A FAIR TRANSITION TO ENERGY EFFICIENT RESIDENTIAL REAL ESTATE?

MIXED-METHOD APPROACH

This thesis answers the question to what extent the type of owner of residential real estate impacts the investments in energy efficiency and how that relates to their respective investment strategies and capacities. A mixed-method approach is used. The results have been derived from the WoON2018 dataset and in-depth interviews with the stakeholders. The statistical analysis shows a significant positive association between having a green energy label and the housing association as investor type. The in-depth interviews examine whether the energy transition is taking place according to capacity and the underlying reason(s). The results show different framework conditions per investor type affecting the implementation of energy saving measures differently. It can be concluded little is done when no indirect interests ensure the implementation of energy saving measures. Also, the user-effect should not be forgotten when focussing on actual CO2 emissions.

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Keywords: institutional investor, housing association, owner-occupier, private investor, energy label, capacity, justice, fairness, user-effect, sustainability

COLOFON

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1. INTRODUCTION

1.1. SOCIETAL RELEVANCE

The Dutch CO2 emission is 30 percent higher in comparison to the average EU country, only five EU countries have a higher CO2 emission per capita (CBS, 2016). Multiple agreements have been signed and laws have been created to be able to reduce the CO2 emission of the Netherlands, one of these is the Climate Agreement (Ministry of Economic Affairs and Climate Policy, 2019). The goal of the Climate Agreement is to reduce the CO2 emission with 25 percent. However, in 2018 emissions only went down by 14.5 percent relative to 1990 (CBS, 2019). Substantial investments are needed in order to reduce the Dutch CO2 emission and to be able to achieve the climate objectives.

When looking at the distribution of the greenhouse gas emissions, about 30 percent of the Dutch CO2 emission is caused by the built environment, more than half can be related to the residential sector (Ministry of the Interior and Kingdom Relations, 2015). Within the Climate Agreement, goals have been set up to make the Dutch built environment more energy efficient. This results in 1.5 million residential homes need to become more energy efficient in coming years. However, the Climate and Energy Outlook (KEV) of 2020 shows the observed decrease in CO2 is not enough to be able to achieve the target of 49 percent reduction in 2030 compared to 1990 (PBL Netherlands Environmental Assessment Agency, 2020).

When focusing on society, 71 percent of the Dutch population has concerns regarding climate change (I&O Research, 2020). Also, 41 percent wants the Dutch government to do more to reduce the greenhouse gas emission of the Netherlands (I&O Research, 2020). Though, half of the Dutch population has no confidence in the feasibility of the agreements made in the Climate Agreement for the built environment (ABN, 2019). Besides, 79 percent of the Dutch population indicates that they had not yet received any information about what the energy transition will mean for them (I&O Research, 2020). However, more than half of the Dutch population wants to be involved (55 percent), preferably by giving their opinion (30 percent of the total Dutch population) or by being informed (24 of the total Dutch population). It can be concluded citizens do want to play a role in the energy transition of the built environment.

In addition, there is more attention for the social dimension of real estate in recent years, resulting in Socially Responsible Investing (SRI). The focus of Socially Responsible Investing is to pursue other pro-social objectives next to the perspective of maximizing profits (Hebb et al., 2010). This focus has been extended over the past decade to community property development projects. In these projects social and environmental considerations are related not only to the property, but also to the project site and the surrounding community is integrated into the management and investment decisions (Hebb et al., 2010). An increasing support for SRI is seen in Dutch society with the emphasis of making the Dutch housing stock more sustainable (Metro, 2020). However, making the Dutch housing stock more sustainable is complex. Sustainability is not only expensive, it requires collaboration of many parties and homeowners must settle for a potential lower return or higher costs (Duuren et al., 2016). Besides, the Natural Gas-Free Neighborhoods Program (PAW) highlights that in practice more detailed customization is often required than expected when energy saving measures are implemented (PBL Netherlands Environmental Assessment Agency, 2020). A neighborhood often appears to be a single unit, however there are major differences between the residential homes and also regarding the willingness of the residents to participate.

In addition, there will be little or no progress regarding energy efficiency without a financial return (Myers, 2012; Hyland et al., 2013). The responsibility with regard to the implementation of sustainable investments lies by the property owner (Kadaster, 2019). For owner-occupied housing these are the residents-owners of the property. Reducing energy costs is the main motive for owner-occupiers to invest in the energy performance of their residential home (Schoots & Hamming 2015; Schilder et al., 2016). However, literature highlights neutrality of the costs is often not feasible at this moment in time (PBL Netherlands Environmental Assessment Agency, 2020). Waiting till the investment cost are lower

or when better arrangements are possible is the most attractive option for owner-occupiers at this moment. Besides, financial considerations are the most important incentives for landlords as well seeing their portfolios as investment objects (Vringer et al., 2014). Thus, financial feasibility currently appears to be the main obstacle with regard to the implementation of energy saving measures (Vringer et al., 2014). However, to be able to achieve the objectives in the Climate Agreement substantial investments are needed. The question remains who is paying and whether this is done to capacity.

How the type of owner of residential real estate impacts the investments in energy efficiency is central within this study. This study focuses on the energy transition of the Dutch residential housing stock in terms of capacity per investor type and whether these investors contribute according to their capacity. Owner-occupier(s), institutional investor(s), private investor(s) and housing association(s) will be compared in terms of their strategy and progress with regard to the implementation of energy saving measures. Housing association(s) are expected to be frontrunner(s) in the energy transition of the Dutch residential housing stock, while at the same time they need to provide housing for the lower income households.

1.2 SCIENTIFIC RELEAVANCE

Many studies have investigated the concept of sustainability and how to deal with it. The term ''sustainability'', as well as the term ''sustainable'' are widely used referring in the built environment to the energy transition. The term ''sustainability'' can be seen as a complex term and as a so-called container concept focusing on developments that meet the needs of the current generation without jeopardizing the needs of future generations, as well as in other parts of the world (Brundtland, 1987). In this research, sustainability refers to the implementation of energy saving measures in the built environment.

Earlier literature shows that the environmental impact of residential housing has improved over time (Gibson & Krueger, 2018). Implementing sustainable investment practices is primarily used as a risk management device that strengthens the resilience of investor portfolios (Gibson & Krueger, 2018). Bénabou & Tirole (2010) set forth three motivations why investors would engage in sustainable related activities: delegated exercise of philanthropy on behalf of the stakeholders, the adoption of a long-term perspective and insider-initiated corporate philanthropy. At this moment in time, literature mainly focuses on the financial performance of the energy transition, rather than if this occurs to financial capacity.

Besides, earlier literature emphasizes Dutch citizens are concerned about the costs relating to the energy transition (Bouma & Vries De, 2020). Citizens ask for a fair distribution of the costs between themselves, the government and industry. Alongside, industry fears to do more than their competitors abroad. The research from Bouma & De Vries (2020) shows the costs of the energy transition are at this moment in time too high for society and the costs are not fairly distributed. Earlier literature also shows Responsible Property Investment (RPI) has received more attention over the past decades. RPI accounts for the impact of both environmental and social factors (Hagerman et al., 2007; Hebb, 2005, 2007; Sass Rubin, 2007). This can be seen as a consideration of the ''footprint'' and the ''handprint'' in RPI (Hebb et al., 2010). Referring to the ''handprint'' of RPI is a way of capturing the human dimension, including social considerations such as financial capacity (Hebb et al., 2010). Referring to the ''footprint'' of RPI is a way of measuring demand on the environment, by comparing patterns of human consumption with the earth's natural capital. Both concepts are of importance to be able to achieve RPI goals and should be taken into account when making decisions. Accounting for RPI in the investment process has been labelled as Socially Responsible Investing (SRI). However, there is no consensus on what the term SRI exactly means (Berry and Junkus 2013). Most academic literature focuses on the financial performance of SRI rather than the meaning of SRI. However, literature highlights the real estate industry has less concerns for the social consideration (''handprint'') and a greater concern for the environmental (''footprint'') aspects of RPI (Hebb et al., 2010). The ''handprint'' is seen as subjective and is therefore not on the checklist of real estate investors and developers (Hebb et al., 2010). It is necessary the

‘’handprint’’ will be incorporated more into the RPI literature in order to move from the narrow green buildings concept to a more holistic view. This holistic view will be able to capture both the environmental and social considerations and will reflect the aim of RPI more broadly (Hebb et al., 2010).

This study will contribute to the literature regarding the energy transition of the Dutch residential housing stock. The focus will be on the financial capacity of the owners of residential real estate. The current status and underlying reason(s) will be examined by using a mixed-method approach.

1.3. RESEARCH PROBLEM STATEMENT

The aim of this research is to investigate if the type of owner of residential real estate impacts the investments in energy efficiency. To achieve this aim, the following research question will be answered: ‘’*How does the type of owner of residential real estate impact the investments in energy efficiency, how does that relate to their respective investment strategies and capacities?’’*. To conduct an answer to the research question, the following sub questions will be answered:

1. *What factors influence the energy label of the residential housing stock?*
2a. *Does the chance of having a green energy label differ per investor type?*
2b. *Do investors contribute according to their capacity?*
3. *Is the contribution per investor type fair in order to the social context?*

1.4 DATA AND METHODOLOGY

This research will use a mixed-method research approach. By making use of mixed-methods methodological pluralism is possible resulting in superior research (Jonson, 2004). For the quantitative research part, the WoON2018 dataset will be used (DANS, 2019). The WoON dataset has been used in comparable studies in which the dataset is considered as suitable (Ebrahimigharehbaghi et al., 2018). The dependent variable of this research is the energy label of residential homes in the Netherlands. The independent variable is the investor type owning the residential home. To test the hypotheses, a statistical analysis is performed using a binary logistic regression model. The aim of the regression model is to measure if the investor type is a predictor for the energy label. The qualitative part consists of semi-structured interviews with the stakeholders. The semi-structured interview technique is chosen because it allows new ideas to be brought up as a result of what the interviewee says during the interview, resulting in more flexibility (Punch, 2013). By the use of a deductive coding scheme the interviews will be analyzed in the program ATLAS.ti. The interviews will take place with owner-occupier(s), institutional investor(s), private investor(s), housing association(s) and tenant(s).

1.5 OUTLINE

Chapter 2 outlines the contextual framework in which the energy label, Climate Agreement and residential housing stock are mapped out. Chapter 3 consists of a theoretical framework that examines the important predictors of the energy label and the role of the investor type. The theoretical framework answers the first sub-question and forms the foundation for the research hypothesis. Chapter 4 describes the WoON2018 dataset, and the statistical test used for the qualitative research part. In addition, attention will be paid to the semi-structured interview guides and the deductive coding scheme as well as to ethical considerations. Chapter 5 contains the results from both the qualitative and quantitative research. The interpretations of the statistical models will be analyzed for the quantitative sub-question. Besides, attention will be paid to the qualitative data by analyzing the semi-structured interviews using the coding scheme. Chapter 6 deals with the conclusion and discussion, which includes a critical reflection on the research. In addition, this chapter provides suggestions for further research and policy recommendation.

2. CONTEXTUAL FRAMEWORK

Before switching to the theoretical framework, an explanation is given about the current situation regarding the energy transition of the residential housing stock in the Netherlands. National and international climate related goals have been set up to reduce greenhouse gas emission. The Dutch government has made agreements with many sectors to achieve these climate goals, including the built environment. The current policies and fundings which relate to the energy transition of the residential housing stock will be discussed. In addition, the current status of the Dutch residential housing stock and the energy label itself will also be discussed.

2.1 DUTCH HOUSING STOCK

The Netherlands is expected to have 18.8 million inhabitants in 2035. Therefore, the demand for residential homes will naturally increase (Rijksoverheid,2020c). Besides, the decrease in household size will increase the demand for residential homes as well (Rijksoverheid, 2020c). To be able to meet the growing demand, 845,000 residential homes need to be built between 2020-2030 (Rijksoverheid, 2020d). However, the housing shortage in 2020 was 331,000, 4.2 percent of the total housing stock (ABF research, 2020). The residential housing stock grew to 7.89 million homes in 2020, an increase of seven percent with regard to 2012 (Ministry of the Interior and Kingdom Relations, 2020c). The owner-occupied sector grew with 300 thousand residential homes to 4.49 million between 2012-2020. The housing stock of housing associations remained more or less stable at approximately 2.3 million. The housing stock of private- and institutional investors increased from 0.85 million to 1 million residential homes between 2012-2020 (CBS, 2020b).

Besides, the average house price rose 6.9 percent in 2019 because of economic growth, tightness in the market and low interest rates (Ministry of the Interior and Kingdom Relations, 2020c). The average house price in 2019 was 308 thousand euros. In addition to rising house prices, rents have also risen sharply (CBS, 2020a). The highest rent increase was in the private sector, namely 3.0 percent in July 2020 (CBS, 2020a). The rents of housing associations rose on average 2.7 percent. These price increases can be explained by low inflation rates. However, the ongoing Covid-19 pandemic has a major impact on the economy (Rijksoverheid, 2020b). The IMF forecasted an economic decline of 7.5 percent in 2020 which can affect house prices and rents negatively (International Monetary Fund, 2020). Though, the housing market remained overheated in 2020 resulting in an average price increase of 7.8 percent (CBS, 2021). The price index of owner-occupier residential real estate rose to the highest level since the measurement started in 1995, 141.9 percent.

2.2 THE ENERGY LABEL

The energy label indicates the energy performance of a residential house. The energy label is an official certificate that provides information about the amount of energy required for the standard use of a building (Milieu Centraal, 2020). Residential housing with label A is most energy efficient. The least efficient residential homes are labeled as G which can be seen in table 1 (Milieu Centraal, 2020). The *Rijkdienst voor Ondernemend Nederland* carries out the energy label registration on behalf of the Ministry of the Interior and Kingdom Relations. An energy label is mandatory when a house is offered for sale or rent in the Netherlands (Milieu Centraal, 2020). More than 3.7 million residential homes had a registered energy label in 2019 (Ministry of the Interior and Kingdom Relations, 2019). The rental sector is at the forefront with almost 70 percent of the homes having a registered energy label. In the owner-occupied sector a lower share has a registered energy label, 20 percent of the homes (Ministry of the Interior and Kingdom Relations, 2020c).

Label(s)	A	B	C	D	E	F	G
Energy index per m2 per year	0.7 – 1.05	1.05 – 1.3	1.3 – 1.6	1.6 – 2.0	2.0 – 2.4	2.4 – 2.9	> 2.9

Table 1: possible energy labels. Source: Milieu Centraal (2020).

The (old) energy label is based on various housing characteristics which together form the classification of the energy label (Rijksoverheid, 2020a). The housing characteristics of interest for the (old) energy label determination can be found in table 2. The (old) energy label had to be applied online by completing a number of multiple-choice questions focusing on housing characteristics and by submitting documents as evidence for the implementation of sustainable measures. However, a new energy label is in place since January 1, 2021 (Ministry of the Interior and Kingdom Relations, 2020a). At this moment an appointment with a qualified energy consultant is necessary to receive the (new) energy label instead of requesting it online. The consultant will determine the characteristics of the residential house including its surface, the installations and the insulation present. Based on these characteristics a calculation is made indicating how much energy is needed for heating, hot water provision, ventilation and cooling the residential property. Also, case specific recommendations regarding potential energy saving measures will be worked out for possible adjustments in the future (Ministry of the Interior and Kingdom Relations, 2020b). In this way, the (new) energy label is determined more accurately. However, the cost associated with the (new) energy label will be higher. The costs of the (new) energy label are expected to be 190 euros for a single-family home and 100 euros for an apartment. The (old) energy label will be used in this study. Data regarding the (new) energy label are not yet available.

construction year	< 1945, 1946-1964, 1965-1974, 1975-1982, 1983-1987, 1988-1991, 1992-1999, 2000-2005, 2006-2012, 2014 >
surface in square meters	< 80, 81-100, 101-120, 121-140, > 140
property type	detached housing, semi-detached housing, terraced housing, corner housing, apartment with one floor, apartment with several floors, others
glass living- & bedroom(s)	single glass, double glass, HR glass
facade-, roof- and floor isolation	not extra insulated, extra insulated
type of heating	boiler installed before 1998, boiler installed after 1998, district heating, gas heater, heat pump
water provision bathroom	boiler installed before 1998, central heating boiler installed after 1998, district heating, gas water heater, heat pump, gas water heater, electric water heater, solar water heater
ventilation system	yes, no
solar panels & solar water heater	yes with a solar boiler, yes with XX.XX m2 solar panels, yes with a solar boiler and XX.XX m2 solar panels
exceptional measures	triple glazing in living area(s), triple glazing in sleeping area(s), 12 cm facade insulation, 12 cm roof insulation, 12 cm floor insulation

Table 2: determination (old) energy label). Source: Rijksoverheid (2020a).

The Dutch housing stock has improved significantly over the past years when looked at the distribution of the energy labels in table 3. This is reflected in an increasing share of green energy labels over the years. This can be explained because of the positive impact of new constructed residential properties. These are in general built in a more energy efficient way. Besides, energy saving measures are implemented with regard to the existing housing stock affecting the overall energy label as well. The trends feasible in table 3 shows a stable improvement regarding the overall energy label. The share of labels classified as E, F or G has decreased over the past years. While the share of energy labels classified as A & B has increased over the past years.

	Label A		Label B		Label C		Label D		Label E		Label F		Label G	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
2010	7,81	4.70	25,96	15.63	51,98	31.30	39,02	23.50	23,83	14.35	12,35	7.43	5,13	3.09
2011	19.69	4.98	69.53	17.60	75.06	32.14	53.44	23.39	26.80	12.81	13.56	6.56	4.84	2.52
2012	38.95	6.29	124.04	20.05	200.08	32.36	136.31	22.03	69.81	11.28	35.43	5.73	14.14	2.29
2013	66.85	8.26	176.04	21.76	254.36	31.45	169.06	20.90	84.20	10.41	41.62	5.15	16.72	2.07
2014	93.27	9.24	228.15	22.59	309.91	30.69	205.73	20.37	102.68	10.17	50.26	4.98	19.84	1.96
2015	206.11	13.97	196.98	20.13	442.81	30.02	266.66	18.08	139.65	9.47	76.47	5.18	46.59	3.16
2016	329.70	16.92	354.85	18.22	577.98	29.67	332.16	17.05	177.77	9.12	102.12	5.24	73.75	3.79
2017	460,17	18.48	425,77	17.10	744,28	29.89	406,34	16.32	222,49	8.93	130,03	5.22	101,14	4.06
2018	644.89	20.58	527.02	16.82	908.14	28.98	488.77	15.60	274.39	8.76	161.33	5.15	129.08	4.12
2019	857.91	22.49	636.94	16.70	1072.89	28.13	569.76	14.94	325.97	8.55	192.90	5.06	157.87	4.14

*Table 3: energy labels of the Dutch housing stock, total per year, per thousands (*1000) residential homes. Source: RVO (2020).*

2.3 CLIMATE AGREEMENT

PARIS AGREEMENT

On December 11, 2015, the Paris Agreement was signed by 196 countries including the European Union on behalf of the United Nations member states (United Nations, 2015). A broad scientific consensus of global climate change through human action was the motive behind the Paris Agreement. The central aim of the Paris Agreement is to keep the increase in global average temperature to below 2 °C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5 °C. Recognizing this would reduce the risks and impacts of climate change worldwide (United Nations, 2015). This should be done by reducing emissions as soon as possible, in order to *"achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases"* in the second half of the 21st century (United Nations). This includes the requirement of all parties involved to report regularly on their energy saving implementation and emissions (United Nations, 2015). The aim of the Paris Agreement is to decrease global warming as described in Article 2, *'' This Agreement, in enhancing the implementation of the Convention including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty''* of the United Nations Framework Convention on Climate Change (United Nations, 2015):

DUTCH CLIMATE AGREEMENT

The Dutch government presented the Climate Agreement on June 28, 2019 as result of the Paris Agreement to be able to achieve the target of 3.4 Mton CO2 reduction in the built environment by 2030 (Rijksoverheid, 2019). Approximately 1.5 million existing residential homes must undergo a sustainable transition to reduce CO2 emissions as mentioned before (Rijksoverheid, 2019). To be able to succeed this target everyone should be able to participate. The implementation of energy saving measures should be affordable for everyone to be able to achieve the targets set. Therefore, neutrality of the transition cost is seen as a starting point to achieve affordability (Rijksoverheid, 2019). Neutrality of the costs could be achieved if the cost of the energy transition can be reduced through upscaling, bundling supply and demand, ensuring better financing and by innovations. A structured approach will be taken to be able to tackle the problem per district. Municipalities and local governments will play a crucial role within the energy transition the Netherlands is currently facing (Rijksoverheid, 2019). The following three aspects will be leading to be able to achieve the targets in the Climate Agreement.

1. Neighborhood-oriented approach: Municipalities will play a central role in the energy transition. Municipalities will determine the order and timeline of the energy transition on neighborhood-level by at latest 2021. The local government will together with residents and property-owners determine the best feasible sustainable adaptions regarding heating and electricity. Also, new construction will no longer use gas unless it is not possible otherwise (Rijksoverheid, 2019).

2. Agreements rental sector: By bundling demand, innovations, upscaling and standardization, the cost of making rental homes more sustainable must significantly decrease. Also, tenants have to be prevented from higher rents due to the implementation of energy saving measures. In advance to the neighborhood-oriented approach 100,000 homes owned by housing associations will undergo a sustainable transition by 2020. This target group will be used as a role model for the energy transition of the Dutch housing stock (Rijksoverheid, 2019).

3. Financial agreements: A wide range of attractive financing options will be in place for all investor types. The monthly costs of these loans should not exceed the financial benefits of the energy saving measures implemented. Also, building related financing will be available meaning loans relating to energy saving measures can be transferred to new occupiers. To further stimulate the implementation of energy saving measures taxes on gas will increase while taxes on electricity will decrease (Rijksoverheid, 2019).

3. THEORY

3.1 CONCEPTUAL FRAMEWORK

This study is based on a conceptual framework in which independent and control variables directly and indirectly affect the dependent variable. The dependent variable of this research is the energy label of the Dutch residential housing stock. Predictors for the energy label can be observed in the conceptual model shown in figure 1. The control variables are based on literature with regard to the energy label. The independent variable of interest in this study are the owners of residential real estate in the Netherlands. The investors indirectly affect the energy label because of the investment appetite affecting the housing characteristic as can be seen in figure 1.

HOUSING CHARACTERISTICS

The direct linkage to be able to explain the energy label of residential homes is found in the literature by focusing on building characteristics only (Baumhof et al., 2019; Black et al., 1985; Trotta, 2018). Building characteristics are directedly associated with the energy label of residential homes. Besides, building characteristics are also seen as important factors associated with the application of building-related suitable measures (Baumhof et al., 2019; Black et al., 1985; Trotta, 2018). The construction year, property surface and type of housing are identified as the most important building characteristics associated with the energy label of a property and the implementation of energy saving measures (Kastern & Stern, 2015; Mills & Schleich, 2009; Leicester & Stoye, 2016). Firstly, the construction year is mentioned as one of the most important building characteristics associated with the implementation of energy saving measures in the literature (Ebrahimigharehbaghi et al., 2019; Mills & Schleich, 2009). The construction year and the energy label of a residential home show a clear correlation (Kastern & stern, 2015). The construction year is predominately significantly positive correlated with the application of energy saving measures with regard to residential housing (Ebrahimigharehbaghi et al., 2019). Secondly, when focusing on the housing-type, literature describes households living in a flat are significantly less likely to apply building-related sustainable measurements when compared to households living in terraced housing (Trotta, 2018). While households living in detached housing are significantly more likely to apply building-related sustainable measurements in comparison to households living in terraced housing. Though, households living in a flat seem more likely to adopt energy saving behavior than households living in terraced housing (Trotta, 2018). This can partly be explained by households living in flat having a lower income and do not own the dwelling in which they live. Trotta (2018) also emphasizes the type of housing is closely linked to factors such as the property surface, household income and tenure. Thirdly, when looked at the property surface, non-significant direct results are found in relation to the application of energy saving measures in most relevant studies (Mills & Schleich, 2012; Ebrahimigharehbaghi et al., 2019). However, non-significant to sufficiently positive associations are found for the implementation of an energy efficient heating system. Also, earlier research shows a non-significant to negative significant association between the property surface component and the implementation of solar energy (Mills & Schleich, 2019).

SOCIO-DEMOGRAPHIC FACTORS

An indirect linkage between the socio-demographic factors of the residents and the energy label of residential housing is found in the literature (Trotta, 2018; Ebrahimigharehbaghi et al., 2019; Kastner & Stern, 2015; Leicester & Stoye, 2016). Socio-demographic factors relating to age, education level, household composition and income are seen as the most important factors in affecting the likelihood of investing in energy saving measures. Ebrahimigharehbaghi et al. (2019) emphasizes socio-demographic factors are critical in the initial stage of the implementation of energy saving measures. Firstly, income is seen as an important socio-demographic factor affecting the energy label. Middle-income households mainly apply energy saving measures is found in the literature (Trotta,2018; Aziz et al., 2019, Ebrahimigharehbaghi et al., 2019). This can be clarified by higher educated people having the knowledge an income needed to implement energy saving measures. Besides the low-income

group is seen as less likely to be able to afford energy saving measures. In contrast the high-income group is seen as less triggered by financial motivations resulting in less implementations of energy saving measures (Trotta, 2018). Besides, households who belongs to medium and high-income group tend to be less likely to save on energy use than low-income group when focusing on the overall energy consumption (Trotta, 2018). The energy demand of low-income groups tends to be more elastic than the consumption of wealthier households, meaning they are adjusting their behaviors, if prices increase, they use less energy (Trotta,2018). Secondly, the observed associations with regard to the education level is overall insignificant or positive significant related to the implementation of energy saving measures (Kastern & Stern, 2015; Ebrahimigharehbaghi et al., 2019). The education level is positively associated with the awareness of the implementation of energy saving measures. Besides Trotta (2018) suggest highly educated people tend to have higher income level and can therefore afford the implementation energy saving measures. Thirdly, when looked at family compositions, both household size and the presence of children are positive significant predictors associated with the implementation of energy saving measures (Trotta, 2018). Fourthly, the age factor is perceived in different ways in the literature in relation to the implementation of energy saving measures ensuring mixed results (Barr et al., 2005, Trotta,2018, Ebrahimigharehbaghi et al., 2019). Age is observed as positive significant as well as negatively associated or not associated with regard to the implantation of energy saving measures. Household's heads are more likely to adopt energy saving measures when belonging to the 24-34, 35-44 and 55-65 age group (Barr et al., 2005, Trotta, 2018). Barr et al., (2005) indicates these age relating categories may be more likely to approach energy saving measures from economic perspective. Besides, positive associations are also found due to higher income capacities and a higher energy consumption. Older people also tended to be more at home ensuring higher potential savings (Trotta, 2018).

LOCATION CHARACTERISTICS

Location characteristics reflect framework conditions that cannot be attributed to the household level or building characteristics. Residential areas are associated with climatological, social, economic and political differences on a national and local level (Michelen & Nadlener, 2012; Kastner & Stern, 2015). Kastern & Stern (2015) emphasize that the factor location has a strong association with the likelihood of the implementation of energy saving measures. Though, the association is hard to interpret because of different living areas go hand in hand with social, economic and climatic differences. In several countries including the Netherlands, not only national but also regional policies relating to the environment are in place (International Energy Agency, 2014). However, a factor that can be compared in a proper way and is examined frequently in the literature is the urban context (Collins & Curtis, 2016). For urban location an overall positive effect with regard to the energy label is observed. Environmental and energy-related household choices are often socially embedded and influenced by institutional constraints.

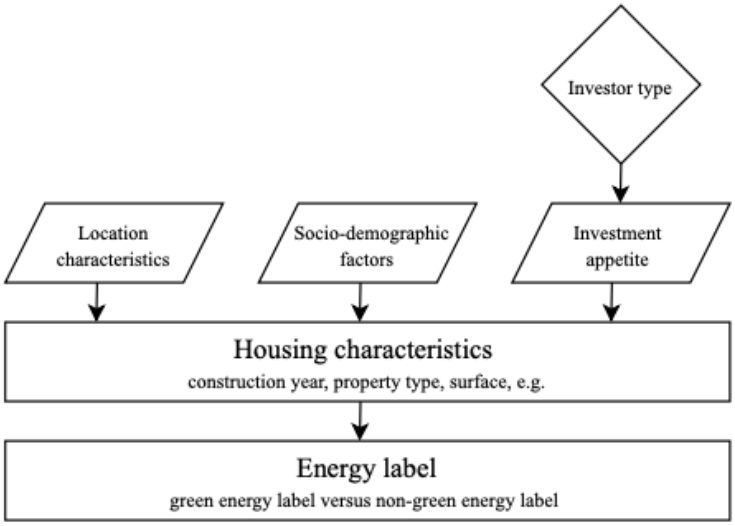

Figure 1: conceptual model explaining the energy label of the Dutch residential housing stock

3.2 CAPACITY

The term, ‘’capacity’’, as well as ‘’economic capacity’’ are often used in daily life. Capacity can be seen from several dimensions such as technology, economic, individual, adaptive, advisory and administrative capacity. The term capacity is broadly described as *‘’The total amount that can be contained or produced’’* or as *‘’someone’s ability to do a particular thing’’* (Cambridge Dictionary, 2020). Economic capacity is defined as the amount an economy can produce using its current equipment, workers, capital and other resources. It is the financial limit of an economy, sector, business or person. Capacity utilization defines the relationship between the output produced with the given resources and the potential output that can be produced if capacity was fully used (Corrado & Mattey, 1997).

In addition, adaptive capacity is a component of both resilience and vulnerability (Adger, 2006). Adaptive capacity refers to the conditions that enable people to anticipate. The goal of adaptive capacity is to minimize the consequences of change (Adger & Vincent 2005). Societal changes have undermined certain aspects of adaptive capacity, made others obsolete, and have resulted in emerging vulnerabilities in certain sections of community. This relates to the concept of economic sustainability, referring to practices that support long-term economic growth without negatively impacting social, environmental, and cultural aspects of the community (Anand & Sen, 2000).

JUSTICE & FAIRNESS

The terms ‘’justice’’ and ‘’fairness’’ are often interlinked to capacity. This interlinkage occurs mainly when capacity is not met. The term justice is broadly described as *‘’The condition of being morally correct or fair’’* (Cambridge Dictionary, 2021a). The term justice refers to a concept on ethics and law that emphasis peoples behave in a way that is fair, equal and balances for everyone (Lucas, 1972). This is followed up by the term fairness which is broadly described as *‘’ The quality of treating people equally or in a way that is right or reasonable’’* (Cambridge Dictionary, 2021b). Fairness is marked by impartiality and honesty; conformed with the established rules. Fairness is not only making sure everyone is treated in the same way (Francez, 2012). Fairness encourages respect, responsibility, leadership, trust and a life that matters. The importance of contributing according to capacity is therefore often emphasized by referring to the concepts of justice and fairness.

OWNERS OF REAL ESTATE STRATEGY AND CAPACITY

The qualitative part of this research focuses whether the owners of real estate fairly distribute the cost of the energy transition the Netherlands is facing. The focus is on whether the distribution of the cost relating to the energy transition can be seen as fair when the social interest is taken into account. As mentioned before, housing associations are expected to be the frontrunner(s) in the energy transition of the Dutch residential housing stock, while at the same time they need to provide housing for the lower income households. However, the question is whether this can be seen as legitimate.

3.3 INVESTOR TYPE(S)

OWNER-OCCUPIER(S)

Owner-occupied housing is residential housing owned by a private individual, generally the resident of the home. From the perspective of owner-occupiers ‘’user costs’’ are seen as important. The ‘’user costs’’ include all cost relating to owning a residential home (Diaz & Luengo-Prado, 2011). User costs depend on house prices, preferential tax treatments of owner-occupied housing services, the availability of collagenized credits, insurance of owner-occupied housing against rental-price risk as well as current and expected transaction costs (Diaz & Luengo-Prado, 2011). Reducing user cost is a key motive regarding the implementations of energy saving measures in the owner-occupied sector. Therefore, policymakers currently use financial-economic policy instruments to boost the energy transition of the owner-occupied housing stock (Schilder & Staak Van Der, 2020). However, making the owner-occupied

housing stock more sustainable barely succeeds for the time being (Spyridaki et al., 2016; Groot De & Ryszak, 2019).

At this moment, the national government faces two main problems in making the owner-occupied housing stock more sustainable. First, energy saving measures do not always seem financially attractive for owner-occupiers (Schilder et al., 2016). Secondly, not all owner-occupiers are able or willing to pay the investment cost required in one go (Schilder et al., 2016). At the same time, energy saving measures do not always result in higher house prices. Owner-occupiers are not sure if they recoup the investment when the house is sold hereby (Isreal et al., 2016). To be able to realize the targets in the Climate Agreement the national government strives for cost neutrality with regard to the implementation of energy saving measures as mentioned earlier. However, Schilder and van der Staak (2020) highlight it is almost impossible to achieve housing cost neutrality. Permanent subsidization seems inevitable as long as no innovation is in place that significantly lower the price of energy saving measures (Schilder & Staak van der, 2020).

In addition to the financially visibility, there is a coordination problem in the owner-occupied sector. Owner-occupiers usually own one residential home; economies of scale are not possible to implement because of these circumstances. Therefore, energy saving measures usually take place after a home has been sold (Ministry of the Interior and Kingdom Relations, 2019). Therefore, a rapid circulation of owner-occupied has a positive effect on the implementation of energy saving measures. Another major challenge in making the owner-occupied housing stock more energy efficient is heterogeneity (Schilder & Staak van der, 2020). Almost every home is (slightly) different, hereby a ‘’one size fits all’’ solution is not possible. Besides, heterogeneity also plays a role when the owner-occupiers themselves are compared (Schilder & Staak van der, 2020). This can be in terms of preferences and household composition. For example, the current monthly energy cost of a one-person household in comparison to a family household.

INSTITUTIONAL INVESTOR(*S*)

Institutional investors are funds or companies that by the nature of their business want to invest capital. Common institutional investors are pension funds and insurance companies. Aspects such as financial returns and image are seen as important, as being a profit-oriented business as well as a corporate social activity (Tang et al., 2017). Two views could support institutional investors motivations to hold equity portfolios with better sustainable footprints: overcoming short-termism & managerial driven philanthropy (Gibson & Krueger, 2018). Institutional investors can benefit from these ESG improvements as a result of increased tenant satisfaction, energy cost savings, and growing market demand for green real estate (Eichholtz et al., 2009; Kok, 2008). Besides, institutional investors also experience reputational benefits resulting from adopting ESG standard (Hebb et al., 2010).

In 2018, Dutch and foreign institutional investors invested 7.6 billion euros in residential real estate projects (Ministry of the Interior and Kingdom Relations, 2019). Institutional investors mainly invest in new-built homes and mid-rental properties (Ministry of the Interior and Kingdom Relations, 2019). Besides, institutional investors are also increasingly interested in senior housing. While some studies find premiums for the construction cost of green buildings, on average green buildings result in lower life cycle cost (Kats et al., 2003). Savings of 20 percent of the total construction costs can be observed (Kats et al., 2003). In addition, investors with longer investment horizons exhibit better environmental footprints than investors with a short investment horizon (Gibson & Krueger, 2018)

In general, institutional investors have a selective regional investment policy, especially in Noord-Brabant and the Randstad. Dutch institutional investors focus on larger investment volumes per transaction and invest predominantly for the long-term (Ministry of the Interior and Kingdom Relations, 2019). They mainly sell assets older than 10 years due to maintenance costs and are less interested in already existing properties. Hereby they avoid investments needed relating to energy saving measures. Besides, institutional investors also regularly resell their properties to each other (Ministry of the Interior

and Kingdom Relations, 2019). In addition, foreign institutional investors mainly look for already existing real estate in the Dutch middle segment. Foreign institutional investors are also interested in the housing associations' housing stock due to observed privatizations in the German housing associations sector (Ministry of the Interior and Kingdom Relations, 2019).

PRIVATE INVESTOR(S)

A private investor is an individual who invests capital in the real estate market to achieve a financial return. The business model of private investors is often based on rental income and aims to minizine vacancy. A share of 6 percent of the total transactions in the residential housing sector was bought by private investors in 2018. In general, private investors buy in or around city centers (Ministry of the Interior and Kingdom Relations, 2019). In 2017, by more than 10 percent of the transactions made in Amsterdam, The Hague, Delft, Leeuwarden, Groningen, Rotterdam and Enschede, a private investor was involved (Ministry of the Interior and Kingdom Relations, 2019). From the private investors' perspective, real estate is a hedge against inflation and a risk reducer to be able to meet the investment objectives of families with wealth intended for future generations (Hudson-Wilson et al., 2003). Hudson-Wilson et al. mentioned five primary reason to consider real estate as a private investor. The reason all relates to the financial return: reducing the overall risk, achieve a return above the risk-free rate, hedge against inflation, deliver strong cash flows and constitute a portfolio reflects the overall investment universe (2003). Financial incentives are the main driver for private investors can be concluded

Private investors share a number of guiding motives in relation to their actions in the real estate sector. Private investors aim for a stable direct return, the indirect long-term returns are less relevant for them (Schilder et al., 2020). The strategic choices of private landlords are focusing on the prevention of vacancy and value retention for next generations. However, private investors cannot be seen as a homogenous group (Schilder et al., 2020). Crucial differences can be observed with regard to demographic characteristics and by the investing methods used. However, due to an increase in the number of households and by new constructions lagging behind, rent- and purchase prices are rising (Schilder et al., 2020). As a result, first-time buyers are displaced because the investment value of a residential home exceeds the maximum mortgage possible.

When looked at the implementation of energy saving measures the Netherlands Environment Assessment Agency emphasizes private investors are lagging behind (Van der Staak et al., 2020). When focusing on the Climate Agreement, private investors can no longer lag behind when the targets want to be achieved. Long-term financial motives appear to be leading in the choice of private investors to make their real estate more sustainable (Lennartz, et al., 2019). Private investors tend to look closely at consumer preferences. Because of this, private investors expect residential homes with better energy labels will be easier to rent out in the future due to higher comfort standards and lower energy bills (Van der Staak al., 2020).

HOUSING ASSOCATION(S)

Housing associations are not-for-profit organizations to provide affordable housing. Clear ambitions are expressed by the sector to be able to make their portfolios more sustainable. According to the *Koepelconvenant*, the housing associations housing stock should arrive at an average energy index of 1.25 before 2020. This energy index corresponds to label B (Ministry of the Interior and Kingdom Relations, 2012). When making the housing stock of housing associations more sustainable it is important to map out financial consequences for the housing associations itself but also for the tenants. Financial investments are needed to be able to implement energy saving measures. However, higher rents are not desirable for these vulnerable low- or middle-income tenants. A trade-off between the adaptation of energy saving measures and the adaptation costs relating to these energy saving measures arises (Dow et al., 2013).

When looked at the core tasks of housing associations mentioned in the *Woningwet 2015*, the overarching objective is to meet housing needs, particularity for vulnerable low- or middle-income households (Oyebanji et al., 2017). However, housing associations have the right to charge a higher rent when specific types of maintenance are carried out, including energy saving measures. According to Article 7: 217 BW *"alle uitgevoerde werkzaamheden die een verhoging van het woongerief tot gevolg hebben, niet zijnde onderhoud of grootonderhoud"* (Huurcommissie, 2018). Though, the Climate Agreement assumes cost neutrality for tenants, an increase in the rent is therefore only possible if lower energy costs are a direct consequence (Rijksoverheid, 2019). To ensure cost neutrality for tenants rent increase will be lower than the average savings possible (Aedes & Woonbond). However, a potential rent increase makes tenants hesitate and is sometimes not affordable for this vulnerable group (Buikema, 2020).

So, the implementation of energy saving measures with regard to the housing association housing stock is complex can be concluded. The financial feasibility of making the housing association housing stock more sustainable is largely determined by two components (Schilder et al., 2016). Firstly, the financial position of the housing associations. The financial capacity of housing association is under pressure, as result of the landlord levy and the imposed core tasks of housing associations. On the other hand, the financial capacity of the target group plays an important role. More and more tenants are faced with payment risks (Schilder et al., 2016). Besides, the implementation of energy saving measures in the housing association sector is only possible if a majority of tenants agree. When it comes to project level, 70 percent of the tenants must agree to the implementation of energy saving measures regarding art. 220, lid 3 BW. The *Woonbond* emphasizes that the implementation of energy saving measure is crucial to be able to achieve the *Koepelcovenant* (Jager, 2018). In 87 percent of the examined plans regarding energy saving measures the required minimum of 70 percent was achieved. The pictures emerge that poor communication and haste played a role if the minimum of 70 percent was not achieved (Jager, 2018). In conclusion, Buikema (2020) also highlights the energy transition for housing associations is not financially profitable. An investment of at least five thousand euros per residential home is required for an improvement in the energy label. To cover these costs, the housing associations can only increase the rent to a very limited extent. Resulting in a considerably longer payback period. Moreover, the costs relating to energy saving measures do not increase in proportion making further steps increasingly expensive (Buikema, 2020).

3.4 RESEARCH HYPOTHESES

The research hypothesis has been formulated based on the theoretical framework mentioned earlier. The factors influencing the energy label have been identified using academic literature. The research hypothesis examines the relationship between the energy label of the Dutch housing stock and the investor-type effect.

H0: The change of a green energy label is the same for all investors in the population

H1: The change of a green energy label is not the same for all investors in the population

4. METHODOLOGY & DATA

This chapter describes the mixed-method research design used in this research. The data sources will be discussed and examined. First, the datasets will be discussed, followed by an explanation of the statistical model and the regression equation. Also, a sensitivity analysis is provided to test for homoscedasticity. Hereafter, the in-dept interviews will be discussed including the coding-scheme. Attention will also be paid to ethical considerations.

4.1 RESEARCH APPROACH

A combination of quantitative and qualitative research methods is used in this research. Achieving methodological pluralism is possible by making use of mixed-methods resulting in superior research (Jonson, 2004). These methods are all insightful by themselves but only by applying them in conformity gives the most complete outlook. The datasets WoON2018 will be used for the quantitative research part. Also, semi-structured interviews will take place forming the qualitative part of this research. The investor types involved are owner-occupier(s) institutional investor(s), private investor(s) and housing association(s). In addition, tenants are included to represent all stakeholders with regard to the energy transition.

4.2 QUANTITATIVE RESEARCH DESIGN

This paragraph focusses on the quantitative part of this research. The research design will be described, and the data sources used will be discussed.

DATASET

Data from the last edition of the *Woon Onderzoek Nederland 2018* is used to conduct this research. WoON is a survey which provides preferences and living situations of households in the Netherlands (DANS, 2019). Since 2006, the survey has replaced the *Woningbehoefte Onderzoek (WBO)* and the *Kwalitatieve Woningregristratie (KWR).* The WoON dataset has a duration of three years, the most recent version is from 2018 with 67,523 participants and 922 variables. The data collection is carried out by the Statistics Netherlands on behalf of the Minister of the Interior and Kingdom Relations to gain insight into the living situation of Dutch households. The WoON datasets provide insights into various characteristics such as: household composition, housing characteristics, socio-economic position and the living environment (DANS, 2019). The dataset is usable for this research because it includes the dependent (energy label) and independent variable (investor type) of interest (DANS, 2019). In addition, the WoON dataset has been used in comparable studies in which the dataset is considered as suitable, making it appropriate for the research (Ebrahimigharehbaghi et al., 2019).

DATA TRANSFORMATION

Before performing a statistical analysis, the dataset needs to be transformed. Firstly, outliers have to be taken into account. Outliers are observations that deviate markedly from the bulk of data. Because of the discordance outliers introduced in the data, outliers make modeling difficult. Isolation of outliers can improve the performance of predictive modelling by offering better data quality and reduction outlier's influence on the model fit (Su & Tsai, 2011). Including outliers in the dataset can result in deviant results. In this research, outliers relating to the property value, rent and the number of rooms have been taken into account. The property value which dataset started varied between 2,268.9 and 2,000,000. The bottom and top 1 percent are removed from the dataset, because these observations are seen as outliers. Observations including more than 20 rooms are removed from the dataset because it is not clear if these parcels function as residential housing or have other functions. Also, the rent which dataset started varied between 0 and 4300. Finally, the bottom and top 1 percent are removed from the dataset, because these observations are seen as outliers, comparable to the property value. Excluding

these outliers stated above results in a dataset with a number of 65,620 observations, 1,903 cases are removed.

REPRESENTATIVENESS OF THE DATA

When looking at the representativeness of the dataset, it is important to consider a number of different distributions to assess whether the sample is representative for the population. Firstly, the distribution across the Netherlands, as can be seen in Appendix 1. There is no special deviation in the representation of the dataset relative to the population with regard to the distribution. Secondly, the ratio between rental and owner-occupied sector in the Netherlands is checked for representativeness, as can be seen in Appendix 1. There is no deviation found in the rental ratio relative to the population. Thirdly, the ratio of the different investor types is compared, as can be seen in Appendix 1 Also, no special deviation of the investor types is found in the representation relative to the population. Finally, the housing-type ratio is checked for representativeness, as can be seen in Appendix 1. No special deviation in the representation relative to the population is found with regard to the housing type. It can be concluded the sample is representative for the population. The literature also indicates the WoON2018 dataset is representative for the Dutch population. Janssen & Jansen (2018) indicate the preconditions for data collection are met in the WoON2018 dataset: the number of responses, example design, approach strategy and various quality requirements. In addition, the data have been collected on such a scale it provides support for reliable statements at the national, provincial and local level (Jansen & Jansen, 2018).

4.3 OPERATIONALIZATION OF VARIABLES

DEPENDENT VARIABLE ENERGY LABEL

The dependent variable as mentioned before is the energy label. The energy label is measured as an ordinal variable. The ordinal scale is distinguished from the nominal scale by having a ranking within the categories (Brooks & Tsolacos, 2010). It also differs from interval and ratio scales by not having category widths that represent equal increments. Figure 2 shows the distribution of the energy label in the WoON2018 dataset. The energy label variable has 25,266 observations and 40.354 missing values as can be seen in table 4. Figure 2 and table 4 indicate the energy label cluster is located at energy label C with a representation of 31,83 percent. Also, 62.31 percent of the housing stock has a green energy label can be seen (label A, B or C). The labels F & G have the lowest representation, namely 9.2 percent in total as can be seen in table 4. Furthermore, the descriptive statistics of the dependent variable can be found in Appendix 2

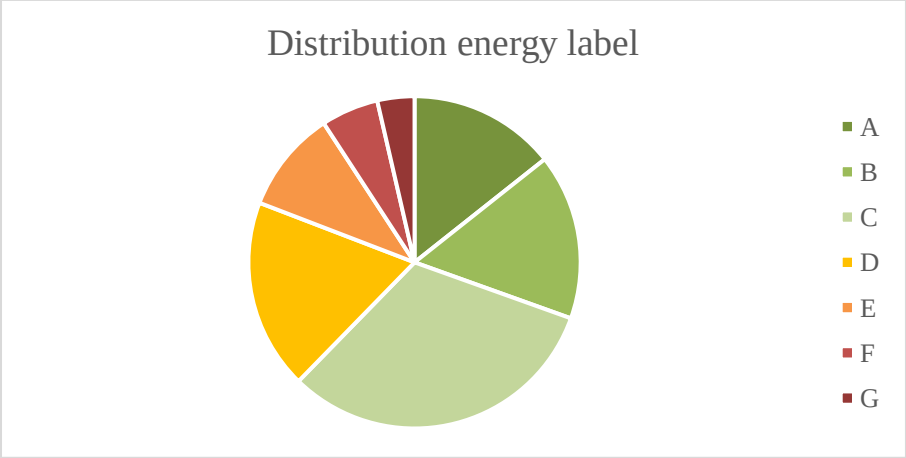

Figure 2: distribution of the dependent variable. Source: DANS (2019).

Label(s)	*N energy label*	*Percentage*	*Cumulative percentage*	*N provisional energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
A	3,623	14.34	14.34	5,427	8.66	8.66	5.68
B	4,077	16.14	30.48	10,001	15.95	24.61	0.19
C	8,042	31,83	62.31	19,574	31.22	55.83	0.61
D	4,682	18.53	80.84	4,746	7.57	63.40	10.96
E	2,517	9.96	90.80	7,751	12.36	75.76	-2.39
F	1,413	5.59	96.39	7,075	11.28	87.07	-5.69
G	912	3.61	100.00	8,123	12.96	100.00	-9.35
Total	25,266	100.00		62,697	100.00		

Table 4: composition of the energy label and provisional energy label variable. Source: DANS (2019).

To be able to test the H0 hypotheses, the energy label variable is operationalized as binary variable. The aim of the H0 hypotheses is to find out whether the chance of a green energy label is the same for all investor types included in this research. When using a binary variable as dependent variable it is possible to predict the relationship between the predictors and a predicted variable (Brooks & Tsolacos, 2010). The predicted binary variable takes the value 0 or 1 to indicate the absence or presence of a categorial effect. The operationalized dependent dummy variable indicates whether a property is energy efficient or non-energy efficient based on the energy label. The energy efficient labels are represented in the green section in table 5 (label A, B & C). The non-energy efficient labels are represented in the orange and red section in table 5 (label D, E, F & G).

Label(s)	*N energy label*	*Percentage*	*Cumulative percentage*	*N provisional energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
Energy efficient	15,742	62.31	62.31	35,002	55.83	55.83	6.48
Non-energy efficient	9,524	37.31	100.00	27,695	44.17	100.00	-6.48
Total	25,266	100.00		62,697	100.00		

Table 5: composition of the energy label dummy and provisional energy label dummy variable. Source: DANS (2019).

INCLUDING THE PROVISIONAL ENERGY LABEL AS DEPENDENT VARIABLE

The provisional energy label shows an estimate of the energy label and can be seen in table 4 & 5. Furthermore, the descriptive statistics and distribution of the provisional energy label can be found in Appendix 3. The provisional energy label is an estimate based on the date registered by Het Kadaster. Variables determining the provisional energy label are the year of construction, surface and the property type (Milieu Centraal, 2020). Every property has received a provisional energy label in 2015. In practice, a property can have a more negative or positive energy label than the provisional energy label indicates. However, the provisional energy label variable has 62,697 observations and 2,923 missing values as can be seen in table 4. Resulting in 248.15 percent more observations when compared to the determined energy label. The provisional energy label will be tested as dependent variable as well to see whether this causes differences for the results. The provisional energy label variable is measured as an ordinal variable, meaning the data is ordered in categories and the distance between the categories is not known (Brooks & Tsolacos, 2010). When looking at table 4 it can be seen the provisional energy label cluster is located at energy label C with a representation of 31,22 percent. 55.83 percent of the housing stock has a green energy label (label A, B or C). The labels F & G have a representation of 22.24 percent. When the energy label variable and provisional energy label variable are compared differences per class run up to 10.96 percent in comparison to each other. It can be seen these differences are mainly visible in the lower classes of the energy label. It can be seen that the distribution of the labels B & C corresponds almost perfectly. Though, it can be concluded the determined energy label variable shows a more positive overall outcome.

INDEPENDENT VARIABLE INVESTOR TYPE

The independent variable of interest is the investor type, the investor type shows which type of investor owns the house. The descriptive statistics, a visual interpretation and the survey questions referring to the investor type(s) can be found in Appendix 5. An overview of the nominal categories having no

intrinsic ordering of the categories with qualitative values representing the different investor types can be found in table 6. The categories of the independent variable will be included in the binary logistic regression as dummy variables considering the independent variable being nominal.

Label	*N*	*Percentage*	*Cumulative percentage*
owner-occupier	37,339	67.23	67.23
private investor	2,724	4.90	72.13
housing association	14,279	25.71	97.84
institutional investor	1,199	2.16	100.00
	55,541	100.00	

Table 6: composition of the categories of the independent variable investor type. Source: DANS (2019).

4.4 VISUAL INTERPREATION VARIABLES

Before performing a statistical analysis, a visual interpretation of the relationship between the dependent and independent variable is made as can be seen in figure 3. Besides, a more detailed overview per investor type can be found in Appendix 6. When looking at figure 3, differences are visible regarding the distribution of the energy label. It can be seen private investor(s) are lagging behind while housing association are at the forefront when focusing on the distribution of the energy label.

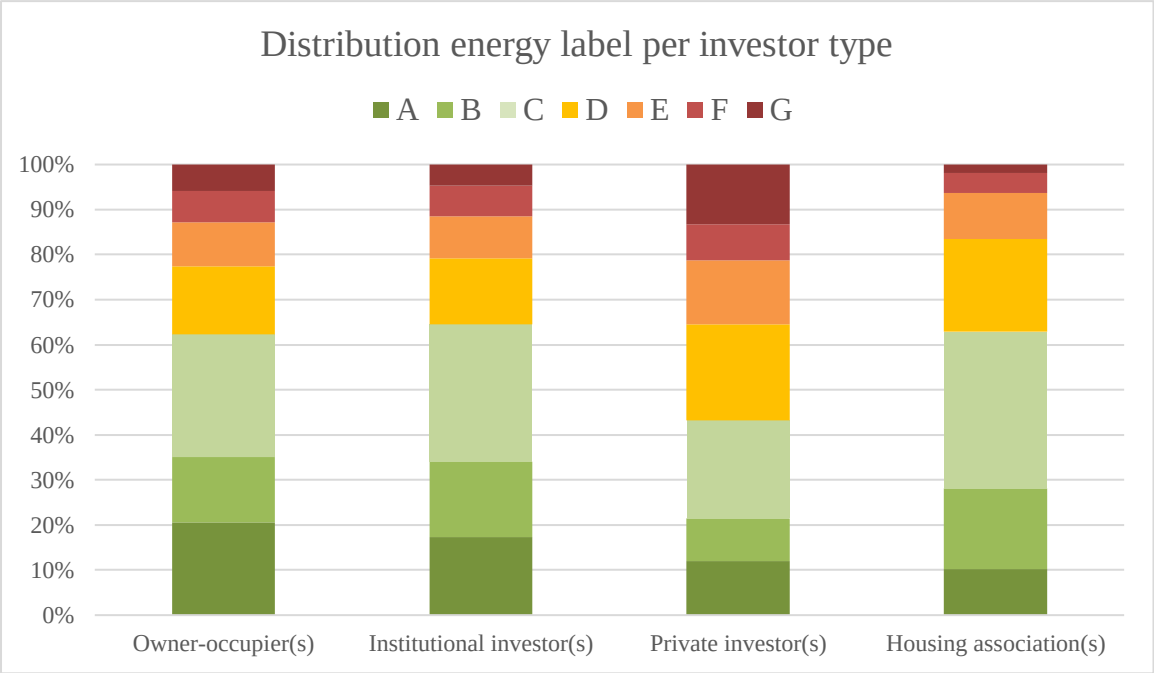

Figure 3: distribution of the dependent variable per investor type. Source: DANS (2019).

When looking at the different investor types individually in figure 3, it can be seen that the owner-occupied sector has the highest representation of energy label A in comparison to the other investor types, namely 20.62 percent. When the mean of the energy label is compared with the other investor types, the owner-occupied housing stock ranks 2 out of 4. The owner-occupied cluster is located at energy label C with a representation of 27.28 percent. When the energy label is divided into the section's energy efficient and the non-energy efficient labels, 62.35 percent of the owner-occupied housing stock has a green energy label. In terms of allocation, the owner-occupied housing stock ranks 3 out of 4 when the section efficient and non-efficient are compared.

Secondly, when looked at the institutional investor housing stock in figure 3 it can be seen 64.56 percent of the housing stock has a green energy label (label A, B or C). When the mean of the energy label is compared with the other investor types, the sector ranks 3 out of 4. Though, 64.56 percent of the institutional investors housing stock has a green energy label when the sections energy efficient and non-energy efficient are compared with each other. In terms of allocation the institutional investor

housing stock ranks 1 out of 4 when the energy efficient and non-energy efficient sections are compared. However, it must be realized when all label categories are included, the sector is in third place.

Thirdly, the private investor sector has the highest representation of energy label G in comparison to the other investor types, namely 13.21 percent. Also, the private investor cluster is located at energy label C-D, the lowest cluster which burdens the environment the heaviest. When the mean of the energy label is compared with the other investor types, the sector ranks 4 out of 4, the lowest position. When the sections energy efficient labels and non-energy efficient labels are compared for the private investor housing stock, 43.16 percent has an energy efficient label. Resulting in the lowest position as well in comparison to the other investor types.

Lastly, when looking at the housing associations' mean energy label of the housing stock in figure 3, the sector ranks 1 out of 4. 62.93 percent of the housing association housing stock has a green energy label (Label A, B or C). Also, the housing association housing stock has the lowest representation of the labels F & G, namely 6.35 percent. When the sections energy efficient and non-energy efficient are compared for the housing association housing stock, 62.93 percent has a green energy label.

4.5 FOCUS GROUP

A wide range of cases is included to test the H0 hypotheses to see whether the chance of a green energy label differs per investor type. However, the factors construction year, living area and type of housing are identified as the most important building characteristics associated with the application of building related sustainable measures (Kastern & Stern, 2015; Mills & Schleich, 2009; Leicester & Stoye, 2016). To ensure an equivalent comparison, a focus group will be used with regard to the construction year. In addition to the binary linear regression in which all cases are included, the focus group will be tested individually to see whether this affects the results.

All cases with a construction year between 1945-1969 are included in the focus group. Resulting in 22.23 percent of all cases as can be seen in table 7 The period 1945-1969 is chosen because this period is characterized by poor building quality. The construction methods used have resulted in low building quality due to the intense housing shortage after the Second World War (Ministry of the Interior and Kingdom Relations, 2015). The period is characterized by building as many homes as possible, instead of building high-quality homes. During construction little attention was paid to sealing cracks, central heating was not yet the standard and the houses were made of cheap materials. Properties constructed between 1945-1969 are originally constructed with an energy label F or G (Ministry of the Interior and Kingdom Relations, 2015). By using 1945-1969 as focus group, it is possible to make a fair comparison to see if energy efficient measures have been implemented because of the equivalent starting point. When a green energy label is determined for a property constructed between 1945-1969, energy saving measures must be implemented.

Label	***N***	***Percentage***	***Cumulative percentage***
within focus group	14,585	22.23	23.23
outside focus group	51,035	77.77	100.00
	65,620	100.00	

Table 7: composition of focus group. Source: DANS (2019).

REPRESENTATION DEPENDENT VARIABLE IN FOCUS GROUP

When the focus group is compared to the overall dataset in terms of allocation of the energy label, the focus group performs poorly. The energy label distribution referring to the focus group can be found in figure 4 and Appendix 7. An overrepresentation in the lower energy classes and an underrepresentation in the higher energy classes, when comparing the focus group results to the overall dataset results, can be observed. Though, the original conducted energy label no longer applies for 84.80 percent of the focus group, which means energy saving measures have been implemented generally speaking. When the sections energy efficient and non-energy efficient are compared, 36.64 percent of the focus group

has a green energy label. When this percentage is compared to the outcomes of the overall dataset, the focus group scores 25.67 percent lower on the possession of energy efficient labels. It can be concluded the focus group scores poorly when compared to the overall dataset.

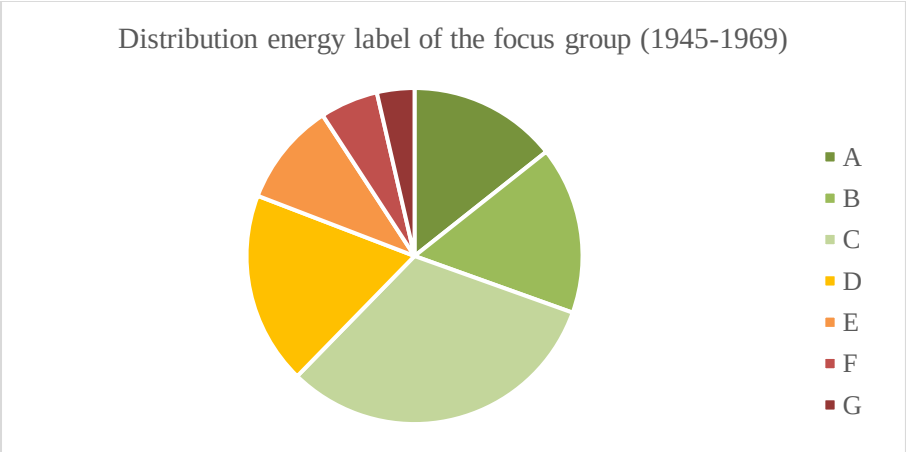

Figure 4: distribution of the dependent variable regarding the focus group. Source: DANS (2019).

REPRESENTATION OF INDEPENDENT VARIABLE IN FOCUS GROUP

The representation of the independent in the focus group is corresponding to the representation in overall sample or the deviation is explainable. The distribution of the independent variables in the focus group can of be found in table 8. The owner-occupier sector scores 8.54 percent lower with regard to the focus group. An explanation for this is the 47.5 percent share of the owner-occupied housing stock within the construction period 1945/1970 (CLO,2019). The overall owner-occupied housing stock represents 56.2 percent of the Dutch housing stock. The housing association(s) housing stock represents 9.6 percent above regarding the focus group. An explainable motive is the 39.9 percent share of social housing within the construction period 1945/1970 (CLO,2019). The overall housing association(s) housing stock represents 29.9 percent of the Dutch housing stock. The private investor(s) and institutional investor(s) housing stock representativeness corresponds to the overall dataset as can be seen in table 8.

Label	***N focus group***	***Percentage***	***Cumulative percentage***	***N total dataset***	***Percentage***	***Cumulative percentage***	***Deviation percentage***
owner-occupied	7,297	58.69	58.69	37,339	67.23	67.23	-8.54
private investor	569	4.69	63.38	2,724	4.90	72.13	-0.21
housing association	4,420	35.31	98.69	14,279	25.71	97.84	9.6
institutional investor	158	1.27	100.00	1,199	2.16	100.00	-0.89
total	12.444	100.00		55,541	100.00		

Table 8: independent variable comparison dataset versus population. Source: DANS (2019).

4.6 CONTROL VARIABLES

The control variables of interest will be discussed now. The control variables consist of various housing-characteristics influencing the energy label. The control variables are continuous or discrete and present as interval, ratio, nominal, ordinal or binary variables. Measurements were taken at one point in time, namely 2018. No repeated measurements are included in the dataset. The variables used in this research from the WoON2018 dataset can be found in the notational glossary in Appendix 4.

Regarding the socio-demographic factors, income emerges as an important and frequently used variable (Trotta,2018; Aziz et al., 2019, Ebrahimigharehbaghi et al., 2019). Because of the observed associations with the application of building-related sustainability measures, the property value and the disposable income of households is added to the model. The property value is included in the model which is related to the disposable income of a household. The property value represents a social demographic component in the form of the financial resources of a household. Also, a representation of the average modal gross

household income is included to represent income. The variable represents a social demographic component in the form of the financial resources of a household. Further, the socio-demographic control variables age and education level which are characteristics of the respondent questioned are used. A subdivision with regard to the age component is frequently used in studies such as Aziz et al. (2019), Ebrahimigharehbaghi et al. (2019) and Trotta (2018). The education component is used in its original state since the studies by Azizi et al. (2019) also uses relatively many categories for the variable education level. In addition, research shows that in terms of age and education level there is a strong similarity regarding partner choice. Therefore, these variables also indicate to some extent the characteristic of possible co-owner or inmates (Doosje, 1999). The last socio-demographic control variable of interest is the household composition, used in its original state. Though, the category *''niet-gezinshuishouden''which* indicate pronominally young professions and student housing is relatively low represented in the WoON2018 dataset. This category will not be merged because otherwise a specific group would not be treated separately.

Regarding the housing characteristic the construction year is mentioned as one of the most important building characteristics associated with the application of building relating sustainable measures. Literature shows the construction year is strongly correlated with the energy performance of a property (Kastner & Stern, 2015). The construction year is predominantly significantly positively correlated with the application of building related sustainability measures (Ebrahimigharehbaghi et al., 2019; Kastern & Stern, 2015; Mills & Schleich, 2009; Leicester & Stoye, 2016). Earlier research includes the construction year as a categorical variable in order to be able to indicate different architectural styles per decade (Aziz et al., 2019). However, for the determination of the energy label other categories are taken into account with regard to the construction year. A comparison between the two categorical distributions can be found in Appendix 8. Because of the categorization's deviation and the use of a focus group, it is decided to include the construction year as categorical variable based on the earlier literature. Secondly, the housing type is included. In order to lose as little information as possible, the five categories will be included in its original state, no categories are merged. The literature describes households living in a flat are significantly less likely to apply building-related sustainable measurements than households living in terraced housing (Trotta, 2019). While households living in detached housing are significantly more likely to apply building-related sustainably measurements in comparison to households living in terraced housing. Thirdly, the property surface is included. The living room(s), bedroom(s), kitchen(s), bathroom(s) are included. Any garden, garage or driveway do not count for living space surface. Non-significant associations are found for the property surface in most relevant studies into all types of building related sustainable measures. The variable is included in other studies as a categorical or non-categorical scale due to conflicting results in the literature. In earlier research the variable is included as a categorical variable in order to indicate different sizes which can be explained on the basis of a pattern in the study by Trotta (2018). However, other categories are taken into account by determining the energy label with regard to the property surface than in the literature. A comparison of the categorical distributions can be found in Appendix 8. It is decided to include the property surface as categorical variable based on earlier literature.

Lastly, location characteristics reflect framework conditions that cannot be attributed to household level (Michelen & Nadlener, 2012). Little research has been carried out into the causal relationship between location characteristic and the implementation of energy saving measures. Residential areas are associated with climatological, social, economic and political differences on a national and local level (Kastner & Stern, 2015). Households' choices relating to environmental choices are often socially embedded and influenced by institutional constraints. Therefore, analysis of household's beliefs should be taken into account in a specific territorial context. A measurement that can be reasonably compared and is frequently used in research is the urban context. Besides, a desire to move is taken into account. While energy saving measures usually take place after a property has been sold (Ministry of the Interior and Kingdom Relations, 2019).

4.7 DESCRIPTIVE STATISTICS

The descriptive statistics of the variables included in the statistical analyses can be found in table 9. The table gives an overview of the number of observations, mean, median, standard deviation, minimum and maximum.

Variables	*Observation*	*Mean*	*Median*	*Std. Dev.*	*Min*	*Max*
energy label	25,259	3.249	3	1.529	1	7
provisional energy label	62,673	3.847	3	1.857	1	7
dummy energy label	25,259	0.623	1	0.485	0	1
dummy provisional energy label	62,673	0.558	1	0.497	0	1
investor type						
owner-occupier(s)	57,440	0.650	1	0.477	0	1
Housing association(s)	65,596	0.218	0	0.413	0	1
institutional investor(s)	65,596	0.018	0	0.134	0	1
private investor(s)	65,596	0.042	0	0.199	0	1
focus group dummy	65,620	0.222	0	0.416	0	1
construction year						
< 1945	65,620	0.172	0	0.378	0	1
1945-1959	65,620	0.088	0	0.283	0	1
1960-1969	65,620	0.134	0	0.341	0	1
1970-1979	65,620	0.177	0	0.382	0	1
1980-1989	65,620	0.154	0	0.361	0	1
1990-1999	65,620	0.129	0	0.336	0	1
2000 >	65,620	0.145	0	0.352	0	1
income						
below average	65,620	0.301	0	0.459	0	1
up to 1.5 times average	65,620	0.208	0	0.406	0	1
up to 2 times average	65,620	0.172	0	0.377	0	1
up to 3 times average	65,620	0.200	0	0.400	0	1
>3 times average	65,620	0.119	0	0.323	0	1
surface in square feet						
< 50	55,212	0.231	0	0.150	0	1
50-69	55,212	0.811	0	0.273	0	1
70-89	55,212	0.163	0	0.370	0	1
90-119	55,212	0.319	0	0.466	0	1
120-149	55,212	0.207	0	0.405	0	1
150-199	55,212	0.134	0	0.340	0	1
200 >	55,212	0.073	0	0.260	0	1
property value						
< 150.000	65,620	0.261	0	0.439	0	1
150.000-199.999	65,620	0.246	0	0.436	0	1
200.000-249.999	65,620	0.186	0	0.389	0	1
250.000-299.999	65,620	0.108	0	0.310	0	1
300.000-399.999	65,620	0.108	0	0.310	0	1
400.000-499.999	65,620	0.048	0	0.213	0	1
500.000 >	65,620	0.034	0	0.180	0	1
property type						
multi-story housing	55,212	0.267	0	0.443	0	1
terraced housing & others	55,212	0.299	0	0.458	0	1
semi-detached housing	55,212	0.145	0	0.352	0	1
corner house	55,212	0.132	0	0.338	0	1
detached housing	55,212	0.157	0	0.364	0	1
location characteristic dummy	65.426	0.454	0	0.498	0	1
highest completed education						
primary school	65,620	0.053	0	0.224	0	1
VMBO, HAVO- VWO-lower secondary, MBO 1	65,620	0.258	0	0.438	0	1
HAVO, VWO, MBO 2-4	65,620	0.349	0	0.477	0	1
higher vocational education-, university bachelor	65,620	0.191	0	0.393	0	1
higher vocational education-, university master, doctor	65,620	0.118	0	0.322	0	1
desire to move	65,620	0.387	0	0.487	0	1
household composition						
one person	65,620	0.279	0	0.449	0	1
couple	65,620	0.295	0	0.456	0	1
couple with child(ren)	65,620	0.328	0	0.469	0	1
one parent	65,620	0.077	0	0.267	0	1
nonfamily	65,620	0.021	0	0.142	0	1
age						
17-24	65,620	0.124	0	0.329	0	1
25-34	65,620	0.139	0	0.346	0	1
35-44	65,620	0.128	0	0.335	0	1
45-54	65,620	0.168	0	0.374	0	1
55-64	65,620	0.174	0	0.380	0	1
65-74	65,620	0.157	0	0.364	0	1
> 75	65,620	0.110	0	0.312	0	1

Table 9: descriptive statistics

4.8 BINARY LOGISTIC REGRESSION MODEL

To test the hypotheses, statistical analyses are performed using binary logistic regression models. A binary logistic regression model can be used to model the probability of a certain class or event existing such as pass/fail, win/lose or yes/no (Hilbe, 2009). In a binary logistic regression model, the dependent variable has two categorial levels, labelled as 1/0. The binary logistic regression model is a statistical model that in the basic form uses a logistical function to model the binary dependent variable (Hilbe, 2009). Using binary logistic regression models with the energy label as dependent variable and the investor type as independent variable enables to determine to what extent the investor type is a predictor of the energy label. Where energy label E is a function of the independent variable and various control variables. α is a constant and ε the error term, as a non-systematic component of the relevant variables. The following binary logistic regression models will be used:

MODEL (1)

The dependent variable of interest in Model (1) is a dummy variable indicating if residential properties are energy efficient (label A, B or C) or non-energy efficient. The aim of the regression models is to measure if the investor type of a residential home is a significant predictor for the energy label focusing on the overall dataset.

$$E\ (Y) = \frac{1}{1 + e^{-}(\beta_0 X_{type\ of\ investor} + \beta_1 X_{socio-demographic\ charact.} + \beta_2 X_{property\ charact.} + \beta_3 X_{location\ charact.} + \varepsilon}$$

MODEL (2)

The provisional energy label will be tested as dependent variable to see whether this causes differences for the results in relation to the energy label tested in Model (1). The dependent variable of interest in Model (2) is a dummy variable indicating if the provisional determination of residential properties is energy efficient (label A, B or C) or non-energy efficient.

$$provisional\ E\ (Y) = \frac{1}{1 + e^{-}(\beta_0 X_{type\ of\ investor} + \beta_1 X_{socio-demographic\ charact.} + \beta_2 X_{property\ charact.} + \beta_3 X_{location\ charact.} + \varepsilon}$$

MODEL (3)

The dependent variable of interest in Model (3) is a dummy variable indicating if residential properties are energy efficient (label A, B or C) or non-energy efficient including focus group cases only. The focus group selected by the construction year will be tested separately because it makes a fair comparison possible because of the equivalent starting point. When an energy efficient energy label is found, energy saving measures must be implemented when focusing on focus group cases.

$$focus\ group\ E\ (Y) = \frac{1}{1 + e^{-}(\beta_0 X_{type\ of\ investor} + \beta_1 X_{socio-demographic\ charact.} + \beta_2 X_{property\ charact.} + \beta_3 X_{location\ charact.} + \varepsilon}$$

MODEL (4)

Model (4) combines the two adjustments made in model (2) and model (3). The provisional determined energy labels of the focus group will be tested. The dependent variable of interest in Model (4) is a dummy variable indicating if the provisional determination of residential properties is energy efficient (label A, B or C) or non-energy efficient including focus group cases only.

$$focus\ group\ provisional\ E\ (Y) = \frac{1}{1 + e^{-}(\beta_0 X_{type\ of\ investor} + \beta_1 X_{socio-demographic\ charact.} + \beta_2 X_{property\ charact.} + \beta_3 X_{location\ charact.} + \varepsilon}$$

Besides, five conditions underlie binary logistic regression models (Hilbe, 2009). First, binary logistic regression requires the dependent variable to be binary. Second, the observations should not come from repeated measurements or matched data. This is because a binary logistic regression requires the

observations to be independent of each other. Third, the independent variables should not be too highly correlated with each other, because binary logistic regression requires little or no multicollinearity among the independent variables. Fourth, binary logistic regression requires that the independent variables are linearly related to the log odds. Log odds play a central role in logistic regression models. Probabilities can be converted to log odds by finding the odds ratio and taking the logarithm (Brooks & Tsolacos, 2010). So, linearity of the independent variable and log odds should be assumed. Finally, binary logistic regression requires a large sample size. These five assumptions have been checked on the basis of various visualizations and tests which can be found in Appendix 9 & 10 showing all conditions are met (Hilbe, 2009). The data changes made, and the regressions performed can be found in the Stata DO-file in Appendix 19 to increase the reliability of this research.

4.9 QUALITATIVE RESEARCH DESIGN

This paragraph focusses on the qualitative part of the research. The research design will be described, and the data analysis used will be discussed. Primary data were collected through qualitative semi-structed interviews with the stakeholders. This allowed to gain insights into the strategies of the stakeholders and how they operate within the energy transition.

DATA COLLECTION

To be able to appropriately prepare the interviews, an interview guide was developed with questions which helps to provide flexibility and effectivity during the interviews (Roulston & Choi, 2018). At the beginning the researcher needs to operationalize the variables of interest within the conceptual model (Mills et al., 2010). The conceptual model and theoretical framework have defined the core concepts involved and determined as set of actors affecting investors. Hereafter, a set of questions need to be formulated per core concept to gain relevant data and information (Mills, et al. 2010). Accordingly, five interview guides were made, one for each stakeholder which can be found in Appendix 12 up to and including 16. The interviews were held in Dutch, as this is the native language of the interviewees. The interviews were taken from 2020 December to 2021 February and took place in timeslots which expired from 29:27 to 53:39 minutes. Basic information about the interviews can be found in table 10. The judgmental sampling technique is used to select the participants. The judgmental sampling technique is a non-probability sampling technique in which the sample member is chosen on the basis of the research knowledge and judgment (Etikan & Bala, 2017). As the knowledge of the researcher is instrumental in creating the sample, there are chances that the results obtained will be highly accurate with a minimum margin of error.

Interview:	**Role of the interviewee:**	**Profession of interviewee:**	**Investor type:**
in-depth interview 1	owner-occupier	does not apply	owner-occupier
in-depth interview 2	employee	asset manager	housing association
in-depth interview 3	employee	manager strategy & research	institutional investor
in-depth interview 4	investor	does not apply	private investor
in-depth interview 5	tenant	does not apply	does not apply

Table 10: descriptive overview of interviewees

At the begin of the interviews, an explanation about the research topic was given to the participants. Besides, permission to record the interviews was asked in advance. Within the interviews confidentiality of responses was guaranteed, which provides an increase in the likelihood of the interviewees answering question truthfully. At the beginning of the interviews, a start was made with general question referring to sustainability. This was followed by question related to the implementation of energy saving measures and the energy transition. Next, questions were asked regarding capacity, central is whether they consider their contribution as fair. To end the interviews, a closing question was used to put the interviewee at ease.

DATA ANALYSIS

The first step taken in the data analysis was a preparation of the data by producing transcripts of the interviews. After this the qualitative data is analyzed using the qualitative data analysis software ATLAS.tl. The software package of ATLAS.ti enables the researcher to work with the data without losing the original context (Mills et al., 2010). First, it is important to get familiar with the data and to list key ideas and themes. Hereafter it is necessary to break the data in manageable units. A deductive coding method is used, allowing to generate codes before the data collection starts (Miles & Huberman, 1994). Descriptive and deductive codes are used because this enables analyzing the core concepts as well as new areas of interest, patterns or relationships found during data analyzing (Lewins & Silver, 2007). The codebook can be found in Appendix 17. Hereafter, the data is compared by using the codes looking for similarities and differences. During this phase of analyzing the qualitative data, a search for data that might provide preliminary assertions and results is in place. These qualitative findings have been supported by linking them to the quantitative research results.

4.10 ETHICAL CONSIDERATIONS

During the research, the principle of the Dutch code of conduct for research integrity have been respected (Dowling, 2016). This section will elaborate on the considerations that were made to ensure the Dutch code of conducts is respected. These considerations include informed consent, confidentially and privacy and the data management plan for both the qualitative and quantitative research (Dowling, 2016). Every step in the research process is considered carefully. The book 'introduction to social research' emphasizes research ethics are *"the study of what are good, right, or virtuous courses of action*" (Punch, 2013). This is considered by focusing on the participants being as comfortable as possible and by taking care of given answers. The research relies partly on conducting semi-structured interviews with interviewees, complying to the code of ethics for social research is essential as well. This code emphasized the importance of obtaining and informed consent for the participants within the research (Punch, 2013).

Before the interviews took place, the interviewees were given a substantive explanation of the content of the interview by e-mail. Due to the COVID-19 pandemic during the data collection period, extra consideration was needed to manage the safety of the interviewees. Therefore, the most preferred interview technique of the participants was chosen (videocall, telephone, face-to-face with social distance). Before the interviews took place, each participant was asked to agree to participate within the interview. Also, permission was asked to record the interviews. Furthermore, information given during the interview cannot be traced back to an individual or institution, anonymity is guaranteed. Concerning the quantitative data collection and analysis anonymity of the respondents is guaranteed as well. Information could not be traced back to individual level because the WoON2018 dataset does not foresee these personal characteristics.

Additionally, all data are stored on a personal, password-secured laptop. The obtained data will only be used for this research. The recordings of the interviews will only be available for the researcher and supervisor and will be deleted after a five-year period. In addition, it is possible for participants to withdraw their contribution at any time without a reason. It is of importance participants may not experience any negative effects from the research and the research outcomes, this will be closely monitored.

5. RESULTS

5.1 VALIDATION OF THE QUANTITATIVE MODEL

The results of the binary logistic regressions are presented in the table 11 and provide insights into the relationship of the independent- and dependent variable. Also, the table provides insights into the significant relationships of the control variables included. Model (1) indicates the binary logistic regression results of the most important variables found in the literature in relation to the application of energy saving measures. These variables consider of factors socio-demographic, building- and location characteristics as mentioned before. Model (1) does not yet consider the investor type of a residential home as predictor.

The null hypothesis states that the chance of a green energy label is the same for all investor types in the population. When the p value is sufficiently small, the results are not easily explained by change alone, and the data is deemed inconsistent with the null hypotheses (Brooks & Tsolacos, 2010).
In this case, the null hypothesis of chance alone as an explanation of the data is rejected in favor of a more systematic explanation. When the p-value is large, the results in the data are explainable by change alone and the data are deemed consistent with the null hypothesis (Brooks & Tsolacos, 2010). The McFadden pseudo R^2 is used to find out how precisely the binary logistic regression model fits the data (Brooks & Tsolacos, 2010). The McFadden pseudo R^2 test gives the result of the theoretical control variables in the baseline model contribute for 0.3063 to the explanation of the dependent variable. In other words, the expandability of the baseline model including the theoretical control variables is 30.63 percent. Subsequently, with the addition of the independent variable investor type a higher explain ability of 30.96 percent for the model is observed. The McFadden pseudo R^2 test gives the result of the theoretical control variables plus the investment type contribute for 0.3096 to the explanation of the dependent variable.

The Spearman's rank correlation coefficient is a nonparametric measure of rank correlation. It assesses how well the relationship between two variables can be described using a monotonic function to see whether they are linear or not (Spearman, 1906). When each of the variables is a perfect monotone function of the other, a perfect Spearman correlation of +1 or -1 occurs. High correlation is undesirable in the model because it means predictors explain more or less the same. It means that the presence of multicollinearity. The lack of multicollinearity is one of the assumptions of the binary logistic regression model (Sperandei, 2014). Besides using the Spearman's rank correlation coefficient to investigate multicollinearity, the variance inflation factor (VIF) is used to verify for multicollinearity as well. The VIF is a method for detecting multicollinearity in which a VIF greater than 10 is an indicator of multicollinearity (Mansfield & Helms, 1982). In this research multicollinearity should not be seen as an issue, the average variance inflation factor is below a level of 10, namely 3.92. An overview of the VIF values and the Spearman's rank correlation coefficient can be found in Appendix 9 & 10.

		model (1) coefficients	model (1) marginal effects
constant	-1.322531*** (0.184)	-1.638559*** (0.207)	
construction year			
< 1945	base	base	base
1945-1959	0.3407736*** (0.069)	0.2953929*** (0.070)	0.0587889*** (0.011)
1960-1969	0.8116516*** (0.064)	0.7707229*** (0.065)	0.1293644*** (0.009)
1970-1979	1.345459*** (0.063)	1.319256 *** (0.064)	0.1973618*** (0.008)
1980-1989	2.736565*** (0.068)	2.718252*** (0.069)	0.3087275*** (0.008)
1990-1999	4.511184*** (0.121)	4.508445*** (0.122)	0.3391433*** (0.008)
2000 >	6.021715*** (0.198)	6.025841*** (0.198)	0.4537072*** (0.005)
income			
below average	base	base	base
up to 1.5 times average	-0.0568137 (0.049)	0.030479 (0.051)	-0.0106174 (0.009)
up to 2 times average	-0.0395588 (0.064)	0.0841114 (0.066)	-0.007385 (0.0119)
up to 3 times average	-0.0428515 (0.074)	0.0831968 (0.077)	-0.0080065 (0.014)
>3 times average	-0.1130025 (0.110)	0.0169364 (0.111)	-0.0214761 (0.020)
Surface in square feet			
< 50	base	base	base
50-69	-0.2248248** (0.106)	-0.2235615** (0.107)	-0.0430315** (0.021)
70-89	-0.2485389** (0.105)	-0.2423015** (0.106)	-0.0461559** (0.020)
90-119	-0.1516675 (0.110)	-0.1211963 (0.111)	-0.0226283 (0.021)
120-149	-0.1951796 (0.121)	-0.107454 (0.122)	-0.0202728 (0.023)
150-199	-0.010929 (0.142)	0.0732133 (0.143)	0.0133214 (0.026)
200 >	-0.072926 (0.167)	-0.0068037 (0.168)	-0.0012606 (0.031)
property value			
< 150.000	base	base	base
150.000-199.999	0.142849*** (0.045)	0.1786648*** (0.045)	0.026057*** (0.008)
200.000-249.999	0.1931829*** (0.069)	0.2712673*** (0.069)	0.0344708*** (0.012)
250.000-299.999	0.281943*** (0.096)	0.36645*** (0.115)	0.0489147*** (0.015)
300.000-399.999	0.219372* (0.114)	0.2937311** (0.160)	0.0385841** (0.018
400.000-499.999	0.0883577 (0.159)	0.1631807 (0.189)	0.0160188 (0.027)
500.000 >	0.0632391 (0.188)	0.1256684 (0.040)	0.0115354 (0.033)
[property type			
detached housing	base	base	base
multi-story housing	0.1086251 (0.107)	0.0579973 (0.108)	0.0200349 (0.020)
terraced housing & others	0.6084177*** (0.098)	0.5272733*** (0.099)	0.1058805*** (0.016)
semi-detached housing	0.1982076* (0.103)	0.1761353* (0.103)	0.0351495** (0.018)
corner house	0.3276036*** (0.101)	0.2380313** (0.101)	0.0570159*** (0.017)
location characteristics			
rural	base	base	base
urban	-0.2093216*** (0.040)	-0.2002228*** (0.040)	-0.0386173*** (0.007)
highest completed education			
primary school	base	base	base
VMBO, HAVO- VWO-lower secondary, MBO 1	-.00456966 (0.056)	-.027994 (0.056)	-0.0085114 (0.010)
HAVO, VWO, MBO 2-4	-0.0691699 (0.0.059)	-0.0341019 (0.059)	-0.0129073 (0.011)
higher vocational education-, university bachelor	-0.0930489 (0.067)	-0.0297928 (0.068)	-0.017503 (0.013)
higher vocational education-, university master, doctor	-0.1251581 (0.081)	-0.0572914 (0.081)	-0.0237674 (0.015)
desire to move			
no	base	base	base
yes	0.04357 (0.037)	0.0472331 (0.037)	0.0080519 (0.006)
household composition			
one person	base	base	base
couple	0.0045874 ((0.048)	-0.0057086 (0.049)	0.0008497 (0.009)
couple with child(ren)	-0.0700875 (0.061)	-0.1017549* (0.061)	-0.0131265 (0.012)
one parent	0.1213185* (0.136)	0.0764338 (0.067)	0.021905** (0.012)
nonfamily	-0.2631716* (0.136)	-0.277548** (0.138)	-0.0518339** (0.288)
age			
17-24	base	base	base
25-34	0.0802097 (0.136)	0.0289078 (0.113)	0.0146795 (0.021)
35-44	0.1771425 (0.111)	0.0946288 (0.118)	0.031769 (0.021)
45-54	0.2033825** (0.116)	0.0923467 (0.117)	0.0363411* (0.021)
55-64	0.1765035 (0.115)	0.0422435 (0.118)	0.031724 (0.022)
65 -74	0.0925088 (0.114)	-0.0245054 (0.121)	0.0168725 (0.022)
> 75	-0.041149 (0.115)	-0.1481495 (0.223)	-0.0076833 (0.024)
investor type			
private investor(s)		0.1637975 (0.144)	0.0290886 (0.025)
housing association(s)		0.5330519*** (0.095)	0.0998388*** (0.018)
institutional investor(s)		-0.1447108 (0.136)	-0.0276747 (00271)
owner-occupier(s)		0.163854 (0.101)	0.0299086 (0.018)
number of observations	22,223	22,223	
LR chi2	9018.69	9117.33	
prob > chi2	0.0000	0.0000	
pseudo R2	0.3063	0.3096	

Table 11: binary logistic regression main model (1) coefficients and marginal effects

Note: The dependent variable is the dummy variable labeldummy*, indicating if a property is energy efficient or non-energy efficient. The table gives the coefficients of the variables. The standard errors are given in parentheses. *;**;*** are significant at 10%, 5%, 1% respectively.*

5.2 QUANTITATIVE RESULTS

MODEL (1) MAIN MODEL

The marginal effects relating to model (1), (2), (3) & (4) can be found in table 13, Appendix 11 gives an overview of the coefficients relating to the Models. The results of model (1) show that housing associations are a positive significant predictor of having a green energy label. Therefore, housing associations are indirectly associated with the implementation of energy saving measures. Based on the results, the null hypothesis can be rejected in favor of the alternative hypothesis:

H0: The change of a green energy label is the same for all investors in the population

H1: The change of a green energy label is not the same for all investors in the population

A greater likelihood (***) of having a green energy label is expected for residential homes with a housing association as investor type. The probability of having a green energy label increases by 10.0 percent as the investor type is a housing association. This means energy saving measures are more often applied when the investor type is a housing association. For the other investor types, no significant results are found. When looked at these non-significant results, a positive association is found for the private investor & owner-occupier investor type. The institutional investor category shows a non-significant negative association. The control variables in model (1) show results according to the expectations resulting from the literature.

PROVISIONAL ENERGY LABEL

The results of the binary logistic regression model (2) show no significant results for the independent variable. The investor type is not relevant regarding the chance of having a green energy label in model (2). Based on the results, the null hypothesis cannot be rejected. Therefore, the results do not show convincing evidence for an interaction between the provisional energy label and the investor type. When the results of model (1) & model (2) are compared deviating results can be observed. The results with regard to the explanatory variables differ, as the control variables do as well. When looked at the explanatory variable biased results can be observed. A positive significant relationship for the housing associations is found in model (1). When looked at model (2) a non-significant predictor is found. Besides owner-occupiers & private investors are seen in model (1) as a non-significant positive predictor. When looked at model (2) owner-occupiers & private investors are seen as non-significant negative predictors. For institutional investors this appearance is reversed meaning model (1) shows a non-significant negative association, while model (2) shows a non-significant positive association. Besides, the control variables do not meet the expectations resulting from model (1) and the literature. The control variable: income, education, age and location show unexpected outcomes in relation to the outcomes of model (1) as can be seen in table 13 and Appendix 18. It can be concluded the provisional energy label gives biased results. The determined energy label therefore remains central in this research.

FOCUS GROUP

The results of model (3) show that housing associations are a positive significant predictor of having a green energy label in the focus group. Based on the results, the null hypothesis can be rejected in favor of the alternative hypothesis as in model (1). A greater likelihood (***) of having a green energy label is expected for residential homes with a housing association as investor type. The probability a residential home has a green energy label increases by 15.4 percent as the investor type is a housing association. A higher probability of having a green energy label is found in model (3) when compared to model (1) with regard to the housing associations investor type. For the other investor types, no significant results are found. When looked at these non-significant results a positive association is found for the institutional investors & owner-occupiers. The private investor category shows a non-significant negative association. The control variables in model (3) show results according to the expectations resulting from the literature.

	model (1)	**model (2)**	**model (3)**	**model (4)**
construction year				
< 1945	base	base	base	base
1945-1959	0.0587889*** (0.011)	0.0164803 (0.057)	-0.1124183*** (0.013)	-0.0682779*** (0.005)
1960-1969	0.1293644*** (0.009)	0.4799292*** (0.017)		
1970-1979	0.1973618*** (0.008)	0.6649987*** (0.016)		
1980-1989	0.3087275*** (0.008)	0.7962183*** (0.010)		
1990-1999	0.3391433*** (0.008)	0.7269033*** (0.012)		
2000 >	0.4537072*** (0.005)	0.7144948*** (0.013)		
income				
below average	base	base	base	base
up to 1.5 times average	-0.0106174 (0.009)	0.0269823** (0.013)	-0.004926 (0.018)	-8.49e-06 (0.001)
up to 2 times average	-0.007385 (0.0119)	0.0134086 (0.016)	0.0306572 (0.025)	0.0015971 (0.002)
up to 3 times average	-0.0080065 (0.014)	0.059563*** (0.017)	0.0223802 (0.030)	0.0014097 (0.002)
> 3 times average	-0.0214761 (0.020)	0.0539492** (0.022)	0.0580589 (0.050)	0.0049117 (0.004)
surface in square feet				
< 50	base	base	base	base
50-69	-0.0430315** (0.021)	.0095602 (0.043)	-0.0534584 (0.043)	0.0005457 (0.006)
70-89	-0.0461559** (0.020)	-.1043505** (0.045)	-0.082045* (0.043)	-0.0034745 (0.006)
90-119	-0.0226283 (0.021)	-.0017182 (0.043)	-0.0419437 (0.046)	0.007231 (0.007)
120-149	-0.0202728 (0.023)	-.0189485 (0.044)	-0.028809 (0.050)	0.0112541 (0.010)
150-199	0.0133214 (0.026)	.0299298 (0.044)	0.0090875 (0.063)	0.0057029 (0.012)
200 >	-0.0012606 (0.031)	.0808021* (0.043)	-0.0413224 (0.069)	0.011224 (0.017)
property value				
< 150.000	base	base	base	base
150.000-199.999	0.026057*** (0.008)	0.0457903*** (0.013)	0.025052 (0.016)	-0.0000507 (0.001)
200.000-249.999	0.0344708*** (0.012)	0.0557981*** (0.016)	0.0410217 (0.029)	0.001237 (0.002)
250.000-299.999	0.0489147*** (0.015)	0.0660553*** (0.020)	0.0807238* (0.048)	-.0059647*** (0.003)
300.000-399.999	0.0385841** (0.018	0.0472528** (0.023)	0.0241641 (0.052)	-0.0027335 (0.003)
400.000-499.999	0.0160188 (0.027)	0.0215485 (0.32)	0.0150523 (0.078	-0.0091887*** (0.002)
500.000 >	0.0115354 (0.033)	-0.0598251 (0.044)	0.3405151*** (0.092)	-0.012539*** (0.001)
property type				
detached housing	base	base	base	base
multi-story housing	0.0200349 (0.020)	0.0444999* (0.024)	-0.0248105 (0.042)	0.0108681* (0.006)
terraced housing & others	0.1058805*** (0.016)	0.5689705*** (0.015)	0.1113633*** (0.042)	0.2115428*** (0.034)
semi-detached housing	0.0351495** (0.018)	0.0110048 (0.018)	0.0069725 (0.042)	0.0004089 (0.005)
corner house	0.0570159*** (0.017)	0.0821227*** (0.018)	0.0274498 (0.044)	0.0198505** (0.008)
location characteristics				
rural	base	base	base	base
urban	-0.0386173*** (0.007)	-0.0020719 (0.011)	-0.0170442 (0.015)	-0.0011023 (0.001)
highest completed education				
primary school	base	base	base	base
VMBO, HAVO- VWO-lower secondary, MBO 1	-0.0085114 (0.010)	0.0352487*** (0.016)	-0.015666 (0.019)	0.0025575 (0.001)
HAVO, VWO, MBO 2-4	-0.0129073 (0.011)	0.0490781*** (0.017)	-0.0001259 (0.021)	0.0065417*** (0.002)
higher vocational education-, university bachelor	-0.017503 (0.013)	0.0479666 *** (0.018)	-0.0242976 (0.025)	0.0064083** (0.003)
higher vocational education-, university master, doctor	-0.0237674 (0.015)	0.0284979 (0.021)	0.0150978 (0.032)	0.0064996* (0.003)
desire to move				
no	base	base	base	base
yes	0.0080519 (0.006)	0.0085222 (0.010)	-0.002442 (0.014)	0.0005457 (0.001)
household composition				
one person	base	base	base	base
couple	0.0008497 (0.009)	-0.0155517 (0.0128)	-0.0035997 (0.018)	0.0004743 (0.001)
couple with child(ren)	-0.0131265 (0.012)	-0.0450183*** (0.017)	-0.0083523 (0.022)	-0.0008752 (0.001)
one parent	0.021905** (0.012)	-0.0000601 (0.021)	-0.0018367 (0.22)	-0.0009168 (0.002)
nonfamily	-0.0518339** (0.288)	-0.1047503** (0.052)	-0.1173248*** (0.041)	-0.0024002 (0.005
age				
17-24	base	base	base	base
25-34	0.0146795 (0.021)	0.0505966 (0.040)	-0.0090042 (0.041)	0.002882 (0.006)
35-44	0.031769 (0.021)	0.0616185 (0.040)	0.0418975 (0.044)	0.0052428 (0.006)
45-54	0.0363411* (0.021)	0.063695 (0.040)	0.006835 (0.043)	0.0047029 (0.006)
55-64	0.031724 (0.022)	0.0775476** (0.039)	0.0058934 (0.043)	0.003309 (0.006)
65 -74	0.0168725 (0.022)	0.0550157 (0.040)	-0.0118959 (0.043)	0.0057067 (0.006)
> 75	-0.0076833 (0.024)	-0.0190422 (0.044)	-0.0319791 (0.043)	0.0076126 (0.006)
investor type				
private investor(s)	0.0290886 (0.025)	-0.0357943 (0.005)	-0.0182249 (0.060)	-0.0013443 (0.005)
housing association(s)	0.0998388*** (0.018)	0.0078121 (0.033)	0.1544035*** (0.037)	0.0027348 (0.005)
institutional investor(s)	-0.0276747 (00271)	0.0434651 (0.044)	-0.0563446 (0.067)	0.0165046 (0.014)
owner occupier(s)	0.0299086 (0.018)	-0.0066983 (0.033)	0.0265995 (0.044)	-0.0021193 (0.005)

Table 12: binary logistic regression model (1), (2), (3) and (4) marginal effects

Note: marginal effects table, the dependent variable for model (1) is the dummy variable *labeldummy*, indicating if a property is energy efficient or non-energy efficient. The dependent variable for model (2) is the dummy variable *labelvlpdummy*, indicating if the provisional energy label is energy efficient or non-energy efficient. The dependent variable for model (3) is the dummy variable *focusdummy*, indicating if a property in the focus group is energy efficient or non-energy efficient. The dependent variable for model (4) is the dummy variable f*ocusvlpdummy*, indicating if the provisional energy label for property in the focus group is energy efficient or non-energy efficient. The table gives the coefficients of the variables. The standard errors are given in parentheses. *;**;*** are significant at 10%, 5%, 1% respectively

5.3 QUALITATIVE RESULTS

This section will elaborate on the qualitative data gathered during the interviews with the stakeholders. A discussion of the characteristics will be given, revealing various patterns, similarities and differences followed with an explanation on how the stakeholders try to contribute to the energy transition. Appendix 18 gives an overview of the characteristics of the stakeholders involved such as aims, vision, mission, key values and goals with regard to sustainability.

1. THE INTEREST IN SUSTAINABILITY DIFFERS PER TYPE OF STAKEHOLDER

The stakeholders are concerned about sustainability and the energy transition for various reasons, they approach the concept of sustainability in different ways. Improving living comfort is central to the owner-occupier when energy saving measures are implemented. Environmental aspects do not outweigh living comfort for the owner-occupier. Also, the financial aspect is seen as more important than the climate itself. Being able to recoup the investment is included in decisions made with regard to energy saving measures. However, these financial returns or cost do not outweigh the living comfort improvements realized with regard to energy saving measures. For the housing association, it mainly relates to affordability, lowering rental costs is their main motivation for the implementation of energy saving measures. Making their housing stock more sustainable is seen as a way to lower rental cost for their tenants due to decreasing energy cost. Improving living comfort for tenants also plays a role with regard to the implementation of energy saving measures from the perspective of the housing association. Also, energy saving measures are often implemented when maintenance is necessary to be able to work as (cost) effective as possible.

‘*’Our starting point is that we reclaim 50 percent of the theoretical savings from tenants in the rent. We see this as a social investment, because we are of course designed for the target group that does not have much to spend. ‘’*

Interviewee housing association

The cost aspect is leading for the private investor with regard to energy saving measures, the investment must pay for itself. When maintenance is required, energy saving measures are taken into account. However, the financial consequences remain leading. When maintenance is not directly necessary, no adjustments are made. For institutional investors, a balance between a financial and social returns is central since recent years. Institutional investors use their (societal) financial recourses to invest in societal issues. In here, benchmarking plays a major role into the steps taken with regard to sustainable and energy saving measures. High benchmark scores show social commitment and influence their image in society in a positive way. The core task of institutional investors is however to achieve a stable and risk averse return. The implementation of energy saving measures must fit within this framework within which stable returns are crucial.

‘’Sustainability was a trick in the real estate sector. You just came up with a certificate or label and opened an institute for it. One pays a considerable amount of money and then has the certificate showing they are sustainable. That was the initial period of sustainability, which we are fortunately past now.’’

Interviewee investor for institutional investors

From the tenant’s perspective, the rental price is leading regarding energy saving measures. The rental price is a crucial factor that is liked to be kept as low as possible. This finding is supported by the results of the WoON2018 dataset. 41.49 percent of the tenants agrees they do not want to pay more rent for the implementation of energy saving measures when this is not earned back by a lower energy bill as can be seen in table 14. Also, 54.28 percent of the tenants do not want energy saving measures to be implemented at all when this affect the rent, regardless of whether this can be recouped by a lower energy bill. This means 95.77 percent of the renters do not want to pay a higher rent for energy saving measures reducing their footprint.

''Would you be willing to pay more rent for an energy efficient home''	Total		Housing association(s)		Institutional investor(s)		Private investor(s)	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Yes, but only when I can earn it back	8,268	41.49	5,628	39.52	595	49.62	1,318	48.38
Yes, even when I cannot earn it back	844	4.23	489	3.43	66	5.50	189	6.94
No	10,818	54.28	8,125	57.05	538	44.87	1,217	44.68
Total	19,930	100.00	14,242	100.00	1,199	100.00	2,724	100.00

Table 13: descriptive statistics question ''would you be willing to pay more rent for an energy efficient home''. Source: DANS (2019).

2. KNOWLEDGE AND MASS MAKE A DIFFERENCE

The stakeholders emphasize knowledge is seen as an important aspect with regard to the energy transition. In addition, mass is also seen as an aspect having a major influence on the energy transition process. The housing association indicates they can be resilient within the energy transition because of their financial resources and the volume which they own. The transition can proceed more smoothly for housing associations than for a private individual because of these gaps relating to finance, mass and knowledge. Besides, in order to further increase or maintain the effectiveness of the energy transition the housing association is constantly looking for new strategies and methods to tackle problems relating to the energy transition. The next step is to enter a strategic partnership with a construction party and an innovative data-analyzing party to be able to make their housing stock more sustainable.

''To improve sustainability, we keep doing the same trick, but with a different resident. If you do that with a good team, then you are attuned to each other. Then you have a kind of standard approach that works and keeps getting better. Then we enter the cycle of thinking, doing, evaluating, adjusting, planning and doing it all again''

Interviewee housing association

From the perspective of the institutional investor, the strategy behind the energy saving measures is considered as crucial. A proper sequence must be observed in order to make the process as effective and efficient as possible. The Trias Energetica is seen as most effective and should be taken into account with regard to the energy transition of the entire residential housing stock in the Netherlands. The Trias Energetica is a three-step strategy to create an energy efficient design. The first step is to limit energy consumption by preventing waste. The stakeholder representing the perspective of the institutional investors emphasizes step one gets insufficient attention or is even overlooked. This results in an inefficient approach with regard to the actual CO2 emission. This problem is caused by a knowledge gap and is emphasized form the institutional investors' perspective. Step two is to maximize the use of energy from renewable sources. A step which is often carried out too early affecting efficiency negatively. The last step is to use fossil fuels as efficiently as possible. By carrying out the three steps in the correct order, the energy saving measures have the highest impact.

'' The joke is that the standard reaction is to go for all kinds of sustainable solutions. The question is whether that is the most suitable solution if you know what I mean. The intention must be to bring the demand down. The question is whether that is the most sustainable solution if you know what I mean''

Interviewee investor for institutional investors

Also, having awareness or knowledge about the energy consumption of residential homes is necessary to be aware of the need of energy saving measures is highlighted by the stakeholders. This finding is supported by the outcomes of the WoON2018 dataset. The owner-occupiers give themselves a more positive overall score whether or not their home is energy efficient, which is striking and does not correspond to reality. This can be seen in table 15. When no awareness of the situation is in place regarding energy-efficiency, a change focused on energy saving measures will not be taken because the urgency is not seen.

''My home is energy efficient''	Total of investors		Owner-occupied sector		Housing association(s)		Institutional investor(s)		Private investor(s)	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Totally agree	5,103	8.91	3,841	10.29	959	6.73	73	6.09	98	3.60
Agree	19,265	33.64	13,981	37.44	4,062	28.52	289	24.10	457	16.78
Neither agree nor disagree	17,816	31.11	12,664	33.92	3,835	26.93	266	22.19	611	22.43
Disagree	10,730	18.74	5,637	15.10	3,486	24.48	324	27.02	835	30.65
Totally disagree	4,355	7.60	1,216	3.26	1,900	13.34	247	20.60	723	26.54
Total	57,269	100.00	37,339	100.00	14,242	100.00	1,199	100.00	2,724	100.00

Table 14: descriptive statistics question: my home is energy efficient''. Source: DANS (2019).

3. THE GOVERNEMENT HAS A LEADING ROLE

Various layers of government have implemented policies with regard to sustainability. In this way they ensure a framework within which the stakeholders must operate. European, national and regional policies play a role in the energy transition of the Dutch residential housing stock. The housing association emphasizes the *Woningwet 2015* has given a boost to the energy transition of housing association on a national level. The law ensured performance agreements are truly anchored in national law. This makes it easier to work on joint achievements and goals, the energy transition is tackled together instead of individually.

In addition, the *Woningwet 2015* also states that housing associations are obliged to have a visitation carried out at least once every four years. A visitation is an assessment of the social performance of a housing association. The visitation method reflects the requirements society places on housing associations. The *Methodiek Maatschappelijke Visitatie* assesses the housing associations from a number of perspectives: challenges and ambitions, stakeholders, assets and governance. The assessment of the concept contributing according to capacity is therefore consistently tested and is anchored in legislation by the *Woningwet 2015.*

The stakeholder representing the perspective of the institutional investors emphasizes that a legislative change at European level will take place in the near future, having a major impact. The Sustainable Financial Disclosure Regulation will be a set of rules which aim is to make the sustainability profile of funds more comparable and better understood. The SFDR will focus on pre-defined metrics for assessing the environmental, social and governance outcomes (ESG). Because of SFDR much more emphasis will be placed on disclosure, including new rules that must identify any harmful impact made by the investment company. The stakeholders emphasize that this regulation forces financial services to be very open about the implantation of energy saving measures. The focus will be on which goals are achieved in relation to sustainability and how sustainable investments are, this will generate an impulse for the institutional investors.

''That (SFDR) is what we are now working on behind the scenes and at other parties as well. To meet all kinds of preconditions, it is an enormous push factor''

Interviewee investor for institutional investors

The private investor and owner-occupier experience too little support and stimulants from the government regarding the energy transition. Tax benefits are mainly mentioned when it comes to a more active role the government could take. Providing information about the energy transition is also seen as important and something that happens insufficiently. Actively informing citizens about the possibilities with regard to the energy transition and offering a tax advantage is seen as appropriate.

'' I think as a society we can still take real steps in this regard (energy saving measures). Maybe it could be better supported by the government. A lot of people really focus on the costs, resulting in less energy saving measures are implemented''

Interviewee owner-occupier

4. THE USER HAS A KEY ROLE IN THE ACTUAL CO2 EMISSION

The tenant is offered as an important factor affecting the actual CO2 emission by stakeholders which can be seen as landlords. The private investor, institutional investor and housing association are all aware of the user-effects affecting the actual CO2 emission. In addition to the implementation of energy saving measures taken by the landlord, a residential home should be used in a sustainable way to ensure an actual lower CO2 emission. However, it is seen as difficult to actively contribute to this user-effect concern from the landlord perspective. Landlords see the environmental impact of the user-effect as something beyond their reach. It is seen as a social problem, not much as something in which the landlords can make a difference. Behavior is seen as something difficult to change structurally, somewhere the responsibility of the landlord ends, is their angle of approach. The physical improvements of the residential homes with regard to energy saving measures is within their reach, actively approaching living habits of their tenants is not. When looking at the goals and ambitions of the stakeholders that have been drawn up with regard to sustainability, the user component is included and addresses as can be seen in Appendix 18. However, the actual implementation of these goals and ambitions with regard to the user-effects are considered as difficult. A way to tackle this properly has not yet been found and is not yet part of the operational management, though the realization is there.

''To see if there are clues why in one complex which is technically exactly the same as another complex has a much higher CO2 emission. You can then look at the age and lifestyle of people. We try to do more and more with this to see if there are any opportunities to make people aware of it''

Interviewee housing association

''No, too little. We stay far away from the tenants in a crazy way. We always say we don't have much to do behind the front door. Well, that is true in itself, but on the other hand when it comes to these kinds of issues it is not an obstacle to give them tips or nudging.''

Interviewee investor for institutional investors

''The impact on sustainability goes beyond my reach. You can invest in sustainability and that sounds great on paper, but in the end the user is leading. The tenant can make a much bigger difference than I can, there is more to be gained on that side''

Interviewee private investor

When this user-effect is considered from the perspective of the tenant, ignorance dominates. Little or no knowledge about the energy consumption or a vision on how to deal with energy consumption from the tenant's perspective is in place. There is no or little awareness of the energy consumption with regard to the user-effects of residential homes. Also, no information about user-effects is provided by the landlord with regard to the energy consumption is indicated by the tenant. Alongside, the tenant does not feel an incentive to change behavior due to the fact no direct negative effects are noticed by high energy consumption. This is due to the fact that the rent is inclusive.

''Maybe I could turn the heating on less. Rather put on a blanket or a vest instead of turning the heating higher. For example, I was not at home for a weekend and then I forgot to turn off the heating which is of course not very smart. These things can be done more consciously''

Interviewee renter

'' I must honestly say I have no idea what the energy label is at this moment. I once read if you apply for the energy label it is valid for 10 years and I do not want to move for the time being, so I have never applied for it. If I make a guess, I think we are now at C because of all the energy saving measures.''

Interviewee owner-occupier

Though, 88.01 percent of the residents agrees energy efficient residential homes contribute to keep the earth livable. Residents of all types of investors strongly agree with this statement as can be seen in table 16. Residents of residential homes owned by institutional investors and private investors are at the forefront. 52.63 percent of the residents of institutional investors and 49.16 percent of the residents of private investors strongly agree with the statement as can be seen in table 16. These findings indicate there is a strong support for energy saving standards in society. Raising more awareness of the user-effect with regard to the actual CO2 emission can cause residents to become more aware of their own influence. A consequence of paying attention to the user-effect principle may ensure actual changes in residential behavior.

''Energy efficient homes contribute to keep the earth livable for future generations''	Total of investors		Owner-occupied sector		Housing association(s)		Institutional investor(s)		Private investor(s)	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Totally agree	21,858	38.17	13,858	37.11	5,257	36.91	631	52.63	1,339	49.16
Agree	28,544	49.84	19,012	50.92	7,130	50.06	465	38.78	1,122	41.19
Neither agree nor disagree	5,525	9.65	3,625	9.71	1,483	10.41	83	6.92	193	7.09
Disagree	1,025	1.79	658	1.76	276	1.94	16	1.33	49	1.80
Totally disagree	317	0.55	186	0.50	96	0.67	4	0.33	21	0.77
Total	57,269	100.00	37,339	100.00	14,242	100.00	1,199	100.00	2,724	100.00

Table 15: descriptive statistics question: energy efficient homes contribute to keep the earth livable for further generations. Source: DANS (2019).

5.4 OVERALL RESULTS

This section will bring the findings of the qualitative- and quantitative research parts together, which identifies if the investor types contribute according to capacity with regard to the energy transition of the Dutch residential housing. The quantitative part of this research has shown housing associations have a positive significant effect (***) on the change of having a green energy label. The probability of a green energy label increases by 10.0 percent as the investor type is a housing association. Furthermore, the focus group also shows housing associations have a positive significant effect (***) on the change of having a green energy label. This means building-related sustainable measures are more often applied because of the equivalent starting point. The probability of having a green energy label increases by 15.4 percent as the investor type is a housing association. No significant results were found for the other investor types. Therefore, it can be concluded housing associations are further in the energy transition when compared to the other investor types. However, the question arises whether this is fair.

HOUSING ASSOCATION(S)

At its core, a housing association is an organization that focuses on building, managing and renting out high-quality housing with an affordable rent. A characteristic of a housing association is a rental income which is not profitable compared to the foundation cost. This is also reflected in the implementation of energy saving measures. Housing associations can attract a lot of capital, this is possible because of their high asset values. The loan to value principle makes it possible to attract and use debt for the implementation of energy saving measures. Also, the Dutch housing market is booming meaning asset values are rising. This makes it possible to attract even more debt by the loan to value principle. In addition, interest rates are currently low ensuring low interest cost. Because of these circumstances it is possible for housing associations to finance the energy transition. However, the housing association emphasizes sustainable interventions are not comprehensive. This is accepted because it improves affordability for tenants. Given these facts, it can be concluded housing associations contribute according to capacity. Because of a side-effect (affordability for tenants) housing association are triggered to implement energy saving measures.

''There are a lot of housing associations that are perhaps not so much concerned with sustainability from an environmental perspective, but because it improves affordability for tenants.''

Interviewee housing association

OWNER OCCUPIER(S)

The main purpose of an owner-occupied home is being a place to live comfortably. Energy saving measures are implemented because this positively effects living comfort. The positive environmental consequences related to energy saving measures are overall seen as side-effect. Attention is also paid to whether it is possible to recoup the investment. It must be noticed, energy saving measures are sometimes not implemented in the most effective way. This is due to a knowledge gap concerning the effectiveness of energy saving measures in particular situations. Given these facts, it can be concluded owner occupiers feel the tendency to contribute according to their capacity because of living comfort. Whether this actually happens also relates to necessary maintenance, knowledge and whether funding is possible.

''First of all, living comfort. Because you notice that if everything is better isolated, it becomes a lot more comfortable in the house. You also have considerable savings on your monthly expenses, mainly on gas and electricity''

Interviewee owner-occupier

INSTITUTIONAL INVESTOR(S)

The core task of institutional investors is to ensure a stable return to be able to pay out pensions and insurance claims. To control this, institutional investors are obliged by the AFM and de Nederlandsche Bank to act within set boundary conditions. In addition, ESGs play nowadays an important role due to societal pressure. Institutional investors use their (societal) financial recourses to invest in societal issues to be able to pay out pensions and insurance claims. The growing importance of ESGs has a positive effect on the implementation of energy saving measures. In here, benchmarking pays a major role because it determines the degree of social responsible behavior. However, the implementation of energy saving measures must fit within this framework within which stable returns are crucial. Because of these circumstances, it is only possible for institutional investors to implement energy saving measures when the return is not jeopardized. Given these facts, it can be concluded institutional investors start to contribute more according to their capacity because of societal pressure.

''That will be too expensive, too expensive in the sense that you have to reach a certain limit value in terms of return, which is demanded by the regulators''

Interviewee investor for institutional investors

PRIVATE INVESTOR(S)

At its core, private investors focus on the financial return of their investment. Energy saving measures could be implemented if this positively affect their investment return. Renting out properties is seen as an investment strategy in which the highest return is pursued. Given these facts, it can be concluded private investors do not feel the tendency to contribute according to their capacity. When the private investor framework is compared to the institutional investor framework SDGs and image play no role. Creating affordable housing does not play a role either, the motive for housing associations. Finally, the realization of better living comfort does not play a role as in the framework of the owner-occupiers. Because there is no indirect incentive for private investors to invest in energy saving measures, little action is observed.

''That is a question of conscience! If I could achieve a lot of return with it. If the return is there I would definitely do it''

Interviewee private investor

6. DISCUSSION AND CONCLUSION

This chapter will summarize the findings and link them with the conceptual and theoretical framework. This will provide an answer to the research and sub-questions. Also, policy recommendations and recommendations regarding further research will be discussed. The end of this chapter will contain a critical reflection on the outcomes and the research process.

6.1 DISCUSSION

This study aimed to gain a better understanding if the investor types contribute according to their capacity regarding the energy transition of the Dutch residential housing stock. Understanding this could provide an answer whether the contribution of the investor types is fair or not when the social interests are considered. The assumption is that the investor type affects the implementation of energy saving measures and therefore the energy label. This assumption was based on sub-question 1. & 2a. Sub-question 1, is related to the theoretical conceptualization of the energy label. In short, the energy label of a residential property is related to building characteristics, socio-demographic factors of the resident and location characteristics.

Sub-question 2a. is related to the statistical analysis performed. By using a binary logistic regression model, a positive significant relation is found for housing associations as investor type. The probability of a green energy label increases by 10.0 percent as the investor type is a housing association (***). When looked at the focus group, the probability of having a green energy label increases by 15.4 percent as the investor type is a housing association. This means energy saving measures are more often applied because of the equivalent starting point. Housing association are further in the energy transition than other investor types can be concluded. No significant results were found for the other investor types.

The remaining part of this discussion will explain if the investor types contribute according to their capacity to see whether the energy transition of the Dutch residential housing stock can be considered as fairly distributed. This explanation identifies the investor type strategy and the context based on the results from the results in chapter 5.

FRAMEWORK DIFFERENCES AND OTHER INTERESTS PLAY A ROLE

Contribution according to capacity goes further than green energy labels. Focusing on energy labels only can create a distorted view of the situation because framework conditions cannot be ignored. It can be concluded sustainability is not considered as first priority by any of the stakeholders when energy saving measures are applied. The institutional investor wants to achieve a stable return. Alongside, the housing associations wants to ensure lower rents for their tenants. From the perspective of the private investor, financial returns are leading. While the owner-occupier is focused on creating more living comfort. In addition, tenants would like an affordable rent and high comfort standards. The environmental impact of energy saving measures plays a role but is not considered as leading by any the stakeholders when energy saving measures are implemented. In addition, the framework conditions within which the stakeholders act, differ strongly from each other. These differences in framework conditions ensure that energy saving measures can be implemented smoothly or more difficult because of precondition within the deviating frameworks.

It can be concluded if there are no interests that indirectly ensure the implementation of energy saving measures little is done. The environmental aspect is not sufficient at this moment in relation to the implementation of energy saving measures. This is because the climate has a secondary role for the stakeholders. This is the main reason why the housing stock of private investors is lagging behind at this moment. Interest stimulating the other stakeholders are not considered as important by the private investors. A high direct investment return is most important for private investors. Therefore, energy saving measures are not seen as interesting. It is necessary that the government or the tenants take action to be able to change the private investor framework conditions. Creating a side-effect that relates to the

implementation of energy saving measures without the climate being the guiding principle can ensure an impulse in the implementation of energy saving measures.

CAPACITY GOES FURTHER THAN FINANCIAL CAPACITY, EVERYONE IS INVOLVED

Capacity goes further than financial capacity with regard to the energy transition of the Dutch residential housing stock. All citizens in society can contribute through the user-effect aspect. The ultimate goal of the energy transition is to reduce the actual C02 emission, this is also possible through behavioral adjustments. The Trias Energetica shows reducing demand is step one. This can be done by making physical sustainable adjustments as well as by behavioral adjustments. The actual CO2 emission will be affected the most when behavioral and physical adjustments are both made. It is not possible to tackle climate change by energy saving measures only, behavioral adjustments are crucial as well. When energy efficient housing is not used efficiently by the residents, the investments will not provide the desired CO2 reduction. Only focusing on the financial capacity of the investor will not have the desired effects. Focusing on the overall capacity of investors and users is necessary.

6.2 CONCLUSION

This study aimed to investigate if the investor types contribute according to their capacity with regard to the implementation of energy saving measures. The guiding research question of this thesis was: *''How does the type of owner of residential real estate impact the investments in energy efficiency, how does that relate to their respective investment strategies and capacities?''*

The quantitative part of this study has shown housing associations are further in the energy transition in comparison to the other investor types. The probability of a green energy label is 10 percent higher when compared to the other investors. The probability of a green energy label is even 15.4 percent higher for housing associations when focussing on the construction period 1945-1959. No significant results are found for the other investor types. It can also be concluded the provisional energy label gives biased results and is therefore useless within this research.

The qualitative part of this study has revealed strategies within which the investor types approach the concept sustainability. This shows sustainability often plays a secondary role with regard to the energy transition. Aspects central to the stakeholder are living comfort, lowering actual renting cost, image and a financial (stable) return. Therefore, the energy transition is approached from different frameworks, because of these deviating frameworks differences arise in terms of potential capacity with regard to the implementation of energy saving measures. Besides, other interests play a role, sustainability is not the main interest. When focussing on capacity, most can be achieved from the private investor perspective. Besides, the user-effect is also of importance affecting the actual CO2 emission. The user-effect is an aspect that should not be forgotten with regard to the energy transition. Steps can be taken without a financial investment necessary.

6.3 POLICY AND RESEARCH RECOMMENDATIONS

The first aim of this thesis related to policy recommendation was to understand if the investor type contribute according to capacity with regard to the energy transition and how governmental institutions can mobilize them to act. Besides, recommendations will be made relating to the user-effect. Firstly, it is recommended to promote the new energy label actively. This is most relevant for in the owner-occupier and private investor sector, which experience an overall knowledge gap in relation to the implementation of energy saving measures. It can be concluded owner-occupiers and private investors are frequently not aware of the energy label or actual CO2 emission relating to their home, they mainly underestimate it. When there is no awareness relating to the implementation of energy saving measures, sustainable interventions will not take place. By actively promoting the advantages of energy saving measures that can be derived from the (new) energy label, owner-occupiers are inclined to apply for the (new) energy label even when there is no desire to move (making the application mandatory). The new

energy label namely provides customized steps that can be taken with regard to possible energy saving measures. This ensures owner-occupiers and private investors to get grip on the situation, making it possible to implement energy saving measures in the most efficient way. The (new) energy label should be seen as a tool to inform people in the first place.

In addition, the prohibition of inclusive renting can lead to major changes with regard to the energy consumption of tenants. The actual CO2 emission can decrease sharpy if tenants experience direct financial effect of their (high) energy consumption. This creates the realization that one's own behavior and lifestyle has financial consequences. Energy efficient living is cheaper and therefore worth to be taken into account. This will result in a more conscious approach in relation to the energy consumption, resulting directly in a lower actual CO2 emission without the implementation of energy saving measures.

Also, various layers of government implement policies with regard to sustainability. In this way they ensure a framework within which stakeholders must operate. European, national and regional policies play a role in the energy transition of the Dutch residential housing stock. However, owner-occupiers and private investors not yet experience any pressure or incentive from the government to commit to sustainability as mentioned. A clear framework in which action must be taken by owner-occupiers and/or private investors can give the energy transition a positive impulse.

Lastly, user-effects are an important actor for the actual CO2-emission. A behavioral adjustment ensures a direct decrease on the demand side without requiring an investment. This makes behavioral adjustment financially affordable for everyone. Actively informing residents is a task of the community itself. Including a potential active role of governmental institutions, landlords, businesses and citizens' initiatives.

6.4 CRITICAL REFLECTION

First, the mixed-method approach of this research proved strength to be able to include all stakeholders involved. This was done to avoid any bias from one of the stakeholder perspectives. For the limitations' discussion of this research, a distinction is made between the theoretical-, qualitative- and quantitative research part.

A great deal of literature appeared to be available with regard to the implementation of energy saving measures. Besides, the literature was written from different disciplines approaching the subject differently because of different frameworks. Given the context of the master's thesis (goals, time and word count) only a limited explanation had been given and the depth per subject remained limited.

When focusing on the qualitative research part there is spoken with one party per stakeholder, a higher number would improve validity. This is because the investor types are no homogenous groups, mutual differences are visible per investor type. Also, because of Covid-19 most interviews took place digitally or by telephone, affecting dynamics during the interviews. As a result, the quality of interview is a bit lower because body language is less observed. However, it can be assumed this has little or no adverse effect on the outcomes because facial expressions and language use were still observed. When focusing on the stakeholders included, a government institution would be a good addition. Given the fact the government influences framework condition within which stakeholders are operating. Besides, using a focus group with a variety of stakeholders involved could have resulted in interesting outcomes.

When focusing on the quantitative research part, several aspects should be taken into account. For example, the dataset used is from 2018, which not perfectly provides the current situation, although the WoON2018 dataset is the most recent dataset available. Deviations are possible given the fact sustainability is a hot topic. Though, different impacts are not expected when more accurate data are used. No indications are in place of investors starting to invest significantly faster than earlier. It is not expected that owner-occupiers, private investors or institutional investors will catch up any time soon when compared to housing associations. Also, when looked at the WoON datasets available, it was not

possible to use cross-sectional time series due to a lack of the dependent- and independent variables in the WoON datasets 2012 & 2015. Therefore, the data should be seen as cross-sectional data. When the data contain observations about different cross sections across time, it is possible to track the movement of the chosen data points in the future when panel data are obtained.

Besides, the energy label is also a snapshot and can deviate if energy saving measures have been taken after requesting the energy label. Given this fact the energy labels can give a distorted picture especially because the energy label is valid for a 10-year period and is only mandatory when a residential home is rented out or sold. Also, energy label C has been determined as a green energy label, but the question remains how green label C actually is. Residential homes with energy label C are relatively energy efficient, but there is still room for further improvements regarding energy saving measures. In addition, it should also be emphasized a new energy label is in place since January 1, 2021. A detailed energy label providing more information regarding energy efficiency of residential home. This new label allows for a better comparison between the different investor types. Due to the short implementation of the new energy label, data are not yet available. Though, the new energy label provides a better overview of the actual situation regarding energy efficiency which will strengthen the outcomes in reliability. Lastly, the energy label gives no insights into the actual CO2 emission of a residential home, the user-effect is not taken into account. The ultimate goal of the Climate Agreement is to reduce Dutch C02 emissions. The implementation of energy saving measures does not necessarily result in lower energy consumption.

When focusing on the control variables used selected by literature, the perfect classification level was not always presented in the WoON2018 dataset. Therefore, not all control variables are optimally included in the research which may influence the results. Besides, not all control variables apply for the investors included, nevertheless these control variables are included in the regressions. However, the binary logistic regressions are also executed or run without these critical control variables and this does not cause large deviation for the results. In here, attention was mainly paid to the housing associations investor type because of the significant results found before. Housing associations remained a positive significant predictor for having a green energy label after removing the control variables relating to social-demographic factors of the tenants

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APPENDIX

APPENDIX 1: REPRESENTATIVINESS OF THE DATASET

Rent or owner-occupied	N total population	Percentage	N dataset	Percentage	Deviation percentage
Owner-occupied	4,386,769	56.67	37,339	64,98	-8.31
Rent	3,275,965	42.32	20,125	35,02	7.3
Total	7,740,984	100	57,464	100	

Table 16: representativeness of the dataset rental ratio of households

Province	N total population	Percentage	N dataset	Percentage	Deviation percentage
Drenthe	220,828	2.83	1,279	1.95	0.88
Flevoland	166,487	2.13	2,299	3.50	-1.37
Friesland	298,425	3.82	1,837	2.80	1.02
Gelderland	893,989	11.44	9,695	14.77	-3.33
Groningen	277,113	3.55	1,538	2.34	1.21
Limburg	529,301	6.77	5,571	8.49	-1.72
Noord-Brabant	1,116,102	14.28	8,915	13.59	0.69
Noord-Holland	1,318,336	16.87	6,210	9.46	7.41
Overijssel	499,951	6.40	4,338	6.61	-0.21
Utrecht	557,564	7.13	4,003	6.10	1.03
Zeeland	185,264	2.37	2,142	3.26	-0.89
Zuid-Holland	1,677,634	21.47	17,794	27.12	
Total	7,814,912	100	65,620	100	

Table 17: representativeness of the dataset distribution of the variable province

Investor type	N total population	Percentage	N dataset	Percentage	Deviation percentage
Owner-occupier	4,386,769	57.25	37,339	64.98	-7.73
Social housing cooperation	2,268,383	29.60	14,279	24.85	4.75
Others	1,007,582	13.15	5,840	10.16	2.99
	7,662,734	100	57,458	100	

Table 18: representativeness of the dataset distribution of the variable investor type

Type of property	N total population	Percentage	N dataset	Percentage	Deviation percentage
Single-family house	4,987,389	64.43	41,690	72.80	-8.37
Multi-family house	2,753,595	35.57	15,579	27.20	8.37
Total	7,740,984	100	57,269	100	

Table 19: representativeness of the dataset distribution of the variable housing-type

APPENDIX 2: VISUAL INTERPREATION VARIABLE ENERGIEKLASSE & LABELDUMMY

Label	*N*	*Percentage*	*Cumulative percentage*
A	3,623	14.34	14.34
B	4,077	16.14	30.48
C	8,042	31,83	62.31
D	4,682	18.53	80.84
E	2,517	9.96	90.80
F	1,413	5.59	96.39
G	912	3.61	100.00
Total	25,266	100.00	

Table 20: composition of the variable energieklasse

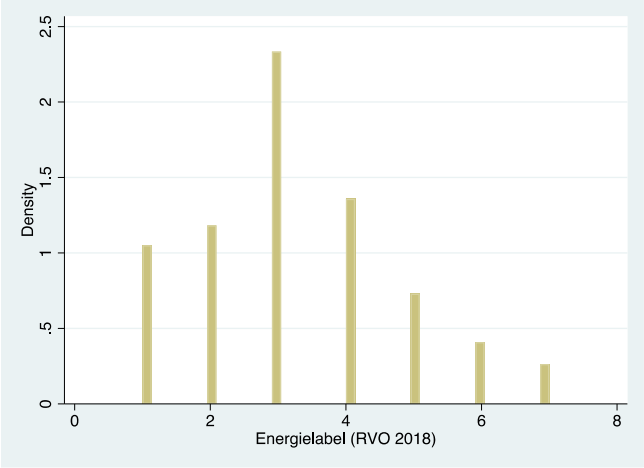


Figure 5: visual interpretation of the variable energieklasse

Label	*N*	*Percentage*	*Cumulative percentage*
Positive (A,B,C)	15,742	37.69	37.69
Negative (D,E,F,G)	9,524	62.31	100.00
Total	25,266	100.00	

Table 21: composition of the variable labeldummy

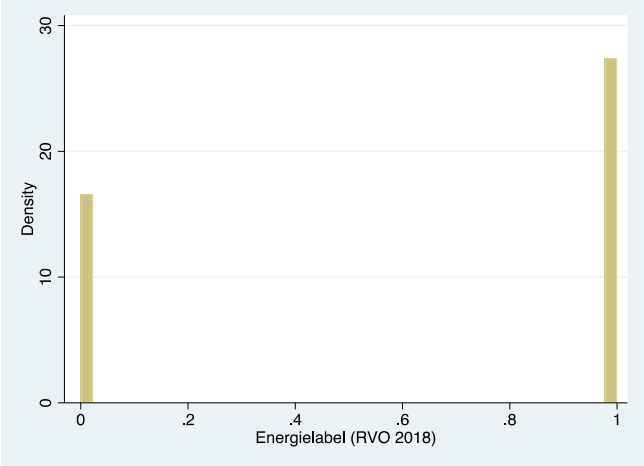


Figure 6: visual interpretation of the variable labeldummy

APPENDIX 3: VISUAL INTERPREATION VARIABLE ENERGIEKLASSE_VLP & LABELVLPDUMMY

Label	*N*	*Percentage*	*Cumulative percentage*
A	5,427	8.66	8.66
B	10,001	15.95	24.61
C	19,574	31.22	55.83
D	4,746	7.57	63.40
E	7,751	12.36	75.76
F	7,075	11.28	87.07
G	8,123	12.96	100.00
Total	62,697	100.00	

Table 22: composition of the variable energieklasse_vlp

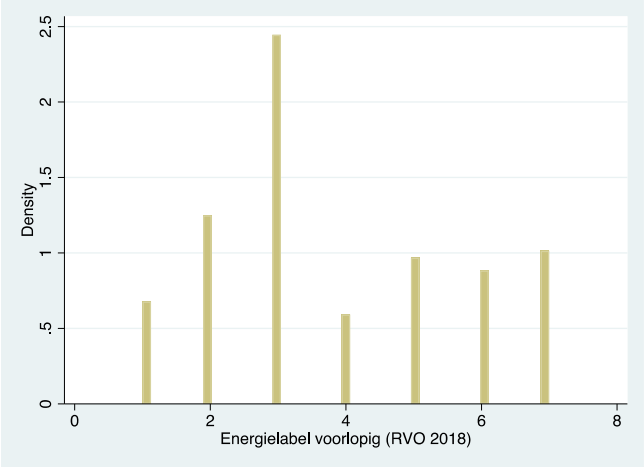


Figure 7: visual interpretation of the variable labelvlp

Label	*N*	*Percentage*	*Cumulative percentage*
Positive (A,B,C)	35,002	55.83	55.83
Negative (D,E,F,G)	27,695	44.17	100.00
Total	62,697	100.00	

Table 23: composition of the variable labelvlpdummy

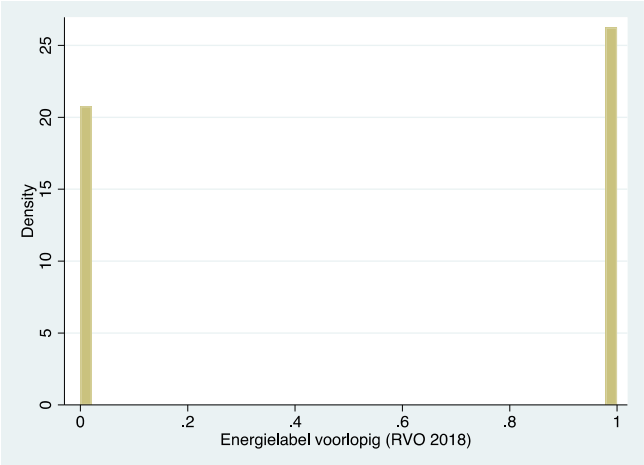


Table 24: visual interpretation of the variable labelvlpdummy

APPENDIX 4: NOTATION GLOSSARY

label	energy label, A (1) low energy consumption up to G (8) high energy consumption
labelvlp	provisional energy label, A (1) low energy consumption up to G (8) high energy consumption
labeldummy	variable dividing energy efficient (energy label A, B & C) and non-energy efficient labels (D, E, F & G), dummy (yes/no)
labelvlpdummy	variable dividing provisional energy efficient (energy label A, B & C) and non-energy efficient labels (D, E, F & G), dummy (yes/no)
koopwoning	investor type: owner-occupied, dummy (yes/no)
woningcorporatie	investor type: social housing cooperation, dummy (yes/no)
institutionelebelegger	investor type: institutional investor, dummy (yes/no)
privatebelegger	investor type: private investor, dummy (yes/no)
focus	focus group including properties with a construction year between 1945/1969, dummy (yes/no)
constructie (1,2,3,4,5,6,7)	construction year of the property, categorical scale, dummy (yes/no)
inkomen (1,2,3,4,5)	income household, categorical scale, dummy (yes/no)
oppervlakte (1,2,3,4,5,6,7)	surface in square feet, categorical scale, dummy (yes/no)
wozwaarde	property value in euro's, categorial scale, dummy (yes/no)
etage	housing type: multi-story housing, dummy (yes/no)
tusseoverig	housing type: terraced housing, & others dummy (yes/no)
tweeondereen	housing type: semi-detached housing, dummy (yes/no)
hoek	housing type: corner housing, dummy (yes/no)
vrij	housing type: detached housing, dummy (yes/no)
urbaan	variable dividing urban and rural property locations, dummy (yes/no)
leeftijd (1,2,3,4,5,6,7)	age of correspondent, categorial scale (yes/no)
verhuis	desire to move, dummy (yes/no)
opleiding (12,3,4,5)	education level of correspondent, categorial scale (yes/no)
eenpersoon	household composition: one person, dummy (yes/no)
paar	household composition: couple, dummy (yes/no)
paarmetkinderen	household composition: couple with child(ren), dummy (yes/no)
eenouder	household composition: parent with child(ren), dummy (yes/no)
nietgezin	household composition: nonfamily, dummy (yes/no)
α	constant term
β	coefficient
ε	error term
X_K	control variables (k=1,2,3 .., K)

APPENDIX 5: INDEPENDENT VARIABLE DESCRIPTIVE STATISTICS EIGHUUR & WIEVERH

Investor type: EigHuur ''ben u of een van de leden van uw huishouden eigenaar van deze woning?''
1. Ja
2. Nee

Label	***N***	***Percentage***	***Cumulative percentage***
Ja	37,339	64.98	64.98
Nee	20,125	35.02	100.00
Total	57,464	100.00	

Table 25: descriptive statistics variable eighuura

Investor type: WieVerh ''Van wie huurt u de woning?''
1. Woningcorporatie
2. Gemeente, provincie, waterschap of het rijk
3. Pensioenfonds, verzekeringsmaatschappij, belegger of een makelaar
4. Particulier persoon
5. Familie
6. Zorginstelling
7. Geen van deze

Label	***N***	***Percentage***	***Cumulative percentage***
Woningcorporatie	14,279	70.97	70.97
Gemeente, provincie waterschap	126	0.63	71.60
Verzekeringsmaatschappij, pensioenfonds	1,199	5.96	77.56
Particulier person	2,346	11.66	89.22
Familie	378	1.88	91.10
Zorginstelling	56	0.28	91.38
Geen van deze	1,735	8.62	100.00
Total	20,119	100.00	

Table 26: descriptive statistics variable wieverh

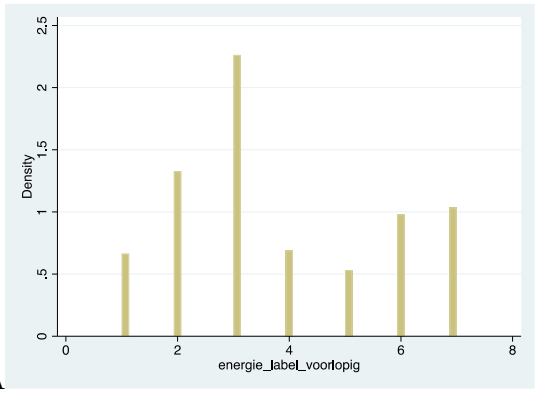
APPENDIX 6: VISUAL CHECK CORRELATION DEPENDENT & INDEPENDENT VARIABLE

Label	*N energy label voorlopig*	*Percentage*	*Cumulative percentage*	*N energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
A	3,168	8.86	8.86	1,595	20.62	20.62	-11.76
B	6,334	17.72	26.58	1,118	14.45	35.07	3.27
C	10,789	30.17	56.75	2,111	27.28	62.35	2.89
D	3,300	9.23	65.98	1,160	14.99	77.34	-5.76
E	2,542	7.11	73.09	759	9.81	87.15	-2.7
F	4,683	13.10	86.19	542	7.01	94.16	6.09
G	4,939	13.81	100.00	452	5.84	100.00	7.97
Total	35,755	100.00		7,737	100.00		

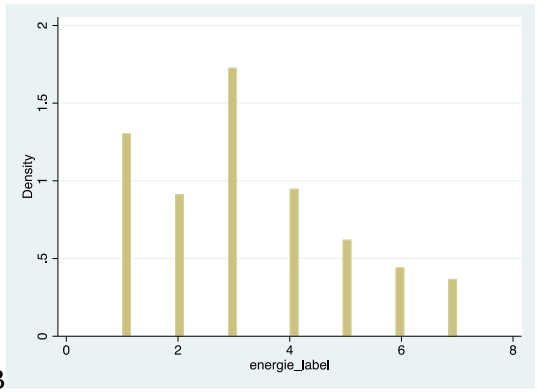
Table 27: composition of the dependent variables and the owner-occupied category

Label	*N voorlopig energy label*	*Percentage*	*Cumulative percentage*	*N energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
Positive (A,B,C)	20,291	56.75	43.25	4.824	62.35	62.35	-5.6
Negative (D,E,F,G)	15,464	43.25	100.00	2.913	37.65	100.00	5.6
Total	35,755	100.00		7,737	100.00		

Table 28: composition of the dependent dummy variables and the owner-occupied category



A



B

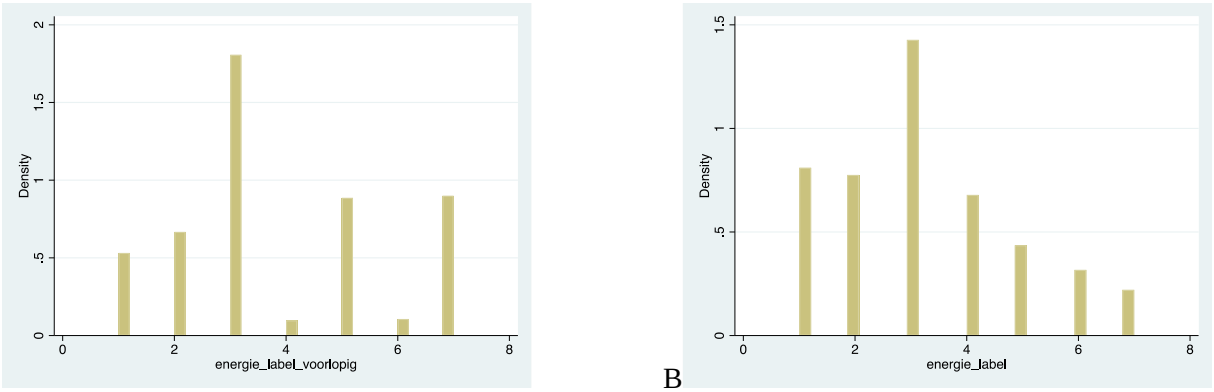
Figure 8 & Figure 9: histogram variables labelvlpdummy (A) & labeldummy (B) for the category owner-occupied

Label	*N energy label provisional*	*Percentage*	*Cumulative percentage*	*N energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
A	114	10.64	10.64	143	17.35	17.35	-6.71
B	143	13.35	24.00	137	16.63	33.98	-3.28
C	387	36.13	60.13	252	30.58	64.56	5.55
D	21	1.96	62.09	120	14.56	79.13	-12.6
E	190	17.74	79.83	77	9.34	88.47	8.4
F	23	2.15	81.98	56	6.80	95.27	-4.65
G	193	18.02	100.00	39	4.73	100.00	13.29
Total	1,071	100.00		824	100.00		

Table 29: composition of the dependent variables and the institutional investor category

Label	*N provisional energy label*	*Percentage*	*Cumulative percentage*	*N energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
Positive (A,B,C)	644	60.13	60.13	532	64.56	64.56	-4.43
Negative (D,E,F,G)	427	39.87	100.00	292	35.44	100.00	4.43
Total	1,071	100.00		824	100.00		

Table 30: composition of the dependent dummy variables and the institutional investor category



B

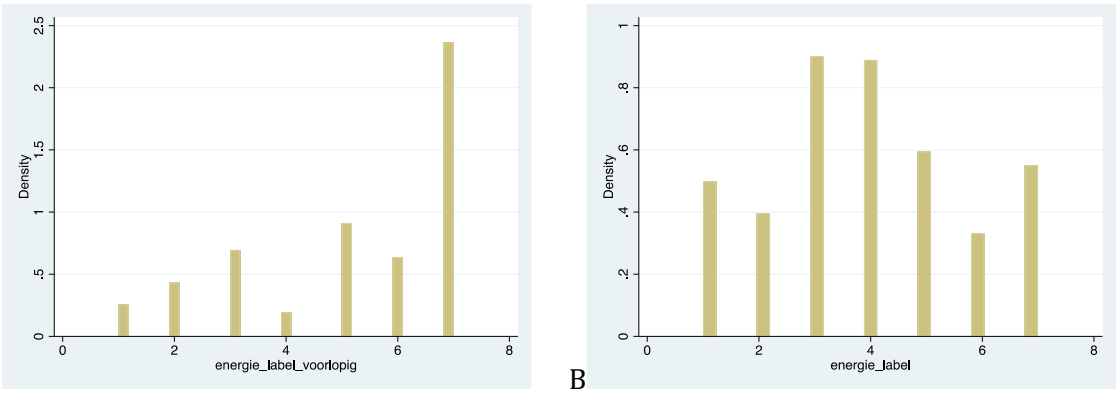
Figure 10 & Figure 11: histogram variables labelvlpdummy (A) & labeldummy (B) for the category institutional investor

Label	***N energy label provisional***	***Percentage***	***Cumulative percentage***	***N energy label***	***Percentage***	***Cumulative percentage***	***Deviation percentage***
A	116	4.68	4.68	78	11.98	11.98	-7.3
B	196	7.91	12.59	62	9.52	21.51	-1.61
C	314	12.67	25.26	141	21.66	43.16	-8.99
D	88	3.55	28.81	139	21.35	64.52	-17.8
E	411	16.59	45.40	93	14.29	78.80	2.3
F	288	11.62	57.02	52	7.99	86.79	3.63
G	1,065	42.98	100.00	86	13.21	100.00	29.77
Total	2,478	100.00		651	100.00		

Table 31: composition of the dependent variables and the private investor category

Label	***N provisional energy label***	***Percentage***	***Cumulative percentage***	***N energy label***	***Percentage***	***Cumulative percentage***	***Deviation percentage***
Positive (A,B,C)	626	25.26	25.26	281	43.16	43.16	-17.9
Negative (D,E,F,G)	1,852	74.74	100.00	370	56.84	100.00	17.9
Total	2,478	100.00		651	100.00		

Table 32: composition of the dependent dummy variables and the private investor category



B

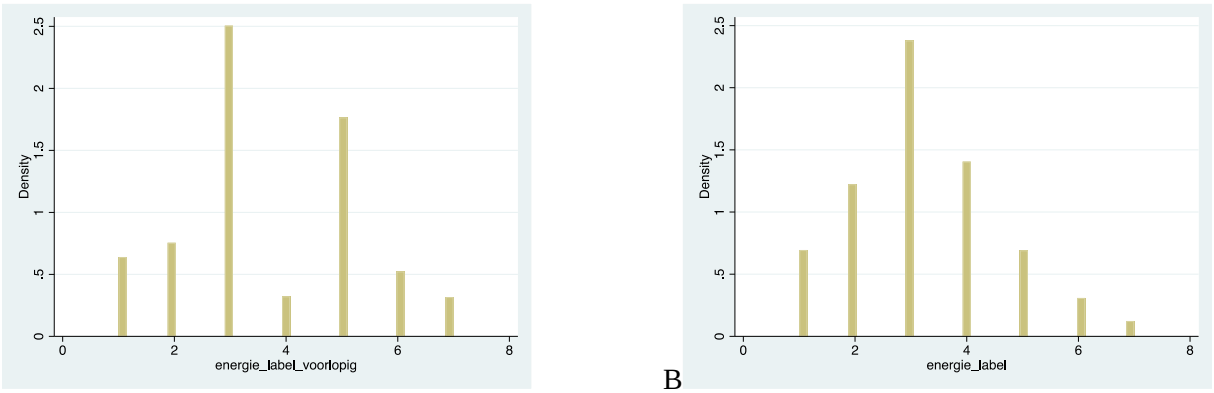
Figure 12 & Figure 13: histogram variables labelvlpdummy (A) & labeldummy (B) for category private investor

Label	*N energy label provisional*	*Percentage*	*Cumulative percentage*	*N energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
A	1,301	9.37	9.37	1,300	10.17	10.17	-0.8
B	1,534	11.05	20.43	2,291	17.92	28.09	-7.66
C	5,090	36.68	57.10	4,454	34.84	62.93	-1.84
D	657	4.73	61.84	2,631	20.58	83.51	-15.85
E	3,586	25.84	87.68	1,296	10.14	93.65	15.7
F	1,065	7.67	95.35	580	4.54	98.19	3.13
G	645	4.65	100.00	232	1.81	100.00	2.84
Total	13,878	100.00		12.784	100.00		

Table 33: composition of the dependent variables and the housing association category

Label	*N provisional energy label*	*Percentage*	*Cumulative percentage*	*N energy label*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
Positive (A,B,C)	7,925	57.10	57.10	8.045	62.93	62.93	-5.83
Negative (D,E,F,G)	5,953	42.90	100.00	4.739	37.07	100.00	5.83
Total	13,878	10.00		12.784	100.00		

Table 34: composition of the dependent dummy variables and the housing association category



B

Figure 14 & Figure 15: histogram variables labelvlpdummy (A) & labeldummy (B) for the category housing association

APPENDIX 7: VISUAL CHECK CORRELATION DEPENDENT & INDEPENDENT VARIABLE FOCUS GROUP

Label	*N focus group*	*Percentage*	*Cumulative percentage*	*N total dataset*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
A	142	2.05	2.05	3,623	14.34	14.34	-12.29
B	532	7.69	9.74	4,077	16.14	30.48	-8.45
C	1,862	26.90	36.64	8,042	31.83	62.31	-4.93
D	1,900	27.45	64.09	4,682	18.53	80.84	8.92
E	1,433	20.71	84.80	2,517	9.96	90.80	10.75
F	736	10.63	95.43	1,413	5.59	96.39	5.04
G	316	4.57	100.00	912	3.61	100.00	0.96
Total	6,921	100.00		25,266	100.00		

Table 35: composition of the dependent variable focus group in comparison to sample

Label	*N focus group*	*Percentage*	*Cumulative percentage*	*N total dataset*	*Percentage*	*Cumulative percentage*	*Deviation percentage*
Positive (A,B,C)	2,536	36.64	36.64	15,742	62.31	62.31	-25.67
Negative (D,E,F,G)	4,385	63.36	100.00	9,524	37.69	100.00	25.67
Total	6,921	100.00		25,266	100.00		

Table 36: composition of the dependent dummy variable focus group in comparison to sample

APPENDIX 8: CONTROL VARIABLES

Control variable income

Variables	*Name variable*	*Observation*	*Mean*	*Median*	*Std. Dev.*	*Min*	*Max*
income	inkomen	65,620	2.63	2	1.396	1	5

Table 37: descriptive statistics control variable inkomen

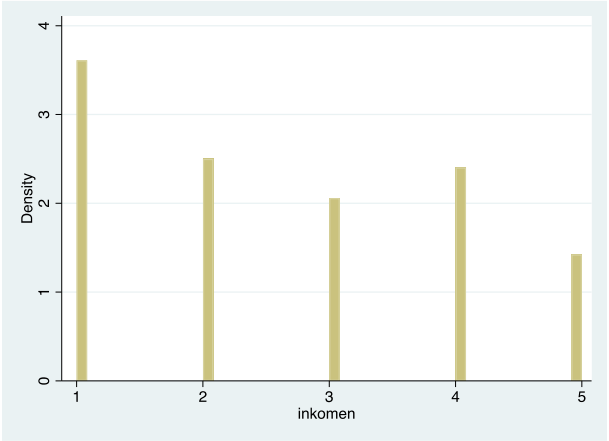


Figure 16: histogram control variables inkomen

Control variable property value

Variables	*Name variable*	*Observation*	*Mean*	*Median*	*Std. Dev.*	*Min*	*Max*
property value	wozwr7	65,620	2.822	2	1.665	1	7

Table 38: descriptive statistics control variable wozwaarde

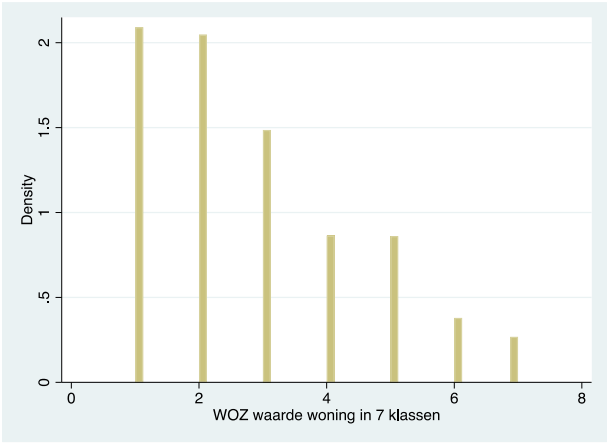


Figure 17: histogram control variable wozwr7

Control variable construction year

< - 1945
1945 - 1956
1960 - 1969
1970 - 1979
1980 - 1989
1990 - 1999
2000 - >

Table 39: categories variable constructie corresponding to earlier literature

Tot en met 1945
1946 t/m 1964
1965 t/m 1974
1975 t/m 1982
1983 t/m 1987
1988 t/m 1991
1992 t/m 1999
2000 t/m 2005
2006 t/m 2013
2014 t/m heden

Table 40: categories variable constructie corresponding tot he determination of the energy label

Variables	***Name variable***	***Observation***	***Mean***	***Median***	***Std. Dev.***	***Min***	***Max***
construction year	constructie	65,620	1968.812	1975	43.722	1005	2018

Table 41: descriptive statistics control variable constructie

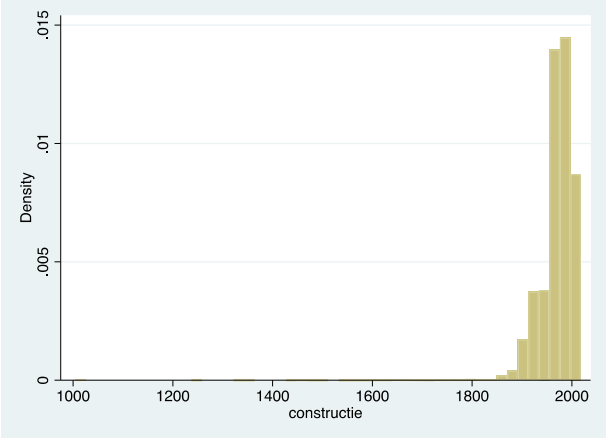


Figure 18: histogram control variable constructie

Control variable housing type

Variables	***Name variable***	***Observation***	***Mean***	***Median***	***Std. Dev.***	***Min***	***Max***
multi-story housing	etage	55,212	0.267	0	0.443	0	1
terraced housing & others	tussenoverig	55,212	0.299	0	0.458	0	1
semi-detached housing	tweeondereen	55,212	0.145	0	0.352	0	1
corner housing	hoek	55,212	0.132	0	0.338	0	1
detached housing	vrijstaand	55,212	0.157	0	0.364	0	1

Table 42: descriptive statistics control variables etagewoning, tussenwoning, halfvrijstaand and vrijstaand

Control variable surface

< 50 m3
50 - 69 m2
70 - 89 m2
90 - 119 m2
120 - 149 m2
150 - 199 m2
200 - > m2

Table 43: categories variable woonopp corresponding to earlier literature

t/m 80 m2
81 t/m 100 m2
101 t/m 120 m2
121 t/m 140 m2
meer dan 140 m2

Table 44: categories variable woonopp corresponding to the determination of the energy label

Variables	***Name variable***	***Observation***	***Mean***	***Median***	***Std. Dev.***	***Min***	***Max***
surface in square feet	woonopp	65,620	126.380	113	76.431	15	2970

Table 45: descriptive statistics control variable woonopp

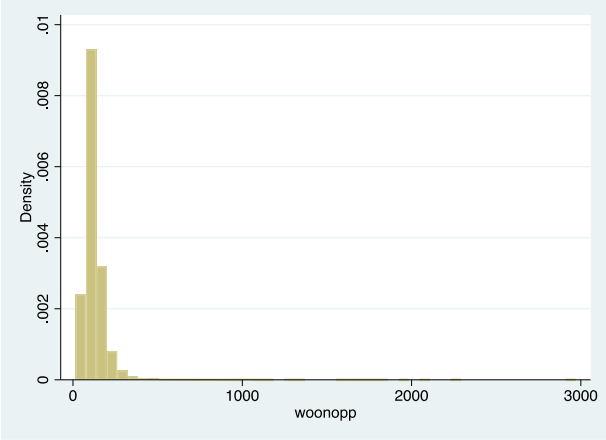


Figure 19: histogram control variable woonopp

Control variable rural versus urban

Variables	***Name variable***	***Observation***	***Mean***	***Median***	***Std. Dev.***	***Min***	***Max***
location characteristic dummy	urbaan	65,426	0.454	0	0.498	0	1

Table 46: descriptive statistics control variable logwoonopp

Control variable age

Variables	***Name variable***	***Observation***	***Mean***	***Median***	***Std. Dev.***	***Min***	***Max***
age	leeftijd	65,620	4.040	4	1.893	1	7

Table 47: descriptive statistics control variable age

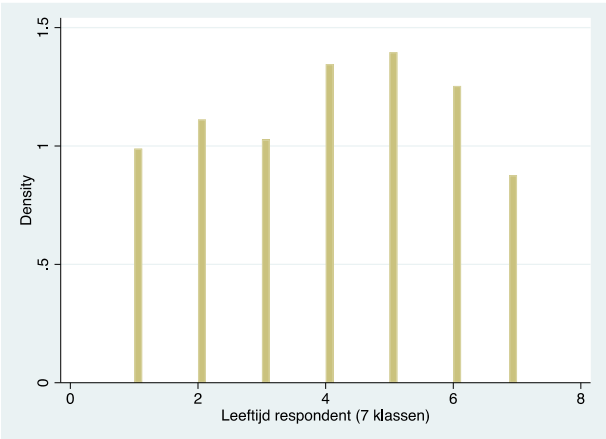


Figure 20: histogram control variable age

Control variable education

Variables	***Name variable***	***Observation***	***Mean***	***Median***	***Std. Dev.***	***Min***	***Max***
Education	vltoplop5	65,620	23.70	21	15.35	11	99

Table 48: descriptive statistics control variable vltoplop5

Control variable moving wish

Variables	***Name variable***	***Observation***	***Mean***	***Median***	***Std. Dev.***	***Min***	***Max***
desire to move	verhuis	65,620	0.387	0	0.487	0	1

Table 49: descriptive statistics control variable verhuis

APPENDIX 9: BINARY LOGISTIC REGRESSION TEST CONDITION PEARSON'S CORRELATION COEFFICIENT

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
labeldummy	1.000										
constructie	0.561	1.000									
gebruiksopp	0.048	0.048	1.000								
inkomen	0.047	0.055	0.415	1.000							
wozwaarde	0.089	0.107	0.587	0.545	1.000						
urbaan	-0.115	-0.126	-0.256	-0.084	-0,113	1.000					
woontype	0.014	0.091	-0.561	-0.388	-0.494	0.410	1.000				
samenstelling	-0.001	-0.039	0.214	0.330	0.190	-0.043	-0.212	1.000			
leeftijd	0.038	0.076	-0.014	-0.278	-0.044	-0.029	0.052	-0.325	1.000		
opleiding	0.0041	-0.014	0.023	0.085	0.043	0.043	-0.000	0.028	-0.095	1.000	
verhuis	-0.023	-0.077	-0.078	0.016	-0.076	0.078	0.093	0.063	-0.241	0.040	1.000

Table 50: pearson's correlation coefficient

APPENDIX 10: BINARY LOGISTIC REGRESSION TEST CONDITION CHECKING VIF-TEST

		VIF	1/VIF
WOZ value	< 150.000		
WOZ value	150.000 – 199.999	2.07	0.482062
WOZ value	200.000 – 249.999	1.84	0.542604
WOZ value	250.000 – 299.999	1.62	0.617945
WOZ value	300.000 – 399.999	1.77	0.566294
WOZ value	400.000 – 499.999	1.46	0.685779
WOZ value	500.000 >	1.45	0.690542
urban	urbaan	2.88	0.347282
urban	ruraal		
education	basisonderwijs		
education	vmbo, havo-, vwo-onderbouw, mbo1	3.11	0.321719
education	havo, vwo, mbo 2-4	3.60	0.277509
education	hbo-, wo-bachelor	2.80	0.357689
education	hbo-, wo-master, doctor	2.30	0.435070
construction year	< 1945		
construction year	1945 - 1959	2.05	0.488368
construction year	1960 - 1969	2.73	0.366483
construction year	1970 – 1979	3.08	0.325051
construction year	1980 - 1989	2.71	0.368681
construction year	1990- 1999	2.12	0.470998
construction year	2000 >	2.76	0.362052
desire to move	wel verhuiswens	1.78	0.560974
desrie to move	niet verhuiswens		
household	eenpersoon		
household	paar	2.34	0.427647
household	paar + kind(eren)	2.56	0.390044
household	1-oudergezin	1.41	0.708712
household	niet-gezins	1.14	0.877319
housing type	vrijstaand		
housing type	2-onder1-kap	2.37	0.422212
housing type	hoekwoning	4.09	0.244497
housing type	tussen en overig	7.96	0.125595
housing type	etagewoning	12.06	0.082909
income	beneden modaal		
income	tot 1.5 keer modaal	1.85	0.541384
income	tot 2 keer modaal	1.97	0.507752
income	tot 3 keer modaal	2.29	0.437184
income	>3 keer modaal	1.88	0.531097
surface	< 50		
surface	50 - 69	4.64	0.215481
surface	70 - 89	8.23	0.121460
surface	90 - 119	12.21	0.081872
surface	120 - 149	5.84	0.171354
surface	150 - 199	3.62	0.276534
surface	200 >	2.39	0.417967
investor type	private belegger	1.49	0.673035
investor type	koopwoning	8.50	0.117691
investor type	instuttionele belegger	1.76	0.568689

investor type	woningcorporatie	12.20	0.081998
age	17 – 24 jaar		
age	25 – 34 jaar	6.60	0.151504
age	35 – 44 jaar	5.47	0.182868
age	45 – 54 jaar	5.81	0.172109
age	55 – 64 jaar	6.14	0.162956
age	65 – 74 jaar	6.22	0.160652
age	75 jaar en ouder	5.36	0.186675
MEAN VIF		3.92	

Table 51: VIF test

APPENDIX 11: BINARY LOGISTIC REGRESSION COEFFICIENTS

	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**
constant	-1.638559*** (0.207)	-8.20878*** (0.341)	-0.7713232** (0.371)	-4.87893*** (0.822)
construction year				
< 1945	base	base	base	base
1945-1959	0.2953929*** (0.070)	0.0735541 (0.255)	-0.5031161*** (0.060)	-4.22469*** (0.211)
1960-1969	0.7707229*** (0.065)	4.332601*** (0.156)		
1970-1979	1.319256 *** (0.064)	7.299124*** (0.162)		
1980-1989	2.718252*** (0.069)	12.84347**** (0.251)		
1990-1999	4.508445*** (0.122)	12.56087**** (0.237)		
2000 >	6.025841*** (0.198)	11.85007**** (0.204)		
income				
below average	base	base	base	base
up to 1.5 times average	0.030479 (0.051)	0.1205803** (0.060)	-0.0216483 (0.080)	-0.0006268 (0.109)
up to 2 times average	0.0841114 (0.066)	0.05964 (0.073)	0.1325754 (0.107)	0.1134581 (0.136)
up to 3 times average	0.0831968 (0.077)	0.2710706*** (0.081)	0.0970441 (0.130)	0.1003418 (0.158)
>3 times average	0.0169364 (0.111)	0.2465919** (0.105)	0.2469967 (0.210)	0.3153129 (0.234)
surface in square feet				
< 50	base	base	base	base
50-69	-0.2235615** (0.107)	0.0425003 (0.191)	-0.2407871 (0.201)	-0.6599378 (0.666)
70-89	-0.2423015** (0.106)	-0.4443113** (0.187)	-0.3676804* (0.199)	-0.2740217 (0.629)
90-119	-0.1211963 (0.111)	-0.0075925 (0.188)	-0.1855632 (0.207)	-0.2740217 (0.630)
120-149	-0.107454 (0.122)	-0.0831569 (0.194)	-0.1285275 (0.230)	0.6554995 (0.647)
150-199	0.0732133 (0.143)	0.1344477 (0.202)	0.0396475 (0.273)	0.655499(0.668)
200 >	-0.0068037 (0.168)	0.3783125** (0.216)	-.186603 (0.321)	0.6201225 (0.727)
property value				
< 150.000	base	base	base	base
150.000-199.999	0.1786648*** (0.045)	0.205719*** (0.058)	0.1090981 (0.071)	-0.0037468 (0.093)
200.000-249.999	0.2712673*** (0.069)	0.2534372*** (0.075)	0.1762499 (0.124)	.00884376 (0.131)
250.000-299.999	0.36645*** (0.115)	0.3043483*** (0.095)	0.3402938* (0.195)	-0.5497046** (0.228)
300.000-399.999	0.2937311** (0.160)	0.2149454** (0.106)	0.104522 (0221.)	-0.221444 (0.269)
400.000-499.999	0.1631807 (0.189)	-0.0966172 (0.145)	0.0654208 (0.338)	-1.060797* (0.561)
500.000 >	0.1256684 (0.040)	-0.2559504 (0.181)	1.421542*** (0.429)	-2.174346** (1.086)
Property type				
detached housing	base	base	base	base
multi-story housing	0.0579973 (0.108)	0.1998124* (0.109)	-0.1091993 (0.195)	0.6819349** (0.040)
terraced housing & others	0.5272733*** (0.099)	3.627158*** (0.098)	0.4781377*** (0.179)	4.202217*** (0.283)
semi-detached housing	0.1761353* (0.103)	0.0489141 (0.083)	0.0304694 (0.184)	0.0298611 (0.359))
corner house	0.2380313** (0.101)	.03814606*** (0.089)	0.1190562 (0.182)	1.009876*** (0.304)
location characteristic				
rural	base	base	base	base
urban	-0.2002228*** (0.040)	-0.0091582 (0.047)	-0.0746436 (0.066)	-.0813771 (0.080)
highest completed education				
basisonderwijs	base	base	base	base
vmbo, havo- vwo-onderbouw, mbo1	-.027994 (0.056)	0.1577075** (0.074)	-0.0689889 (0.085)	.182151 (0.131)
havo, vwo, mbo 2-4	-0.0341019 (0.059)	0.2199766*** (0.077)	-0.0005524 (0.091)	0.4427116*** (0.138)
hbo-, wo-bachelor	-0.0297928 (0.068)	0.2166525*** (0.084)	-0.1078437 (0.110)	0.4116197*** (0.161)
hbo-, wo-master, doctor	-0.0572914 (0.081)	0.1279338 (0.097)	0.0656888 (0.139)	0.4058348** (0.195)
desire to move				
no	base	base	base	base
yes	0.0472331 (0.037)	.0377481 (0.044)	-0.0107154 (0.060)	0.040043 (0.083)
household composition				
one person	base	base	base	base
couple	-0.0057086 (0.049)	-0.0685332 (0.056)	-0.015807 (0.078)	0.0347954 (0.107)
couple with child(ren)	-0.1017549* (0.061)	-0.1964901***(0.073)	-0.0367667 (0.095)	-0.0656909 (0.133)
one parent	0.0764338 (0.067)	-0.0002657 (0.093)	-0.0080641 (0.099)	-0.0696346 (0.161)
nonfamily	-0.277548** (0.138)	-0.4396671** (0.211)	-0.5686518** (0.223)	-0.1938027 (0.406)
age				
17-24	base	base	base	base
25-34	0.0289078 (0.113)	0.2302682 (0.189)	-0.0396408 (0.180)	0.1983314 (0.338)
35-44	0.0946288 (0.118)	0.2818415 (0.190)	0.180571 (0.187)	0.3422122 (0.340)
45-54	0.0923467 (0.117)	0.290168 (0.189)	0.0298944 (0.187)	0.313671 (0.338)
55-64	0.0422435 (0.118)	0.3555107* (0.188)	0.0257862 (0.187)	0.227194 (0.337)
65-74	-0.0245054 (0.121)	0.2497793 (0.188)	-0.0524617 (0.190)	0.3726929 (0.338)
> 75	-0.1481495 (0.223)	-0.0834027 (0.190)	-0.1426139 (0.195)	0.4748373 (0.341)
investor type				
private investor(s)	0.1637975 (0.144)	-0.1550234 (0.194)	-0.0808946 (0.271)	-0.1039339 (0.425)
housing association(s)	0.5330519*** (0.095)	0.034629 (0.145)	0.707442*** (0.181)	0.1958245 (0.330)
institutional investor(s)	-0.1447108 (0.136)	0.1983973 (0.207)	0.7074426 (0.319)	0.8112606* (0.490)
owner occupier(s)	0.163854 (0.101)	-0.0296582 (0.147)	0.1157808 (0.192)	-0.1544519 (0.332)
number of observations	22,223	52,742	6,022	12,273
LR chi2	9117.33	56,056.85	331.49	4381.99
prob > chi2	0.0000	0.0000	0.0000	0.0000
pseudo R2	0.3096	0.7739	0.0421	0.4904

Table 52 binary logistic regression model (1), (2), (3) and (4) coefficients

Note: The dependent variable for model (1) is the dummy variable labeldummy*, indicating if a property is energy efficient or non-energy efficient. The dependent variable for model (2) is the dummy variable* labelvlpdummy*, indicating*

if the provisional energy label is energy efficient or non-energy efficient. The dependent variable for model (3) is the dummy variable focusdummy*, indicating if a property in the focus group is energy efficient or non-energy efficient. The dependent variable for model (4) is the dummy variable f*ocsuvlpdummy*, indicating if the provisional energy label for property in the focus group is energy efficient or non-energy efficient. The table gives the coefficients of the variables. The standard errors are given in parentheses. *;**;*** are significant at 10%, 5%, 1% respectively.*

APPENDIX 12: SEMI-STRUCTURED INTERVIEUW GUIDE WONING CORPORATIE

Introductie vraag

1. Kan je iets over jezelf en de woningcorporatie vertellen?
    a. Welke functie bekleed je binnen de corporatie?
    b. In welke sector(en) actief?
    c. Link tussen corporatie en vastgoedsector?
    d. Visie van de corporatie?
    e. Heeft de corporatie een visie rondom het begrip duurzaamheid?
    f. Is de corporatie actief bezig rondom het begrip duurzaamheid?

Onderwerp gerelateerde vragen

2. Hoe verloopt de transitie naar een duurzame woningvoorraad binnen de woningcorporatie?
    a. Wat is het energielabel van de woningvoorraad?
    b. Naar welk doel wordt gesteven?
    c. Welke stappen zijn gemaakt binnen de energietransitie?
    d. Staan er nog energiebesparende maatregelen op de agenda?
    e. Zijn er knelpunten binnen het verduurzamen van de woningvoorraad welke (vaak) vorkomen?

3. Wat zijn belangrijke redenen waarom de woningvoorraad verduurzaamd wordt?
    a. Imago?
    b. Financieel?
    c. Klanten?
    d. Ethiek?
    e. Wetgeving?
    f. Risico?
    g. Maatschappij?

4. Komt er vanuit de huurder ook het verzoek om de woningen te verduurzamen?
    a. Hoe staan huurders tegenover de verduurzaming? Zijn ze overwegend positief of hebben ze een andere mening?
    b. Hebben sommige huurders ook vraagtekens rondom de verduurzaming?
    c. Beslissen huurders mee binnen de energietransitie?
    d. Wat voor effecten hebben de verduurzaming voor de huurders?
        i. Invloed huur? & Invloed comfort?

5. Hoe belangrijk is benchmarking voor woningcorporaties?

6. Wat zijn de reden dat het de woningcorporatie lukt de energietransitie van de eigen woningvoorraad zo Positieve te laten verlopen?

7. Wat is de hoofdreden dat er wordt voorgelopen/achtergelopen binnen de energie transitie op andere investeringstype?
    a. Financiën? & Wet en Regelgeving? & Idealen? & Imago?

8. Als gekeken wordt naar draagkracht en het maatschappelijk belang, is het dan ethisch verantwoord hoe het bedrijf zich inzet binnen de energietransitie?

9. Als gekeken wordt naar de energietransitie van de eigen woningvoorraad, draagt de woningcorporatie dan bij naar draagkracht?

10. Wat is de voornaamste reden waarom de energie transitie van de woningvoorraad niet sneller verloopt?

Afsluitende vraag

11. Wat zou een boost kunnen geven binnen energietransitie van de Nederlandse woningvoorraad naar uw perspectief?

APPENDIX 13: SEMI-STRUCTURED INTERVIEUW GUIDE INSTITUTIONAL INVESTOR

Introductie vraag

1. Kan je iets over jezelf en het bedrijf vertellen
    a. Welke functie bekleed je binnen het bedrijf?
    b. In welke sector(en) actief?
    c. Link tussen bedrijf en vastgoedsector?
    d. Visie van bedrijf?
    e. Heeft het bedrijf een visie rondom het begrip duurzaamheid?
    f. Is het bedrijf actief bezig rondom het begrip duurzaamheid?

Onderwerp gerelateerde vragen

1. Hoe verloopt de energietransitie van de woningvoorraad?
    a. Wat is het gemiddelde energielabel van de woningvoorraad?
    b. Word er een doel nagestreefd met betrekking tot duurzaamheid?
    c. Welke stappen zijn gemaakt binnen het proces rondom de energietransitie?
    d. Staan er nog energiebesparende maatregelen op de agenda?
    e. Verschilt het per opdrachtgever in hoeverre duurzaamheid een agenda punt is?
    f. Zijn er opdrachtgever die duurzaamheid niet interessant vinden binnen hun investering?
    g. Zijn er opdrachtgever die dit juist heel belangrijk vinden?
    h. Hoe staat de gemiddelde opdrachtgever hier tegenover?
    i. Is het te merken dat een bepaald type opdrachtgever afwijkt hierbinnen?
    j. Is er contact met huurders over het energiezuinig gebruiken van de woningen?
    k. Komt er vanuit de huurder het verzoek om de woningen te verduurzamen?

2. Wat zijn belangrijke redenen waarom de woningvoorraad verduurzaamd wordt?
    a. Imago?
    b. Financieel?
    c. Klanten?
    d. Ethiek?
    e. Wetgeving?
    f. Risico?
    g. Maatschappij?
    h. Gaat het hierbij dan vooral de waarde van het bedrijf of de opdrachtgever?

3. Als gekeken wordt naar de transitie naar een duurzame woningvoorraad, draag de opdrachtgevers dan naar draagkracht bij?
    a. Financieel
    b. Verschilt dit per type opdrachtgever?

4. Wat is de hoofdreden dat er wordt voorgelopen/achtergelopen binnen de energie transitie op andere investeringstype?
    a. Financiën?
    b. Wet en Regelgeving?
    c. Idealen?
    d. Imago?

5. Wat is de hoofdreden dat er wordt voorgelopen/achtergelopen met betrekking tot de energietransitie op hetzelfde investeringstype tussen de opdrachtgevers?
    a. Financiën?
    b. Wet- en Regelgeving?
    c. Idealen?
    d. Imago?

6. Als gekeken wordt naar draagkracht en het maatschappelijk belang, is het dan ethisch verantwoord hoe de opdrachtgevers zich inzet binnen de energietransitie?

7. Als gekeken wordt naar draagkracht en het maatschappelijk belang, is het dan ethisch verantwoord hoe het bedrijf zichzelf inzet binnen de energietransitie?

8. Wat is de voornaamste reden waarom de energie transitie van de woningvoorraad niet sneller verloop van het bedrijf /coöperatie /investeringsmaatschappij?
    a. Wet en regelgeving?
    b. Kennis?
    c. Financiën?
    d. Belangen?

Afsluitende vraag

9. Wat zou een (enorme) boost kunnen geven aan de energietransitie van de Nederlandse woningvoorraad naar uw perspectief (voor zowel de gehele woningvoorraad als van het eigen investeringstype)?

APPENDIX 14: SEMI-STRUCTURED INTERVIEUW GUIDE PRIVATE INVESTOR

Introductie vraag

1. Kan je iets over jezelf vertellen?
    a. Leeftijd?
    b. Gezinssituatie?
    c. Baan, opleidingen, hobby's?
    d. Levensloop?
    e. Woonsituatie?
    f. Affiniteit met vastgoed?

Onderwerp gerelateerde vragen

2. Hoeveel woningen heb je in het bezit?
    a. Hoe bent je aan deze panden gekomen?
    b. Voornaamste reden van het in het bezit hebben van de panden?
    c. Waar bevinden deze panden zich?
    d. Hoeveel tijd besteed je aan het aanhouden van de panden?

3. Hoe staat je tegenover duurzaamheid?
    a. Wat doe je persoonlijk aan duurzaamheid?
    b. Vind je duurzaamheid belangrijk?
    c. Heb je een persoonlijk doel wat je nastreeft welke betrekking heeft op duurzaamheid?
    d. Hoe vind je dat de maatschappij zich bezighoudt met het onderwerp duurzaamheid?
    e. Vind je het verduurzamen van woningen bijvoorbeeld wel of niet belangrijk?

4. Hoe zit het met het energieverbruik van de panden in je bezit?
    a. Wat is het energielabel van de panden?
    b. Zijn er stappen gemaakt binnen de energietransitie van de panden?
    c. Worden er bepaalde doelen nagestreefd op het gebied van duurzaamheid?
    d. Wordt er gebruik gemaakt van gas?
    e. Hoe zit het met de Isolatie?
    f. Word er gebruik gemaakt of groene energie of word deze opgewekt?
    g. Staan er duurzame aanpassingen op de planning voor de panden?
    h. Wat is de belangrijkste reden waarom de panden wel of niet verduurzamen worden (imago, financieel, bewoners, ethiek, wetgeving, risico, maatschappelijk belang)

5. Hoe zit het met het energieverbruik van uw eigen woning?
    a) Wat is het energielabel van je eigen woning?
    b) Zijn er stappen gemaakt binnen de energietransitie van uw woning?
    c) Worden er bepaalde doelen nagestreefd op het gebied van duurzaamheid?
    d) Wordt er gebruik gemaakt van gas?
    e) Hoe zit het met de Isolatie?
    f) Word er gebruik gemaakt of groene energie of wordt deze opgewekt?
    g) Staan er duurzame aanpassingen op de planning voor uw woning?

6. Wanneer je de eigen woning vergelijkt met de panden, kijk je dan anders naar het toepassen van duurzame aanpassingen?
    a. Ben je eerder geneigd in de eigen woning of de panden te investeren met betrekking tot duurzaamheid?
    b. Wat is de voornaamste reden voor het (mogelijke) verschil tussen je visie voor de eigen woning en de panden in je bezit?

7. Als gekeken wordt naar de energie transitie waarbinnen gestreefd wordt naar een duurzame woningvoorraad, draag je als pandeigenaar dan bij aan draagkracht aan de transitie?
    a. Hoe groot vind je dat je draagkracht zou kunnen of ethisch zou moeten zijn?
    b. Wat is de reden dat er wel of niet wordt bijgedragen?
    c. Wat zou je kunnen motiveren om meer bij te dragen aan de energietransitie?
    d. Merk je een stimulans vanuit de overheid of andere rijksinstellingen(en)?

8. Wie vind je dat de energietransitie uiteindelijk zouden moeten bekostigen? Ligt deze taak vooral bij de bewoners van de woning of bij de woningeigenaar?
    a. Denk je dat de huurders open zouden staan voor een huurverhoging welke betrekking op duurzaamheid heeft?
    b. Zou je een lager rendement accepteren met betrekking tot duurzame investeringen?
    c. Vind je dat duurzame veranderingen altijd kostendekkend zouden moeten zijn?

9. Wat is de hoofdreden dat er wordt voorgelopen/achtergelopen binnen de energie transitie op andere investeringstype?
    a. Imago
    b. Financieel
    c. Bewoners
    d. Ethiek
    e. Wetgeving
    f. Risico
    g. Maatschappelijk belang
    h. Kennis
    i. Belangen

10. Als gekeken wordt naar draagkracht en het maatschappelijk belang, is het dan ethisch verantwoord hoe je jezelf inzet voor de verduurzaming van de panden?
    a. Zou je het anders doen nu je erover na denk?
    b. Hoe zou je met een kleine (financiële stap) een bijdrage kunnen leveren?
    c. Vind je het vooral de taak van u als verhuurder om maatschappelijk bij te dragen of ook van de huurders zelf?
        i. Hoe zouden de huurders zelf kunnen bijdragen in uw belevenis?
        ii. Heb je gesprekken over duurzaamheid met de bewoners gevoerd?

Afsluitende vraag

11. Wat zou een enorme boost kunnen geven aan het verduurzamen van de woningvoorraad naar uw perspectief

APPENDIX 15: SEMI-STRUCTURED INTERVIEUW GUIDE RENTERS

Introductie vraag

1. Kan je iets over jezelf vertellen?
    a. Leeftijd?
    b. Gezinssituatie?
    c. Baan, opleidingen Hobby's?
    d. Levensloop?
    e. Woonsituatie?

Onderwerp gerelateerde vraag

2. Wat is de reden dat je ervoor gekozen hebt om deze woning te huren?
    a. Afweging koop/huur?
    b. Locatie?
    c. Financieel?
    d. Type woning?

3. Hoe staat je tegenover duurzaamheid?
    a. Wat doe je persoonlijk aan duurzaamheid?
    b. Hoe vind je dat de maatschappij bezig is rondom het begrip duurzaamheid?
    c. Vind je duurzaamheid belangrijk?
    d. Waarom vind je het verduurzamen van woningen wel of niet belangrijk?
    e. Heb je een persoonlijk doel rond het begrip duurzaamheid?

4. Hoe zit het met het energieverbruik van de huurwoning?
    a. Energielabel?
    b. Wordt er gebruik gemaakt van gas?
    c. Isolatie?
    d. Groene energie?
    e. Staan er duurzame aanpassingen op de planning?

5. Vind je het de taak van de verhuurder of van jezelf om ervoor te zorgen dat de woning verduurzaamd?

6. Hoe belangrijk of onbelangrijk vind je het dat uw verhuurder investeert in energiebesparende maatregelen?

7. Zou je ook zelf stappen kunnen zetten op het gebied van duurzaamheid naast de verhuurder?
    a. Lampen?
    b. Energiezuinige apparaten?
    c. Gebruik verwarming en of douche?
    d. Folie achter de verwarming?
    e. Vervangen douchekop?

8. Vind je dat je naar draagkracht bijdraagt binnen de energietransitie?
    a. Bijdrage door middel van huurwoning?
    b. Bijdrage door middel van andere factoren?

9. Zou je meer willen betalen voor een duurzamere huurwoning?
    a. Waarom zou je wel/niet meer willen betalen?
        i. Imago & Financieel & Ethiek & Wetgeving
    b. Hoeveel zou je meer willen betalen?

10. Als je kijkt naar de energie transitie in Nederland met betrekking op de woningvoorraad vind je dan dat deze eerlijk verloopt en dat de maatschappij naar draagkracht zijn steentje bijdraagt?

Afsluitende vraag

11. Wat is je droomwoning?

APPENDIX 16: SEMI-STRUCTURED INTERVIEUW GUIDE OWNER-OCCUPIERS

Introductie vraag

1. Kan je iets over jezelf vertellen?
    a. Leeftijd?
    b. Gezinssituatie?
    c. Baan & opleidingen?
    d. Hobby's?
    e. Levensloop?
    f. Woonsituatie?

Onderwerp gerelateerde vraag

2. Wat is de reden dat je ervoor gekozen hebt om deze woning te kopen?
    a. Afweging koop/huur?
    b. Locatie?
    c. Financieel?
    d. Type woning?

3. Hoe staat je tegenover duurzaamheid?
    a. Wat doet je persoonlijk aan duurzaamheid?
    b. Hoe vind je dat de maatschappij bezig is rondom het begrip duurzaamheid?
    c. Vind je duurzaamheid belangrijk?
    d. Waarom vind je het verduurzamen van woningen wel of niet belangrijk?
    e. Heb je een persoonlijk doel rond het begrip duurzaamheid?

4. Hoe zit het met het energieverbruik van de woning?
    a. Energielabel?
    b. Wordt er gebruik gemaakt van gas?
    c. Isolatie?
    d. Groene energie?
    e. Staan er duurzame aanpassingen op de planning?

5. Vind je het een belangrijke taak voor jezelf om ervoor te zorgen dat de woning verduurzaamd?

6. Hoe belangrijk of onbelangrijk vind je het investeren in energiebesparende maatregelen rondom de woning?

7. Vind je dat je naar draagkracht bijdraagt binnen de energietransitie?
    a. Bijdrage door middel van energie transitie woning?
    b. Bijdrage door middel van andere factoren?

8. Zou je meer willen betalen voor een duurzamere woning?
    a. Waarom zou je wel/niet meer willen betalen?
        i. Imago
        ii. Financieel
        iii. Ethiek
        iv. Wetgeving
    b. Hoeveel zou je meer willen betalen?

9. Als je kijkt naar de energie transitie in Nederland met betrekking op de woningvoorraad vind je dan dat deze eerlijk verloopt en dat de maatschappij naar draagkracht zijn steentje bijdraagt?

Afsluitende vraag

10. Wat is je droomwoning?

APPENDIX 17: CODINGS SCHEME SEMI-STRUCTED INTERVIEUW

Stap 1 Open coderen → labels hangen aan tekstfragmenten

Stap 2 Axiaal coderen → welke verschillen en overeenkomsten tussen de labels = overkoepelende code groepen

Stap 3 Selectief coderen → concept uitwerken tot een theorie

Labellijst:
Stakeholder: huurder
Stakeholder: institutionele belegger
Stakeholder: private belegger
Stakeholder: woningcorporatie
Stakeholder: koopwoning

Kenmerken: individu
Kenmerken: organisatie
Kenmerken: eigen woning(en)
Kenmeren: woningvoorraad

Keuze: eigenwoning
Keuze: woningvoorraad

Duurzaamheid: visie
Duurzaamheid: actie
Duurzaamheid: motivatie
Duurzaamheid: gevolgen

Energiebesparende maatregelen: wijze
Energiebesparende maatregelen: gevolgen
Energiebesparende maatregelen: motivatie
Energiebesparende maatregelen: hoofreden
Energiebesparende maatregelen: rol overheid
Energiebesparende maatregelen: stimulans
Energiebesparende maatregelen: actie
Energiebesparende maatregelen: visie
Energiebesparende maatregelen: gevolgen aanpassing(en) woning(en)
Energiebesparende maatregelen: kennis
Energiebesparende maatregelen: financieel aspect
Energiebesparende maatregelen: invloed context
Energiebesparende maatregelen: overheid
Energiebesparende maatregelen: huurder
Energiebesparende maatregelen: gedrag

Effect: gebruik bewoner(s)
Effect: verduurzaming

Bijdrage: draagkracht versus maatschappij, financieel
Bijdrage: draagkracht versus maatschappij, gedrag
Bijdrage: draagkracht versus maatschappij, intentie
Bijdrage: draagkracht versus maatschappij, ethiek
Bijdrage: draagkracht versus maatschappij, reden

APPENDIX 18: BACKGROUND INFORMATION INSTITUTIONAL INVESTOR

Type of company	Investment manager real estate
Function interviewee	Manager Strategy & Research
Gender interviewee	Male
Financial resources in manage	> 25 Billion
Customers (institutional investors)	70
Active in the market segments	Residential, retail, mortgages, international real estate, healthcare real estate
Number of objects within the residential category	119
Energy label of residential objects	100 percent has a green energy label
Fund size residential sector	+ - 1,500 million
MSCI yield Q1 2020	3.5 percent
Vision	Our asset management contributes to a sustainable future
Mission	We chose for sustainable investments with a financial and social return.

Table 53: descriptive stakeholder institutional investor

Gender	Male
Age	58
Family composition	Family with children
Education level	HBO
Job	Engineering
Location property	Municipality Epe
Surface of home	180 square feet
Construction year	‘30
Type of housing	Detached housing
Property value	650.000
Purchase year	2001
Energy label	C
Energy saving measures implemented	Solar panels, wall insulation, roof insulation, replacement of glass
Reasons for energy saving measures	Living comfort, financial benefit, environment
Sees sustainability as something important	Yes
Applies sustainability in daily life	Yes

Table 54: descriptive stakeholder owner-occupier

Gender	Male
Age	42
Family composition	Family with children
Education level	HBO
Job	Engineering
Number of properties owned as investor	1
Location property	Municipality Ede
Property value	180.000
Rent	750 euros
Housing benefit	Not possible
Payment of gas, water and electricity	Not included within the rent
Type of housing	Apartment
Vereeniging van eigenaren	Ja
Purchase year	2007
Sales year	2019
Energy label	C
Sees sustainability as something important	Yes
Applies sustainability in daily life	Yes
Energy saving measures implemented	HR-kettle
Earnings from the property (monthly)	700 (net)

Table 55: descriptive stakeholder private investor

Company	Housing association
Function interviewee	Asset manager
Gender interviewee	Female
Sectors active	*Vrije sector* and public housing
Number of residential homes	> 10,000
Number of residents	Circa 22,000
Location of the residential homes	Northern Netherlands
Average EI index of residential homes	1.44
Average rent price public housing	+ - 500 euros
Average rent price *vrije secor*	+ - 900 euros
Energy label residential properties	Label A 30 percent, Label B 22 percent, Label C-D 42 percent, Label E-F-G 6 percent.
Mission	Our ideal is that people with different background and social position live together in neighborhoods and can choose where and how they live in a house that feels like home.
Key values	Involvement, space, self-will and common sense

Table 56: descriptive stakeholders housing association

Gender	Female
Age	25
Family composition	Single household
Education level	HBO
Job	Working in healthcare sector
Place of residence	Municipality Groningen
Location	City center
Rent	630 euros
Housing benefit	Yes, 275
Payment of gas, water and electricity	Included within the rent
Surface of home	37 square feet
Type of housing	Apartment
Energy label	Unknown by renter
Willing to pay more rent for energy efficient measures	Yes, 15 euros per month
Sees sustainability as something important	Yes
Applies sustainability in daily life	No

Table 57: descriptive stakeholder renter

APPENDIX 19: DO-FILE

```
** first impression dataset WoON2018 Woon Onderzoek
histogram eighuura
summarize eighuura
table energieklasse
summarize energieklasse
table energieklasse_vlp
summarize energieklasse_vlp
histogram srtwon
histogram wieverh

**** cleaning the dataset****

** cleaning WOZ value
summarize wozwaarde, detail
table wozwaarde
drop if wozwaarde < 68000
keep if wozwaarde < 730000 | missing(aankprs)

** cleaning rent
generate toevoegentoeslag = ihsmndbd2_r if hubegrip ==1
replace toevoegentoeslag = 0 if missing(toevoegentoeslag)
generate huur = huurmnd + toevoegentoeslag
summarize huur, detail
table huur
keep if huur< 1550 | missing(huur)
drop if huur <= 0

**cleaning rooms
summarize kamers, detail
table kamers
keep if kamers < 20 | missing(kamers)

**cleaning purchase year
summarize jrgekocht, detail
table jrgekocht
drop if jrgekocht < 1920
** checking influence of cleaning the dataset
histogram energieklasse
histogram eighuura
histogram srtwon

**representativeness check for population of the dataset
table eighuura
table prov
table wieverh
table benbuur

**creating dependent variable
table energieklasse
table energieklasse_vlp
generate label = energieklasse
generate labelvlp = energieklasse_vlp
generate labeldummy = energieklasse
generate labelvlpdummy = energieklasse_vlp
recode labeldummy 1/3=1 4/7=0
recode labelvlpdummy 1/3=1 4/7=0
table labeldummy
table labelvlpdummy
```

```
**visual check of creating dependent variable
histogram energieklasse
histogram energieklasse_vlp
histogram label
histogram labelvlp
histogram labeldummy
histogram labelvlpdummy

****operating dataset dependent and independent variables****

**creating dummy variables investor types of interest independent variable
tabulate eighuura, generate(dum)
rename dum1 koopwoning
drop dum2
replace wieverh= 0 if missing(wieverh)
tabulate wieverh, generate (dum)
rename dum2 woningcorporatie
rename dum4 institutionelebelegger
generate privatebelegger = dum5+ dum6
drop dum1 dum3 dum5 dum6 dum7 dum8

****visual interpretation****

** looking at descriptive statistics of dependent and independent variables within dataset
table label
histogram label
table labelvlp
histogram labelvlp
table labeldummy
histogram labeldummy
table labelvlpdummy
histogram labelvlpdummy
table koopwoning
histogram koopwoning
table woningcorporatie
histogram woningcorporatie
table institutionelebelegger
histogram institutionelebelegger
table privatebelegger
histogram privatebelegger

**visual observation checking relationship dependent and independent variable
histogram label if koopwoning ==1
tab label if koopwoning ==1
histogram labeldummy if koopwoning ==1
tab labeldummy if koopwoning ==1
histogram label if woningcorporatie ==1
tab label if woningcorporatie ==1
histogram labeldummy if woningcorporatie==1
tab labeldummy if woningcorporatie ==1
histogram label if privatebelegger ==1
tab label if privatebelegger ==1
histogram labeldummy if privatebelegger ==1
tab labeldummy if privatebelegger ==1
histogram label if institutionelebelegger ==1
tab label if institutionelebelegger ==1
histogram labeldummy if institutionelebelegger ==1
tab labeldummy if institutionelebelegger ==1
```

```
**visual observation checking relationship dependent and independent variable
histogram labelvlp if koopwoning ==1
tab labelvlp if koopwoning ==1
histogram labelvlpdummy if koopwoning ==1
tab labelvlpdummy if koopwoning ==1
histogram labelvlp if woningcorporatie ==1
tab labelvlp if woningcorporatie ==1
histogram labelvlpdummy if woningcorporatie==1
tab labelvlpdummy if woningcorporatie ==1
histogram labelvlp if privatebelegger ==1
tab labelvlp if privatebelegger ==1
histogram labelvlpdummy if privatebelegger ==1
tab labelvlpdummy if privatebelegger ==1
histogram labelvlp if institutionelebelegger ==1
tab labelvlp if institutionelebelegger ==1
histogram labelvlpdummy if institutionelebelegger ==1
tab labelvlpdummy if institutionelebelegger ==1

**creating focus group cases building year 1950-1969
summarize bjaarbag
table bjaarbag
generate focus = bjaarbag
recode focus 1970/2018=0
recode focus 1005/1944=0
recode focus 1945/1969=1
generate focusdummy= labeldummy if focus ==1
generate focusvlpdummy= labelvlpdummy if focus ==1

**looking at descriptive statistics of the focus group
tab labelvlp if focus ==1
histogram labelvlp if focus ==1
tab label if focus ==1
histogram label if focus ==1
tab labeldummy if focus ==1
tab labeldummy if focus ==1

**check representation independent variable for focus group
tab institutionelebelegger if focus ==1
tab privatebelegger if focus ==1
tab woningcorporatie if focus ==1
tab koopwoning if focus ==1

**visual observation checking relationship dependent and independent variable
histogram label if focusdummy ==1 & koopwoning ==1
tab label if focusdummy ==1 & koopwoning ==1
histogram labeldummy if focusdummy ==1 & koopwoning ==1
tab labeldummy if focusdummy ==1 & koopwoning ==1
histogram label if focusdummy ==1 & woningcorporatie ==1
tab label if focusdummy ==1 & woningcorporatie ==1
histogram labeldummy if focusdummy ==1 & woningcorporatie ==1
tab labeldummy if focusdummy ==1 & woningcorporatie==1
histogram label if focusdummy ==1 & privatebelegger==1
tab label if focusdummy ==1 & privatebelegger ==1
histogram labeldummy if focusdummy ==1 & privatebelegger ==1
tab labeldummy if focusdummy ==1 & privatebelegger ==1
histogram label if focusdummy ==1 & institutionelebelegger ==1
tab label if focusdummy ==1 & institutionelebelegger ==1
histogram labeldummy if focusdummy ==1 & institutionelebelegger ==1
tab labeldummy if focusdummy ==1 & institutionelebelegger ==1
```

```
**visual observation checking relationship dependent and independent variable
histogram labelvlp if focusdummy ==1 & koopwoning ==1
tab labelvlp if focusdummy ==1 & koopwoning ==1
histogram labelvlpdummy if focusdummy ==1 & koopwoning ==1
tab labelvlpdummy if focusdummy ==1 & koopwoning ==1
histogram labelvlp if focusdummy ==1 & woningcorporatie ==1
tab labelvlp if focusdummy ==1 & woningcorporatie ==1
histogram labelvlpdummy if focusdummy ==1 & woningcorporatie ==1
tab labelvlpdummy if focusdummy ==1 & woningcorporatie==1
histogram labelvlp if focusdummy ==1 & privatebelegger==1
tab labelvlp if focusdummy ==1 & privatebelegger ==1
histogram labelvlpdummy if focusdummy ==1 & privatebelegger ==1
tab labelvlpdummy if focusdummy ==1 & privatebelegger ==1
histogram labelvlp if focusdummy ==1 & institutionelebelegger ==1
tab labelvlp if focusdummy ==1 & institutionelebelegger ==1
histogram labelvlpdummy if focusdummy ==1 & institutionelebelegger ==1
tab labelvlpdummy if focusdummy ==1 & institutionelebelegger ==1

** **operating dataset control variables****

**operating control variable construction year
tab bjaark8
generate constructie = bjaark8
recode constructie 7/8=7
tabulate constructie, generate (dum)
rename dum1 constructie1
rename dum2 constructie2
rename dum3 constructie3
rename dum4 constructie4
rename dum5 constructie5
rename dum6 constructie6
rename dum7 constructie7

**operating control variabele living area
tab gebruiksopp
histogram gebruiksopp
tab oppwon7
generate oppervlakte = oppwon7
tabulate oppervlakte, generate (dum)
rename dum1 oppervlakte1
rename dum2 oppervlakte2
rename dum3 oppervlakte3
rename dum4 oppervlakte4
rename dum5 oppervalkte5
rename dum6 oppervalkte6
rename dum7 oppervlakte7

** operating control variable income
tab inkmod5
generate inkomen = inkmod5
tabulate inkomen, generate (dum)
rename dum1 inkomen1
rename dum2 inkomen2
rename dum3 inkomen3
rename dum4 inkomen4
rename dum5 inkomen5

**operating control variable wozwaarde
```

```
tab wozwaarde
histogram wozwaarde
tab wozwr7
histogram wozwr7
tabulate wozwr7, generate (dum)
rename dum1 woz1
rename dum2 woz2
rename dum3 woz3
rename dum4 woz4
rename dum5 woz5
rename dum6 woz6
rename dum7 woz7

**operating control variable urban versus rural
tab stedbuurt
gen urbaan = stedbuurt
recode urbaan 3/5=0
recode urbaan 1/2=1
recode urbaan 9/9=.

** operating control variable property type
tab woontype
tabulate woontype, generate (dum)
rename dum1 vrij
rename dum2 tweeondereen
rename dum3 hoek
rename dum4 tussenoverig
rename dum5 etage

*** operating control variable family composition
tab samhh5
rename samhh5 huishoudsamenstelling
generate samenstelling = samhh5
tabulate samhh5, generate (dum)
rename dum1 eenpersoon
rename dum2 paar
rename dum3 paarmetkinderen
rename dum4 eenouder
rename dum5 nietgezin

** operating control variable age
tab leeftijd
tabulate leeftijd, generate (dum)
rename dum1 leeftijd1
rename dum2 leeftijd2
rename dum3 leeftijd3
rename dum4 leeftijd4
rename dum5 leeftijd5
rename dum6 leeftijd6
rename dum7 leeftijd7

**operating control variable education level
tab vltoplop5
generate opleiding = vltoplop5
tabulate opleiding, generate (dum)
rename dum1 opleiding1
rename dum2 opleiding2
rename dum3 opleiding3
rename dum4 opleiding4
rename dum5 opleiding5
```

```
drop dum6

**operating variable desire to move out
sum verhwens
tab verhwens
generate verhuis = verhwens
recode verhuis 1=0 2/5=1
tab verhuis

**** binary logitstic regression test condition ****

** checking correlation Pearson's correlation coefficient
correlate labeldummy constructie gebruiksopp inkomen wozwaarde urbaan woontype samenstelling leeftijd
opleiding verhuis

** checking VIF-test
logit labeldummy constructie2 constructie3 constructie4 constructie5 constructie6 constructie7 woz2 woz3 woz4
woz5 woz6 woz7 urbaan tweeondereen hoek tussenoverig etage inkomen2 inkomen3 inkomen4 inkomen5 paar
paarmetkinderen eenouder nietgezin leeftijd2 leeftijd3 leeftijd4 leeftijd5 leeftijd6 leeftijd7 opleiding2 opleiding3
opleiding4 opleiding5 verhuis koopwoning woningcorporatie institutionelebelegger privatebelegger
oppervlakte2 oppervlakte3 oppervlakte4 oppervalkte5 oppervalkte6 oppervlakte7
vif, uncentered

**** binary logistic regressions ****

** binary logistic regression baseline model
logit labeldummy constructie2 constructie3 constructie4 constructie5 constructie6 constructie7 woz2 woz3 woz4
woz5 woz6 woz7 urbaan tweeondereen hoek tussenoverig etage inkomen2 inkomen3 inkomen4 inkomen5 paar
paarmetkinderen eenouder nietgezin leeftijd2 leeftijd3 leeftijd4 leeftijd5 leeftijd6 leeftijd7 opleiding2 opleiding3
opleiding4 opleiding5 verhuis oppervlakte2 oppervlakte3 oppervlakte4 oppervalkte5 oppervalkte6 oppervlakte7
mfx

** binary logistic regression main model, dependent variable labeldummy
logit labeldummy constructie2 constructie3 constructie4 constructie5 constructie6 constructie7 woz2 woz3 woz4
woz5 woz6 woz7 urbaan tweeondereen hoek tussenoverig etage inkomen2 inkomen3 inkomen4 inkomen5 paar
paarmetkinderen eenouder nietgezin leeftijd2 leeftijd3 leeftijd4 leeftijd5 leeftijd6 leeftijd7 opleiding2 opleiding3
opleiding4 opleiding5 verhuis koopwoning woningcorporatie institutionelebelegger privatebelegger
oppervlakte2 oppervlakte3 oppervlakte4 oppervalkte5 oppervalkte6 oppervlakte7
mfx

** binary logistic regression main model, dependent variable labelvlpdummy
logit labelvlpdummy constructie2 constructie3 constructie4 constructie5 constructie6 constructie7 woz2 woz3
woz4 woz5 woz6 woz7 urbaan tweeondereen hoek tussenoverig etage inkomen2 inkomen3 inkomen4 inkomen5
paar paarmetkinderen eenouder nietgezin leeftijd2 leeftijd3 leeftijd4 leeftijd5 leeftijd6 leeftijd7 opleiding2
opleiding3 opleiding4 opleiding5 verhuis koopwoning woningcorporatie institutionelebelegger privatebelegger
oppervlakte2 oppervlakte3 oppervlakte4 oppervalkte5 oppervalkte6 oppervlakte7
mfx

** binary logistic regression main model, dependent variable labelfocusdummy
logit focusdummy constructie2 constructie3 constructie4 constructie5 constructie6 constructie7 woz2 woz3
woz4 woz5 woz6 woz7 urbaan tweeondereen hoek tussenoverig etage inkomen2 inkomen3 inkomen4 inkomen5
paar paarmetkinderen eenouder nietgezin leeftijd2 leeftijd3 leeftijd4 leeftijd5 leeftijd6 leeftijd7 opleiding2
opleiding3 opleiding4 opleiding5 verhuis koopwoning woningcorporatie institutionelebelegger privatebelegger
oppervlakte2 oppervlakte3 oppervlakte4 oppervalkte5 oppervalkte6 oppervlakte7
mfx

** binary logistic regression main model, dependent variable labelfocusvlpdummy
logit focusvlpdummy constructie2 constructie3 constructie4 constructie5 constructie6 constructie7 woz2 woz3
woz4 woz5 woz6 woz7 urbaan tweeondereen hoek tussenoverig etage inkomen2 inkomen3 inkomen4 inkomen5
paar paarmetkinderen eenouder nietgezin leeftijd2 leeftijd3 leeftijd4 leeftijd5 leeftijd6 leeftijd7 opleiding2
```

opleiding3 opleiding4 opleiding5 verhuis koopwoning woningcorporatie institutionelebelegger privatebelegger oppervlakte2 oppervlakte3 oppervlakte4 oppervalkte5 oppervalkte6 oppervlakte7
mfx

*** descriptive statistics in-dept interview ***

** variable indicating if a renter agrees to pay more rent for an more energy efficient home
sum huurenerg
tab huurenerg
histogram huurenerg
tab huurenerg if woningcorporatie ==1
tab huurenerg if institutionelebelegger ==1
tab huurenerg if privatebelegger ==1

** variable indicating if the participant finds the property energy efficient
sum zuinigstel1
tab zuinigstel1
histogram zuinigstel1
tab zuinigstel1 if koopwoning ==1
tab zuinigstel1 if woningcorporatie ==1
tab zuinigstel1 if institutionelebelegger ==1
tab zuinigstel1 if privatebelegger ==1

** variable indicating if the participant thinks the property should be more energy efficient
sum zuinigstel2
tab zuinigstel2
histogram zuinigstel2
tab zuinigstel2 if koopwoning ==1
tab zuinigstel2 if woningcorporatie ==1
tab zuinigstel2 if institutionelebelegger ==1
tab zuinigstel2 if privatebelegger ==1

** variable indicating whether the participant thinks sustainable homes contribute to a liveable earth
sum zuinigstel3
tab zuinigstel3
histogram zuinigstel3
tab zuinigstel3 if koopwoning ==1
tab zuinigstel3 if woningcorporatie ==1
tab zuinigstel3 if institutionelebelegger ==1
tab zuinigstel3 if privatebelegger ==1

** variable indicating the main reason of implementing the energy saving measure(s) for owner occupiers
sum belangener
tab belangener
histogram belangener
tab belangener if focus ==1
tab belangener if focus ==0

** variable indicating for what reason(s) no energy saving measures have been implemented in the past 5 year
tab redgeenem1
tab redgeenem2
tab redgeenem3
tab redgeenem4
tab redgeenem5
tab redgeenem6
tab redgeenem7
tab redgeenem8
tab redgeenem9

** variable indicating which energy saving measures have been implement in the past 5 year

tab enerzmaat1
tab enerzmaat2
tab enerzmaat3
tab enerzmaat4
tab enerzmaat5
tab enerzmaat6