (e.g. physical footprint, dimensional flexibility, size of floor plate), aesthetic appeal, comfort, decoration and building purpose (DEH, 2004; ICOMOS, 1999; Murtagh, 2006; ReFoMo, 2014; Bullen and Love, 2010; Bullen and Love, 2011; Lewis, 2013; Mickaityte et al., 2008).

Heritage significance

There is considerable value attached to retaining the style and character of historic buildings, and conservation prevents irreversible loss of heritage. Successful ERHB projects are those that respect and retain a building's significance. The challenge is how to achieve this without damaging the intrinsic architectural or historic character and significance of a building or structure (Douglas, 2006; Love and Bullen, 2009; Bullen and Love, 2010; Bullen and Love, 2011a, b; DEH, 2004**).**

Cultural significance

Feeling of belonging and attachment to the place are identified as the central motivational forces behind the decision to retrofit a historic building. A barrier that might arise in ERHB is ensuring retrofitting without changing the common cultural identity of the location. Cultural compatibility is an important factor for the realisation of ERHB (Stubbs, 2004; Yuen, 2006; Tweed and Sutherland, 2007; Bullen and Love, 2011a, b).

Social compatibility

The compatibility of ERHB measures with the values, lifestyles and demands by the adopting community, can positively influence the success project. ERHB can provide the community with new housing and commercial opportunities. Visual amenities, location, access to public transport and an assemblage of occupancy usage with contemporary image are factors that can contribute to the social compatibility of ERHB (Steinberg, 1996; Rodwell, 2003; Nasser, 2003; Stubbs, 2004; Tweed & Sutherland, 2007; Bullen & Love, 2011a, b).

Technical compatibility

The installation and implementation of green technologies in historic buildings are oftentimes difficult and can retard the energy retrofitting process. When measures are difficult to implement, the potentiality for horizontal scaling-up is deemed to be weaker. Additionally, complexity increases the chance that measures at not implemented correctly, thereby obstructing the attainment of climate mitigation targets (Rogers, 1995; van Bueren and Priemus, 2002; Zhang et al., 2011; Stieß and Dunkelberg, 2013; Love and Peter, 2011a, b).

Economic advantages

Additionally, the extent to which the ERHB project induces tourism is seen as a measure of economic success, and is influenced by the local character of the district. Economic viability highly influences the decision-making of EERH projects (Larkham, 1996; NSW Department of Planning and RAIA, 2008; UNESCO, 2007; Murtagh; 2006; English Heritage, 1997; Feilden and Jokilehto, 1998; Nasser, 2003; Tweed & Sutherland, 2007).

3.1.2 Operational orgware

The second set of factors is associated with the organisational structure of the ERHB.

Stakeholder participation

Stakeholder participation refers to the participation of the representatives of organizations, communities, interest groups that have a direct interest in LCUIs. Collaboration enables parties to exchange their experiences, perceptions and interests regarding the LCUIs. Through participation in negotiations and reflections on institutional adjustments, stakeholders can also support mainstreaming of ERHB initiatives, by ensuring that the tenets of sustainability are met (Lewis et al., 2013; Van Bueren and Priemus 2002; Chmutina et al. 2014; Feige et al., 2011; Woolthuis et al., 2013; UN Habitat, 2004; Yuen, 2006).

Mutual interests

In undertaking ERHB projects, the different stakes of the different actors might be act as a barrier or incentive. Conflicts might emerge between the interests of the monument conservationist and the owner, who pursues economic interests with respect to the historic building. Contrasting interests can be a burden to the scaling-up ERHB, as it can retard the ERHB process or even impede its complete realisation (Linares and Labandeira, 2010; Go Solutions, 2014).

Leadership

A person who guides or directs a group in realizing the initiative is deemed important for the success and scaling-up of LCUIs. Leaders can motivate and align stakeholders' interests, create a common vision, promote commitments, facilitate communication, mobilize resources and enhance confidence in the initiative (Chmutina et al., 2014; Van Bueren and Priemus, 2002).

Communication between actors

In all stages of ERHB implementation, communication and interaction demonstrate to be highly recommended (ReFoMo, 2015; Go Solutions, 2014) Communication refers to information and ideas exchange within the project team (internal communication) or with the external actors (external communication). External communication is important to involve stakeholders and mobilize their respective resources. External communication is also important to communicate clients about the benefits of ERHB and foster demand (Cooke et al., 2007). Internal communication is required to discuss about climate mitigation goals, share ideas and foster learning about the principles of LCUIs (Hwang and See Tan, 2012).

Resource mobilisation at the micro level

The mobilisation of financial, human, information, technical and natural resources is needed for the successful realisation and horizontal scaling-up of EHRB. Feasibility studies afford the required information in the initiation and planning phases concerning social compatibility, technical compatibility and cost-efficiency of the project. The mobilisation of human resources is critical in the planning and carrying out of ERHB projects. Availability of suitably qualified craftsmen locally or even nationally demonstrates to be an obstruction. Expertise and capacity of actors to execute retrofitting has to be adequate its realisation on heritage buildings. The availability of natural resources can influence the realisation of ERHB projects and fragmented land ownership can act as a hindrance to the horizontal scaling-up (Hoffman and Henn 2008; Hunt and Rogers 2005; Bullen & Love, 2011a, b; Travezan, 2012).

3.1.3 Urban policy

The third set of factors consists of formal and informal institutions and the local governance capacity at the urban environmental context. In view of these factors already have been presented (see 2.3), here these are only briefly illustrated in table 1 below.

Formal & Informal Institutions	
Informative policy instruments	Carmin, Anguelovski and Roberts, 2012; Romero Lankao, 2007; Azevedo et al., 2013; Hoffman and Henn, 2008; Hwang and Tan, 2012; Williams, 2013.
Regulatory policy instruments	Azevedo et al., 2013; Betsill, 2001; Schreurs, 2008; Williams, 2013; Yao et al., 2005; Mairie de Paris, 2010.
Economic policy instruments	Azevedo et al., 2013; Williams, 2013; Bullen and Love, 2010; Bullen and Love, 2011a, b; Yao et al, 2005.
Voluntary agreements	Jordan and Lenschow, 2010; Chmutina et al., 2014; Yao et al., 2005.
Local Governance Capacity	
Political leadership	Bulkeley and Bestill, 2003; Bulkeley and Kern, 2006; Schreurs, 2008.
Trust in the policy framework	Sullivan et al., 2013; Hwang and Tan, 2012.
Resources mobilisation	Bulkeley & Betsill, 2003; Bulkeley & Kern, 2006; Bulkeley et al., 2009; Bullen & Love, 2011; Betsill, 2011; Hoffman & Henn, 2008; Holgate.

Table 1: Formal and informal institutions and local governance capacity

3.1.4 External trends

The last set of factors is related to the external trends and events that indirectly have an influence on the scaling-up of ERHB.

Market demand

Historic buildings are usually demolished because they no longer have any value. Oftentimes, it is the market that determines this value, albeit such an evaluation may be grounded on incomplete information with no consideration given toward externalities. Thus, market demand can negatively and/or positively impact the scaling-up of ERHB (Petersdorff et al., 2006; Kohler and Yang, 2007; Bullen and Love, 2010; Murtagh, 2006).

Environmental awareness & societal values on sustainability

Numerous stakeholders share a conservative position that is averse to risk-taking. This results in contexts that are highly resistant to change, innovation and to government interventions. Demand for LCUIs is unsatisfactory due to the enduring uncertainty about climate change impacts, complexity (or lack of understanding) of innovative technologies, costly implementation processes and etc. It is argued that environmental awareness and societal values on the importance of sustainable development can strengthen the understanding of essentiality of LCUIs. It can consequently facilitate the demand and thus the scaling-up of ERHB (Lovell, 2005; Barlow and Ozaki, 2003; Vermeulen and Buch, 2005; Schimschar et al., 2011).

Altogether, the review discloses that scaling-up ERHB is not a straightforward process. Numerous factors from the four interrelated LCUIs systems are exerting influence on the successful realisation and scaling-up of ERHB projects. These factors are either contributing to or obstructing the process of horizontal scaling-up. The identified explanatory factors demonstrate to be oftentimes interdependent and are influencing the scaling-up processes interactively. If ERHB is to achieve large-

scale and systemic coverage at the urban level, special examination of these explanatory factors and how urban policy can address them should not be bypassed.

3.2 Synthesis

In this section, the theoretical framework on urban policies for scaling-up ERHB is presented in the form of a conceptual visualization (see figure 5). The overall rationale maintained in this study, and depicted in the conceptual visualisation, is the following.

ERHB as a LCUI is characterised by interrelated systems of hardware, software and operational orgware, which are directly influenced by urban policies and indirectly by external trends. Each of these systems contains a set of components that are deemed necessary for the successful realisation of ERHB. Put differently, each of these systems has a direct or indirect influence on the accomplishment of ERHB. The literature review discloses that, although the magnitude of benefits ERHB can bring about, successful ERHB projects are not being implemented on a wider scale and therefore remains little more than "islands of excellence" (see 3.1). A potential approach to expanding and upgrading the performance of ERHB is that of scaling-up. Scaling-up is necessary to assure that ERHB goes beyond mere ad hoc projects and delivers its conclusive goal of the run towards low-carbon cities. As discussed in Chapter 3, scaling-up entails two different processes, one of which is emphasised in this study: the horizontal scaling-up. Horizontal scaling-up concerns the replication and quantitative growth of ERHB projects at the urban level. Scaling-up ERHB projects however does not demonstrate to be an easy exercise.

Empirical papers reporting on ERHB processes (Douglas, 2006; Bullen and Love, 2010; Bullen and Love, 2011a, b; DEH, 2004; ICOMOS, 1999; Murtagh, 2006; ReFoMo, 2014; Lewis, 2013; Mickaityte et al., 2008; Yung and Chan, 2012) disclosed that a range of factors in the hardware, software and organisational orgware systems are manipulating the advancement of ERHB. In fact, not only were barriers identified at the project level but as well at the city level. The urban environmental context is not always enabling the nurture of LCUIs, suggesting that urban policies can also act as hindrances to the scaling-up process. In this study, urban policy emerges in the form of local governance capacity and formal and informal institutions. Synergies between urban policy and the systems of hard-, software and operational orgware of ERHB are necessary if ERHB projects are to be horizontally scaled-up. Lastly, the oscillating external trends can indirectly influence the whole system and therefore impact the overall success and up-scaling of the LCUI.

In sum, it is assumed that barriers to the uptake and upscaling of ERHB can relate to one of the hardware, software and orgware systems of a particular ERHB project, as well as to the predominant urban policies in place. This study looks at how urban policy can promote the uptake, replication and growth of ERHB projects. Put differently, it investigates how urban policy can remove barriers related to the hardware, software and operational orgware systems of ERHB projects, instigate its realisation and foster its horizontal scaling-up.

In figure 5, an illustration of the underlying line of reasoning that substantiates this study is presented. The circles indicate an ERHB project, which is characterised by systems of hardware, software and operational orgware. Each of these systems consists of a number of factors that can influence the realisation of a particular ERHB project. These factors are displayed in the external circle. The solid arrows indicate when the ERHB project undergoes an additional step in the scaling-up process. It is assumed that urban policies can instigate the successful realisation and bolster the scaling-up potential of ERHB projects. Therefore, urban policy in figure 5 is presented as an overarching factor. External trends are positioned in an outer extent, for it does not have a direct influence in the realisation and scaling-up of ERHB. Overall, it is assumed that urban policies can enable the achievement of a large-scale coverage of ERHB projects. Urban policies are also anticipated to support heritage building conservation and the run towards low-carbon cities.

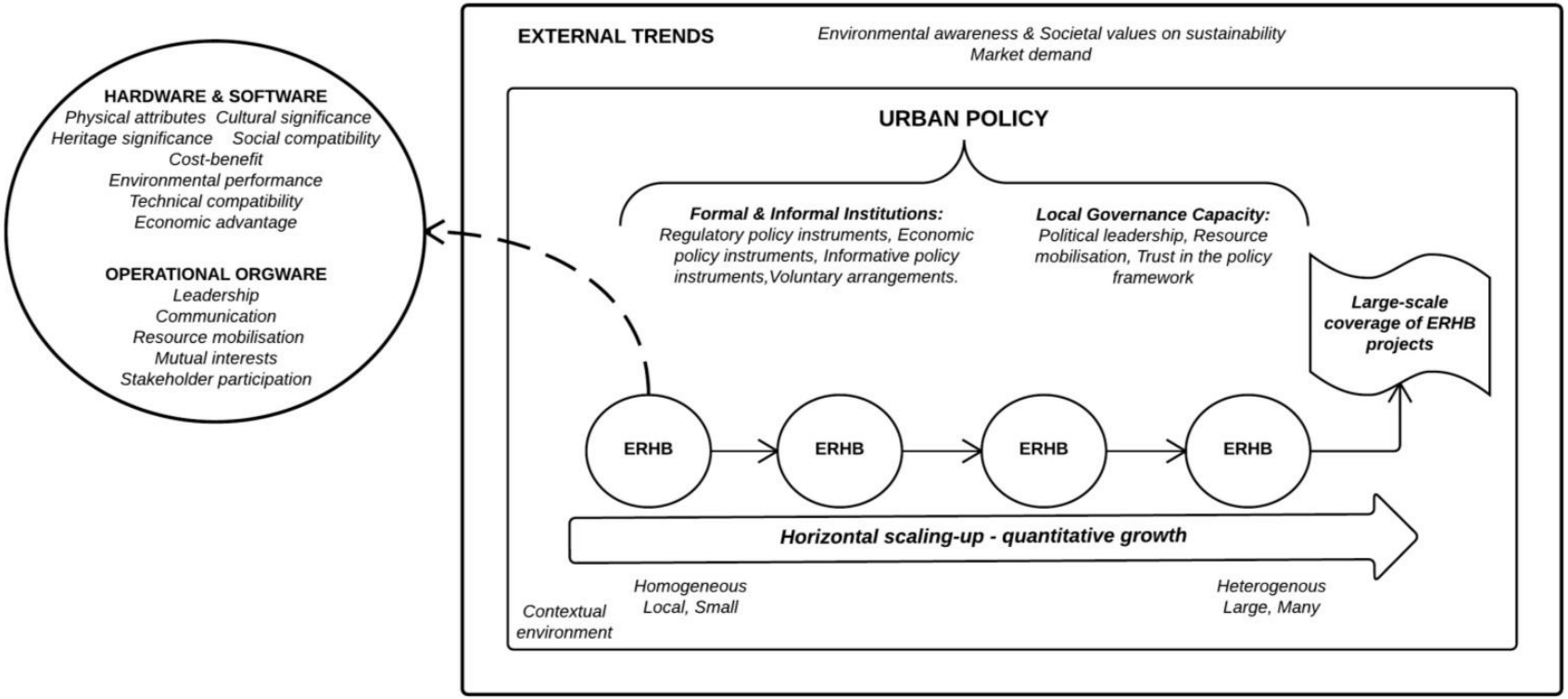

Figure 5: Urban policies to foster the horizontal scaling-up of ERHB projects, based on: Van Doren, D., Driessen, P.J., Runhaar, A.C.H. & Giezen, M. (forthcoming). Identifying the factors that influence the scaling-up potential of low-carbon urban initiatives: towards a conceptual framework. Utrecht University, Faculty of Geosciences, Copernicus Institute of Sustainable Development. The Netherlands

Chapter 4: Research Methods

The following section outlines the methodology for this research. Here, the research design as well as the specific research methods used during the empirical research is discussed. The research strategy is discussed in section 4.1. In section 4.2, the case selection and justification is put forth in the light of the research questions, literature gaps and theoretical approach chosen. Section 4.3 describes the methods for data collection. Lastly, in section 4.4 the methods for analysing the data collected will be explained.

4.1 Qualitative comparative case study

The research strategy to be implemented in this study is qualitative by means of an in-depth *comparative case study* approach. A case study is a well-documented and systematic investigation of decision-making processes and/or outcomes of a project, which is performed to inform policy, practices, theory and/or education (Gerring, 2004). Case studies deliver factual context dependent knowledge appropriate for social scientific research that are distinguished by the analysis of complex contradictory social situations, thus fitting the case under scrutiny (van der Zouwen, 2006; Campbell, 2003). A central weakness to the method is the problem with generalisability. If one only regards a single case, how would one know if it‘s applicable to all similar cases? To tackle this problem, a comparative section is included in this study. A comparative case study approach is commonly applied to increase the validity of the research, considering that additional cases can strengthen conclusions (van der Zouwen; Campbell, 2003). The results from the case studies will be compared against each other to reveal possible patterns of influential factors in the ERHB scaling-up process. As stressed by Gerring (2006, p.85), “Without this cross-cased generalization, the case study sits alone. Its insights, regardless of their brilliance, cannot be integrated into a broader field of study”.

This qualitative approach demonstrates appropriateness for this research as it aims to identify factors that are influencing the uptake of ERHB projects and urban policies that can be enforced by local governments to overcome barriers and boost the up-scaling potential of ERHB projects in the Netherlands. Numerous propositions listed by Gerring (2004) with respect to the adequacy of a case study approach apply to this project, namely that inferences are descriptive rather than causal, insight into the causal mechanisms is more relevant than insight into causal effects, propositional depth is prized over breadth and that the nature of this research is exploratory, rather than confirmatory. Lastly, an in-depth case study approach is singled out in light of time and resource constraints. By incorporating semi-structured interviews and a comparative case approach, the research is to systematically investigate the relative importance of scaling-up ERHB and how urban policies can contribute to its successful realisation.

4.2 Case Selection

A comparative case study can be used in a way that allows for the application of a theory, or set of assumptions, in a new problem setting and for the provision of practical insights for the interested parties (Flyvbjerg, 2006). To increase generalisability from the research findings, the selected cases should vary on distinctive independent variables. Ideally, there should be as much variations as possible on these factors to underline mechanisms of interest. In doing so, the researcher can draw attention to factors that have an effect on the dependent variable, if any is present (Ibid. 2006). Accordingly, in this study the so-called "diverse case" method (Seawright and Gerring, 2008) is applied to identify cases to compare for experiences in the ERHB field. The objective of this method is to identify cases with a maximum variance along relevant dimensions (Ibid. 2008). Incorporating of a full range of variation can enhance the representativeness of the sample of cases, which is a distinct advantage of the method (Ibid. 2008). The "diverse case" method is therefore likely to have stronger claims to representativeness than any other small-N sample (Ibid. 2008).

The scope of this research is delimited to analysing two contrasting ERHB projects in two contrasting Dutch cities. The case studies were selected based on a number of criteria: i) only buildings that were built before 1945 are selected, falling under the historic building definition, earlier disclosed in this study; ii) the chosen historic buildings are subject to the cultural heritage legislation, for these buildings have a cultural or historical value to the society; iii) the objective of renovation was to improve the energy performance of the historic building; iv) the ERHB project was realised at the municipal level; v) the historic buildings under study are still in use; vi) the ERHB project is either implemented or has passed the planning phase; and vii) the cases under analysis are large-scale ERHB projects in terms of their financial scope and building size, making it more likely that all relevant factors were encountered.

The first case study concerns a passive renovation in Rotterdam. The passive renovation on the Sleephellingstraat is singled out for its successful realisation. The Sleephelling project was the first project and one of the most effective attempts to reduce energy consumption to meet the Passive House Standard in the Netherlands (Agentschap NL, 2010). The Sleephelling can be regarded as an example of how private actors can come together and successfully achieve high energy efficiency levels even in more challenging circumstances, whereby the original character of the historic building required being intact. Choosing this best-practice case is expected to reveal a comprehensive picture of the success factors of such projects.

Fort de Gagel is selected as the second case-study. Being part of the New Dutch Waterline, the fortress has a specific historic value for the country and therefore holds a protected status as a National Heritage Site and National Landscape. In 2000, a plan was established to redevelop the waterline and give all fortresses a different purpose. Here, sustainability was an important aspect, especially for the Fort de Gagel (Almeida, *forthcoming*). Retrofitting the fortress to improve its energy performance is an objective supported by a EU project, ReFoMo, which aims to create a lighthouse effect that can serve as

example for future energy efficient renovation of fortresses. Its historic importance and the attention given to sustainable solutions made this project well suited as second case.

Both ERHB projects have similar goals, namely to bring the energy performance of the historic building to sustainable levels. But, from the brief description it is apparent that the case studies are different in nature, in several aspects. The case studies are unique projects that share similarities but were intentionally selected to also differ in terms of: (i) location - Rotterdam vs. Utrecht; (ii) project time-period - terminated vs. ongoing project; (iii) building use - housing vs. office space; (iv) building design - apartment vs. fortress; and (v) project ownership - private vs. public. These discrepancies should allow the researcher to yield deeper insights than a traditional case study, by activating "more actors and more basic mechanisms" (Flyvbjerg 2006, p.229).

It is expected that the selected "diverse cases" will disclose differentiation with respect to the ERHB project characteristics. Factors from the hardware and software systems are expected to differ per case study, for these factors are project specific and have higher probability of being influenced by technical aspects, for instance. As for factors from the operational orgware, urban policy and local governance capacity, these are expected to display more similarity and comparability, considering that differences between the two big Dutch municipalities are most likely to be marginal. Here, it is anticipated that factors from these systems have greater representation potential. Accordingly, factors from the external trends are expected to be similar, as these factors are found in more general cultural and economic trends that are not under municipal control.

This research is designed to identify patterns in urban policies that facilitate the realisation and bolster the scaling-up of ERHB projects, and its corresponding barriers and opportunities. The intention is to provide valuable lessons for local authorities in the Netherlands with reference to the realisation of ERHB projects and efforts to bring ERHB to scale. It is not the objective to assess the municipalities against each other and do any distinctive statements on them. Structural and contextual differences are being taken into account and it is not expected that what is practicable in one municipality will necessarily be practicable in another. That being said, the two diverse cases under study are anticipated to provide a broad and balanced basis for identifying cross-project success factors and developing more generally applicable recommendations.

4.3 Data Collection

The scope of this research is delimited to analysing two contrasting ERHB projects in two contrasting Dutch cities, both at municipal and project levels. The second part of the research therefore consists of gathering data for both units of analysis through desk research, expert elicitation and semi-structured interviews with key stakeholders. The latter in particular, which is in line with the exploratory nature of this research, are an important data collection method as it allows one to comprehend the driving factors of ERHB projects in contrasting urban contextual environments. Semi-structured

interviews also do not only ensure that predetermined subjects are covered and but leave room for the respondents to influence the topics under scrutiny, so unexpected issues emerge (Bryman, 2012).

At the municipal level, desk research is carried out to investigate how ERHB is being governed by the local authorities. For this, prior to conducting the semi-structured interviews, a review of municipal legislation on cultural heritage preservation and sustainable building interventions, and municipal strategic plans, policies and programmes on building energy efficiency and urban climate mitigation, more generally, is performed. Consecutively, semi-structured interviews with policy officials and representatives are undertaken. At the project level, a similar approach is followed: a combination of semi-structured interviews with key stakeholders, site visits and desk research are undertaken to examine project-specific information. Conducting semi-structured interviews is anticipated to support the identification of the perceived barriers and incentives in undertaking and scaling-up ERHB projects from a wide range of stakeholders. In addition to conducting semi-structured interviews with key stakeholders, external expert opinions were elicited to corroborate the findings and accordingly the theoretical framework. Expert elicitation was held with cultural heritage and sustainable experts, practitioners and scientists in the field of sustainable cultural heritage. This combination of sources supports triangulation (Verschuren et al., 2010).

Respondents were strategically singled out to get a representative source of information from different fields. Respondents were selected on the basis of two criteria: their involvement and actor type. The first criterion indicates that the respondents were selected based on their involvement in the ERHB project, indicating that they should have been directly involved in one of the phases of building retrofit processes: (i) *problem set-up*; (ii*) retrofitting options*; (iii) *decision-making*; (iv) *implementation*; and (v) *verification* (see Mestre and Rosales Carreón, forthcoming). The second selection criterion indicates the type of actor involved in the ERHB project realisation. Three general groups that take part in ERHB processes were covered. First, *governmental group*: includes officials from the municipality, province or central government. Second, *project leader or project owner group*: includes actors who have been present in the design and implementation or stimulation of the ERHB project. Third, *third parties group*: includes actors that have been actively involved in the project such as consultants, non-governmental organisations, citizens. Relevant actors who take part in ERHB process were previously identified by a study from ReFoMo (2014), namely:

1. *Owners*. The owners of historic buildings can be private entrepreneurs or government agencies. These owners can also be active as the operator of the building, but usually leave the exploitation of the building to the operator.

2. *Operators.* The operator uses the building as a platform for a certain business. This can be a restaurant, meeting facilities, party venue or other catering activities. The operator is thus concerned with the day-to-day management of the building and to a large extends the energy use within the building.

3. *Users.* The user is a client of the operator, a tourist or a member of the community surrounding the heritage building. Users visit the building to partake in the activities provided by the operator. The users experience is crucial to the successful exploitation of the building by the operator.

4. *Government*. The government acts on the national, provincial and municipal level. It provides the legislation that prevents or encourages the possible retrofitting and it determines the possibilities for exploitation by the operator. Although governmental organisations can also own heritage buildings, the two actors should be viewed as separate at all times.

5. *Designers/architects*. The designers/architects figure out how the retrofitting options that are selected by the owners and operators are to be implemented in the building by the contractors.

6. *Contractors.* The contractors execute the actual retrofitting. They are the construction workers that fit the energy saving technologies into the heritage building. Contractors and designers/architects often work closely together, and are sometimes even a part of the same large diversified firm. The distinction between contractors and designers/architects is sometimes hard to make, because of their actions sometimes overlap. The energy saving technologies that the contractors use for the retrofitting is provided by subcontractors. These are the firms that develop and produce the technologies that make the retrofitting possible.

7. *Financial institutions.* These institutions are banks and investment agencies that are willing to lend money to the owner or operator to finance the retrofitting. They can directly block the retrofitting if they do not see the retrofitting as a profitable action.

8. *NGO's*. Any non-profit, citizens' group which is organized on a local level. In this particular case, their tasks are driven by an interest in preserving the cultural heritage of a city. If there is not a particular interest in preserving the cultural heritage, at least they have the intention of improving the sustainability of the city where they are located.

In a first stance, the objective was to cover all eight actors who are customarily involved in ERHB projects. However, the range of involved actors differed per ERHB project, which suggests that a number of the above mentioned actors were not identified. Nonetheless, by means of desk research, other stakeholders were pinpointed and incorporated in the list of potential interviewees. The identification of experts for elicitation was accordingly done through desk research and also through snowballing sampling. Snowballing sampling was employed to find additional stakeholders who were knowledgeable about the ERHB projects. The snowballing approach was useful for it was oftentimes difficult to identify actors that were involved in an ERHB project through desk research alone, particularly for the Sleephelling case study, considered that the project was completed eight years ago. In total, a number of 19 respondents have provided valuable feedback on these cases studies, and represent various facets of ERHB projects (planning, technical, governance). Each interview lasted approximately 90 to 110 minutes. An overview of the respondents and their functions can be found on Appendix 1. Prior to the interview, an introduction e-mail was sent to each of the respondents. This letter contained the

objective of the interview, the context and required time. As all interviews were to be recorded, at the start of the interview the interviewee was asked for permission to record the interview. The interviewees were asked questions pertaining to: hardware, software and operational orgware structures of ERHB projects; the main barriers in undertaking and scaling-up ERHB projects; and to urban policies that should be reinforced to overcome barriers and trigger the scaling-up of ERHB. For the comprehensive semi-structured and expert interview guide, see Appendix 2.

4.4 Data analysis

The data collected through semi-structured interviews with key stakeholders and expert elicitation is of a qualitative nature. The reactions of the different interviewed actors have been diverse and at times almost incomparable in a direct manner. Therefore, it has been necessary to structure and code the data in a way that makes it possible to relate it directly to the theoretical framework on urban policies to scale-up ERHB projects (see chapter 5). NVIVO was applied to analyse the collected data. NVIVO is a software package that demonstrates appropriateness for analysing large amounts of qualitative data, and enables the researcher to examine the relationships between topics within the data.

Coding the empirical data was the primary method of analysis in this research. The coding structure was in first instance fully based on the theoretical framework presented on chapter 5, guided by the research question: How can urban policies contribute to the urban scaling-up of ERHB projects in the Netherlands. To prevent information loss, the coding process followed an open coding methodology rather than a purely deductive approach based on the coding structure derived from the theoretical framework alone. This inductive approach allowed concepts and phenomena that had not been incorporated in the theoretical framework to emerge from the collected data. The first round of open coding was based on the interviews of the Sleephelling project. The original coding scheme grounded on the theoretical framework was adjusted by adding new coding nodes to subsystems where it deemed necessary. Thereafter, the coding scheme once more adjusted where necessary, when the interviews of the Fort de Gagel project were incorporated. A final adjustment in the coding scheme was exercised preceding the expert elicitation. The coding process became progressively open as the process continued, which ultimately triggered the introduction of a revised theoretical framework on urban policies to bring ERHB projects to scale[5].

Once the data was coded and analysed, the next step comprised critical deliberation on the findings. The case studies were separately described and analysed guided by the framework of analysis as presented in chapter 5. The in-depth analysis of the studied cases followed a comparative analysis, which enables for a thorough identification of resemblances and assessment of the contrasting findings. It is expected that, by confronting the different EHRB projects in the different Dutch municipalities, prominent factors that influence the uptake and scaling-up of ERHB are to be disclosed. It is through the

[5] For those interested in following the coding process in more detail, a set of NVIVO files is available upon request.

comparison of the case studies that a complete synopsis and understanding are to be achieved, and general patterns are to be identified.

Chapter 5: Results part A. Application of the theoretical framework

The succeeding sections present the results of the application of the theoretical framework in the Sleephelling and Fort de Gagel case studies, respectively. The analysis follows the structure of the theoretical framework presented in Chapter 3. Firstly, the findings pertaining to the hardware and software structures of the ERHB project are put forth, followed by findings from the operational orgware. Consecutively, the findings pertaining to the formal and informal institutions are presented. Then findings from the local governance capacity are discussed. Lastly, findings from the external trends are disclosed. At the end of each section, the analysed data is synthesised and presented in a table. The table displays important factors that influenced the ERHB project realisation and are deemed significant in efforts to bring ERHB projects to scale.

5.1 De Sleephelling, Rotterdam

5.1.2 Case study background

"Monument becomes a passive house"

The retrofitting of dwellings that are part of a conservation area is a distinctive challenge for housing associations. On the one hand, there is the obligation to preserve this cultural heritage. On the other hand, there are often major adjustments needed to reduce the energy consumption of these ancient dwellings. At first sight, these goals seem difficult to reconcile. However, the housing association of Rotterdam Woonstad demonstrated that energy efficient renovation of listed buildings is indeed possible. The houses on the Sleephellingstraat in Rotterdam successfully accomplished an energy label A++ after a thorough renovation, without affecting the historic appearance of the houses.

The Sleephellingstraat is situated on the North Island in the middle of the city of Rotterdam. North Island is a neighbourhood surrounded by the river that offers residents peace and greenery. The place is child-friendly and easily accessible, providing all downtown amenities and activities within walking or cycling distance. The North Island is "one of the best kept secrets" of Rotterdam: it is a conservation area distinguished by many historic buildings of pre-war architecture, stately avenues, water and the intimate nature, which makes the island a great place to live in a metropolitan area (Agentschap NL, 2010).

Woonstad Rotterdam had the ambition to bring seven historic buildings on the Sleephellingstraat to Passive House Standards. The so-called "passive house principles" have long been successfully applied to renovations in Germany: excellent insulation levels and high degree of airtightness of the building shell, which keeps future maintenance to a minimum and provides substantial energy savings. In the Netherlands, the concept has been applied on a very limited scale in renovation projects, although the growing attention for sustainable building concepts (Rotterdam

Climate City, 2010). The Sleephellingstraat project was the first project and one of the best attempts to reduce energy consumption to meet the Passive House Standard in the Netherlands (Agentschap NL, 2010).

In 2009, seven historic buildings that date from 1903 were renovated and remodelled into fourteen highly energy-efficient and comfortable homes. The team consisted of multidisciplinary actors such as BAM Woningbouw, VillaNova Architecten, Rockwool and DHV. At first, the potential for energy-efficient renovation seemed limited due to the beauty of the location and nature of the buildings: the facades are part of a designated urban conservation area in view of their unique architectural and historic interest. The approach therefore required that the unique character of these buildings was preserved. *"BAM Housing came up with the initiative to renovate the houses according to the passive principle"*, says the project manager for the residential town. The objective was to increase the living comfort and the energy performance as much as possible. As the passive principle provides a constant indoor climate in both summer and winter and creates a more comfortable and healthy indoor environment, the approach seemed adequate to apply in the Sleephelling project. The implemented sustainable measures included triple glazing, high quality insulation, solar water heaters, ventilation and heat recovery, airtight construction, proper sun blinds and energy efficient appliances. After the successful realisation of the Sleephelling project (figure 6), the value of the building block was significantly raised.

Figure 6: Sleephellingstraat, Rotterdam

5.1.2 Application of the framework

The Sleephelling project was the first project in the Netherlands to apply the Passive House renovation concept in practice and is considered one of the best attempts in lowering the energy consumption to meet passive level in an historic building. The renovation project received the Passive House Award in 2009, which was granted for the first time that year. With that being said, what factors are behind such a successful project realisation? Were there any barriers and if so, with what instruments were these minimised? The following section describes the factors that were influential in the project realisation, which were disclosed from the interviews.

Hardware & Software

Factors from the hardware and software systems that played a role in the realisation of the Sleephelling project amount to "heritage significance", "technical compatibility", "physical attributes" and "cost-benefits". Other factors from this explanatory system did not demonstrate to be influential. In the following, a comprehensive understanding of the event is given.

The houses on the Sleephellingstraat date back to 1903, so the building block was not the most appropriate choice for renovating according to the passive house concept as it falls under the one of the conservation areas of Rotterdam ("heritage significance"). In consultation with the Monument Committee, it was agreed that the facades would remain visible on the street side and restored to its original state, and that the existing window frames would be repaired if necessary. Everything from the front-side needed to be done from the inside, so an internal insulation concept was developed. As for the facades on the back side, the Municipality of Rotterdam suggested less specific aesthetic requirements, thus a different approach applied. So, the fact that the building was a historical building was not seen a barrier as such. As a public affairs official mentioned "*It was also to my surprise that the municipality was so relaxed about that. But, you see the heritage significance back in the costs, of course*".

Identifying solutions that were applicable to the historic building and satisfied the requirements posed by the Monument Committee did not demonstrate to be a big challenge ("technical compatibility"). The team knew that some problems and discussions would come across throughout the process, and that the project would require a lot of calculations and special attention to details, but technically the approach was not exactly perceived as a barrier. It was perceived as a given: "*The passive house concept was to be implemented and that suggested insulating an existing building, which can require more complicated and riskier steps. That is typically the problem with passive houses*". Bringing a historic building to passive standards was generally regarded as troublesome. *"You face many limitations and need innovative solutions for it […] passive houses are more difficult to achieve",* observed the ex-project leader. Still, only the most optimal solutions for the building were proposed and carried out. According to an architect "*We brought back the old ethics and all other details that were lost. So, these buildings are now more original than they ever were*". Along these lines, "cultural compatibility" did not influence the project realisation as the project was regarded as a very attractive product for both the Municipality of Rotterdam and Monument Committee. New users also did not

necessitate adapting their behaviour ("social compatibility") as the implemented installations in the Sleephelling were not complex in their operation and maintenance. Under different circumstances, it was argued that "technical compatibility" can play a bigger role. *"People are usually not willing to spend their money on things that are not nice or easy to implement*", as noted by a public affairs official.

As for "cost-benefits", this was a factor that was highly discussed as the project required a substantial additional investment per house. The Sleephelling was at that time owned by Woonstad Rotterdam, a housing corporation. After the project implementation, the objective of Woonstad Rotterdam was to sell the newly energy efficient renovated houses to private owners. These houses could only be sold for a price that future users would consider to be reasonable, based on aspects such as location, aesthetic appeal and comfort. As the ex-project leader explained, *"Per house, an additional investment of approximately €25,000 was required. We could not have passed that investment on to the future user, also not partially, regardless of the fact that energy costs would considerably decrease and accordingly their housing costs. Energy efficiency is for most people a side issue, and therefore it cannot be translated properly in the value of the property"*. Hence, BAM, the building contractor, accepted the additional costs, which were not going to be taken by future users otherwise. It is important to stress here that the contractor only took on the extra costs because it was a show-case project: BAM wanted to learn from the experience and be a pioneer in the field. Due to the high renovation costs and uncertainty about the increase in value of the houses, the financing of similar projects can act as a barrier to the horizontal scaling-up. Observed by an expert in building physics, *"It is very expensive to carry out these projects. If you have to improve the facade like we did in the Sleephelling, you get almost to the built costs. You have to deal with high costs and very specific solutions […] also, the pay-back time of measures is still pretty long".* Ultimately, the houses were sold within a few days for an additional investment of only €5,000. An influential factor that stimulated the auction and attracted numerous buyers at that time was the location ("physical attributes").

The North Island is an upcoming and developing area in Rotterdam, so not only was the potential for renovation in the area optimal but also for quickly selling the brand new historic apartments. As noted by an interviewee, *"The fact that these apartments were located in a very nice area in Rotterdam was very beneficial. Everybody wanted to live there. It is an area in development with a very nice view on the Erasmus Bridge; it is close to the water. The location was so perfect that asking the €5,000 euros extra per apartment was not a problem at all"*. Other building physical attributes were not as influential as location. In fact, location demonstrated to be the determining factor in selling the houses, suggesting that factors such as comfort, indoor climate ("physical attributes") and energy performance ("environmental performance") of the building were secondary concerns. As observed by an interviewee, *"Location has always driven the market in the Netherlands. People choose their buildings based on: 1) the location; 2) the location; and 3) the location. This is very well-known in the Netherlands, and nobody really cares about the performance of the buildings, maybe a little bit".* According to the respondents, the predominant inclination of Dutch consumers towards the location aspect of housing highly affects how the value of properties is measured by housing agencies: it depreciates the value of

sustainable housing measures and of other building physical attributes that are important for the well-being of users.

This aptitude was reflected in the sale prices of the houses on the Sleephellingstraat, which was undervalued by the housing agency at that time. As mentioned by an interviewee, *"We came across that appreciation for renovation is not really there with the project evaluators and that was very well illustrated in the Sleephelling project […] One year later, one of the houses was sold by a user for €100,000 more than he initially had paid for and by then the market had not increased that much".* In terms of cost-benefits, it was stressed that users should start thinking in housing costs instead of rent and energy costs or pay-back time ("housing market"). According to the project leader, *"Nowadays we still have a silly system, in which everyone looks at the house only from the mortgage costs perspective and not from the total costs of a house […] if you do not change this system, you will not be able to change the market. People are still paying too much attention to costs and the way that the building looks like, and very little to sustainability. Consumers are concerned about what they can invest in at this moment, and not in the future".* Furthermore, it was stressed that it is difficult to single out what part of the investment pays back a certain measure, upgrades the building quality or improves the building energy performance. Respondents accentuated that renovation needs to be looked at from a holistic point of view because too often the issue narrows down to marginal cost calculations and that prevents men from carrying out projects. Respondents underlined that modifications in the Dutch housing market to include building quality are necessary to enable greater opportunities for retrofitting projects, especially in purchasing houses ("housing market"). Yet, firstly consumers should be informed that building performance is an important aspect to consider. Over-discounting the future and demanding short-term investment returns are still predominant consumer attitudes that aggravate the scaling-up potential of retrofitting projects and that too needs to be altered. As stated by the ex-project leader, *"As one better understand what an energy efficient home constitutes, one will also realize that is it worthwhile to pay a little extra for such a house. It pays off in the subsequent years".* For the horizontal scaling-up of retrofitting projects, it is crucial that consumers become more aware of the advantages that energy efficient buildings can bring about. But for that, policy adjustments are also necessary to incentivise the public.

In terms of "environmental performance", respondents emphasised that energy savings from improved energy performance does not raise the value of the building. As noted by many, "*sustainability does not sell", "sustainability it is not sexy".* Other benign aspects of building retrofit that can have greater marketing value than building "environmental performance" are improved comfort and indoor air quality levels. These are however still not sufficiently communicated to the public. Respondents stated that this is a major missed opportunity considered that improved comfort and indoor climate ("physical attributes") can act as additional incentives for users to invest in retrofitting, and accordingly to instigate its scaling-up. Respondents stressed the importance of identifying and marketing additional building improvement performances to boost the horizontal scaling-up of retrofitting projects.

Another factor that deemed important for the realisation of building retrofitting projects and was not covered in the analytical framework is that of "renovation timing". As mentioned by a consultant, *"The best moment to renovate is when the life-cycle of the building is running out […] it is when the building needs a new impulse, not only from the market but also from technical improvements*". In considering the right "renovation timing", much of the costs and complexities in carrying out a renovation are minimized.

Operational Orgware

With regards to the organisational structure of the Sleephelling project, all factors were considered important for the successful realisation of the passive renovation project.

The realisation of the Sleephelling project took place in the form of a passive experiment and was therefore a very attractive opportunity for different actors to come together, demonstrate their specific expertise and deliver the optimal solutions. All the involved parties were highly interested in the show-case project and that opened place to a very motivated and enthusiastic team, which wanted to sell the same concept ("mutual interests"). *"All participants wanted to participate because it was a show-case project",* indicated a public affairs official. Similarly, observed a senior expert in sustainable buildings, *"[…] project was developed with the showcase objective. So, all parties involved were willing to do that"*. Throughout the project implementation, "communication" also played an important role. "*In this project, all the actors knew what was exactly expected. And that is very important for renovation projects because you can easily make mistakes. Collaboration and good communication are key factors in energy efficient renovation projects and are not specific of historic buildings",* as noted by a public affairs official. The mobilisation of financial instruments and knowledge also supported the successful implementation of passive measures in the historic building ("mobilisation of resources"). *"BAM mobilised the resources to enable the complete realisation of the project*", stated an expert in building physics. In terms of knowledge, "*[…] given our technical knowledge as an architecture company, we got the contractor to trust us"*, indicated an architect. Good feasibility studies ("mobilisation of resources") were also considered as elementary in undertaking retrofitting measures as mistakes can be easily made in projects with this nature. Feasibility studies enable one to be aware of the technical possibilities and constraints and therefore make an adequate choice.

"Leadership" is another factor that influenced the project realisation on the Sleephellingstraat. Respondents stressed that leadership played a significant role during the project realisation, but it is not specific of retrofitting projects. In the Sleephelling project, the leadership role was adopted by two actors in two different ways. On the one hand, leadership was clearly observed from the building contractor, who initiated and took on all the costs of the project as BAM wanted to be a pioneer in the field. *"BAM showed their leadership, which was also their aim at that moment, to show their leadership in the sector",* observed a public affairs official. On the other hand, the project architect was considered by many as one of the success factors in the realisation of the Sleephelling project. *"It was Andries Laane, from VillaNova, the one person who enable the realisation of the Sleephelling project. He was and is still very engaged in the passive approach"*, asserted the ex-project leader. The architect is a passive

house expert and strong advocate, who demonstrated great enthusiasm and engagement throughout the whole project and ensured that a common vision was in place. Interesting to observe here is the association of successful project realisation with leadership and actor attributes. It is still by virtue of a niche of inspired individuals who share similar principles that successful LCUI projects are in place. As noted by an architect, "*I would say that the success of passive projects lies in individual enthusiasm. It lies in the hands of people who are really connected with similar principles"*. In the Sleephelling case, this individual enthusiasm and belief is recognized from the architect, who passionately encouraged the passive approach and incentivized others to engage in it.

As for "stakeholder engagement", this factor was similarly important for the project realisation. *"The reason that the project was very well dealt with is due to the team constellation […] we had a very motivated team, which was enabled to sell the same concept again",* observed a public affairs official. *"We had a very nice team and still collaborate with each other",* stated a senior expert in sustainable buildings. *"I think that the success factor always amount to leadership and having a common agenda. This project was developed with the show-case objective. So, all parties involved were willing to do that",* further pointed out the respondent.

Urban Policy

In addition to understanding how the systems of hardware, software and operational orgware influenced the Sleephelling project realisation, it is similarly important to comprehend how urban policies address the uptake of ERHB projects. In the following, an analysis of the perceived influence that policy instruments and local governance capacity have on the retrofitting of historic buildings is disclosed.

Formal & Informal Institutions

Regulatory policy instruments

In the Sleephelling project, the regulatory policy instruments at the city level were not influential in the attainment of the passive house standards in the historic building. According to the respondents, the building requirements posed by the municipal Monument Committee on the renovation were deemed reasonable and did not obstruct the realisation of the project. As noted by a public affairs official *"[…] regulations by then were not a big issue. I cannot remember that there was a specific thing, which hampered the realisation of this low-energy building, also not with regards to energy label".* The team did however need to "convince monument officials" that the proposed passive measures would respect the established legal and construction borders and would not endanger the unique characteristics of the building. This is supported by an architect, *"The only thing in play is that you have to convince them [municipality and Monument Committee] that the way you will renovate will not damage the building by, for instance, too much air or moist, or rotting components that are not being taken care of well"*. Convincing monument officials that the proposed renovation measures were the most appropriate ones was also not regarded as an issue in this case, which is mainly owed to the strong team constellation (see operational orgware). Although existing regulatory policy instruments of

the municipal Monument Committee did not determine the realisation of the Sleephelling project, it did influence the investment costs of the project due to building requirements that called for tailor made solutions (see hardware & software). Here, it is important to recall that the passive renovation of the Sleephellingstraat was only financially attainable because it was an experiment.

As for the overall impression of the Dutch regulatory system on the retrofitting of historic buildings, the respondents' reactions were miscellaneous. In general, respondents asserted that the legislation on the preservation of cultural heritage can be counter-productive to the scaling-up of ERHB, because frequently a substantial amount of rules applies. As noted by the ex-project leader, *"In Holland we have too many rules and that is the problem"*. For instance, individual building and house owners, who want to undertake building renovation, have to undergo extensive legal and administrative procedures to be granted a permit. "*Another thing that could be facilitated is the administrative procedure. It often takes a lot of time to get the licenses granted to building owners and this is not necessary",* reported a cultural heritage advisor. These procedures can be burdensome and demotivating, especially for building owners who are not very knowledgeable about ERHB. And, in the field of ERHB, *"knowledge is crucial"*. Another drawback regards the application of innovative technologies in historic buildings, which can be confined by legislation. This is the case when a building owner ponders about installing solar panels in the building but is obstructed with visibility requirements by the legislation. *"In Rotterdam, installing solar panels in monuments is rather restricted, but for historic houses, things are more flexible",* observed a cultural heritage advisor. This limitation in the light of energy concerns undermines the impact of green technologies in efforts to mitigate climate change. Yet, as emphasised by consultant in building physics, *"The physical attributes of old buildings are very different […] one cannot just simply say that you should improve the glazing of your building because that can result in other problems".* A consecutive barrier arises when the Cultural Heritage Agency or the municipal Monument Committee considers the preservation of cultural heritage to be more significant than the relatively large environmental footprint and corresponding financial costs. As an architect observed, *"People who work with monuments are conservative in general. They like the old buildings and are afraid of new technologies and changes"*. But, as stated by a senior sustainable building advisor, *"You cannot freeze the world and think that buildings built before 1945 is the only way they should look like".* The need to convince authorities that the renovation plans will not damage the historical values of the building in order to get a permission granted was also considered as an obstruction. As noted by a senior expert in sustainable buildings *"[…] you often hear that if one wants something, this will have to defend his plans. So, the municipality here is not really helping them".*

Another point of discussion concerns the delegated responsibility to local authorities in developing their own policies on cultural heritage preservation. For some respondents, delegating the responsibility to city officials to govern for the built heritage results in confusion, aggravates "institutional fragmentation" and influences the demand for ERHB projects. As observed by an interviewee, *"The regulations for historic buildings are simply turned down to such a level that the interpretation of the local authority is the only thing that determines a reasonable demand level".* Other respondents indicated that empowering local authorities to develop their own rules and policies is well-

founded because conditions are highly divergent. As noted by a consultant in building physics, *"[…] delegating them [local authorities] the responsibility and freedom to develop their own rules and policies is adequate due to the different contextual environments".* The uniqueness of heritage buildings causes the legislation to differ per municipality, posing a barrier to the horizontal scaling-up of ERHB.

In terms of energy policies, these are not applicable to historic buildings. This exemption according to an architect is, *"Disastrous. […] Monuments do not have to be insulated. You hardly have to do anything in an old building. You can infinitely exploit an old building with single glazing or with no insulation at all, and that is ok because you are not required to do anything".* A senior expert in sustainable buildings argued that *"energy policy for existing buildings hardly exists*" and that the few existing regulations address new buildings only. Respondents indicated that, apart from respecting the building code, newly constructed houses are now required by the government to have an energy label A++. Housing associations were also recently requested to increase the energy performance of their buildings to the B level. For historic buildings, the legislation allows much flexibility: no energy performance requirement is enforced. *"There is actually a lot of flexibility for existing buildings because even insulation requirements are exceptional"*, asserted a senior sustainable building advisor.

In undertaking major historic renovation projects, one has to meet building requirements imposed by local officials but one is not obliged to improve the energy performance of the building. Thus, "*If you have built rubbish, you maintain this rubbish until the end of times because you are not obliged to do otherwise, which is nonsense"*, according to an architect. This flexibility does not encourage the market to undertake energy efficient renovation projects. As noted by a senior sustainable building advisor, the government is *"[…] absolutely incentivizing it in the wrong way"*, for *"[…] you get a passage not to do so [upgrade energy performance] because it is a historic building. So, there is a negative incentive to improve it".* The majority of the respondents stressed that demand from the government side is the only way to convince people to carry out energy efficient renovation. To this, omitting historic buildings from energy policies demonstrates to be a barrier to the scaling-up of ERHB. Yet, requiring energy performances for historic buildings also demonstrates to be a highly polemic issue.

The discussion on whether to demand energy performances for historic buildings disclosed to be dichotomic. On the one hand, respondents stressed that enforcing a minimum energy performance standard for historic buildings is the most effective way to scale-up ERHB projects. Conforming to an architect, *"I personally think that labels should be obligatory: one cannot renovate a building without reducing the energy consumption of it, unless one proves that it is impossible in that particular case. […] And people should demand for energy efficiency to a certain level because most monuments can be renovated in an energy efficient way […] People should also demand from local governments to set out extra performances because everyone will claim exceptions for monuments".* The ex-project leader argues in similar lines, *"[…] it would be better if our government makes it obligatory to do something about low energy performances".* In similar lines argued a cultural heritage advisor, *"Maybe authorities should say that when a building owner starts renovating, he should half the energy consumption of the building. That is easy. If you start with G you can easily get into a C. That would be then the goal. And*

that would be quite a nice calculation. If everybody is obliged to half their energy performance, maybe you then earn more energy wise then by changing it". Requiring a minimal energy performance for historic buildings has potentiality. However, *"when you force people to do something, these will be awaiting for some sort of financial support to carry out what they are obliged to"*, as remarked by the ex-project leader.

On the other hand, omitting historic buildings from energy policies is well founded. Reported by a cultural heritage advisor, *"We always try to be energy efficient, more generally. New buildings need to have an energy labelling, it is fixed. As for monuments, this not fixed, luckily, because sometimes it is not possible and it is difficult. It is not only about isolation, but also about humidity. If you isolate too much, it is not good for the monument. It is always about balancing […] it is also difficult to make interventions in those buildings without damaging its cultural values".* Once more the "physical attributes" and "cultural and heritage significance" of monuments is put forward as an impediment in efforts to improve the energy performance of these buildings. Another factor that complicates the enforcement of energy performance for historic buildings amounts to the legal argument of property purchase under legal conditions that cannot simply change over time. As noted by a senior expert in sustainable buildings *"That is of course the big debate all over Europe and probably all over the world: can you impose things that were acceptable by the time you purchased the building?"* Further, it was stressed that adjusting policies in the field of ERHB is a very ambitious exercise, not only because historic buildings are a delicate matter but also because policies are simply not easily changed. In accordance with a building physics expert, *"I think that a big group would only go for energy efficiency in these buildings if they were required to".* Similarly argued an architect, *"[…] the government has to make it obligatory to retrofit, instead of hoping that from goodwill people will choose for improve energy performances and spend their money on it. You have to regulate. It is impossible to ask from individuals who do not have proper knowledge to take decisions".* Notwithstanding, "*the government should find a way to stimulate it but requiring it will be harder […] you have to deal with some many different aspects at the same time and it is difficult".* Additional aspects that influence the demand for energy performances of historic buildings are identified in the current energy policy system of the Netherlands.

It was accentuated that numerous opportunities are being missed out, which are mainly owed to imperfections in the current energy policy system. The first debated issue regards the implementation of the energy certification scheme in the Netherlands. Energy labels are an effective way of translating the value of buildings in energy performance standards. The Dutch experience in enforcing the certification scheme was nevertheless not the most optimal. According to an interviewee, *"[…] everybody is doing that in Europe, apart from Holland. The Dutch did nothing for six years and when the deadline came in sight, they faced a huge charge of the EU. So, the Dutch decided to give out labels for free, without any calculations behind it. Everybody got a letter, in which they were assigned a very bad label […] they simply failed to have any organization working in a serious way to get these houses labelled. And we are the only ones in Europe who do not face this obligation".* Not only was the course of the implementation of the Dutch energy labelling system criticized, but also its approach. As observed by a senior sustainable building advisor, *"[…] the Dutch energy labelling system has been defined in such*

a conservative way that what is named energy label A in this country is named energy label B or D in other countries. We have the European system of energy certification but we have around 45 ways of interpreting this because we did not want to have a common European approach". The Dutch energy label is further criticized for it is based on physical matters rather than on building use. This approach does not stimulate building owners to invest in energy upgrading measures, especially not in historic buildings, considering that the focus of the system lies on building equipment than on real building energy performance. As previously observed, the employment of green technologies in historic buildings is not straightforward and oftentimes not applicable. Hence, having an energy label that only regards building equipment to assess the energy performance of the building does not benefit the scaling-up of ERHB.

Another point of critique addresses building evaluators, who, according to the respondents, lack serious knowledge in the field. Building evaluators cannot see beyond the current Dutch energy label and therefore can also not translate the benefit of energy efficiency into the value of the property (see 7.2). In general, respondents underlined that the Dutch government does not seem to be taking the energy certification scheme seriously. According to an interviewee, *"In Holland, we wanted to avoid that the implementation of the energy label would cost anything so we made it cheaper and cheaper, simpler and simpler, more stupid and more stupid, until we got an useless instrument because it steers in an area that is not relevant".* Yet, the government is not the only to blame. Respondents underlined that the majority of Dutch consumers are not interested in the quality of their buildings and even less in the energy performance of it. It is not appealing to them. It was argued that the state of energy certificate in the country is unsatisfactory because *"nobody asks for the energy performance of an old building"* and, in fact, *"nobody likes it"*. In addition, *"The Dutch believe that the minimum regulation of the government is at the same time the maximum that they need",* as noted by a public affairs official. Thus, consumer awareness and behaviour also necessitate adjustments to instigate demand and accordingly the scaling-up of ERHB. This aspect is however highly associated with culture and less likely to be conveniently versatile*. "This is a cultural thing and I do not think that you can easily change that in the Netherlands"*, indicated the respondent*.* Overall, the Dutch experience in energy label demonstrates much impracticability, which is mainly owed to deficiencies in demand from both policy makers and consumers. The lack of market demand for energy upgrade performances is a barrier for the up-scaling of ERHB projects.

The minimum building insulation level set by the Dutch government is an additional point of critique, which, according to a sustainable building advisor, is "*still much lower than in other EU countries"*. For passive house advocates, this is a major setback. Advocates stated that achieving energy efficiency is losing pace for "zero-on-the-meter" technologies, and whereas solar panels are useful to improve the generation of renewable energy in the Netherlands, these measures do not improve the quality of the building. As stressed by a respondent, *"We need better buildings and solar panels will not provide that. This is where changes in the legislation are needed".* Much of the criticism by passive house advocates lays in the tolerated energy performance exemptions for historic buildings, in the excuses to circumvent energy efficiency measures and in the overall disregard of building quality by the Dutch

market. Advocates also indicated that discussions on energy efficiency are concentrated in the perspective of the energy supplier, which does not benefit the scaling-up of ERHB. *"The focus on energy efficiency is still in the area of the energy supplier",* observed a senior sustainable building advisor.

Economic policy instruments

The realisation of the Sleephelling project was not influenced by the availability of economic policy instruments for it was an initiative of a private actor who took on all the investment costs, including losses. Again, it is important to recall that the passive renovation of the Sleephelling was only financially attainable because it was a show-case project. The scaling-up of equivalent projects has been very limited, primarily owed to the cost factor. According to an architect, *"Nowadays the building contractor would not get the permission to re-do the project because it is not allowed to accept any losses in buildings that are sold"*. Thus, replicating a project as in the Sleephelling is not appealing if one wants to profit from it. Financial policy instruments could be therefore supportive in efforts to scale-up ERHB, especially for individual building owners.

At the city level, the municipality of Rotterdam does not afford subsidies for ERHB projects. Building owners can nevertheless benefit from low interest rate loans to maintain monuments. Loans are however not being mobilised for the sustainable renovation of historic buildings. Reported by a cultural heritage advisor, *"The municipality could mobilise subsidies by means of reinvesting the money that they get from building permits […] but subsidising is difficult because then the municipality gives money away. So, what they do is to facilitate. They have people to facilitate it and support the management of the programme".* Thus, the municipality of Rotterdam takes on a soft approach to incentivise the realisation of ERHB projects ("mobilisation of resources"). In terms of loans, *"The municipality also does not mobilise loans for the renovation of monuments. This building received a monument status a couple years ago and what I know is that I can borrow money for lower rates. But, I can only apply for this loan if the foundations of this building are bad. So, it is to maintain the building and not for painting, or new windows. It is to keep the structure of it".*

With respect to economic policy instruments in place for ERHB, respondents stated that governments are generally concerned with subsidies and stimulation projects and the financial system is gradually improving. In the industry sector, the government stimulates improved energy performance by means of the BREEAM certification scheme, which, if obtained, can in turn facilitate the allocation of subsidies for businesses. Pointed out by an expert in building physics, *"BREEAM is a European system and in the Netherlands most buildings are BREEAM certified […] this BREEAM certification has around nine topics and energy is one of them. The energy label is an input for the energy part of the system. So, that is facilitating the realisation of projects in the private sector".* Businesses can also benefit from green tax reduction if they manifest investments to improve the energy performance and overall sustainability of their buildings. However, investing in energy efficiency measures for the business sector does not demonstrate to be very attractive.

It was indicated that industries have rather low energy costs and energy prices are much lower for businesses than for house owners. As noted by an expert in building physics, *"[…] energy costs for businesses are usually peanuts […] energy companies give better energy rate prices to companies than to individuals. It is stupid that there is such big difference"*. Further, *"companies are not investing in green energy to lower their energy bills but to demonstrate their social corporate sustainability because their pay-back time is of 20-30 years".* This suggests that there is no real business-case for the industry to invest in energy upgrading performances. *"While for housing with higher energy rates, it is more interesting to achieve energy savings",* asserted the expert. Hence, efforts to incentivize the scaling-up of ERHB should be rather concentrated in the housing market. According to an expert in building physics, *"the potential in the housing market is much bigger than in some other projects".* The circumstances for this sector are nevertheless different.

Respondents stated that "green subsidies", such as for solar panels, are frequently used by individual building owners. Yet, the subsidy scheme in the Netherlands demonstrates to be unstable, which causes people to hesitate to ask for them ("trust in the policy framework"). As noted by an expert in building physics, *"People in the Netherlands do not trust subsidies because they are quickly changing during the year and people are not sure whether they will get the same subsidy five years later".* For individual housing owners, it was suggested that more incentives could be in place in the form of higher mortgage and loan allowances ("housing market") if the owner invests in energy efficiency measures, for instance. According to a respondent, *"For housing, you can better apply the total housing costs, the rent price and the energy bill to further encourage them [building owners] to invest in improved energy performances. I think that if you have stimulation like that it would be much more interesting to get higher energy performances of existing buildings".* An additional discussion point concerns taxes, *"Why do people who buy new green cars can get their taxes reduced and not people who buy houses? When you buy a new house in Holland, you have to pay 21% taxes. Maybe the government has to change that: if you invest in or a buy a sustainable house, instead of paying 21% taxes, you will pay 10%"*.

Loans to undertake energy efficient renovation of existing buildings are also available. Yet, it was indicated that loans are not being frequently used. Conforming to a senior expert in sustainable buildings, the lack of demand for loans can be partially owed to *"[…] too many rules around it and too strict regulations to get them".* Another point stressed by the respondent is that it is oftentimes more difficult to only a get a loan for the energy efficiency aspect of the renovation, therefore the need to integrate energy performance in overall renovation purposes is crucial. To illustrate, *"[…] housing associations are allowed to build social houses and that means that they get some subsidies, but not for the energy-friendly part"*, asserted an architect. Hence, conforming to a senior expert in sustainable buildings, *"I think that energy efficiency should be integrated into the whole renovation approach and costs. Only then will it be part of the normal economy […] we cannot keep on using the energy performance as an extra".* The mobilisation of subsidies that is specific for the preservation or (energy efficient) renovation of historic buildings was not touched upon. Feed-in tariffs were similarly not mentioned.

Informative policy instruments

Informative policy instruments were not influential in the achievement of the Sleephelling project. As heretofore mentioned, the team constellation was very knowledgeable on the topic and was also very determined to demonstrate that successfully transforming a monument into a passive house was feasible (see operational orgware). Again, the Sleephelling was a show-case project. Under different circumstances, respondents indicated that the availability of informative instruments can influence the scaling-up potential of ERHB.

In general, respondents stated that information on ERHB is being disseminated but it could be improved. In Rotterdam, a cultural heritage advisor disclosed that, *"We, as the Monument Committee, increasingly try to share more information on the possibilities to make monuments more sustainable. We try to encourage and to demonstrate what is possible, but maybe not enough".* It was argued that information on green measures to upgrade the energy performance of existing and new buildings, such as roof insulation or solar panels, is rather sufficient. In contrast, information on ERHB deemed harder to find. According to a respondent, *"For someone who does not know much, it is more difficult to find correct information on the topic".* Therefore, *"It is important to invite people and explain what is possible. It is also important to show them that it is beneficial to do so. Energy prices are now still very low, but it is argued that the price will increase in the future. So, at the end, it is worth to invest in these energy savings measures. The best thing you can do is to change public opinion: you have to demonstrate that it is wise and it is nice to have low energy costs, instead of imposing energy labels",* accentuated a cultural heritage advisor. Notwithstanding, respondents also pondered whether the provision of more information on the topic would be helpful. *"I do not really know whether this would help the market if you make more information available"*, reported a building physics expert. Reasons range from excessive information resulting in misleading information and confusion to shortcomings in demand for ERHB.

The predominant argument that upholds this stance amounts to the overall lack of interest from Dutch citizens in energy efficiency matters ("awareness"). As a public affairs official stressed, *"It is very difficult to reach the citizens. Nobody is really interested in doing something […] the Dutch people prefer to spend their money on a new kitchen instead of improving the energy efficiency of their houses. This has always been the problem and is still the problem".* Similarly, an expert in building physics stresses, *"I see that social housing corporations are stimulated enough, but all the house owners and individuals are not further motivated than to improve their windows*". It was emphasized that affording more information on ERHB is not likely to result in greater demand for energy efficiency of historic buildings, because *"[…] people care more about the location and the way that buildings look. It is not exactly lack of information because everybody knows something from somewhere"*, as noted by a senior sustainable building expert. Again, "building physic attributes", such as location and building aesthetics, demonstrate to play a role in the realisation and scaling-up of ERHB.

An additional point regards the amount of effort and capital injected in disseminating information on ERHB, which could be otherwise spent in directly facilitating the scaling-up of ERHB

projects. According to an architect, *"The amount of money that is spent to exploit the lack of regulation and to deliberately misinform the public is too large"*. In the same lines argues a senior sustainable building expert, *"All the introduction rephrasing is out there […] but officials should always anticipate the next phase and be very critical about it".* Put differently, authorities should talk less and act more. In general, respondents stated that since the Sleephelling project, a lot of improvements have been observed. Respondents indicated that the government is gradually promoting energy efficiency in new buildings and examples are increasingly in place. Also, *"[…] people are a bit more aware and are looking at energy labels a little bit more than in the past*", as noted by a public affairs official. Yet, in terms of historic buildings, energy efficiency does not yet benefit from an agenda, which in turn does not support the scaling-up of ERHB projects.

Voluntary agreements

Voluntary agreements between private and public actors did not play a role in the realisation of the Sleephelling project. BAM, the building contractor, however, had signed an agreement with a non-governmental organization called "Stichting Natuur en Milieu" to perform at least ten initiatives for new construction or renovation purposes according to the passive house principle (VROM, 2010). With this collaboration, BAM and "Stiching Natuur en Milieu" aimed at a far-reaching breakthrough in energy efficient construction and renovation of the housing market (VROM, 2010). This arrangement spurred the completion of the Sleephelling project.

Public-private partnerships

With respect to the scaling-up of ERHB projects, respondents indicated that "public-private partnerships" (PPP's) can be advantageous. As mentioned by an architect, *"I find them [PPP's] highly effective in delivering very good solutions"*. In the field of ERHB, collaboration between the government and the private parties is essential, for numerous rules are in place and building contractors necessitate getting construction licenses granted. Thus, ensuring that collaboration is in place in the very beginning of the project design can facilitate the realisation of ERHB projects. Also important is the collaboration of different disciplines for the scaling-up of ERHB. As noted by a senior expert in sustainable buildings, *"Collaboration of different disciplines is also in place and I am part of a few of those groups. It is very nice because then you know each other better, you know what an architect is doing, you know what suppliers can do and you understand each other's language"*. The consideration of both public and private stances can facilitate the enactment of a common agenda and accordingly ERHB project realisation. Additionally, PPP's can support the development of packages that can alleviate the high costs associated to energy retrofitting measures and therefore instigate demand. Indicated by the respondent, *"[…] partnerships can play a big role. These can help the development of packages of measures that could be easily done and sold. So, it is also a matter of demonstrating it and placing it in the right magazines".* Public-private partnerships are not incorporated in the analytical framework but from the interviews it was disclosed that it can have a positive influence in the field of ERHB.

Local Governance Capacity

Political leadership

Local political leadership demonstrated to be of importance in the realisation of the Sleephelling project. It was disclosed that, by the time of the Sleephelling project, the government was actively encouraging the passive house approach, which was considered elementary in terms of achieving energy efficiency in buildings. However, the passive house approach was overshadowed by "zero-on-the-meter" technologies, for the passive approach was considered *"counterproductive for the ones promoting energy in a fast running economy"*, observed by an architect. According to the respondent, *"Passive homes would actually fit in an economy that is not rising, but slowing down and accepting the level they have. And our economy is based on the idea that we have to get bigger and bigger every year".* Since 2008, "zero-on-the-meter" measures have been increasingly incentivized by the government, consecutively affecting the scaling-up of passive home projects. This particular subject was not raised by all respondents; in fact, it was only discussed by the project architect. The overall perspective of respondents on the political leadership aspect was only indirectly touched upon, yet rather critically. Reported by a cultural heritage advisor, *"Maybe the focus on the value of cultural heritage is more emphasised in other municipalities, but in Rotterdam it is not".*

In Rotterdam, the preservation and sustainable redevelopment of cultural heritage does not demonstrate to be a first concern for reasons that are rooted in the city's history. *"Ever since Rotterdam was bombarded during the war period, people feel sort of footloose. Our history is gone, so we might as well change and go for the future. This is sort of the urban mind set here. Thus, keeping the monuments is quite difficult, the discussions are difficult"*, explained a cultural heritage advisor. The respondent continued by arguing that, *"Rotterdam is very poor, whereas Amsterdam has a huge budget and can ask for huge prices per square meter. Here the problem lies in finding the programme and keeping it cheap. It is more necessary to be more creative with these kinds of things. The other part is that the city loves to destroy old buildings and build new ones. They love the sound of huge concrete beams going into the ground".* Nonetheless, efforts by the Monument Committee are being increasingly directed towards shifting the predominant mind-set in Rotterdam. *"This is the fight we try to put on the agenda. It is changing a bit now. If it is really old, people understand more and more that it is important to keep them […] we are discussing about whether a city improves if you add new layers to it or whether it improves if you try to redevelop it",* indicated a cultural heritage advisor.

At the municipal level, the Monument Committee addresses new buildings and monuments concurrently, and is cognisant that monumental buildings have greater potentiality to be preserved if these are being used. *"In Rotterdam, the Monument Committee is a combination of new buildings and monuments. We are a group of six people from different backgrounds […] some of my colleagues have a historical background, are architects or are in the urban development. We try to bring all this knowledge into the Committee […] we basically judge all the building permits on aesthetic levels: so, how does it fit into its environment and into the city? And how does it help the city to advance? We also judge for monuments: monuments should not be abandoned, but should be used. From the interventions that are*

proposed, we judge whether these fit into the monumental values. We are quite a liberal committee but that is part of Rotterdam", clarified a cultural heritage advisor. In ERHB, the respondent stated that frequently building owners do not have a real reason for undertaking interventions in monuments. Proposals for interventions are not well founded, which is not acceptable by cultural heritage authorities. *"Often, we see that people do not like their buildings, so they have a problem. They do not see the value of the building but only the problem. And we need to solve that. What we always try to do in discussions is to judge the building. We have the cultural heritage values to protect and the project ambitions of men to consider. We try to bring both together: we evaluate what impacts on the building would be caused by interventions and whether the value of the building would be damaged or lost. We often ask developers to turn on different buttons. Sometimes it is possible to change things and we help to bring this change in a much better way, which enables the realisation of greater opportunities in monuments. But we have to understand why interventions are necessary or wanted; if it is logical, than it is ok. But if interventions are not justified, then we are stricter",* emphasised a cultural heritage advisor. "Well founded intervention" is a prerequisite to the realisation of ERHB projects. This factor is not covered in the analytical framework, but discloses significance in ERHB undertakings.

In Rotterdam, *"What the municipality should actually do is, when they see that projects like those are taking place, to support these projects, make them showcase projects and trigger other people to visit the site. They should also ask for monitoring so that they can follow up on the results in coming years […] if these evaluations can demonstrate the real benefit of investing energy measures, then the municipality should spread the information and people will then simply follow it. This is a simple thing that governments can do […] the municipalities should also support, but they are not taking the lead. If municipalities would take the initiative and invest in their own buildings and indicate that it is also economically interesting to invest in energy performance, then people would feel more encouraged to do so as well […] the municipality has numerous ways to help and facilitate the realisation of these projects, and that they can better facilitate than provide the money",* suggested a cultural heritage advisor. Put differently, the municipality should activate other means to encourage and facilitate the realisation of ERHB projects. Local authorities should take the lead and bring ERHB projects forward. Authorities should further encourage the "demonstration" of ERHB projects. Also pivotal is to "monitor" and "follow-up" projects and developments in the field of ERHB, and to accordingly communicate about the benefits to the public. These factors were not covered in the analytical framework, but are necessary for the scaling-up of ERHB projects.

In terms of climate strategy, respondents stated that many opportunities are overlooked in the Netherlands. The EU has, for instance, defined a speed for energy efficient renovation of 3% per year for the whole building stock to support efforts in achieving 80-90% reduction in CO_2 emissions. And, as observed by a senior sustainable building advisor, *"I am not aware of any measure that is supporting this and we are not at that speed in this country"*. Another interviewee accentuated that "*If we want to accomplish our 2020 objectives, in which every new house will be energy efficient, but do not translate that in any way to obligations and into our old buildings […] we will never meet any of the international targets we agreed to"*. Respondents asserted that the Dutch government may indeed have the objective

to meet climate targets, but they also speculated about the shortcoming in measures to realize these: *"why should they now stop the subsidies for solar panels, for instance? And not pay people back from their energy investments in the system?"* and *"why do people who buy new green cars can get his taxes reduced and not people who buy houses?"* An additional remark concerns the energy market, which is likely to undergo disadvantages resultant from improved building energy performances. A building physics expert commented that, *"I get now the idea that the government has limited goals, they just want to improve a little bit and not go too fast because they need those improvements for another years. The government might be afraid that the money they earn from gas and energy taxes might get too low if the energy performance of houses improves too much. So, they have to stimulate it but sometimes they are not really doing it".* To this, the government demonstrates to have an ambiguous role in climate issues.

Another point of discussion relates to the delegated responsibility to local authorities to address climate change concerns. Conforming to the ex-project leader, *"The problem is that local authorities have their own rules. Local authorities only tend to look at their rules and not at the ultimate objective of projects. In Rotterdam, there is this problem of having a big vision but sometimes local authorities just do not get these. And when that happens, they lay stress upon their autonomy"*. Similarly, it was observed that assigning local authorities the responsibility to support efforts in mitigating climate change aggravates the "fragmentation" of the system. According to a respondent, *"[…] there is a trend that it is at the city level that climate issues should be addressed. But with this, you sort of lose sight of reality".* As heretofore mentioned, cultural heritage conservation regulations are as well an accountability of local authorities. This suggests that demand from the local officials can determine the scaling-up potential of ERHB projects, because *"demand from the government side is the only way to convince people"*, according to an architect. And if the demand is low or inexistent, the scaling-up likelihood of ERHB will be uncertain. Yet, it was also emphasized that consumers should take on the initiative and demand for improved energy performances of old buildings. As noted by the ex-project leader, *"It is a pity that the government is the one who has to act to get the mind-set different. It is better when the consumers are the ones who initiate it. But I guess that the only opportunity there is to change the system is when the government stands behind it".*

Trust in the policy framework

Trust in the policy framework did not play a role throughout the project realisation on the Sleephellingstraat, for the involved actors did not necessitate demanding for subsidies nor loans, and did not undergo any legislative fluctuations in getting their construction licenses allocated. As a result, this factor was solely indirectly discussed.

Discussion points that came across and that can be associated with trust in the policy framework amount to the regulatory and economic policy instruments. As previously observed, the implementation of the energy certification scheme has been at issue in the Netherlands. Many respondents pondered whether the government is determined to take the issue purposefully. According to a respondent, *"The Netherlands seems to not be taking that [climate targets] so seriously or are thinking too easily about it.*

For instance, with the energy label, they first introduced something that was not really working […] the government started with a general label for houses and maybe that did not encourage a lot of people". Yet, respondents stressed that deficiencies in climate objectives are not fully accountable of the government. As emphasized by a public affairs official, *"[…] willingness is missing from all sides. From the side of the overall society as well as from side of policy-makers and this is recognizable from current energy label discussions".* It was also mentioned that policies are not justly founded because policies are not based on the stake of the citizens. This aspect was pointed out by the ex-project leader, *"Rules are of course made by the government but they ask advice from installation companies and consultancies. The government follows the advice of consultancies and therefore implements many rules that do not take the consumer into consideration".* Policies that are enforced but do not take public stake into consideration can influence the trust in the policy framework. However, in the light of overall disinterest in sustainability from the society, it seems like this aspect would not be yet influential for the scaling-up of ERHB.

Another issue concerns the availability of economic incentives. Formerly indicated, the fluctuating subsidy scheme is causing people to hesitate to ask for them. This is observed by a building physics expert, *"[…] people in the Netherlands do not trust subsidies because they are quickly changing during the year and people are not sure whether they will get the same subsidy five years later".* It was also observed that, apart from the limited amount of subsidies, there are not many other economic stimulants for building owners to consider for energy efficiency measures. Considered the high costs associated with green measures, shortcomings in economic incentives are not supportive of the scaling-up of ERHB. Authorities necessitate finding additional innovative and attractive means to financially stimulate building owners to undertake energy efficiency renovation. As indicated by an expert in building physics, *"It is very expensive to carry out these projects. If you have to improve the facade like we did in the Sleephelling, you get almost to the built cost […] so the government should find a way to stimulate it".*

In general, trust in the policy framework did not influence the success of the Sleephelling project. However, it was assumed that trust can play a role in the realisation and scaling-up of ERHB, for reasons that range from policy imperfections to self-disregard of the importance of upgraded building energy performance.

Mobilisation of resources

As previously mentioned, by the time the Sleephelling project took place, local authorities were supportive of the passive house approach, which was considered elementary in efforts to achieve improved energy efficiency in buildings. Since 2008, however, the passive movement was decelerated because it was considered counterproductive for the energy sector. The passive approach was then overshadowed by "zero-on-the-meter" measures, which were deemed more appealing in a fast running economy. Nevertheless, the realisation of the Sleephelling project was not influenced by the capacity of local authorities in mobilizing resources. On the contrary, the success of the Sleephelling manifests to be resultant of the capacity of team members in mobilizing resources, especially knowledge wise.

The mobilisation of knowledge aspect predominate the interviews in terms of perceived barriers for the realisation and scaling-up ERHB projects. As stressed by an architect, in the field of ERHB *"knowledge is crucial"* and *"[…] acquiring sufficient knowledge on the opportunities there are to retrofit and to make smart decisions by general building owners is impossible"*. Yet, conforming to a building physics expert, *"they [local authorities] have limited information on this particular topic"* by reasons of *"[…] people who work with historic buildings are typically the people who want to restore buildings to the previous stage"*, as observed by a senior expert in sustainable buildings. Generally, the conservative standpoint of actors in the field of cultural heritage preservation prevails and, as heretofore mentioned, the inexistent integration of building energy performance in cultural heritage is not supportive of efforts to scale-up ERHB.

At the city level, Rotterdam demonstrates to take on a more facilitative approach towards ERHB instead of mobilising economic instruments. Reported by a cultural heritage advisor, *"Subsidising is difficult because then the municipality gives money away. So, what they do is to facilitate. They have people to facilitate it and support the management of programmes. They ask us to make a standard plan that people can use to renovate or extend their houses. As this standard is technically correct, they get the building permit for free. This is more or less how the municipality is pushing people to make use of these facilities. The objective here is to make neighbourhoods better. So by facilitating this part, allowing free permits and providing free advice, the municipality tries to trigger people to invest in measures to upgrade the environment. And I think that it is better than giving 1,000 euros for new windows or something".* Although the municipality has means to facilitate the realisation of ERHB projects, it is however not actively engaged in programmes that are supportive of ERHB projects. *"The "nul-op-de-meter" programme is being promoted, but it is a national initiative. The municipality chooses a few neighbourhoods to be part of this programme, but they are not really doing a lot. They are keen in being part of the programme but are actually not doing much",* disclosed the respondent.

Formerly illustrated, respondents argued that the omission of historic buildings from energy policies results in missed opportunities. As observed by a senior expert in sustainable buildings, *"[…] integrating the necessity to have low energy buildings is still not there and I find it personally crucial. For me, the need of low energy buildings is a given and then you only need to find solutions to realize that".* In Rotterdam, ERHB is not a prerogative. *"I think no one looks at improved energy performances of historic buildings. There is no floor in this huge municipality building that is focused on this issue; maybe in abstract"*, indicated a cultural heritage advisor. Collaboration between different departments could support efforts in overcoming barriers and uncertainties associated with ERHB considering that knowledge exchange issues. Individual departments would be then more likely to integrate energy efficiency in their policies, and thereby spur the scaling-up potential of ERHB. Still, it remains unclear in what fashion this exercise should take place. Besides, the capacity of local authorities to mobilise knowledge for ERHB within the municipality of Rotterdam demonstrates to be insufficient.

Respondents indicated that the conditions for ERHB are further aggravated due to the lack of "interdepartmental cooperation", notably in bigger municipalities. In Rotterdam, cultural heritage

authorities do no collaborate with environmental authorities. According to a cultural heritage advisor, *"Collaboration should help. It would be really helpful to have some sort of team represented by energy efficiency stakeholders or construction companies who are used to deal with old existing buildings, especially here in Rotterdam because we are used to build new things. Maybe the focus on the value of cultural heritage is more emphasized in other municipalities, but here it is not*". Deficiencies in "interdepartmental cooperation" complicates communication and accordingly the exchange of knowledge both internal (amongst local authorities) and externally (between local authorities and the public). Fragmentation also contributes to the shifting of responsibilities at the municipal level. This is supported by the ex-project leader, *"[…] nobody really knows what is going on. Specifically in Rotterdam, there is no one at the municipal level who takes the responsibility for a particular project. So, there is no support to carry out projects. This frequently happens in big municipalities, because they have just too many departments, and these do not collaborate with one another"*. An architect deliberated that, *"This deregulation will be brought back to a more centralized system, which will enable better control".* "Institutional fragmentation" is not an indicator covered in the analytical framework, but disclosed importance from the interviews.

External Trends

Environmental awareness & societal values on sustainability

Respondents raised the issue of lacking public awareness concerning the benefits associated with ERHB and sustainability, more generally. The ex-project leader asserted, *"People are still paying too much attention at costs and the way that the building looks like, and very little at sustainability"*. Accordingly, a public affairs official stressed that, *"Nobody in the Netherlands is really interested in sustainability concerns. So, nobody will invest money for the sake of the environment. People will only do it if there is a very clear economic advantage*". Awareness also demonstrates to be deficient among building evaluators. Observed by a senior expert in sustainable buildings, *"There is no serious awareness, no serious knowledge among evaluators […] property evaluators are the most conservative and the last actors in this chain of decision-makers and are still very poor in terms of awareness".* The interviewee further points out that, *"Evaluators assign the same price to the building, whether it is low energy of not. And this we learned in the Sleephelling*". Indeed, following the project realisation, the newly passive renovated houses on the Sleephellingstraat were undervalued for building evaluators do not concentrate on building quality when assessing properties. The shortcoming in knowledge among building evaluators on the benefits ERHB can bring about influenced the Sleephelling project outcome.

Respondents indicated that *"principles of low energy buildings are hard to sell"* because building evaluators are still incapable of looking beyond the Dutch energy label. Translating the benefit of energy efficiency into the value of the property remains therefore unsettled. Considered that buildings are still auctioned for its explicit rather than implicit values, *"nobody will pay an extra 10% to get it passive, unless one knows very well what passive means",* as observed by an architect. The prevailing inclination of the housing market towards expressing building value in terms of location or aesthetic appeal does not benefit the scaling-up of ERHB as the public is then not incentivized to consider for other building

qualities, especially improved energy performance. Notwithstanding, according to the ex-project leader, *"interest in sustainable development is needed".* Consumers should be firstly informed that building energy performance is important to consider. Only then will consumer interest arise and consecutively the demand for ERHB. Yet, *"you can only reach those people when you give something in turn, which often entails giving money".*

The economic return aspect of investing in ERHB is once more stressed upon as influential in the realisation and scaling-up of ERHB projects. This is supported by a public affairs official, *"Whatever you do, there should be a financial component. The Dutch are driven by money. It is nice to see show-case projects but when people have to pay for it, they will not do it".* The respondent continues by indicating that, *"We have sufficient knowledge and sufficient show-cases, but the willingness is missing from all sides: from the side of the overall society as well as from side of policy-makers".* Regardless of those shortcomings, respondents stated that improvements have been observable. "*Awareness has risen a little bit"*, asserted a respondent. An expert in building physics remarked that, *"In comparison with ten years ago, we see a lot of improvements. It seems like more and more people trust that they are to benefit from investing in energy efficiency, but also from an improved comfort level […] you see that in the last couple of years, people, who were totally not interested in energy before, are now improving their cavity insulation […]".* Similarly argues the ex-project leader, *"Every year we get more sustainable new houses and that goes very good"*. However, *"new houses in Holland are only a tiny fraction of the whole building stock, so we have to look at the old houses"*. Awareness and interest in the ERHB is still necessary to instigate demand and to support efforts in scaling-up ERHB projects. It remains however unclear how to most effectively reach the public.

Market demand

Market demand is another point in question that was discussed among interviewees. Overall, respondents accentuated that demand for ERHB is still inadequate. *"There is no demand, this is the first drawback. Nobody asks for the energy performance of an old building"*, observed by an architect. *"Comfort and economic reasons are much more important than environmental arguments in the Netherlands*", indicated a public affairs official. An additional shortcoming concerns the potential of the sustainable renovation market, which according to the interviewee, *"Here (in the Netherlands) we have big buildings doing all the construction and renovation is not really the market"*. Likewise, a senior expert in sustainable buildings observed, *"[…] The Netherlands was rather late in adopting good energy efficiency standards […] and I think that it is still innovative for the Dutch market to work with energy efficiency".* Demand for energy efficiency of existing buildings is not yet satisfactory and it demonstrates to differ per building sector.

Respondents stated that the market potential for improving the energy performance of existing buildings lies in buildings that are not listed, for monuments represent a small percentage of the Dutch building stock. Conforming to an architect, *"If you look at fortresses, for instance, they only make up a very tiny percentage of the whole building stock. So, they are irrelevant for our energy reuse. It would be beautiful if they were changed but these are the sort of monuments that I do not care about. It is not*

very important to make them energy efficient. Living buildings are the ones that are interesting and important to address". In the same lines emphasises an expert in building physics, *"The potential in the housing market is much bigger than in some other projects". "Old houses are the problem here […] too many old energy inefficient houses"*, accentuates the ex-project leader. Although these 1930's buildings rank very low in energy efficiency, and also in usable and unusable space, *"They are still very popular in the Netherlands"*, observed an architect. Historic buildings that comprise the housing market provide the greatest opportunities in scaling-up ERHB projects and in fostering the run towards low-carbon cities in the Netherlands. But for that, adjustments in the "housing market" are necessary.

Asserted by the ex-project leader, *"Nowadays we still have a silly system, in which everyone looks at the house only from the mortgage costs perspective and not from the total costs of a house […] if you do not change this system, you will not be able to change the market".* Switching the focus from total investment costs to total living costs can be beneficial to ERHB. Yet, respondents emphasised that it is still difficult to reach people and incentivize them to consider for energy efficient buildings, partially owed to costs associated with ERHB. Furthermore, it was stressed that it is difficult to single out what part of the investment pays back a certain measure, upgrades the building quality or improves the building energy performance. Respondents accentuated that renovation needs to be looked at from a holistic point of view because too often the issue narrows down to marginal cost calculations and that prevents men from carrying out projects. Respondents underlined that modifications in the Dutch housing market to include building quality are necessary to enable greater opportunities for retrofitting projects, especially in purchasing houses. Yet, firstly consumers should be informed that building performance is an important aspect to consider

Monuments also demonstrate potentiality, yet to a smaller extent. Pointed out by an architect, *"Monuments are very important in the way that they are carriers of the soul of Holland, in some sort of way. And the Dutch like these buildings […] and that is the main quality you need to have sustainable buildings in the long-term […] retrofitting monuments serves as an example that it is possible to improve the energy performance of these buildings […] monuments is the best platform to invest in [...] because it proves that monuments have a long-term exploitation period".* However, *"[…] if Holland wants to be energy efficient, then we have to address the 99% of the building stock"*.

The issue of cost-benefits was again raised and regarded as a barrier for the realisation and scaling-up of ERHB. According to a senior expert in sustainable buildings, *"[…] many people are still in the stage of only considering the cost effectiveness of the project. And that works similarly in our parliament: policy makers evaluate the new step in energy performance levels, but there must be a study demonstrating that measures will be cost effective, otherwise it will not take place".* Prices associated with ERHB measures are another problem, which can demotivate people to opt for improved building energy performances. According to a building physics expert, *"[…] at the moment, prices are too high and the crisis is not really helping*". Likewise argues the ex-project leader, *"At the moment investing in retrofitting of historic buildings is more difficult because it is still very expensive to do so"*. Nevertheless, a growing number of initiatives on energy efficient renovation of historic buildings are taking shape in

the form of partnerships. The interviewee indicated that the "stroomversnelling" initiative is *"[…] particularly interested in innovative technologies that can be applied in historic and monumental buildings, in an easier and cheaper way. So, there is something happening but it takes time. The four big builders in the Netherlands are active here […] You also see that the housing associations are more and more active in engaging the house owners to think about the future".* Nonetheless, *"You have to integrate sustainability into the overall renovation approach".*

An additional matter concerns "energy prices". Some respondents pointed out that "energy prices" can indirectly influence the scaling-up potential of ERHB projects. Noted by a public affairs official, *"[…] the price of energy is not high enough and we are too rich… we can still pay for it. So, we do not want all this trouble, or at least we perceive it as trouble or not interesting*". Thus, with respect to improved energy performances, *"Consumers might only care when prices go sky high"*, as indicated by the ex-project leader. "Energy prices" was not covered in the analytical framework but disclosed as a conceivable influential factor in scaling-up ERHB from the interviews.

Another point in question raised by the respondents concerns the "energy market" in the Netherlands. As explained by a cultural heritage advisor, *"[…] considering that I live in a monument, I cannot easily install a solar panel here also because I have a strange roof. So, for me it would be wiser to put solar panels on the roof of the neighbours and to collect electricity from it. But this is not possible. I know there are a few examples now. For instance, to use the roof of a school from a neighbourhood to produce energy, for the roof is completely flat, people cannot see these panels and it is not ugly for the city landscape. It also has this educational aspect. But, officially it is not possible because the part that you own should be in your property. So, feed-in-tariff is not possible. It would be very helpful if people could invest in solar panels, place them somewhere else and still get that green energy provided back to their buildings. I would do it immediately. This would be really simple. In Germany, the money that you get for the energy that you produce is the same money that you pay for getting that energy. In the Netherlands, if you produce more energy than you consume, you have to pay taxes because you are then considered an energy producer. When you sell the energy you produce, you have to cover for the tax costs and therefore you sell that energy for lower prices. That is not a good incentive. It is really important to understand the energy system of this country, because it affects a lot of different sectors. Also totally stupid is that energy prices are much lower for businesses than for households […] it is quite a strange system".* The prevailing energy system in the Netherlands is controversial. On the one hand, it is the objective of the government to meet the set climate targets in the near future. On the other hand, the government is hindering instead of facilitating this transition. Numerous adjustments in the energy market are necessary to accommodate the transition towards improve historic building performances.

5.1.2 Synthesis

Table 2 depicts a representation of the factors that are deemed influential in the realisation and scaling-up of ERHB projects, derived from the literature and empirical data collection. The blue colour indicates that, although relevant, the factor did not play a role in the realisation of the Sleephelling. The yellow colour indicates that the factor was important to a certain extent for the realisation of the

project. The red colour indicates that the factor shaped the realisation of the Sleephelling project. Within the red colour categorisation, the positive symbol indicates that the factor contributed to the realisation of the project, while the negative symbol indicates that the factor acted as an obstruction but did not however determine the project realisation. The tick symbol indicates that the factor can influence the scaling-up potential of ERHB projects.

It is important to stress here the Sleephelling was a pilot project, implying that several of the identified indicators were not applicable to the case study. In other circumstances, it is assumed that more factors come into play in carrying out ERHB projects. This is observed from the extensive case study analysis, whereby factors that were considered important for the success and scaling-up of ERHB were more generally discussed and reflected upon. In Chapter 6, the Sleephelling case study is discussed on a more abstract level and confronted with the findings from the following case study: Fort de Gagel.

Hardware & Software	Cost-benefit **(-)**	Physical attributes **(-)**	Technical compati-bility	Economic advan-tage	Heritage signifi-cance **(-)**	Cultural signifi-cance	Social compati-bility	Environ-mental perfor-mance	Renova-tion timing
Operational Orgware	Mobilisation of resources **(+)**		Leadership **(+)**		Mutual interests **(+)**	Communication **(+)**		Stakeholder engagement **(+)**	Local authorities direct engagement **(+)**
Informal & Formal Institutions	✓ Regulatory policy instruments		✓ Economic policy instruments		Informative policy instruments		Voluntary agreements		✓ Public-private partnerships
Local Governance Capacity	✓ Political leadership		✓ Trust in the policy framework	✓ Mobilisa-tion of resources		✓ Interde-partmental coopera-tion		✓ Monitoring	✓ Follow-up mecha-nisms
External Trends	✓ Market demand **(-)**		✓ Environmental awareness & Societal values on sustainability **(+)**		✓ Housing market		✓ Energy market		✓ Energy prices

Table 2: Influential factors in the realisation and scaling-up of the Sleephelling ERHB project.

5.2 ReFoMo, Fort de Gagel, Utrecht

"NHW fortress to become climate-proof"

5.2.1 Case study background

The Reduced Footprints of Monumental Structures, Landscapes and Buildings (ReFoMo) is a project that has been responsive to the omission of heritage buildings in energy policies. Heritage buildings have a significant impact on climate change in view of their inefficient energy consumption (Climate-KIC, 2014). In response to this controversy, ReFoMo explored ways to reduce the footprint of unique heritage buildings by bridging the gap between the energy performance of heritage buildings and the potential energy savings (ReFoMo, 2014). ReFoMo studied three buildings: i) fortresses in Utrecht (Netherlands), ii) a historic building working as the Faculty of Engineering in Bologna (Italy); iii) an industrial gas production building in Budapest (Hungary). This research concentrates on the Dutch historic fortress Fort de Gagel. Following, background information on Fort de Gagel is put forth to substantiate the understanding and importance of the historic fortress.

Fort de Gagel is part of the New Dutch Waterline (NHW). NHW is a large-scale military defence system designed in 1815 consisting of 60 fortresses, 5 fortified towns and over 1500 smaller water networks, with over 85 kilometres extension (personal communication, Provincie Utrecht, 2015). The military defence line worked as a protective ring of 3–5 km wide defending the western part of the Netherlands around the cities of Amsterdam and Utrecht by means of enabling controlled inundation through landscape engineering. During the Second World War, the concept of a waterline as a defensive mechanism demonstrated to be ineffective and was therefore abandoned, leaving an extensive ensemble of cultural and natural heritage behind.

Nowadays, the NHW no longer serves a military purpose and holds a protected status as a National Heritage Site and Landscape (personal communication, Provincie Utrecht, 2015). In 1999, the government announced a National Project to consolidate, protect and revitalize this cultural landscape through: i) the redevelopment of the NHW as one recognizable landscape enhancing visibility and accessibility; ii) inclusion of the NHW as a national monument in the minds and hands of owners, experts, visitors and inhabitants; and iii) support of an economic and socially sustainable exploitation of the NHW (Provincie Utrecht, 2015). Sustainability is an important aspect in the redevelopment, i.e. viability of renewable energy production, biodiversity conversation and water retention (Dam et al., 2012). By *"preservation through redevelopment"*, this military landscape is now starring on the Dutch tentative list of UNESCO World Heritage (personal communication Provincie Utrecht, 2015; Gemeente Utrecht, 2015; Rijksdienst voor het Cultureel Erfgoed, 2015). Fort de Gagel is one of the fortresses that is currently undergoing preservation through redevelopment under the National Project. Fort de Gagel is as well one of the Dutch case studies of ReFoMo.

The construction of Fort de Gagel started in 1819 but it was only in 1875 that its definitive form was realised. The fort is now entirely in the condition of 1880's and functions as offices. Since 1971, Fort de Gagel is governed by the policy principles of the municipality of Utrecht, the provincial government

of Utrecht and the national government. On the one hand, these entities are accountable for safeguarding the legacy of the Dutch military history. On the other hand, it is also their objective to enhance the landscape and wildlife value and to give a new purpose to these fortresses in a sustainable fashion. Only minor renovations, such as heating systems installations and wooden floor restoration took place in the periods of 1960-1970 and 2000-2010. Figure 7 shows the current state of the Fort de Gagel.

Next to its current use as offices, it is envisioned to redevelop the fortress as an information centre, café-restaurant and centre for outdoor activities. Green, nature and the environment are paramount in this redevelopment. Visitors will be able to get something to eat and drink in a typical 19th century fortress. Additionally, it will be possible to rent bicycles and canoes so that visitors can explore the surrounding areas. Sustainability is also playing a role in the redevelopment project as the objective is to reduce the footprint and energy consumption of the buildings (personal communication Gemeente Utrecht, 2015; Provincie Utrecht, 2015). Retrofitting Fort de Gagel to improve its energy performance is an objective supported by ReFoMo, which aims to create a lighthouse effect that can serve as example for future energy retrofitting of monuments.

Figure 7: Fort de Gagel, Utrecht.

5.2.2 Application of the framework

Fort de Gagel holds a protected status as National Heritage Site and National Landscape and is additionally on the shortlist of the UNESCO World Heritage. Fort de Gagel is one of the fortresses owned by the Municipality of Utrecht. It is also their last fortress to undergo renovation under the National Project on *"preservation through redevelopment"* (personal communication, Gemeente Utrecht). The Municipality of Utrecht has therefore great ambitions to undertake the redevelopment of Fort de Gagel

in a sustainable way. The owners are taking on an exemplarity role and want the sustainable redevelopment of Fort de Gagel to serve as a model for future energy retrofitting of historic fortresses in the Netherlands. Notwithstanding, as a listed monument, the interventions to improve the energy performance of Fort de Gagel are limited. Further, as owners of cultural heritage, the Municipality is accountable for the preservation of the inherent values of its fortresses. The endeavour to integrate improved energy performances to cultural heritage is not an easy exercise; yet, accomplishments have been realised. That being said, what factors are behind these accomplishments? What were the barriers and with what instruments were these minimized? The following section describes the factors that were influential in the project realisation, which were disclosed from the interviews.

Hardware & Software

Factors from the hardware and software systems that played a role in the realisation of the Fort de Gagel project include "heritage significance", "cultural significance", "physical attributes", "technical compatibility", "cost-benefits", "economic advantages" and "right renovation timing". In the following, a comprehensive understanding of the event is given.

Fort de Gagel holds a protected status as a National Heritage Site and Landscape and, being part of the NHW, it is as well on the shortlist of the UNESCO World Heritage ("heritage significance" and "cultural significance"). This suggests that retrofitting the fortress is a demanding exercise and only a limited number of interventions can be realised because of its inherent cultural and heritage values. *"Insulation is difficult because, most of the times, the walls are an original part of the building and people would like to keep it preserved. This is not only a standpoint of the municipality, of the policies, but also of the owners themselves because they are part of the character and charm of the building",* observed a sustainable historic building advisor. Similarly, a civil servant stressed that, *"There will be always difficulties because you are talking about cultural heritage of buildings that are two-hundred years old, are nationally listed, and so on. People who are working in the technical department do have the solutions but we, as guards of our cultural heritage, have to secure a healthy maintenance of these building and secure its values".* In the view of integrating sustainability in cultural heritage, it was stressed that a holistic approach is needed. *"[…] if you want to do something with heritage and sustainability, there is no one solution to look at for the building. We need a holistic approach for everything. And if you find some kind of businesses like the … [company A], which can deliver this holistic approach, that would be the best chance for heritage buildings"*, indicated the ReFoMo project leader.

Respondents accentuated that "engaging" the Cultural Heritage Agency is crucial in undertaking renovation of national monuments, especially in the design phase. According to a policy official, "*The Netherlands has very strict monumental laws and if they [Cultural Heritage Committee] disagree with your project, there is usually no way out*". *"We learned a lesson that you have to work closely with the Monument Agency and start talking to them in the very first part of the project because if they do not agree with your plans for sustainable energy or etc., you will not be able to do anything"*, explained a civil servant. The respondent described that for the redevelopment plans of Fort de Gagel, *"[…] after talking to an architecture bureau and collecting some ideas, we decided to contact the National*

Monument Agency and to ask for their opinion on the plans. They looked at it, made some small adjustments and in the end they agreed with the plans, of course, under many conditions". "Early engagement" is not a factor covered in the analytical framework, but demonstrates relevance with respect to undertaking energy retrofitting in fortresses considering the intrinsic values that these buildings sustain. Howbeit, as observed by civil servant, *"Indeed what we need is people who talk with each other and find solutions that are agreeable to all. But of course, those discussions, processes and developments cost a lot of money. And you have to demonstrate, do experiments. These experiments also cost a lot of money, but that is the only way, I think. We have decided that we will redevelop cultural heritage in a sustainable way. There is no going back".*

"Social compatibility" is an additional factor that played a role in the redevelopment plans of Fort de Gagel, but to a much lesser extent. According to a civil servant, *"[…] we have neighbours and a busy highway next to the fortress. So, it is important to give the new space a quiet environment, not only for the clients of the future restaurant, but also for our neighbours".* Still, it was indicated that "social compatibility" and "cultural significance" usually do not come across as important in undertaking ERHB projects for, *"If the retrofitting is done right then there will be only advantages, also in the usage of the building"*, observed a senior energy retrofitting advisor.

With respect to the energy retrofitting of Fort de Gagel, respondents indicated that the building "physical attributes" can obstruct the realisation of improved energy performances. Here, knowing the building behaviour is perceived as fundamental. As described by a civil servant, *"We have been here [at Fort de Gagel] for two and a half years now but before there was no heating in the building, no gas installation in this fortress […] so we brought gas to the building, put new boilers and we now have a central heating upstairs. Since we have been here and are using the building regularly, so the heating is also regularly on, it caused a new crack in the building. Something is happening to the building due to the heating that we now have and I think it is drying the stones more and more. When we came here, we could feel that the in-door climate was very moist. But no one really knows what caused that crack, or how to do something about it. Those are things that are happening to the building but you still cannot do much about it"*. Thus, humidity and in-door climate control play a big role in attempts to improve the energy performance of fortresses. *"[…] from the start, climate issues within these types of buildings have always been a problem because the nature of the buildings makes it difficult to reuse them*. *These buildings ask for energy, specifically for the inner climate. Air circulation and humidity are the biggest issues in those buildings. And, humidity and climate control are still done in an energy consuming way",* explained a cultural heritage landscape official. Knowing the building use also demonstrates to be crucial in undertaking ERHB. As stressed by a sustainable historic building advisor, *"It is essential to know the use of the building because that determines what the possibilities are […] if your building is fully used and has high energy costs because of the gas boiler, then it would make sense to invest in something that can alleviate your costs and there you can save a lot and very quickly. So, there should be a balance […] but also important is the user's perspective, because often they are not apt to going for a holistic renovation, so you have to search for the possibilities within limitations".*

The implementation of innovative and energy saving technologies in fortresses is troublesome ("technical compatibility"). Being a national monument, the fortress' "cultural" and "heritage significance" influences the employment of technical solutions. Its "physical attributes" are also not beneficial of the employment of green technologies. Asserted by a senior energy retrofitting advisor, in the field of ERHB, *"[…] you have to find solutions that will fit into the building. I saw a project that implemented PV solar panels and it was only permitted because it was reversible. So, if the solution would have been permanent, then the project would have been rejected"*. Reversibility of green installations is an important condition set out by the majority of local authorities on cultural heritage preservation ("regulatory policy instruments") that can confine efforts to bring about more energy friendly historic buildings. Reversibility does not however indicate to shape the course of ERHB. As disclosed by a cultural heritage landscape official, *"Frequently we find that energy savings solutions are possible. Solar panels are possible; biomass could also be of use to reduce the energy consumption of fortresses, considering that it respects the value of these buildings"*. Similarly argued a sustainable historic building advisor, *"I think that the biggest potential for old buildings to be sustainable lays on installations, like more sustainable ventilation, thermal solar panels, etc. […] most of the times, historic buildings are still single glazed and there you can replace them for double glazing if these fit the original window frames. I think this is the weakest point of the building and that can be usually easily tackled".* Put differently, if one wants to upgrade the energy performance of fortresses one should rather invest in green installations than insulation, for the latter can jeopardize the building design and cultural heritage significance. Yet, a civil servant noted that, *"[…] for the new building, in terms of sustainability, I am still looking for ways to install solar panels or heating storage in the bottom of the building. I do not know if they will agree with that".* Albeit the redevelopment of Fort de Gagel takes sustainability into account, limited attention to improved energy performance ("environmental performance") has been observed.

Another factor that adds to overlooking the "environmental performance" of Fort de Gagel amounts to "cost-benefits". *"We do see that sustainable measures are beneficial but their pay-back time is usually a bit longer […] cost-benefits are still very decisive*", asserted a sustainable historic building advisor. Likewise, a senior energy retrofitting advisor indicated that, *"[…] there is a large emphasis on the cost-benefits. If compared to other costs that you have in retrofitting a building... nobody asks about the costs of the walls, or the windows. But if you talk about energy, then everybody wants to have a pay-back. This can also be a limitation because if you have a very short pay-back horizon, then somethings are not possible. And I personally think that if you have a heritage building, which has lasted for 300 years and will be likely there for another 100 years, then a long pay-back time sounds more appealing as you can then do numerous things during that time".* Shortcomings in subsidies further aggravate the issue. A civil servant explained that, *"For a city that owns cultural heritage it is very hard to receive subsidies in this [ERHB] field. You can of course look at private investors but most of them are not really interested in […] so, there is a real problem here. The investments in solar panels and in storing heat will be huge and we do not know if we can find national or international funding for it".*

An additional drawback concerns the so-called "who-pays-what". According to the fortress project leader, *"[…] we are the ones who have to do the investments in making the fortress more sustainable. And the entrepreneur, who will come afterwards, will benefit from it […] if the energy comes from a green source then he will pay less and this is his benefit, not ours. But we first have to install these solar panels and he will not pay much for that. And maybe there is some difference in the rent he will have to pay, but it will take us a lot of years before the investment pays itself back"*. A civil servant continues by explaining that, *"[…] in the end, he [entrepreneur] pays less and less for his energy bill, so then he can pay us a higher rental price. But, this will not be the case in the coming 2-3 years, it will take more time. There are many discussions in place on whether sustainability is economically profitable at the moment. And at the time that it demonstrates its profitability, then there will be no longer discussions on it. But you have to convince people at the moment that it will be profitable in two-three years, and that it will probably be still economically profitable within 10 years, or 15 years. You see that there are a lot of investors, but also the government is more interested in short-term profit. And this is a huge problem"*. The dispute on "who-pays-what" can be nevertheless alleviated by a system of sharing of benefits. According to the NHW project leader, *"They [municipality of Utrecht] also have a system for the fortresses around Utrecht: the entrepreneur who owns the most has to contribute to the other fortresses. The earnings have to be equalized among the different fortresses. So, we have Fort aan de Klop, which is a very good running business and part of the money that is being earned there, goes to the other fortresses for maintenance purposes".*

Another problem concerns the identification of an entrepreneur who is apt to establishing a long-term commitment with the fortress owners. *"We will try to have the renting contract for at least 10 years with the same entrepreneur. We hope they will agree with it so that it gives us some sustainability as well",* pointed out the fortress project leader. In the light of "cost-benefits", it was stressed that it is necessary to advocate other advantages that result from ERHB, apart from improved energy performances ("environmental performance"). *"Also important is the quality of the building in terms of comfort, which is increased after refurbishment. Especially when you have energetic refurbishment, it will increase the level of comfort. If you have insulation people benefit from it. And that could be more emphasised"*, accentuated a senior energy retrofitting advisor. If one only regards the "cost-benefit" aspect of the retrofitting, one is also limited with measures he can take. Promoting the benefit of improved comfort levels from ERHB can counterbalance the problematic of "cost-benefits".

The concept of *renovation through redevelopment* is central in the NHW ("economic advantage"). Respondents stressed that the most advantageous way to preserve those fortresses for future generations is to give them a new purpose. *"I am convinced that when you do not use those buildings, they will decay"*, asserted the fortress project leader. *"These buildings have to be daily used. Use is essential here. And it has to be profitable to enable the daily maintenance. But doing restauration just for the sake of preservation is useless"*, explained a civil servant. In the same lines, a sustainable historic building advisor argued that, *"The function a building has and its opportunities are also very important. If it is a well working business, like a restaurant, then I think that there is more buffers to invest".* The redevelopment plans for Fort de Gagel are promising: a restaurant will be established, along

with an information centre, which will inform visitors on what recreational activities they can do. Visitors will have the opportunity to rent bicycles and canoes to explore the green surrounding areas, and enjoy a nice drink and meal in a typical 19th century fortress. According to the NHW project leader, the greatest opportunity to redevelop and therefore to preserve fortresses is when these are seen as an economic touristic product ("economic advantage"). *"Luckily, we are going for the UNESCO nomination and that can serve as an incentive for politicians because it [fortresses] will be then more important and they will have to do more to preserve and run them. I hope that goes on because then we have a touristic product for the Netherlands. And I think that this is the main goal, to see it as a touristic product so it is economically relevant, of course".* It is expected that once the NHW is appointed on the UNESCO World Heritage List, more consideration to preserving these fortresses will be in place. Yet, this does not suggest that attention will be devoted to improved building energy performances or to sustainable redevelopment more generally.

"Renovation timing" is another factor that disclosed importance, yet it was not covered by the analytical framework. Observed by a sustainable historic building advisor, *"I think that one of the barriers concerns timing. So, "is it the right moment to renovate?" I think that you can do much more on a natural time for maintenance and you can also do much more if it is a running business".* Similarly, a senior energy retrofitting advisor explained that, *"You have to wait until the moment that there is actually a need for refurbishment […] if you have, for example, a project in which the same equipment is not desired anymore and the owner wants something completely different, a totally different concept, then it is the right moment because there will be then no rest values of former equipment at that moment. That would have been replaced anyways. So, it is then a natural replacement moment that has occurred and then you can easily make proposals about completely different solutions […] you cannot replace something that has been placed in recent years. That is not interesting for anybody because you throw away new equipment".* "Renovation timing" came also into sight in the view of the opportunities to undertake ERHB in the selected case studies by ReFoMo. Respondents stated that the second selected case study, Fort aan de Klop, does not offer many opportunities for ERHB. Fort aan de Klop had already undergone renovation, thus respondents explained that adding another layer of energy retrofitting would bring about minimal improvements. According to a sustainable historic building advisor, *"I think that the Fort aan de Klop is not under time priority […] the building was already renovated in 2006-2007, so I do not think there is a big necessity to already re-renovate it […] as for Fort de Gagel, I think that the case is a better example because there will be things executed in a few years […] they are planning on a large restauration and are also planning to expand it".* Thus, the most beneficial opportunity to combine sustainability with cultural heritage lies on Fort de Gagel for that, *"We have to start from the beginning with the restauration and redevelopment"*, asserted the fortress project leader. With respect to ReFoMo, the NHW project leader emphasised that *"The selection of the case studies could have been better"*. A more detailed overview of this issue follows in the next section.

Operational Orgware

Every single factor from the operational orgware was considered important for the successful realisation of ERHB projects. Yet, with respect to the organisational structure of the Fort de Gagel redevelopment project, especially of ReFoMo, the responses were paradoxical.

Respondents pointed out that "leadership" is one of the most critical factors to bring about a successful project. *"ReFoMo is a big project, so communication is very important. Project leadership is very important. If we talk about general retrofitting projects then I personally regard this factor as the most relevant one. And this is maybe surprising but I think it is true. If you have an extraordinary ambition, you have to have commitment from the organisation but also a person who can pursue that. I think that this is one of the key success factors"*, observed a senior energy retrofitting advisor. Notwithstanding, "leadership" proved to deficient within the ReFoMo project. According to the ReFoMo project leader, *"A colleague of mine was the initiator of the ReFoMo project; he was working for the Dutch New Water Line and submitted this project for one of the calls of Climate-KIC. He did not want to carry out the whole organisation of the project, so they asked me because I had experience with other EU programmes and funding. So, that is how I got involved […] what astonishes me is that all the people who were involved in the preparations were not there anymore. They had assistants or someone else young […] so then you get all these people who are not owners of the whole idea behind the project and that makes it difficult to manage. So, you have to re-invent the whole project and I do not think I really managed that well […] personally, I will never step into a project in which I was not involved from the beginning".* Thus, "stakeholder engagement" was also missing within ReFoMo. A sustainable historic building advisor observed that, *"[…] the project leader had a hard time in managing all parties from this project. And I think that all the projects had a different time line and these were not facilitative. In general, it was difficult to manage the different projects".* Also observed by civil servant, *"There is a new project leader at the Province but someone else did it from the start. And he was shifted to another project […] and then contact became less and less"*. Further, *"I think that in the ReFoMo project something went wrong when they changed the project leader at the Province. I do not know what happened and why"*, mentioned the fortress project leader. It can be derived that the shortcoming in "leadership" also affected the "communication" amongst stakeholders.

"Communication" was a common issue between all parties in the ReFoMo project. According to a sustainable historic building consultant, *"[…] communication in the ReFoMo project did not go that well […] if communication were better, then I think we could have achieved more out of this project. I think that all the projects have nice results but there is no coherent result".* A civil servant pointed out that, *"[…] in the beginning there was a lot of contact and we met several times, and we had these students interviewing us. Then, I only saw one report from this student party but not for both fortresses […] I have not yet seen the resulting report of ReFoMo. I do not know what happened".* A sustainable historic building consultant suggested that, *"I think that sitting in one big table, maybe in the kick-start meeting, is important for collaboration. But what happened then is that we were all part of this big project, but we did not know who the others were and how they were involved".* Besides, the ReFoMo project leader stressed that, *"I thought that the partnership was very difficult. I had the feeling that most*

partners were doing their own little thing and there was not much interaction. I would have also liked to work with a more innovative company or business. That would have been probably more inspiring". This implies that "stakeholder engagement" and "mutual interests" were additional factors that undermined the organisational performance of the project.

Respondents pointed out that "stakeholder engagement" was accordingly missing in the ReFoMo, which hampered the internal project organisation as well as the delivery of an innovative product. According to the ReFoMo project leader, *"The … [company A], for instance, was involved on a later stage. They were not involved from the beginning in setting up the whole partnership. But it would have been better to have had them involved in the beginning than a big company like … [company B], who are very expensive and did not have time enough to put much effort into the project. These aspects had also a big influence on the project".* A sustainable historic building consultant indicated that, *"There was a little bit of a struggle there, but I do not know the exact form. We did our part, and tried to fill that in as good as we could. But most things went through the project leader, so we were a little bit left out".* To counter-act and learn from this project fragmentation, a workshop will take place to single out points for improvements for an eventual project follow-up. According to the NHW project leader, *"The ReFoMo project leader is now trying to bring the different parties together to develop a concluding report for the project. He is also trying to bring these parties together so that they can discuss how the project eventually can be followed up".* In the field of ERHB, follow-up mechanisms can be advantageous for the scaling-up of ERHB projects. Observed by a civil servant, *"[…] I think that having an organisation, a number of meetings where people from different backgrounds come together and hear from each other about experiments and learn from these experiments, which either failed or were successful, is an important incentive […] I think we can win by collaborating more. And keep on demonstrating to learn from best and less good practices"*.

With respect to "mutual interests", these also did not demonstrate to be well aligned within the ReFoMo project. According to the ReFoMo project leader, *"I think that, also from previous experience with many EU projects, the idea of ReFoMo is ok: you want to have a look at sustainability or retrofitting of buildings. Then you have to find partners and something opportunistic happens. The partners maybe have the same idea, but everyone has their own little project or research question. It is difficult to make one issue out of it".* The respondent continued by arguing that, *"I think I would have looked at the main research question and then looked for the right partners instead of having two separate approaches: someone writing a project that sounds very interesting and being agreed upon, and then for the sake of the whole project partners, you elaborate a common issue and ownership".* Further, the ReFoMo project leader indicated that, *"[…] you need someone in your partnership that has that ambition. And there was no one with big ambition. The … [company A] came in on a later stage, but that was too late, I think".* In contrast, a senior energy retrofitting advisor stated that in the field of ERHB, *"I think that the ambition is there, among the clients and especially from the municipalities".* Still, *"[…] these ambitions have to be organised. But you also have to deal with tenants and owners and that can result in all kind of problems for the projects, so these have to be overcome. And only a good leadership can accomplish that*", pointed out the respondent.

Concerning the "mobilisation of resources", a number of shortcomings were as well disclosed. In general, it was stressed that having a project leader can facilitate the mobilisation of resources to realize ERHB projects. *"I think that if you have a good project leader, this person can also mobilise these resources. He can organize everything. That is just what the key factor is about. There are a lot of people involved in such projects. So by having a person who can give the right lead to a project, you can then achieve optimal results with regards to the resources*. *And knowledge is available in the Netherlands*", explained a senior energy retrofitting advisor. Indeed, knowledge did not demonstrate to be a barrier within the ReFoMo project. Mentioned by the ReFoMo project leader, *"[…] the Climate-KIC network is not only located in Utrecht but also in Delft and other EU cities. So, it is easy to collect the knowledge".* As for mobilisation of financial resources, *"The budget was very tight for this project. That is why this is a path finder*", asserted the ReFoMo project leader. Another shortcoming concerns time. *"We spent too much time in trying to contact others, instead of investing that time in delivering a good investigation, for instance […] we had little to time to really overlook again the results and from there deliver a more coherent and stronger output. I think it would need another review".*

Urban Policy

In addition to understanding how the systems of hardware, software and operational orgware influenced the redevelopment plans for Fort de Gagel, it is similarly important to comprehend how urban policies address the uptake of ERHB projects. In the following, an analysis of the perceived influence that policy instruments and local governance capacity have on the retrofitting of historic buildings is disclosed.

Formal & Informal Institutions

Regulatory policy instruments

The redevelopment of Fort de Gagel is a rousing illustration of how far one can go in introducing energy retrofitting measures in cultural heritage. It displays how far the regulatory policy on cultural heritage preservation is amenable to uphold the instigation of ERHB projects. Emphasised by a monument expert, *"The renovation of Fort de Gagel is an example of taking the maximum from the Cultural Heritage Agency; of course, through a lot of negotiations".* Indeed, collaboration played a significant role in enabling the realisation of Fort de Gagel redevelopment plans. According to the respondent, *"The huge advantage is that the municipality of Utrecht owns this fortress. We then have more feeling with the object […] an entrepreneur who owns a fortress and wants do a project like this will face more difficulties".* The respondent continues by explaining that, "*The project at Fort de Gagel is primarily taking place because the municipality is involved. If you are a single entrepreneur and you do not have a contact person within the municipality with whom you could discuss the project, it would be much harder to come into a nice redevelopment design".* A civil servant also indicated the importance of engaging the Monument Committee in the project design phase. The respondent pointed out that from previous experiences, *"I learned a lesson that you have to work closely with the monument commission and start talking to them in the very first part of the project, because if they do not agree with your plans*

for sustainable energy or etc., you are not able to do anything". Thus, by means of good communication and mediation, the redevelopment plans for Fort de Gagel are taking shape.

The respondents' perspectives on the Dutch regulatory system on the retrofitting of historic buildings were divergent. On the one hand, it was stated that rules obstruct the instigation and scaling-up of ERHB projects. According to the ReFoMo project leader, *"There are too many rules, far too many. The ones who maintain the rules are doing their job very well. But they are so focused on the rules that the idea behind of it gets out of sight […] this is counterproductive. In my opinion, less rules but clearer guidelines are much easier".* Correspondingly, a senior energy retrofitting expert argued, *"I think governments should be more pragmatic. So, afford simple rules and set them out for a long time. The government should set the right example and communicate about that, which can be done in a right- or left wing fashion, it does not matter".* A sustainable historic building pointed out that, *"Sometimes the rules are too narrow and too outdated but there is some freedom within these rules […] still, concerning solar panels, why create a rule that only 30% of the roof can be covered? You can never go for a 100%. I think that local authorities do want to avoid costs and also accelerate the process of granting or not a permit, but then they also have to put more time and costs in the process to realize this".* A cultural heritage advisor named an example of two fortress owners who had the ambition to undertake ERHB. In similar lines, the respondent argued that, *"[…] entrepreneurs have individual ambitions that are often much higher than what is possible. These entrepreneurs did not meet their aims in wishing to be self-supporting at the energy level"* and *"still have difficulties in getting their permits and going through all the administrative procedures".*

Another issue concerns the implementation of energy retrofitting measures in historic buildings, which can be oftentimes unwelcomed. In re-examining the above example of the two fortress owners, a cultural heritage advisor stated that, *"[…] this fortress is located next to the water and in the summer, the owner could use the warm water to generate energy. But the facilities needed for that were an issue. The water management bodies were not ready for those innovative ideas, so to say".* This condition was as well observed in Fort de Gagel. The monument project leader explained that in Fort de Gagel, *"[…] windows do not have double glazing and in the winter, it can get very cold in here. Or when there is a lot of win, we can also feel it. Double glazing would help and, as you can see, these windows are not very old. They are not 200 years old. But when we mentioned that we wanted to install double glazing here with the heritage department, they simply said no. They did propose another possibility, single glazing but it is very expensive. So, we now have to find a way to collect money to invest in it".* A civil servant continued, *"It is more or less the legislation and that applies to all the sixteen fortresses. In all sixteen fortresses, we have the same sort of window. For instance, at the Fort aan de Klop, during winter, if you are dinning there, you get uncomfortable with the cold wind. The owner of the restaurant pays a lot of money to heat the building but at the moment you cannot change it".*

In general, respondents communicated that the legislation on the protection of cultural heritage can certainly be a hindrance to the realisation and scaling-up of ERHB projects, as opportunities then are more limited and investment costs are higher. It was notwithstanding stated that if one is indeed eager

to undertake ERHB, that one will also find ways to negotiate the endeavour with the accountable authorities. As noted by a senior retrofitting advisor, *"Monuments cannot be touched that much and that is obviously a problem. So, there are a lot of things that cannot be done, which you could probably do with regular buildings. This is clearly a limitation, I would say, and you have to deal with that".* A cultural heritage advisor additionally accentuated that, *"[…] it is also a responsibility of the entrepreneur, owner, or whomever is in place to propose a renovation plan. If you have a plan, go ahead. Convince us. It is not that my colleagues are not willing to step in such discussion. We know that a successful exploitation or use of these buildings is a very valuable factor in preservation".* In fact, the respondent observed that frequently building owners do not have a real motive to undertake ERHB, which is not satisfying for the Monument Committee in view of the cultural values these buildings endure. *"The question then is whether these men really want to carry out the redevelopment of that monument and have that energy performance"*, indicated the respondent. Similarly observed a cultural heritage expert, *"What I see a lot is that owners do not exactly know what they want. Owners only say that they want to have double glazing in the building because it is very good".* The successful realisation of ERHB projects also sums up to "convincing" the Monument Committee that one's ambitions are well founded. Thus, not everything is over restricted.

The majority of respondents asserted that flexibility to undertake energy retrofitting in fortresses is gradually being afforded within the Dutch legislation on cultural heritage preservation. As reported by the ReFoMo project leader, *"What you see in the Netherlands since the 90's is the concept of "preservation through development". So, if you want to maintain your heritage, you also need to develop new business models for them. This is as well the idea behind the Dutch Water Line for these fortresses were not used. The Monument Committee is sometimes giving building permits to make a new entrance or to add a new building to the fortress".* The fortress project leader stated that, *"Things are changing. I think that we, as the city of Utrecht, are in the front of these types of redevelopment".* Noted by a redevelopment expert on cultural heritage, *"I think that it mainly has to do with the opportunities within the monument legislation that have been given to several owners to experiment with alternative ways of heating or improving inner climate […] the Cultural Heritage Agency is really willing to cooperate. That is not a big problem. Municipalities have to seek the advice of the National Agency. If the agency does not agree, then of course the project cannot go on".* Accordingly, the market is adjusting to the new necessities and demand. Pointed out by a cultural heritage advisor, "*I think things are advancing, especially if you compare it to ten years ago. There are more possibilities and the market is creating more solutions. For instance, installing double glazing windows, especially in listed buildings, was not there twenty-years ago".* According to a redevelopment expert on cultural heritage, *"In my experience, much more is possible than it has been implemented until now".*

An additional observation concerns the essentiality to make mistakes and to keep on "experimenting". Remarked by a cultural heritage expert, *"I think that it is really important to be able to make mistakes and to be aware of that. People should not wait to take action. You have to experiment otherwise you will not achieve anything. Especially in energy retrofitting, I think that it is a nice thing to discuss about. Sometimes we have to accept that some things can go wrong because we cannot predict*

the future. If it goes wrong, maybe we then have to restore the building and find other solutions, but I think that we have to keep on experimenting". According to the respondent, energy retrofitting is a relevant point in question to deliberate about with cultural heritage officials*. "People who work with cultural heritage are more conservative and are a bit anxious for the future. Those buildings are 200-300 years old but hold a protected status for only 60 years. In the past 50 years, these buildings have also changed because of various reasons: fire, climate alternations, or other instances that required some transformation. And we learned about that. In my opinion, we are a little bit too anxious for the future and to learn, especially within the heritage department*". This position was also observed by a civil servant, *"[…] The Dutch Water Line has been all about changes. Fortresses were built and turned down. It is part of the history of the Dutch Water Line. Of course, I do support the monumental and cultural heritage laws and they have to be strict and so on, but they could look at the other side. We could look together at solutions, which are sustainable".* Similarly, the fortress project leader explained, *"Suppose that the Dutch Water Line was still a good defensive opportunity and these fortresses had remained in the Ministry of Defence. The building attributes would have changed […] they would not have remained in the same state as in 1815. They would have changed without any regulations, probably. So, why can't we, as owners now, bring some changes that benefit the use nowadays?".* Lastly, a renewable energy for heritage building advisor indicated that, *"I think that in Utrecht, the cultural heritage department is pretty forward about changes and are not so conservative […] here we have all kinds of alterations of different periods already in our historic centre. So, you can make some add some high tech add on in those buildings".* It can be derived that more demonstration projects and regulatory flexibility is needed for the scaling-up of ERHB projects.

Delegating the responsibility of cultural heritage preservation to local authorities was regarded as favourable for numerous reasons. A renewable energy for heritage building advisor pointed out that, *"Every city has its own approach and method. Standardizing is difficult because the government has delegated the municipality the responsibility to care for cultural heritage and municipalities therefore have their own power. I think that this is a positive thing. And on a national level, they should not bother about heritage but about their own ambitions in renewable energy. They are far too low. They have to adjust the gas and energy price. They have many buttons to press in order to influence things, but there are not. It is national politics, which is way less green than local politics*". Furthermore, a heritage building advisor remarket that, *"I think it is better because then there is more contact between the municipality and the civilians. In that way I think that it is a good thing. But for the implementation of some things it can be harder […] here we have more a bottom-up approach and implement policies on a slower pace"*. A senior energy retrofitting advisor observed that, *"Of course it would be advisable to have coherent regulations for the whole country […] but then again, you have to look at the specifics of one building".* In similar lines, a sustainable historic building consultant argued that, *"I think that it would probably more efficient if you make it more general for all the municipalities. However, I do think that historic buildings also differ within every municipality so there is some logic behind this system. But maybe it would be good to have a national portal, for instance, where all the rules and the distinctions for every municipality are collected and informed. I think that this should also be clearer for house*

owners". Instituting a national policy on cultural heritage preservation does not demonstrate to be a desirable solution by the respondents to advance ERHB projects. Yet, instituting a national portal in which the different municipal legislations on cultural heritage protection is compiled and clearly explained can be beneficial to the scaling-up of ERHB projects.

In terms of energy policy, reactions were miscellaneous. According to the NHW project leader, *"I think that historic buildings are relevant to reduce the energy level and therefore CO_2 levels […] it is worth to pay attention to the energy performance of these buildings also because there are not so many new buildings built. So, they have to renovate. Many techniques are therefore developed and part of them is applicable in monuments. Monuments face extra problems but I think it is worth the challenge".* Although historic buildings can support efforts to reduce CO_2 emissions, energy policies do not apply to historic buildings. Respondents asserted that omitting historic buildings from energy policies is adequate, for reasons that range from the content of the Dutch labelling scheme to the peculiar "heritage and cultural significance" and unique "physical attributes" of these buildings.

As explained by a sustainable historic building consultant, *"I think that having the energy label is difficult to accomplish because you also have to look at the overall improvement of the building. Historic buildings are different from new buildings in many ways. They are different in their breathing capacity, but also in their use and in the way they behave […] especially for historic buildings, I think that having an energy label can be negative, because it does not consider the user aspect".* Also, the way in which the energy labelling scheme has been introduced in the Netherlands, *"[…] was a mess. So, requiring that for cultural heritage would be worse",* observed the ReFoMo project leader. Further, a redevelopment expert on cultural heritage indicated, *"I understand that completely. If you calculate the hours that these buildings are being used, that is so minimal. That is not where the big loss of energy is in our system. I mean, measures could help entrepreneurs at the end of the month to have a low energy bill, but for the rest, on the scale of Holland, it is just not big".* Likewise argued a cultural heritage expert, *"In my opinion, it is ok because we are talking about 1-2% of the whole building stock. And if you invest in the other 98%, you have a much greater impact […] I think that giving these buildings a new use, so redeveloping them, has the greatest opportunity. And if an owner complaints about high energy costs, then this owner can come to us and we will then think about solutions that are applicable to that building. There are possibilities but the initiative has to come from the owner himself. Heritage buildings are unique, so measures as also unique. You cannot generalize. There is no standardization. If you go for a top-down approach, there will be tensions".* The respondent indicated that, *"We try to convince people to improve the energy performance of their buildings, but we cannot oblige them because we do not have any money to subsidise it".*

On the other hand, respondents also pointed out that bypassing historic buildings from energy policies is also not the most efficient way to go. For historic buildings, *"[…] there is no regulation for that at all. You do not need an energy label. But then again, not needing anything may lead to doing nothing at all. And that, from a point of view on national regulations, is a problem",* observed a senior energy retrofitting expert. The respondent suggested that, *"There should be a base-line with conditions; a*

conditional base-line. You have to have a scape, perhaps, if things are not possible. I am aware of the fact that it is difficult to make a base-line that cannot be touched. But you have to do something because if you do not set the rules, nothing will then happen or at least for some buildings". This stance is as well supported by a civil servant, *"I think it is worthwhile looking at the direction of having a minimum energy performance. Of course, buildings all behave differently but I think it would be a good thing if people are pressured to improve their energy performance levels".* The respondent argued that, "*I think it would help to have such minimum energy targets. It helps to get the discussion among the heritage commission, heritage owners and technicians on sustainable energy going on. We need a lot more discussion between those actors to find solutions that are agreeable to both sides, and realize our energy targets".* In general, the omission of historic buildings from energy performances is a EU controversy. The laws and regulations are not specified for energy supply and historic buildings. This corresponds to the EPBD, in which monuments are not taken into account in the sustainability goals (Directive 2010/31/EU).

Economic policy instruments

As heretofore disclosed the redevelopment plans for Fort de Gagel are resourceful and demonstrate how the integration of sustainable measures into cultural heritage can be accomplished. Conforming to a cultural heritage expert, *"I think we will have a very good example of a fortress redevelopment. It will demonstrate that a monument can have a new purpose. It will make the visitors more aware of the possibilities in redevelopment in a sustainable way. It is a very nice example, but also a very expensive example".* Indeed, the National Project on "preservation through redevelopment" of the NHW required an enormous amount of money to give fortresses a new purpose. A redevelopment expert on cultural heritage indicated that, *"Provinces have money to carry out those restorations, but this is almost finished. Since 2004, we have invested over 200 million euros in the NHW. We have done a lot of work to collect the money because that money wasn't just there. Big part of it came from the national government, but also from the owners themselves, provinces and municipalities. We did many European projects that helped to finance part of our work on NHW".* Financial policy instruments are therefore assumed to be supportive in efforts to scale-up ERHB.

For Fort de Gagel, investments are being mobilised by and from the municipality of Utrecht. The municipality succeeded to mobilise some funding from the EU and as well as from the national government, still the mobilisation of financial resources does not demonstrate to be an easy exercise. *"It has become more and more difficult […] five to six years ago there were many more financial resources, also from the European Union, for these kinds of projects […] there is hardly any national funding […] for a city that owns cultural heritage it is very hard to receive subsidies in this field. You can of course look at the private investor then, but most of them are not really interested in doing that in the phase that they are just starting their companies and so on. So, there is a real problem here. The investments in solar panels and in storing heat will be huge, and we do not know if we can find national or international funding for it"*, explained a civil servant. Nonetheless, after much struggle, the fortress' owners were able to single out entrepreneurs who are accordingly willing to invest in the sustainable redevelopment of Fort de Gagel. According to the respondent, *"We found potential entrepreneurs, who are aware that*

we want to do this renovation in a very sustainable way and are very interested in that. They want to invest in sustainability themselves too". Identifying potential entrepreneurs is as well a demanding exercise. Noted by the NHW project leader, *"When one starts to develop a fortress and tries to find an entrepreneur; well, it usually takes a period of 6-7 years to find one. So, it is not easy".* In short, the mobilisation of economic instruments for the redevelopment of Fort de Gagel is a pressing exercise, yet it is crucial for its realisation. The limited availability of restoration funds and subsidies can play a big role in the advancement of the project.

With respect to economic instruments in place for ERHB more generally, respondents once more pointed out the limited amount of subsidies and funds, which can be an obstruction to the scaling-up of ERHB. Still, the provision of loans and other economic incentives seem to alleviate the high costs associated with the retrofitting of historic buildings. According to a sustainable historic building consultant, *"There are not a lot of subsidies but loans, which you can get for a lower interest rate. These loans we see a lot and this is positive because if the rent is lower than the savings, this is still a good combination".* An additional economic instrument in place is the energy investment deduction ("energiesinvestering aftrek"). *"This is an instrument that you can be sure of. If you have profited with your business and have invested in sustainable solutions, then you can deduct that from your taxes. That is really nice and it works very well. You then have approximately 11% net benefit. There is one restriction. You have to have revenues and only commercial firms have revenues. So, if you are the municipality and you want to retrofit, you cannot access these funds since you are the government and cannot deduct anything. Actually, this is logical. On the other hand, the municipality owns many buildings but they cannot benefit from this instrument. So, this should be changed"*, stressed a senior energy retrofitting advisor. Indeed, the economic instruments afforded by the municipality of Utrecht are more concentrated on the business sector. As described by a renewable energy for heritage building advisor, *"We have a restoration fund, which is normally only for upholding the monument and we have at the moment an extra fund for sustainability. For companies, we go much further. For businesses we give subsidies. We give them a business case for renewable energy and we can cover 50% of the investment. And once there is a good business case, we then also have a fund for loans or guarantees. But those are for much larger investments".* Mobilising innovative economic incentives that do not only address private actors but also individual building owners is necessary to instigate the realisation of ERHB projects.

The availability of subsidies for ERHB is limited and likely to cease. Observed by the NHW project leader, *"We have mobilised a lot of subsidies in the past, but I think that in the future there will be no subsidies. It will be more about loans, funds and pre-investments".* A senior energy retrofitting advisor explained that, *"The problem with subsidies is that these are very complicated, and they change a lot. There is no guarantee that you will have a long-term agreement. For instance, the system for solar panels changes almost every year. Another problem is that it is difficult to get these subsidies. The system is very complicated and there is no guarantee that you will get subsidies, it depends. Often, the money is gone after one month, and there is not enough money for everybody. So you cannot really incorporate the subsidy in your budget. That is also a problem. Subsidies should be in place that last for*

10 years, guaranteed. Like in Germany, they have a longer horizon and you can also get the subsidy on the exploitation […] the government should also afford subsidies for all situations and not only for the commercial segment". Having a subsidy scheme that fluctuates and prioritises the business sector does not benefit "trust in the policy framework", nor the realisation and scaling-up of ERHB projects. However, respondents also stated the mobilisation of subsidies is not the most optimal solution for ERHB.

According to a cultural heritage expert, *"In my opinion, it is not always good to only provide subsidies. I think that everyone should be aware of the sustainability effect. If you subsidise, then citizens will benefit from it but, in my opinion, they are not well aware of the real sustainability issue*". It was additionally mentioned that the money that is spent on subsidising green installations could be better invested in advisory bodies. *"I think those subsidies should be better secured for the consultancy part. In Utrecht, they have financial incentives for the DUMO*[6] *advisers and I think that this is very good. I think that then you stimulate people to make the right choices because they then have a better overview of what is the best option in their case, what the pay-back time is and what they could save",* argued a sustainable historic building consultant. Indeed, the municipality of Utrecht is taking on a more soft approach to incentivise individual owners to undertake energy retrofitting ("mobilisation of resources"). "*We have a climate programme with lots of encouraging measures. For the house owners, monument or not, they can also get free scans or loans. It is not excluded from a non-monument house. It is one target group: the households",* pointed out a renewable energy for heritage building advisor. *"We have the DUMO scan, or a sustainable heritage scan, with which you can compare the monumental values against the sustainability of the building and that is for free. That is for the private owners […] I think that soft measures can strengthen communication and understanding of the issue in hand, and raise awareness on sustainability".*

Informative policy instruments

Informative policy instruments were not influential in the redevelopment project of Fort de Gagel. Both the municipality of Utrecht and the province of Utrecht are taking part in the DUMO network and are increasingly investing in mobilising knowledge in ERHB. As heretofore mentioned, the engagement of cultural heritage authorities in the project design and frequent dialogue on eventual developments positively influenced the advancement of this big scale redevelopment project. A cultural heritage official emphasised this stance, *"The dialogue is essential between the ones who work with buildings in general and the ones who work with cultural heritage. Personally, I think we are missing opportunities if we do not communicate. We are missing opportunities, if knowledge in this field is missing at the municipal level, for instance. Then decisions are narrowed to "yes" or "no". Knowledge is crucial to base better decisions on and to lay down conditions".* Under different ownership circumstances, the realisation of such redevelopment project could have required more input from informative instruments.

[6] DUMO: Platform for the sustainable conservation of cultural heritage in the Netherlands.

Generally, respondents stated that information on ERHB is being disseminated but improvements are necessary; improvements in the quality of information that is being afforded to the public as well as to experts in the field of ERHB. In fact, a renewable energy for heritage building advisor observed that, *"There is too much information. There is a whole advisory world, numerous different instruments, there is also now the DUMO label instead of the energy label... but why? It is pretty straightforward: you have to maintain your heritage value and then you can go for renewable energy, and, in the meantime, you try to save energy. There is too much advice. The overload in information is actually holding people back than encouraging them to take those measures*". A senior energy retrofitting advisor observed that, *"information is being disseminated but you cannot disseminate all the complexity".* To this, a redevelopment of cultural heritage advisor indicated that there is no entity in place that assembles information on developments in the field of ERHB. The absence of such an entity does not benefit the dissemination of accurate information on ERHB nor does it encourages follow-up and learning mechanisms. "*Experiences of other projects are not being monitored and the outcome is not being shared. That has to do with the fact that there is no longer a central knowledge centre for the redevelopment of military heritage. We are working on that, on that new centre. People just do not know where to go or who to call. It is common knowledge that people want to do things themselves and are not asking others about their experiences".* The respondent continued by accentuating that, *"I think that the government should supply a facility, a platform so that we can learn from each other. The responsibility is now handed over to the provinces and they have set up a knowledge centre, but the focus of this knowledge centre is that, being a potential World Heritage Site, you need to have the knowledge centre for educational reasons. It also has to have an archive with the history of the site. But for me it is much more important to have a library, developed by a community with experts, on the actual renovations of today, of the best practices and pilots that have been carried out".*

At the municipal level, informative policy instruments are taking place in different ways. According to the fortress project leader, *"There are programmes within the municipality that concern renewable energy, energy efficiency, sustainability and so on".* To name an example, a renewable energy for heritage building disclosed that, *"We are making a new energy plan now for the local areas, which is made by the inhabitants. Around 170 inhabitants had three meetings, in groups of eight and they pointed out their priorities in energy management […] in our energy plan, we asked locals to contribute to our efforts and they know just as much. Population knowledge is as big as advisory knowledge. It is no high-tech what we have here. There we have house owners and neighbours working together. So they themselves have their own network […] It is a bottom-up approach; a different way of governance".* The respondent further elaborated, *"I am doing a programme with churches. I am bringing them together so that they can discuss themselves about what is best to do. Oftentimes some engineering companies also participate in those discussions. They have their own community and knowledge. When you bring that together, it is very interesting. It does not cost us a cent and they are still interested in each other".* Another example named by the respondent follows, *"We have local energy corporations and they are interested in monuments as well. They do nothing else than trying to raise money and put solar panels on buildings or schools. It is more community driven"*, further elaborated the respondent. In terms of

disseminating information and raising awareness, *"The municipality of Utrecht is doing it well. We have energy ambassadors per neighbourhood and they try to convince citizens to go for sustainability, to go for sustainable buildings or to partially invest in a windmill",* indicated a cultural heritage advisor. *"In every renovation we try to inform them about the heating system and the costs related to it. And most people accept them. So, it is only a matter of communicating better and raising their awareness"*, pointed out the respondent. In the field of ERHB, the municipality of Utrecht count on bottom-up approaches and soft measures to raise awareness and encourage citizens to consider for improved building energy performances and sustainability, more generally.

Voluntary agreements

Voluntary agreements between private and public actors did not directly play a role in the realisation of the Fort de Gagel redevelopment project. The municipality of Utrecht does however participate in the DUMO network. *"We have networks of experts, which we chair, and there we discuss possibilities to integrate sustainability with cultural heritage. DUMO network is one of them",* pointed out a cultural heritage advisor. *"I think we are a good example for the Netherlands because we participate in the DUMO network already since a long time. So, we are since early times a common team and we collaborate"*, indicated an energy advisor for historic buildings. In participating in the network, the municipality has been increasingly gaining expertise in the field of ERHB and are accordingly more inclined to support the realisation of ERHB projects. This is beneficial for the scaling-up of ERHB. Apart from participating, the municipality of Utrecht also subsidises the DUMO network. By doing so, DUMO experts perform sustainable heritage scans for private owners interested in ERHB without charges. As observed by a sustainable historic building consultant, *"In Utrecht, they have different financial incentives for the DUMO advisers and I think that this is very good. I think that then you stimulate people to make the right choices, because building owners then have a better overview of what is the best option in their case, what the pay-back time is and what they could save".*

Public-private partnerships

Public-private partnerships also spur the culmination of redevelopment projects along the NHW. Noted by the fortress project leader, *"We own eight fortresses and we have done already seven renovations, so people are convinced that we can do it in public-private cooperation". "Cooperation is the strongest factor in this whole concept: cooperation between the entrepreneur and the municipality",* emphasised a cultural heritage advisor. Considering that the redevelopment plans for Fort de Gagel comprise the establishment of an outdoor centre and a restaurant facility, the fortress owners cooperate in negotiations with private entrepreneurs so as to make investment costs attractive for these actors. According to the fortress project leader, *"It is very important that we, as the city of Utrecht and as the owner of the fortress, and the private party, who is going to run is business here, agree on the details. That is why the next six months is so crucial for the whole project"*. Public-private partnerships in the redevelopment of fortresses are essential. *"Private companies are also showing their growing interest and commitment in the area. So, together these actors [public and private actors] are making change happen",* noted a sustainable historic building consultant. Public-private partnerships are not

covered in the analytical framework but are regarded important for the realisation and potential scaling-up of ERHB projects.

Local Governance Capacity

Political leadership

Local political leadership is present within the municipality of Utrecht and that is facilitative of the sustainable redevelopment project of Fort de Gagel, as well as of the scaling-up of ERHB. An energy advisor for historic buildings stressed that, *"Our city identity is with our old, historic town […] here we have tiny buildings and we are trying to do the best with locals and supporting them when we can […] we have a coalition programme, called "we do it together". That is our slogan. But it all depends on the stakeholder willingness to participate and engage in the programme".* In addition to encouraging the locals to take part in discussions and programmes, and providing them some support in their energy retrofitting undertakings, the municipality of Utrecht collaborates with other EU cities in the field of ERHB. The respondent indicated that, *"[…] we are actually working together with similar cities like Gent, Bologna and Stuttgart. These cities all have historic centres, which are not too big, have a lot of heritage, and are student cities".* Furthermore, the municipality put efforts in advocating examples of energy retrofitting projects to the public. *"As the municipality, we are trying to put projects forward as good examples",* indicated the respondent. In general, the energy for historic buildings advisor pointed out that, *"I think that the cultural heritage department in Utrecht is pretty forward in that [integrating sustainability in cultural heritage] and are not so conservative. In Hilversum, for instance, they have new heritage so people there are stricter. As for in Utrecht, we have all kinds of alterations already of different periods in our historic centre. So, you can make some add some high tech add on in those buildings. But that will take some time, because now it is not necessary. Everyone has money enough to pay for everything. Gas is cheap*". In spite of the efforts to instigate and advance the realisation of ERHB projects, "energy prices" demonstrate to play a pervasive role.

With respect to the redevelopment of the NHW fortresses, *"We as the government had invested a lot of money in it but we are now in the situation where the entrepreneurs should be the ones to make it work. That is quite a challenge, of course, because it is not an easy market: you have high costs, the energy costs are mostly very high, and you cannot do the same in the different fortresses",* observed the NHW project leader. Nonetheless, the municipality of Utrecht demonstrates to be performing good work in redeveloping the fortresses under their accountability. *"The municipality of Utrecht is doing very well. They are finding entrepreneurs, and from the costs of the rent, they can do the maintenance. That works. And for the municipality of Utrecht, it is relatively easy to redevelop those fortresses because there are so many people around Utrecht. So, I think that they deal very well with it",* observed the NHW project leader.

All in all, respondents pointed out that the municipality of Utrecht can be regarded as a front runner in the field of ERHB in the Netherlands, which is partially owed to its local green politics. *"Since six years already we have a pretty green local politics"*, indicated an energy advisor for historic buildings.

In similar lines, a civil servant indicated that, *"The policies of this city are very much in line with sustainability. We are represented by the green left party and they are very strong on green energy and energy efficiency discussions. So, we are being supported by the municipal council. This is not the issue. The problem is that we are such a small and special field, and within this field a lot of things are limited".* In spite of the actual political leadership, it is once more disclosed that in the field of ERHB efforts should be concentrated on boosting discussions and cooperation, and on facilitating negotiations amongst the different stakeholders. Local authorities should also increasingly set the right example and communicate about it to the public. It is necessary to continue demonstrating, and to advance monitoring and follow-up of projects and developments in ERHB in order to instigate learning from best and less good practices. By doing so, the potential for scaling-up ERHB projects is reinforced.

Trust in the policy framework

Trust in the policy framework played an indirect role throughout the redevelopment project of Fort de Gagel. As heretofore mentioned, the mobilisation of investments was done by and from the municipality of Utrecht. The municipality also succeeded to mobilise some funding from the EU as well as from the national government, however additional investments are still required. It was stressed that the mobilisation of financial instruments is becoming increasingly difficult. Subsidies and funds fall short not only at the municipal, provincial and national level, but also at the EU level. The municipality can neither benefit from subsidies nor from the energy tax reduction mechanism, for the municipality is a public entity. The shortcoming and limited access of economic incentives by the city of Utrecht can result in project interruptions. Thus, uncertainties in the provision of economic incentives influence the project development of Fort de Gagel.

Another point in question concerns the uncertainties associated with the governance of ERHB more generally. As reported by a redevelopment of cultural heritage advisor, *"People are scared. Not only the building owners but as well the municipalities. There many factors contributing to this stance in place: lack of knowledge, fear that the planning will be rejected and having to negotiate with unfamiliar parties".* A cultural heritage official attempted to explain this hesitation. According to the respondent, *"Well, this very broad feeling so it is a bit hard to explain it. I do know that this organization embodies now three to four specialties. Before, the listed buildings were assigned to a specific organization with a more traditional mentality. That could play a role in the hesitation of some entrepreneurs. Those things are changing and therefore we have specific magazine issue to illustrate that times are changing, as well as the institute […] I think we are doing a lot to encourage them and show that there is an open spirit here, with publications and research. If you look at the reuse and redevelopment field right now, since the crisis, it is far more organic on a smaller scale. People are using crowd-funding, a lot of social media awareness. So, I would be surprised if this is the target group that is hesitating in starting a dialogue. This is the level in which most initiatives are taking place right now".* The often oscillation of institutional accountability ("institutional fragmentation") on cultural heritage preservation can have an influence on the apparent hesitation of building owners to approach local cultural heritage officials, and of municipalities to approach the national Cultural Heritage Agency. Notwithstanding, the respondent accentuated that, *"It is too easy to say "I am not willing to work with the government because they are*

not actually facilitating anything". Some types of buildings, for instance, with iron window frames and single glazing, are difficult to deal with. But even for those issues, there is a range of solutions. And there is a solution that optimizes the preservation of the monumental value and there is a solution that can save a lot of energy, but costs a lot. What would be the case? Well, there will be a negotiation about what to choose within the spectrum. And sometimes, if these things are so crucial for the monumental values, I can imagine that sometimes we have to say "no".

Mobilisation of resources

As previously mentioned, the municipality of Utrecht is regarded as a front runner in the field of ERHB. Its local policies are in line with sustainable development. The municipality is represented by the green left party, which is strong on green energy and energy efficiency discussions. Apart from the local green politics, the municipality takes on a bottom-up approach to incentivise the public to consider building energy performances. For instance, the municipality encourages local inhabitants to engage in deliberations about energy issues and to conceive green solutions that can potentially alleviate building energy use. The municipality also has local energy corporations that are interested in monumental buildings, and these corporations are solely focused on trying to raise money to install solar panels in local neighbourhoods.

The municipality counts on soft-measures to stimulate the undertaking of ERHB projects. The mobilisation of economic instruments is limited. For individual building owners, the municipality economically incentivise the realisation of ERHB with DUMO scans and with the provision of loans. For the business sector, the mobilisation of economic instruments is more elaborated. Businesses can benefit from energy tax reductions, fund for loans and guarantees for renewable energy business cases. In terms of knowledge, the municipality of Utrecht takes part in the DUMO network. In participating in the network, the municipality has been increasingly gaining expertise in the field of ERHB and are accordingly more inclined to support the realisation of ERHB projects. This is beneficial for the scaling-up of ERHB. The municipality is also seeking for knowledge in ERHB outside Dutch borders. It collaborates with similar cities like Gent, Bologna and Stuttgart. In addition, the city of Utrecht seeks to put forward examples of energy retrofitting projects to the public. It is increasingly setting the right example and communicating about developments to the public.

Within the municipality of Utrecht, the cultural heritage and sustainability department work closely together ("interdepartmental cooperation"). Noted by a cultural heritage advisor, *"We work very close with our colleagues from the environmental department. They have a special department on buildings and sustainable buildings. So, we combine each other's knowledge and we all know that not all listed buildings can be transformed into a sustainable building […] we really cooperate. Sometimes it is hard, but this is normal. I think that it is very important that they understand our philosophy and that we understand theirs. And if you come together, then you can come to a nice moderated decision. Sometimes it is better for the environment, and sometimes is better for the cultural heritage".* Similarly, an energy advisor for cultural heritage pointed out, *"With the colleagues from the cultural heritage department, we have a good relationship. There are differences, of course. We are working on the same*

floor now, and it is going ok". In Utrecht, the municipality *"[…] makes sure the cultural heritage authorities and the energy authorities at least know each other and work together on the energy retrofitting of cultural heritage, and do not contradict each other with a monument owner. We try to gain expertise and make networking in the city. That is our role in this field"*, further elaborated the respondent. The local capacity of the municipality of Utrecht to mobilise resources for the realisation of ERHB is constructive. This benefits the scaling-up potential of ERHB projects.

External Trends

Environmental awareness & societal values on sustainability

Respondents raised the issue of lacking public awareness of the benefits associated with ERHB and sustainability issues, more generally. Lack of awareness is grounded on deficiencies in the provision of information about ERHB. Observed by a sustainability consultant for historic buildings, *"A factor that I regard as a barrier concerns information, or the lack thereof. A lot of people do not know what can be done in their historic building […] people are not aware or are uncertain about the topic and the possibilities they could take advantage from […] communication is missing".* An energy advisor for historic buildings similarly noted that the public is still not knowledgeable about building energy performances. *"A lot of people have no insight on what the energy use of their building is. Before the retrofit, it is important to have a goal on that. It is important to know what is expected after the retrofit […] usually, this is not a topic at all and this is also owed to the fact that building evaluators do not pay attention to the energy use as a value. This is something that my heritage colleagues could influence, but they are not yet doing so. However, before that, building owners and tenants are actually the ones who have to ask for it. It is in their interest".* Indeed, measures to improve the building energy performance do not demonstrate to be appealing to building owners yet. *"I think that there is a real lack of awareness. And people really do not find it an attractive solution. They like to point at their new belongings, at tangible things. Intangible things, no matter its benefits, are not really in the mind of people in Holland. This is the kind of mind set we have here"*, pointed out a cultural heritage advisor. In general, a civil servant indicated that energy retrofitting of historic buildings is deliberately gaining space in the market; however, *"People are still inclined to say that it is difficult and there are a lot of problems, so why not do the conventional way? That is more or less the approach of people".*

It was stated that the field of ERHB remains *"ad-hoc and very niche"*. In efforts to scale-up ERHB projects, *"The problem is that we are such a small and special field, and within this field a lot of things are limited"*, a civil servant indicated. In similar lines, an energy advisor for historic buildings accentuated that, *"I think that this is a selected group. The entire sustainability world is focused on the new buildings, new quarters, while most people already live in a house. Existing buildings are far more interesting to look at. They always have showcases in new buildings, but much more can be gained from existing ones"*. With respect to the implementation of the energy labelling scheme in the Netherlands, respondents reported that it was a positive attempt to shift public attention to considering the energy performance of buildings. *"Energy labels are a good thing because people are more and more paying attention to these aspects and are trying to make their buildings more sustainable",* remarked a

sustainable historic buildings consultant. An energy advisor for historic buildings accordingly observed that, "*The introduction of the energy label helped to shift the focus to energy performance a little bit".* However, *"it is mostly not the topic at all",* pointed out the respondent. As disclosed by the NHW project leader, "*I think that in policy, the energy discussion is understated. Three years ago, they had installed a big energy meter in front of this building to raise awareness about energy consumption here. But I think we are passing this time".* Awareness and interest in ERHB is still necessary so as to instigate demand and to support efforts in scaling-up ERHB projects.

Market demand

Market demand is another point in question that was discussed among interviewees. The reactions were nevertheless dichotomous. Part of the respondents accentuated that demand for ERHB is still inadequate. *"There is a low market demand. It goes more about talking than actual market demand. The price mechanism plays a role here again. In Utrecht, there is probably a higher market demand but this is political. This is the group of authorities that go for green"*, observed an energy advisor for historic buildings. According to the NHW project leader, shortcomings in demand for ERHB projects are comprehensible for it is a perplexing market. *"That is quite a challenge, of course, because it is not an easy market: you have high costs, the energy costs are mostly very high, and you cannot do the same in the different historic buildings".* Other respondents indicated that demand is gradually progressing. *"I see that more and more people are asking for it. Monumental and historic buildings are also a big part of our building stock in the Netherlands, so there is plenty to do. And I also think that house owners are busy with it, not only because of the energy label but also because of their energy bill and sustainability in general",* observed a sustainable historic building advisor. Likewise, a senior energy retrofitting advisor argued, *"I think that the market demand is there. Of course you have a market that is fluctuating, but you should not worry about that too much because the whole market is fluctuating. So, the refurbishment market is also fluctuating. But, I think that the demand is there and it just has to be well addressed. What I also think is that sustainable refurbishment is not a stand-alone thing. It should be incorporated into the total refurbishment of historic buildings".*

Respondents stated that the market potential for improving the energy performance of existing buildings lies in buildings that are not listed, for monuments represent a small percentage of the Dutch building stock. *"Only one or two percent of the buildings in the Netherlands are listed buildings. The majority of buildings in Utrecht are modern: buildings that were built after 1990 or pre-Second World War, so buildings from the 30's or 50's. Those buildings have greater possibilities to become energy efficient than listed buildings"*, observed a cultural heritage advisor. In similar lines, an expert on redevelopment of fortresses stressed that, *"The most attractive and effective sector to address is where people live or work 38 hours per week. So, that would be in housing areas".* In fact, the municipality of Utrecht is increasingly cooperating with housing associations in the field of energy retrofitting. Reported by a cultural heritage advisor, *"We have very good contact with big housing associations and I see that they are paying more and more attention to sustainability. As housing associations also own some listed buildings, we provide advice to them. Other colleagues of mine, from the environmental department, have greater relations with housing associations and are seeking ways to help them, to cooperate in*

order to bring more sustainable buildings. They are working on a project to bring 20.000 houses to CO_2 neutral homes". A cultural heritage official further explained that, *"It is very nice to encourage, within our field of work, the achievement of the 2020 objectives. But I would say that this should be discussed on a larger scale, with a lot of volume. Individual examples [ERHB examples] demand a lot of effort and have small impact. So, it would be more interesting to work with housing associations, and then we are talking about a lot of volume".* Building use once more discloses to play an important role in efforts to undertake ERHB. Considering that monuments are not frequently in operation, the greatest potential to instigate ERHB projects and alleviate climate impacts lies within the historic housing market.

Monuments also demonstrate potentiality, yet to a smaller extent. As noted by the NHW project leader, *"I think that historic buildings are relevant to reduce the energy level and therefore CO_2 levels […] it is worth to pay attention to the energy performance of these buildings also because there are not so many new buildings built. So, they have to renovate. Many techniques are therefore developed and part of them is applicable in monuments. Monuments face extra problems but I think it is worth the challenge".* Fortresses, on the other hand, afford more limited possibilities. *"The energy costs are relatively high but the number of fortresses in the Netherlands is relatively low, so not a lot of CO_2 emissions. If you look at a broader scale, so on EU scale, then it is worth to look at energy reduction of these buildings because of CO_2 emissions",* observed the respondent. According to a cultural heritage advisor, the greatest potential to undertake energy retrofitting of monuments lies in redevelopment plans. *"There is a demand for the redevelopment of monuments. Projects like those can be very profitable on the long-term […] the potential in redevelopment is huge […] at the moment there are many parties who want to invest in the redevelopment of these fortresses".* The biggest opportunities to scale-up ERHB projects lie in, *"Long-term exploitation business cases. For a monument you should always think at least over fifteen years, whether or not you do an energy retrofitting, or a new tenant, new insulation*", pointed out an energy advisor for historic buildings. Furthermore, being on the list of the UNESCO World Heritage list, the energy retrofitting of NHW fortresses can bring about a positive side effect. Observed by a fortress redevelopment expert, *"NHW being the biggest national monument wanting to be on the UNESCO World Heritage list, it is a statement if you can say that in a fifth of the fortress we introduced alternative forms of energy or we focused on insulation. It is something that you can do to advertise yourself with".*

An additional matter concerns "energy prices". In the field of ERHB, *"I think some things have to change in the long-term, but it has to aesthetically fit into the building or street […] In Utrecht we have all kinds of alterations already of different periods in our historic centre. So, you can make some high tech add on in those buildings. But that will take some time, because now it is not necessary. Everyone has money enough to pay for everything. Gas is cheap",* observed an energy advisor for historic buildings. "Energy prices" was not covered in the analytical framework but disclosed as a conceivable influential factor in scaling-up ERHB from the interviews.

Another point in question raised by the respondents concerns the "energy market" in the Netherlands. Disclosed by a cultural heritage official, *"I think that the network of the current energy*

suppliers and government on the three institutional levels should be more focused on the tailor-made scale. There are certain initiatives right now where solar panels are being installed on the roof top of a common building, but it is difficult to distribute those benefits to all the individual owners. Fortress owners and entrepreneurs we speak to stated that they can deliver more energy than they use themselves but right now it is not very beneficial to redeliver energy into the system". In the Netherlands, building owners who generate too much green energy are considered as energy producers and consequently have to pay taxes. This is counterproductive in efforts to realise ERHB projects. Clarified by an energy advisor for historic buildings, *"An issue concerns the tax reduction of solar panels. If you generate too much energy in the Netherlands, you have to pay taxes on it. It is a very complicated thing. You are then regarded as an energy producer and energy producers have to pay taxes. It is a completely idiotic system, still it exists".* According to the respondent*, "This is something that needs to be changed on a governmental level because you are then punished. That is way most people only use five solar panels, but they have a roof top in which then can place forty panels. You can also not yet rent a roof and put a solar panel on it. For instance, on those big industrial or apartment complexes, there is a huge potential to install solar panels for the roofs are flat. But you cannot simply buy a share of the installed capacity. The legislation makes it hard to enable this".* A cultural heritage official continued, *"We should look at sustainable energy on a different level with a different infrastructure than we are doing at the moment […] it would make it easier for stakeholders to make a move towards more sustainable exploitation of a building, whether or not it is a listed building […] and if you do it in the right way, it is also attractive because it meets the common sense of respecting the value of cultural heritage. I think that you then can add an extra value if you show that you are self-supporting or at least sustainable in a certain way. Personally, I understand the struggle of these stakeholders on the tailor-made case. And to take away a part of that struggle, I think that it is important to look at the energy system".* Emphasised by the respondent, *"It will also require a shift of paradigm that we are currently looking at: very top-down organized energy industry. I think that it is there where the potential lies".*

7.2.3 Synthesis

Table 3 depicts a representation of the factors that are deemed influential in the realisation and scaling-up of ERHB projects, derived from the literature and empirical data collection. The blue colour indicates that, although relevant, the factor did not play a role in the realisation of Fort de Gagel. The yellow colour indicates that the factor was important to a certain extent for the realisation of the project. The red colour indicates that the factor shaped the realisation of the Fort de Gagel redevelopment project. Within the red colour categorisation, the positive symbol indicates that the factor contributed to the realisation of the project, while the negative symbol indicates that the factor acted as an obstruction but did not however determine the project realisation. The tick symbol indicates that the factor can influence the scaling-up potential of ERHB projects. In the following chapter, the Fort de Gagel case study is discussed on a more abstract level and confronted with the findings from the Sleephelling case study.

Hardware & Software	Cost-benefit **(-)**	Physical attributes **(-)**	Technical compati-bility	Economic advan-tage **(+)**	Heritage signifi-cance **(-)**	Cultural signifi-cance **(-)**	Social compati-bility	Environ-mental perfor-mance	Renova-tion timing **(+)**
Operational Orgware	Mobilisation of resources **(-)**		Leadership **(-)**		Mutual interests **(-)**		Communication **(-)**	Stakeholder engagement **(-)**	Local authorities direct engagement **(-)**
Informal & Formal Institutions	✓ Regulatory policy instruments		✓ Economic policy instruments **(-)**		✓ Informative policy instruments		✓ Voluntary agreements		✓ Public-private partnerships **(+)**
Local Governance Capacity	✓ Political leadership **(+)**		✓ Trust in the policy framework **(+)**		✓ Mobilisa-tion of resources **(+)**		✓ Interde-partmental coopera-tion **(+)**	✓ Monitoring	✓ Follow-up mechanisms
External trends	✓ Market demand		✓ Environmental awareness & Societal values on sustainability **(+)**				✓ Energy prices	✓ Energy market	

Table 3: Influential factors in the realisation and scaling-up of the Fort de Gagel ERHB project.

Chapter 6: Results part B. Scaling-up ERHB projects - revised

The objective of this chapter is to obtain a comprehensive understanding of the ERHB field as a whole. For this, a comparative analysis will be performed: to look at similarities and differences between the Sleephelling and Fort de Gagel case studies, so that patterns can be identified. By confronting two contrasting ERHB projects in two different Dutch municipalities, prominent factors that influence the uptake and scaling-up of ERHB are to be disclosed. This exercise is carried out on a level of abstraction by placing all the factors in general. Although it is acknowledged that every historic building is unique and therefore needs customised energy solutions, and that contextual environments are divergent, it is expected that some aspects specific to ERHB projects and urban policy aspects can be generalised. It is through the comparison of the case studies that a complete synopsis and understanding are to be achieved (Verschuren et al., 2010). The disclosure of these influential factors will in turn enable the development of recommendations with respect to urban policies that should be enforced by local authorities to instigate the horizontal scaling-up of ERHB projects in the Netherlands, which is the final contribution of this research.

Firstly, ERHB project specific similarities and differences are analysed in terms of hardware, software and operational orgware structures. Secondly, attention is concentrated on analysing urban policies, which emerge in the form of local governance capacity and formal and informal institutions. It is not the intention here to make a comparison of urban policies, which would be a research in its own right. Rather, it brings forward urban policies aspects that were influential in the realisation of the ERHB project. Thirdly, external trends are investigated in so far as relevant for this research. Again, this comparison is guided by the framework of analysis as presented in chapter 4. Lastly, and most importantly, a redesigned conceptual framework derived from the comparative analysis is presented.

6.1 Comparative analysis

Based on the preceding application of the scaling-up of ERHB projects framework several conclusions are drawn, which are relevant for future ERHB practice and research. While the differing contextual environments, exclusive building characteristics and project magnitude determined the realisation of both ERHB case studies, the framework supported the identification of key drivers and barriers for the up-scaling of ERHB projects.

6.1.1 Hardware & Software

Table 4 depicts a representation of the factors from the hardware and software systems that are deemed influential in the realisation of ERHB projects, derived from the literature and empirical data collection. The blue colour indicates that, although relevant, the factor did not play a role in the realisation of the ERHB project. The yellow colour indicates that the factor was important to a certain extent for the realisation of the project. The red colour indicates that the factor gave shape to the

realisation of the ERHB project. Within the red colour categorisation, the positive symbol indicates that the factor contributed to the realisation of the project, while the negative symbol indicates that the factor acted as an obstruction but did not however determine the project realisation. For this subset of indicators, the analysis is conducted at the project level.

	De Sleephelling								
Hardware & Software	Cost-benefit **(-)**	Physical attributes **(-)**	Technical compati-bility	Economic advantage	Heritage signific-ance **(-)**	Cultural signific-ance	Social compati-bility	Environ-mental perfor-mance	Renova-tion timing
	Fort de Gagel								
	Cost-benefit **(-)**	Physical attributes **(-)**	Technical compati-bility	Economic advantage **(+)**	Heritage signific-ance **(-)**	Cultural signific-ance **(-)**	Social compati-bility	Environ-mental perfor-mance	Renova-tion timing **(+)**

Table 4: Factors from the Hardware & Software systems that influence the realisation of ERHB projects.

Generally, the systems of hardware and software of ERHB projects are vital for the realisation of ERHB. The majority of the indicators incorporated in the analytical framework are deemed influential in bringing about ERHB projects, namely: cost-benefit, physical attributes, technical compatibility, heritage and cultural significance, economic advantage and renovation timing. The latter was not formerly covered by the analytical framework, but is considered an important condition to perform energy retrofitting in historic buildings. In contrast, social compatibility does not come across as an affecting factor, considering that building energy retrofit only brings about advantages for the building life cycle and usage. Environmental performance accordingly does not influence the realisation of ERHB, for improved building energy performance remains overshadowed by other building attributes: it does not raise the building value and is therefore not considered as a benefit. Improved comfort and indoor climate can act as stronger incentives for building owners to invest in ERHB.

Cost-benefit

Cost-benefit proved to be an obstacle in the undertaking of both the Sleephelling and Fort de Gagel projects. The Sleephelling project realisation required a substantial additional investment per house. Cost-benefit was similarly influential in the redevelopment plans for Fort de Gagel. For a municipality that owns cultural heritage, it is very hard to receive subsidies in ERHB. Additional factors that add to the cost-benefit concern are “cultural” and “heritage significance”, building “physical attributes” and “technical compatibility”. It was stressed that if one only regards the cost-benefit aspect of the retrofitting, one is also limited with measures he can take. Promoting the benefit of improved comfort and air quality levels (“physical attributes”) resultant from ERHB can counterbalance the problematic of cost-benefits. In general, ERHB remains an expensive undertaking.

Physical attributes

Improving the insulation, ventilation and indoor climate levels in historic buildings is a demanding pursuit. The energy retrofitting project on the Sleephellingstraat was realised according to

the passive house principles and as the building falls under the protected city landscape, it was settled that the facades would remain visible on the street side and restored to its original state. Thus, everything from the front-side needed to be done from the inside therefore an internal insulation concept was developed. Internal insulation is a complicated task and regarded a typical problem of the passive house approach.

The physical attributes of Fort de Gagel likewise act as an obstruction to the energy retrofitting of the fortress. Changing the inner climate, humidity and temperature levels of a two hundred years old fortress is highly complex. Apart from that, the building owners also have to deal with cracks on the walls, ground cover and dam. Knowing the building use also demonstrates to be crucial in undertaking ERHB because use determines what the possibilities are. It is impractical to install expensive techniques to upgrade energy performances if the building is only being used one in every four days. Fortress owners have to scrutinize what the actual use of the building is, for the investment costs in energy retrofitting are enormous.

In general, other physical attributes advantages resultant from ERHB are improved comfort and indoor air quality levels. In view of investment costs in ERHB, it was accentuated that these benefits should be further communicated to the public considering that it can serve as additional incentives for users to invest in energy retrofitting. Respondents stressed the importance of identifying and marketing additional building improvement performances to boost the horizontal scaling-up of retrofitting projects.

Technical compatibility

In the Sleephelling project realisation, the identification of solutions that were applicable to the historic building and satisfied the requirements posed by the Monument Committee did not come across as a major barrier. The achievement of passive house standards in itself is considered complex. Still, bringing the historic building to passive standards was not a limitation and only the most optimal solutions for the building were proposed and carried out. It is important to stress the successful realisation of the Sleephelling was owed to its pilot nature. Under different circumstances, technical compatibility can play a bigger role. Indeed, this is observed in the Fort de Gagel case study.

The implementation of innovative and energy saving technologies in Fort de Gagel demonstrates to be troublesome. Being a national monument, the fortress' "cultural" and "heritage significance" influences the employment of technical solutions in the building. Its "physical attributes" are also not beneficial of the employment of green technologies to upgrade the building energy performance. Technologies are usually implemented under a reversibility condition, which is set out by the majority of local authorities on cultural heritage preservation. Reversibility of installations can confine efforts to bring about ERHB but does not shape the course of ERHB. In fact, the employment of green installations offers the greatest potential in bringing historic buildings to energy friendly levels. Insulation, in turn, offers less potentiality for it is likely to jeopardize the building design and its inherent cultural heritage significance.

Economic advantage

Economic advantage displayed importance in the sustainable redevelopment plans for Fort de Gagel, but not for the Sleephelling project realisation. A civil servant from the municipality of Rotterdam did however point out that the economic advantage factor is playing an increasingly significant role in the field of ERHB. The interviewee indicated that a city is higher valued for its cultural heritage. Thus, it is economically beneficial for a municipality to bear cultural heritage layers. With regards to Fort de Gagel case study, economic advantage is central in the sustainable redevelopment plans for the fortress. The concept of renovation through redevelopment is pivotal in the NHW: the greatest opportunity to redevelop and therefore preserve fortresses is when these are seen as an economic touristic product.

Heritage significance

Heritage significance was influential in the realisation of both case studies. The houses on the Sleephellingstraat date back to 1903 and fall under the one of the conservation areas of Rotterdam. Fort de Gagel holds protected status as a National Heritage Site and Landscape Site and, being part of the NHW, it is as well on the shortlist of the UNESCO World Heritage. This suggests that the energy retrofitting of the historic buildings is a demanding exercise and only a limited number of interventions are applicable for its inherent heritage values. It is important to underline that heritage significance does not determine but influences the realisation of ERHB projects. The fact that these buildings are historic is not considered a barrier as such. Interventions are tolerated, seeing that these respect the heritage values of the buildings.

Cultural significance

Cultural significance played a role in the redevelopment plans of Fort de Gagel, but not of the Sleephelling. The latter does hold the status as a protected city landscape, but does not bear considerable cultural significance. Fort de Gagel, in turn, endures cultural-historical, monumental, civil engineering and military-historical values. Fort de Gagel does not only hold a protected status as National Heritage Site and National Landscape but is additionally on the shortlist of the UNESCO World Heritage. In general, it was stated that cultural significance plays a minor role in the realisation of ERHB projects.

Social compatibility

Social compatibility influenced the energy retrofitting plans of the ERHB projects, but to a much lesser extent. The fortress building owners reckoned with social disturbances resultant from the recreational plans for Fort de Gagel, but did not face any additional issues other than complying with social standards. As for the Sleephelling, succeeding the project realisation, new users did not necessitate adapting their behaviour for the implemented installations were not complex in their operation and maintenance. In general, it was indicated that social compatibility usually do not come across as an affecting factor in undertaking EHRB projects as the retrofitting only brings about advantages for the building life cycle and usage.

Environmental performance

Improved energy performance from energy retrofitting is not yet considered as an added value as it does not raise the value of the building. This was clearly observed in the Sleephelling case study, in which the newly passive renovated passive houses were undervalued by building evaluators, for the attention is accentuated on other building properties than its qualities. In fact, good location was the determining factor in selling the houses on the Sleephellingstraat, suggesting that the energy performance is a secondary concern. With respect to Fort de Gagel, although the redevelopment plans take sustainability into account, limited attention to improved energy performance is observed. One factor that adds to overlooking the environmental performance of the fortress amounts to "cost-benefits". In general, it was stressed that building environmental performance is still not appealing to the public and therefore does not sell.

Renovation timing

Renovation timing is a factor that was not covered in the analytical framework but disclosed relevance in undertaking ERHB projects. In the Sleephelling project realisation, the renovation timing did not play a role for it is a show-case project; yet, respondents pointed out the importance of choosing the right renovation timing for including building energy upgrading measures. In opting for a natural maintenance or replacement time, under which there is an actual need for retrofitting, building owners can alleviate much of the costs and complexities in carrying out ERHB. Fort de Gagel comprises the right renovation timing for no recent renovation has been undertaken in the past years. The potential to bring about substantial improvements after the retrofitting are therefore in place.

6.1.2 Operational Orgware

Table 5 depicts a representation of the factors from the operational orgware that are deemed influential in the realisation of ERHB projects, derived from the literature and empirical data collection. The red colour indicates that the factor influenced the realisation of the ERHB project. Within the red colour categorisation, the positive symbol indicates that the factor contributed to the realisation of the project, while the negative symbol indicates that the factor acted as an obstruction but did not however determine the project realisation. The analysis is exercised at the project level.

	De Sleephelling					
Operational Orgware	Mobilisation of resources **(+)**	Leadership **(+)**	Mutual interests **(+)**	Communication **(+)**	Stakeholder engagement **(+)**	Local authorities direct engagement **(+)**
	Fort de Gagel					
	Mobilisation of resources **(-)**	Leadership **(-)**	Mutual interests **(-)**	Communication **(-)**	Stakeholder engagement **(-)**	Local authorities direct engagement **(+)**

Table 5: Factors from the Operational Orgware system that influences the realisation of ERHB projects.

Every factor pertaining to the operational orgware played a role in the course of the two ERHB projects; yet in a dissimilar fashion. The Sleephelling can be regarded as an example of how private

actors can come together and successfully achieve high energy efficiency levels even in more challenging circumstances. All factors from the operational orgware were considered essential for the successful realisation of the Sleephelling project. While respondents indicated that in general all the factors from the operational orgware are important, the specific organisational structure of the ReFoMo project was not facilitative of its realisation. An additional crucial factor derived from the interviews is that of direct engagement of local authorities. Prior also referred to as "convince monument officials" and "early engagement", the direct engagement of local authorities is not an indicator included in the analytical framework. In the field of ERHB, it is fundamental for building owners to work closely together with monument officials because they can determine the course of the ERHB project.

Mobilisation of resources

The mobilisation of resources is an important aspect in bringing about ERHB projects. In the Sleephelling project, the mobilisation of financial instruments and knowledge supported the successful implementation of passive measures in the historic building. The building contractor raised the entire investment costs to enable the complete realisation of the project. Again, this was only feasible for the Sleephelling is a show-case project. The project team endured distinguished expertise in the field of ERHB, which invigorated efforts to bring the apartments on the Sleephellingstraat to passive house standards.

With respect to Fort de Gagel, particularly ReFoMo, a number of shortcomings were disclosed. It was pointed out that time and financial constraints played a role in the delivery of an adequate final product for Fort de Gagel. It was stressed that "leadership" can facilitate the mobilisation of resources to realise ERHB projects. Knowledge did not demonstrate to be a problem in bringing about the ReFoMo project. In fact, respondents disclosed that knowledge in the field of ERHB is sufficient in the Netherlands.

Leadership

Leadership is imperative to bring about successful ERHB projects. Leadership and individual enthusiasm are considered as central success factors that enabled the prosperous passive renovation on the Sleephellingstraat. In the ReFoMo project, leadership is correspondingly considered as one of the most significant factors that positively contributes to the successful realisation of ERHB projects; especially with regards to the controversial building owner-tenant relationship. Yet, within ReFoMo, leadership proved to be deficient. Respondents stressed that the lack of leadership was nevertheless owed to a shift in project leaders throughout the project realisation. This deviation in leadership position resulted in poor "communication" amongst the different stakeholders, and accordingly undermined the level of "stakeholder engagement" in ReFoMo.

Mutual interests

Having mutual interests also disclosed to be of importance. The realisation of the Sleephelling project took place in the form of a passive experiment and was therefore a very attractive opportunity for different actors to come together, demonstrate their specific expertise and deliver optimal solutions.

All the involved parties were highly interested in the show-case project and that opened place to a very motivated and enthusiastic team, which wanted to sell the same concept. Interests were therefore not conflicting and supported the establishment of a common agenda. As for the ReFoMo project, interests acted as an obstruction throughout the project execution, for these did not demonstrate to be coordinated. It was indicated that usually partners are opportunistic when research objectives and strategies are not clearly set out. Further, interviewees indicated that ambition levels were not high. Insufficiency in ambitions influenced "stakeholder engagement", "leadership" and project output.

Communication

Good communication is vital for an effective project implementation. In the Sleephelling project, responsibilities were clearly defined and assigned to the different parties, so everyone knew exactly what to do and what was expected. Communication deemed very important in the passive house renovation project, for calculation errors can be easily made. Respondents accentuated that communication and collaboration are key factors in energy retrofitting projects, and are not specific of historic buildings. With regard to ReFoMo, communication was a common issue between all parties. Respondents indicated that communication gradually decreased throughout the project design, which resulted in lack of stakeholder engagement and ultimately in lack of awareness of the project output. It was pointed out that if communication were more frequent, the project team would then have succeeded to deliver a more comprehensive redevelopment plan for Fort de Gagel.

Stakeholder engagement

Stakeholder engagement is similarly an important factor in ERHB project realisation. Stakeholder engagement was supportive of the Sleephelling passive renovation, for it resulted in a strong team constellation. The project team was highly motivated to bring the apartments on the Sleephellingstraat to passive house standards in a show-case format. As for Fort de Gagel, engaging stakeholders demonstrated to be a more challenging exercise. The lack of stakeholder engagement aggravated shortcomings in dialogue; and hampered the internal project organisation and the delivery of a cutting-edge output. In the field of ERHB, it was accordingly stressed that engaging innovative stakeholders is supportive to bring about successful cases.

Local authorities direct engagement

Engaging local authorities in the early ERHB project design phase is crucial for its successful realisation. The direct engagement of local authorities is not an indicator covered in the analytical framework but it is an essential condition to bring about ERHB, considering that the legislation ("regulatory policy instruments") on cultural heritage preservation ("heritage and cultural significance") can be counterproductive to ERHB. The successful passive house renovation of the apartments on the Sleephellingstraat is partially owed to the direct engagement of local authorities in the project. The project team exemplified that the proposed passive measures would respect the established legal and construction borders and would not endanger the unique characteristics of the building.

As previously observed, "heritage" and "cultural significance" was highly influential in the sustainable redevelopment plans for Fort de Gagel. Yet, this aspect was overcome through the direct engagement of local authorities in the project design. Respondents accentuated that it is very important to work closely together with monument officials because they can determine the course of an ERHB project.

6.1.3 Formal & Informal institutions

Table 6 depicts a representation of the factors that are deemed influential in the realisation and scaling-up of ERHB projects, derived from the literature and empirical data collection. The blue colour indicates that, although relevant, the factor did not play a role in the realisation of the ERHB project. The yellow colour indicates that the factor was important to a certain extent for the realisation of the project. The red colour indicates that the factor gave shape to the realisation of the ERHB project. Within the red colour categorisation, the positive symbol indicates that the factor contributed to the realisation of the project, while the negative symbol indicates that the factor acted as an obstruction but did not however determine the project realisation. The tick symbol indicates that the factor can influence the scaling-up potential of ERHB projects. Here, the analysis is conducted at both project and city levels.

	De Sleephelling				
Formal & Informal Institutions	✓ Regulatory policy instruments	✓ Economic policy instruments	Informative policy instruments	Voluntary agreements	✓ Public-private partnerships
	Fort de Gagel				
	✓ Regulatory policy instruments	✓ Economic policy instruments **(-)**	✓ Informative policy instruments	✓ Voluntary agreements	✓ Public-private partnerships **(+)**

Table 6: Factors from Formal & Informal Institutions that influence the realisation and scaling-up of ERHB projects.

Overall, a facilitative macro context can positively influence the realisation of ERHB projects and is crucial for the horizontal scaling-up of ERHB.

Regulatory policy instruments

Regulatory policy instruments do not demonstrate to hamper the realisation of ERHB projects but are also not facilitative of the up-scaling of ERHB. There is no agenda yet that addresses ERHB and much controversy remains. In the field of ERHB, two different policy perspectives are borne upon: local legislation on cultural heritage preservation and national energy policy. In the following, a more comprehensive overview of the two is put forth for both ERHB case studies.

Legislation on the conservation of cultural heritage

In the Sleephelling project, the regulatory policy instruments at the city level were not influential in the attainment of the passive house standards in the historic building. The building requirements posed by the municipal Monument Committee on the renovation did not obstruct the

realisation of the project. The team did however need to convince monument officials ("local authorities direct engagement") that the proposed passive measures would respect the established legal and construction borders and would not endanger the unique characteristics of the building. Although existing regulatory policy instruments did not determine the realisation of the Sleephelling project, it did influence the investment costs of the project due to building requirements that called for tailor made solutions ("hardware & software").

With respect to Fort de Gagel, the sustainable redevelopment is a rousing illustration of how far the regulatory policy on cultural heritage preservation is amenable to uphold the instigation of ERHB projects. Collaboration with local authorities ("local authorities direct engagement") played a significant role in project design phase and enabled the endorsement of the fortress redevelopment plans. Under different circumstances, in which a private entrepreneur has no contact person within the municipality, it would have been more challenging to conclude a nice redevelopment design. Hence, it is by means of constant dialogue and mediation that the sustainable redevelopment of Fort de Gagel is materialising.

Generally, respondents from both ERHB case studies pointed out that the Dutch legislation on cultural heritage conservation is regarded as counter-productive because frequently a substantial amount of rules applies. Individual historic building and house owners who want to undertake building energy retrofit have to undergo extensive legal and administrative procedures to be granted a permit. Another drawback regards the application of innovative technologies in historic buildings, which can be confined by legislation. This is the case when a building owner ponders about installing solar panels in the building but is obstructed with visibility requirements set out by local authorities. This undermines the impact of green technologies in local efforts to mitigate climate change. However, it was stated that the "physical attributes" of a historic building set the limits to the ERHB project itself. Thus, this limitation is project specific. A consecutive barrier arises when the Cultural Heritage Agency or the municipal Monument Committee considers the preservation of cultural heritage to be more significant than the relatively large environmental footprint and corresponding financial costs of historic buildings. Yet, cultural heritage authorities are increasingly willing to collaborate, by means of affording advice and, whenever possible, allowing more flexibility.

National energy policy

Reactions on the omission of historic buildings from energy policies are highly divergent and demonstrate to be actor specific. On the one hand, omitting historic buildings from energy policies is well founded for the intrinsic values, uniqueness and physical attributes of historic buildings. Deficiencies in the Dutch energy policy affect the demand for improved energy performances of historic buildings. The implementation of the Dutch labelling scheme was highly debatable and criticised, for its methodology is based on physical matters rather than on building use. This approach does not stimulate building owners to invest in energy upgrading measures, especially not in historic buildings. Another factor that complicates the enforcement of energy performance for historic buildings amounts to the legal argument of property purchase under legal conditions that cannot simply change over time.

Further, it was stressed that adjusting policies in the field of ERHB is a very ambitious exercise, not only because historic buildings are a delicate matter but also because policies are not easily changed.

On the other hand, bypassing historic buildings from energy policies is also not the optimal way to proceed. Respondents pointed about that the potential to instigate discussions on requiring a conditional energy performance base-line for historic buildings is pragmatic. Enforcing a minimum energy performance standard for historic buildings is necessary because it is accommodating for building owners to undertake renovation in the customary fashion. This stance is highly associated with the low level of consumer awareness of building energy performance and sustainability issues. Generally, the demand from the government side is the only way to convince people. Yet, the liberal culture of the national government is not supportive of this approach. In fact, it was accentuated that interest in ERHB is accordingly missing at the national level. So, to actually go for energy retrofitting is one of the biggest barriers in the field of ERHB.

Economic policy instruments

The realisation of the passive renovation on the Sleephellingstraat was not influenced by the availability of economic policy instruments considering it was an initiative of a building contractor, who took on all the investment costs, including the project losses. Again, it is important to recall that the realisation of the Sleephelling project was only financially attainable because it was a demonstration project. The scaling-up of equivalent projects disclosed to be very limited, primarily owed to the high investment costs in undertaking ERHB.

The investment costs for the sustainable redevelopment of Fort de Gagel are high; thus the availability of economic instruments is crucial for its realisation, especially for it is a publicly ran project. The mobilisation of investments was done by and from the municipality of Utrecht. The municipality succeeded to mobilise funding from the EU and from the national government, however additional investments are still needed. Considering that the availability of funds and subsidies is limited, and that the municipality as a public entity cannot benefit from subsidies, the advancement of the project might undergo delays.

Generally, economic incentives for ERHB are hardly existent and uncertain. Yet, it is apparent that governments are generally concerned with funds, subsidies and stimulation projects. In the industry sector, the government stimulates improved energy performance by means of the BREEAM certification scheme, which can facilitate the allocation of subsidies for businesses. Businesses can also benefit from green tax reduction if they manifest investments to improve the energy performance and overall sustainability of their buildings. However, industries have low energy costs and energy prices are much lower for businesses than for house owners. This suggests that there is no real business case for the industry to invest in energy upgrading performances. Hence, efforts to incentivise the scaling-up of ERHB should be rather concentrated on the housing market. Green subsidies, such as for solar panels, are frequently used by individual building owners. Yet, the subsidy scheme in the Netherlands is fluctuating, which causes people to hesitate to ask for them. Loans to undertake renovation of existing

buildings are also available. Yet, they are not being frequently used because the legal and administrative procedures are too lengthy. Another point stressed by the respondent is that it is oftentimes more difficult to only a get a loan for the energy efficiency aspect of the renovation. Apart from the limited amount of subsidies and (unused) loans, there are no other major financial stimulants for building owners to consider for energy efficiency measures.

Informative policy instruments

Informative policy instruments were not influential in the achievement of the Sleephelling project. As heretofore mentioned, the team constellation was very knowledgeable on the topic and was also very determined to demonstrate that successfully bringing a monument into passive house standards was feasible ("operational orgware"). Informative instruments were correspondingly not influential in the redevelopment project of Fort de Gagel. Recurrently, the engagement of cultural heritage authorities in the project design and the frequent dialogue on eventual developments positively influenced the advancement of this big scale redevelopment project. In terms of knowledge, both the municipality and the province of Utrecht take part in the DUMO network and are increasingly investing in the mobilisation of knowledge for ERHB. Here, it is important to recall that the nature of both the Sleephelling (show-case) and Fort de Gagel (publicly driven) case studies accordingly influenced its own project realisation. In the field of ERHB, projects are unique and limitations are inclined to be project specific. Under different circumstances, respondents indicated that the availability of informative instruments can play a role in the realisation and up-scaling potential of ERHB projects.

Voluntary agreements

Voluntary agreements between private and public actors played an indirect role in the realisation of both ERHB projects. In the Sleephelling project, the building contractor had signed an agreement with a non-governmental organisation to perform at least ten initiatives for new construction or renovation purposes according to the passive house principle. With this collaboration, the building contractor and the non-governmental organisation aimed at a far-reaching breakthrough in energy efficient construction and renovation of the housing market. With respect to Fort de Gagel, having the municipality participating and collaborating with the DUMO experts positively influences the attainment of the sustainable redevelopment plans and of ERHB projects, more generally. In general, voluntary agreements play a minor role in the realisation of ERHB, but can serve as a stimulus for the up-scaling of ERHB projects.

Public-private partnerships

Public-private partnerships are not incorporated in the analytical framework but demonstrate to positively influence the realisation and the scaling-up of ERHB projects. In the field of ERHB, collaboration between local authorities and private parties is essential, for numerous rules are in place and building owners necessitate getting construction licenses granted. The consideration of both public and private stances can facilitate the enactment of a common agenda and accordingly ERHB project realisation. Thus, ensuring that collaboration is in place in the very beginning of the project design can facilitate the realisation of ERHB projects. This was observed in both the Sleephelling and Fort de Gagel

projects, in an opposite fashion: private actors-local authorities and local authorities-private actors, respectively. To illustrate, as the redevelopment plans for Fort de Gagel comprise the establishment of an outdoor centre and restaurant facility, the fortress owners (municipality of Utrecht) cooperate in negotiations with private entrepreneurs so as to make investment costs attractive for these actors.

Cooperation amongst different disciplines is likewise significant in efforts to up-scale ERHB projects. Public-private partnerships can accordingly support the development of packages of measures, which can alleviate the high costs associated with energy retrofitting measures and therefore instigate demand. Generally, private parties are increasingly displaying interest and commitment in the field of ERHB. So, together public and private actors are supporting the scaling-up of ERHB transition.

6.1.4 Local Governance Capacity

Table 7 depicts a representation of the factors from the hardware and software systems that are deemed influential in the realisation of ERHB projects, derived from the literature and empirical data collection. The blue colour indicates that, although relevant, the factor did not play a role in the realisation of the ERHB project. The yellow colour indicates that the factor was important to a certain extent for the realisation of the project. The red colour indicates that the factor gave shape to the realisation of the ERHB project. Within the red colour categorisation, the positive symbol indicates that the factor contributed to the realisation of the project, while the negative symbol indicates that the factor acted as an obstruction but did not however determine the project realisation. The tick symbol indicates that the factor can influence the scaling-up potential of ERHB projects. Here, the analysis is exercised both at the project and city level.

Local governance capacity	**De Sleephelling**				
	✓ Political leadership	✓ Trust in the policy framework	✓ Mobilisation of resources	✓ Interdepartmental cooperation	✓ Monitoring & Follow-up mechanisms
	Fort de Gagel				
	✓ Political leadership **(+)**	✓ Trust in the policy framework **(+)**	✓ Mobilisation of resources **(+)**	✓ Interdepartmental cooperation **(+)**	✓ Monitoring & Follow-up mechanisms

Table 7: Factors from the Local Governance Capacity that influence the realisation and scaling-up of ERHB projects

Political leadership

Political leadership can positively influence the uptake and scaling-up of ERHB projects. The energy retrofitting of historic buildings remains a small and distinguishing field, in which numerous operations are limited. Thus, having municipalities taking on the exemplarity role in ERHB while incentivising the public to accordingly undertake building energy retrofitting, can be advantageous for the up-scaling of ERHB projects.

In the Sleephelling case study, local political leadership indirectly supported the realisation of the project and is assumed relevant in advancing ERHB projects. By the time of the project realisation, the government was actively encouraging the passive house approach, which was considered elementary in terms of achieving energy efficiency in buildings. However, the passive house approach was overshadowed by "zero-on-the-meter" technologies, which consecutively affected the scaling-up of passive house projects. At the municipal level, the preservation of cultural heritage and the energy retrofitting of historic buildings does not demonstrate to be a first concern. Nonetheless, efforts by the Monument Committee are being increasingly directed towards shifting the predominant modernist mind-set of locals. The Monument Committee has a liberal stance and affords a lot of flexibility in ERHB undertakings. Still, the municipality is strict when interventions are not well justified.

In Fort de Gagel case study, within the municipality of Utrecht local political leadership is present, which is supportive of the sustainable redevelopment plans for the fortress as well as of the up-scaling of ERHB projects. The municipality of Utrecht can be regarded as a front runner in the field of ERHB in the Netherlands, which is partially owed to its local green politics. The municipality also collaborates with other EU cities in the field of ERHB and puts efforts in advocating examples of energy retrofitting projects to the public. In terms of the redevelopment of the NHW fortresses, the municipality correspondingly performs well.

Generally, political leadership in climate talks is missing in the Netherlands, which does not bolster efforts to scale-up ERHB. It was emphasised that a renewed agenda is needed, because many opportunities are overlooked and the focus of the government does not lie further than meeting the Kyoto targets. Aspects that contribute to insufficient climate commitments are deemed to be rooted in the Dutch culture of liberals and merchandisers. "*The Dutch believe that the minimum regulation of the government is at the same time the maximum that they need" and "The Dutch rely on policies but you cannot easily change the policies"*, accentuated a public affairs official. That being said, political leadership and the establishment of an agenda for ERHB are necessary to strengthen efforts to scale-up ERHB.

Trust in the policy framework

Trust in the policy framework did not play a role throughout the project realisation on the Sleephellingstraat, for the involved actors did not necessitate demanding for subsidies nor loans, and did not undergo any legislative fluctuations in getting their construction licenses allocated. As a result, this factor was solely indirectly discussed. However, it was assumed that trust can play a role in the realisation and up-scaling potential of ERHB, for reasons that range from policy imperfections to self-disregard of the importance of upgraded building energy performance.

In the Fort de Gagel case study, trust in the policy framework played an indirect role. Considered the large scope of the project and accordingly the enormous amount of investment costs, the municipality of Utrecht is dependent on the mobilisation of financial instruments, which is becoming increasingly difficult. The municipality can neither benefit from subsidies nor from the energy tax

reduction mechanism, for the municipality is a public entity. The shortcoming and limited access of economic incentives by the city of Utrecht can result in project interruptions. Thus, uncertainties in the provision of economic incentives influence the project development of Fort de Gagel.

Uncertainties associated with the governance of ERHB are generally touched upon. It was indicated that building owners and municipalities are still reluctant to collaborate with authorities accountable for cultural heritage preservation. The inconsistency of institutional accountability on cultural heritage preservation can have an influence on the apparent hesitation of building owners to approach local cultural heritage officials, and of municipalities to approach the national Cultural Heritage Agency. Additional factors that contribute to this hesitation regard lack of knowledge, apprehension that ERHB planning will be rejected and having to negotiate with unfamiliar parties. Improved information sharing, dialogue and cooperation amongst stakeholders are crucial for the realisation and scaling-up of ERHB. The availability of economic incentives also influences trust in the policy framework.

Mobilisation of resources

Local capacity to mobilise resources for ERHB is generally regarded important for its advancement. As previously mentioned, by the time the Sleephelling project took place, local authorities were supportive of the passive house approach, which was considered elementary in efforts to achieve improved energy efficiency in buildings. Nevertheless, the realisation of the Sleephelling project was not influenced by the capacity of local authorities in mobilising resources for ERHB. On the contrary, the success of the Sleephelling manifests to be resultant of the capacity of team members in mobilising resources, especially knowledge wise. In the Sleephelling case study, the mobilisation of knowledge aspects predominate the interviews in terms of perceived barriers in the realisation and up-scaling of ERHB projects. It was indicated that local authorities have very limited information on ERHB. Considering that cultural heritage preservation is not a first concern within the municipality of Rotterdam, the potentiality to integrate improved building energy performance in cultural heritage is further aggravated.

The local capacity of authorities to mobilise resources for ERHB projects positively influences the sustainable redevelopment plans for Fort de Gagel. Heretofore disclosed, the municipality of Utrecht is regarded as a front runner in the field of ERHB. The municipality is represented by the green left party, which is strong on green energy and energy efficiency discussions. Apart from the local green politics, the municipality takes on a bottom-up approach to incentivise the public to consider building energy performances. The municipality encourages local inhabitants to engage in deliberations about energy issues and to conceive green solutions that can potentially alleviate building energy use. The municipality also has local energy corporations that are interested in monumental buildings and raise money to install solar panels in local neighbourhoods.

Interdepartmental cooperation

Interdepartmental cooperation is not a factor incorporated in the analytical framework but is considered vital in the field of ERHB. As formerly illustrated, the integration of improved energy performances in cultural heritage is still absent. ERHB does not yet have an agenda at the policy level, which suggests that numerous opportunities are being missed.

In Rotterdam, ERHB is not precedence. There is no collaboration between the departments in terms of ERHB: cultural heritage authorities do not collaborate with environmental authorities. In fact, within the municipality, there is no department in place that could be addressed with regards to ERHB. ERHB is only dealt with in an abstract fashion. Deficiencies in interdepartmental cooperation are detrimental to communication and accordingly the exchange of knowledge both internal (amongst local authorities) and externally (between local authorities and the public). In contrast, the cultural heritage and sustainability department work closely together within the municipality of Utrecht. The municipality also comprises a department on sustainable buildings. It was accentuated that cooperation and arriving at a moderated decision can be hard. Yet, local authorities acknowledge that sometimes decisions are better for the environment but are also sometimes better for the cultural heritage

In general, collaboration between different departments can support efforts to overcome barriers and uncertainties associated with ERHB considering that knowledge exchange issues. Individual departments would be then more likely to integrate energy concerns in their policies, and thereby spur the scaling-up potential of ERHB.

Follow-up mechanisms: monitoring & controlling

Follow-up mechanisms were not covered by the analytical framework but are crucial in efforts to up-scale ERHB projects. Follow-up mechanisms are disclosed as necessary steps in the field of ERHB, considering that knowledge is not being exchanged amongst stakeholders. Local authorities should increasingly encourage the demonstration of ERHB projects and accordingly improve the monitoring and follow-up of these projects. It is important to continue undertaking show-case ERHB projects and to communicate about the ERHB processes and outcomes, so as to instigate learning from best and less good practices. It also important to communicate about the benefits that ERHB brings about to the public in order to raise awareness. Like this, the scaling-up of ERHB projects will follow. Respondents generally stressed that there is need for more collaboration, communication and knowledge exchange.

6.1.5 External Trends

Table 8 depicts a representation of the factors from the hardware and software systems that are deemed influential in the realisation of ERHB projects, derived from the literature and empirical data collection. The blue colour indicates that, although relevant, the factor did not play a role in the realisation of the ERHB project. The red colour indicates that the factor gave shape to the realisation of the ERHB project. Within the red colour categorisation, the positive symbol indicates that the factor contributed to the realisation of the project, while the negative symbol indicates that the factor acted as an obstruction but did not however determine the project realisation. The tick symbol indicates that the

factor can influence the scaling-up potential of ERHB projects. The analysis is exercised at the project, city and national levels.

	De Sleephelling, Rotterdam				
External trends	✓ Environmental awareness & Societal values on sustainability **(+)**	✓ Market demand **(-)**	✓ Housing market	✓ Energy market	✓ Energy prices
	Fort de Gagel, Utrecht				
	✓ Environmental awareness & Societal values on sustainability **(+)**	✓ Market demand	✓ Energy market	✓ Energy prices	

Table 8: Factors from External trends that indirectly influence the scaling-up of ERHB projects.

Environmental awareness & societal values on sustainability

Environmental awareness and societal values on sustainability played an indirect role in both ERHB projects, however in a different fashion. Respondents raised the issue of lacking public awareness concerning the benefits associated with ERHB and sustainability. Lack of awareness is grounded on deficiencies in the provision of information about ERHB. Awareness does not demonstrate to be deficient amongst the public but also amongst building evaluators. Indeed, following the Sleephelling project realisation, the newly passive renovated houses were undervalued for building evaluators do not concentrate on building quality when assessing properties.

In contrast, the endorsement of the sustainable redevelopment plans for Fort de Gagel was partially attainable due to the present awareness of energy and sustainability concerns within the municipality of Utrecht, as previously disclosed. The fortress owners demonstrate great willingness to redevelop Fort de Gagel in a sustainable fashion and aim at upgrading the energy performance of the building. The private entrepreneur, who will run businesses in the fortress, is accordingly interested in and is supportive of the sustainability concept of redevelopment project. Environmental awareness and societal values on sustainability indirectly positively influenced Fort de Gagel redevelopment plans.

In general, ERHB remains an ad-hoc and niche market. The principle of low energy buildings is still hard to sell. The implementation of the energy labelling scheme in the Netherlands is a positive attempt to shift the public attention to considering building energy performance; however it seems not to be a first concern. The incapability of building evaluators to look beyond the Dutch energy label is also a contention. Translating the benefit of improved building energy performance into the value of the property is unsettled. The public is then not incentivised to consider for other building qualities, especially improved energy performance. Notwithstanding, consumers should be firstly informed that building energy performance is important to consider. It is accordingly relevant to present the pay-back costs from investing in ERHB. Only then will consumer interest arise and consecutively the demand for ERHB.

Nonetheless, gradual improvements have been observed. Cultural heritage authorities are increasingly affording more flexibility and cooperating with sustainability authorities, as well as with historic building owners. Awareness and interest in ERHB is still necessary to instigate demand and support efforts in scaling-up ERHB projects.

Market demand

The reactions on market demand were dichotomous. Overall, it was accentuated that demand for ERHB is still inadequate and it differs per building sector. The housing market is the building sector that provides the greatest opportunities for ERHB, as houses are regularly used and comprise the largest part of the building stock in the Netherlands. It was nevertheless stated that adjustments in the housing market are necessary to incentivise consumers to opt for improved building energy performances. Upgrading the energy performance of monuments can be cost-effective for investors, considering that these building have long exploitation since they are more likely to be preserved for its cultural heritage values and sustain long-term exploitation business cases.

Housing market

The Dutch housing market system is considered prejudicial in efforts to improve building energy performances. Switching the focus from total investment costs to total living costs can be beneficial to ERHB. Yet, it is still difficult to reach people and incentivise them to consider for improved building energy performances, partially owed to the high costs associated with ERHB. Furthermore, it is difficult to single out what part of the investment pays back a certain measure, upgrades the building quality or improves the building energy performance. ERHB needs to be regarded from a holistic point of view because often the issue is narrowed down to marginal cost calculations, preventing projects to be realised. Modifications in the Dutch housing market to include building quality are necessary to enable greater opportunities for retrofitting projects, especially in purchasing houses. Yet, firstly consumers should be informed that building performance is an important aspect to consider.

Energy market

The prevailing top-down energy system in the Netherlands is regarded controversially. On the one hand, the national government has the objective to reduce CO_2 emissions in order to meet its set climate targets and alleviate the environmental impact. On the other hand, the national government does not demonstrate to facilitate this transition. In fact, it demonstrates to indirectly hinder the accomplishment of reduced existing building footprint. An issue concerns the tax reduction of solar panels. In the Netherlands, building owners who generate too much green energy are considered as energy producers and consequently have to pay taxes. As a result, it is not beneficial to redeliver energy into the system. This is counterproductive in efforts to realise EHRB projects. The system necessitates several adjustments to accommodate the transition towards improved building energy performances, which has to be addressed by the national government.

Energy prices

Energy prices can significantly influence financial advantage of the instigation and horizontal scaling-up of initiatives. However, energy prices are difficult to predict and are often influenced by uncertain global developments. This factor was not covered in the analytical framework but it influences the interest and demand for ERHB projects.

6.2 Framework on urban policies to scale-up ERHB projects – revised

Derived from the previous comparative analysis, this section presents an adjusted version of the conceptual framework on urban policies to up-scale ERHB projects (see figure 8). The framework corresponds to the Dutch experience in the field of ERHB.

Factors from the hardware and software systems determine the realisation of ERHB projects. Particularly physical attributes, cost-benefit and heritage significance set the limits and conditions to the ERHB project realisation. These factors are the very first barriers encountered by historic building owners and are considered as central obstacles in the field of ERHB. Social compatibility and environmental performance are ruled out from the framework, as their relevance in ERHB is minor. In turn, renovation timing is incorporated in the framework. Renovation timing can influence the successful realisation of ERHB. Economic advantage does not demonstrate to be highly influential yet; however cultural heritage is increasingly seen as an economic advantage in the Netherlands. Factors from the operational orgware are notably relevant in the project design and execution phases, distinctly, leadership and communication. Direct engagement of local authorities is an additional factor that is assimilated in the framework and is a prerequisite to bring about ERHB projects. These factors can determine the level of success of an ERHB project.

Factors from the formal and informal institutions and local governance capacity are accordingly important, but do not determine the realisation of ERHB projects. Factors from the urban policy arrangements influence the course of ERHB: they can either facilitate or hinder the realisation and scaling-up of ERHB projects. In particular, regulatory and economic policy instruments can manipulate the *realisation and scaling-up* of ERHB projects. The remaining factors from the urban policy arrangement influence the *scaling-up potential* of ERHB projects. Considering that supportive measures are in place, urban policy can instigate demand and boost the scaling-up potential of ERHB projects, and ultimately contribute to the run towards low-carbon cities. Voluntary agreements are ruled out from the formal and informal institution arrangement. In turn, interdepartmental cooperation is consolidated in the local governance capacity.

Follow-up mechanisms are incorporated in the analytical framework and are crucial in efforts to up-scale ERHB projects, for knowledge is not being exchanged amongst stakeholders. Local authorities should increasingly encourage the demonstration of ERHB projects and accordingly improve the monitoring and follow-up of these projects, so as to instigate learning from best and least good practices.

External trends play an indirect yet significant role in efforts to up-scale ERHB. Factors from the external trends arrangement are influenced by national and global interests. Overall, demand for ERHB in the Netherlands is determined by interest that is in turn influenced by the level of public awareness on environmental issues and societal values on sustainability, which is manipulated by energy prices and the energy market. The housing market accordingly affects the potential to up-scale ERHB projects. This vicious cycle necessitates interventions if ERHB is to be scaled-up.

In the following, general recommendations are elaborated based on the importance of respondents' perceived barriers in scaling-up ERHB projects. An additional approach is accordingly suggested to bolster efforts to scale-up ERHB projects and contribute to the run towards low-carbon cities.

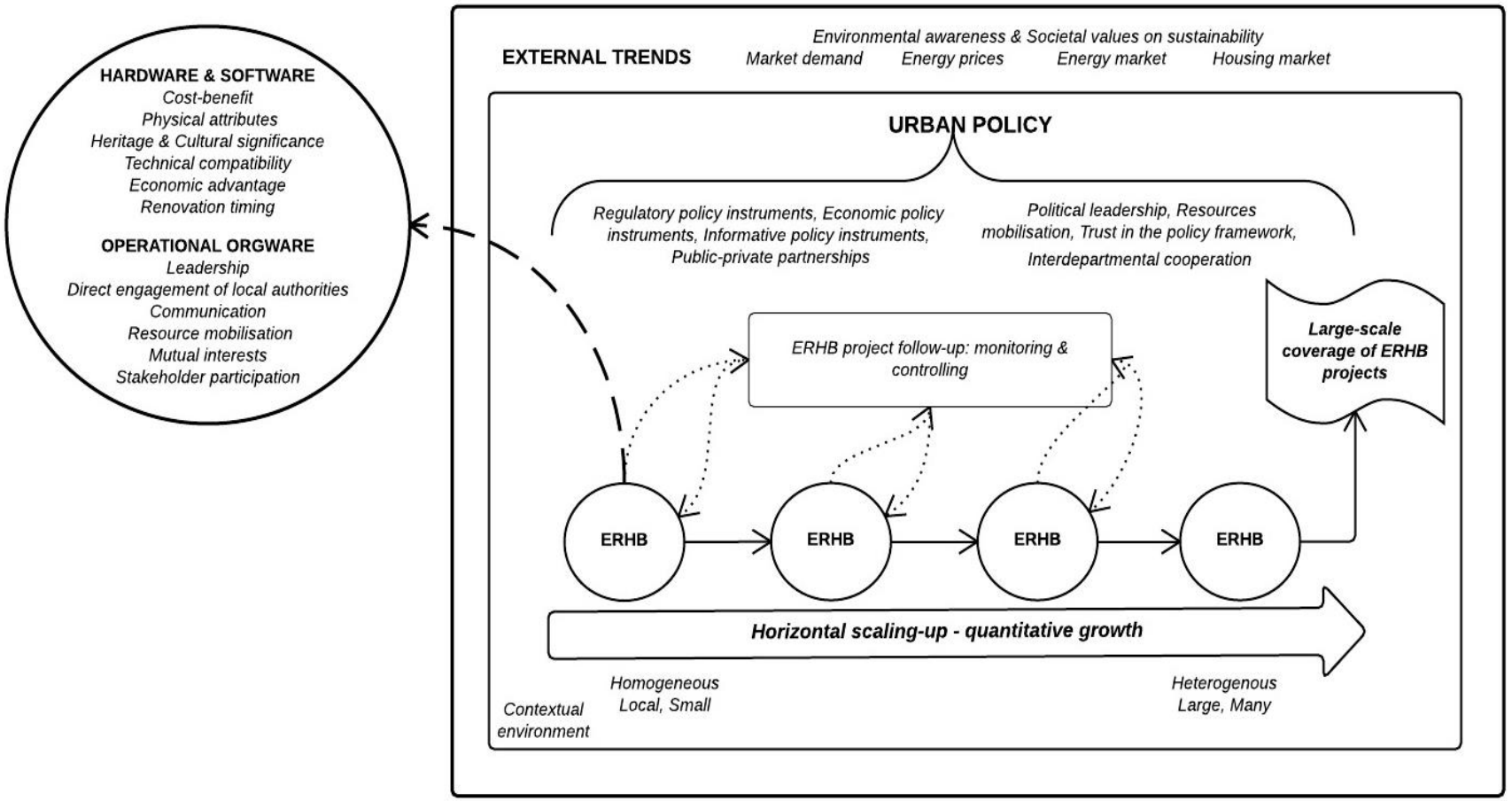

Figure 8: Revised framework on urban policy to scale-up ERHB projects in the Netherlands. Based on: Van Doren, D., Driessen, P.J., Runhaar, A.C.H. & Giezen, M. (forthcoming). Identifying the factors that influence the scaling-up potential of low-carbon urban initiatives: towards a conceptual framework. Utrecht University, Faculty of Geosciences, Copernicus Institute of Sustainable Development. The Netherlands

6.3 Recommendations to bolster the scaling-up potential of ERHB

Grounded on the preceding comparative analysis of the two ERHB projects, recommendations with respect to urban policies to instigate the horizontal scaling-up of ERHB projects in the Netherlands are put forth. The recommendations are elaborated in a generic fashion and incorporate aspects that are deemed important from the respondents' perspective, namely: regulatory, economic and informative policy instruments; political leadership; resource mobilisation; and interdepartmental cooperation. Although aspects from the external trend structure displayed important influence, recommendations are not presented for this factor, as it is out of the influence zone of local authorities.

In the Netherlands, the responsibility for cultural heritage conservation has been shifted to the municipalities. Municipalities develop their own local policies, and local Commissions for Aesthetics and Monuments advise instead of determining whether a license can be awarded for planned interventions in new and historic buildings. This results in significant disparities amongst Dutch municipalities: Interventions which are accepted in one municipality are rejected in another, and vice versa. Institutional fragmentation is a big issue in the Netherlands. The central "government" does not exist and that opens room to a lot of local subjectivity and inconsistency. A resultant positive aspect from this arbitrary arrangement is that it triggers creativity and the identification of innovative solutions. After all, in every historic building sustainable interventions are conceivable, but standard measures are implausible. Yet, to alleviate the burden of institutional fragmentation, it is important to communicate about the legislative differences. It is important that local authorities communicate about their arguments and why limitations are in place. Instituting a national portal, where all the contrasting municipal policies are assembled and well clarified, and where all the commonalities are displayed in a coherent framework can counterbalance this problematic. Box 1 introduces urban policy recommendations to bring ERHB projects to scale.

Box 1: Urban policy recommendations for ERHB

- ✓ Integrate energy and sustainability issues in cultural heritage legislation by means of stimulating cooperation between monument and sustainability departments.
- ✓ Consistent and well justified legislation on cultural heritage conservation has to be in place to avoid subjectivity and confusion.
- ✓ Institute a national portal to afford accurate and transparent information on the differences and commonalities amongst all municipal policies on cultural heritage in a coherent framework.
- ✓ Alleviate the legal and administrative license procedure.
- ✓ Trigger the discussion on the adjustment on the Dutch labelling scheme methodology: lay focus on the user perspective.
- ✓ Trigger the discussion on the enforcement of a conditional energy performance baseline for historic buildings. For instance, demand a minimal percentage of building energy performance improvement when undertaking renovation.

The working spheres of cultural heritage preservation and sustainable buildings are still quite far apart. Indicated by a senior expert in sustainable historic buildings, *"The first thing that sustainability experts do is to establish a sustainability ambition. For example, they have the ambition to achieve a certain percentage of CO_2 emissions reduction within a determined period. Then they look at what the degree of touchability of the historic building is. And this is not the way monument officials work. Monument officials establish the touchability first and then set the maximum feasible sustainability targets. This follows the principle that conservation precedes restoration and restoration precedes renovation. In monuments it is very difficult to lay down an ambition in advance because you never know what you will encounter in the restoration work. It can happen that beautiful paintings are discovered in the removal of a double wall; or that archaeological findings are discovered from excavation works, especially in medieval city centres".* In current practice, sustainability experts generally presume that they are dependent on monumental officials who are not fond of alterations. As for monument officials, these indicate that sustainability experts are dogmatic. Communication between the two disciplines is therefore important to enable mutual understanding, and correspondingly the identification of appropriate innovative solutions. For this, knowledge and experience exchange is crucial. EHRB demands transparency, willingness to look beyond disciplinary borders and mutual trust between monument and sustainability experts. Box 2 presents recommendations with respect to local governance capacity to foster efforts to scale-up ERHB projects.

Box 2: Local governance capacity recommendations for ERHB

- ✓ Improve the quality of information on ERHB that is being provided to the public and to experts.
- ✓ Institute a knowledge portal or entity where experiences in the field of ERHB are exchanged. This is important to instigate learning from best and least good practices.
- ✓ Develop a reference book in which the possibilities to make sustainable interventions in historic buildings are structurally presented.
- ✓ Encourage experiment and demonstration of ERHB projects.
- ✓ Encourage follow-up mechanisms so that ERHB projects are monitored and evaluated. Communicate about developments to the public.
- ✓ Cooperation is a prerequisite in ERHB: cooperation between historic building owners and the municipality, between monument and sustainability officials, and between all the different disciplines in the field of ERHB.

Economic incentives for energy retrofitting of historic buildings are hardly existent and uncertain. It follows from the study on ERHB projects that programmes for sustainable interventions are constantly changing and have short-term horizon. Deficiencies in economic incentives are further aggravated by institutional fragmentation, which results in ad-hoc programmes. Correspondingly, efforts to mitigate CO_2 emissions throughout the country are disproportionate. The problematic of short-term and ad-hoc programmes is highly controversial, in view of the long-term national vision on climate change mitigation.

The realisation of ERHB projects is still inevitably costly and the unavailability of economic incentives poses a barrier to individual building owners. Loans with low interest rates and can therefore alleviate the burden of investing in building energy retrofit for building owners. In fact, it was indicated that local authorities can learn from the funding concept employed by the Cultural Heritage Agency of the Netherlands. Observed by a senior expert in sustainable historic buildings, *"The national restauration funds has a very interesting approach: they loan you money for lower interest rates and give you actually five times the amount of money so that you can undertake a renovation. The condition is that you first have to maintain the cultural and heritage values of the building. Then you still have enough money left to carry out other ambitions. In other words, you have to restore the building value in order to realise what you really want. In terms of sustainable interventions, authorities could learn from it. Authorities would then indirectly incentivise the implementation of solar panels. The building owner would then consider the installation of solar panels because he can still do much more than that".* The mobilisation of economic incentives is supportive of realisation and scaling-up of ERHB. The identification of innovative and attractive means to financially stimulate building owners to undertake energy retrofit is crucial. Box 3 presents economic policy recommendations to accommodate the transition towards urban large-scale implementation of ERHB projects.

Box 3: Economic policy recommendations for ERHB

- ✓ Mobilise long-term financial programmes to stimulate sustainable interventions in existing buildings.
- ✓ If subsidies are provided, these should be accordingly guaranteed on a long-term basis to enable for robust business cases. Subsidies should be also guaranteed for other segments other than the commercial one. Subsidies can be provided by means of reinvesting the money from building permits.
- ✓ The provision of financial resources should be concentrated for the historic housing market. More incentives could be in place in the form of higher mortgage and loan allowances as a reward for investments in energy efficiency measures, for instance. The introduction of green tax reductions also offers potential and should be deliberated upon.
- ✓ Mobilise financial resources for advisory means in order to enable the public to make the right choices in ERHB.
- ✓ Provide loans under the precondition of maintaining cultural heritage values and integrating sustainable interventions in undertaking renovation in historic buildings.

The following section, a different approach to reinforce efforts to scale-up ERHB projects is discussed in the light of the alleviated climate impact that ERHB projects can bring about.

6.3 Regional approach to reinforce efforts to scale-up ERHB projects

From the study, it became apparent that a significant reduction of the energy usage of historic buildings is highly desirable because energy costs and lack of comfort form the bottlenecks for a healthy exploitation and thus sustainable management and protection of these buildings. However, the possibilities for interventions are limited and require customised solutions. Historic buildings do not only bear unique cultural heritage values, but also unique physical attributes and building use. The contextual environments, in which these buildings are located, are accordingly highly divergent. An additional ongoing discussion concerns the real impact that historic building have on the environment and what level is the most effective to alleviate climate concerns: object-oriented or area-based approach?

From the analysis, it became clear that the alleviated climate impact of individual ERHB projects is not substantial. The proportion of listed buildings is small. Only 1.7% of the existing buildings in the Netherlands are listed monuments, and 350 valuable historical urban ensembles are protected town and preservation areas (Dulski, van der Vliet and van Unen, 2012). Historic houses nevertheless offer greater potential. Around 20% of Dutch homes were building before 1940, and around 5% before 1990 (Ibid.2012). Still, the potential lies in energy savings rather than real reduced climate impact. In fact, historic buildings are more energy efficient than expected. Research on the real building energy use disclosed that historic buildings have better energy performance than it has been speculated, on account of the omission of the user perspective from Dutch energy labelling scheme (Dulski, personal communication, 2015). The Dutch energy labelling methodology looks at the period, standard and type of historic building. The methodology is based on physical matters instead of user behaviour. Building

owners are increasingly adapting their behaviour according to the oscillating performance of buildings throughout the year (Dulski, personal communication, 2015). That being said, the debate on ERHB has to be deliberated on a far-reaching scope. If ERHB is to contribute to climate mitigation efforts, the attention should be shifted to looking at a higher scale of ERHB interventions. Indeed, efforts to mitigate CO_2 emissions are a fortiori.

Similar to other EU countries, the Netherlands has the objective to reduce CO_2 emissions in 2020 by 20% compared to 1990. Many Dutch municipalities have even higher climate aspirations. Considering that the building sector in the Netherlands is responsible for 33-40% of CO_2 emissions, the sector can make essential contributions to alleviate climate change concerns. The proportion of new building construction is nevertheless low and is greatly reduced as a consequence of the current economic crisis. It is anticipated that at least 90% of the buildings in 2020 are already present today (Dulski, van der Vliet and van Unen, 2012). Efforts to meet climate ambitions should be therefore concentrated on existing buildings. Avoiding gaps will be a great challenge in the coming years, as recently portrayed in Dutch landmark ruling to cut emissions to protect citizens from climate change impacts (The New York Times; The Guardian; BBC News, 2015).

In terms of climate impact, the focus should be shifted from energy retrofitting single historic buildings to larger scales: neighbourhood or city level. Arrangements to minimise the climate impact of historic buildings should be identified at the district level. A potential arrangement concerns the redistribution of heat and cold. A senior expert in sustainable historic buildings named an example, "*I always pick up the example of a church in a historic city centre. Churches are a special challenge, for its limited budgets, large volumes and irregular use. There, the heating system has to be turned on days before the actual use so that the building is completely warmed up. In historic city centres, there are also many shops, restaurants, offices, housing. And, if you stand on the top of a tower in the middle of an old city centre, you see that in numerous historic roofs air conditioning is installed. (…) So, you have churches that are very cold and usually shops that are saturated with heat. Why not exchange heat and cold demand? Technically it is not a problem. It offers the potential for a collective thermal storage system combines with heat pumps. The problem is that there are too many owners and they all have to cooperate. The different owners have their own interest and want quick solutions. They expect it to be very complicated, and therefore hesitate to engage. The scale is a very important factor to consider, because you can then do much more".*

Another example of a large scale approach to bring about ERHB and heat and cold exchange is observable in Rotterdam. Indicated by a monument official, *"In Rotterdam, the harbour produces too much heat. Now there is a pipe going from the harbour to the city in order to use this surplus in heat. The pipe is only connected to the southern part of Rotterdam, but the surplus of heat that is being produced in the harbour can feed Rotterdam and the Hague area together, which is quite amazing. This is however a private investment. The municipality helps a bit by softening regulations but they do not invest money. The municipality speeds processes up and supports the idea".* The question of at what level is ERHB the most effective to address is compelling. "*One could say that it is not interesting to retrofit all these old*

buildings in the southern area of Rotterdam, but to connect them to the pipe. These buildings would not be entirely energy efficient, but the solution would alleviate some energy demand and be the most efficient and effective step. Maybe in combination with solar panels, then it would be the most efficient option", the respondent further elaborated.

There are also discussions on the possibility to adopt historic buildings in order to make them more energy friendly. The concept is built in view of the limitations to install solar panels in historic buildings and of the drawback of having a surplus of energy production from solar panels. As explained by a senior expert in sustainable historic buildings, *"The idea is that a historic building owner invests in the installation of solar panels in new buildings and gets the produced energy transferred back to the historic building. The condition is that these buildings have to be located close to each other. These buildings have to locate within a neighbourhood. Then building owners can install solar panels on each other's roof and benefit from green energy supply without paying taxes".* Occasionally, solar panels are installed on the roof top of a common building, but it is difficult to distribute those benefits to all the individual owners. The barrier once more is not technical.

Bottom-up initiatives are another approach that can bring about greater impact in terms of climate alleviation. Collective energy initiatives are increasingly taking place in the Netherlands. Most initiatives do not come from the government but from the municipality itself. These are often projects in which residents, including building owners, work together to find sustainable measures to improve their homes. As observed by a sustainable cultural heritage official, *"In terms of cultural heritage preservation, my colleagues and I are more top-down. But there is ongoing research on what they call 'bottom-up cultural heritage'. In the art work, you see more bottom-up approaches, where the elite are telling you what is valuable. There the public is also participating […] I think that people are sensitive to some buildings and want to preserve them as it is […] they are aware that these buildings are important, so there is a positive view here".* An example of a neighbourhood initiative is of "klushuizen". *"Historic houses or buildings are sold for a very little price because these have been abandoned or something alike. The concept of klushuizen is based on the idea of allowing people to renovate these buildings according to their wishes. Usually, this kind of renovation then involves a group of neighbours, or bigger groups. It is a nice initiative to re-use buildings, together with the community, instead of waiting for it to be demolished. In Rotterdam, it started in Spangen, and lately these initiatives are taking place all over the Netherlands. This is of course not applicable to monumental buildings, but this is a very nice example of how you can achieve greater climate impact if the objective is on much larger scale"*, pointed out a cultural heritage official. In Amsterdam, industrial heritage is also being re-used and preserved by neighbourhood initiatives. Public awareness and willingness demonstrate to be present. The question now is how monument and sustainability officials can facilitate these bottom-up initiatives.

It follows from the above that ERHB has greater potentiality on a larger scale than singular historic building retrofits. Self-supporting energy production can achieve a more considerable impact than technical solutions to upgrade individual building energy performance. Thus, attention should be shifted to much higher levels of sustainable interventions and infrastructure. Adjustments in the current

energy system are necessary to accommodate tailor-made scale solutions. Communal energy production, for instance, can facilitate building owners to take actions towards more sustainable exploitation of historic buildings, whether or not these are listed buildings (Bootsma, personal communication, 2015). In terms of energy savings, individual building owners can benefit from simple and economic solutions to improve building energy performance. For example, the use of thick curtains and window shutters, which together have similar insulation level as double-glazing. Sealing an unused chimney also provides many benefits (Smit, personal communication, 2015). An additional straightforward solution to achieve energy savings regards the building owner behaviour (Dulski, personal communication, 2015). The building owner behaviour should be in harmony with the fluctuating building behaviour in the different calendar seasons to bring about energy savings. Local authorities should transfer this knowledge and inform historic building owners of these possibilities, which can bring about more optimal solutions for both the building owner and building cultural heritage values. Yet, it is first necessary to ensure that local authorities accordingly bear this knowledge (Smit, personal communication, 2015).

Chapter 7: Conclusion

This study looks into the challenges of undertaking and bringing ERHB projects to scale. It investigates how urban policies can instigate the realisation and boost the scaling-up potential of ERHB projects in the Netherlands. The retrofitting of heritage buildings to lower energy demand is necessary, plausible and economically feasible. There are distinct alternatives that can be applied in finding appropriate ways to balance cultural heritage preservation requirements with the need for optimised building energy performance – from design to technology and materials. Yet, successful ERHB projects are oftentimes not applied on a larger-scale and accordingly do not lend themselves readily to urban policy launches. ERHB projects remain therefore little more than ad-hoc projects.

This research attempts to contribute to the provision of insights into urban policies to scale-up ERHB project through: i) literature review on LCUIs, scaling-up, urban climate governance and historic building energy retrofit; ii) development of an analytical framework on urban policies to scale-up ERHB projects; iii) individually analysing two contrasting ERHB projects in two contrasting municipalities in the Netherlands; iv) comparing the two contrasting case studies; v) refining and presenting a new framework on urban policies to scale-up ERHB projects founded in the Dutch experience; and vi) provision of urban policy recommendations to reinforce efforts to bring ERHB projects to scale. The central research question that substantiates this project is the following:

How can urban policies contribute to the scaling-up of energy retrofitting of heritage buildings in the Netherlands?

The study disclosed that significant reduction of the energy usage of historic buildings is highly desirable because energy costs and lack of comfort form the bottlenecks for a healthy exploitation and thus sustainable management and protection of these buildings. However, the possibilities for intervention are limited and require customised solutions. Historic buildings do not only bear unique cultural heritage values, but also unique physical attributes and building use. The contextual environments, in which these buildings are located, are accordingly highly divergent. Tensions between the monument and sustainability disciplines are therefore oftentimes inevitable, but it is acknowledged. Taken together, recommendations with respect to urban policies to facilitate the realisation and instigate the horizontal scaling-up of ERHB projects in the Netherlands are put forth. In order to untap the full potential in bringing ERHB projects to scale, the following soft-measures are proposed.

Urban policy can facilitate the realisation and scaling-up of ERHB projects in a number of ways. With respect to regulatory policies, local authorities necessitate to integrate energy and sustainability issues in cultural heritage legislation, i.e. by triggering cooperation between monument and sustainability departments. The legislation on cultural heritage preservation necessitates more transparency. Existing legislations need to be consistent and well justified in order to prevent subjectivity and confusion. There is also a necessity to institute a national portal, in which accurate and transparent information on the

differences and commonalities amongst all municipal legislation on cultural heritage preservation is provided in a coherent framework. In terms of the building licenses, local authorities necessitate to alleviate the legal and administrate procedures, which oftentimes come across as a burden for building owners. With regards to energy policies, local authorities should trigger the discussion on adjusting the Dutch labelling scheme methodology, so that the user behaviour is taken into account. This is especially important in assessing the energy performance of historic buildings, in view of the complicacy of historic building physical attributes and technical incompatibility. Local authorities should accordingly trigger the discussion on the enforcement of a conditional energy performance baseline for historic buildings, considered that there is a much higher potential to implement sustainable interventions in historic buildings than the current status.

With reference to local governance capacity to accommodate the transition towards large-scale implementation of ERHB projects, advancements are accordingly significant. Local authorities necessitate improving the quality of information on the possibilities to bring about ERHB projects that is being provided to both the public and to experts. A potential measure rests on instituting a knowledge portal or entity, where experiences in the field of ERHB are exchanged and learning from best and least good practices is instigated. Correspondingly useful entails the development of a reference book in which the possibilities to energy retrofit historic buildings are structurally presented. Also essential is to integrate follow-up mechanisms, which are presently inadequate. This is important to ensure that ERHB projects are monitored and evaluated, which again provides a learning effect. Additionally important is to communicate about ERHB processes, output and developments to the public, to raise awareness and instigate demand. Overall, local authorities have to take the lead and foster the experiment and demonstration of ERHB projects. Cooperation between monument and sustainability officials, between historic building owners and municipalities, as well as between all the different disciplines present in the field of ERHB has to be accentuated and bolstered.

The existent economic incentives around ERHB are generally lacking. The realisation of ERHB projects is still inevitably expensive and the uncertain availability of economic incentives poses a barrier to individual building owners. Economic instruments therefore necessitate improvements to support the realisation and the scaling-up of ERHB projects. It is important to mobilise financial programmes that have a long-term horizon to overcome the lack of trust in the policy framework and consequently stimulate the implementation of sustainable interventions in existing buildings. While it is acknowledged that the provision of subsidies is not likely to ensure that historic building energy retrofit is to take place, subsidies can still alleviate some of the costs associated with ERHB. Thus, if subsidies are provided, these should be accordingly guaranteed on a long-term basis to enable for robust business cases. Subsidies can be mobilised by means of reinvesting the money from building permits. More incentives could be in place in the form of higher mortgage and loan allowances as a reward for investments in energy efficiency measures, for instance. The introduction of green tax reductions also offers potential and should be deliberated upon. An alternative to the provision of subsidies is the provision of financial resources for advisory means, which in turn allow the public to make smarter choices with regards to ERHB. Finally, the provision of funds should incorporate the possibility to undertake sustainable

interventions. A potential concept concerns the provision of loans under the precondition of maintaining cultural heritage values and integrating sustainable interventions in renovating historic building.

This study also disclosed that the debate on ERHB has to be deliberated on a far-reaching scope. ERHB has greater potentiality on a larger scale than singular historic building retrofits in view of climate discussions. It is apparent that alleviated climate impact of individual ERHB projects is not substantial and that the potential of ERHB lies in energy savings rather than real reduced climate in impact. In fact, historic buildings are more energy efficient than expected and building owners are increasingly adapting their behaviour according to the oscillating performance of buildings throughout the year. In view of these findings, arrangements to minimise the climate impact of historic buildings should be therefore identified at the district level. Self-supporting energy production can achieve a more considerable impact than technical solutions to upgrade individual building energy performance. Communal energy production, for instance, can facilitate building owners to take actions towards more sustainable exploitation of historic buildings, whether or not these are listed buildings. That being said, the attention should be shifted to much higher levels of sustainable interventions and infrastructure. To accommodate this transition towards tailor-made scale energy solutions, a transformation in the current top-down energy system paradigm is accordingly needed.

Generally, sustainable interventions are only effective if they are actually realised. The regional approach can have a greater impact in efforts to bring about low-carbon cities; however, individual approaches oftentimes bring about a distinct sustainability concept, which triggers experimenting and learning. In the field of ERHB, learning from best and least good practices is crucial to bolster the scaling-up potential.

7.1 General remarks

Throughout the empirical data collection, controversies on the definition of a real *successful* ERHB project were put forward. In this study, a successful ERHB project is defined as a project that has achieved an improved building energy performance preceding the retrofitting exercise. Yet, this definition bypasses the cultural heritage perspective of a successful ERHB project. It takes on an environmental standpoint and does not take into account that the legislation on cultural heritage preservation in the Netherlands differs per municipality, and accordingly the perspective on what successful ERHB projects are. Numerous examples on energy retrofitting of historic buildings are indeed in place, but not every example has been regarded as a success by different stakeholders. From the discussion with experts, it became clear that defining a successful project is difficult. Reactions on what a successful project entail differ not only between monument and sustainability officials, but also amongst architects, building constructors and policy makers. And every stakeholder has his own reason and consideration. Future researchers should therefore deliberate on what a real successful ERHB entails and brings about.

Accordingly difficult is *defining what a heritage building is*. In this study, heritage buildings are defined as every building built before the Second World War. The definition is therefore extensive: it incorporates listed buildings, protected urban and city landscapes, and post-war constructions and historic homes. Each type of these buildings sets the limit to what rights and obligations a building owner has, but also what kind of financial possibilities to fund maintenance, restoration or rebuilding a building owner can benefit from. Considered the extensive definition of heritage buildings taken on in this research, generalisations are harder to make. Furthermore, the heritage building market is very diffuse. There are numerous segments: residential, churches, castles, offices, wind mills, and etc. And these buildings also have different functions, which only aggravates the problematic of generalisation. The undertaken scope proved to be broad; however every heritage building is unique and bears tailor made possibilities and limitations, which is not exactly facilitative of generalisability. The field of ERHB is simply extraordinary.

Chapter 8: Discussion

This final chapter discusses the scientific and societal contribution of this research, reflects upon the framework of analysis and on the research methodology, and concludes with recommendations for future research.

8.1 Contribution of this research

Successful ERHB initiatives are oftentimes not applied at a larger-scale and do not lend themselves readily to climate mitigation policy launches. Thus, the underlying question concerns the problematic of how to go from such incremental intervention to systemic and large-scale change (Bulkeley and Broto, 2013). Previous studies have investigated the transformation to low-carbon cities from contrasting scientific perspectives; however, these do not afford an all-inclusive overview of key drivers and barriers that are influencing the advancement of the initiatives (van Doren et al., 2014, forthcoming). A comprehensive theoretical framework on ERHB to enhancing the run towards low carbon cities is accordingly missing (Yung and Chan, 2012), which further complicates its scaling-up.

The incorporation of historic conservation with environmental concerns has become an innate characteristic to support the sustainability agenda. Albeit the aptitude, there is insufficient research to climate proof heritage buildings. Research has been conducted principally with regards to the technical aspects of retrofitting, and little on aspects of scaling-up and on aspects that fall within the urban climate governance realms. There has been limited work to investigate new comprehensive governance strategies based upon better knowledge of the heritage building, a need identified by Hassler et al. (2002). The general exemption of heritage buildings from energy regulations is also increasingly questioned, including by conservation interests.

The concern evidences no central position in any political agenda worldwide yet. The issues of adaptability and sustainability are discussed primarily in the context of buildings in Western Australia, China, the United States and UK (Godwin, 2011; Bullen and Love, 2010, 2011; Wang and Zeng, 2010; Yung and Chan, 2012). In Europe, research is slowly progressing, observed in EU programmes on energy efficiency solutions in existing buildings (e.g. ReFoMo, 2014; URBACT Programme, 2014; 3ENCULT Project, 2010; EFFESUS, 2012; New4Old, 2008) but no real contemplation has been afforded with regards to its scaling-up and governance aspects. This suggests a substantial disregard of numerous opportunities to integrate ERHB in climate mitigation policies as a means to contribute to the advancement of low-carbon cities.

This research contributes to filling in the ERHB literature gap, through the provision of a comprehensive overview of the underlying barriers and incentives in undertaking and scaling-up ERHB projects. It also contributes to the advancement of the theoretical framework on LCUIs and to the literature on urban climate governance. Founded in the conceptual framework of LCUIs (Van Doren et al., forthcoming), scaling-up, urban climate governance and ERHB literature, this research attempted to

develop a theoretical framework to explore how urban policies influence the scaling-up potential of ERHB projects in the Netherlands. The applicability of the framework was verified throughout the singular and later comparative analysis of two ERHB case studies. The framework was accordingly adjusted based on the comparative case analysis results to better fit the Dutch experience in the field of ERHB. The research also aligns with the objectives of the EU funded ReFoMo project and accordingly contributed to their research. Advancing the understanding of ERHB building contributes to the quality and durability improvement of future LCUIs. In the light of the pressing global environmental problems, it is beyond questions that innovative approaches to urban climate governance are needed.

8.2 Reflection on the framework of analysis

The analytical model used in this research is founded in different scientific literatures. This approach served the research well, in the sense that it provided the analysis of case-studies with a solid guiding framework to identify commonalities and discrepancies between the two ERHB case studies. The conceptual framework on LCUIs (van Doren et al., forthcoming) was adapted to fit the aspirations of exploring ERHB projects, and proved to be useful to guide the analysis of central barriers and drivers in undertaking ERHB projects. In fact, it supported the identification of unexplored factors that are significant in the realisation of ERHB projects. Thus, formerly the conceptual framework was adjusted to accommodate the scope and objectives of this research projects, and was further refined succeeding the empirical data collection and comparative analysis to better represent the Dutch experience in the field of ERHB. The literature on urban climate governance was accordingly useful (Betsill & Bulkeley, 2007; Bulkeley & Betsill, 2003; Bulkeley & Kern, 2006; Alber & Kern, 2003; Schreurs, 2008; Bai, 2007; Romero Lankao, 2007; Betsill, 2001). It supported the navigation of a stream of urban policies that influence the realisation and scaling-up of ERHB projects, and to single out points for amelioration. It is nevertheless important to stress that integrating different literature to conclude the development of a framework on urban policies to scale-up ERHB projects was not an easy exercise. Aspects that contributed to difficulties amount to the relatively unexplored field of LCUIs and ERHB. The ERHB, in particular, proved to be challenging to address. ERHB remains a much specialised field, characterised by numerous singularities and therefore limitations.

An additional point in question concerns the assumption that urban policies can remove the barriers associated with the hardware and software and operational orgware structures of ERHB projects. The research disclosed that urban policies cannot exactly remove barriers of the hardware and software and orgware structures because the factors pertaining to these structures are project specific. Urban policies can facilitate both the realisation and scaling-up of ERHB projects, through the provision of soft policy measures and mobilisation of resources, for instance. Yet, urban policies do not tackle barriers at the project level, for barriers are unique and differ per project. Also, policies are not easily amended, which sets a limit to the level of influence on factors from the hardware, software and operational orgware structures. What does support the realisation of ERHB projects is collaboration between the building owner and local authorities, and between monument and sustainability officials. It is through strengthened collaboration that the realisation of ERHB projects is taking place. In view of

these findings, the analytical framework was therefore revised and anew put forth, now representing an all-inclusive overview of factors that influence the realisation and scaling-up course of ERHB projects founded in Dutch experiences.

8.3 Reflection on the research methodology

The qualitative approach was the dominant research methodology in this research. The qualitative nature of the research allowed for a more comprehensive insight into the stimulating and obstructing factors in realising and scaling-up of ERHB projects in the Netherlands. Moreover, aligned with the explorative nature of this research and the relative recentness of ERHB, the qualitative case study approach has been identified as a suitable approach for research (Gerring, 2004). Qualitative case study design was a suitable research design, but this approach does come with a number of limitations.

A deficiency of the case study method concerns the limited empirical generalisability of the findings. Conducting case studies suggests that the research will yield low external validity: the extent to which the research findings can be generalised beyond the case studies (Verschuren et al., 2010). The external validity of the research is limited because the sample of the studied cases is representative only for urban policies to bring ERHB projects to scale in the Netherlands. In fact, it might even be argued that for a large part of the results the external validity of the research does not reach beyond the cases included in the analysis (Rotterdam and Utrecht), seeing that the legislation on cultural heritage preservation differs per municipality. The accountability of cultural heritage preservation in the Netherlands is delegated to local authorities. Heretofore accentuated, the uniqueness of historic buildings causes the legislation to vary per municipality, which suggests that replicating the same ERHB project in another municipality is not a straightforward exercise, considering that different municipalities oftentimes have different stand points, which are grounded on their specific environmental context. This implies that the knowledge gained from the empirical analysis has most relevance for the municipalities of Rotterdam and Utrecht, and findings are not likely to be generalisable to other municipalities. Yet, differences in policy are likely to be less significant when analysing other large municipalities, because the availability of resources to accommodate the scaling-up of ERHB projects is anticipated to be comparable. To counteract the question of generalisability, the “diverse case” method was applied in order to incorporate a full range of variation, which enhances the representativeness of the sample cases (Gerring, 2007).

Inasmuch as the lack of external validity applies to theoretical framework on urban policies to scale-up ERHB projects, it is less problematic. A possible lack of external validity is not an impediment for the employment of the framework as an analytical tool even in a context other than that of the Netherlands: it is arguably comprehensive because it amalgamates a wide range of elements from existing scientific literature on ERHB, scaling-up and urban climate policies, has been validated and refined on the basis of empirical research. No comprehensive theoretical framework to study ERHB is in place (Yung and Chan, 2012), which is actually one of the contributions of this research. Also, the results are partially be generalisable and applicable to the low urban carbon development literature and

ultimately to urban climate governance debate. Moreover, the theoretical framework developed in this research project is a general one and is not a theory or model for predicting the behaviour of actors in the field of ERHB. While it is true that the framework will prove to be more incomplete and perhaps contradictory with the reality when employed in a completely different contextual environment than the one upon which it has been based in this study, the theoretical framework provides a valuable structure for analysis in any context.

The findings flowing from the second part of the research are likely to have a somewhat larger external validity. In the second part of the research, a conscious choice was made for a comparative analysis. While this allows for the generation of general patterns, it might become too abstract to cover the full and complex reality of the ERHB field. This is overcome as much as possible by doing detailed case study descriptions of both ERHB projects prior to the comparative analysis. Those interested in the details are referred to chapter 5 of this study.

In terms of the research results, it is considered that the triangulation of research methods and sources, amalgamated with a common framework of analysis grounded on extensive literature review, expert elicitation and semi-structured interviews, together with in-depth analysis of two strategically sampled cases, have delivered robust results that are able to withstand the internal validity assessment and to some extent the external validity. Studying most dissimilar case studies enabled the delivery of well represented results and comprehensive understanding of the ERHB field. The resulting sample of the two contrasting case studies is not perfectly representative, but has strong claims of representativeness in view of the primary objective to achieve a maximum variance along the population. Evidently, investigating more cases would have increased the external validity. Speaking of which, one of the recommendations for further research comprises verifying the universality of the newly developed analytical framework on urban policies to scale-up ERHB projects in a broader range of case studies in the Netherlands.

8.4 Recommendations for future research

Insofar as this research focused on a high level analysis across a broad spectrum of criteria, a number of interesting topics emerged that could not be investigated in considerable depth. Some recommendations for future research are therefore presented in the following.

Studying most dissimilar case studies enabled the delivery of comprehensive representation of results and understanding of the ERHB field. To invigorate representativeness and generalisability, more case studies are needed. Future research should be devoted to exploring a broader and more diverse range of ERHB projects, under different contextual environments. This could be done by expanding the research with most dissimilar, or alternatively with similar cases, in smaller municipalities than Rotterdam and Utrecht, for instance. It is expected that the availability of resources in smaller municipalities is less ample than in big municipalities, which would make it interesting to explore how local authorities approach the realisation of ERHB projects and maybe learn from the deployed

strategies in view of their limited resources. Additionally the research could be extended into additional historic building segments, to analyse whether conditions to bring about and scale-up ERHB projects hold similarly. Otherwise, lessons learnt could be incorporated in the analytical framework to refine and reinforce its representation and generalisability. It would be also interesting to concentrate on a single historic building segment to enable the development of an exclusive governance approach in dealing with building energy retrofit within that segment.

It is clear-cut that bringing a historic building to sustainable energy performance levels calls for tailor made solutions and that oftentimes the ambition to improve the energy performance of historic building conflicts with the ambition to cultivate cultural and heritage values. Much of the controversy lies in what is technically possible and desirable, legally tolerated, economically feasible, and etc. One intriguing topic that aroused throughout the empirical data collection is the debate of what level is the most effective to approach ERHB projects. In terms of climate impact, it is currently being discussed whether to undertake building energy retrofit from an "object-oriented or area-based" approach. It is assumed that the debate on ERHB has to be deliberated on a far-reaching scope: if ERHB is to contribute to climate mitigation efforts, the attention should be shifted to looking at a higher scale of ERHB interventions. In the light of the intrinsic values of historic buildings and its relative climate impact, it would be particularly advantageous to further contemplate about this research topic. It would be accordingly interesting to explore the field of "bottom-up cultural heritage" as an innovative approach to preserve cultural heritage through the integration of sustainable interventions. An additional recommendation for future research concerns the investigation of the real energy performance and impact that historic buildings have on the climate. This is especially important considered the deficiencies in the Dutch energy labelling scheme, which bypasses the user perspective. This is important to ascertain whether these buildings possibly necessitate energy retrofitting. Within these lines, a final research recommendation concerns the study on the possibility to lay down a minimum building energy performance for historic buildings, on the account of *"much more is possible than it has been implemented until now".*

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Appendices

Appendix 1: List of interviewees

Name	Title	Organisation
Experts overall		
Bill Wei	Program manager "Duurzaam Erfgoed"	Rijksdienst voor het Cultureel Erfgoed
Birgit Dulski	Senior researcher sustainable building	Nyenrode University
Jeroen Bootsma	Advisor urban planning, contact person of the New Dutch Waterline	Rijksdienst voor het Cultureel Erfgoed
Cees van der Vliet	Area development and energy expert	Municipality of Utrecht
Hilde van Werven	Managing Director	Het Utrechts Monumenten Fonds
Marieke Muilwijk	Independent advisor and researcher	Muilwijk Landschap Advies
Actors/Stakeholders - De Sleephelling, Rotterdam		
Andries Laane	Architect	VillaNova
Agnes Schuurmans	Public affairs official	Rockwool International
Chiel Boonstra	Managing director	Trecodome
Daan Bakker	Architect and member of the Monument Committee of the city of Rotterdam	DaF-architecten and Municipality of Rotterdam
Nico van der Zee	Former external consultant	Woondstad Rotterdam
Loes Joosten	Building physics and sustainable construction consultant	Royal Haskoning DHV
Actors/Stakeholders – Fort de Gagel, Utrecht		
Anton van Emst	Senior advisor/programme manager fortresses	Municipality of Utrecht
Erik van Tooren	New Dutch Waterline Programme manager	Province of Utrecht
Lodewijk le Grand	ReFoMo project leader	Municipality of Utrecht
Marjolijn Bonnike	Research project leader on sustainable monuments	De Groene Grachten
Menno Smit	Project leader planning assurance for the New Dutch Waterline	Municipality of Utrecht
Paul Brouns	Senior advisor in energy efficiency	Arcadis
Teun Winkelman	Project leader fortresses	Municipality of Utrecht

Appendix 2: Interview guide

General

1. Please introduce yourself briefly:
   A. How did you get involved in the project?
   B. How does your current job relate to ERHB?
   C. What was your motive to engage with ERHB?
   D. How would you describe the role your organization plays in ERHB?

Phase I. What is exactly impeding ERHB projects of going to scale?

Successful realisation of ERHB

Hardware & Software

2. ERHB project description: Why and how did the project begin?
3. Empirical studies on retrofitting of historic buildings demonstrate that there are a number of factors influencing the decision making process of the project.
   a. Cost-benefit (tangible and intangible benefits; predicting investment returns is difficult)
   b. Environmental performance of the building (does improved building energy performance sell?)
   c. Physical attributes (building materials, location and orientation, structural conditions, aesthetic appeal, comfort and decoration, building purposes)
   d. Technological compatibility (quality, complexity, reversibility of technologies)
   e. Heritage and cultural significance
   f. Social compatibility (does not require users to adapt their behavior, or when users are willing to adopt sustainable behavior when adaptation is required)
   g. Economic advantages (tourism, job creation, revitalization of the area, visual amenities)

Do you recognize any of these factors? What were, according to you, the most influential factors in the decision making process of the project? Please elaborate.

Operational orgware

4. [Mobilisation of resources]
   a) How important was the mobilisation of resources in carrying out the project (E.g. financial, material goods, labor, skills & knowledge, networks, community, natural)?
   b) Did you face any difficulties in mobilizing these?
5. [Stakeholder participation & Interests & Communication]
   c) How important was the participation of stakeholders (including civil society, local citizens) in the ERHB process?
   d) Did the involvement of different actors with different interests influence the progress of the project implementation? How did you go about their contrasting interests?

e) How important was communication among the different stakeholders in undertaking the project? Could you describe how you experienced collaboration with the stakeholders?

6. [Leadership]
   f) How important was individual leadership in the ERHB implementation process?
   g) Would you say that the presence of a leader facilitates ERHB project implementation?
7. [General] Do you recognize any additional factors that can influence the realisation of ERHB?

Phase II. What urban policies can be applied by local governments to minimize barriers and to enable the scaling-up of ERHB projects?

Assumption: The overall approach taken by the municipality at a strategic, policy and regulatory level can help to address many historic buildings, going beyond an ad hoc approach to a comprehensive vision for the local community, supporting the maintenance of its cultural heritage and changing the energy use to more efficient and sustainable approaches.

Informal & Formal Institutions

8. [Regulatory policy instruments]
   a. How influential were national and local regulatory instruments in the realisation of your project (e.g. regulations, policies, building codes, energy standards, support programmes)? Please elaborate.
   b. What is your opinion about the current regulatory system for ERHB? Do you think that the local strategy and policies on building retrofitting are facilitative of ERHB project?
   c. Do you think that the enforcement of building regulations, protection and maintenance of monuments could support or restrain the up-scaling of ERHB? Why?
9. [Economic policy instruments]
   a. How important were financial resources for the success of the project?
   b. What concrete support in the form of resources did you receive from the municipality, if any? Did you face any obstacles in attaining it?
   c. In general, would you say that the system of financial loans and subsidies in place are facilitative of ERHB?
10. [Informative policy instruments]
   a. What can you say about the sharing of information by the municipality on resources for ERHB (e.g. fragmented, concise?) Would you say that local authorities are making adequate use of these instruments to raise public awareness about ERHB possibilities?
   b. Were informative policy instruments important for the realisation of the project?
11. [Voluntary arrangements]
   a. Was there any voluntary agreement between the private actors and public authorities that facilitated the undertaking of the project?

Local Governance Capacity

12. [General] Did the municipality play any role the project implementation?

13. [Political leadership]
    a. Do you think that local authorities are adequately encouraging the up-take and scaling-up of ERHB projects? (E.g. taking lead in ERHB implementation in own historic buildings; shaping local climate strategy; providing incentives for R&D; encouraging the local community to engage in sustainable energy transitions)
    b. Would you say that the success of your project can be partially owed to the presence of a political leader?
14. [Trust in the policy framework] It is acknowledged that complex, changing or inconsistent policy instruments can undermine trust in the policy, thereby demotivating stakeholders to invest in ERHB.
    a. What is your opinion on this matter?
    b. Did you experience anything here (e.g. fluctuating policies and subsidy schemes)?
15. [Mobilisation of resources]
    a. What is your opinion about the capacity of local authorities in mobilizing financial resources for ERHB and in governing ERHB (e.g. adequate knowledge on ERHB; secure additional (EU) funding to support the realisation and advancement of ERHB projects)?

[Questions specific to policy makers] Horizontal scaling-up of ERHB projects

Formal and Informal Institutions

[Regulatory policy instruments]
    a. How do national and local regulatory instruments affect the realization of ERHB projects (e.g. regulations, policies, building codes, energy standards, support programmes)? Please elaborate.
    b. What is your opinion on the enforcement of building regulations, protection and maintenance of monuments for the scaling-up of ERHB projects?
    c. How would you describe the local strategy and policy on climate mitigation? Do you think these are facilitative of ERHB?
    d. What about the local strategy and policy on building retrofitting? Do you think these encourage the uptake and scaling-up of ERHB projects?

[Economic policy instruments]
    a. What concrete support in the form of resources is existent at the municipal level for ERHB? Please elaborate.
    b. Does the municipality provide any sort of restauration funds?

[Informative policy instruments]
    a. What kind of informative instruments does the municipality use for disseminating information on ERHB?
    b. Is there are dedicated unit in place, which supports stakeholders with concise information on the different guidelines, regulations, polices, and financial loans and incentives?

[Voluntary arrangements]
    a. What is your opinion on voluntary agreements to advance the implementation of ERHB projects?

b. Are there any voluntary agreements between private actors and public authorities that facilitate the accomplishment of ERHB projects?

Local Governance Capacity

[General] What is the role of the municipality in the process of ERHB?

[Political leadership]

a. What is the level of political support for ERHB in your municipality?
b. In general, would you say that the local government is adequately encouraging the up-take and advancement of ERHB projects? (e.g. taking lead in ERHB implementation in own historic buildings; shaping local climate strategy; providing incentives for R&D; encouraging the local community to engage in sustainable energy transitions)

[Trust in the policy framework]

a. How would you describe the current state of the local policy framework on building retrofitting? (E.g. complex, inconsistent)
b. Do you think that the current state of the local policy framework encourages stakeholders to invest in ERHB?
c. How could trust in the policy framework be enhanced, according to you?

[Resources mobilisation] Resources at the macro level incorporate the mobilisation of human and financial assets with which local governments can deploy in relation to addressing and scaling-up ERHB projects.

a. What is your opinion upon the current mobilisation of resources at the municipality level? Are there adequate financial and human resources to promote the scaling-up of ERHB projects?
b. Is there any additional funding that the municipality secures to enable the realization and boost the scaling-up of ERHB?
c. Does your agency/division have sufficient knowledge with respect to ERHB?
d. What kind of knowledge is still missing?

External trends or events

16. [Market demand & Environmental awareness and societal values on sustainability] The literature reveals that the often fluctuating market demand influences the success and scaling-up of ERHB projects.

1. Is there a market demand for ERHB projects?
2. What building segment affords the greatest potential for ERHB?
3. Is there adequate awareness on the benefits ERHB can bring about, and on sustainability more generally?

Concluding

17. Based on the knowledge you have acquired in this project, in which circumstances would you recommend the application of an energy retrofitting project? Would you do anything different?

18. In your opinion, what are the conditions that make the energy retrofitting of a building to take place?

19. What changes are necessary in the system to advance efforts in scaling-up ERHB projects?

20. What are the main opportunities for urban policy to overcome barriers and boost the scaling-up of ERHB?
21. Would you like to express any other issues related to urban policy for the up-scaling of ERHB projects, which have not yet been addressed or discussed in this interview?