

# Green building certificates and the energy transition

*A study about the effects of BREEAM-NL In Use certifications for owners, tenants and financiers of office buildings*

## **AR3R010 GRADUATION LABORATORY**

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# ***Foreword***

This february I started with the graduation trajectory of the master Management in the Built Environment at Delft University of Technology. After having finished all courses and projects the time has come to start writing my master thesis. In this foreword I will explain the subject that I have chosen, including my vision on this subject. Lastly, I will explain the personal development goals that I have set for this trajectory.

## **Motivation**

In the second semester of 2015 I spent six months in Vancouver for an internship. As Researcher Sustainable Building for the Consulate General of the Kingdom of the Netherlands I explored the built environment of West-Canada. Personally, I was astonished by the large-scale application of green building certificates such as LEED and WELL. It is even a mandatory requirement in order to gain a building permit. I started to question myself: why are these green building certificates so well integrated in the built environment of West-Canada while in the Netherlands this still remains largely on the background? From the moment I arrived back in the Netherlands I was convinced that I have to do something with green building certificates.

## **Vision**

The European Union is working towards climate neutral built environment in 2050. Therefore, the Netherlands must decrease its emissions by 80-95%. This is a huge challenge that will need a widespread approach that combines governmental means and market approaches. Vancouver already showed that it is possible to use green building certificates as an accelerator for their transition towards a green city. My vision is that a similar development could be realized in the Netherlands.

However, it must be admitted that the real estate sector can be very conventional and is not always flexible in implementing innovative solutions. Therefore, it is important that innovations receive wide support resulting from substantiated research that is clearly communicated from the academic field into practice. It will be the generation of students that is graduating at this moment that will determine the future of the built environment.

## **Personal development goals**

The course book prescribed personal development goals as part of this foreword. I must admit that I do not necessarily have set new personal development goals for this master thesis. More important for me is that I am able to show everything that I have learned over the years I am studying at this university. This means being able to academically analyse a complex problem in a rational way by breaking the problem into little pieces that step by step can be solved and composed in a substantiated solution.

I hope you enjoy reading this research proposal.

***Vincent Steenkamp***

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# ***Abstract***

By signing the Climate Agreement of Paris, Europe is working towards energy neutrality in 2050 (United Nations, 2015; SER, 2013). Therefore, the target for the Netherlands is to reduce its emissions by 80-95% (McKinsey, 2016). Large improvements can be made in the current building stock that consumes 32% of all primary energy and is responsible for 19% of the related emissions (IPCC, 2014). A major challenge that is estimated to cost the Netherlands 4 to 11 billion euros per year over a period of 20 years (De Jonge, 2017). The Dutch government introduced stricter regulations and incentives to stimulate the transition towards a more sustainable built environment (Blok, 2016). Also market based approaches emerged and are integrated in the real estate sector because of the economic advantage and institutional pressure for green buildings (Eichholtz, Kok & Quigley, 2015). Remarkable is the development of voluntary green building certificates that recognize and award sustainable measures that go further than is required by the Building Code (Fuerst & McAllister, 2011a). The number of certified BREEAM-NL buildings in the Netherlands is increasing since its origin in 2010. Despite its popularity, the number of certificates for newly developed buildings increases three times faster than buildings that are already built (DGBC, 2016). This research aims to study the effects on building value, business performance and capital justification for users, owners and financiers of office buildings that are certified with a green building certificates while being already in use. Based on prior theory a theoretical framework and a conceptual model are designed and tested in practice. Results of this research are relevant for building owners and tenants, investors, institutions and policy makers.

***Key words – Green building certificates, BREEAM, office buildings, corporate real estate.***

# 1. Introduction

This chapter describes the research problem and its relevance, which is divided in societal, sectoral and scientific relevance. From this a research aim is formulated. The chapter ends with a reading guide for this report.

## Relevance of Research

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### **Societal relevance**

In December 2015, the Climate Agreement of Paris was signed by 195 countries with the goal to limit the rise of the average global temperature to well below 2°C (United Nations, 2015).

The built environment is a major contributor to global warming: 32% of all primary energy is consumed by buildings, causing 19% of energy related GHG-emissions worldwide (IPCC, 2014). Continuing trends in population growth, increasing levels of wealth and migration to cities continue, energy use and related emissions could double or even triple by 2050 (McKinsey, 2016).

### **Sectoral relevance**

The real estate sector is becoming more aware of the importance of reducing environmental effects of the built environment (Stern, 2007). Over the last decades, governments introduced stricter regulations to reduce the environmental impact of the building stock (Fuerst & McAllister, 2011). In the Netherlands this started in 1974 when the government introduced its first subsidy for energy efficient measures (VROM, 2002). A few years later, in 1978, a national insulation program was launched to improve the energy efficiency of 200.000 residences per year over a period of ten years. In the same year the Note of Energy Policy was introduced that required heat-efficient boilers and promotion of district heating. From the early nineties, the Dutch government and market parties started to collaborate more on this topic. Resulting in the energy performance coefficient (EPC) for buildings that was brought into practice in 1995. The EPC-norm started with 1,4 in 1995 and this gradually became more strict to 0,4 in 2015 (RVO, n.d.; Van Straalen, De Winter, Coppens, & Vermande, 2007). Next to EPC, a more simplified energy performance measurement tool, energy labelling, was introduced by the government in 2000. In 2009 all building owners in the Netherlands were required to label the energy performance of their buildings.

As described above, the Netherlands has a history of energy efficiency measures of more than 40 years. Contemporary policies aim their goals for 2020 to 2050 and combine national policies as well as European policies. The ultimate goal is a climate neutral built environment in 2050 (SER, 2013). The first step was already taken in 2010, when the European Court and European Parliament agreed on a directive that requires all new residential buildings in Europe to be built nearly zero energy from 2020 (European Parliament, 2010).

Next to governmental policies also market based approaches emerged and are integrated in the real estate sector because of the economic advantage and institutional pressure for green buildings (Eichholtz, Kok & Quigley, 2015). Remarkable is the development of voluntary green building certificates that recognize and award sustainable measures that go further than is required by the Building Code (Fuerst & McAllister, 2011a). Green building certificates aim to mitigate energy consumption, maximize resource efficiency and minimize environmental impact by stimulating integrated design and implementation of innovative technologies (Krizmane, Slihte & Borodinecs, 2016). In the Netherlands, BREEAM-NL is the most commonly used green building certificate.

Building Research Establishment Environmental Assessment Method (BREEAM) was developed by the United Kingdom based research institute Building Research Establishment (BRE). In collaboration with the Dutch Green Building Council it was designed for application in the Netherlands. BREEAM is one of the most used green building certificates in Western Europe. BREEAM-NL has four types of certificates for new buildings, buildings that are in use, urban developments and demolition. Credits can be scored on nine categories: management, health, water, energy, materials, waste, pollution, ecology and transport. It is claimed that BREEAM certified buildings offer lower operation costs, provide an increase in productivity and healthier indoor environment for building users. It is also noted that BREEAM certified buildings have a verified sustainability value and are eligible for Dutch and European subsidies.

### **Scientific relevance**

Academic research on green building certificates started to grow increasingly from 2004. Since then publications on this subject increased almost every year. Half of the publications are related to Engineering and Environmental Sciences. Most research is done in North America, followed by South Korea and Europe.

Internationally, research on green building certificates already has an extensive body of knowledge varying from research on drivers and barriers to financial implications for building values and rents.

This research builds further on a prior framework of Eichholtz et al. (2015) on the ecological responsiveness of corporate real estate, research on drivers for obtaining green building certificates (Qiu et al., 2016; Darko et al., 2017; Devine & Kok, 2015), financial effects (Fuerst & McAllister, 2011a; Fuerst & McAllister, 2011b) and reputational effects (Van der Voordt & Koppels, 2013).

Considering that BREEAM-NL was launched in the Netherlands in 2010, the use of green building certificates and their impact on the Dutch built environment is a relatively new topic for the academic field. Moreover, the current research body does not distinguish between green building certificates for new buildings and buildings that are in use. There is a lack of insight in the effects of green building certificates on the building performance and its stakeholders of office buildings that are already in use. This omission is the main subject of this graduation thesis.

### **Problem Definition**

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What is described above implies a problem statement that is best defined as the lack of insight in the effects of green building certificates on the building value, business performance and capital justification for users, owners and financers of office buildings that are in use. In comparison with new buildings, certification of buildings that are already in use must comply with all stakeholders involved. For instance, rent premiums can not simply be changed after a building is certified because of continuing contracts between the tenant and building owner. Moreover, it can be questioned if a rent premium is even justified because a certificate does not necessarily change the building is physically. This is similar for statements regarding increase in productivity and reduction of operation costs. Herefrom follows, if there are no physical adjustments to the building what does then change for the owner and user? Why would a building be certified with BREEAM-NL In use?

### **Demarcation**

The aim of this research is to identify and explain these effects. Because green building certificates are more preferred in tenant markets rather than owner occupier markets (Qui, Su &

Wang, 2016), this research focuses on office buildings in tenant markets. Moreover, the most prominent green building users are corporate companies and non-profit organisations (Devine & Kok, 2015). Therefore, this research focuses on certified BREEAM-NL In use office buildings with tenants of this focus group.

In order to execute this research data is needed about certified in use buildings, its owners, financiers and tenants. DGBC has made this data available for BREEAM-NL In use buildings.

## Research Question

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The main question of this research is formulated as follows:

*How do green building certificates affect the building and organisation of tenants, owners and financiers of in use office buildings?*

## Research Design & Methodology

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The main goal of this research is identify and explain the effects on the building and organisation of tenants, owners and financiers of office buildings that are certified while at the moment of certification the building was already in use. Research is already done on the drivers for obtaining green building certificates. Based on these prior theories a theoretical framework is designed. From this propositions are formulated and a conceptual model was designed in order to test their applicability on existing buildings. This investigated both qualitatively and quantitatively. It is important to distinguish findings by hard and soft values. For instance, operation costs can be expressed in hard values but for findings in productivity this is difficult to measure and must be expressed in soft values.

The research design starts with literature study on prior theories in order to design a theoretical framework. Based on this theoretical framework a conceptual model is designed. This conceptual model is further investigated with the use of a multi-method research approach that combines semi-structured interviews with case studies and a questionnaire. Finally, findings for each are discussed, confirmed or rejected and evaluated by an expert panel.

## Reading Guide

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This research proposal is further elaborated in the following chapters. In the next chapter, an overview of prior theory on green building certificates is given. The proposed research method is further elaborated in the third chapter. This is followed by the fourth chapter that describes the academic and practical relevance of this research. Finally, a summary of this research proposal is given in the conclusion.

## 2. Literature review

This chapter contains a literature review. Firstly, an introduction is given on the exploration of the research field. Secondly, the literature review is described and categorized in three perspectives. Lastly, the findings of the literature lead to the design of a theoretical framework that is presented at the end of this chapter.

### Exploration of Research Field

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Academic research on the topic of green building certificates goes back to 2004 when the number of publications on this subject started to grow increasingly. Most publications find their origin in North America, but from 2010 publications on green building certificates also increased in Europe and Asia. The body of knowledge is becoming extensive and research topics range from studies on the drivers and barriers of green building certificates to financial effects on building values and operational expenses.

In the first phase of this graduation trajectory the aim of the literature study was to diverge and get a grip on the current state of prior theories on green building certificates. During the P1 it was decided to focus on the effects of green building certificates on the building and organisation of owners, tenants and financiers. After the P1 convergence took place and the literature review was categorized. In order to categorize the findings of the literature review effects of green building certificates were described from three perspectives. The effects on the building value are described from the owner perspective. The effects on business performance are described from the tenant perspective. The effects on capital justification describe the financier perspective. The effects that were found lead to the design of a theoretical framework. The chapter ends with the design of this theoretical framework that summarizes the effects from the three perspectives.

### Building Value - *owner perspective*

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Building owners may benefit from obtaining a green building certificate that may contribute to their building value. Fuerst and McAllister (2011a) confirmed with their research that certified green buildings have higher building values compared to non-certified buildings. Their study covered a sample of 25,000 office buildings in the United States. They found that both the building owner and tenant(s) benefited from the certification. The beneficial effects for the owner will be described here, the benefits for the tenant(s) are elaborated in the next paragraph.

Building owners that own a certified green building benefit from a reduction in holding costs, building depreciation, operational costs and regulatory risks (Fuerst & McAllister, 2011a; Devine & Kok, 2015). A reduction in holding costs is caused by lower vacancy rates and higher tenant retention. Less energy consumption and other utility costs lead to a reduction in operational costs. An increase in building quality and integration of technologies lead to a reduction in building depreciation. Moreover, certified green buildings are better protected against future regulatory changes and, therefore, offer less regulatory risks for the owner.

Next to the benefits there are also extra costs related to green buildings. Extra costs related to additional construction costs to meet the certification standard and costs for certification result on average in a premium of 2% of the total construction costs (Fuerst & McAllister, 2011a). However, these costs premium are covered since it was found that LEED certified buildings offer 5% rental premiums and 25% sale premiums. These premiums do only account for certified green buildings and do not account for buildings with Energy Performance Certificates (Fuerst & McAllister, 2011b). This difference could be explained by the impact of green

building certificates go further than energy efficiency and have a broader sustainability approach. Furthermore, Qui et al. (2017) found that green building certificates are more preferred by investor-owners than owner-occupiers since they operate in a competitive market for tenants.

Based on the research described above the following proposition can be stated:

**Proposition 1** Office buildings with a green building certificate offer a reduction in operation costs compared to non-certified buildings.

**Proposition 2** Office buildings with a green building certificate experience higher occupancy rates and increasing rent rates compared to non-certified buildings.

### Business Performance - *tenant perspective*

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Tenants may benefit from tenancy in a certified green building that may contribute to their business performance. Benefits of tenancy in a certified green building are higher user productivity, less operation costs, attraction of human capital and reputational benefits (Darko, Chan, Owusu-Manu & Ameyaw, 2017; Danna & Griffin, 1999; Zingales, 2000; McAllister & Fuerst, 2011a; Van der Voordt & Koppels, 2013).

Literature suggests that a higher user productivity is experienced in certified green buildings because of increased comfort levels and related lower employee absence rates. Also tenants benefit from the reduction in operational costs because of less energy consumption and other utility costs. Energy costs determine on average ten percent of total housing costs of commercial buildings. Kaats (2003) calculated that LEED-certified buildings use on average 30% percent less energy compared to conventional buildings. Increasing importance of sustainability values influence the attraction of new talent for organizations. Green building certificates contribute to an organization's Corporate Social Responsibility and strengthen sustainability in their brand values.

Van der Voordt and Koppels (2013) explored the reputational benefits in their research on how brand values are incorporated in corporate real estate strategies to strengthen corporate identity. Sustainability, people oriented and innovation are brand values that are incorporated in location strategies, real estate strategies, workplace strategies and portfolio management of corporate real estate. It was found that nowadays sustainability is of the prime brand values of organisations. These brand values are communicated through Corporate Social Responsibility. The importance of Corporate Social Responsibility is growing and this is expressed through buying or leasing certified green buildings (Thyssen, 2011), implementation of energy efficiency programs and BREEAM or LEED certifications (Van der Voordt & Koppels, 2013). Moreover, the most prominent green building tenants are companies in the banking sector, non-profit organizations and, ironically, in oil industries (Eichholtz, Kok & Quigly, 2015).

Based on the research described above the following proposition can be stated:

**Proposition 3** Tenants of office buildings with a green building certificate experience higher productivity compared to non-certified buildings.

**Proposition 4** Tenants of office buildings with a green building certificate score higher in Corporate Social Responsibility compared non-certified buildings.

Financers may benefit from financing certified green buildings that may contribute to their capital justification. Benefits from financing certified green buildings are better credit ratings, lower costs of equity and better social responsible investments.

Empirical evidence shows that certified green buildings offer lower interest ratings on debt and better credit ratings for real estate investment trusts (Eichholtz, Kok & Yonder, 2015). Financers increasingly demand Socially Responsible Investments (SRI) because their equity providence reflects their environmental stance (Eichholtz, Kok & Quigley, 2016).

Financers are able to screen, for instance, institutional investors with the Global Real Estate Sustainability Benchmark (GRESB) that measures sustainability performance. Moreover, institutional pressures stimulate financers to implement these environmentally responsible investments towards an energy efficient and less polluting built environment. An example in the Netherlands is the commercial bank ABN AMRO that certified its own building portfolio with BREEAM-NL. Furthermore, ABN AMRO and ING set a new direction by only investing in green building, divesting in "brown buildings" and requiring sustainability for upgrading brown buildings to green buildings.

Based on the research described above the following proposition can be stated:

**Proposition 5** Owners of office buildings with a green building certificate have less difficulty with obtaining financial investments compared to owners of non-certified buildings.

## Design of a Theoretical Framework

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The findings of the literature review on each perspective are summarized in the design of a theoretical framework. This framework presents a categorization of each effect, including the reference, that was found in the literature review. The theoretical framework is presented in table 1.1.

### ***Theoretical Framework***

<b><i>Effects of Green Building Certificates</i></b>		
<b><i>Building value (owner perspective)</i></b>	<b><i>Business Performance (tenant perspective)</i></b>	<b><i>Capital justification (financer perspective)</i></b>
Increase in rent rates (Devine & Kok, 2015)	Increase in employee productivity (Danna & Griffin, 1999)	Better credit ratings (Bassen, Holz & Schange, 2006)
Increase in occupancy levels (Devine & Kok, 2015)	Lower operating costs (Kaat, 2003; Devine & Kok, 2015)	Lower costs of equity (Derwal & Verwijnen, 2007)
Lower operating costs (Kaat, 2003; Devine & Kok, 2015)	Attraction of human capital (Zingales, 2000)	Better Corporate Social Responsibility (Eichholtz, Kok & Quigley, 2016)
Increase in building value (Fuerst & McAllister, 2011a)	Reputational benefits (Van der Voordt & Koppels, 2013)	

*Table 1.1: Theoretical framework on the effects of green building certificates (own illustration)*

# ***3 Research methods***

In this chapter the research methods are described. It starts with an elaboration of the problem statement. Then a conceptual model is designed based on the theoretical framework from the previous chapter. This followed by sub-questions that were formulated. From this the research design is elaborated. Lastly, a provisional table of contents is presented including a planning for the upcoming semester.

## Problem Statement

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According to the theoretical framework presented in chapter 3 it is stated that certified green office buildings offer a higher building value for owners, better business performance for users and better financial conditions for financiers.

However, when an office building is being certified while it is already in use it does not mean that the above stated instantly applies for all stakeholders. Many benefits depend on the agreements that are made between stakeholders. Compared to newly developed office buildings, office buildings that are in use do not start with a clean slate. If then the situation changes and a green building certificate is obtained, new arrangements must be made in order to achieve the benefits. The situation becomes even more complex when a building already meets the minimum requirements of a green building certificate and no changes are made to the building or its use. For instance, it would be very hard for the owner to justify an increase in rent towards the tenant.

Yet, certification costs can be expensive for the building owner and these costs need to be recouped in some way. In contrast, according to the theoretical framework certification of an office building should have beneficial effects on the rent rates, occupancy levels, operating costs, building value, employee productivity, attraction of human capital, reputational benefits, costs of equity and corporate social responsibility. However, these effects are not yet confirmed for the certification of office buildings that are already in use.

By studying the certification of office buildings that are in use much can be learned about if these beneficial also apply in these situations. Furthermore, challenges can be identified in the process towards the certification and implementation of new arrangements. For instance, insight these challenges could help policy makers with designing measures or subsidies to stimulate this development.

If the certification of office buildings becomes easier and the benefits are clear for all stakeholders it could be logically argued that number of green buildings in the Netherlands will eventually rise. This development will stimulate the market and increase its demand for green buildings. Subsequently, the current building stock will be largely transformed into green buildings. A development that assists the Dutch government with achieving its climate goals and reduces the environmental impact of the building stock.

This research aims to provide insight in the applicability of the beneficial effects for the certification of office buildings that are in use.



## Problem statement

*“Green building certification of buildings that are in use, of which the implementation is complex because of a rigid context for owners, tenants and financiers compared to newly developed buildings, can be stimulated with insight in the applicability of the beneficial effects”*

## Conceptual Model

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BREEAM-NL offers two kinds of green building certifications: BREEAM-NL New Developments and Renovation and BREEAM-NL In Use. Both certificates have different implementation consequences. In case of the new development, the owner, tenant and financier start with a clean slate. When the building is developed agreements are made between these stakeholders about, for instance, rental payments and other costs. In case of buildings that are already in use it could be possible that one of the stakeholders proposes to certify their buildings. For each stakeholder the drivers for obtaining a green building certificate will differ creating complex implementation challenges. The current agreements must be reviewed and new agreements must be made between all stakeholders before executing the certification.

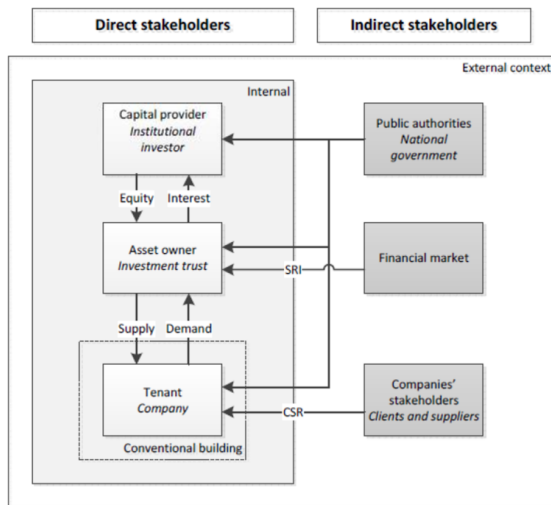
Based on the theoretical framework and the stakeholder analysis a conceptual model is designed (Figure 3.1). It illustrates two situations, the situation without a certificate and the situation with a certificate. The connections between the stakeholders describe the interactions and the difference between the two situations describes the effects.

In the model on the left side, a situation is described of a building that does meet the minimal requirements but is not BREEAM-In Use certified. In the internal context, the tenant has a contract with the building owner wherein rental payments and operational costs are settled. One level higher, the owner of the asset has an agreement with its financier about the costs of equity and, for instance, availability of additional financial fundings. In the external context, there is a market wherein the tenant can choose a building, the owner determines its rent and the financier determines its investment opportunities. Corporate Social Responsibility index and Socially Responsible Investment index provide market transparency based on performance ratings of these stakeholders.

This is further explained with the model on the right side where the situation with a certificate is described. The theoretical framework claims that green buildings offer several benefits for the tenant, owner and financier. The beneficial effects from the tenant perspective are increased Corporate Social Responsibility towards clients and suppliers, less operational costs and better attraction of human capital. From the owner perspective, beneficial effects are increased Socially Responsible Investments, increased rents and building value and less vacancy. The effects for the financier perspective are increased Socially Responsible Investments, better credit ratings and lower costs of equity.

## Conceptual model of the effect of a green building certificate

### Situation without a certificate



### Situation with a certificate

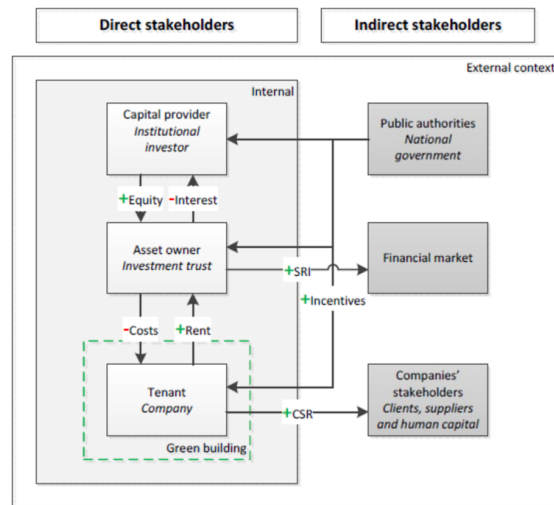


Figure 3.1: Conceptual model that visualizes the effects of a green building certificate (own illustration)

This conceptual model visualizes the effects of green building certificates based on the theoretical framework. In this research it will be studied if these effects are applicable on real life case studies of buildings that are certified with In use certificates. Therefore at least five case studies are done with samples that match with the case study criteria.

It is expected that results of cases will depend on the stakeholder that takes the initiative. Comparing these case studies will deliver interesting findings that might help with designing stimulative instruments for the green building transition.

## Research Questions

The main research question, that was already presented in the Introduction Chapter, is:

*How do green building certificates affect the building and organisation of tenants, owners and financiers of in use office buildings?*

In order to come to answer several sub-questions are formulated to answer each aspects of the main question.

### Sub-question 1

#### Literature study

What is the current state of prior theory and research on the effects of green building certificates for the owners, users and financiers?

### **Sub-question 2**

#### *Conceptualize*

How can the effects of an in use green building certificate on the business performance of owners, users and financiers be visualized based on the theoretical framework?

(The term business performance in this question covers effects that were described in the theoretical framework)

### **Sub-question 3**

#### *Research method*

How could the applicability of the conceptual model be tested on office buildings that obtained a BREEAM-NL In Use certificate?

### **Sub-question 4**

#### *Empirical question*

Does the conceptual model describe the effects for the owners, users and financiers in case studies of office buildings where a BREEAM-NL In Use certificate was obtained?

### **Sub-question 5**

#### *Synthesis of theory and in practice*

Could the findings of this research stimulate the transition towards green office buildings in the Netherlands?

## Research Design

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### **Literature study**

The literature study and the design of the theoretical framework forms the base of this research. The body of knowledge on this topic is becoming extensive. Also in the Netherlands this is a topic that gained more attention over the past few years because of increasing interest from practice. Based on the literature study effects for the owner, user and financier could be described. From this a theoretical framework was designed that subsequently was used for the design of the conceptual model.

Further literature study must be done to enhance the research process and for describing findings of the case studies.

### **Case studies**

The conceptual model visualizes the effects of a green building certificate for the owner, tenant and financier according to academic literature. In this research it is questioned what the effects of a green building certificate are for office buildings that are already in use. Therefore, case studies are used in order to study the applicability of the effects that are sketched in the conceptual model. This will entail an ex-post study of multiple projects in the Netherlands wherein an office building with one or several tenants was certified with a BREEAM-NL In Use certificate.

The case studies will consist of a project analysis and semi-structured interviews with representatives for the owner, tenant and financier. The aim of the project analysis is to collect financial, functional and operational data about the buildings and compare data from before and after certification. This will be done using a document study that combines market data, historic data and building visits. The findings of the project analysis will be used to compare the case

studies and could also be used as input for the semi-structured interviews. The aim of the semi-structured interviews is two sided. Firstly, it is aimed to identify what the drivers of the stakeholders were to obtain a green building certificate. Moreover, stakeholders will be also asked about challenges they endured to achieve a certificate. Secondly, it is aimed to identify how the building and stakeholders were affected after a green building certificate was obtained. Therefore, the effects of the theoretical framework will be used. The findings of the semi-structured interview will reconstruct the dynamic process behind obtaining the certificate, the involvement of the stakeholders and the beneficial effects. For each interview an interview guide is constructed according to the methods described in Bryman (2016).

After the project analysis and semi-structured interviews for all case studies are conducted the data will be analysed and compared. This is done using a cross-case analysis wherein findings for the owner, tenant and financier are summarized for all case studies and deviations are described. From this conclusions can be formulated and an overall conclusion will be written. It is expected that the results will clarify whether the effects described in the conceptual model are applicable for office building that obtained a BREEAM-NL In Use certificate. This will explain how the green building certificates affect the building and organisation of owners, tenants and financiers of office buildings that are in use and, thus, answer the main research question. However, it will be hard to generalize the results of the case studies done in this research. Therefore, there is an option elaborated for a questionnaire amongst a larger public. This option can be found in the next paragraph.

#### *Case study selection*





Case studies will be selected based on the following criteria:

- The project is defined as an multi-tenant office building located in the Netherlands.
- The project is owned by a single owner.
- The owner is financed by a single financier.
- The project is certified with BREEAM-NL In Use.
- All selected case studies are of similar scale.

BREEAM-NL projects are registered in a publicly accessible database. Using this database case studies can be selected on BREEAM-In Use, office function, location and date of certification. Additional information is provided on GFA, client, assessor, certificate with scores and a concise description of the project.

The following projects are pre-selected as potential case studies (Table 3.2).

### ***Potential Case Study Projects***

<b><i>Building</i></b>	<b><i>Location</i></b>	<b><i>Stakeholders</i></b>	<b><i>GFA</i></b>	<b><i>Certificate Date</i></b>
 <p><i>Vinoly</i></p>	Amsterdam Zuidas	Tenant: a.o. Savills Owner: Dekamobilien Asset Manager: Savills? Financier: Dekamobilien	18.000 sqm	Opening: 2005 Certification: 2016
 <p><i>The Outlook</i></p>	Schiphol Amsterdam	Tenant: a.o. Microsoft Owner: Schiphol Real Estate Asset Manager: SRE? Financier: SRE?	38.000 sqm	Opening: 09/2014 Certification: 02/2017
 <p><i>HeadQuarter</i></p>	The Hague	Tenant: a.o. AT&T Owner: Real Estate Asset Manager: Cushman W. Financier: UBS?	18.000 sqm	Opening: 2001 Certification: 22/2014
 <p><i>Haagsche Zwaan</i></p>	The Hague	Tenant: a.o. Q8, Deloitte Owner: Union Investment Asset Manager: Savills Financier: ?	17.800 sqm	Opening: 10/2010 Certification: 08/2015

*Table 3.2: Potential Case Study Projects (own illustration)*

For the execution of the case studies it will be important to start early with the preparations and maintain a strict time schedule given the number of interviewees for each case. In order to start well prepared a 'test case' will be executed in order to troubleshoot the case study design, whereafter the case study design is being improved.

### **Questionnaire**

In the case studies section it was already explained that it is hard to generalize the findings of this research based on only a number of case studies. Therefore, there is also an option for a questionnaire that will be conducted amongst a larger public. The aim of this questionnaire is similar to the aim of the semi-structured interviews of case studies but the results will be less detailed.

The feasibility of the questionnaire is highly determined by the number of respondents. The Dutch Green Building Council has a network of BREEAM-NL In Use clients. In order to access this network of potential respondents DGBC must be able to collaborate. Therefore, the questionnaire is an option that depends on this collaboration.

### **Expert panel**

By combining the findings of the case studies and the questionnaire conclusions can be formulated. How these conclusions are formulated is very important since it is expected to answer the main research question. Moreover, the impact of these conclusions on the use of BREEAM-NL In Use in the Netherlands must be discussed. Therefore, an expert panel will be composed. The expert panel has two aims. Firstly, the aim is to evaluate the findings of the case studies and questionnaire and a confirmation of the conclusions by experts. Secondly, the aim is to discuss the dissemination of the conclusions and formulation of recommendations for the use of BREEAM-NL In Use.

The setup of the expert panel will entail a presentation of the findings of the case studies and questionnaire, and a workshop to identify opportunities and challenges to accelerate green building certification, based on the confirmed conclusions of the previous part.

The output of the expert panel will be a confirmation of the conclusions on how BREEAM-NL In Use affects the building and organization of owners, tenants and financiers of office buildings that are in use. The second part of the output are the recommendations for stimulating the use of BREEAM-NL In Use amongst owners, tenants and financiers of office buildings that are in use.

The expert panel will consist of experts, policy makers and selected representatives of each stakeholder from the interviews. An example of a potential expert panel formation is presented in table 3.3.

## Expert Panel

Representatives	Description	Name	Position
Owner	Deka Immobilien, owner of the Haagsche Zwaan	-	Senior Asset Manager
Tenant	Deloitte, tenant of the Haagsche Zwaan	-	Senior Manager Real Estate Consulting
Financer	ING	Peter Gobel	Director Real Estate Finance
DGBC	Organisation behind BREEAM	Annemarie van Doorn	Director of DGBC
Expert	Well-known author on this research subject	Nils Kok	Associate Professor Real Estate at University of Maastricht

Table 3.3: Expert panel (own illustration)

## Research design

The literature study, case studies, semi-structured interviews, questionnaire and expert panel are all used to answer the overarching main research question. An illustration of the research design is made to visualize the connections between the research topics, methods and products. This is shown in figure 3.4.

## Research Design

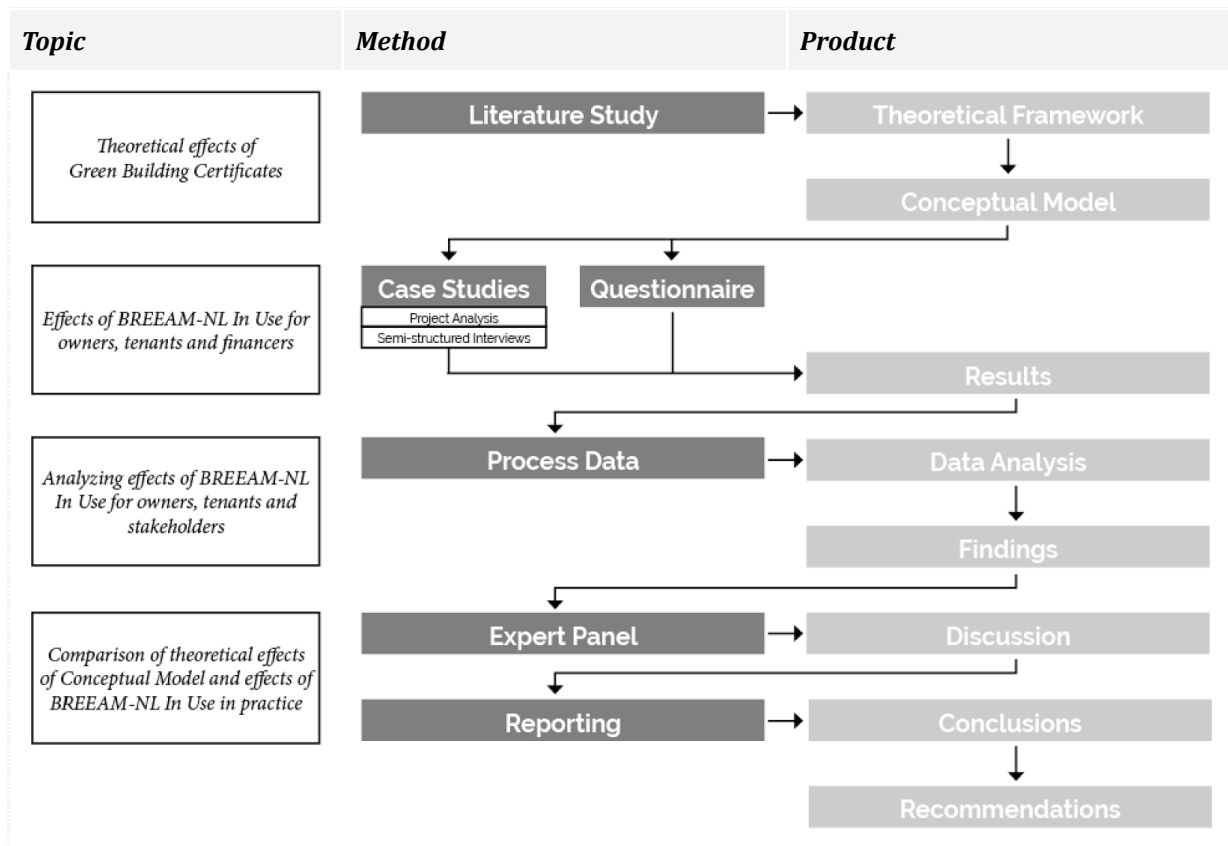


Table 3.4: Research Design (own illustration)

## Provisional Table of Contents - *Master Thesis*

This research proposal will be followed up by a graduation thesis that will be written during the next semester. A provisional table of contents is designed as a structure for the thesis and as a visualization for what can be expected in this thesis. The provisional table of contents is presented in table 3.5.

### ***Provisional Table of Contents***

Front	<b>4. Empirical Research</b>
	4.1 Case studies
Colofon	4.1.1. Technique
Preface	4.1.2. Sample
Table of Contents	4.1.3. Data Collection and Analysis
	4.1.4. Analysis of Cases
<b>1. Research Summary</b>	4.1.5. Cross Case Analysis
1.1. Introduction	4.1.6. Case Study Conclusions
1.2. Research Methodology	4.2. Interviews
1.3. Results Literature Study	4.2.1. Technique
1.4. Results Empirical Study	4.2.2. Sample
1.5. Discussion	4.2.3. Data Collection and Analysis
1.6. Conclusion	4.2.4. Analysis of Interviews
	4.2.5. Discussion on the Results
<b>2. Introduction</b>	4.2.6. Interview Conclusions
2.1 Research Background	
2.1.1 Relevance of Research	<b>5. Discussion, Conclusion and Recommendations</b>
2.1.2 Problem Statement	5.1. Discussion on the Results
2.1.3 Research Question	5.1.1. Discussion by Expert Panel
2.2. Research Methodology	5.1.2. Discussion of Case Studies
2.2.1 Theoretical Framework	5.1.3. Discussion of Interviews
2.2.2. Conceptual Model	5.1.4. Applicability of Research
2.2.3. Research Strategy	5.2. Conclusion and Recommendations
2.2.4. Research Method	5.2.1. Conclusion
	5.2.2. Recommendations
<b>3. Theoretical Framework</b>	
3.1 Owner perspective	<b>6. References</b>
3.2 Tenant perspective	
3.3 Financer perspective	<b>7. Appendices</b>

Table 3.5: Provisional Table of Contents (own illustration)



This graduation trajectory started in February 2017 and is expected to be finished in February 2018. The trajectory consists of five phases and each phase ends with a presentation and report deadline. An illustration of the research planning is presented in figure 3.6.

### **Time schedule**

#### **Phase 1      Introduction**

In phase one a research subject is chosen and a start is made with reading academic literature and writing the first research proposal.

#### **Phase 2      Theoretical methods**

In phase two this proposal is further elaborated until it meets the requirements of the graduation plan as defined in the course book. In this phase a more in depth literature review is done and the theoretical framework and conceptual model are designed. Priority lies in the elaboration of the research methods that will answer the main research question. Eventually, the graduation plan will act as research plan for the fall semester.

In July a head start will be prepared for September by planning meetings for interviews and case studies. Also a preparation case study is held to troubleshoot and improve the case study method.

#### **Phase 3      Empirical methods**

In phase three the research plan is executed. Operation of the case studies takes place, projects are analysed and semi-structured interviews are conducted. The questionnaire is dispatched to a network of potential respondents. The data that is gathered will be processed before the end of this phase. Phase 3 ends with a presentation of the first findings and progress.

#### **Phase 4      Analysis of findings**

In phase four all the data is analysed and first conclusions can be drawn. The expert panel will be used to evaluate the conclusions and formulate recommendations for stimulative approaches for implementing green building certificates in the built environment. Finally, all findings are added to the master thesis which will be handed in at the end of this phase.

#### **Phase 5      Conclusions**

A final presentation will be given in phase five.

## Research Planning

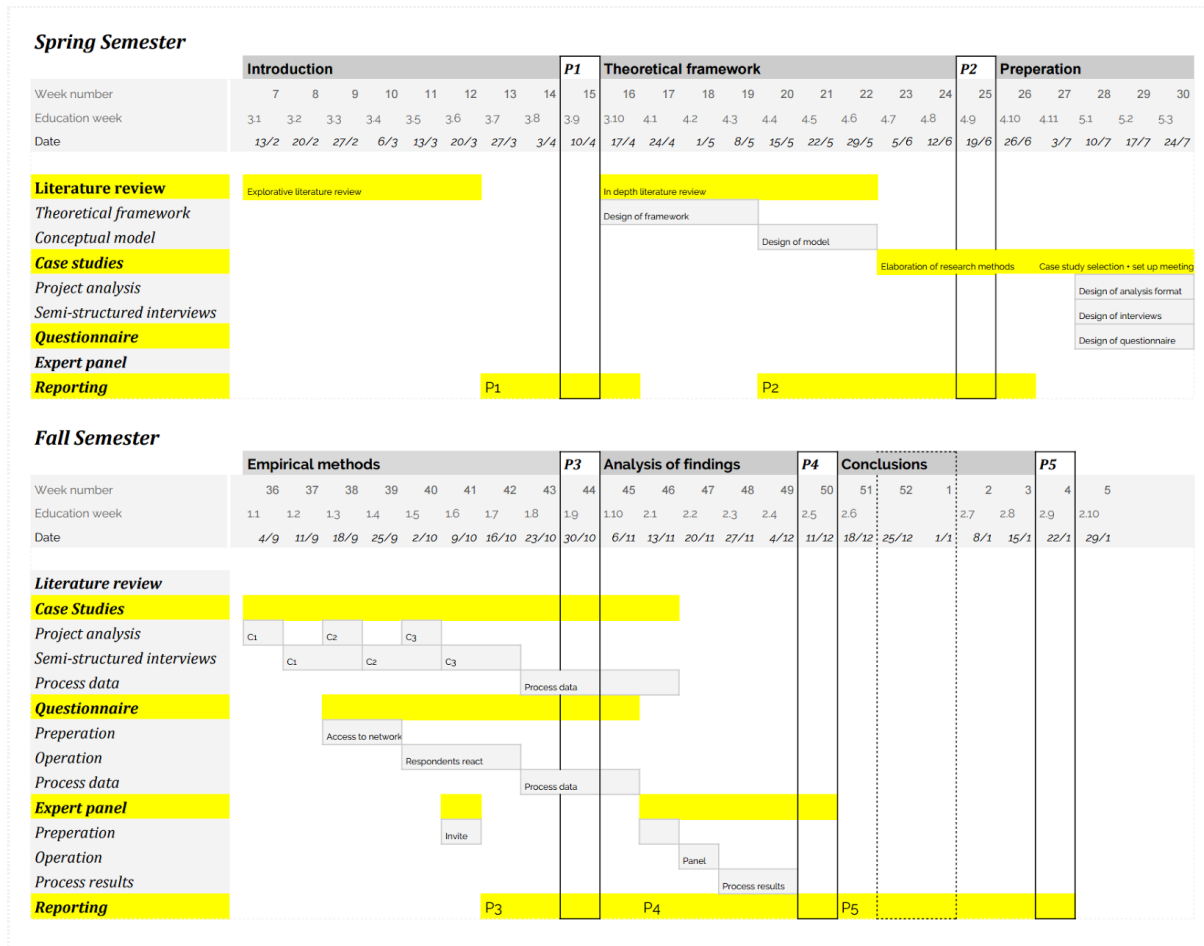


Figure 3.6: Research planning (own illustration)

## 4. Dissemination

In this chapter, the dissemination of this research is described. The term dissemination can be described as how a message is delivered and received by professional practitioners and researchers. Therefore, the academic relevance and practical relevance are described.

### Academic Relevance

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Research on green building certificates started in 2004 and emerged from then, gaining more attention worldwide. Most research is done in the United States, Canada and South-Korea. Since 2010, also Europe is publishing more research on green building certificates. The remains a relatively new topic for the academic field in the Netherlands since BREEAM-NL originated in 2010. Research is done by Van der Voordt and Koppels from Delft University of Technology who published research on the reputational effects of green building certificates and Eichholtz and Kok from the University of Maastricht published research on economical effects of green building certificates. In this research proposal prior theories on the effects of green building certificates were combined into one theoretical framework. By researching the applicability of the effects on office buildings that obtained a BREEAM-NL In use certificate a new addition can be made to the current body of knowledge in this field. The current research body does not distinguish between green building certificates for new buildings and buildings that are in use. There is a lack of insight in the effects of green building certificates on the building performance and its stakeholders of office buildings that are already in use. An important message of this research towards the academical world is to make this distinction and create awareness for the current building stock and its stakeholders.

### Practical Relevance

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The environmental impact of the Dutch building stock must be improved substantially in order to meet the European targets for 2050. Although more strict regulations help reducing this impact of new buildings, the biggest challenge will be to upgrade the current building stock. This requires a widespread approach on a national scale and reduction of costs (McKinsey, 2016). Green building certificates like BREEAM have potential in making this possible, but there remains a lack of insight in the costs and benefits.

The message of this research towards professional practitioners is creating awareness for the large impact that (green) buildings have within the energy transition. It is important to make them understand the effects of green building certificates, especially for those who do not have this expertise and knowledge in their organization. Insight in the effects of green building certificates for different stakeholders could then be a start for discussion and, eventually, taking action.

### Business Case

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#### Energy transition

The Netherlands must reduce its emissions by 80-95% in order to achieve the targets set by Europe for 2050. The energy transition is estimated to cost the Netherlands 200 billion euros over the upcoming 20 years, of which, 120 billion must be invested in the built environment.

## **Quality of stock**

Despite the legal mandation of energy labels in the Netherlands, insight in the quality distribution of the total building stock is relatively poor. However, with the announcement of the increasing minimum requirement of energy label C from 2023 for offices, it was analysed that this would affect 52% of the total office stock.

## **Building stock**

The number of certified BREEAM-In use buildings in the Netherlands is growing increasingly. In 2014, only 70 registrations were made but this grew to 400 registrations at the end of 2016 (DGBC, 2016). These registrations cover a GFA of 5 million square meters. Nevertheless, this is less than one percent of 600 million square meters GFA of the total stock of utility buildings in the Netherlands (Sipma, 2014). Leaving aside the residential stock that covers 850 million square meters. Most progress is made in the office stock, 3.4 million square meters GFA is BREEAM-NL In use certified of a total of 85 million square meters GFA office stock (EIB, 2016).

## **Challenge**

Without the right means to stimulate the energy transition, the Netherlands will not achieve its targets. Green building certificates are a scalable approach against relatively low costs that could stimulate this transition. However, the challenge will be to effectively integrate this means into the Dutch built environment and its context.

## 6. References

- ABN AMRO Real Estate. (2015). *ABN AMRO - Versneller van verduurzaming bestaande bouw*. Retrieved from [https://www.abnamro.com/en/images/Documents/040\\_Sustainable\\_banking/Publications/ABN\\_AMRO\\_Resultaten\\_Green\\_Quest\\_-\\_20151204.pdf](https://www.abnamro.com/en/images/Documents/040_Sustainable_banking/Publications/ABN_AMRO_Resultaten_Green_Quest_-_20151204.pdf)
- Blok, S. (2016). *Kamerbrief over energiebesparing gebouwde omgeving*. Retrieved from <https://www.rijksoverheid.nl/documenten/kamerstukken/2017/01/24/kamerbrief-over-evaluatie-energieakkoord-en-nationale-energieverkenning-2016>
- Bryman, A. (2016). *Social Research Methods* (5th ed.). Oxford: Oxford University Press.
- CE Delft. (2015). *Op weg naar een klimaatneutrale gebouwde omgeving 2050*. Delft. Retrieved from [http://www.ce.nl/publicatie/op\\_weg\\_naar\\_een\\_klimaatneutrale\\_gebouwde\\_omgeving\\_2050/1638](http://www.ce.nl/publicatie/op_weg_naar_een_klimaatneutrale_gebouwde_omgeving_2050/1638)
- Danna, K., & Griffin, R. W. (1999). Health and Well-Being in the Workplace: A Review and Synthesis of the Literature. *Journal of Management*, 25, 357–384.
- Darko, A., Chan, A. P. C., Owusu-Manu, D. G., & Ameyaw, E. E. (2017). Drivers for implementing green building technologies: An international survey of experts. *Journal of Cleaner Production*, 145, 386–394. <https://doi.org/10.1016/j.jclepro.2017.01.043>
- De Jonge, H. (2017). *De waarde van duurzaam vastgoed. Presentatie op BREEAM Congres 2017*. Retrieved from [https://www.dgbc.nl/sites/dgbc.nl/files/bijlagen/BREEAM\\_Congres\\_Hans\\_de\\_Jonge.pdf](https://www.dgbc.nl/sites/dgbc.nl/files/bijlagen/BREEAM_Congres_Hans_de_Jonge.pdf)
- Devine, A., & Kok, N. (2015). Green Certification and Building Performance: Implications for Tangibles and Intangibles. *Journal of Portfolio Management*, 7, 14. Retrieved from <http://www.nilskok.com/>
- DGBC. (2016). In-Use statistieken van BREEAM-NL. Dutch Green Building Council. Retrieved April 10, 2017, from <https://www.breeam.nl/projecten/statistieken/in-use>
- DGBC. (2016). *Deltaplan Duurzame Renovatie*. Retrieved from [https://www.dgbc.nl/sites/dgbc.nl/files/bijlagen/Stap1-Deltaplan Duurzame Renovatie.docx..pdf](https://www.dgbc.nl/sites/dgbc.nl/files/bijlagen/Stap1-Deltaplan_Duurzame_Renovatie.docx.pdf)
- DGBC. (2015, April). BREEAM-NL #4. *BREEAM-NL Magazine*. Retrieved from <https://www.breeam.nl/webshop/breeam-nl-magazine-4>
- EIB. (2016). *Rapportage: Verplicht energielabel voor kantoren*. Retrieved from <https://www.rijksoverheid.nl/documenten/rapporten/2016/11/24/label-c-verplichting-kantoren>
- Eichholtz, P. M. A., Kok, N., & Yonder, E. (2013). (2013). Operating Efficiency and the Cost of Debt: The Case of REITs. *Maastricht, The Netherlands. Maastricht University*.

- Eichholtz, P. M. A., Kok, N., & Quigley, J. M. (2015). Ecological Responsiveness and Corporate Real Estate. *Business & Society*, 1–31. <https://doi.org/10.1177/0007650315575118>
- European Parliament. (2010). *Richtlijn betreffende energie neutrale gebouwen*. Retrieved from [http://eur-lex.europa.eu/legal-content/NL/TXT/?uri=uriserv%3AOJ.L\\_.2010.153.01.0013.01.NLD](http://eur-lex.europa.eu/legal-content/NL/TXT/?uri=uriserv%3AOJ.L_.2010.153.01.0013.01.NLD)
- European Parliament. (2010). Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. Retrieved March 7, 2017, from <http://eur-lex.europa.eu/eli/dir/2010/31/oj>
- Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach* (March 2010). University of Virginia.
- Fuerst, F., & McAllister, P. (2011). Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Values. *Real Estate Economics*, 39(1), 45–69. <https://doi.org/10.1111/j.1540-6229.2010.00286.x>
- Fuerst, F., & McAllister, P. (2011). The impact of Energy Performance Certificates on the rental and capital values of commercial property assets. *Energy Policy*, 39(10), 6608–6614. <https://doi.org/10.1016/j.enpol.2011.08.005>
- Gmelich, M. (2017). A sustainable office, a necessity and obligation. *Vastgoedjournaal*. Retrieved from <https://vastgoedjournaal.nl/news/30386/een-duurzaam-kantoor-noodzaak-en-plicht>
- Gurgun, A. P., Polat, G., Damci, A., & Bayhan, H. G. (2016). Performance of LEED Energy Credit Requirements in European Countries. *Procedia Engineering*, 164(June), 432–438. <https://doi.org/10.1016/j.proeng.2016.11.641>
- IPCC. (2014). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report. Report of the Intergovernmental Panel on Climate Change. Chapter 9: Buildings.* (Vol. 33). <https://doi.org/10.2753/JES1097-203X330403>
- Jrade, A., & Jalaee, F. (2013). Integrating building information modelling with sustainability to design building projects at the conceptual stage. *Building Simulation*, 6(4), 429–444. <https://doi.org/10.1007/s12273-013-0120-0>
- Kats, G. (2003). *Green Buildings Costs and Financial Benefits*. Boston, MA: Massachusetts Technology Collaborative.
- Krizmane, M., Slihte, S., & Borodinecs, A. (2016). Key Criteria Across Existing Sustainable Building Rating Tools. *Energy Procedia*, 96(October), 94–99. <https://doi.org/10.1016/j.egypro.2016.09.107>
- Lippiat, B. C. (1999). Selecting Cost-Effective Green Building Products: BEES Approach. *Construction Engineering and Management*, 125(6), 448–455.

- McKinsey. (2016). *Versnellen van de energietransitie: kostbaar of kansrijk?* McKinsey Amsterdam. Retrieved from <http://www.mckinsey.com/global-themes/europe/versnellen-van-de-energietransitie-kostbaar-of-kansrijk>
- Qiu, Y., Su, X., & Wang, Y. D. (2016). Factors influencing commercial buildings to obtain green certificates. *Applied Economics*, 0(0), 1–13. <https://doi.org/10.1080/00036846.2016.1229434>
- Regales, C. (2017). *Stimulating Sustainable Urban Development Investments: Incentivize developers to sustainable mixed-use urban development projects. Master thesis.* Delft University of Technology. Retrieved from <https://drive.google.com/drive/folders/0B49WzetV9QHOQTNuZ0pienN0UkU>
- Rijksdienst voor Ondernemend Nederland. (n.d.). Energieprestatie - EPC. Retrieved April 3, 2017, from <http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/energieprestatie>
- Sabapathy, A., Ragavan, S. K. V, Vijendra, M., & Nataraja, A. G. (2010). Energy efficiency benchmarks and the performance of LEED rated buildings for Information Technology facilities in Bangalore, India. *Energy and Buildings*, 42(11), 2206–2212. <https://doi.org/10.1016/j.enbuild.2010.07.014>
- SER. (2012). *Energieakkoord voor duurzame groei.* Retrieved from <http://www.energieakkoordser.nl/energieakkoord.aspx>
- Sipma, J. M. (2014). *Energieverbruik in de utiliteitssector. Verbetering van het Referentiebeeld.* Retrieved from <https://www.ecn.nl/publicaties/PdfFetch.aspx?nr=ECN-V--14-011>
- Stern, S. (2006). *Stern Review: The Economics of Climate Change.* London: HM Treasury.
- Thyssen, J. (2011). *Corporate Socially Responsible - Real Estate Management. Understanding how a corporate real estate object interacts with society.* Delft University of Technology. Retrieved from <http://repository.tudelft.nl/islandora/object/uuid%3A12a6ef87-4f4d-432d-b1df-5c4d818529da?collection=education>
- UNEP. (2007). *Buildings and Climate Change: Status, Challenges and Opportunities.* Retrieved from <http://www.unep.fr/shared/publications/pdf/DTIx0916xPA-BuildingsClimate.pdf>
- United Nations. (2015). Convention on Climate Change: Climate Agreement of Paris. (pp. 1–27). Retrieved from [https://unfccc.int/files/essential\\_background/convention/application/pdf/english\\_paris\\_agreement.pdf](https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf)

- Van der Voordt, T. J. M., & Koppels, P. W. (2013). Corporate real estate mirrors brand : A conceptual framework and practical applications. *Journal of Corporate Real Estate*, 15(3/4), 213–230. <https://doi.org/10.1108/JCRE-01-2013-0003>
- Van Straalen, I. J., De Winter, P. E., Coppens, E. G. C., & Vermande, H. M. (2007). *Eindrapport historisch onderzoek technische bouweisen (TNO-rapport No. 2007-D-R0929/B)*. Retrieved from [http://www.bouwbesluitinfo.nl/media/download/Externe toetsen en beoordelingen Bouwbesluit 2012/Eindrapport historisch onderzoek technische bouweisen - TNO 070917.pdf](http://www.bouwbesluitinfo.nl/media/download/Externe%20toetsen%20en%20beoordelingen%20Bouwbesluit%202012/Eindrapport%20historisch%20onderzoek%20technische%20bouweisen%20-%20TNO%20070917.pdf)
- VRM. (2002). *Energiebesparende maatregelen in de woningvoorraad. KWR 2000 maakt de balans op.* Retrieved from <https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2002/12/01/energiebesparende-maatregelen-in-de-woningvoorraad/energiebesparende-maatregelen-in-de-woningvoorraad.pdf>
- Winch, G. M. (2010). *Managing Construction Projects. An Information Processing Approach*. (Second edi). West Sussex: Wiley & Blackwell Publishing Ltd.