World Business Council on Sustainable Development

"Sustainable development involves the simultaneous pursuit of economic prosperity, environmental quality and social equity. Companies aiming for sustainability need to perform not against a single, financial bottom line but against the triple bottom line."

"Over time, human and social values change. Concepts that once seemed extraordinary (e.g. emancipating slaves, enfranchising women) are now taken for granted. New concepts (e.g. responsible consumerism, environmental justice, intra- and inter-generational equity) are now coming up the curve."

UN Brundtland Commission Report 1987 on Sustainable Development

“A Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Peter van den Tol on Sustainable Real Estate Development

“A sustainable office building has a long technical and functional lifespan with a persistent demand by tenants through offering a high level of comfort and air quality while consuming as few resources as possible.
GRADUATION RESEARCH

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The added value of Sustainable Design

Peter van den Tol
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MANAGEMENT SUMMARY

Introduction
Due to rapidly growing consumption throughout the world the pressure on the environment by CO₂ emissions is rising. One of the main causes for these large CO₂ emissions lies in the energy consumption of the built environment.

The built environment is responsible for 25-40% of total energy use and pollution emission, 30% of raw material use, 30-40% of global greenhouse gas emissions and 30-40% solid waste generation and consumption is rising (Lorenz, d’Amato, des Rosiers, Elder, van Genne, Hartenberger, Hill, Jones, Kauko, Kimmet, Lorch, Lützkendorf, Percy, 2008). If the energy consumption of emerging countries like China and India grows to the current standards of the US or the EU the total energy consumption world wide will grow dramatically, resulting in an increased pressure on the environment (International Energy Agency, 2006). By reducing the energy consumption of new and current buildings a good step can be made towards a more durable relation with the environment.

Social relevance
The profession occupied with the built environment developed many measures to reduce the CO₂ emission of buildings but the appliance of these measures is below desired. An increasing number of architects and developers start new developments with high ambitions for the sustainability aspect of the new project. In most of the projects these sustainable measures are removed from the design due to the additional investments needed and the lack of good knowledge on the economical benefits and how these can and should affect Real Estate property value. Especially in the field of finance and valuation an important role can be played in demonstrating the added value of sustainable design for investors, developers and tenants.

This study has a focus on the effects of sustainable design on the investment budget through assessing the value of Dutch office buildings. At present, mere ideology is not sufficient to convince investors to invest in sustainable developments. This makes the research on the financial performance of sustainable real estate property essential to increase the investments in sustainable real estate.

The relevance of the research on the economical benefits and their valuation is evident. The more developers and designers create buildings that are significantly less energy consuming and have a lower carbon footprint, the better it is for all. Not only will it make the European governmental aim to reduce CO₂ emission with 30% below 1990 levels by 2020 and 60-80% by 2050 (European Communities, 2008) more feasible but also will it have a direct positive influence on the operational value of buildings.

Therefore the aim of this study is to gain insight in the relation between the level of sustainability in Dutch Office Buildings and the assessment of market and investment value of sustainable office buildings compared to conventional office buildings in order to increase the application of sustainability measures in new office buildings.
Definition of sustainability
Throughout the world, people are working on databases of sustainable property performance. The collection of market evidence is not only complicated because of unwillingness to share financial performances of property but also because there is no global consensus on the definition of a sustainable building. (CBRE, 2009)

In many countries a building is sustainable when it gets a minimum score from a labeling methodology but the methodologies vary per country. Even Green Star Buildings (Australia), BREEAM (United Kingdom), DCBA (Netherlands) or LEED labeled buildings (America) with the same amount of stars or points could have earned these in different ways. There are different sustainability provision combinations to acquire a certain amount of certification points. This even makes market comparisons of buildings with the same size, location, age, lease type etc. disputable. In research articles often referred to such as the study by Eichholz and Kok on the market value of LEED buildings (Eichholz, Kok, Quigley, 2008) they measure the effect of a label on the price, not specific elements of sustainable design.

Within this study the following definition of a sustainable office building is used:

A sustainable office building has a long technical and functional lifespan with a persistent demand by tenants through offering a high level of comfort and air quality while consuming as few resources as possible.

Problem Statement
Mainstream financial professionals are unwilling to include sustainability issues in property investment and financing decisions until the financial sector understands the benefits of green to the net value of an asset (RICS, 2005).

There is a lack of insight on the relation between sustainability measures and their effects and the valuation of sustainable office buildings. At present, appraisers do include in their valuation assessments the additional costs associated with the buildings sustainable accreditation level (varying between 0.66% and 12% for LEED; Katz et al, 2003) but not the benefits. Appraisers refuse to take these benefits into account because “there is no market demand for valuations that incorporate sustainability effects”. This is the result of a rather conservative profession since decades which is continuing with the same business as usual despite the fact that we are currently in a rapidly changing market.

It is the duty of appraisers to reflect property values are accurate as possible. Not taking into account the potential benefits leads to lower expected market values than appropriate, rendering many planned sustainable designs unfeasible. When the development of sustainable office buildings is to increase, it is essential that the relationship between value and sustainability is acknowledged as well as included in the value assessments of new office buildings.

Main research question
The report on the valuation of sustainable office buildings sheds light on the main research question of this study:

What is the effect of sustainability measures, in particular the measures to reduce energy consumption, on the value of office buildings and how should these effects be implemented in a valuation method for sustainable office buildings?
**Research Method**

The research performed in order to answer the research questions consists out of several elements that together form the research strategy. The methods used are a literature study followed by a simultaneously performed semi-open interview session parallel with a test case analysis of the Triodos Bank in Papendorp. The conclusions of the interviews and the test case led to the development of a valuation method for sustainable offices and an online survey for appraisers to serve as a triangulation check for the interview and test case results.

The initial valuation method proposal resulting the previous research steps was submitted to a sensitivity analysis. The final result is the Green Valuation Method as described in chapter 9. To finalize the valuation method it should be presented to valuation professionals for an expert panel review. This is proposed to be done in a follow-up study.
Theoretical Framework

In the literature study a wide survey was done on the different aspects related to valuation of sustainable office buildings. The literature survey provided further insight in the effects of sustainable building, energy performance indicators, real estate valuation methods, lease contracts and the current ideas on the valuation of sustainable real estate.

To fully understand the value of sustainability it was essential to have more knowledge on the effects of sustainable building. From the literature could be concluded that sustainable building resulted in direct and indirect effects. The direct effects can result in a higher market value via the indirect effects as shown in the two schemes presented below. The chart in figure 2 is based on the income approach; the chart in figure 3 is based on the all-risk yield assessment.

The potential effects of sustainable building were clear to most of the parties involved in the real estate sector. However the lower water and energy consumption of the buildings in question should not only benefit the user but also the investor. This is where the type of lease contract comes into play. According to the literature there are several ways to take the expected effects into account in the lease contracts. The most complex lease model is the DBFMO contract in which the tenants pay rent to a consortium of companies that delivers a plug and play package of a complete building including facilities, water and energy and maintenance (Geerligs, 2006). A less complex lease model is the All-In contracts including reduced energy operation and maintenance costs. A third option is the Gross Lease contract with a premium for a higher rent depending on the sustainability level. Research performed by Koppels and Snoei in 2009 showed that tenants are prepared to pay a premium of maximum 76% of the financial gains related to the reduced energy consumption (Koppels, Snoei, 2009).
To determine the energy consumption and the expected energy saving of a building under appraisal several energy performance indicators can be used. Available indicators are the Energy Index score (EI) from the Energy Performance of Buildings Directive (EPBD), the Energy Performance Coefficient (EPC), the more recent (2010) BREEAM (NL), LEED and GreenCalc+.

The EI score is seen as the most reliable indicator of the actual energy consumption of a building in the Netherlands (Van der Ham, 2004) and. The Energy Performance of Buildings Directive (EPBD) assigns a certain energy label to a building varying from A++ to G (with A++ being the most sustainable label and G the least). The label corresponds with an Energy Index score that is the result of the expected energy consumption of the building. The formula for the EI score is presented in figure 4. In figure 5 the EPDB labels are presented in relation to the EI score.

\[
 EI_{\text{new}} = \frac{Q_{\text{total;EI new}}}{155 \cdot A_{g_{0;EI \text{ new}}} + 106 \cdot A_{s;EI \text{ new}}} \cdot 9560 
\]

In which:
- \(Q_{\text{total;EI new}}\) = yearly energy use of a house (MJ)
- \(A_{g_{0;EI \text{ new}}}\) = total ground surface (m²)
- \(A_{s;EI \text{ new}}\) = total thermal transmission surface (m²)

Figure 4: EI formula (Entrop, Reinders, Brouwers, 2008)

The literature study on valuation methods and the valuation of sustainable real estate indicated several potential valuation methods. Possible methods that were reviewed were the Sales comparison method, the Income Capitalization with the DCF technique, the Income Capitalization with the All-Risk yield (GIY) technique and the Replacement Cost method. According to the literature the Income Capitalization (GIY and DCF) were the most suited for the valuation of sustainable real estate because they are transparent and because within the methods there is sufficient possibilities to include corrections in market rent assumptions, rent premiums and or yield estimations.
Interview Design
Based on the theoretical framework, semi open interviews were held with 8 professionals from the Real Estate sector: 4 appraisers specialized in the valuation of sustainable office buildings from leading valuation companies, 2 investors and 2 developers. In the interviews a wide variety of subjects regarding sustainable office buildings were discussed. The six main themes discussed in the interviews were: the elements associated with sustainability, the vision on sustainable office buildings, the different targets of the actors with regards to sustainable offices, expected effects of sustainable office buildings and the valuation of sustainable office buildings: potential methods and adjustable parameters.

Interview Results
The majority of the respondents associated several similar building elements with ‘sustainability’. Based on the shared opinions on sustainability a new definition for a sustainable office building was formulated:

A sustainable office building has a long technical and functional lifespan with a persistent demand by tenants through offering a high level of comfort and air quality while consuming as few resources as possible.

Furthermore the overall vision of the respondents was that sustainable office buildings will financially (and socially) outperform regular office buildings.

On the valuation method the respondents indicated that sustainable office building valuations can be performed using the standard existing valuation methods. A combination of the DCF method with the GIY/NIY + Top Slice method is seen as the best way to assess the value of the sustainable office. Regarding the value of a sustainable office building the respondents emphasized on the difference in market value (The value at which rate the object under assessment is expected to be sold in the market to an interested party on a short term (Tazelaar, 2002)) and investment value (the value that an individual investor would be willing to pay for the object under assessment (Tazelaar, 2002)). In the assessment of the market value, the appraiser is restricted to the use of “market evidence based” parameters that reflect the current market situation. The market value is assessed with as little subjective elements as possible. In the assessment of the investment value, the appraiser has more maneuverability space to include future expectations.

The valuation parameters that could be adjusted in the market valuation according to the respondents were the following: A slightly lowered risk yield (GIY) based on reduced vacancy and incentive assumptions; the inclusion of the capitalized green finance agreement as a correction post; a partial inclusion of the energy savings.

Additional adjustments that cannot be used in the assessment of market value but can be used in the estimation of the investment value were the following: longer lease periods for sustainable buildings, at least 50% of the energy savings should be added to the rent of service fee.
Online Survey Design
In order to support the interview results, an internet survey was composed based on the interview discussions and set out under the leading appraisal companies in the Netherlands. Participating parties in the survey were CB Richard Ellis, Troostwijk, Jones Lang LaSalle, DTZ, Colliers, Savills and Cushman & Wakefield. The target of the survey was to determine the current practice of valuing sustainable office buildings and what would be the best practice in the future.

The survey comprised of three sections: an initial section with background questions to determine what the vision of the respondent to sustainability was; a section containing questions on which elements of sustainability would affect valuation parameters in what way and a final section in which the respondents could fill in a bandwidth of the adjustments of valuation parameters (if any).

Online Survey Results
The online survey provided further insight on the perspective of appraisers regarding the valuation of sustainable offices. However the number of respondents does not offer the required representativeness to draw generic conclusions.

The DCF, the GIY and the GIY + Top slice method were perceived by the respondents as the most suited method for the valuation of sustainable office buildings. According to the opinion of 64% of the respondents the value of a sustainable office building should be higher than that of a regular one. 44% of the appraisers thought that this would be the result of a value depreciation of the regular buildings, whereas 19% of them expect the value of sustainable buildings to rise between 5 and 10% compared to regular ones.

For a building to get the “title” of being sustainable, the object has to have at least an EPBD label B according to 71% of the respondents. Label C is the minimal requirement for the guideline sustainable acquisition from the Dutch government and will also be used for the benchmark energy consumption to determine the energy savings premium.

Additionally, a majority of the respondents Energy efficiency is expected to have a positive influence on rent levels, vacancy assumptions and the exit value.
Test Case Design
To review the current practice amongst appraisers in the Netherlands, a test case performed by BRE G. berkhou from the Triodos Bank in Zeist was analysed. The data of the test case was provided by the Triodos Bank and the conclusion are based on my personal interpretation.

The building from the portfolio under study in this test case is situated on the Blaeulaan in Papendorp, Utrecht. The building consists of 2 building parts connected by an enclosed corridor. The first part was built in 2002 and has an EPC score of 1,5; the second part was recently delivered in 2009 with an EPC of 1,05 and a green finance agreement. The fact that this object consists of two parts that are fairly similar in size and appearance, but differ in energy efficiency made it highly suitable for a comparison of valuations performed by 6 of the largest appraisal companies in the Netherlands.

Six of the main appraisal companies in the Netherlands were invited to assess the value of the two building parts of the Blaeulaan Utrecht. The value assessments were performed in the same period to guard for market changes. The appraisers were asked to assess the value of the two building volumes separately in order to make the difference in value between the regular and the sustainable part visible.

Test Case Results
An analysis was done on different aspects of the valuations. The estimations and assumptions of the different appraisers regarding the market value, the market rent, the exit yield, the vacancy and incentives, the capitalization of the green finance agreement and the Gross Initial Yield were compared and analyzed.

The six appraisers all valued the sustainable office part higher than the regular building part. On average the market value of the sustainable building section was 11,35% higher than the regular building section. Interestingly there was also a wide variation in the market values presented by the appraisers not only for the sustainable building part but also for the regular part.

Figure 8: Market rent value regular versus sustainable.        Figure 9: Gross Initial Yield regular versus sustainable.
Market rent regular: mean=€ 191,67 St. Dev.= € 9,31  GIY regular: mean=7,27%  St. Dev.= 0,593%
Market rent sustainable: mean=€ 197,83 St. Dev.= € 8,38  GIY sustainable: mean=7,27%  St. Dev.= 0,593%

On average the appraisers estimated a 3,9% higher market rent and a 0,2498 percentage point lower GIY (already corrected for age difference)for the sustainable building part. The 3,9% higher market rent is only an indication of the rent difference. In future valuations the recommendation is to determine the addition to the market rent based on the energy savings premium.

The estimated market rent on the other hand was still 21% lower than the actual rent price in the lease contract.
Energy Savings Premium

As concluded from the survey and the interviews, a sustainable office building is expected to consume less energy than a conventional building. At present this energy saving is solely beneficial to the tenant. In order to reflect the lower energy consumption in the value of the sustainable office building, the energy saving has to be incorporated in the valuation of the office building. To enable the appraiser to do so, the amount of saved energy needs to be determined and compared to a benchmark for the energy consumption of conventional office buildings. The energy saving can be calculated in Mega Joules primary energy after which it has to be converted to kWh and m³ gas in order to connect a certain price level to the energy saving.

To determine the energy savings premium, the assessment tool as described in chapter 8 is developed based on the results from the survey and the interviews as well as on recent studies on energy performance of buildings and the relation of the energy performance of buildings with the added value of sustainable office buildings (Van der Ham, 2004; Snoei, 2009; Peeters, 2008).

In order to determine the energy savings premium the following steps need to be taken:

- Determine benchmark to compare consumption per m² LFA
- Determine the buildings’ energy consumption per m² LFA
- Determine energy price level per m³ and kWh
- Create energy price development scenario
- Capitalize the energy saving per m² LFA
  - Calculate energy consumption per m² LFA
  - Calculate benchmark building type per m² LFA
  - Calculate total energy saving
  - Calculate energy saving per m² LFA
  - Determine height of the energy saving per m² LFA
  - Calibrate for willingness to pay: 75% of savings €/m² LFA

The energy savings premium can be included in the market and investment value assessments in four different ways:

- GIY
  - The Energy Savings Premium is added to the rent.
  - The Energy Savings Premium is added to the value assessment as a separate correction post: With a DCF calculation in which an energy price development scenario can be included, the Savings Premium can be capitalized for the length of the DCF period.
- DCF
  - The Energy Savings Premium is added to the rent
  - The Energy Savings Premium is added to the value assessment as a separate income stream on which an energy price development scenario can be connected, the Savings Premium can be capitalized for the length of the DCF period

For the further explanation on the steps to determine the energy savings premium we refer to chapter 8 of the report.
**Green Valuation Method**

All actors from the Real Estate profession expect sustainable office buildings to financially (and socially) outperform conventional office buildings. The expectations amongst the actors varied between value decreases of conventional office buildings and increased values for sustainable office buildings. In order to reflect the impact of sustainability aspects on the value of office buildings as expected by the respondents the “Green Valuation Method” is developed.

For an office building to be suitable for this Green Valuation Model the object under appraisal has to score at least an EPBD label C or a BREEAM NL Good score. Label C is used as the benchmark to test the method. By comparing the object under appraisal, the added value for the sustainability aspect can be calculated.

For the valuation of sustainable office buildings the two existing income approaches can be used according to the respondents. The Gross Initial Yield method with Top Slice for corrections should be used in combination with the Discounted Cash Flow method. Both methods should be used alongside each other for cross check purposes. The GIY with Top Slice method is the least complicated valuation technique while it still offers the appraiser sufficient adjustment possibilities.

In the market value assessment with the GIY method and the 100 year DCF, several critical parameters can be adjusted. The size of the adjustment of the parameter is depending on the level of sustainability. Adjustable parameters are: the market rent estimation (increase for buildings scoring above label C; decrease for buildings below label C); the GIY estimation (varying between -0.00 percentage point for label C to -0.25 percentage point for labels>A); the inclusion of the Energy savings Premium depending on the EPC score or the EI score; the capitalization of the Green Finance Agreement; the rent difference correction; adjustments to the rental growth and adjustments in the vacancy and incentive assumptions.

Important to note is the fact that the adjustment in the market rent assumption is not combined with the inclusion of the energy savings premium (to prevent double inclusion of the effect of energy savings).

The proposed adjustments as tested against the benchmark. This sensitivity analysis indicate that the value changes are fitting within the bandwidth for the increased market value for sustainable office buildings as indicated in the interviews and the survey (between 5% and 10% value increase).

The proposed parameter changes are not based on accepted market evidence but on the personal interpretation of results from the interview, survey and test case. Appraisers might consider the method insufficiently founded by the market evidence, however no complete and coherent valuation method for sustainable office buildings has been developed as of yet.

When this valuation method is not completely accepted by the profession it can serve as a starting point for a general discussion amongst appraisers how to valuate sustainable offices.
Conclusions

In the current Real Estate process, appraisers play a silent role. They are sometimes seen as a necessary ‘evil’ and sometimes as a ‘regular’ advisor. Despite objections from the appraisal profession, it is my opinion that appraisers have much more influence in the real estate process than can be expected. With the decision making during valuations, they have a serious influence on the perception and creation of value: when one appraiser values the building for a buying party at 2 million and the appraiser for the selling party at 1 million it is likely that the value of a building to be sold will eventually lie in between the values given by the buying and selling parties. This scenario seems nonsense, however a buyer of a property can ask three appraisers to assess the value. From these values the buyer will take the lowest value assessment to the negotiation. The opposite can happen with the seller of the property. That value assessments can vary greatly is shown by the Triodos Test case.

Precisely because of this fact, the appraisal profession should take up this initiative for the development of a mutual valuation guideline for sustainable office buildings. Not only building tenants, owners and ‘the market’ determine the value of a building, also the appraiser and the broker play a mayor role.

By taking up the distinction in the valuation of conventional office buildings and sustainable offices, the appraisal profession can play an important role in the greening up of the Dutch office stock. Through assessing the values of new sustainable developments in a proper way, more sustainable building developments can become feasible. The green valuation can also be applied to assess the impact of greening-up measures on the value: is the greening-up measure financially feasible; does it add value to the building.

The valuation method for sustainable office buildings as presented in this report result in value changes that fit within the bandwidth as derived from the interviews and the survey. The value difference between the value of the sustainable building and the conventional one as found in the sensitivity analysis of the method also correspond with the average value difference found in the Triodos test case (Berkhout, 2010).

Pitfalls

A potential pitfall of the method lies in the minimal requirement for an object to be fit for the green valuation method. Questions can and should be asked whether the benchmark for the energy consumption is fair or whether the minimal EPBD label B requirement is right. Growing insight in sustainability among appraisers can stimulate the debate on this topic. A strong argumentation for the requirements and the energy benchmark will strengthen the case for the green valuation method.

The valuation model has a significant dependency on higher rents for sustainable buildings. This requires a willingness to pay higher rents amongst tenants. Even though studies indicate that there is in fact a willingness to pay higher rents, building owners and appraisers remain skeptical. To reply to this skepticism, the estimation for the rent can still be based on the bandwidth of the market rent as described in chapter 9.

A threat in the development of the green valuation method lies in the will to ‘create’ a higher value for sustainable buildings. An appraiser should not forget his silent control over the perception of value but the appraiser should also watch out for creating value that is not there.
INTRODUCTION

The graduation research for the dual master course Real estate and Housing and Architecture has a focus on the effects of sustainable design on the investment budget through assessing the value of Dutch office buildings.

At present, mere ideology is not sufficient to convince investors to invest in sustainable developments. This makes the research on the financial performance of sustainable real estate property essential to increase the investments in sustainable real estate.

An extensive body of research literature on the potential effects of sustainable office design is already in place. Potential effects include lower vacancy rates, increased occupant productivity and wellbeing, decreased exploitation costs, longer useful life spans, easier letting, increased marketability, lower maintenance costs due to higher material quality and durability, improved company image, higher effective rents and higher sale premiums. Nevertheless it is unclear how to take the economical implications of these possible effects into account when determining the future value of Real Estate property. The absence of the sustainability benefits in the value assessment of commercial real estate property results in lower expected future values than legitimate. Since sustainable building is generally more expensive than regular building, this lack of added value often leads to cuts in the sustainability budget. Therefore it is essential to increase the knowledge on the valuation of sustainable buildings through this research.

The aim of this study is to gain insight in the relation between the level of sustainability in Dutch Office Buildings and the assessment of market and investment value of sustainable office buildings compared to conventional office buildings.

The emphasis is placed on measures that reduce the buildings energy consumption because these have a clear measurable effect and the most direct financial impact on the investment budget. These measures will be studied in the context of new office buildings. In this sector the awareness of possible benefits of sustainable building is increasing and decision makers are focused on the mid to long term whereas consumers on the housing market have a much lower awareness of the expenses for rents and energy bills. Subsequently, consumers often make the energy payments using automated incases as a result of which they often lack insight in their expenses (www.cbs.nl).

Nowadays, many experts in the field of sustainability are working on ways to calculate the added value of sustainable design solutions in order to increase the amount of sustainable measures in the built environment. With the cooperation of experts from the practice of sustainability as well as economics I will contribute to this line of research. By means of an extensive literature study on the topics directly related to sustainable design and development, this study will be embedded in the existing body of knowledge. An empiric multiple case study will add more data to this knowledge. This should eventually form the basis for a valuation method that will deal with the effects of sustainable design on the property’s value.
CONTENTS

ACKNOWLEDGEMENTS 4
MANAGEMENT SUMMARY 5
INTRODUCTION 18
CONTENTS 19

1 PERSONAL ASPECTS 23
1.1 Background 23
1.2 Interest in sustainability 23
1.3 Vision 23
1.4 Objectives 23

2 PROBLEM DEFINITION 25
2.1 Social relevance 25
2.2 Problem identification 26
2.2.1 Definitional precision of term sustainability 26
2.2.2 Willingness to invest 26
2.2.3 Actors and motives 27
2.2.4 Vicious Circle of Blame 28
2.2.5 Contractual models 29
2.2.6 Dependence on energy prices 30
2.2.7 Potential effects of sustainable building 31
2.2.8 Effectiveness of measures 32
2.2.9 Valuation of sustainable Real Estate property 32
2.2.10 Regulation and subsidies 33
2.3 Problem statement 34
2.4 Goals 34
2.5 Research boundaries 34
2.6 Research questions 35
2.6.1 Main research question 35
2.6.2 Background questions 35
2.6.3 Sub questions 35

3 METHODS 37
3.1 Research design 37
3.2 Literature study 38
3.3 Semi-open interviews 38
3.4 Triodos test case analysis Papendorp 38
3.5 Online survey 38
3.6 Sensitivity analysis 38
3.7 Expert panel review 38
3.8 ROZIPD guideline valuation of sustainable office buildings 38
# THEORETICAL FRAMEWORK

4.1 **Effects of sustainable building**

4.1.1 Direct financial effects of energy consumption reducing measures

4.1.2 Indirect financial effects of energy use reducing measure

4.1.3 Benefits of superior air quality and measures for self-regulation

4.1.4 Benefits of durable materials

4.1.5 Overview total effects of sustainable office buildings

4.2 **Lease contracts**

4.3 **Performance indicators**

4.3.1 Energy Performance Building Directive (EPBD)

4.3.2 BRE Environmental Assessment Method NL (BREEAM (NL))

4.3.3 Leadership in Energy & Environmental Design (LEED)

4.3.4 Energy Performance Coefficient (EPC)

4.3.5 GreenCalc+

4.4 **Valuation of sustainable real estate property**

4.4.1 Valuation Methods

4.4.2 Effect of sustainability measures on valuation

5 **INTERVIEWS**

5.1 **Main elements associated with sustainable office buildings**

5.1.1 Overall matrix

5.1.2 Appraisers

5.1.3 Investors/Financiers

5.1.4 Developers

5.1.5 Discussion

5.2 **Perceptions of sustainable office buildings**

5.2.1 Overall matrix

5.2.2 Appraisers

5.2.3 Investors/Financiers

5.2.4 Developers

5.2.5 Discussion

5.3 **Respondents goals with regard to sustainable office buildings**

5.3.1 Overall matrix

5.3.2 Appraisers

5.3.3 Investors/Financiers

5.3.4 Developers

5.3.5 Discussion

5.4 **Expected effects of sustainable office buildings**

5.4.1 Overall matrix

5.4.2 Appraisers

5.4.3 Investors/Financiers

5.4.4 Developers

5.4.5 Discussion

5.5 **Valuation of sustainable office buildings: potential methods**

5.5.1 Overall matrix

5.5.2 Appraisers

5.5.3 Investors/Financiers

5.5.4 Developers

5.5.5 Discussion

5.6 **Valuation of sustainable office buildings: adjustable parameters**
5.6.1 Overall matrix 69
5.6.2 Appraisers 69
5.6.3 Investors/Financiers 70
5.6.4 Developers 70
5.6.5 Discussion 70

5.7 Additional statements and opinions 72
5.7.1 Appraisers 72
5.7.2 Investors/Financiers 73
5.7.3 Developers 73

5.8 Conclusions from the interviews 75
5.8.1 Definition of sustainability 75
5.8.2 Perceptions of sustainability 75
5.8.3 Valuation Method 75
5.8.4 Valuation Parameters 76
5.8.5 Assessing the investment value: advice for buying and selling 77

6 ONLINE SURVEY 79
6.1 Survey 79
6.2 Respondents 79
6.3 Results 80
6.3.1 Background questions 80
6.3.2 Sustainability in office valuations 81
6.3.3 Value Affecting Elements Of Sustainability 82
6.3.4 Effects of aspects of sustainable building on valuation parameters 83
6.3.5 Minimum requirement title ‘sustainable’ 85

6.4 Conclusions 85
6.5 Discussion 86

7 TRIODOS TEST CASE PAPENDORP 87
7.1 Description of test case 87
7.2 Method 88
7.3 Results 89
7.3.1 Market value 89
7.3.2 Total market rent value 90
7.3.3 Market rent value office space 91
7.3.4 Exit Yield 92
7.3.5 Gross Initial Yield 93
7.3.6 Vacancy and incentives 94
7.3.7 Capitalization of the Green Finance Agreement 94

7.4 CONCLUSIONS 95

8 ENERGY SAVINGS PREMIUM 97
8.1 The energy savings premium 97
8.2 Benchmarking theoretical energy consumption 99
8.3 Determination of the energy consumption 101
8.4 Determination of energy price 102
8.4.1 Current price level 102
8.4.2 Price level development scenario 104
8.5 Capitalization of Energy Savings Premium 105
9 GREEN VALUATION METHOD PROPOSAL

9.1 General
9.1.1 Definition of sustainability: minimal requirements
9.1.2 Market value and investment value
9.1.3 Energy savings potential

9.2 Valuation techniques

9.3 Fictive comparison building

9.4 Adjustable parameters GIY and DCF method
9.4.1 Market Rent estimation
9.4.2 Gross Initial Yield estimation
9.4.3 Energy Savings Premium 50%/75%
9.4.4 Green Finance Agreement Capitalization
9.4.5 Rent difference correction
9.4.6 Regular Maintenance
9.4.7 Large maintenance correction
9.4.8 Rental growth
9.4.9 Vacancy and incentives
9.4.10 Combining the adjustments
9.4.11 Sensitivity of the parameter adjustments

9.5 Qualitative assessment

9.6 Discussion

10 CONCLUSIONS

10.1 Research method
10.2 Definition of sustainability
10.3 The role of the appraiser
10.4 Valuation method
10.5 ROZ guideline changes
10.6 Market evidence
10.7 Character of valuations
10.8 Added value of sustainable office buildings
10.9 Buyers sellers dilemma
10.10 Pitfalls
10.11 Recommendations for future research

11 REFERENCES

11.1 Books and papers
11.2 Websites
11.3 Personal communication

12 APPENDICES

12.1 Definitions of terms
12.2 Abbreviations

Because of confidentiality agreements, the other appendices, further appendices can be found in the separate appendix booklet.
1 PERSONAL ASPECTS

1.1 BACKGROUND

For the last 6 years I have been involved in the building sector. The first three years I did my bachelor at the faculty of Architecture in Delft of which my last project of the Stylos pavilion was the first sustainable design project. In between my bachelor and master studies I worked at the architectural firm KOW in The Hague on a wide variety of projects. In my master course I started to develop a broader interest than pure architecture. Real Estate and Housing became an important part of my study. Now I work at KOW X (international department of strategy, sustainability and innovation) on a sustainable high rise building for Utrecht Central Station district during my dual graduation research.

1.2 INTEREST IN SUSTAINABILITY

Working in the field of architecture the increased interest in sustainable design soon became apparent. Many companies varying from architectural firms to developers to governmental branches started investigating this topic including the firm I worked at. During the design phases of sustainable buildings I started to notice that many sustainable measures were being removed from the design and I started thinking why this should be.

In discussions with designers and teachers I found out that it were mainly the investors and developers that started cutting in the sustainability budget. They did this because they would have no clear financial advantage from the lowered energy consumption and other effects of sustainable building. Therefore I saw it as an important research to study the financial advantages of sustainable building. This was the basis for my graduation research.

1.3 VISION

It is my opinion that through broader knowledge on the property value created through sustainable design or the depreciation of property value by not doing so, that investors will be more willing to invest in sustainable buildings. In this context it is critical to study the impact of sustainability aspects in the valuation of sustainable commercial real estate. Only when a sustainable office building shows a clear added value in comparison to regular office buildings will the necessary additional investment be acceptable.

1.4 OBJECTIVES

The prime objective of this study is to contribute to the greening up of the building stock in the Netherlands. Furthermore I to develop my skills in academic research and improve my scientific writing. Furthermore I want to enlarge my knowledge on sustainable design and increase my insight in value creation and Real Estate property valuation. Not only can this study help to increase the amount of sustainable real estate, it can also help to formulate new design strategies aimed at creating value for developers and investors through sustainable design.
2 PROBLEM DEFINITION

2.1 SOCIAL RELEVANCE

Due to rapidly growing consumption throughout the world the pressure on the environment by CO₂ emissions is rising. One of the main causes for these large CO₂ emissions lies in the energy consumption of the built environment.

The built environment is responsible for 25-40% of total energy use and pollution emission, 30% of raw material use, 30-40% of global greenhouse gas emissions and 30-40% solid waste generation and consumption is rising (Lorenz, d’Amato, des Rosiers, Elder, van Genne, Hartenberger, Hill, Jones, Kauko, Kimm, Lorch, Lützkendorf, Percy, 2008). If the energy consumption of emerging countries like China and India grows to the current standards of the US or the EU the total energy consumption world wide will grow dramatically, resulting in an increased pressure on the environment (International Energy Agency, 2006). By reducing the energy consumption of new and current buildings a good step can be made towards a more durable relation with the environment.

The profession occupied with the built environment developed many measures to reduce the CO₂ emission of buildings but the appliance of these measures is below desired. An increasing number of architects and developers start new developments with high ambitions for the sustainability aspect of the new project. In most of the projects these sustainable measures are removed from the design due to the additional investments needed and the lack of good knowledge on the economical benefits and how these can and should affect Real Estate property value. Especially in the field of finance and valuation an important role can be played in demonstrating the added value of sustainable design for investors, developers and tenants.

The relevance of the research on the economical benefits and their valuation is evident. The more developers and designers create buildings that are significantly less energy consuming and have a lower carbon footprint, the better it is for all. Not only will it make the European governmental aim to reduce CO₂ emission with 30% below 1990 levels by 2020 and 60-80% by 2050 (European Communities, 2008) more feasible but also will it have a direct positive influence on the operational value of buildings.

To be able to break out of the vicious circle of blame (Cadman, 2007) referred to in discussions about sustainable development, all actors in all fields have to take action. They have to do their part of research needed to adept their profession to the future standards of sustainable property development. In breaking out of this circle of blame, valuation professionals and the valuation process can and should play a central role. This is backed by one of the main conclusions of the 2008 RICS conference “Investing in a sustainable built environment – do energy efficient buildings make economic sense?” that mainstream financial professionals are unwilling to include sustainability issues in property investment and financing decisions unless and until sustainable building features and related performance are integrated into property valuation (RICS, 2008).
2.2 PROBLEM IDENTIFICATION

Prior to initiating the research an inventarisation of the potential problems relating sustainable development and the assessment of sustainable Real Estate property value was executed, resulting in the following issues.

2.2.1 Definitional precision of term sustainability

Throughout the world, people are working on databases of sustainable property performance. The collection of market evidence is not only complicated because of unwillingness to share financial performances of property but also because there is no global consensus on the definition of a sustainable building. (CBRE, 2009)

In many countries a building is sustainable when it gets a minimum score from a labeling methodology but the methodologies vary per country. Even Green Star Buildings (Australia), BREEAM (United Kingdom), DCBA (Netherlands) or LEED labeled buildings (America) with the same amount of stars or points could have earned these in different ways. There are different sustainability provision combinations to acquire a certain amount of certification points. This even makes market comparisons of buildings with the same size, location, age, lease type etc. disputable. In research articles often referred to such as the study by Eichholz and Kok on the market value of LEED buildings (Eichholz, Kok, Quigley, 2008) they measure the effect of a label on the price, not specific elements of sustainable design.

In this study is worked with the following definition of a sustainable office building:

An office building that uses significantly less energy than a conventional office building, features high water efficiency and superior indoor air quality and uses as much as possible non-toxic and renewable materials.

In this study the focus will be on the verifiable and quantifiable energetic aspect of sustainable building. The other mentioned elements are elaborated upon because of the intangible characteristics of their potential effects.

2.2.2 Willingness to invest

Despite the fact that the knowledge and technologies to produce sustainable buildings are available, the application of sustainable measures in the built environment is still below the level required in order to reach the Dutch energy use reduction target of 50% in 2015 compared to the energy consumption of non-sustainable building in 2007 (VROM, 2008). Even though the economic benefits of sustainable design and construction are now well-documented in the literature there is a low willingness to pay for them. To stimulate investors to invest in sustainable measures, we need to explore the relation between possible benefits and the effect on property value. In order to be able to say how these measures can and should benefit the investor, it is important to look at who the decision makers are and what the different motives are, that determine the will to invest in sustainability.
2.2.3 Actors and motives

Investors have different motives to invest in buildings but those are always driven by concepts of value, whether this is through increased value by being sustainable or reduced value due to being unsustainable. The following actors and value drivers should be distinguished. In orange the actors with an actual interest in the projects’ sustainability are indicated.

<table>
<thead>
<tr>
<th>Actor</th>
<th>motives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financier</td>
<td>Return on capital, development profitability and cash flows, value on completion, marketability, financial banking ratios, ease of letting or selling</td>
</tr>
<tr>
<td>Developer</td>
<td>Company profile and exposure, return on capital, internal rate of return, development profit, marketing exposure, ease of letting and selling</td>
</tr>
<tr>
<td>Occupant</td>
<td>Labour productivity and profitability organizational vision, image and identity, corporate brand and reputation, corporate social responsibility, operational costs</td>
</tr>
<tr>
<td>Appraiser</td>
<td>Fair value, current market value, depreciated replacement cost, tax implications, market share, competitiveness</td>
</tr>
<tr>
<td>Contractor</td>
<td>Profitability of project, company continuity</td>
</tr>
</tbody>
</table>

Table 1: Actors and value drivers. (Green Building Council Australia, 2008)
2.2.4 Vicious Circle of Blame

Investors, occupiers, constructors and developers all blame each other for the lack of incentive to develop sustainable property. This is called the vicious circle of blame because it will only change when all actors involved change their way of perceiving things and start to recognize the events happening in their profession regarding sustainable development.

![Figure 1: The Vicious Circle of Blame. (RICS, 2008a)](image)

The following conclusions can be drawn from various literature sources regarding each profession.

**Investors** will have to recognize the growing demand for sustainable office buildings, when tenants start to see the potential benefits of sustainable buildings. Indications that non-sustainable buildings have a significant higher risk of becoming obsolete are evident. This means that investors need to adjust their portfolios. When lower exploitation costs are taken into account of property valuation assessments as a result of sustainable building, the market value of the property will rise, leading to higher profits.

**Occupiers** will have to recognize the benefits of sustainable building (especially the ones with superior air quality) on user productivity, lower sick leaves and lower exploitation costs, when more definitive evidence is in place. If due to sustainable building the exploitation costs of the building appear to be lower, they should be capable of paying higher rents than for non-sustainable buildings when thinking of the total accommodation costs.

**Developers** can get lower interest rates from investors as soon as investors start to recognize the lower risks associated with sustainable building. When investors agree to benefits such as easier letting and lower vacancy risks, they are capable of accepting lower interest on loans.
Constructors will get a larger demand from developers when all actors mentioned before accept the stated arguments. When they get a larger demand, experience in sustainable building will rise, leading to lower failure costs.

In bringing all actors together lies a central role for the valuation profession. Taking the benefits of sustainable building into value assessments of real estate property will lead to higher incentives.

### 2.2.5 Contractual models

Lease terms can have large impacts on the value and feasibility of sustainable developments. When leases are set up in such a way that merits from sustainable measures are beneficiary only for tenants, the incentive for investors and developers to develop in a sustainable manner are absent. One of the upcoming contractual models that real estate property professionals have increasing confidence in is the DBFMO model.

In the DBFMO model tenants pay rent to a consortium of companies that delivers a plug and play package of a complete building including facilities, water and energy and maintenance. Because the water, energy and maintenance are included in the rent price, a part of the potential savings due to sustainability measures can flow back to the owners and financiers. However, DBFMO contracts are considered very complicated and to expensive for small buildings (Bijsterveld, 2005). It is important to research how DBFMO can also be used in small scale projects in order to have a broader usefulness. A less optimistic statement however is that DBFMO leads to an upward pressure and shift of costs to the operating phase (Mol, 2008).

A less complex lease model is the All-in contracts with the net lease including reduced energy, operation and maintenance costs. This model requires incentives to reduce energy consumption. A deeper analysis of this model has to be made.

Another possible lease form is the Gross lease contract with higher rent premiums. The gross lease contract is the most commonly used lease model in the Netherlands. Recent research evidence done by P. Koppels and G. Snoei indicates that occupants of office buildings independent of the energy label are prepared to pay a maximum of 76% of the financial gains by reduced energy consumption as a rent premium (Koppels, Snoei, 2009).
2.2.6 Dependence on energy prices

An interesting aspect of sustainability measures is their potential dependence on the energy price. At present many people have the fears that because of the recent drop of the oil price, the investments in sustainability will stay behind. Evidently there is some misunderstanding of the relation between the spot market of oil and the energy market with long term, fixed price, oil contracts. Where the oil spot market reflects rapid changes in the market through harsh price fluctuations, the energy market shows a more moderate fluctuation. Therefore the rapid drop of recent oil prices will not truly be reflected in energy prices.

Looking at the prognosis of the amount of energy the resting world fossil fuels can deliver for the years to come combined with the continually rising population and energy demand per capita, one can draw the conclusions that the energy price will rise explosively. The least of all worries is therefore the fear for lowering energy prices. If sustainability is indeed strongly connected to the energy price, the coming energy crisis will only strengthen the business case for sustainable building.
2.2.7 Potential effects of sustainable building

Initial literature review showed a large variety of potential effects of sustainable building. The effects can be separated in direct effects related to sustainability measures and indirect effects. The indirect effects are resulting from the direct effects. For purposes of completeness the whole range of direct and indirect effects is presented. The direct effects have a better chance of delivering input for the valuation model than the indirect effects. The direct effects are better verifiable and possible to quantify than the indirect effects. Another category of important benefits are the effects from superior air quality. These benefits are often connected to sustainable building, but they actually have stronger connections to self adjustable windows and day light intrusion (Katz, Alevantis, Berman, Mills, Perlman, 2003; Leijten, 2002).

Since superior air quality falls under the study’s definition of sustainability, these benefits are also named as important additional arguments. As they are typically intangible effects with very low market acceptance, they will not be included in the valuation model. Another category that will be kept out of the valuation model is durability, because potential effects lie to far ahead in the future. Interrelations of potential effects and beneficiary actors will be drawn in the theoretical framework in chapter 4.

Direct effects of water and energy reducing measures

- Reduced energy consumption: lower operational costs for the tenant
- Reduced water consumption: lower operational costs for the tenant
- Access to better financing conditions, subsidy programs and tax credits

Indirect effects of water and energy reducing measures (are interrelated)

- Longer lease periods: more stable cash flow
- Lower vacancy risks
- Higher effective rent or net operating income (NOI)
- Higher sale premiums
- Higher rental growth
- Increased marketability
- Improved company image and reputation
- Lower capital costs
- Increased market value

Benefits of superior air quality and measures for self-regulation

- Improved company image and reputation
- Increased occupant comfort and wellbeing
- Lower sick leave and increased occupant productivity
- Fewer sick-building syndromes
- Increased marketability

Benefits of durable materials

- longer useful life span
- Reduced cleaning costs
- lower maintenance
2.2.8 Effectiveness of measures

Several surveys show that the energy consumption of the reviewed buildings is actually 25% higher than could have been expected on the basis of the implemented measures (Elkhuizen, Scholten, Rooijakkers, de Knegt, Deutz, 2006). 85% of the extra energy consumption is the result of ill functioning climate systems during the realization and operating phase. The causes for this ill functioning can be divided in 4 groups:

- **Technique**
  - Energy effective techniques are defective or do not work optimally
  - Effects are not measured leading to a lack of feedback
- **Market**
  - Financial drive is missing
  - Market barrier: costs and benefits on account of different actors
- **Process**
  - Poor maintenance and installation management
  - Performance of systems is not a part of the contract between actors
- **Knowledge**
  - Internal knowledge and education level is insufficient to guarantee correct use of the installations.

Contractual models like DBMFO can help increase the effectiveness of sustainable measures. They integrate building performance in the contracts and include services such as maintenance and installation management.

2.2.9 Valuation of sustainable Real Estate property

The valuation profession handles a wide range of valuation methods. These methods vary from traditional sales comparisons to artificial neural networks and hedonic price modeling. The valuation profession is traditionally rather conservative and often relies on sales comparisons from a database of millions of square meters, leading to the exclusion of developing and or emerging trends. This creates extra complexities when dealing with changing markets as we perceive today. The valuation profession is doing a large deal of research regarding the valuation of sustainable property. In the Vancouver Valuation Accord (Vancouver Valuation Accord, 2007), over 140,000 valuation professionals placed their commitment to work towards embedding sustainability within valuation practices.

Through literature study the Discounted Cash Flow method was identified as the most suitable method to assess the valuation of sustainable buildings (Green Building Council Australia, 2008). The DCF method is perceived as the most transparent method in reflecting the various aspects of sustainable building.
2.2.10 Regulation and subsidies

Regulations for energy performance of office buildings are not yet forceful enough to press the real estate sector towards sustainable development. The Energy Performance Coefficient standards (EPC) are dropping from 1.5 in 2006 to 1.1 in 2009 (Hulshof, 2009). The EPC standard expectation for 2020 is an EPC of 0 to 0.5, with an EPC of zero meaning an energy neutral building. This can also be achieved through buying “green energy”.

![EPC demand expectation till 2020](image)

Fig. 3 EPC demand expectation till 2020. (Van der Ham, 2004)

An important driver of sustainable development is the government, the largest tenant of Dutch office space. New regulation called Duurzaam Inkopen 2010 is becoming effective in 2010. As of 2010, the Dutch government has to acquire and rent property according to the guidelines of sustainable acquisition: 100% of their newly acquired office buildings need to have minimal Greencalc+ score of 200 or have an GPR score (Gemeentelijke Praktijk Richtlijn) of at least 7.0. New rental space is required to have at least an energy C-label (EI score between 1.13 and 1.3).

The green finance agreement is a stimulation tool for sustainable projects with a positive effect on the environment. As a result of tax benefits for “green” savers and investors a bank can offer a loan for lower interest rates to investors and developers of sustainable real estate. On average the interest rate reduction is around 1.5% (www.senternovem.nl; www.rabobank.nl). In order to be taken into consideration for the green finance agreement, the object under development has to have a green finance declaration. To get this declaration the building has to perform 30% better than the building code requirements. The declaration is valid for 10 years.
2.3 PROBLEM STATEMENT

Mainstream financial professionals are unwilling to include sustainability issues in property investment and financing decisions until the financial sector understands the benefits of green to the net value of an asset (RICS, 2005).

There is a lack of insight on the relation between sustainability measures and their effects and the valuation of sustainable office buildings. At present, appraisers do include in their valuation assessments the additional costs associated with the buildings sustainable accreditation level (varying between 0.66% and 12% for LEED; Katz et al, 2003) but not the benefits. Appraisers refuse to take these benefits into account because “there is no market demand for valuations that incorporate sustainability effects”. This is the result of a rather conservative profession since decades which is continuing with the same business as usual despite the fact that we are currently in a rapidly changing market.

It is the duty of appraisers to reflect property values are accurate as possible. Not taking into account the potential benefits leads to lower expected market values than appropriate, rendering many planned sustainable designs unfeasible. When the development of sustainable office buildings is to increase, it is essential that the relationship between value and sustainability is acknowledged as well as included in the value assessments of new office buildings.

2.4 GOALS

The main goal for this research is to increase the application of sustainable measures in the built environment. By incorporating the benefits of sustainable building, in particular the energy consumption reducing measures, into valuation assessments, future market values can be predicted more accurate. This results in a stronger investment motivation for sustainable office buildings.

The final goal of this study is to develop a future value assessment method for sustainable office buildings. This will be accomplished by analyzing existing value assessment reports of built sustainable office buildings and testing the outcome of those reports with the future value predicted by the new method of this study.

2.5 RESEARCH BOUNDARIES

This research will be limited to the effects of water and energy consumption reducing measures on the valuation of office buildings. The owners, financiers and tenants of office buildings have more experience in looking at longer term effects. They are expected to make decisions largely based on calculations and experience whereas consumers on the housing market make decisions based mainly on emotion. Also, house buyers usually have no idea how high the energy costs of a new house are (Kompier, 2008), whereas office tenants show a strong focus on efficient energy use (Jones Lang LaSalle, 2008).

Other aspects of sustainable design such as durability, flexibility, superior air quality and material use are not taken into account in this study because the effects they show are unpredictable and intangible as opposed to the effects of water and energy efficiency. The (inter)relation of the effects derived from energy and water efficiency with the benefits from the other aspects will be described. They will not be used for input in the valuation model.
2.6 RESEARCH QUESTIONS

The research on added value of sustainable design has a wide scope. In order to cover the concept of added value of sustainable building it is necessary to do a diverging literature study followed by a converging analysis. The diverging study is based on the following research questions related to the topic of added value, sustainability, valuation of sustainable offices, and sustainable development within the context of energy consumption reducing measures in office buildings. The theoretical research will be followed by an empirical qualitative study under Dutch Real Estate professionals to embed the theoretical framework in the Dutch valuation practice.

2.6.1 Main research question

What is the effect of sustainability measures, in particular the measures to reduce energy consumption, on the value of office buildings and how should these effects be implemented in a valuation method for sustainable office buildings?

2.6.2 Background questions

What is sustainability?

How can the energetic sustainability of buildings be measured and quantified; which systems are available?

What are current and upcoming governmental policies relating sustainability?

Which valuation assessment methods are commonly accepted and used in the Netherlands?

2.6.3 Sub questions

What are known effects of sustainable, energy efficient, office buildings?

What are probable financial effects of being unsustainable in the future?

Do current valuation methods accurately assess the value of sustainable buildings?

Which benchmark should be used to best assess the energy saving potential of the office building under appraisal in order to use the energy saving as added value?

Which valuation method is most suited to adaptation for the appraisal of sustainable buildings?

How can potential added value be used to increase the investment budget for sustainability measures?

How can current valuation methods be adjusted in order to best assess the value of a sustainable office building?
3 METHODS

3.1 RESEARCH DESIGN

Figure 4. Research Design
3.2 LITERATURE STUDY

The explorative literature study was performed in order to define the problem statement and to shape the theoretical framework. The framework served as basis for the empirical research element of this study.

3.3 SEMI-OPEN INTERVIEWS

Interviews were held with multiple actors from the Real Estate process to verify the theoretical framework: appraisers, developers and investors. The framework served as a base for the question structure of the interviews. The interviews were held on a semi-open setting in order to obtain a complete view from the respondents.

The interviews were held to identify the best valuation methods and adjustable valuation parameters according to the leading appraisal companies in the Netherlands. Information, perspectives and opinions were gathered on valuation methods, assessment tools, current valuation practice and best valuation practice with regards to sustainable office buildings.

3.4 TRIODOS TEST CASE ANALYSIS PAPENDORP

The Triodos Bank agreed to share portfolio information to be analyzed in this study for further insight in the current valuation practice for sustainable office buildings under Dutch appraisal professionals. Next to the portfolio information a case study performed by Guus Berkhout from the Triodos Sustainable Real Estate Investment Fund was shared to offer perspectives on bandwidths of adjustments in the valuation parameters. This case study resulted in the initial quantitative elements in the proposed valuation method.

3.5 ONLINE SURVEY

The online survey functioned as support to the interview and test case results. The survey attended to valuation methods, opinions on the value of sustainable office buildings and potential adjustments in the valuation methods.

3.6 SENSITIVITY ANALYSIS

The interviews, survey and case study resulted in an initial valuation method proposal. A sensitivity analysis was applied to the proposed method to check whether the adjustments in the method were not over sensitive; were the bandwidths of the adjustments too large, is the value increase not to high.

3.7 EXPERT PANEL REVIEW

The proposed method is presented to valuation experts for a expert panel review. Comments of the experts will be used to improve the method.

3.8 ROZ IPD GUIDELINE VALUATION OF SUSTAINABLE OFFICE BUILDINGS

Conclusions of the study result in ROZ IPD guidelines for the valuation of sustainable office buildings and the buying and selling advice of this type of building.
4 THEORETICAL FRAMEWORK

4.1 EFFECTS OF SUSTAINABLE BUILDING

The effects of sustainable office design should be seen as a chain of reactions that be categorized in 4 main clusters: Environmental effects, direct financial effects, indirect financial effects and social effects. Environmental effects are mainly caused by the used material type, compact building and the water and energy consumption of a building. Direct financial effects are connected to the risks appointed to a specific property, to lease models and to operational costs. Indirect financial effects are the result of the direct effects. In a chain reaction the indirect effects and social effects follow the direct effects of lower energy consumption. Social effects relate to the health, safety, comfort and wellbeing of the occupant.

At present, developers see the comfort and wellbeing of the occupant as an important motivational argument in marketing strategies to attract tenants (NEPROM, 2009; Lorenz et al, 2008a). This research focuses on the effects of energy efficient building. For completeness of the report, additional spin-off effects such as the social effects are named and possible connections with the indirect effects described and explained.

Effects can be divided in direct effects and indirect effect. The direct effects result in a chain of indirect effects. The potential effects of the direct effect are presented in the following two flowcharts of the chains of effect.

FLOW CHARTS

Following the line of logical reasoning the effects were placed in two different flow charts: one for the income stream perspective and one for the all-risk yield assessment perspective. The income stream of a sustainable office building in combination with its connected all-risk assessment will form the basis of the valuation method for sustainable office buildings.
Effect flow income stream perspective

The flows of effects are based on rational argumentation. The first chart is related to the income perspective:

![Flow chart indirect effects sustainable building: Future income](image)

Figure 5. Flow chart indirect effects sustainable building: Future income
**Effect flow all-risk yield assessment perspective**

The second flow is based on the perspective of risk assessment:

The lower energy usage will lead to improved tenant image and tenants can use the EPC value or the building label for PR reasons. This increases the marketability of the property by offering additional arguments in favor of renting.

Lower energy usage will protect the property against rising energy prices and necessary upgrades to the building in case of tightening performance regulations.

Lower energy usage will lead to lower gross leases for tenants because of the lower operating costs. Lower gross rents have positive effects on the vacancy, result in longer lease periods and tenant retention with more stable cash flows as a consequence. Lower gross rents also offer an increased marketability. Increased marketability in turn leads to easier letting and again to lower vacancy.

Together this leads to a lower risk assessment than without considering sustainability effects, which in turn accumulates in a lower acceptable yield for investors.
4.1.1 Direct financial effects of energy consumption reducing measures

**Lower operating costs**
As a result of the increased energy efficiency, the amount of consumed energy will drop. A drop of energy consumption will evidently result in a lower expenditure for energy. How much water and energy a sustainable building will consume depends on the energetic characteristics of the building. There is not a predetermined amount of water and energy that a sustainable building will consume. Research on the energy performance throughout the world show a big range in results:

Studies in Australia on Green Star office buildings show on average a reduction of 85% in energy consumption and 60% in water consumption compared to non Green Star buildings (GBCA, 2008).

Studies in America on LEED accredited buildings showed that depending on the level of improvement, water and energy usage savings at least exceed 10% and could well be over 50% compared to unsustainable or unaccredited buildings (CBRE 2009; Katz et al, 2003)

Another study performed in 2003 by Katz et al on the performance of LEED buildings in America revealed reductions of 30% in energy consumption, 23% in water usage and 50-75% in waste production (Katz et al, 2003)

So, depending on the energy efficiency of the building (measurable with EPC calculations) and the share of energy costs in the total operating costs of the building, the operating costs will lower.

To what extend the lower operational costs are connected to the energy performance of an office building will be analyzed. To examine this, the database of the ROZ/IPD and SenterNovem will be used. The ROZ database contains valuation reports of over 100,000 m² office space in the Netherlands including their operating costs. Operating costs and energy usage from the ROZ data base will be connected with the EPC rating from SenterNovem (when they are not included in the ROZ database). At that moment, conclusions can be drawn to the extent of proportionality in the relation between EPC and operating costs.

On average, the energy consumption accounts for 30% of the total operating expenses of a typical office building (CBRE, 2009). When we consider that an office building consumes about three times its initial capital costs over a 25 year period with operating costs (Kotaji, Schuurmans, Edwards, 2003) the relevance of significantly lower operating costs is clear.

The effects of reduced energy consumption will be further enhanced by the upcoming EU Emission Trading System (ETS) in 2012. The ETS is based on the recognition that creating a price for carbon emission offers the most cost-effective way to achieve the deep reductions in global greenhouse gas emissions that are needed to prevent climate change from reaching dangerous levels. THE ETS will drive the price of energy to further heights (European Communities, 2008). When the price of energy increases, the difference in operating costs of sustainable offices compared to non sustainable offices will grow.
The upcoming energy crisis as a result of continually rising population, increased energy consumption per capita and the depletion of fossil fuels in the near future will be a further driving force of the energy price.

**Access to better financing conditions, subsidy programs and tax credits**
Performing according to predetermined standards on EPC can give the building access to tax benefits, direct subsidies and better finance conditions. The Dutch government had established specific tax regulations like the MIA, EIA and VAMIL.

The MIA decrees that entrepreneurs who invest in environmental friendly ways and means can reduce up till 40% of the investment amount on the fiscal profits.

The VAMIL offers entrepreneurs that invest in environmental friendly ways and means can write off these means.

The EIA offers entrepreneurs financial benefits on investments in energy reducing measures or in sustainable energy production.

Further benefits can also be found in the banking sector in the Green Financing arrangement. The Green Finance scheme is a spin-off from tax regulations in the Netherlands and other non-OECD countries on sustainable investments. Banks can provide loans with lower interest rates to companies that invest in sustainable projects because of the lower tax implications for capital gains from these investments. (www.senternovem.nl, www.rabobank.nl)

**Lower resource use and raw material depletion**
The last clear direct effect from lower water and energy consumption is of course the lower depletion of resources and raw materials. However this effect can not be transformed in a financial input for the appraisal of an office building.
4.1.2 Indirect financial effects of energy consumption reducing measures

The indirect effects of a water and energy efficient building can be look at from 2 different perspectives: the all-risk yield assessment and the income assessment. Both perspectives are defendable and should probably both be used as input in the valuation model. The potential indirect effects were:

- Higher effective rent or net operating income (NOI)
- Lower vacancy risks
- Longer lease periods: more stable cash flow
- Improved company image and reputation
- Increased marketability
- Higher sale premiums
- Higher rental growth
- Lower capital costs/risk yield
- Increased market value
- Future proofing

Studies from literature show the following results regarding these effects:

**Higher effective rent or NOI, direct return**

Various studies show evidence of higher effective rents or higher direct returns as a result of the higher effective rents.

Recent research performed on the financial performance of sustainable buildings in America showed an increase of 2-3 % in the direct return. When corrected for the lower viewed vacancy, the return even showed an increase of 6 to 9 % (Eichholz et al 2008).

A study of the US market by McGraw Hill found that sustainable buildings delivered an operational cost decrease of 8-9% and the return on investment (ROI) improved by 6.6% (GBCA, 2008). A study performed in Canada showed similar results.

Research in the US showed a 6% higher rent for sustainable office buildings than for comparable office buildings in US (CBRE, 2009).

Tenants increasingly anticipate total costs instead of bare rents. If the amount of the operating costs is low, investors can realize higher rents (Steixner, Koch, Bienert, 2008).

The average tenant is willing to pay a maximum of 76% of the expected financial benefits as a result of lower water and energy consumption, despite the energy label of the building (Koppels et al 2008).
**Vacancy**
As a result of the lower operational costs of sustainable buildings, unsustainable buildings face a reduced demand. This leads to an increasing vacancy (RICS, 2008):

Sustainable office buildings showed a higher and more stable occupancy ratio than comparable unsustainable buildings. (Eichholz et al, 2008)

A study of the US market by McGraw Hill found that LEED accredited buildings perceive an increased occupancy ratio of 3% compared to non LEED accredited ones. (GBCA, 2008)

**Higher sale prices, indirect return**
Recent research performed on the financial performance of sustainable buildings in America showed an increase of 16% of the indirect return of American green labeled office buildings (Eichholz et al, 2008).

Case studies of Green Star office buildings in Australia revealed an increase in building market value of 7.5% compared to non Green Star office buildings (GBCA, 2008). The majority of investors indicated that they were willing to pay this premium because of the improved marketability as main competitive advantage.

**Decreased value of non sustainable property**
Placing sustainability in property-related decision-making leads to a clear win-win situation for all. The realization of this will depend upon a dialogue and convergence between supply and demand side actors as well as those involved in governance. But the reverse is also true: unsustainable property investment and management practices will lead to losses with regard to financial performance and asset value. (Lorenz et al, 2008)

At least non-Green Star buildings will face accelerated value depreciation compared to Green Star buildings (GBCA, 2008).

**Future Proofing**
Sustainable buildings are better equipped for adapting to changes in the future. The expected ETS and the upcoming energy crisis are expected to increase the energy prices in such a way, that tenants will start to become more critical on the operational cost of office buildings. This will lead to a lowering in the demand for unsustainable office buildings, rendering them increasingly obsolete (GBCA, 2008).

A lower EPC norm is expected in the future. In 2020 the EPC performance indication of office buildings will be 0 (www.SenterNovem.nl). Existing buildings will not have to comply with that strict norm, but refurbishments and additions will by necessary. This implies additional costs in the future for unsustainable buildings.

Looking at the fossil fuel crisis to come and the highly probable explosive rise in energy price, the demand for energy efficient buildings in the future will only rise. It can even be stated, that non-energy efficient buildings will become obsolete due to rapid rising operational costs and as a result of that, lower market demand. (Lützkendorf et al, 2008)
**Longer lease periods**

Expert counseling in Australia revealed a longer lease term preference for sustainable buildings than for unsustainable ones. Green tenants preferred long-term lease periods of around 15 till 20 years. (GBCA, 2008)

The result from the US study done by Eichholz et al of a higher and more stable occupancy ratio for sustainable buildings also indicate a longer lease period. Naturally lower vacancy risks and longer lease periods share a connection (Eichholz et al, 2008)

**Rental Growth**

Studies in the US on sustainable buildings showed a rental growth of 8.2%, whereas non sustainable buildings revealed a growth rate of: 7.2% (CBRE, 2009)

During interviews with over 100 real estate professionals and valuation experts in Australia, over 85% considered long term rentals growth as one of the main market impacts of sustainable office buildings (GBCA, 2008).

**Marketability**

In Australia, the majority of investors indicated that they would pay more for a Green Star building. The reason for this is the improved marketability of Green Star buildings as main competitive advantage: they are easier to sell and lease. (GBCA, 2008)

German valuation experts see improved marketability as a result of energy and water efficient building. (Lützkendorf et al, 2008)

Marketability is an important expected impact of sustainable buildings. This is mainly related to the rising demand in combination with a shortage on the supply side. (Lorenz et al, 2008a). In the future this effect can be expected to be lower.

**Capital Costs/all-risk yield**

German valuation experts expect energy efficiency and water savings to result in a reduction of risks through changes in water and energy prices, improved marketability and reduced risks of becoming obsolete as result of changing norms (Lützkendorf et al, 2008),

Interviews with Austrian valuation experts indicate that lower yield are theoretically possible. Small changes in the all-risk yield result in a huge impact, this makes it harder to control. (Steixner et al, 2008)

Multiple case studies of Green Star buildings in Australia performed by the GBCA revealed reduced capitalization rates varying between -0.25 and -0.5% (GBCA, 2008).

Subsidies, tax regulations and Green Finance schemes enable investors to get tax benefits on investments in sustainable measures and or to receive lower interest on loans from banks (SenterNovem; VROM; Rabobank; ING; Triodos Bank)
The added value of Sustainable Design

Peter van den Tol

Technical University Delft – Faculty of Architecture – Real Estate and Housing - DCM

The indirect effects described previously are backed up by results from interviews with real estate professionals in Australia by the Green Building Council:

Figure 2: Market Impact of Green Buildings

Table 2. Economic market impact of sustainable buildings [Green Building Council Australia, 2008].

Figure 1: Economic Impact of Green Buildings // *Scale: 1 equals no weight - 5 equals most weight

4.1.3 Benefits of superior air quality and measures for self-regulation

The benefits from superior air quality and measures for self-regulation of daylight and temperature are described. However the market acceptance for these intangible benefits is limited (GBCA, 2008).

**Improved marketability**

The use of environmental friendly and non-toxic materials can increase the image and reputation of potential occupants. This delivers additional arguments for an improvement in marketability. (Lützkendorf et al, 2008)

**Increased occupant comfort, wellbeing, productivity and sick leave**

Several research studies show that there is a direct correlation between sustainable design and a 6 to 16% increase in labour productivity. This mainly relates to indoor climate quality, natural ventilation and non toxic materials. Other results are significant lower sick leave by improved indoor environmental quality and individual control over thermal conditions (US Department of Energy, 2003).

Superior air quality due to natural ventilation and non-toxic and environmental friendly materials result in an increased occupant comfort and wellbeing (Katz et al, 2003).

Individual control over the climate in offices (Temperature, air, light, acoustics) lead to increased wellbeing, lower sick leave and higher occupant productivity (Linden, 2002).

A high quality indoor climate contributes to an increase in productivity. Thermal climate and air quality are important aspects in this matter (Boerstra, 2004).

Research to the effects of indoor climate on health and wellbeing show an increased occupant productivity of 10-15% and a lowering in sick leave of max 2.5% compared to offices with a bad indoor climate (Leijten, 2002).

4.1.4 Benefits of durable materials

Longer useful lifespan, reduced cleaning costs and lower maintenance are named as potential benefits of sustainable design. However, they are not effects of sustainable building but of high quality materials. Reduced cleaning is more an effect of type of use and filth production by carpets. The potential benefits of durable materials are too strongly derived from qualities and conditions of the equipment used to be able to generalize. Also the financial benefits lie too far ahead in the future to be able to make credible predictions. They are named for completeness of the report.

4.1.5 Overview total effects of sustainable office buildings

In the table on the following page from Lützkendorf and Lorenz the effects of sustainable building are connected to sustainable measures and the beneficiaries. Categories B1, B2, B3 and B4 are the most quantifiable and have the strongest relation to sustainable building. They are also the categories with the strongest effects.
Table 4: Effects of sustainable design on building value related to actors. (Lützkendorf, et al, 2008)

<table>
<thead>
<tr>
<th>Environment</th>
<th>Society</th>
<th>User/Tenant</th>
<th>Developer/Owner/Landlord</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presumption of Redundancy</td>
<td>Environmental benefit</td>
<td>Higher operating costs</td>
<td>Higher rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Reduction of waste on the site</td>
<td>Environmental profit</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Lower resource use and new materials</td>
<td>Lower environmental impact</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Reduction of energy costs, improved</td>
<td>Easier sale and development</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Material</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Health</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Social design and functionality</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>User satisfaction</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Higher satisfaction of needs and wants</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Improved operational performance and local</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Higher operational performance, more efficient</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Access to lower turnover; enhanced comfort;</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Improved operational performance and local</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Training of clients/tenants</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Education/rediscovery</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Long-term, regulation costs</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Reduction of maintenance costs</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
<td>Maintenance of existing costs</td>
<td>Improved social benefits</td>
<td>Lower operating costs and net present value</td>
<td>Lower rental rents; more value; less maintenance needed</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

Source: Lützkendorf and Lorenz (2007)

= strong/direct impact; = weak/indirect impact
4.2 LEASE CONTRACTS

Techniques are already there, lot of research is done on the possible effects of sustainable building but how do we get these benefits to the investors?

Which kind of contracts/financing/lease constructions are available and acceptable for dividing costs and benefits amongst all actors?

Lease terms can have large impacts on the value and feasibility of sustainable developments. When leases are set up in such a way that merits from sustainable measures are beneficiary only for tenants, the incentive for investors and developers to develop in a sustainable manner are absent. So which types of lease models are available and acceptable to create such a beneficiary division of costs and benefits of sustainable building?

One of the upcoming contractual models that real estate property professionals have increasing confidence in is the DBFMO model. In the DBFMO model tenants pay rent to a consortium of companies that delivers a plug and play package of a complete building including facilities, water and energy and maintenance (Geerligs, 2006). Because the water, energy and maintenance are included in the rent price, a part of the potential savings due to sustainability measures can flow back to the owners and financiers. However, DBFMO contracts are considered very complicated and too expensive for small buildings (Bijsterveld, 2005). It is important to research how DBFMO can also be used in small scale projects in order to have a broader usefulness. A less optimistic statement however is that DBFMO leads to an upward pressure and shift of costs to the exploitation phase (Mol, 2008).

A less complex lease model is the All-in contracts with the net lease including reduced energy, operation and maintenance costs. This model requires incentives to reduce energy consumption. A deeper analysis of this model has to be made.

Another possible lease form is the Gross lease contract with higher rent premiums. The gross lease contract is the most commonly used lease model in the Netherlands. Recent research evidence done by P. Koppels and G. Snoei indicates that occupants of office buildings independent of the energy label are prepared to pay a maximum of 76% of the financial gains by reduced energy consumption as a rent premium (Koppels et al, 2009).

For all lease models regarding sustainable buildings longer rental periods can be negotiated (Green Building Council Australia, Valuing Green, 2008).
4.3 PERFORMANCE INDICATORS

4.3.1 Energy Performance Building Directive (EPBD)

On January 2004 the EPBD (Energy Performance of Buildings Directive) was published. This performance indicator is a European Union guideline that was designed to lead to an improved energy performance of the buildings within the European community. The idea was that a building with a "better" energy label would generate higher incomes, enhancing the drive of building owners and developers to improve the energy efficiency of their properties.

The EPBD required new developments and existing buildings to present an energy performance certificate when the object was to be sold. In order to define the value of the label (A++, A+, A, B to F) the Energy Performance Advice (EPA) assessment tool was developed. This tool has the capabilities to calculate the characteristic energy consumption of the building specific installations. (SenterNovem 2008; www.epaenergielabel.nl)

In the EPA report, the CO2 emissions of the building, the energy consumption of the building specific installations and potential improvements to enhance the energy performance in the future are presented. The calculation of the characteristic energy consumption: Qperformance;total (Qpres;tot) and the allowed energy consumption: Qperformance;allowed (Qpres;toel) is based on the NEN code 2916. Qperformance;allowed divided by Qperformance;total leads to the Energy Index (EI) score. For new developments the EI score is required to be at least 1: Qpres;tot/Qpres;toel ≤ 1.0 in order for the project to get a building permit. The EI score determines the label value.

\[
\frac{Q_{\text{total, EI new}}}{155} \frac{A_{\text{Gr, EI new}}}{106} \frac{A_{\text{Gl, EI new}}}{9560} \leq 1.0
\]

In which:
- \( Q_{\text{total, EI new}} \) = yearly energy use of a house (MJ)
- \( A_{\text{Gr, EI new}} \) = total ground surface (m²)
- \( A_{\text{Gl, EI new}} \) = total thermal transmission surface (m²)

Figure 7: EI formula (Entrop, Reinders, Brouwers, 2008)

Figure 8: EPBD label with EI scores (www.senternovem.nl)
4.3.2 BRE Energy Assessment Method NL (BREEAM NL)

The BREEAM assessment method consists of a weighted checklist system and software tools to judge the environmental impact of the building in question. Based on previously established criteria with weighted points per aspect a total score for the building under assessment can be given. Depending on the score of the project and the score range attached to the label review the object is given a label: Poor, Pass, Good, Very Good and Excellent.

The BREEAM method is initially developed in the UK and is now introduced in the Netherlands after alteration by the Dutch Green Building Council (DGBC) as BREEAM NL. The method is still under development and more tools are being developed at present by the DGBC for new developments and area development. (SenterNovem, 2008)

4.3.3 Leadership in Energy & Environmental Design (LEED)

The certification method LEED (Leadership in Energy and Environment Design) has been under development since 2000 by the United Stated Green Building Council (USGBC). LEED is a voluntary, open and on consensus based certification tool that assesses the building in question based on a total score. Previously determined aspects with weighted scoring points determine the total score of the project. The total score determines the certificate of the building: LEED Certified, LEED Silver, LEED Gold and LEED Platinum (the highest score). The LEED tool is based on the BREEAM UK method.

4.3.4 Energy Performance Coefficient (EPC)

The EPC is similar to the EPBD EI calculation method but uses a different formula to determine the score:

\[
\text{EPC} = \frac{Q_{\text{total,EPC}}}{330 \times A_{gEPC}^{\text{total,EPC}}} + \frac{65}{A_{gEPC}^{\text{total,EPC}}} + \frac{1}{C_{EPC}}
\]

In which:
- \(Q_{\text{total,EPC}}\) = yearly energy use of a house (MJ)
- \(A_{gEPC}^{\text{total,EPC}}\) = total ground surface (m²)
- \(A_{gEPC}^{\text{total,EPC}}\) = total thermal transmission surface (m²)
- \(C_{EPC}\) = correction factor (-)

Figure 9: EPC formula (Entrop, Reinders, Brouwers, 2008)

The EPC score is a dimensionless value (coefficient) that indicates the essential energetic capacities of a building with the installations included. Most governmental regulations, subsidy programs and guidelines use specific EPC scores as minimal requirements. These EPC score requirements are increasingly tightening. In order to keep the value neutral and uncompromising for buildings with less efficient proportions or with air conditioning, the EPC calculation includes correction factors for age, building size and air conditioning.

At present professionals believe the EPC method to be at its system limits: an EPC score below 1 is seen as less reliable (SenterNovem, 2008).
4.3.5 GreenCalc+

The GreenCalc+ method is the most extensive assessment tool for the level of sustainability of buildings. The tool offers a single value: the environment index based on the energy consumption, water consumption, material usage and accessibility. The environment index can be connected, alike the EI score, to the EPBD label system.

Next to the environment index, the GreenCalc+ tool can calculate the EI score, EPC score, EPL and WPC. (www.greencalc.com)

![GreenCalc+ score per label](www.greencalc.com)

Figure 10: GreenCalc+ score per label (www.greencalc.com)
4.4 Valuation of sustainable Real Estate property

The presented theoretical effects of sustainable building and of energy efficiency in particular are not to be neglected. Even though the appraisal profession is relatively conservative, it cannot ignore results from frontline countries such as Australia, Canada and Germany. They might be countries with a higher awareness for the environment, but nonetheless the given results as promising. It is only a matter of time that countries like the Netherlands will follow.

A crucial role lies now with the appraisers to include these effects in the property valuations and with developers to accept and demand these inclusions. Only by incorporating the benefits in the value assessments it is possible to create a solid business case for the additional costs associated with sustainable building. Depending on the level of accreditation or energy effectiveness these additional costs vary between 2-12% for integrated design (Katz et al., 2003). Recent studies performed by the CEC in North America however show a range over additional costs between 0 and 5% (CEC, Green Building in North America, Canada, 2009). Results are already there, that it is possible to make sustainable buildings within standard budgets but for those cases arguments for additional funding are less pressing. With the benefits of sustainable building included in valuation assessments, the budgets for sustainable measures can increase.

To decide which method of valuation is most suited for assessing the value of sustainable office buildings a short analysis of common valuation methods is necessary. For assessing the value of the property in question, the perception of market value according to the Red Book of the RICS is used:

"The estimated amount for which a property should exchange on the date of valuation, between a willing buyer and a willing seller in an arm’s length transaction after proper marketing wherein the parties had acted knowledgeably, prudently and without compulsion."

4.4.1 Valuation Methods

Sales Comparison, Direct Comparison
The sales comparison method relies on tangible evidence from sales and leasing contracts. Transactions of office building with similar properties are compared with one another and adjusted for dissimilarities to arrive at a value. Usually a comparison is made based on location, building characteristics and a rent rate per m². Influencing factors that are compared and if needed corrected for are: Date of sale, age, terms and conditions of sale, land dimensions, size, design, condition of improvements, income and lease covenants, topography, zoning and other building specific properties. This method requires sufficient recent transparent homogeneous transactions: at least 10.

A complicating factor for applying this method in the valuation of sustainable office buildings is that this evidence from sales and lease contracts alone is still missing. Work on an evident database for the Netherlands is under way, but within the coming year this database will remain insufficient. Also due to no current agreement on certification labels and the untransparency of the financial performance of properties, this database will only be filled slowly.
**Income capitalization, Investment Approach DCF**

In the income approach, the relationship between the acquisition price and the anticipated future income and expenditure stream of a real estate property is studied. The acquisition price offered or obtained should be at least the same and preferable exceed the anticipated net income stream. The expected income stream is based on the rental income, vacancy, operating expenses, management costs, taxes, insurance and capital expenditures. The total net income stream is then adjusted for inflation in time in a DCF model through a capitalization rate derived from analysis or similar transaction comparisons. The capitalization rate is based on the return required by potential investors and adjusted for appropriate risks. Incorporated in this method are also the depreciated replacement costs to predict the exit value (also called terminal value). Variables should be based on market research and evidence for additional argumentation.

A danger of the income approach lies in the assessed operating period and risk yield. Small misalignments in the yield can generate wide fluctuations in the possible investment and IRR.

A key advantage of the DCF income approach is that it provides a more accurate and transparent profile of value across the forecast holding period, enabling more critical decisions to be made. (Mansfield, 2009). Also the DCF allows for clear adjustments in variables that are defendable by market research.

\[ GMV = \sum_{t=1}^{n} \frac{NOI_t}{(1+r)^t} + \frac{SP}{(1+r)^t} \]

Formula for the Discounted Cash Flow calculation. (Hordijk, Nelisse, Kroon, 2004)

- GMV: Gross Market Value
- NOI: Net Operating Income
- r: Discount rate
- SP: Sale Proceeds, NOI year after final year DCF period

**Income approach All-Risk Yield, Direct capitalization**

The All-Risk yield method also uses an expected income, but does not use a capitalized cash flow. The yield comprises a risk-free yield connected to the return on state bonds and additional risk yields for risks in inflation, vacancy, rental growth and other property specific risks. In this method the rent of year 1 (Rent year 1 * m² lettable floor area) is divided by the all-risk yield. An example of a 5000 m² office building with a rent of 175 euro/m² and an all-risk yield of 7% results in a value of: 5000*175/7% = 12.5 million euro. This method is often used as a quick feasibility check by developers.

\[ GIY = \frac{CRP}{GMV} * 100\% \]

Formula for the Discounted Cash Flow calculation. (Hordijk, Nelisse, Kroon, 2004)

- GIY: Gross Initial Yield, All-Risk Yield
- CRP: Current Rent Passing
- GMV: Gross Market Value
Cost Approach, Replacement approach
The Cost or Replacement approach analyses the costs to replace or reproduce the property under appraisal. By only looking at the cost side of a property, the benefits of sustainable design are neglected. The often higher costs for sustainable buildings result in a potential disproportionately cost reflection, impacting debt without recognizing the value benefits.

Advanced Valuation Methods
Most valuation professionals recognized the DCF method as the most appropriate and suitable method to assess the value of sustainable buildings (GBCA, 2008). But elsewhere, Lützkendorf and Lorenz assert that in order to more accurately establish the impact of sustainability on the market value, it is necessary to employ more advanced valuation techniques, such as artificial neural networks, auto-regressive integrated moving average (ARIMA) and hedonic pricing, to determine which sustainable features affect market value and their impact on it. (Mansfield, 2009). However, since these methods are not within the capabilities of the researcher, they will not be used.

4.4.2 Effect of sustainability measures on valuation
Concluding the section of the effects related to sustainable office buildings the following adaptable variables for the DCF of all-risk yield income method were identified. The appraiser has to be aware of double input of potential effects in the model. For instance not both lower operating costs as result of lower energy consumption and also higher rents. A higher rent is only possible when the tenant pays the energy himself.

- Lower operating costs related to the EPC of the office building or higher gross lease rents in case of gross lease contracts.
- Lower vacancy risk due to longer lease periods, easier letting and increased retention
- Lower all-risk yield
- Increased vacancy for non-sustainable buildings
- Lower capital costs due to Green Financing
- Higher rental growth

Figure 11. Flow chart indirect effects sustainable building: Future income
Figure 12. Flow chart indirect effects sustainable building: All-Risk Yield assessment
<table>
<thead>
<tr>
<th>Sustainable design features</th>
<th>Benefits</th>
<th>Impacts on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility and adaptability</td>
<td>Reduction of risks through changes in market participants’ preferences (obsolescence) and through restricted usability by third parties (i.e. longer useful economic life and more stable cash flow)</td>
<td>Capitalisation/discount rate; rent projection in DCF analyses</td>
</tr>
<tr>
<td>Energy efficiency and savings in water usage</td>
<td>Reduction of risks through changes in energy and water prices; improved marketability; reduced business interruption risks (e.g. caused by power outages) through facilities that derive energy from on-site resources and/or have energy efficiency features</td>
<td>Operating costs; capitalisation/discount rate; rent projection in DCF analyses</td>
</tr>
<tr>
<td>Use of environmentally friendly and healthy building products and materials</td>
<td>Improved marketability; reduction of litigation risks and of being held liable for paying compensation to construction workers and building occupants</td>
<td>Capitalisation/discount rate</td>
</tr>
<tr>
<td>High functionality in connection with comfort and health of user and occupants</td>
<td>Reduction of vacancy risks or of losing the tenant(s); improved marketability</td>
<td>Capitalisation/discount rate; market rent</td>
</tr>
<tr>
<td>Construction quality; ease of conducting maintenance, servicing and recycling activities</td>
<td>Lower repair and maintenance costs; improved marketability</td>
<td>Operating costs; market rent</td>
</tr>
<tr>
<td>Compliance with/over-compliance with legal requirements in the areas of environmental and health protection</td>
<td>Reduction of risks from increasingly stringent legislation (e.g. expensive retrofitting)</td>
<td>Capitalisation/discount rate</td>
</tr>
<tr>
<td>Reduced impacts on the local and global environment</td>
<td>Image and reputation gains for owners and users</td>
<td>Capitalisation/discount rate</td>
</tr>
</tbody>
</table>

Table 5: Effects of sustainable design features on valuation factors. (Lützkendorf et al, 2008)
5 INTERVIEWS

Semi open interviews were held with 8 professionals from the Real Estate sector: 4 appraisers specialized in the valuation of sustainable office buildings from leading valuation companies, 2 investors and 2 developers.

In the interviews a wide variety of subjects regarding sustainable office buildings were discussed. In this chapter the results of the interviews are presented according to the six main themes of the interviews. Positions of the appraisers, developers and investors are compared and discussed with one another in order to assess the level of consensus on the different issues amongst the actors. The six main themes are (5.1) the elements associated with sustainability, (5.2) the vision on sustainable office buildings, (5.3) the different targets of the actors with regards to sustainable offices, (5.4) expected effects of sustainable office buildings and the (5.5) valuation of sustainable office buildings: and (5.6) adjustable parameters. The chapter will conclude with a discussion of the most interesting general remarks during the interviews followed by overall conclusions.

The results of the interviews are presented in tables to make the data suitable for cross analysis. In the table an “x” is filled in under the respondent to indicate that he or she agreed with this aspect. “X-cr” means that the respondent sees this aspect as critical, “(x)” means that the actor agrees with that aspect but has reservations about it. The names of the investors, developers and appraisers are omitted from the report in compliance with confidentiality agreements.

5.1 MAIN ELEMENTS ASSOCIATED WITH SUSTAINABLE OFFICE BUILDINGS

Which building aspects do the different actors associate with sustainable office buildings? This element of the interviews serves mainly as background information to check if actors from different working fields look the same way at sustainability.

5.1.1 Overall matrix

<table>
<thead>
<tr>
<th>ELEMENTS ASSOCIATED WITH SUSTAINABLE OFFICE BUILDINGS</th>
<th>APPRAISERS</th>
<th>INVESTORS</th>
<th>DEVELOPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced energy consumption</td>
<td>x-cr</td>
<td>x-cr</td>
<td>x-cr</td>
</tr>
<tr>
<td>Air quality/Comfort/user satisfaction</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Durability of materials; technical lifespan</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Environmental impact used materials</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Functional flexibility; layout, grid, multi-tenant capacities</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Flex concepts</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Flexibility of installation concept: Size, Replacement, adaptation</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Accessibility</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Space optimization</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Local renewable energy production</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Table 6: Effects of sustainable design features on valuation factors
5.1.2 Appraisers
All appraisers confirmed the reduced energy consumption as the critical aspect of sustainability.

A majority of the appraisers named the durability and the environmental impact of the building materials as important elements.

Flexibility issues, accessibility, space optimization and local energy production were not associated with sustainability by all appraisers.

5.1.3 Investors/Financiers
Investors mainly associated reduced energy consumption and increased air quality and comfort with sustainable office buildings. The other aspects named by appraisers and developers were less associated with sustainability by the investors.

5.1.4 Developers
The developers did not put the emphasis on the energy reduction but more on the air quality and the user satisfaction. This can be explained by the fact that the developer works for the tenant so the user satisfaction is his main concern. Apparently the developers do not fully connect energy efficiency with user satisfaction.

Durability of the building materials, flex concepts and space optimization were also associated with sustainability by both developers.

5.1.5 Discussion
In the interviews, the actors indicated several similar elements that they associated with sustainability.

Energy efficiency was named unanimously by the actors in the interviews as the critical aspect of sustainability. The comfort level and air quality of the building were also named by all actors. Interesting to note is that comfort and air quality are often assumed to be opposed to energy efficiency; high energy efficiency often involves air tight spaces; this reduces the air quality and the experienced comfort level. The developers considered the comfort and user satisfaction as the most important aspect of sustainability.

The durability of the used building materials and their environmental impact were associated with sustainability by 5 out of 8 actors.

Flex work concepts and functional flexibility were associated with sustainability by half the respondents, while flexibility of the installation concept, accessibility, space optimization and the local production of renewable energy were named by less than half of the actors.

Overall there is a consensus on energy efficiency, comfort, air quality and the durability and environmental impact of used building materials as main elements associated with sustainability.

Flex concepts and space optimization are not possible in the majority of the existing buildings so the idea occurred to some respondents that these elements are often used by developers to stimulate the demand for new developments. In other words, some respondents believe that space optimization and flex concepts are part of the developers' strategies to generate demand for new developments.
5.2 PERCEPTIONS OF SUSTAINABLE OFFICE BUILDINGS

What are the actors’ perceptions on sustainable office buildings? How do the different actors look at this relatively new type of office building?

5.2.1 Overall matrix

<table>
<thead>
<tr>
<th>PERCEPTIONS OF SUSTAINABLE OFFICE BUILDINGS</th>
<th>APPRAISERS</th>
<th>INVESTORS</th>
<th>DEVELOPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable buildings: Higher indirect returns, increased market value</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Sustainable buildings will be let out and sold easier than regular ones</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Better compliance with future regulation, demand and price changes</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>New developments HAVE to be sustainable</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Sustainable buildings: Higher direct returns, increased market value</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>A mayor role lies for appraisers mainly in a proactive role in greening up the existing stock</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>Market has to move towards the idea of Total Cost of Ownership</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>Increased demand for sustainable office buildings: policy changes</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>Energy prices continue to grow, increased pressure on energy efficiency</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>Sustainability will play role in valuation but not yet</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>No special market for sustainable office buildings</td>
<td>x</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Clearer distinction building segments: low, middle, high, Middle</td>
<td>x</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Non sustainable buildings will face reduced values, rents and increased risks</td>
<td>x</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sustainable buildings will have more stable income, lower risks</td>
<td>x</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Not focus on valuation but on buying/selling advice</td>
<td>x</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>There is a lack of sustainable office buildings in The Netherlands</td>
<td>not</td>
<td>x</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 7: Effects of sustainable design features on valuation factors

5.2.2 Appraisers

The appraisers did not have a clear shared perception of sustainable office buildings. Looking at the different described perceptions one can conclude that overall the appraisers aim at increasing the knowledge on the whole field of sustainability. They did not speak about higher direct or indirect returns, but mainly about separate parameter changes and effects of sustainability aspects on these parameters, which in return could lead to higher direct and indirect returns.

5.2.3 Investors/Financiers

The investors expect sustainable buildings to be let out and sold more easily than conventional buildings and that sustainable office buildings will therefore generate higher indirect returns. This may mean that investors would rather invest in sustainable buildings than in regular ones.
Overall the investors share the perception that sustainable buildings will perform financially better than regular office buildings.

5.2.4 Developers
The developers are aligned in their perceptions with the two investors, that sustainable offices will financially outperform regular office buildings.

The developers also believe that when they want to develop new buildings these buildings have to be highly sustainable. The developers stated that at present conventional minimal building code objects are not desired by investors and tenants unless they are in a prime A-quality location.

5.2.5 Discussion
The overall consensus amongst the actors is that sustainable office buildings will have a better financial performance than regular office buildings. 7 out of 8 actors believe that sustainable buildings will show higher indirect returns in the near future (table 7). They do not see this in the market yet, but expect this to happen. Other shared perceptions are that sustainable buildings are less perceptive to risks related to future regulation and demand and price changes. Next to that they expect that this type of buildings will be let out and sold easier than regular office buildings.

Three actors share the perception that sustainable office buildings will generate higher direct returns because of higher rent levels. They also warn to be cautious with assuming higher rents in valuations of sustainable office buildings because of a lack of market evidence.

Interestingly, the investors and developers have several shared perceptions. They all expect sustainable buildings to generate higher indirect returns, but expect higher rents less. Apparently they expect to get higher indirect returns on the selling prices, in other words they expect the market value of a sustainable building to rise faster than the market value of a conventional building.

The perceptions of appraisers show a wider variation, which is logical since appraisers do not need to have a clear vision; In their profession they mainly need to reflect the market and not predict what the market will want in the future; they have to look at sustainability with a wide perspective. The perception they all had though was that they had to increase their knowledge on sustainability aspects and effects and on how to incorporate these effects in their valuations.

While the shared perceptions of the actors refer to higher expected future values for sustainable buildings than for regular ones, they mostly remain reserved to reflect this in higher market values because of a lack of market evidence.

Two appraisers did not specifically have the perception that sustainable office buildings would generate higher indirect returns but they did expect higher direct returns. A higher direct return will inevitably also lead to higher indirect returns.
5.3 RESPONDENTS GOALS WITH REGARD TO SUSTAINABLE OFFICE BUILDINGS

What are the different goals of the respondents and how do these goals relate to their perceptions?

5.3.1 Overall matrix

<table>
<thead>
<tr>
<th>GOALS WITH REGARD TO SUSTAINABLE OFFICE BUILDINGS</th>
<th>APPRAISERS</th>
<th>INVESTORS</th>
<th>DEVELOPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serve the client by increasing knowledge on sustainability; best fair value</td>
<td>x x x x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhancing tenant attraction and retention</td>
<td></td>
<td>x x x</td>
<td></td>
</tr>
<tr>
<td>Increase market share; create more work for company</td>
<td>x x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase size of sustainability funds and or start up new funds</td>
<td>x x</td>
<td></td>
<td>(x)</td>
</tr>
<tr>
<td>Valuation of sustainable real estate for distinctive strength</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Change role in Real Estate process: from reactive to pro-active</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Increasing the return of the funds, maximize shareholder value</td>
<td>x x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop new office buildings to reply to/create demand from clients</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Give more buying/selling advice for sustainable buildings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strengthen existing portfolio by &quot;greening-up&quot;</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Develop new offices that are better future proofed than regular offices</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Effects of sustainable design features on valuation factors

5.3.2 Appraisers

The appraisers have two clear shared goals with regard to sustainability in office buildings. The most important goal is to serve their clients in the best possible manner by offering knowledge and insight on the effects of sustainability aspects on the fair value of office buildings. To reach this goal they have to look at sustainability with a wide perspective, herein lays the reason for the variety of perceptions of the appraisers.

Secondly the appraisers (since they are also commercial companies) aim at increasing their market share. They see the way they can incorporate sustainability aspects in valuations as a good way to create more work for their company. The way they incorporate these aspects is seen as a good tool to increase their distinctive strength.

A third goal named by half the appraisers is the idea to change the role of the appraiser from reactive to proactive. With insight on the effect of sustainability aspects, they can also serve as consultants before greening-up decisions are made. When trained for this, they can also do BREEAM measurements for sustainability certificates during the regular building measurements for the appraisal.
5.3.3 Investors/Financiers
The goals of the investors were in relation to the character of their profession. Primary goals of the investors were increasing the return of their funds and maximizing shareholder value. Essential to this goal is the enhancement of tenant attraction and retention; the longer the tenants stay and the easier they are attracted, the higher the fund returns.

The investors believe they can do this by increasing the size of the sustainability funds and or to start up new ones. One investor focuses only on funds with sustainable office building while the other investor focuses mainly on A-quality buildings on A-locations.

5.3.4 Developers
The main goal of the developers is to develop new buildings. Sustainability is used as a tool to stimulate the demand for new office buildings in order to reach this goal. The developers also recognize the chance in greening up the existing stock, once the added value of sustainable building is confirmed.

Next to that they share the goal of tenant attraction and retention with the investors. The developers also believe that sustainability can be used as a tool to enhance the attraction and retention of tenants.

5.3.5 Discussion
Looking at the goals of the different actors we can divide the three actor types in 2 groups: the appraisers in one group that has clear goals that they can achieve through to the assessment of the market value of sustainable office buildings (so increasing their knowledge on the effect of sustainability aspects on this value). The developers and investors can be placed in the second group that has goals they can achieve through developing or acquiring sustainable office buildings. The appraisers share clear goals with each other and the developers/investors share goals.

The appraisers share the goal of serving their clients in their best possible way by increasing their knowledge on the effects of sustainability aspects in valuations. The developers/investors all have the goal to enhance the tenant attraction and retention. They expected sustainable offices to have enhanced attraction and retention.

The investors’ goal to increase the size of the sustainability funds can be a good indication for future market value changes of sustainable office buildings. When the demand increases, the prices will increase. These statements might indicate the accumulation of more market evidence of higher value for sustainable office buildings.

Two appraisers believe that the role of appraisers should change from reactive to pro-active. Here lie some changes with regard to sustainable office buildings. In the greening up of the existing stock and the acquisition of sustainable office buildings, the appraiser can be involved in the initiative stage. Through advice on the investment value (can be higher or lower than the market value; concerns the value for a specific investor and usually involves a longer term strategy) and showing the value changes of greening-up measures in existing buildings, the appraiser can become a valuable advisor in the Real Estate process.

Also, all buildings are appraised before bringing them to market. Thus the appraisers have the opportunity to actively influence the perceived value of buildings, and can play an advocacy role for sustainability – if they act in concert (Heintz, 2010).
5.4 EXPECTED EFFECTS OF SUSTAINABLE OFFICE BUILDINGS

Which effects do the different actors expect of sustainable office buildings and what can these expectation mean for the value of sustainable office buildings?

5.4.1 Overall matrix

<table>
<thead>
<tr>
<th></th>
<th>APPRAISERS</th>
<th>INVESTORS</th>
<th>DEVELOPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher indirect returns/selling prices in future</td>
<td>x x x x x x x x</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Shorter vacancy periods, improved tenant retention and attraction</td>
<td>x x x x x x x x</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Higher rents as result of lower operating costs (reduced energy use)</td>
<td>x x x [x] x [x]</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Fewer incentives</td>
<td>x x x x x</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Increased lettability</td>
<td>x x x x x</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Lower capital costs: Green finance agreement</td>
<td>x x x</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Higher maintenance costs</td>
<td>x x</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lower maintenance costs</td>
<td>x x</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>More stable rental growth sustainable building than regular building</td>
<td>x x</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lower technical depreciation</td>
<td>x x</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Increased labour productivity</td>
<td>x x</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lower risk yield</td>
<td>x x x</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lower frequency of large maintenance due to longer technical lifespan</td>
<td>x x</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Effects of sustainable design features on valuation factors

5.4.2 Appraisers

All appraisers expect sustainable office buildings to generate higher rents as a result of lower operating costs. They believe that tenants will have an increasing willingness to pay higher rents to compensate for their lower energy costs, but that they will not pay the full amount of the savings. The tenants are expected to share in the savings.

The increased lettability and improved tenant retention and attraction is expected which in return will lead to shorter vacancy periods and fewer incentives. Higher rents in combination with shorter vacancy and fewer incentives are expected to result in higher indirect returns and higher selling prices in the future.

Another strong expected effect is the lower capital cost as a result of the green finance agreement (building specific certificate). The extra required investment budget for sustainability measures can be lent for a lowered interest rate (-1.5%). The lower capital cost can increase the return on investment.

Lower technical depreciation as a result of the use of durable materials is expected, which is return might lead to lower maintenance costs and a lower frequency of large maintenance as a result of a longer technical lifespan. On the other hand they also believe that since sustainable buildings on average cost more to build. Maintenance costs will be higher.

Higher tenant labour productivity is also named by most appraisers, but they do not think this should play a part in the valuation yet since it is such an intangible effect. Only when the market evidence indicates a willingness to pay higher rents related to productivity can this aspect be used in the valuations.
5.4.3 **Investors/Financiers**

The investors clearly expect higher selling prices in the future and improved tenant attraction and retention. With expectations of higher rents the investors are more reserved. Overall the investors expect sustainable office buildings to perform better than conventional office buildings.

The investors also expect the demand for sustainable office buildings to increase as a result of higher shareholder pressure of sustainability policy of the big tenants and because of stricter regulations from the government. They already see this happening with the new guidelines Sustainable Acquisition (Duurzaam Inkopen) of the National Building Department (Rijksgebouwendienst, RGD). In this new guideline the buildings that the RGD wants to rent need to be at least BREEAM NL Good or Label-C. Buildings that perform below these requirements are expected to see value decreases.

5.4.4 **Developers**

The expectations of the developers are mainly limited to higher selling prices for sustainable office buildings and increased tenant retention and attraction. The developers are reluctant to name higher rents as expected effects. They indicate that developments should be done based on market rents; otherwise they would disqualify themselves in the market.

Another important expectation is that sustainable office buildings will convince tenants to choose lease contracts with a longer term than is typical for regular office buildings. Also they expect that they can find investors more easily for sustainable buildings than for regular offices.

5.4.5 **Discussion**

Higher indirect returns and improved tenant attraction and retention are the main expected effects of sustainability aspects in office buildings. Other commonly expected effects are fewer incentives, higher rents as a result of lower operating costs and lower capital costs due to the green finance agreement.

The named effects all indicate an expectation of higher values for sustainable office buildings. When higher values for sustainable building than for regular ones are expected by developers and investors, this might indicate that new acquisitions and developments will have a strong focus on sustainability aspects. Because this series of interviews only dealt with 2 developers and 2 investors no general conclusions can be drawn on their statements.

The expectations of the appraisers give an indication on how to deal with sustainability aspects in valuations. How appraisers should deal with the expected effects in the valuations and buying and selling advice will be further elaborated upon in the next paragraphs on valuation methods and adjustable variables.
5.5 VALUATION OF SUSTAINABLE OFFICE BUILDINGS: POTENTIAL METHODS

How should appraisers incorporate the effects of sustainability aspects in value assessments of office buildings? Which method is seen as the best method to reflect these effects by the respondents?

5.5.1 Overall matrix

<table>
<thead>
<tr>
<th></th>
<th>APPRAISERS</th>
<th>INVESTORS</th>
<th>DEVELOPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUATION SUSTAINABLE OFFICE BUILDINGS: POTENTIAL METHODS</td>
<td>1 2 3 4 1 2 1 2</td>
<td></td>
<td>#</td>
</tr>
<tr>
<td>Can be done in existing valuation methods</td>
<td>x x x x x</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Adjustments in DCF for level of sustainability aspects</td>
<td>x x</td>
<td>5, 5</td>
<td>6, 6</td>
</tr>
<tr>
<td>Combination of GIY/NIY with DCF</td>
<td>x x x x x</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Adjustments in GIY/NIY + Top-slice for level of sustainability aspects</td>
<td>x</td>
<td>(x)</td>
<td>5, 5</td>
</tr>
<tr>
<td>Qualitative assessment inclusion: BREEAM NL report</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>Replacement cost for exit value</td>
<td>x</td>
<td>x</td>
<td>2</td>
</tr>
<tr>
<td>100 year DCF: 20 year DCF, remaining 80 years determine Exit value</td>
<td>x</td>
<td>x</td>
<td>1</td>
</tr>
<tr>
<td>Needs a new valuation method</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Table 10: Effects of sustainable design features on valuation factors

5.5.2 Appraisers

The appraisers’ opinion on the most suited to assess the value of sustainable office buildings, is that this can best be done in a combination of the Gross Initial Yield/Net Initial Yield (GIY/NIY) method with Top Slice and a Discounted Cash Flow model (DCF). In the GIY/NIY method with Top Slice the difference between the actual contract rent and the market rent is compensated for. The rent difference is capitalized for the lasting lease period using a capitalization factor (usually 7%) and added to the value of the building.

The appraisers did not deem it necessary (except one appraiser) to develop a completely new valuation method. In the existing methods parameters can be adjusted to reflect the effects of the level of sustainability of the building under assessment.

Which method is most suited to reflect sustainability aspect in the exit value of the object in the DCF method is not clear for the appraisers. Potential methods opted by the appraisers are the use of the replacement cost (which are higher for sustainable office buildings) or the use of the 100 year DCF method in which the final 80 years form an income based exit value.

5.5.3 Investors/Financiers

The investors both share the idea of the appraisers with regards to the best suitable method for the valuation of sustainable office buildings. No new methods are needed. The DCF and the GIY/NIY with Top Slice are the best methods to assess the value of sustainable office buildings.

However important to notice is that the investors are at present more in favor of the inclusion of a qualitative assessment to the valuation than for a quantitative addition because of a lack of ‘market evidence’. They propose the addition of a BREEAM NL report. In the future this qualitative analysis can serve as a basis for the argumentation towards quantitative changes in valuations.
Developers
Only one of the two developers had a statement on the valuation method. The developer is convinced that sustainable office buildings can best be valued in the existing DCF and GIY/NIY method or in a combination of the two for cross checks and protection against overvaluation.

Discussion
There is a general consensus on which valuation method is the most suited to reflect the effects of sustainability aspects. The DCF method and the GIY/NIY method (with Top slice) can both be used, preferably alongside each other for cross checks. Within the GIY and the DCF methods the respondents see several parameters that can be adjusted for sustainability aspects in the office building under assessment.

Initially an assessment for the building should be made as if it is a regular office building. After the “regular” assessment is done, parameters can be adjusted according to the degree of sustainability. By making an initial regular valuation, the added value and the argumentation of the adjustments can be explained in a more transparent manner.

Comment on the DCF method was that this technique can be more transparent than the GIY method, but that on the other hand that it is also more sensitive for parameter changes than the GIY method. Good sensitivity analyses are essential in combination with the GIY method to protect for overvaluation.

The respondents do not think that a specially developed new valuation method is necessary. They think this can and should be done in the existing methods. Not only because this is possible but also because accountants require the valuations done with specific methods.

How to deal with the exit value of the office building in the DCF method is not completely clear yet. The developers and the investors did not make any statements about the exit value, but the appraisers opted several options. Next to their option described above, the exit value can also be determined using the exit yield method. The GIY can be arguably lower for a sustainable building and the rent can be slightly higher. The lower GIY will also lead to a lower exit yield. The combination of the lower exit yield and the higher rent level will also lead to a higher exit value.

In addition to the use of traditional valuation methods, the respondents also proposed an addition of a qualitative section to the valuation. This section can include tenant satisfaction surveys or one of the sustainability assessment methods. It seemed in the interviews that there was a wide support for the use of BREEAM NL for the qualitative assessment.
5.6 VALUATION OF SUSTAINABLE OFFICE BUILDINGS: ADJUSTABLE PARAMETERS

There was a general consensus on which valuation method was the most suitable one to assess the value of sustainable office buildings. Within these methods several parameters can be adjusted. Which parameters can be adjusted according to the respondents is analyzed in the following section.

5.6.1 Overall matrix

<table>
<thead>
<tr>
<th>VALUATION SUSTAINABLE OFFICE BUILDINGS: ADJUSTABLE PARAMETERS</th>
<th>APPRAISERS</th>
<th>INVESTORS</th>
<th>DEVELOPERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher rents (no market evidence yet though) premium for energy saving</td>
<td>x x [x] [x] x (x)</td>
<td>x x</td>
<td>6,5</td>
</tr>
<tr>
<td>Lower vacancy rates</td>
<td>x x x x x</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Reduced GIY (through GIY/NY argumentation; higher NIV; lower GIY)/yield</td>
<td>x x [x] [x]</td>
<td>x x</td>
<td>4,5</td>
</tr>
<tr>
<td>Fewer incentives</td>
<td>x x x x</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Capitalization of green finance agreement</td>
<td>x x x</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Lower technical depreciation</td>
<td>x x x</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Reduced frequency of maintenance</td>
<td>x x</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Exit value; higher replacement value</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Lower replacement cost/maintenance of installations due to smaller size</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Higher large maintenance costs due to higher building costs</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Reduced future investments to keep up to date</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Adjustment in exit value (did not say how)</td>
<td>x</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Table 11: Effects of sustainable design features on valuation factors

5.6.2 Appraisers

The appraisers were all convinced of the possibility to adjust the rent levels of sustainable office buildings despite the lack of market evidence for this. They expressed their concern about the pitfalls for including rent premiums in the valuation assessment. They thought that this could maybe better be done in a buying and selling recommendation to the client, based on an assessment of the investment value.

Rent increases can be justified through the argumentation of energy savings. Part of the energy saving can be added to the rent as a premium but not fully since the tenants are expected to want a share in the savings benefit. The appraisers did not make any statements on how to determine the value of the energy saving.

Next to the higher rents the appraisers think the vacancy periods and the incentive assumption can be reduced in the valuation. Since this is already a semi-objective estimate, the appraiser has some maneuverability on this parameter (the appraiser determines the vacancy and the incentives based on benchmark tables with upper and lower bounds, so part of the estimation is objective, part is subjective). Of course all parameter choices are subjective to the appraiser, but the vacancy and incentives assumption more than others.

A majority of the appraisers believed in the inclusion of as capitalization of the green finance agreement in the valuation. For the remaining period of the agreement, the benefits can be capitalized using a DCF model.
The added value of Sustainable Design  
Peter van den Tol  

The estimation of a sharper yield for a sustainable office building is also seen as a good option because of lower risks associated with this type of building. The appraisers confirmed that there is a risk of double inclusion of sustainability effects: reduced vacancy and incentives are part of the risk assumption.

Lower technical depreciation can be used when the object under assessment is made of durable materials. This can impact the exit value of the office building through the Depreciated Replacement Exit Value method or via a reduced frequency of large maintenance when the appraiser uses a long term (100 years) DCF method for the valuation. In the GIY method the effect of the use of durable building materials can be reflected in a lower percentage of maintenance costs. A remark to this however is that the use of durable materials is usually more expensive, which makes the maintenance and the replacement also cost more.

5.6.3 Investors/Financiers
The investors both agreed to the reduced vacancy for sustainable office buildings but were reluctant to reflect this in their yield demands. When making a new acquisition, the height of the yield determines the return they can get on the investment; the lower the yield in the GIY or the DCF method, the lower the price.

The investors also believed in the possibility to estimate higher market rents for sustainable office buildings but remain highly reserved about this since there is no market evidence yet that tenants are willing to pay higher rents for sustainable office buildings. The study of Koppels and Snoei (Koppels, Snoei, 2008) is not seen by the investors as market evidence.

5.6.4 Developers
The developers both think that lowering the risk yield is possible for sustainable office buildings. On rent levels, one of the developers agrees with an upward adjustment, while the second agrees that it should be negotiable with the tenant but remains reticent to a direct adjustment in the valuation. With bare rents above market level, the developer is afraid he competes himself out of the market.

5.6.5 Discussion
All actors still have their doubts about “searching” for higher values for sustainable office buildings. Most of the respondents are reluctant to actually change parameters in valuations before there is clear market evidence. On the other hand, higher values are the future expectation, so the question remains whether or not there is the need to change valuations or to simply wait for market evidence.

The biggest issue in the valuation of sustainable offices is that the willingness to pay higher rents remains the crucial element in all propositions. Investors will be reluctant to accept changes in the market rents and yields without market evidence even though they also expect higher direct and indirect returns. A solution for this problem might lie in the use of buying and selling advice. This advice can be given by the appraiser based on his market insight and his expectations with regard to the effects of sustainability aspects. The difference with a valuation is that in the advice, the appraiser can also work with expectations instead of input based on “only” market evidence.

With buying and selling advice the first step towards market evidence gathering can be made. The appraiser can take up the proactive role in the Real Estate process for the acquisition of sustainable office buildings and for greening-up existing buildings and
assessing the added value of greenup measures in buying and selling advices. Where in the valuation there is virtually no space for predictions, there is space for this in buying and selling advice. Even with a lack of market evidence, an appraiser can argue with his market knowledge that sustainable buildings will perform better than the regular offices.

An interesting notion during the interviews was that the developer or investor can actually already get a higher value for his sustainable office building than for a regular one without changing parameters in the valuation. When the actual contractual rent is above the market rent, this is reflected as a correction in the DCF or the GIY method for the remaining contract period. By negotiating higher rents with the tenants, the value will be higher. The chance of success to negotiate higher rents is higher for sustainable buildings than for regular ones.

Apparently a complicated issue is the green finance agreement. Only half of the respondents brought up the topic of this agreement and of this half, only 1 actor had a clear idea on how this agreement could be used in the valuation of the office building. Because the green finance agreement is attached to the building in question, the agreement remains valid for the new owner when the object is sold. The new owner gets the benefits of the agreement for the remaining years of the agreement. This benefit should be capitalized for this remaining period. This results in the value of the agreement, which in return should be added to the value of the sustainable office building. The building has to meet the requirements of the agreement: 30% below building code energy performance requirements.

One of the main problems with the adjustment of the rent levels in practice is that this can be complicated without another type of lease contract. Most of the actors believe we need to go towards a total cost of ownership lease model with the energy costs included in the lease contract in order to achieve higher rents for sustainable office buildings.

Most actors agreed with the idea to place the energy savings premium in a separate correction post in the service fee instead of adding this savings premium on top of the bare rent. This should be done to enhance the chances on higher income for the building owner during the negotiations: tenants can argue strong cases to keep the rent at market levels based on market evidence but the negotiations on service costs are a lot less transparent. Respondents stated that recent internal studies indicated that 85% of the tenants do not look at their service costs. During the interviews it became clear that (according to the respondents) negotiations on rent levels can last weeks or months and the negotiations on service fees are finished in a day.

The determination of the energy saving premium remains a topic of discussion. Initially a valid method for the assessment of the theoretical building specific energy consumption needs to be established, followed by a fitting benchmark for the specification of the height of the savings. When the energy saving is determined in Mega Joules (MJ), this amount of energy needs to be capitalized according to current market energy prices. The energy price combined with the energy saving result in the yearly energy savings potential in euros/m². How much of the energy saving should be added to the rent is part of the contract negotiations, but the writer expects that the appraiser can assume a fair share of at least 50%. The energy savings premium will be further described in chapter 8.
5.7 ADDITIONAL STATEMENTS AND OPINIONS

Besides the comments and opinions on the 6 main themes, the respondents made several interesting remarks during the interviews. To give the interviews an extra dimension these additional statements are presented and discussed in this paragraph.

5.7.1 Appraisers

**Appraiser 1**
Most articles from RICS on valuation are very general and vague, appraisers should incorporate sustainability in valuations, but they do not offer solutions how this should be done.

The appraiser did not agree with statements from developers and investors that tenants are not willing to pay higher rents for sustainable buildings than for regular ones. He perceives a trend amongst tenants to go for a sustainable office with a slightly higher rent than for an unsustainable building with a slightly lower rent.

**Appraiser 2**
One of the main problems according to the appraiser with greening up the existing stock is the coming aging of the population in combination with the trend for space optimization and working at home. This combination of trends means that less office space is needed. This has a rent level reducing effect. Lower rent levels will reduce the feasibility of greening up old stock.

Assessing the added value of a sustainable building should be done before the greening-up is done; the appraiser has to be more active in the process instead of reactive.

**Appraiser 3**
The appraiser is studying better arguments to prove the added value of sustainable buildings and agree that they can play a larger role with strategic buying and selling advice. In the advice is more room for speculation than in valuations.

“An appraiser does not create but reacts to and reflects the market.” Question marks can be placed on that statement. In total, the appraisal profession had an enormous impact on the market value through the valuation methods that he uses and choices that the appraiser makes.

**Appraiser 4**
The appraiser can have ideas on how values might develop in the future based on research and logical reasoning, but he can not include predictions in valuations without market evidence. He can include these predictions in the buying and selling advice.

The appraiser only registers what is happening in the market. The last thing a valuer should do, is think in scenarios. The question to the appraiser is always: “For what can I sell this building now?”

The appraiser agrees to the statement that he is partially responsible for the origin of the price level. With the choices he makes in the valuation and in the advice he gives, he has some influence in the value of the building. He can participate in the creation of awareness on the added value of sustainability.
5.7.2 Investors/Financiers

Investor 1
The key to sustainability can lie in performance contracts. This type of contract is still under development. The main element of this type of contract is the incorporation of the energy performance of the building in the lease contract. This type of agreement has similarities to green leases and all-in contracts.

The valuation report is nothing more than a representation of the interest of potential tenants in a building. As long as the willingness to pay is disputable, incorporating premiums in the valuation is disputable.

There is general consensus that the focus in the real estate sector will shift from new developments to the existing property stock.

Investor 2
The value of a building at this moment is not really interesting, more important is the projection of how the object will perform in the future. This makes valuations of current value less useful. This statement of the investor expresses the need for appraisers to not only reflect and react but to be more pro-active in valuations. The appraisers stated on this topic that it was not their task to predict market behavior.

If appraisers want to have more significant role in the real estate process, they must start to think in scenarios: a building at this moment has the value “X” but in the future this value will be different in such and such a way.

There is no real distinction between the lease of an antenna on the roof and the green finance agreement. Both are object specific and without the object they are attached to, they are worthless.

The investor expects performance contracts to make a big contribution toward more sustainable real estate.

5.7.3 Developers

Developer 1
At present the only possible new development is a highly sustainable development. A non-sustainable development will not be possible to finance because investors are not willing to invest in non-sustainable offices.

A service premium for energy can be included in the contract, but the problem there is that negotiations on bare rent are usually done by the financial director of the tenant and the negotiations on the service fee are performed by the operational director of the tenant.

A premium in the service fee can be difficult to capitalize. Usually the service fees go to the property manager, whereas the building owner should get the energy saving premium. A possibility here is to sell this premium within the property management contract and let the other party buy the cash flow of the premium.
Service costs and operating costs are still not transparent and highly diverse, that is why investors at present mainly look at the bare rent and the market yields when assessing the building value.

**Developer 2**
A critical problem with sustainable building can be found in the way that tenders for new developments work. The average tender consists of a traditional program of requirements in which sustainability criteria play a very small or no role, when the developer presents a plan that goes beyond the program he disqualifies himself. The developer will therefore not develop propositions that go beyond the brief.

The valuation of the office building is of great importance for the budget of the investment and the return of the project.

85% of the tenants never look at the energy and service bill, they all accept and believe the bill. This shows the need to make tenants more aware of their behavior and consumption.
5.8 CONCLUSIONS FROM THE INTERVIEWS

5.8.1 Definition of sustainability

Several building elements were associated by the majority of the respondents with sustainability. Based on aligned opinions on sustainability a new definition for a sustainable office building can be formulated:

“A sustainable office building has a long technical and functional lifespan with a persistent demand by tenants through offering a high level of comfort and air quality while consuming as few resources as possible.”

Alongside this definition the actors indicated that sustainability should not be looked at through a single description but through degrees. Sustainability in office buildings can be found in many different degrees varying from the environmental impact of the used materials to the energy consumption of the building.

In the valuation of sustainable office buildings this character of sustainability should be taken into account. A building that uses 30% less energy than the building code requires is worth more than an office building that consumes 10% less energy than required by the building code. Ideally this distinction of looking at sustainability as “degrees of sustainability” can encourage developers and building owners to improve the buildings even more: the higher the sustainability level, the higher the building value.

Based on the requirements for obtaining a license for the green finance agreement it can be said that an office building should only be named “sustainable” when the object performs 30% below the minimal required building code standard. This is the current requirement for the green finance agreement. In the near future, these requirements can change because of the potential upcoming connection to BREEAM NL instead of the EPC requirement.

5.8.2 Perceptions of sustainability

The overall vision of the respondents was that sustainable office buildings will financially (and socially) outperform regular office buildings.

5.8.3 Valuation Method

The respondents indicated that sustainable office building valuations can be performed using the standard existing valuation methods. A combination of the DCF method with the GIY/NIY + Top Slice method is seen as the best way to assess the value of the sustainable office.

The appraisers used different types of DCF methods and different methods to determine the exit value. Most of the appraisers used the exit yield method to determine the exit value but some used a 100 year DCF in which the first 20 years determined the income stream value and the remaining 80 years the exit value. In my opinion the latter is the best method to use for the assessment of market or investment value of sustainable office buildings because it offers the most options to reflect sustainability aspects and effects in a transparent manner.
5.8.4 Valuation Parameters

Within the traditional DCF and GIY Top Slice valuation methods several parameters were indicated by the respondents that could be adjusted for sustainable office buildings depending on the level of sustainability. The biggest obstacle in adjusting the parameters is the absence of market evidence for the majority of the adjustments. The parameters of which the market evidence is lacking can be adjusted in the assessment of the investment value. This can mean that the investment value of a non-sustainable building can be below the market value and the investment value for a sustainable object can actually be above the market evidence based value. The appraiser has more maneuverability in the assessment of the investment value to adjust parameters according to his future expectations: When the appraiser (as they expect) believes that a sustainable building will generate higher rents (above present market rent) he can increase the rent level according to his argumentation. In the assessment of the market value the appraiser has less maneuverability to do this. Another case described by one of the appraisers was the building owner that tried to sell his building: the market value was based on the market rent and yield worth €1,000,000.00 but because the appraiser had market knowledge he could give the advice that if he could sell it for €800,000.00 the price would be better than he would get in a years time.

Parameters that can be adjusted in valuations are the following:

- Inclusion of the capitalized green finance agreement as a correction post in the GIY Top Slice method or as a yearly income in the DCF method for the remaining period of the agreement.

- Slightly lowering the risk yield in the GIY method based on reduced vacancy and incentives.

- Based on the RICS Red book definition of a valuation ("The estimated amount for which a property should exchange on the date of valuation, between a willing buyer and a willing seller in an arm’s length transaction after proper marketing wherein the parties had acted knowledgeably, prudently and without compulsion" the energy savings can partially be added to the rent of the building. In this case the appraiser can assume good negotiation skills of both the tenant and the building owner. The research of Koppels and Snoei (Koppels, 2008) indicated that tenants had a willingness to pay 76% of the energy savings as a rent premium. How much of this energy savings can be added can not be concluded based on the interviews.

- To what extent the adjustments can take place is still a topic of discussion among appraisers. A case study of the Triodos Bank performed by Guus Berkhout can shed further light in the height of the adjustments.
5.8.5 Assessing the investment value: advice for buying and selling

As discussed in the previous section, expectations of the appraiser can be used in the assessment of the investment value for a buying or selling advice to a specific investor, that an appraiser can give alongside a regular market valuation; before greening-up a building in the clients portfolio or before a new acquisition of the client.

Parameters that can be adjusted in the assessment of the investment value for greening-up portfolio buildings or new acquisitions are the following:

- Inclusion of the capitalized green finance agreement as a correction post in the GIY Top Slice method or as a yearly income in the DCF method for the remaining period of the agreement.

- The assumptions for the vacancy and incentives can be lowered for sustainable office buildings due to enhanced lettability. By how much the assumptions can be lowered is subjective to the appraiser. This will be elaborated upon in the following chapters.

- Lower risk yields in the DCF and the GIY method. (with care not to double count vacancy benefits).

- Sustainable office buildings can have longer lease periods. This has an increasing effect on the reduction of the vacancy period and the height of the incentives.

- The energy savings can partially be added to the rent of the building. In this case the appraiser can assume good negotiation skills of both the tenant and the building owner. At least 50% of the energy savings should be added to the rent or service fee.

- The difference of the contract rent and the market rent should already be added to the value of the building under appraisal for the resting contract period. In the buying and selling advice it can be assumed that the initial rent difference can also be used as a correction post after the contract periods expired. In this case the 50% of the rent difference should be capitalized using a higher capitalization risk yield. On the next page an example DCF calculation is showed how this can be done.

- To what extend the adjustments can take place is still topic of many discussions among appraisers. Given percentages are indications of potential adjustments. A case study of the Triodos Bank performed by Guus Berkhout can shed further light in the height of the adjustments.
Table 12: DCF calculation example for rent price correction

In the table an example of a DCF calculation for the rent difference correction is presented. The lasting lease period is 9 years. The present value of this rent difference for the remaining contract period is € 276,620,24.

The assumption that this rent difference can partially (50%) be realized again in the following contract period (for the remaining cash flow period of a 20 year DCF) will lead to a higher value of € 35,595,46 based on a risk yield of 14% (doubled standard correction yield). This calculation is based on an office building with a lettable floor area (LFA) of 3000m².
6 ONLINE SURVEY

6.1 SURVEY

In order to support the interview results, an internet survey was composed based on the interview discussions and set out under the leading appraisal companies in the Netherlands.

The target of the survey was to determine the current practice of valuing sustainable office buildings and what would be the best practice in the future. The complete design of the survey can be found in the appendices.

The survey comprised of three sections: an initial section with background questions to determine what the vision of the respondent to sustainability was; a section containing questions on which elements of sustainability would affect valuation parameters in what way and a final section in which the respondents could fill in a bandwidth of the adjustments of valuation parameters (if any).

6.2 RESPONDENTS

The survey was send to the directors of the following appraisal companies with the question to distribute the survey amongst the appraisers in their firms:

- CB Richard Ellis
- Troostwijk
- Jones Lang LaSalle
- DTZ
- Colliers
- Savills
- Cushman & Wakefield

At present 22 appraisers filled in the online survey. More respondents are expected to reply to the survey later in January. Appraisers from all 7 appraisal firms responded.

Intermediate results of the survey are presented in the following paragraph. In the tables and graphics, the answers of the respondents are indicated in percentages. In most questions the respondents could fill in multiple answers so the presented percentages can add up to over 100%.

The respondents came from companies of the following size:

<table>
<thead>
<tr>
<th>Size of the company of the respondent</th>
<th>% of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 25 FTE</td>
<td>6%</td>
</tr>
<tr>
<td>Between 25 and 50 FTE</td>
<td>6%</td>
</tr>
<tr>
<td>Between 50 and 100 FTE</td>
<td>6%</td>
</tr>
<tr>
<td>Over 100 FTE</td>
<td>83%</td>
</tr>
</tbody>
</table>

n=18

The full results from the survey can be found in appendix 12.9.
6.3 RESULTS

6.3.1 Background questions

Which valuation methods do you use for the valuation of office buildings?

<table>
<thead>
<tr>
<th>Which valuation methods do you use for the valuation of office buildings?</th>
<th>% of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIY/NIIY</td>
<td>72%</td>
</tr>
<tr>
<td>GIY/NIIY + Top Slice Corrections</td>
<td>89%</td>
</tr>
<tr>
<td>DCF 10 years + exit value</td>
<td>33%</td>
</tr>
<tr>
<td>DCF 15 years + exit value</td>
<td>39%</td>
</tr>
<tr>
<td>DCF 20 years + exit value</td>
<td>28%</td>
</tr>
<tr>
<td>DCF 100 years + exit value</td>
<td>33%</td>
</tr>
<tr>
<td>Comparative method</td>
<td>50%</td>
</tr>
<tr>
<td>Cost method</td>
<td>28%</td>
</tr>
</tbody>
</table>

Table 13: Commonly used valuation methods; n=18

Which valuation methods do you use to determine the exit value of an office building?

<table>
<thead>
<tr>
<th>Which valuation methods do you use to determine the exit value of an office building?</th>
<th>% of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement costs</td>
<td>17%</td>
</tr>
<tr>
<td>Exit yield</td>
<td>67%</td>
</tr>
<tr>
<td>Remain period of 100 year DCF</td>
<td>39%</td>
</tr>
<tr>
<td>Technical depreciation + rise of construction costs + replacement cost</td>
<td>6%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
</tr>
</tbody>
</table>

Table 14: Exit value determination methods; n=18

Can you rate the following aspects of sustainable building according to importance?

<table>
<thead>
<tr>
<th>Sustainability aspect rating</th>
<th>Score</th>
<th>St.Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency</td>
<td>8.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Durability used materials</td>
<td>7.6</td>
<td>2.2</td>
</tr>
<tr>
<td>Locally produced renewable energy</td>
<td>6.9</td>
<td>2.9</td>
</tr>
<tr>
<td>Durability of structure</td>
<td>6.4</td>
<td>2.5</td>
</tr>
<tr>
<td>Air quality</td>
<td>6.4</td>
<td>2.7</td>
</tr>
<tr>
<td>Space optimization</td>
<td>6.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Accessibility</td>
<td>6.3</td>
<td>2.7</td>
</tr>
<tr>
<td>Comfort</td>
<td>6.1</td>
<td>2.7</td>
</tr>
<tr>
<td>Flexibility of installation concept</td>
<td>6.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Functional flexibility</td>
<td>5.5</td>
<td>2.7</td>
</tr>
<tr>
<td>Location</td>
<td>4.8</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Figure 13: Rating sustainability aspects; n=16
6.3.2 **Sustainability in office valuations**

How will the sustainability level of an office building affect its market value?

![Pie chart showing the effects of sustainability on market value.](Image)

**Figure 14: Effect sustainability level on market value**

Which valuation method is, according to you, the most suited for the valuation of sustainable office buildings?

![Pie chart showing the preferred valuation methods.](Image)

**Figure 15: Most suited valuation method sustainable office buildings**

Do you think that sustainable office buildings should have a higher value than regular buildings of similar size and location type?

![Pie chart showing opinions on the value of sustainable buildings.](Image)

**Figure 16: Value sustainable office buildings compared to regular office buildings**
6.3.3 Value Affecting Elements Of Sustainability

Which elements of sustainable building affect the value of the sustainable building?

Energy efficiency

- Has no influence
- Has influence
- Don’t know

Durability materialization

- Has no influence
- Has influence
- Don’t know

Functional flexibility: function & grid

- Has no influence
- Has influence
- Don’t know

Flexibility of installation concept

- Has no influence
- Has influence
- Don’t know

Optimized space usage

- Has no influence
- Has influence
- Don’t know

Accessibility

- Has no influence
- Has influence
- Don’t know

Air quality and comfort

- Has no influence
- Has influence
- Don’t know

Multi-tenant capacities

- Has no influence
- Has influence
- Don’t know

Figure 17: Value affecting elements of sustainable building  
n=13
### 6.3.4 Effects of aspects of sustainable building on valuation parameters

#### Effect of energy efficiency on following parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Negative</th>
<th>Positive</th>
<th>Neutral</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent level</td>
<td>0</td>
<td>8</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>GIY demand</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Yield demand in DCF</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Vacancy assumption</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Height of incentives</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Frequency large maintenance</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Exit value</td>
<td>0</td>
<td>6</td>
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<td>0</td>
</tr>
<tr>
<td>Rental growth assumption</td>
<td>0</td>
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<tr>
<td>Total</td>
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#### Effect of durability materialization on following parameters

<table>
<thead>
<tr>
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<th>Positive</th>
<th>Neutral</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent level</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>GIY demand</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Yield demand in DCF</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Vacancy assumption</td>
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<td>0</td>
</tr>
<tr>
<td>Height of incentives</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Frequency large maintenance</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Exit value</td>
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<td>Rental growth assumption</td>
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<td>Total</td>
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</table>

#### Effect of functional flexibility on following parameters

<table>
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<tr>
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<th>Neutral</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent level</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>GIY demand</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Yield demand in DCF</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Vacancy assumption</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Height of incentives</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Frequency large maintenance</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Exit value</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
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<td>Rental growth assumption</td>
<td>0</td>
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</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>23</td>
<td>8</td>
<td>4</td>
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</table>

#### Effect of flexibility installations on following parameters

<table>
<thead>
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<th>Negative</th>
<th>Positive</th>
<th>Neutral</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent level</td>
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<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>GIY demand</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Yield demand in DCF</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
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<tr>
<td>Vacancy assumption</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Height of incentives</td>
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<td>0</td>
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<tr>
<td>Frequency large maintenance</td>
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<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Exit value</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rental growth assumption</td>
<td>0</td>
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<td>1</td>
<td>0</td>
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<td>0</td>
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Table 15: Effects of aspects of sustainable building on valuation parameters

n=5
## Table 16: Effects of aspects of sustainable building on valuation parameters

<table>
<thead>
<tr>
<th>Effect of space optimization on following parameters</th>
<th>Negative</th>
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<th>Don't know</th>
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<tbody>
<tr>
<td>Rent level</td>
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<td>1</td>
</tr>
<tr>
<td>GIY demand</td>
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<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Yield demand in DCF</td>
<td>0</td>
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<td>1</td>
<td>2</td>
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<tr>
<td>Vacancy assumption</td>
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<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Height of incentives</td>
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<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Frequency large maintenance</td>
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<td>Exit value</td>
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n = 6

<table>
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<tr>
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<th>Don't know</th>
</tr>
</thead>
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<td>1</td>
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<td>Height of incentives</td>
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<td>Frequency large maintenance</td>
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<td>Exit value</td>
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n = 6

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<td>1</td>
</tr>
<tr>
<td>GIY demand</td>
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<tr>
<td>Yield demand in DCF</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Vacancy assumption</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Height of incentives</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Frequency large maintenance</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Exit value</td>
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<td>0</td>
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<tr>
<td>Rental growth assumption</td>
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</tr>
<tr>
<td>Total</td>
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<td>19</td>
<td>4</td>
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</tbody>
</table>

n = 6

<table>
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<tr>
<th>Effect of multi-tenant capacities on following parameters</th>
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<th>Positive</th>
<th>Neutral</th>
<th>Don't know</th>
</tr>
</thead>
<tbody>
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<td>Rent level</td>
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<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>GIY demand</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Yield demand in DCF</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Vacancy assumption</td>
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<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Height of incentives</td>
<td>1</td>
<td>1</td>
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<td>0</td>
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<tr>
<td>Frequency large maintenance</td>
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<td>0</td>
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<tr>
<td>Exit value</td>
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<td>Rental growth assumption</td>
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<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>13</td>
<td>11</td>
<td>3</td>
</tr>
</tbody>
</table>

n = 5
6.3.5 Minimum requirement title ‘sustainable’

In order to determine a minimal requirement for an office building to get the title of being sustainable, the respondents had to give their opinion on a minimal standard for the office building to be considered for a ‘sustainable valuation’.

<table>
<thead>
<tr>
<th>What is the minimum requirement for an office building to obtain the title ‘sustainable’?</th>
<th>% of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better than Label C</td>
<td>71%</td>
</tr>
<tr>
<td>Better than Label B</td>
<td>0%</td>
</tr>
<tr>
<td>Better than Label A</td>
<td>12%</td>
</tr>
<tr>
<td>BREEAM Good</td>
<td>35%</td>
</tr>
<tr>
<td>BREEAM Excellent</td>
<td>18%</td>
</tr>
<tr>
<td>30% below minimal EPC requirement according to building code</td>
<td>6%</td>
</tr>
<tr>
<td>10% below minimal EPC requirement according to building code</td>
<td>6%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
</tr>
</tbody>
</table>

Table 17: Minimum requirements title ‘sustainable’

6.4 CONCLUSIONS

The most commonly used methods to appraise office buildings are the Gross Initial Yield method with Top Slice (for the corrections in rent differences between market and contract rents) and the Discounted Cash Flow method. However, the appraisers do not handle a uniform DCF period. Another method used by 50% of the respondents is the comparative method. The appraisers do not use only 1 valuation method.

A majority of the appraisers uses the GIY + Top slice method alongside one of the DCF methods for the appraisal of the object under assessment. In the DCF method, 67% of the respondents used the Exit yield method to determine the exit value whereas 39% of them used the remaining lease period of a 100 year DCF. In the 100 year DCF, the first 20 years are used to assess the income stream value and the remaining 80 years cash flow determines the exit value.

The DCF, GIY and the GIY + Top slice method are perceived by the appraisers as the most suited method for the valuation of sustainable office buildings. The comparative method as used by 50% of the respondents is not seen by any of the appraisers as a suited method for the valuation of sustainable office buildings.

For a building to get the “title” of being sustainable, the object has to have at least an EPBD label B according to 71% of the respondents. Label C is the minimal requirement for the guideline sustainable acquisition from the Dutch government and will also be used for the benchmark energy consumption to determine the energy savings premium as described in paragraph 8.2.

According to the opinion of 64% of the respondents the value of a sustainable office building should be higher than that of a regular one. 44% of the appraisers thought that this would be the result of a value depreciation of the regular buildings, whereas 19% of them expect the value of sustainable buildings to rise between 5 and 10% compared to regular ones. 6% of the appraisers expect sustainable buildings to see a value increase of over 10%.
The fact that 44% of the respondents expect a value decrease for non sustainable building is in controversy with the statements of the appraisers during the interviews. In the interviews the appraisers did not think it likely that non sustainable office buildings would face value decreases. Perhaps the appraisers stated this in the survey because of the current buyers market for the conventional office buildings.

As expected and in line with the interview results the appraisers rated energy efficiency the most important one of the sustainability related aspects.

Of the sustainability related building aspects 6 out of 8 aspects was perceived by more than 60% of the appraisers as affecting the value of a sustainable office building: Functional flexibility (85%), energy efficiency (77%), accessibility (69%), multi-tenant capacities (69%), optimized space usage (62%) and air quality and comfort (62%).

Looking at table 15 and 16 with the effects of sustainability aspects on valuation parameters, energy efficiency, flexibility in installation concept, durability of used building materials and accessibility were on average seen as having a positive (value increasing) influence on the following valuation parameters:

- Energy efficiency is expected to have a positive influence on rent levels, vacancy assumptions and the exit value.
- Flexibility in installation concept is expected to have a positive influence on the frequency of the large maintenance and the exit value.
- Durability of used building material is expected to have a positive influence on the frequency of the large maintenance and the rental growth assumption.
- Accessibility is expected to have a positive influence on the rent level, the GIY demand and the yield demand in the DCF and on vacancy assumptions.

The respondents could not give any indications on the bandwidths of the possible adjustments to the valuation parameters because they depend on the building specifics and the level of sustainability.

6.5 DISCUSSION

The number of respondents does not offer the required representativeness to draw generic conclusions but appraisers from the leading appraisal firms gave their opinion.

The third part of the survey on effects of sustainability aspects on valuation parameters was highly in depth and hard to answer for many respondents given the low response ratio. This might make the given conclusions on this part as described above invalid. In the appraisal firms a small amount of specialist are trained in sustainability and are doing research in this field. This small amount of specialists might explain the low number of respondents in this in depth section of the survey.
8 ENERGY SAVINGS PREMIUM

8.1 THE ENERGY SAVINGS PREMIUM

As concluded from the survey and the interviews, a sustainable office building is expected to consume less energy than a conventional building. At present this energy saving is solely beneficial to the tenant. In order to reflect the lower energy consumption of the sustainable office building, the energy saving has to be incorporated in the valuation of the office building. To enable the appraiser to do so, the amount of saved energy needs to be determined and compared to a benchmark for the energy consumption of conventional office buildings. The energy saving can be calculated in Mega Joules primary energy after which it has to be converted to kWh and m³ gas in order to connect a certain price level to the energy saving. Since tenants are expected to want a share of the energy saving, only a share of the energy saving should be added to the valuation of the building in the form of an energy savings premium.

To determine this energy savings premium, the assessment tool as described in this chapter is developed based on the results from the survey and the interviews as well as on recent studies on energy performance of buildings and the relation of the energy performance of buildings with the added value of sustainable office buildings (Van der Ham, 2004; Snoei, 2009; Peeters, 2008).

The energy savings premium will be useful to determine the added value of sustainable building. For new developments it can be a stimulation tool to increase the degree of sustainability: the higher the energy saving, the higher the building value. Without the energy savings premium the developer and or investor might only be stimulated to create a Label B (minimum requirement for the title “sustainable” according to the survey and the interviews or to a Label C to comply with the Guideline for Sustainable Acquisition.

For greening up the existing stock, the energy savings premium can serve as a tool to determine the potential added value of the greening up exercise. Once again the building owner or the redeveloper is stimulated to maximize the energy savings since the higher the savings, the higher the added value.
In order to determine the energy savings premium the following steps need to be taken:

- **Determine benchmark to compare consumption per m² LFA**
  Which benchmark do we use to make a comparison with the energy consumption of the office building under study? A benchmark with an energy consumption that is too high will result in an energy saving that is too low; a benchmark with an energy consumption that is too low will result in an energy saving that is too high.

- **Determine the buildings’ energy consumption per m² LFA**
  Which method is the most suited to assess the building installation related energy consumption of the office building under assessment?

- **Determine energy price level per m³ and kWh**
  What are current market prices for gas and electricity?

- **Create energy price development scenario**
  What is the future expectation for the development of these price levels?

- **Capitalize the energy saving per m² LFA**
  - Calculate energy consumption per m² LFA
  - Calculate benchmark building type per m² LFA
  - Calculate total energy saving per m² LFA
  - Calculate energy saving per m² LFA
  - Determine height of the energy saving per m² LFA
  - Calibrate for willingness to pay: 75% of savings €/m² LFA

The energy savings premium can be included in the market and investment value assessments in four different ways:

- **GIY**
  - The Energy Savings Premium is added to the rent.
  - The Energy Savings Premium is added to the value assessment as a separate correction post: With a DCF calculation in which an energy price development scenario can be included, the Savings Premium can be capitalized for the length of the DCF period.

- **DCF**
  - The Energy Savings Premium is added to the rent.
  - The Energy Savings Premium is added to the value assessment as a separate income stream on which an energy price development scenario can be connected, the Savings Premium can be capitalized for the length of the DCF period.

Further elaboration on the described steps will follow in the next paragraphs.
8.2 BENCHMARKING TOTAL THEORETICAL ENERGY CONSUMPTION Q PRIMARY;REAL

The benchmark for the comparison of energy consumptions of buildings can be based on several criteria. Average energy consumption, minimal building code requirements and governmental regulation and guidelines programs can be used for the benchmark. Using the latest EPC requirement for new developments (EPC=1,1) is not effective because this EPC demand is too strict to indicate an honest energy reduction in new developments, subsequently all existing stock will perform below the benchmark. The use of the average consumption will result in an energy use reduction assumption that is too high and will lead to unrealistic energy saving premiums.

The criteria related to the new guideline for sustainable acquisition of the biggest tenant of the Netherlands in combination to the EPC requirement as agreed upon in the “Lente Akkoord” are expected to give the best result.

The Benchmark will be based on the EPC requirement of 1.5 as defined in the “Lente Akkoord 2008” and energy Label C, the main criterion for the allowance for renting an office building by a Governmental agency according to the guideline sustainable acquisition. The EPC 2008 of 1.5 can be connected to the minimal Energy Index score for obtaining Energy label C by following the formula EPC=EI*EPC demand (Van der Ham, 2004).

The minimal EI score required to obtain a C Label (1,30) corresponds with an EPC of 1.95 based on the formula of van der Ham and the EPC demand of 1.5 from the Lente Akkoord.

<table>
<thead>
<tr>
<th>EPC requirement 2008</th>
<th>1.50</th>
<th>Average</th>
<th>Average</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>LABEL</td>
<td>EI Score</td>
<td>Average EI</td>
<td>EPC 2008</td>
<td>Primary Energy</td>
</tr>
<tr>
<td>A++</td>
<td>≤ 0.50</td>
<td></td>
<td>0.75</td>
<td>898.76</td>
</tr>
<tr>
<td>A+</td>
<td>0.51-0.70</td>
<td>0.61</td>
<td>0.92</td>
<td>1064.79</td>
</tr>
<tr>
<td>A</td>
<td>0.71-1.05</td>
<td>0.88</td>
<td>1.32</td>
<td>1269.92</td>
</tr>
<tr>
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<td>1.11</td>
<td>1.67</td>
<td>1449.41</td>
</tr>
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<td>2.63</td>
<td>1941.72</td>
</tr>
</tbody>
</table>

Table 19: Primary energy related to EPBD Label

Using the following two formulas we can calculate the benchmark for the Primary energy consumption of the 8 building types specified on the next page.

\[ Q_{\text{performance;total/m² Au}} = 330 \times \text{EPC} \times \text{correction factor} \quad (\text{NEN 2916}) \]

\[ Q_{\text{primary;real/m² Au}} = 1.11 \times Q_{\text{perf.;total}} / \text{Au} + 593 \quad (\text{van der Ham, 2004}) \]

The correction factor in the formula relates to the 8 different building types. The distinction between these 8 types was made between buildings with or without cooling installations and or buildings with different sizes and proportions. These different types have different energy efficiency specifications with varying quality aspects. An example: not having a cooling installation results in lower energy consumption but also in a lower comfort and quality level. In order to protect against a monotonous development of only
the most energy efficient types, correction factors were developed. The following 8 building types are to be distinguished:

- No Cooling: Usable area > 1500 m²; Energy Loss area > 2000 m²
- With Cooling: Usable area > 1500 m²; Energy Loss area > 2000 m²
- No cooling: Usable area < 1000 m²; Energy Loss area < 2000 m²
  - Energy loss area/Usable area = 1
  - Energy loss area/Usable area = 2
  - Energy loss area/Usable area = 3
- With cooling: Usable area < 1000 m²; Energy Loss area < 2000 m²
  - Energy loss area/Usable area = 1
  - Energy loss area/Usable area = 2
  - Energy loss area/Usable area = 3

The combination of the correction factor per building type as described in the previous page and the two formulas to calculate the theoretical energy building specific consumption (Qperf;tot) and the real building specific primary energy consumption (Qprimary) leads to the following table. In the table on the left the correction factors (van der Ham, 2004; SenterNovem) are presented.

The Q primary in the green compartment indicates the benchmark energy consumption per m² for each building type. The benchmark energy consumption reserved for the building installations is the result of Q primary - Q equipment (energy for building equipment). On average 54% of the energy consumed by the building installations is used in the form of electricity and 46% in the form of gas (Koppels, Snoei, 2008).

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Usable Area</th>
<th>Energy Loss Area</th>
<th>Correction Factor CF</th>
<th>Qperf;tot/Ag</th>
<th>Q Primary</th>
<th>Q Install.</th>
<th>Q Elect.</th>
<th>Q Gas</th>
<th>Q Equip.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Cooling:</td>
<td>&gt; 1500 m²</td>
<td>&gt; 2000 m²</td>
<td>1.11</td>
<td>716.19</td>
<td>1387.97</td>
<td>673.97</td>
<td>363.94</td>
<td>310.02</td>
<td>714.00</td>
</tr>
<tr>
<td>Cooling:</td>
<td>&gt; 1500 m²</td>
<td>&gt; 2000 m²</td>
<td>1.19</td>
<td>768.74</td>
<td>1446.30</td>
<td>732.30</td>
<td>395.44</td>
<td>336.86</td>
<td>714.00</td>
</tr>
<tr>
<td>No cooling:</td>
<td>&lt; 1000 m²</td>
<td>&lt; 2000 m²</td>
<td>CF A loss/Au = 1</td>
<td>1500.52</td>
<td>786.52</td>
<td>424.72</td>
<td>361.80</td>
<td>714.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CF A loss/Au = 2</td>
<td>1613.07</td>
<td>899.07</td>
<td>485.50</td>
<td>413.57</td>
<td>714.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CF A loss/Au = 3</td>
<td>1725.63</td>
<td>1011.63</td>
<td>546.28</td>
<td>465.35</td>
<td>714.00</td>
<td></td>
</tr>
</tbody>
</table>

Table 20: Estimated Primary energy per building type
Ua: Usable floor area
A loss: Thermal Loss Surface
CF: Correction Factor
Q perf;tot: Theoretical energy consumption in MJ/m²
Q primary: Primary energy consumption in MJ/m²
Q install.: Energy consumed by the building specific installations in MJ/m² (54% Q Elect; 46% Q Gas)
Q Elect.: 54% of building installation energy is reserved for electrical energy in MJ/m² (Snoei, 2008)
Q Gas: 46% of building installation energy is reserved for gas energy in MJ/m² (Snoei, 2008)
Q equip.: Average energy consumption of the building equipment in MJ/m²
An indication of the energy consumption related to energy label and EPC score is presented in the table below. This indication can be used to check the assumed energy consumption of the building under appraisal. The Q primary in the table is based on the average Q primaries of the 8 different building types (8 different correction factors).

<table>
<thead>
<tr>
<th>Label</th>
<th>EPC</th>
<th>Q Primary</th>
<th>Q Installations</th>
<th>Q Elect. MJ</th>
<th>Q Gas MJ</th>
<th>Q Equip.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Label A++</td>
<td>0.75</td>
<td>898.76</td>
<td>238.76</td>
<td>128.93</td>
<td>109.83</td>
<td>660.00</td>
</tr>
<tr>
<td>Average Label A+</td>
<td>0.92</td>
<td>1064.79</td>
<td>386.79</td>
<td>208.87</td>
<td>177.92</td>
<td>678.00</td>
</tr>
<tr>
<td>Average Label A</td>
<td>1.32</td>
<td>1269.92</td>
<td>574.92</td>
<td>310.46</td>
<td>264.46</td>
<td>695.00</td>
</tr>
<tr>
<td>Average Label B</td>
<td>1.67</td>
<td>1449.41</td>
<td>741.41</td>
<td>400.36</td>
<td>341.05</td>
<td>708.00</td>
</tr>
<tr>
<td>Average Label C</td>
<td>1.95</td>
<td>1593.00</td>
<td>879.00</td>
<td>474.34</td>
<td>404.66</td>
<td>714.00</td>
</tr>
<tr>
<td>Average Label D</td>
<td>2.07</td>
<td>1654.54</td>
<td>926.54</td>
<td>500.33</td>
<td>426.21</td>
<td>728.00</td>
</tr>
<tr>
<td>Average Label E</td>
<td>2.30</td>
<td>1772.49</td>
<td>1037.49</td>
<td>560.24</td>
<td>477.25</td>
<td>735.00</td>
</tr>
<tr>
<td>Average Label F</td>
<td>2.52</td>
<td>1885.31</td>
<td>1140.31</td>
<td>615.77</td>
<td>524.54</td>
<td>745.00</td>
</tr>
<tr>
<td>Average Label G</td>
<td>2.63</td>
<td>1941.72</td>
<td>1191.72</td>
<td>643.53</td>
<td>548.19</td>
<td>750.00</td>
</tr>
</tbody>
</table>

Table 21: Average Primary energy related to EPC score.

Ua: Usable floor area
A loss: Thermal Loss Surface
CF: Correction Factor
Q Perf;tot: Q performance; Theoretical energy consumption in MJ/m²
Q Primary: Primary energy consumption in MJ/m²
Q Install.: Energy consumed by the building specific installations in MJ/m² (54% Q Elect; 46% Q Gas)
Q Elect.: 54% of building installation energy is reserved for electrical energy in MJ/m² (Snoei, 2008)
Q Gas: 46% of building installation energy is reserved for gas energy in MJ/m² (Snoei, 2008)
Q Equip.: Average Energy consumption of the building equipment in MJ/m²

8.3 DETERMINATION OF THE ENERGY CONSUMPTION

Research by van der Ham has shown that the theoretical calculated energy consumption given by the Q performance is not completely accurate for the prediction of the real consumption. However it is seen as more accurate than the use of the EPC score to predict the real consumption. The inaccuracy is the result of incorrect tuning of the installations and of internal company specific behavior. Wrongly adjusted installations and user behavior increase the real consumption, but this addition to the theoretical consumption is the responsibility of the user. It is assumed that with or without the sustainable building this additional consumption would also occur.

The EPA U calculation for the Q performance should be used for the estimation of the real energy consumption and corrected the same way as the benchmark is established: using the formula of Van der Ham to calculate the actual energy consumption. Q primary;real:

\[ Q_{\text{primary;real}} = 1.11 \times Q_{\text{performance;total}} / U_a + 593 \]

In the report an example case is shown with the use of the EI index and corresponding EPC labels to give an indication of the energy consumption per label/EPC score (paragraph 8.5, table 26). This is purely an example, in real valuations the Q performance from the EPA U report should be used in combination with the formula for the Q primary;real to get a good estimation of the actual energy consumption by the building. However when no Q performance estimate is available, table 26 can be used.
8.4 DETERMINATION OF ENERGY PRICE

8.4.1 Current price level

The current price level needed to capitalize the energy saving can be found in multiple ways. The price level can be derived from the CBS StatLine data (StatLine.cbs.nl) but in this case too much data was missing from recent years to give an accurate estimation of the current price level.

Online market research on the energy prices for 2010 per energy supplier in the Netherlands resulted in an accurate estimation for the average current energy price. The energy prices per supplier can be found in appendix 12.8. The following average energy price per consumption scale is derived from the supplier data. The prices are based on the consumer energy prices because the commercial prices were not publicly available. The larger consumption scale associated with commercial clients is assumed to have no implications for the deliverance price. In table 22 no real lowered prices can be seen with an increase in consumption scale. The larger scale will have influence on the energy taxes and might also result in the necessity for a special connection to the power and gas grid.

<table>
<thead>
<tr>
<th>ELECTRICITY PRICE/kWh</th>
<th>€/kWh</th>
<th>€/kWh</th>
<th>€/kWh</th>
<th>Standing Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5000 kWh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;5000 kWh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20000 kWh</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>€ 0,067</td>
<td>€ 0,063</td>
<td>€ 0,067</td>
<td>€ 29,43</td>
</tr>
<tr>
<td>GAS PRICE/m³</td>
<td>€/m³</td>
<td>€/m³</td>
<td>€/m³</td>
<td>Standing Charges</td>
</tr>
<tr>
<td>Consumption scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2000 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;2000 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40000 m³</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>€ 0,275</td>
<td>€ 0,273</td>
<td>€ 0,281</td>
<td>€ 26,75</td>
</tr>
</tbody>
</table>

Table 22: Average energy deliverance price 2010 Dutch Energy Companies per consumption scale

The total energy price per kWh excluding VAT (BTW) is based on the deliverance price plus energy taxes (depending on the consumption scale) plus additional costs (fixed per contract and supplier). The total energy price including VAT (19%) can be found by adding 19% VAT to the total energy price.

The additional costs are fixed by Dutch law except the Standing Charges (Vastrecht). The Standing Charges are supplier specific. In this study the average Standing Charge is used. The table with the additional costs is presented in table 23.
The added value of Sustainable Design  Peter van den Tol

The energy taxes per kWh and m³ depend on the consumption scale as presented in table 24. The first scale applies to all consumed kWh and m³, the energy in the second scale is taxed with the tax level of scale 1 + tax level scale 2. An example: over 15,000 kWh the first 10,000 kWh are taxed with € 0.0716*10000; the remaining 5000 kWh are taxed with (€ 0.0716 + € 0.0369)*5000. The same applies to the taxes on m³ gas.

The total energy price/kWh and m³ depends on the consumption scale (#kWh electricity and #m³ gas) and the provider. The formulas to calculate the energy prices per kWh and per m³ in excel are the presented in the table below following:

\[
\text{€/kWh} = \left\{ \begin{array}{l}
(\text{Average deliverance price} + \text{tax 1}) + \text{MAX}((-10000+\# \text{ kWh})*\text{tax} 2; 0) + \text{MAX}((-50000+\# \text{ kWh}*\text{tax} 3; 0) + \text{MAX}((-10000000+\#\text{kWh})* \text{tax} 4 + \text{Additional Costs Electricity} + \text{VAT})/#\text{kWh} \\
\end{array} \right.
\]

\[
\text{€/m³} = \left\{ \begin{array}{l}
(\# \text{ m³} * (\text{Average deliverance price} * \text{tax 1}) + \text{MAX}((-10000+\# \text{ m³})*\text{tax} 2; 0) + \text{MAX}((-50000+\# \text{ m³}*\text{tax} 3; 0) + \text{MAX}((-10000000+\#\text{m³})* \text{tax} 4 + \text{Additional Costs Gas} + \text{VAT})/#\text{kWh} \\
\end{array} \right.
\]
8.4.2 Price level development scenario

For the estimation of the development of the energy price level, data provided by a large energy company in the Netherlands (name is confidential) was used.

The development of the energy prices is presented in the figure 24 and 25.

Figure 24: Electricity kWh Price level development scenario

The development scenario of the kWh supply price projects a 3.68% yearly increase on the Real Income.

Figure 25: Gas m³ Price level development scenario

The development scenario of the m³ supply price projects a 3.15% yearly increase on top of inflation.

Both figures can be used when the energy savings premium is included in the valuation as a separate income stream and not as a premium on top of the rent.
8.5 **CAPITALIZATION OF ENERGY SAVINGS PREMIUM**

Essential to the insight in the added value of sustainable office buildings is the value related to the reduced energy consumption of this type of building. The height of the energy savings premium for the building in question can be determined following these steps:

**Step 1 Determine the benchmark**

The benchmark for the comparison of the energy consumption of the building under study needs to be established. According to the building type (cooling, size, proportion) the benchmark Primary Energy Consumption (Q primary) can be found in table 25. The primary energy consumption is divided in two energy groups: the energy for building specific installations and the energy for building equipment. For the energy saving, the energy consumption of the building specific installation is needed. On average 54% of the installation energy is used for lighting and other electrical installations, 46% is used for installations that run on gas (Koppels, Snoei, 2008). Example: A building without cooling of 600m² with a proportion for the Thermal Loss Surface and a useable area (A loss/Au) of 2 has the following energy benchmark:

\[
\begin{align*}
Q_{\text{electric}} &= 398.51 \text{ MJ/m}^2 \text{ Usable floor space} \\
Q_{\text{gas}} &= 457.25 \text{ MJ/m}^2 \text{ Usable floor space}
\end{align*}
\]

<table>
<thead>
<tr>
<th>No Cooling: Au &gt; 1500 m² Loss areas A loss &gt; 2000 m²</th>
<th>Qperf;tot/Au</th>
<th>Qprimary</th>
<th>Q Instal</th>
<th>Q Elect.</th>
<th>Q Gas</th>
<th>Q Equip.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correction Factor CF 1.11</td>
<td>679.46</td>
<td>1347.20</td>
<td>633.20</td>
<td>341.93</td>
<td>291.27</td>
<td>714.00</td>
</tr>
<tr>
<td>Cooling: Au &gt; 1500 m² Loss areas &gt; 2000 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction Factor CF 1.19</td>
<td>729.32</td>
<td>1402.54</td>
<td>688.54</td>
<td>371.81</td>
<td>316.73</td>
<td>714.00</td>
</tr>
<tr>
<td>No cooling: Au &lt; 1000 m² Loss areas &lt; 2000 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CF A loss/Au = 1</td>
<td>1.27</td>
<td>775.66</td>
<td>1453.98</td>
<td>739.98</td>
<td>399.59</td>
<td>340.39</td>
</tr>
<tr>
<td>CF A loss/Au = 2</td>
<td>1.43</td>
<td>871.86</td>
<td>1560.76</td>
<td>846.76</td>
<td>457.25</td>
<td>389.51</td>
</tr>
<tr>
<td>CF A loss/Au = 3</td>
<td>1.59</td>
<td>968.06</td>
<td>1667.55</td>
<td>953.55</td>
<td>514.91</td>
<td>438.63</td>
</tr>
<tr>
<td>Cooling: Ag &lt; 1000 m² Loss areas &lt; 2000 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CF A loss/Au = 1</td>
<td>1.37</td>
<td>833.53</td>
<td>1518.22</td>
<td>804.22</td>
<td>434.28</td>
<td>369.94</td>
</tr>
<tr>
<td>CF A loss/Au = 2</td>
<td>1.54</td>
<td>937.75</td>
<td>1633.90</td>
<td>919.90</td>
<td>496.75</td>
<td>423.15</td>
</tr>
<tr>
<td>CF A loss/Au = 3</td>
<td>1.71</td>
<td>1041.97</td>
<td>1749.58</td>
<td>1035.58</td>
<td>559.21</td>
<td>476.37</td>
</tr>
<tr>
<td>Average Label C</td>
<td>EPC 1.85</td>
<td>854.70</td>
<td>1541.72</td>
<td>827.72</td>
<td>446.97</td>
<td>380.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 26: Gas m³ Price level development scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ua: Usable floor area</td>
</tr>
<tr>
<td>A loss: Thermal Loss Surface</td>
</tr>
<tr>
<td>CF: Correction Factor</td>
</tr>
<tr>
<td>Q perf;tot: Q performance: Theoretical energy consumption in MJ/m²</td>
</tr>
<tr>
<td>Q primary: Primary energy consumption in MJ/m²</td>
</tr>
<tr>
<td>Q install.: Energy consumed by the building specific installations in MJ/m²</td>
</tr>
<tr>
<td>Q equip.: Average Energy consumption of the building equipment in MJ/m²</td>
</tr>
<tr>
<td>Q Elect.: 54% of building installation energy is reserved for electrical energy in MJ/m² [Snoei, 2008]</td>
</tr>
<tr>
<td>Q Gas : 46% of building installation energy is reserved for gas energy in MJ/m² [Snoei, 2008]</td>
</tr>
</tbody>
</table>
By multiplying the benchmark Q electric and Q gas with the total Usable floor space of the building under appraisal, the benchmark energy consumption for this building can be finalized.

**Step 2**
The next step is to determine the theoretical energy consumption of the building under analysis. The most accurate way to do this, is to make a Q performance calculation using Energy Performance Advice for non-residential building (EPA U) calculation software from SenterNovem (EP Varianten 2.14) or from another certified company or get an EPA U report from a certified EPA specialist. The Q performance is the calculated theoretical energy consumption of an office building. The calculation is based on the NEN 2916 norm.

According to building climate technology expert Van der Ham the Q performance is the most accurate figure at present to relate to the real energy performance on a building (Van der Ham, 2004).

To transform the Q performance in the real energy consumption of the building (Qprimary;real) the Q performance from the EPA calculation should be used in the formula:

\[
Q_{\text{primary;real}} = 1.11 \times \frac{Q_{\text{perf.}}\text{;total}}{Au} + 593 \quad (\text{van der Ham, 2004})
\]

As a control method the following table is created based on previous work from Van der Ham and Gerald Snoei (Snoei 2008) to give an indication of the energy consumption related to EPC value and energy label. The energy consumption is divided in primary energy, installation consumed energy and equipment consumed energy.

<table>
<thead>
<tr>
<th>Label</th>
<th>EPC</th>
<th>Q primary</th>
<th>Q installations</th>
<th>Q equipment</th>
<th>Q Gas MJ</th>
<th>Q Electricity MJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Label A++</td>
<td>0.75</td>
<td>898.76</td>
<td>238.76</td>
<td>660.00</td>
<td>109.83</td>
<td>128.93</td>
</tr>
<tr>
<td>Average Label A+</td>
<td>0.92</td>
<td>1064.79</td>
<td>386.79</td>
<td>678.00</td>
<td>177.92</td>
<td>208.87</td>
</tr>
<tr>
<td>Average Label A</td>
<td>1.32</td>
<td>1269.92</td>
<td>574.92</td>
<td>695.00</td>
<td>264.46</td>
<td>310.46</td>
</tr>
<tr>
<td>Average Label B</td>
<td>1.67</td>
<td>1449.41</td>
<td>741.41</td>
<td>708.00</td>
<td>341.05</td>
<td>400.36</td>
</tr>
<tr>
<td>Average Label C</td>
<td>1.85</td>
<td>1541.72</td>
<td>827.72</td>
<td>714.00</td>
<td>380.75</td>
<td>446.97</td>
</tr>
<tr>
<td>Average Label D</td>
<td>2.07</td>
<td>1654.54</td>
<td>926.54</td>
<td>728.00</td>
<td>426.21</td>
<td>500.33</td>
</tr>
<tr>
<td>Average Label E</td>
<td>2.30</td>
<td>1772.49</td>
<td>1037.49</td>
<td>735.00</td>
<td>477.25</td>
<td>560.24</td>
</tr>
<tr>
<td>Average Label F</td>
<td>2.52</td>
<td>1885.31</td>
<td>1140.31</td>
<td>745.00</td>
<td>524.54</td>
<td>615.77</td>
</tr>
<tr>
<td>Average Label G</td>
<td>2.63</td>
<td>1941.72</td>
<td>1191.72</td>
<td>750.00</td>
<td>548.19</td>
<td>643.53</td>
</tr>
</tbody>
</table>

Table 27: Gas m³ Price level development scenario

On average, electricity is accountable for 54% of the installation consumed energy and gas for 46%.

In order to translate the given energy consumption from Mega Joules to cubic meters gas and kWh electricity we need to look at the embodied energy in gas and electricity and the loss of energy during the production of electricity.

Dutch gas from Slochteren has an embodied energy of 35.1 MJ/m³, while one kWh has an embodied energy of 3.6 MJ. Because there is a loss of energy of 61% during production (production efficiency of 39%), the actual amount of energy needed to
produce one kWh is $3.6/39\% = 9.23$ MJ/kWh. To find the amount of theoretically consumed m³ gas and kWh electricity the Q gas and the A electricity need to be divided by respectively 35.1 and 9.23.

**Step 3**
The consumed m³ gas and kWh electricity are multiplied by the average energy price as described in the section 8.4. By comparing the building installation energy consumption of the building in question in €/m² with the benchmark building consumption of €16,13/m² LFA the energy savings premium can be determined. Since tenants declared to be willing to pay 75% of the energy saving, the pure energy savings premium needs to be multiplied by 75% in order to get the actual energy savings premium/m². The willingness to pay only 75% of the energy savings can be explained by the uncertainties regarding the correctness of the energy consumption estimations.

<table>
<thead>
<tr>
<th>LABEL</th>
<th>Electricity kWh</th>
<th>Gas m³</th>
<th>€/m²</th>
<th>€/m²</th>
<th>€/m²</th>
<th>€/m²</th>
<th>€/m²</th>
<th>€/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>A++</td>
<td>13.97</td>
<td>3.13</td>
<td>3.00</td>
<td>1.65</td>
<td>4.65</td>
<td>11.48</td>
<td>8.61</td>
<td></td>
</tr>
<tr>
<td>A+</td>
<td>22.63</td>
<td>5.07</td>
<td>4.86</td>
<td>2.68</td>
<td>7.54</td>
<td>8.59</td>
<td>6.44</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>33.64</td>
<td>7.53</td>
<td>7.22</td>
<td>3.98</td>
<td>11.20</td>
<td>4.93</td>
<td>3.69</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>43.38</td>
<td>9.72</td>
<td>9.31</td>
<td>5.13</td>
<td>14.45</td>
<td>1.68</td>
<td>1.26</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>48.43</td>
<td>10.85</td>
<td>10.40</td>
<td>5.73</td>
<td>16.13</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>54.21</td>
<td>12.14</td>
<td>11.64</td>
<td>6.41</td>
<td>18.05</td>
<td>-1.93</td>
<td>-1.44</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>60.70</td>
<td>13.60</td>
<td>13.03</td>
<td>7.18</td>
<td>20.21</td>
<td>-4.09</td>
<td>-3.07</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>66.71</td>
<td>14.94</td>
<td>14.32</td>
<td>7.89</td>
<td>22.22</td>
<td>-6.09</td>
<td>-4.57</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>69.72</td>
<td>15.62</td>
<td>14.97</td>
<td>8.25</td>
<td>23.22</td>
<td>-7.09</td>
<td>-5.32</td>
<td></td>
</tr>
</tbody>
</table>

Table 28: Gas m³ Price level development scenario

**Step 4**
The energy savings premium can now be included in the market and investment value assessments in four different ways:

- **GIY**
  - The Energy Savings Premium is added to the rent.
  - The Energy Savings Premium is added to the value assessment as a separate correction post or service cost income component: With a DCF calculation in which an energy price development scenario can be included, the Savings Premium can be capitalized for the length of the DCF period.

- **DCF**
  - The Energy Savings Premium is added to the rent
  - The Energy Savings Premium is added to the value assessment as a separate income stream or service cost income component on which an energy price development scenario can be connected, the Savings Premium can be capitalized for the length of the DCF period.
The inclusion of the energy savings premium as a separate income stream or as a correction post is preferred by the interviewees: This way the valuation remains transparent; the energy price development scenario can be included and the negotiations on market rent do not become more complex. The energy savings premium should be negotiated on during the negotiations for the service costs since they are related to the service costs.
9  GREEN VALUATION METHOD PROPOSAL

9.1  GENERAL

All actors from the Real Estate profession expect sustainable office buildings to financially (and socially) outperform conventional office buildings. The expectations amongst the actors varied between value decreases of conventional office buildings and increased values for sustainable office buildings. In order to reflect the impact of sustainability aspects on the value of office buildings as expected by the respondents the “Green Valuation Method” is developed.

The Green Valuation Method for sustainable office buildings is developed, based on the results from the interviews, survey and the test case. In the method as described in this chapter, the opinions of appraisers, developers and investors from the Real Estate profession are processed.

9.1.1  Definition of sustainability: minimal requirements

Prior to the presentation of the valuation method the minimal requirements that an office building has to meet to be suited for the green valuation has to be established.

In order to meet the requirements for the green valuation the building under assessment has to perform according to a minimal standard. The criteria as determined in the interviews and the survey are that the object under valuation has to have at least an EPBD Label B or a BREEAM NL Good score.

The respondents stated that sustainability should not be looked at through a single description but through degrees: the higher the sustainability level, the higher the building value should be. In order to comply with this request the energy savings premium as described in chapter 8 was developed.

9.1.2  Market value and investment value

An important distinction has to be made between the market value and the investment value (Geltner, Miller, 2001). The main part of the appraisers’ work is the assessment of the market value: the value at which rate the object under assessment is expected to be sold in the market to an interested party on a short term (Tazelaar, 2002). In the assessment of the market value, the appraiser is restricted to the use of “market evidence based” parameters that reflect the current market situation. The market value is assessed with as little subjective elements as possible. However even the market value assessment uses many subjective appraiser specific decisions.

The investment value is another type of value: the value that an individual investor would be willing to pay for the object under assessment (Tazelaar, 2002). In the assessment of the investment value, the appraiser has more maneuverability space to include future expectations. Since all actors expect sustainable buildings to have a higher value than a conventional one, but a lot of market evidence is still missing we can assume that the investment value of sustainable office buildings will be higher than the market value of the sustainable office building. Because of this distinction in value, we will discuss the valuation of market value and of investment value.
9.1.3 Energy savings potential

In order to include the energy savings potential in the valuation the energy savings premium method has been developed. The premium will not only be applied to buildings that perform better than the benchmark but also to the buildings that perform below. The energy savings premium should still be applied as an extra incentive for the greening up of the existing stock. A building performing below the benchmark energy consumption according to the EPA report of that object should be valued with the inclusion of a ‘negative’ energy savings premium (discount). In this case the energy inefficient building will face value depreciation.

9.2 Valuation techniques

For the valuation of sustainable office buildings the two existing income approaches can be used according to the respondents. The Gross Initial Yield method with Top Slice for corrections should be used in combination with the Discounted Cash Flow method. Both methods should be used alongside each other for cross check purposes.

In the interviews and the survey the preferred DCF period and the method to determine the exit value of the building by the respondents varied strongly. From a 10 year DCF with exit yield to a 100 year DCF in which the first 20 years are used for the income estimate and the last 80 years for the estimation of the exit value of the building.

The 100 year DCF is the best method for the valuation of sustainable office buildings because it offers the best options to reflect sustainability aspects in a transparent manner in the valuation. Since the exit value is based on the remaining 80 years in the cash flow, this method to determine the exit value is seen as the most transparent technique. Also, the method is less sensitive to parameter changes than the 20 year DCF with Exit Yield (to determine the exit value). This gives the method better protection for estimation flaws.

The GIY with Top Slice method is the least complicated valuation technique while it still offers the appraiser the possibility to include corrections for differences in market rent assumption and contract rent.

9.3 Fictive comparison building

The proposed parameter changes as presented in the following paragraphs are tested on a fictive benchmark building in Utrecht Papendorp to compare the effect of the adjustment on the value of the object with the following characteristics and assumptions.

<table>
<thead>
<tr>
<th>Size:</th>
<th>3000 m² LFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building year:</td>
<td>2008</td>
</tr>
<tr>
<td>EPBD label:</td>
<td>A</td>
</tr>
<tr>
<td>Energy consumption:</td>
<td>33,64 kWh/m², 7,53 m³/m²</td>
</tr>
<tr>
<td>Contract rent:</td>
<td>€205/m²</td>
</tr>
<tr>
<td>Market rent:</td>
<td>€185/m²</td>
</tr>
<tr>
<td>GIY/DCF Yield:</td>
<td>7,00%</td>
</tr>
<tr>
<td>Estimated Replacement cost:</td>
<td>€4,500,000.00</td>
</tr>
<tr>
<td>Rise Fixed expenses:</td>
<td>2,30%</td>
</tr>
<tr>
<td>Rise Construction costs:</td>
<td>2,30%</td>
</tr>
<tr>
<td>Rental Growth:</td>
<td>2,00%</td>
</tr>
</tbody>
</table>
9.4 ADJUSTABLE PARAMETERS GIY AND DCF METHOD

In the market value assessment with the GIY method and the 100 year DCF several critical parameters can be adjusted when the object under appraisal concerns a sustainable building as determined in paragraph 9.1.1. In this paragraph, the changes for the valuation parameters as opted in the interviews, survey and test case are described.

9.4.1 Market Rent estimation

The estimations for the market rent are usually derived from a data base containing rent information on different locations. For a specific location for instance Papendorp, Utrecht, the data base gives an indication of the upper and lower bound of the current rent levels at that location. An example derived from the DTZ data base:

<table>
<thead>
<tr>
<th>Place</th>
<th>Location</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utrecht</td>
<td>Papendorp</td>
<td>€168</td>
<td>€170</td>
<td>€170</td>
<td>€170</td>
</tr>
<tr>
<td></td>
<td></td>
<td>€190</td>
<td>€195</td>
<td>€200</td>
<td></td>
</tr>
</tbody>
</table>

Table 29: Rent price indications Papendorp (www.dtz.nl)

With the choice the appraiser makes for the market rent level between the upper and the lower bound of the location, he has a mayor influence of the value of the object. Sensitivity analysis of the choice between the upper bound and the lower bound results in a 7.2% value difference. As seen in the Triodos Test Case (Berkhout, 2010) on average the appraisers estimated a higher market rent for a sustainable office building than for a conventional one, however the argumentation for this choice was not always clear.

The market rent should be determined based on the bandwidth derived from the rent data base. It can be expected that tenants will accept a market rent in between the bandwidth. The height of the market rent within the bandwidth depends on several aspects such as the location quality, neighboring facilities, building quality etcetera. The level of sustainability should be one of the aspects that define the building quality and should therefore also play a role in the estimation of the rent. One of the ways the appraiser can include the level of sustainability in the estimation of the market rent is by using the EPBD label system: The appraiser should initially define the place within the bandwidth based on the location and building characteristics, resulting in the Mean Market Rent; additionally the appraiser can determine an increase or decrease of the market rent based on the label score as presented in table 30. The values correspond with results from the Triodos Test Case regarding the different in rent levels for a sustainable versus a conventional building (Chapter 7).

Market rent estimation = Mean Market Rent + x % of difference between lower and upper bound:

<table>
<thead>
<tr>
<th>Label</th>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Label B</td>
<td>Rent +30% upper-lower bound (200-170)</td>
<td>2.15%</td>
<td>2.09%</td>
</tr>
<tr>
<td>Label B</td>
<td>Rent +15% upper-lower bound (200-170)</td>
<td>1.07%</td>
<td>1.04%</td>
</tr>
<tr>
<td>Label C</td>
<td>Rent +0 % upper-lower bound (200-170)</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Label D</td>
<td>Rent - 15% upper-lower bound (200-170)</td>
<td>-1.07%</td>
<td>-1.04%</td>
</tr>
<tr>
<td>&lt; Label D</td>
<td>Rent - 30% upper-lower bound (200-170)</td>
<td>-2.15%</td>
<td>-2.09%</td>
</tr>
</tbody>
</table>

Table 30: Impact of the rent adjustment per EPBD label on the market value.
The sensitivity of these adjustments (varying between -2.15% and +2.15%) is acceptable. Poor building quality or extra high building quality can influence these estimated adjustments according to the appraiser. In paragraph 9.4.3, the Energy savings Premium is described as a more precise alternative for this method. Both methods should not be used both in the same appraisal unless used as a cross-checking mechanism.

### 9.4.2 Gross Initial Yield estimation

Lower vacancy risks and increased lettability are one of the main elements expected with regard to sustainable office building that relate to the estimation of the risk yield. The Test case showed that appraisers on average estimated a 0.25 percentage point lower GIY for sustainable office buildings than for conventional ones. The appraiser should estimate the yield according to his ‘regular’ methods based on the building characteristics (accessibility, flexibility, quality). When the estimated yield is already ‘low’ the appraiser should apply a smaller yield correction that -0.25 percentage point.

Sensitivity analysis indicated a value change of 3.49% when lowering the yield for the sustainable office building. In combination with the market rent fitting the label (A): Mean Rent + 30% * (€200 – €170), the yield adjustment of -0.25 percentage points resulted in a value change of 5.752%.

Because the risk assumptions related to the vacancy and the incentive are included in the yield assumption in the GIY method, no vacancy and incentive correction is needed. These assumptions can be adjusted in the DCF method.

<table>
<thead>
<tr>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield -0.25 % point</td>
<td>3.64%</td>
<td>3.49%</td>
</tr>
</tbody>
</table>

Table 31: Impact of the yield adjustment of -0.25 percentage point on the market value.

The yield adjustment can also be determined following the same principle of the determination of the market rent: based on the bandwidth of current yields for the location of the building. This way the difference between the values of the EPBD labels can be estimated:

- Label A + 100% yield adjustment 0.25 percentage point
- Label A + 75% yield adjustment 0.25 percentage point
- Label B + 50% yield adjustment 0.25 percentage point
- Label C + 0% yield adjustment 0.25 percentage point
9.4.3 Energy Savings Premium 50% / 75%

Based on the RICS definition of valuations of commercial real estate the appraiser should include part of the energy saving in the valuation. The way to determine the value of the energy saving, the energy savings premium tool as described in chapter 8 can be applied. The respondents in the interviews still doubted the research results found by Koppels and Snoei (Koppels, Snoei, 2008) that tenants were willing to pay 75% of the energy saving as a rent premium. This hesitation in combination with the RICS definition leads to the decision to include only 50% of the energy savings premium in the assessment of the market value.

Based on the Energy Index score and the formulas from Van der Ham, the value change for the inclusion of 50% of the energy savings premium for a building with an EI score of 1.00 is 0.593%. A combination with the reduction of the GIY does not influence the impact of the energy savings premium on the value; the influence of the ESP is independent from the yield correction.

<table>
<thead>
<tr>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Savings Premium 50%</td>
<td>0.59%</td>
<td>0.62%</td>
</tr>
<tr>
<td>Energy Savings Premium 75%</td>
<td>0.89%</td>
<td>0.93%</td>
</tr>
</tbody>
</table>

Table 32: Impact of the energy savings premium on the market value.

An indication of the impact of the inclusion of the energy savings premium in the GIY value assessment related to the Energy Index score is presented in table 33.

<table>
<thead>
<tr>
<th>EPC requirement 2008</th>
<th>1.50</th>
<th>75% inclusion</th>
<th>50% inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>LABEL</td>
<td>EI Score</td>
<td>Avg. EI</td>
<td>EPC 2008</td>
</tr>
<tr>
<td>A++</td>
<td>≤ 0.50</td>
<td>0.75</td>
<td>2.518%</td>
</tr>
<tr>
<td>A+</td>
<td>0.51-0.70</td>
<td>0.61</td>
<td>2.156%</td>
</tr>
<tr>
<td>A</td>
<td>0.71-1.05</td>
<td>0.88</td>
<td>1.272%</td>
</tr>
<tr>
<td>B</td>
<td>1.06-1.15</td>
<td>1.11</td>
<td>0.545%</td>
</tr>
<tr>
<td>C</td>
<td>1.16-1.30</td>
<td>1.3</td>
<td>0.000%</td>
</tr>
<tr>
<td>D</td>
<td>1.31-1.45</td>
<td>1.38</td>
<td>2.07</td>
</tr>
<tr>
<td>E</td>
<td>1.46-1.60</td>
<td>1.53</td>
<td>2.30</td>
</tr>
<tr>
<td>F</td>
<td>1.61-1.75</td>
<td>1.68</td>
<td>2.52</td>
</tr>
<tr>
<td>G</td>
<td>&gt; 1.75</td>
<td>2.63</td>
<td>-1.082%</td>
</tr>
</tbody>
</table>

Table 33: Impact of the energy savings premium on the market value per label score.

To avoid increasing the complexity of the rent negotiations the best way to include the energy savings premium is as a separate correction post. This way the addition remains transparent. Another positive result of this decision is that the energy saving premium can be connected with the price development scenario. The energy savings premium should only be capitalized for 10 years maximum. It is expected that within 10 years the energy efficiency of office building will be increased and the regulations on energy efficiency tightened. After 10 years, the benchmark should be adjusted.

The inclusion of 50% of the ESP is recommendable for the assessment of the market value. It can be expected that at least a 50-50 split of the energy savings benefit will be accepted by the client. For the determination of the investment value, the appraiser can (according to my personal opinion) include the 75% ESP in the value depending on his opinion.
9.4.4 Green Finance Agreement Capitalization

The Green Finance Agreement (GFA; Groen Verklaring) should be included in the valuation. A GFA represents a capital cost advantage: the needed investment for the sustainable measures in the building can be lent for a lower interest rate because of tax benefits for the lender of the money; investors in a fund for the green finance product have to pay less taxes over their profits. A minimum requirement to obtain a GFA is that the building has to perform 30% better than the EI score as required by the building code: EI score < 1,0*0.7 = 0.7. The interest is on average 1.5 percentage point lower than a regular loan. Because the GFA is building specific (the agreement is sold along with the building at the moment of transaction) this interest benefit will also be applicable for the new owner. The new owner can loan a part (the part of the investment as determined on the GFA) of the acquisition cost for 1.5 percentage point less.

In practice this means that the value of the building in question should be increased with the sum of the reduced capital cost: The GFA concerns a loan of €500,000,00 for an interest of 6% instead of the regular 7.5% (assumed) for the remaining period of the GFA (maximum of 10 years). The value of the GFA can be calculated with a DCF. Per year the benefit is 1.5% of the GFA sum: 1.5% * €500,000,00 = €7500,00. For a remaining GFA period of 9 years this represents a value of €56,364,24 based on a yield of 7% and a 9 year DCF.

<table>
<thead>
<tr>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion of Green Finance Agreement</td>
<td>0.67%</td>
<td>0.64%</td>
</tr>
<tr>
<td>Table 34: Impact of the GFA on the market value.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9.4.5 Rent difference correction

At present the rent difference between assumption for the market rent and the contract rent is corrected in the value assessment for the remaining period of the lease contract. It can be expected that a sustainable office building has a higher chance to realize the rent difference again during new negotiations after the initial lease has expired.

It can be argued that the rent difference correction can be continued after the final year of the initial lease term for 50% of the prior rent difference and capitalized for a higher risk. Continuing the rent difference correction for 50% for a yield of 200% of the initial correction yield (2*7%) results in a value increase of 0.262%, using a capitalization yield of 150% of the initial yield results in a value increase of 0.690%. However this is too much a future prediction, making this adjustment less applicable to the assessment of the market value. In the assessment of the investment value, this proposal can be used.

<table>
<thead>
<tr>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cap. rent difference 50%;14% yield</td>
<td>0.69%</td>
<td>0.69%</td>
</tr>
<tr>
<td>Cap. rent difference 50%;10% yield</td>
<td>1.17%</td>
<td>1.17%</td>
</tr>
<tr>
<td>Table 35: Impact of the energy savings premium on the market value.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sustainable office buildings that have a contract rent above the estimated market rent (like the building on the Blaeulaan as described in chapter 7) will inevitably be worth more than a building with a rent at market level or below. This way, building owners can already assure a higher market value for their sustainable building.
9.4.6 Regular Maintenance

The percentage of the regular maintenance should remain the same. Because the rents of the sustainable office building are expected to be higher, the absolute level of the maintenance cost will be higher. Sustainable office buildings should have higher maintenance costs because they require on average higher building costs (Katz, 2003).

9.4.7 Large maintenance correction

Corrections can be made in the frequency of the large maintenance when the building is built with durable materials that require less maintenance. At present a measurement system to determine the durability of the total objects’ building materials is not yet available. Because of this no benchmark or minimal requirement score for the durability can be determined. This makes a correction for the frequency of the large maintenance purely subjective to the appraiser.

Changing the frequency of the large maintenance from once every 20 year to once every 25 year resulted in a value change of 0.67% in the DCF. Input variables related to the maintenance were the increase of construction costs (2.3%) and the initial building cost estimation (€1500,00/m² LFA).

<table>
<thead>
<tr>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large maintenance correction year 25</td>
<td>0.67%</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 36: Impact of the adjustment of the large maintenance on the market value.

9.4.8 Rental growth

The sustainable office building is expected to have a more stable rental growth than a conventional building because of easier letting and higher user satisfaction. The rental growth in the sensitivity analysis for the sustainable office building was estimated at the inflation level. The value change was tested with a reduction in the rental growth expectation for the conventional building leading to relatively high value changes especially in combination with yield and rent adjustments. Adjustments in the rental growth are expected to be too sensitive.

<table>
<thead>
<tr>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>yield -0.25%</th>
<th>Δ Value in GIY method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rental growth +0.15% point</td>
<td>2.38%</td>
<td>-</td>
<td>6.19%</td>
<td></td>
</tr>
</tbody>
</table>

Table 37: Impact of the rental growth adjustment on the market value.

9.4.9 Vacancy and incentives

The assumed vacancy and incentive correction in the benchmark value calculation was 50% of the rent every 10 years. As proposed in the interviews and the survey a reduction of 30% of the incentives and the vacancy assumption after contract expiration is advised and tested against the benchmark for sensitivity.

<table>
<thead>
<tr>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vacancy -30%</td>
<td>0.91%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Incentives -30%</td>
<td>0.91%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Both -30%</td>
<td>1.82%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 38: Impact of the adjustment in vacancy and incentive estimations on the market value.
9.4.10 Combining the adjustments

In the valuation methods three main parameters can be adjusted for a sustainable office building in the following combinations:

- The market rent assumption in combination with the GIY estimation
  Or a more precise method with more transparent argumentation
- The inclusion of the Energy savings Premium in combination with the GIY estimation

Next to that the Green Finance Agreement (GFA) should be capitalized and added to the value when the object has a GFA.

Testing the parameters adjustments in combinations in the GIY and the DCF model indicated that all parameter combinations except the inclusion of the rental growth adjustment will result in acceptable value changes (maximum 10% value increase). In table 39 (DCF) and table 40 (GIY) the results of the parameter combinations are presented.

<table>
<thead>
<tr>
<th>Label</th>
<th>Parameter change</th>
<th>Δ Value</th>
<th>Y</th>
<th>Y+ESP</th>
<th>Y+V+I</th>
<th>Y+V+I+ESP</th>
<th>Y+V+I+ESP+RG</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Label B</td>
<td>Rent +30% (200-170)</td>
<td>2.15%</td>
<td>5.93%</td>
<td>6.56%</td>
<td>8.72%</td>
<td>9.34%</td>
<td>12.10%</td>
</tr>
<tr>
<td>Label B</td>
<td>Rent +15% (200-170)</td>
<td>1.07%</td>
<td>4.78%</td>
<td>5.41%</td>
<td>7.12%</td>
<td>7.74%</td>
<td>10.43%</td>
</tr>
<tr>
<td>Label C</td>
<td>Rent + 0% (200-170)</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Label D</td>
<td>Rent - 15% (200-170)</td>
<td>-1.07%</td>
<td>-1.07%</td>
<td>-1.07%</td>
<td>-1.07%</td>
<td>-1.07%</td>
<td>-1.07%</td>
</tr>
<tr>
<td>&lt;Label D</td>
<td>Rent - 30% (200-170)</td>
<td>-2.15%</td>
<td>-2.15%</td>
<td>-2.15%</td>
<td>-2.15%</td>
<td>-2.15%</td>
<td>-2.15%</td>
</tr>
<tr>
<td>Yield -0.25 %point</td>
<td></td>
<td>3.64%</td>
<td>3.64%</td>
<td>4.26%</td>
<td>5.53%</td>
<td>6.15%</td>
<td>8.76%</td>
</tr>
<tr>
<td>Energy Savings Premium 50%</td>
<td></td>
<td>0.62%</td>
<td>4.26%</td>
<td>4.88%</td>
<td>6.16%</td>
<td>6.78%</td>
<td>8.76%</td>
</tr>
<tr>
<td>Energy Savings Premium 75%</td>
<td></td>
<td>0.93%</td>
<td>4.57%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vacancy -30%</td>
<td></td>
<td>0.91%</td>
<td>4.58%</td>
<td>5.20%</td>
<td>-</td>
<td>5.82%</td>
<td>8.76%</td>
</tr>
<tr>
<td>Incentives -30%</td>
<td></td>
<td>0.91%</td>
<td>4.58%</td>
<td>5.20%</td>
<td>-</td>
<td>5.82%</td>
<td>8.76%</td>
</tr>
<tr>
<td>Both -30%</td>
<td></td>
<td>1.82%</td>
<td>5.53%</td>
<td>6.15%</td>
<td>-</td>
<td>6.77%</td>
<td>8.76%</td>
</tr>
<tr>
<td>Rental growth +0.15% point</td>
<td></td>
<td>2.38%</td>
<td>6.19%</td>
<td>6.81%</td>
<td>8.14%</td>
<td>8.76%</td>
<td>-</td>
</tr>
<tr>
<td>Rent difference 50%:14% yield</td>
<td></td>
<td>0.69%</td>
<td>4.35%</td>
<td>4.97%</td>
<td>6.24%</td>
<td>6.86%</td>
<td>9.49%</td>
</tr>
<tr>
<td>Rent difference 50%:10% yield</td>
<td></td>
<td>1.17%</td>
<td>4.84%</td>
<td>5.46%</td>
<td>6.74%</td>
<td>7.36%</td>
<td>10.00%</td>
</tr>
</tbody>
</table>

Table 39: Value changes as result of parameter adjustment combinations: DCF method.

Y = Yield adjustment
V = Vacancy adjustment
I = Incentive adjustment
ESP = Energy Savings Premium inclusion
RG= Rental Growth adjustment
Table 40: Value changes as result of parameter adjustment combinations: GIY method.

<table>
<thead>
<tr>
<th>Label</th>
<th>Parameter change</th>
<th>Δ Value</th>
<th>Y</th>
<th>Y+EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Label B</td>
<td>Rent +30% (200-170)</td>
<td>2.09%</td>
<td>5.75%</td>
<td>7.12%</td>
</tr>
<tr>
<td>Label B</td>
<td>Rent +15% (200-170)</td>
<td>1.07%</td>
<td>4.63%</td>
<td>5.62%</td>
</tr>
<tr>
<td>Label C</td>
<td>Rent + 0% (200-170)</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Label D</td>
<td>Rent -15% (200-170)</td>
<td>-1.07%</td>
<td>-1.07%</td>
<td>-1.07%</td>
</tr>
<tr>
<td>&lt;Label D</td>
<td>Rent - 30% (200-170)</td>
<td>-2.09%</td>
<td>-2.09%</td>
<td>-2.09%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Label</th>
<th>Parameter change</th>
<th>Δ Value</th>
<th>Y</th>
<th>Y+EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield -0.25 %point</td>
<td></td>
<td>3.49%</td>
<td>-</td>
<td>4.11%</td>
</tr>
<tr>
<td>Energy Savings Premium 50%</td>
<td></td>
<td>0.62%</td>
<td>4.09%</td>
<td>-</td>
</tr>
<tr>
<td>Energy Savings Premium 75%</td>
<td></td>
<td>0.93%</td>
<td>4.39%</td>
<td>-</td>
</tr>
<tr>
<td>Rent difference 50%:14% yield</td>
<td></td>
<td>0.69%</td>
<td>4.06%</td>
<td>4.68%</td>
</tr>
<tr>
<td>Rent difference 50%:10% yield</td>
<td></td>
<td>1.17%</td>
<td>4.44%</td>
<td>5.06%</td>
</tr>
</tbody>
</table>

Table 41: Value changes in % as a result of the parameter adjustments with or without rent corrections.

<table>
<thead>
<tr>
<th>Value changes parameter adjustments</th>
<th>With rent corrections</th>
<th>Without rent corrections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy saving premium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solely</td>
<td>0.93%</td>
<td>0.889%</td>
</tr>
<tr>
<td>With market rent according to EPBD label</td>
<td>3.372%</td>
<td>3.668%</td>
</tr>
<tr>
<td>With GIY reduction</td>
<td>4.090%</td>
<td>4.387%</td>
</tr>
<tr>
<td>With both</td>
<td>7.096%</td>
<td>7.392%</td>
</tr>
</tbody>
</table>

The added value of Sustainable Design

Peter van den Tol

The combinations of the rent adjustment with the yield adjustment result in the highest value changes. The combination of the Yield, Vacancy, Incentive, ESP and Rental Growth adjustment resulted in value changes that were too high. It is advisable not to adjust the rental growth assumption in the valuation to safeguard for overvaluation.

Note that for buildings with an EBPD label < C, only the rent adjustment and the ESP are accounted for, resulting in a decrease in value for these type of buildings.

9.4.11 Sensitivity of the parameter adjustments

The sensitivity of the parameter adjustments is affected by the inclusion of the rent difference in the valuation. When considering the value of the office building without looking at the current contract attached to the building the parameters show a higher sensitivity for the adjustments. This effect is previously found in the Triodos Test Case analysis in chapter 7.

Because the difference in rent is higher in the assessment of the benchmark building value than for the sustainable building, the rent corrections are higher for the benchmark building than for the sustainable building. Without adjusting the rent, the effect of the rent correction is smaller:

What are the key findings regarding the added value of sustainable design and how does it affect property valuations?
Adjusting the market rent for the sustainable building without the rent correction shows the highest sensitivity. This can be explained by the fact that the rent corrections for the benchmark are higher than for the sustainable building.

<table>
<thead>
<tr>
<th>Label</th>
<th>Parameter change</th>
<th>Δ Value in DCF method</th>
<th>Δ Value in GIY method</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Label B</td>
<td>Rent +30% upper-lower bound (200-170)</td>
<td>2.15%</td>
<td>2.09%</td>
</tr>
<tr>
<td>Label B</td>
<td>Rent +15% upper-lower bound (200-170)</td>
<td>1.07%</td>
<td>1.04%</td>
</tr>
<tr>
<td>Label C</td>
<td>Rent + 0% upper-lower bound (200-170)</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Label D</td>
<td>Rent -15% upper-lower bound (200-170)</td>
<td>-1.07%</td>
<td>-1.04%</td>
</tr>
<tr>
<td>&lt;Label D</td>
<td>Rent -30% upper-lower bound (200-170)</td>
<td>-2.15%</td>
<td>-2.09%</td>
</tr>
</tbody>
</table>

Table 42: Value changes in % as a result of the parameter adjustments: GIY and DCF compared.

As can be derived from table 42, the adjustments in the DCF and the GIY method result in similar sensitivities to the parameter adjustments.

9.5 QUALITATIVE ASSESSMENT

Aside from the quantitative assessment of the building value, a ‘softer’ qualitative sustainability report can be added to the valuation. The assessment method proposed by the majority of the respondents in the survey and the interviews is the inclusion of a BREEAM NL report. Currently many appraisal companies are training their employees in the qualitative sustainability assessment method BREEAM NL. Increased knowledge on sustainability amongst appraisers can be used to further specify the requirements a building needs to meet to be considered for a “green valuation”.

Additionally, the qualitative BREEAM NL report can give further information on employee satisfaction (when studied), energy consumption (needed for the determination of the Energy Savings Premium) air quality, environmental impact and other qualitative building aspects.
9.6 DISCUSSION

The proposed adjustments as tested in the benchmark, result in value changes fitting within the bandwidth for the increased market value for sustainable office buildings as indicated in the interviews and the survey (between 5% and 10% value increase).

The method for the determination of the market rent is in line with the expectations of investors, developers and investors that the value of sustainable buildings will increase or the value of conventional buildings (in this case buildings with an EPBD label below C) will decrease. The yield adjustment can be used for an upward effect on the value of sustainable buildings (-0,25 percentage point) or for a downward effect on the value of conventional buildings (scoring below label C).

The yield adjustment can also be determined according to the same principle as applied to the market rent estimation. This will result in a clearer distinction in the market values of the different EPBD labels: Label A++ should have a higher value than Label B.

The proposed parameter changes are not based on accepted market evidence but on the personal interpretation of results from the interview, survey and test case. Appraisers might consider the method insufficiently founded by the market evidence, however no complete and coherent valuation method for sustainable office buildings has been developed as of yet.

When this valuation method is not completely accepted by the profession it can serve as a starting point for a general discussion amongst appraisers how to valuate sustainable offices.

The valuation method can be considered valid as appraisals are already highly subjective to the appraiser. This can clearly be seen in the analysis of the market value estimation in the test case on Papendorp (Berkhout, 2010) as described in chapter 7. Since appraisals are depending on many estimations and assumptions for the parameters, the resulting market values are highly influenced by the personal opinion of the appraiser doing the assessment.

The valuation method as proposed depends on a minimal requirement of a sustainable building as determined based on the interview and survey results. The choice for the EI score to determine the energy savings premium or the label B score as a minimal requirement to be met by the building under appraisal to be suited for the green valuation might be incorrect or not strict enough. Further research on the definition of “sustainability” amongst building owners, tenants, developers and appraisers can be useful.

Finally, when there are clear indications that certain parameters adjustments should be different than proposed, the appraiser can deviate from the proposed adjustment. All proposed adjustments are indicative and based on the personal interpretation of the survey, the interviews and test case.

When using this method the appraiser should keep in mind that the method as described is only subjected to a sensitivity analysis for a building of 3000m². In larger buildings, certain variable changes can have a larger influence on the value change than in smaller buildings. For the ESP this is acceptable, but it might be necessary to adjust the yield correction in bigger buildings. Further research is needed.
10 CONCLUSIONS

10.1 RESEARCH METHOD

The research was designed to study the complex topic of the value of sustainable office buildings. Because of the interrelation of the stakeholders involved in the ‘creation’ of value the study was designed as a qualitative research. As a result of the absence of market evidence the study could not be constructed as a quantitative research.

For validation of the results in the empirical section of the study, multiple research techniques were used for triangulation: interviews with 8 stakeholders in the appraisal process (4 appraisers, 2 investors and 2 developers); a survey amongst the seven biggest appraisal firms in the Netherlands and an analysis of a test case performed by G. Berkhout from the Triodos Bank.

Each part of the empirical study showed different types of results. The interviews provided insight in the ideas and opinions of appraisers, investors and developers on sustainability in office buildings. More importantly, it provided insight in the relation between the different stakeholders and the implication of the different targets of the stakeholders on the valuation of sustainable office buildings: Developers benefit from a higher value for sustainable office buildings because this type of office buildings is their only method to develop new buildings. Appraisers can benefit from the increased knowledge on sustainability and the impact of sustainability on the valuation of office buildings because it can be used to increase their market share and change their role in the real estate process. The implications for investors of a different valuation method for sustainable office buildings are more complex. For investors trying to buy sustainable offices a higher value is obstructing their targets to increase the return on the investment. For investors that already have sufficient sustainable offices in their portfolio a higher value is beneficiary to their portfolio return.

The survey gave insight in the current practice in the valuation profession and on opinions from appraisers on the best valuation methods and adjustable parameters for the valuation of sustainable office buildings. The survey also confirmed part of the conclusions from the interviews. The most important outcome of the survey was the opinion of appraisers on the minimal requirement a building has to meet for the title ‘sustainable’. The data from the interviews and the survey was used for the development of the green valuation method.

The Test Case provided important data on the current practice amongst appraisers in the actual valuation of a sustainable building compared to a conventional one. The data of the test case showed that also the use of market evidence depends highly on the opinion and experience of the appraiser. Data from the test case was used in the testing of the output from the green valuation based on the parameter adjustments.
10.2 DEFINITION OF SUSTAINABILITY

The interviews and the survey presented sufficient information for the creation of a new definition of a sustainable office building according to the three types of stakeholders:

“A sustainable office building has a long technical and functional lifespan with a persistent demand by tenants through offering a high level of comfort and air quality while consuming as few resources as possible.”

Next to the definition, minimal requirements based on the opinion of the survey and interviews respondents were formulated. The building under appraisal has to meet specific requirements to be considered for a green valuation: according to the respondents, only buildings with a minimal EPBD label B or BREEAM NL Good score should be valued according to the proposed green valuation method. Furthermore the interviews and survey were used for the determination of the benchmark for the energy consumption of office buildings. This benchmark was needed to determine the height of the energy savings premium as described in chapter 8.

An important follow up study should be done amongst building tenants to verify or adjust the minimal requirements of the buildings’ suitability for the green valuation.

10.3 THE ROLE OF THE APPRAISER

In the current Real Estate process, appraisers play a silent role. They are sometimes seen as a necessary ‘evil’ and sometimes as a ‘regular’ advisor. Despite objections from the appraisal profession, it is my opinion that appraisers have much more influence in the real estate process than can be expected. With the decision making during valuations, they have a serious influence on the perception and creation of value: when one appraiser values the building for a buying party at 2 million and the appraiser for the selling party at 1 million it is likely that the value of a building to be sold will eventually lie in between the values given by the buying and selling parties. This scenario seems nonsense, however a buyer of a property can ask three appraisers to assess the value. From these values the buyer will take the lowest value assessment to the negotiation. The opposite can happen with the seller of the property. That value assessments can vary greatly is shown by the Triodos Test case.

Precisely because of this fact, the appraisal profession should take up this initiative for the development of a mutual valuation guideline for sustainable office buildings. Not only building tenants, owners and ‘the market’ determine the value of a building, also the appraiser and the broker play a mayor role.

By taking up the distinction in the valuation of conventional office buildings and sustainable offices, the appraisal profession can play an important role in the greening up of the Dutch office stock. Through assessing the values of new sustainable developments in a proper way, more sustainable building developments can become feasible. The green valuation can also be applied to assess the impact of greening-up measures on the value: is the greening-up measure financially feasible; does it add value to the building.
Appraisers have the chance to change their role from a solely reactive profession towards a more pro-active advisor in the initiative phase of the real estate process. Investors are increasingly starting to discuss the appraisal profession primarily due to the reactive nature of the profession.

10.4 VALUATION METHOD

The valuation method for sustainable office buildings as presented in this report gives results that fit within the bandwidth as concluded from the interviews and the survey. The value difference between the value of the sustainable building and the conventional one as found in the sensitivity analysis of the method also correspond with the average value difference found in the Triodos test case on the building in Papendorp (Berkhout, 2010).

The method requires the appraiser to increase his or her insight in sustainability. Since most appraisal companies have already started to train their employees in BREEAM NL or other sustainability assessment methods, it can be expected that the knowledge on sustainability amongst appraisers will grow.

A potential pitfall of the method lies in the minimal requirement for an object to be fit for the green valuation method. Questions can and should be asked whether the benchmark for the energy consumption is fair or whether the minimal EPBD label B requirement is right. Growing insight in sustainability among appraisers can stimulate the debate on this topic. A strong argumentation for the requirements and the energy benchmark will make the case for the green valuation method.

In case the proposed valuation method is not accepted for market value assessments, it can be suited for investment value assessments.

10.5 ROZ GUIDELINE CHANGES

The idea behind the proposed valuation method was to develop a valuation guideline for sustainable office buildings for the ROZ IPD or the RICS. Currently the method is not yet discussed in an expert panel review. The method has to be reviewed by experts from the real estate profession before it can be used for the development of a guideline. The current method is suited for presentation to an expert panel and is open for discussion.

10.6 MARKET EVIDENCE

Even though study results from studies in other countries indicate higher values for sustainable office buildings, there is still a lack market evidence on the higher value of sustainable office buildings in the Netherlands. The reason for the absence of market evidence lies in the way office buildings are rented out in the Netherlands and in the recent financial crisis. The crisis has a limiting effect on the transactions in commercial real estate. The effect of the crisis is expected to last at least one more year (www.dtz.nl).

The lack of market evidence behind the valuation method will be an obstacle for the acceptance of the valuation method as proposed. However as could be seen in the Triodos Case, also in assessments of the market value using market evidence can result in greatly varying result.
10.7 CHARACTER OF VALUATIONS

The value of an office building can be essential for the functioning of a developer or an investor. However in practice, value assessments are a lot less in depth than might be expected. Sometimes, valuations are done based on a desk research and the appraiser does not visit the building in question.

Valuations in practice are more subjective to the opinion of the appraiser than one would think based on the use of ‘market evidence’. The value of an office building in the end depends on many variables that all need estimations and assumptions. The assumptions and estimations are partly based on market evidence but a large part of the decisions are made on gut feeling and experience. This fact can also explain the big difference in market values found in the test case in Papendorp.

10.8 ADDED VALUE OF SUSTAINABLE OFFICE BUILDINGS

The future expectation of the respondents in the research is sustainable office buildings will have a higher value than conventional buildings in the near future. Conventional buildings can have lowered values or sustainable buildings higher ones. Some respondents remained reserved about the ‘search’ for a higher value for sustainable buildings. In light of their comments the value decrease for the conventional office would seem a valid scenario however a value decrease of conventional buildings will not enhance the current market sentiment. Already building owners and investor need to adjust the portfolio values as result of the crisis. Other respondents believed in the increased value for the sustainable offices.

The valuation method as proposed can be used for both scenarios. The testing of the method with the proposed parameter adjustments resulted in a 7.48 higher value for the sustainable building based on the GIY technique and a 8.01% higher value based on the DCF technique.

10.9 BUYERS SELLERS DILEMMA

We expect investors to remain skeptical about the higher value of sustainable office buildings compared to conventional buildings. During the interviews the idea occurred that at present investors are working on the marketability of their portfolio: many investors have badly performing objects in their portfolios with a low energy efficiency.

The expectation is that when investors are selling their objects, they will try to sell the low performance buildings first. When any investor is looking for a new investment in an office building, the interest will probably be solely in sustainable buildings on good quality locations (station areas) because they expect higher indirect returns (higher values when they want to sell the object themselves) for the sustainable office building.

When the valuation of sustainable office buildings as proposed is accepted in the market this can have negative implications for the returns of the investors. When the value assessment of sustainable versus conventional buildings is treated differently the value of sustainable office buildings and conventional ones will start to converge. Conventional buildings can face value depreciation or sustainable objects can achieve higher values. Either way, the investor has no advantage: the first scenario is that the acquisition of the type of buildings that he tries to acquire at present will cost more money. Currently they can buy sustainable office buildings relatively ‘cheap’ so a higher market value will
reduce the return of the buyer. The other possible scenario is that the selling value of the conventional buildings will drop and deliver lower returns than could be expected.

Next to these potential scenarios the remark can be made about the independency of the appraiser. The appraiser is hired by a building owner (the investor) and the employer of the appraiser who has an actual interest in how the appraiser values his objects so the independency of the appraiser can be challenged.

The scenarios involved with making a distinction between the valuation of sustainable and conventional real estate combined with the discussion on the independency of the appraiser might predict opposition from the side of the investors to the proposed valuation method.

10.10 PITFALLS

Besides the positive aspects of the developed valuation method there are several pitfalls to take into account.

During the search for a valuation method to make a case for a higher value for sustainable office buildings, statements from the respondents can be misinterpreted. Even though the interview transcripts were send to the respondents for feedback and comments, the conclusions as drawn from the interviews can be inaccurate. Inaccuracy in the interpretation of data can result in an overvaluation of sustainable office buildings. A critical stance from the user of the method remains important.

The valuation model has a significant dependency on higher rents for sustainable buildings. This requires a willingness to pay higher rents amongst tenants. Even though studies indicate that there is in fact a willingness to pay higher rents, building owners and appraisers remain skeptical. To reply to this skepticism, the estimation for the rent can still be based on the bandwidth of the market rent as described in chapter 9.

The method to determine the energy savings premium can be inaccurate: the benchmark for the energy consumption comparison can be too high or too low. The determination of the theoretical energy consumption of the building in question as proposed can be cause for discussions. The proposed methods in the energy savings premium chapter are at present the most reliable estimation techniques as found.

The buyers and sellers dilemma as described in paragraph 10.9 can be a serious hindrance for the acceptance of any green valuation method developed by students or appraisers. The influence of the investors on the appraisal profession should not be ignored.

A threat during the development of the green valuation method lies in the will to ‘create’ a higher value for sustainable buildings. An appraiser should not forget his silent control over the perception of value but the appraiser should also watch out for creating value that is not there.

In the use of the green valuation method, the appraiser should be aware of the possible “double” inclusion of positive effects of sustainable building: the risk yield is often related to the vacancy and incentive estimation, lowering the yield and the vacancy assumption a double inclusion of effects of sustainable building can occur. The same applies to the double inclusion of rent level adjustment and the ESP.
10.11 RECOMMENDATIONS FOR FUTURE RESEARCH

During the research several decisions had to be made without knowing if they were the absolute correct one. Assumptions were made, benchmarks chosen and calculation methods used because there was no further information yet available. Additional research on the added value of sustainable building is needed. On topics varying from tender proceedings to theoretical energy consumption calculation methods further research is recommended. The following recommendations for future research can be made:

- Tender proceedings: as stated by one of the developers in the interviews, a serious problem with sustainable building can be found in the way tenders for new developments or for redevelopments are offered. Currently, most tenders are based on standard tender requirements without further demands on the level of sustainability. When a developer goes beyond the brief and proposes a building with a high level of sustainability but for a slightly higher price, the proposal is disqualified. Further research on the implementation of sustainability level demands in tender proceedings is advised.

- According to appraisers in the interviews, 85% of the tenants does not look at the service bill at the end of the year because they are highly un-transparent. This implies a low awareness for the energy consumption of the building they rent. Further research on this issue can be interesting to find better arguments for adding the energy savings premium.

- Performance or energy performance contracts are seen as a potential key for the feasibility of sustainable building. SenterNovem is working on this together with the Triodos Bank. Knowledge on the service costs will be essential for further development of performance contracts.

- A follow up research on the way office rents are negotiated can be interesting for the implementation of the willingness to pay higher rents in practice. Who plays a big role in the negotiations on rent levels, service costs and energy costs? This study can be connected to the research on performance contracts.

- Further research is needed to accurately calculate the energy consumption of an office building. What is the accurate benchmark to compare the calculated energy consumption with? This can be part of a study for further development of the energy savings premium.

- Research can be done on benchmarks for other elements of sustainability: is there a good benchmark for the durability of the used building materials?

- The research as performed by Koppels and Snoei on the willingness to pay higher rents for energy efficient office buildings should be continued: a broader study amongst a wider test group should be performed. A simulation should be done on rent negotiations to test whether the willingness to pay will actually be found in practice.
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12 APPENDICES

12.1 DEFINITIONS OF TERMS

Source of definitions from: (www.sustainablemeasures.com) unless expressed otherwise

**Built capital**: Includes roads, heavy equipment, factory buildings, houses, and apartment buildings. It includes basic necessities like food and clothing. It also includes things that, although not strictly necessary, many people in developed countries would be loath to do without, like dishwashers, cars, telephones and computers.

**Capital value**: Assessment of the value of an asset, based on the total income expected over its economic life span.

**Carrying Capacity**: The population that can be supported indefinitely by its supporting systems.

**Equity (or inequity)**: In the context of sustainability, the term equity has to do with fairness -- whether all people have similar rights, opportunities and access to all forms of community capital.

**Carbon neutral**: Calculating total carbon emissions, reducing them where possible, and balancing remaining emissions with the purchase of carbon offsets.

**Community**: A group of people who live and interact within a specific geographic area.

**Community Capital**: The natural, human, social, and built capital from which a community receives benefits and on which the community relies for continued existence.

**Cradle-to-cradle design**: Designing objects that are not just resource efficient but essentially waste free. This is accomplished by using building materials that can either be recycled or reused, or composted or consumed.

**Develop**: To improve or bring to a more advanced state.

**Economy**: The way that goods and services are produced, distributed and consumed.

**Energy efficiency**: Designing buildings to use less energy for the same or higher performance as conventional buildings. All buildings systems can contribute to higher energy efficiency.

**Flex work concepts**: A building concept in which employees do not have their own workplace. In most companies employees are not present in the building 100% of the time. In this concept they share work places and work with laptops on a company server. The laptop can be plugged in the network on the flex-work places.

**Functional flexibility**: The object can change from function A towards function B. An example of this is an office building that can change to a residential function.

**Greening up**: “Verduurzamen”; increasing the level of sustainability of an existing building.

**Gross lease**: A lease for property under the terms of which the tenant is to assume all of the expenses of the property such as taxes, maintenance, etc.

**High-performance building**: A building that uses significantly less energy than a conventional building. Such buildings also feature high water efficiency and superior indoor air quality.

**Human capital**: Each individual’s personal skills and abilities, physical and mental health, and education.

**Integrated design**: The main method used by green builders to design high-performance buildings on conventional budgets. This is accomplished by incorporating efficient building system design that reduces the anticipated energy use of the building so that smaller building systems can be installed.
Internal rate of Return (IRR): The IRR for an investment is the discount rate for which the total present value of future cash flows equals the cost of the investment. When the IRR is higher than the demanded yield, the investment is supposed to be sound.
Interest: The fee that has to be paid for using other people's money.
LCCA (Life-cycle cost analysis, also mentioned as LCC): A method of evaluating energy and water conservation technologies that save money and resources for the long term but may cost more money initially than conventional technologies. Identical to the total cost of ownership concept used in many other industries.
LEED™ (Leadership in Energy and Environmental Design): A third-party certification program operated by the US Green Building Council (USGBC). LEED™ is the primary US benchmark for the design, construction, and operation of high-performance green buildings.
Market value (RICS): The estimated amount for which a property should exchange on the date of valuation, between a willing buyer and a willing seller in an arm’s length transaction after proper marketing wherein the parties had acted knowledgeably, prudently and without compulsion.
Natural Capital: At the base of the pyramid there are three blocks of natural capital: natural resources, ecosystem services, and the esthetics or beauty of nature.
Net lease: A lease in which the tenant pays specific agreed-upon property expenses in addition to the rent such as maintenance, insurance or taxes which the lessor normally pays.
Net operating income: potential gross income – vacancy allowance + other income – operating expenses.
Net Present Value (NPV): NPV compares the value of a dollar today to the value of that same dollar in the future, taking inflation and returns into account. If the NPV of a prospective project is positive, it should be accepted. However, if NPV is negative, the project should probably be rejected because cash flows will also be negative.
Passive solar design: Design strategies that reduce or eliminate the use of fossil fuels and electricity for heating, cooling, and building lighting. This is accomplished by incorporating sunlight and natural ventilation into the basic design of a building, minimizing the need for mechanical system capacity.
Photovoltaics: Also referred to as PV, these are solar electric systems that convert sunlight directly into electricity by using semiconductor materials. These materials do not create any pollution, noise, or other environmental impact.
Potential gross income: maximum gross income a property can produce based on 100% occupation.
Primary energy: includes the energy required to generate, transmit and distribute electricity as well as energy directly used on site.
Productivity: Worker efficiency gains are a major business benefit of green buildings. Numerous studies have identified a link between specific green features and higher employee productivity, which offsets the cost of installing or implementing green features.
Renewable energy: Energy generated from natural resources that are inexhaustible. Renewable energy technologies include solar power, wind power, hydroelectricity and micro hydro, biomass, and biofuels.
Return on investment: A measure of the financial viability of a profit or loss on an investment, often expressed as a percentage.
Standing Charges: Vastrecht; additional energy cost, energy supplier specific.
Sustain: to continue without lessening, to nourish, to allow to flourish. Refers not only to green physical attributes, as in a building, but also business processes, ethics, values, and social justice.
**Sustainable Building**: A building that uses significantly less energy than a conventional building, features high water efficiency and superior indoor air quality and uses as much as possible non-toxic and renewable materials. Also referred to as High-Performance buildings.

**Triple bottom line**: A calculation of financial, environmental, and social performance. Often referred to as “profits, planet, and people.” This calculation method contrasts with the traditional business bottom line, which only considers profits.

**Yield, capital yield**: the total yield is made up of a risk-free return and a risk premium. The risk-free return is based on the return on state bonds. The risk premium attempts to measure the market response to the exposure to a particular level of risk.

### 12.1 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AV</td>
<td>Asset Value</td>
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<tr>
<td>Appr.</td>
<td>Appraiser</td>
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<tr>
<td>CHP</td>
<td>Combined Heat and Power</td>
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<tr>
<td>CSR</td>
<td>Corporate Social Responsibility</td>
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<tr>
<td>DCF</td>
<td>Discounted Cash Flow</td>
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<tr>
<td>EIA</td>
<td>Energy investment tax reduction (Energie-Investeringsaftrek)</td>
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<td>EPBD</td>
<td>Energy Performance in Buildings Directive</td>
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<tr>
<td>ESP</td>
<td>Energy Savings Premium</td>
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<tr>
<td>FOC</td>
<td>Free Of Charge (vrij op naam)</td>
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<tr>
<td>FV</td>
<td>Future Value</td>
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<tr>
<td>GFA</td>
<td>Green Finance Agreement</td>
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<tr>
<td>GHP</td>
<td>Geo-thermal Heat Pump</td>
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<tr>
<td>GIY</td>
<td>Gross Initial Yield</td>
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<tr>
<td>HF</td>
<td>High Frequency</td>
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<tr>
<td>IRR</td>
<td>Internal Rate of Return</td>
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<td>LFA</td>
<td>Lettable floor area</td>
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<tr>
<td>MIA</td>
<td>Milieu-Investeringsaftrek</td>
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<tr>
<td>MV</td>
<td>Market Value</td>
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<tr>
<td>NIY</td>
<td>Net Initial Yield</td>
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<td>NOI</td>
<td>Net Operating Income</td>
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<tr>
<td>NPV</td>
<td>Net Present Value</td>
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<td>PGi</td>
<td>Potential Gross Income</td>
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<tr>
<td>PV</td>
<td>Present Value</td>
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<tr>
<td>RG</td>
<td>Rental Growth</td>
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<td>RGD</td>
<td>Rijksgebouwendienst; National Building Department</td>
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<tr>
<td>RICS</td>
<td>Royal Institute of Chartered Surveyors</td>
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<td>ROI</td>
<td>Return on Investment</td>
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<td>SP</td>
<td>Sales Proceeds</td>
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<td>SRI</td>
<td>Socially Responsible Investment</td>
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<tr>
<td>UFA</td>
<td>Usable floor area</td>
</tr>
<tr>
<td>VMS</td>
<td>valuation model for sustainable office buildings</td>
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<tr>
<td>ZTA</td>
<td>Solar entrance factor (Zontoetredingsfactor)</td>
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</tbody>
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Because of confidentiality agreements, the other appendices, further appendices can be found in the separate appendix document.