Spend to Save?

Factors of influence on owner-occupiers' energy saving investments in Dutch policy

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Abstract

Climate change and fossil fuel depletion call for the decarbonisation of the energy system. Thermal energy consumption in owner-occupied households has a substantial share in total energy use. Thermal energy saving in the existing housing stock is key to the process of decarbonisation. This study therefore aims to provide insight into the extent to which Dutch policies consider factors that are of influence on the decision-making process of owner-occupiers whether or not to invest in thermal energy saving measures. The factors of influence are identified from the literature and compiled into a conceptual model structured by seven categories, i.e. regulatory factors, financial factors, informational factors, contextual factors, household characteristics, building characteristics, and social factors. Policy documents from Dutch national government and the local governments of Amsterdam, Rotterdam, The Hague and Utrecht are qualitatively analysed for these factors of influence. Especially household characteristics are found to be underrepresented while the focus is mainly on financial and informational factors. Governments are recommended to elaborate and extent their policies by including all factors. For future research conducting a Dutch all-factor study to perfect the conceptual model is recommended. Moreover, in further experimental studies particular attention should be given to synergies that can come from combining building and household characteristics with the social norm. At last, for a more complete assessment of factor use in Dutch policy an extended interview oriented study is suggested.

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1. Introduction

Although climate change is only one of the world's environmental problems, it is probably today's best known and most debated problem. Our energy system is one of the large causes of climate change since it is primarily based on fossil fuels and thereby on the emission of the greenhouse gas CO_2. Reducing fossil fuel use is not only necessary to mitigate climate change, but also because fossil fuels will eventually become depleted and an alternative energy system has to be realised before that happens. The European Union (EU) is committed to reduce greenhouse gas emissions up to 95% below 1990 levels in 2050. Replacing fossil fuels by sustainable energy alternatives is therefore necessary, but saving energy is key in the process of decarbonisation (European Commission, 2011).

Making new and existing buildings more energy efficient can make a large contribution to this energy saving objective. The EU stated that 'nearly zero energy buildings' should become the norm and that investments made by households and companies have a major role to play in the transformation of the energy system (European Commission, 2011). In the Netherlands households use the largest portion of their energy consumption for space heating (Menkveld, 2009; Van Dril et al., 2012). Many houses were built before any energy efficiency requirements were in place and are therefore badly insulated. To illustrate, houses built before 1945 use almost twice as much energy for space heating than houses built after 2006 (Vreenegoor et al., 2008).

It is thus important to make buildings more thermally efficient. For new houses this is easier as they can be designed to be optimally thermally efficient. The passive house is an example of such an efficiently designed building. Heat from the sun, internal heat sources and heat recovery are all used to reduce active heating up to 90% compared to existing houses (Passive House Institute, n.d.). For existing dwellings these large savings are often not feasible. A thermal retrofit is nonetheless possible and essential in order to save energy in the existing housing stock. By means of better insulation and more efficient heating systems, less thermal energy is then required to heat the living space up to a comfortable temperature. Implementation of such energy saving measures in the Dutch existing housing stock is estimated to have an energy savings potential ranging from 20% up to 68,5% by the year 2030 (Eichhammer et al., 2009; Tuominen et al., 2012).

With more than 56% of Dutch dwellings being privately owned (Centraal Bureau voor de Statistiek, 2014) it is especially important to persuade this heterogeneous group of owner-occupiers to invest in energy saving measures. Policy in the Netherlands to stimulate owner-occupiers to invest in such measures exists. But by what means are people stimulated and persuaded to make the investment? And, does the policy cover all import factors that play a role in the decision-making process of owner-occupiers whether or not to invest in thermal energy saving measures? And what are those important factors? The objective of this paper is to provide insight in these questions by answering the following research question: *to what extent are different factors, that influence owner-occupiers' decision making on investments in thermal energy saving measures, considered in Dutch policy(ies)?*

Numerous studies have identified a multitude of factors that influences energy saving investments. Yet, no widely accepted and all encompassing model of those factors exists. Neither have Dutch policies been analysed for the use of these factors on a large scale before. Hence, this study can prove relevant for both a better scientific understanding of significant factors in the decision-making process of owner-occupiers and a more practical understanding of what factors are accounted for in Dutch policies.

The remainder of this paper is structured as follows: first, the scope of the study will be described in further detail. Then, the literature review is discussed together with the factors that were identified. The conceptual model is presented subsequently. Thereafter, the methodology of the analysis and data collection is described whereupon the results of the analysis are presented. At last, the final conclusions of the paper are discussed as well as the results and limitations of the study to finish with some recommendations for future research.

2. Theoretical framework

2.1. Scope

This study focuses on the energy saving investment measures in the process of decarbonising the thermal energy consumption in the Dutch existing housing stock. To put this in context, the process of decarbonisation is now discussed. The first step [1] in the process is saving energy so that the least possible active heating is required. Two types of measures are distinguished in the literature in order to save energy. The first type is labelled as behavioural or non-investment measures (Nair et al., 2010; Poortinga et al., 2003). These measures require a change in the residents' behaviour, but do not require a capital investment. Examples of such measures are switching off lights when not needed, and, in the context of thermal energy, turning down the heat.

The second type of measures is labelled as technical or investment (oriented) measures (Nair et al., 2010; Poortinga et al., 2003). Unlike the non-investment measures this type does require a substantial initial capital investment from the owner-occupier, but no changes in the residents' behaviour. Technical or investment measurements can be taken in the building envelope of the house where they include insulation of outer walls, roofs and window glazing. Also, an investment can be made in more energy efficient installations and appliances such as an energy efficient heating system (Mills & Schleich, 2012; Nair et al., 2010).

Step two [2] in the process of decarbonising thermal energy use is to fulfil the remaining thermal energy demand in a sustainable way (e.g. biomass or heat pumps). The majority (86%) of the Dutch housing stock is heated with fossil natural gas (Van Dril et al., 2012). Another investment may thus be required to replace the existing heating system with a sustainable alternative. **Figure 1** tries to visualise the process of decarbonisation schematically.

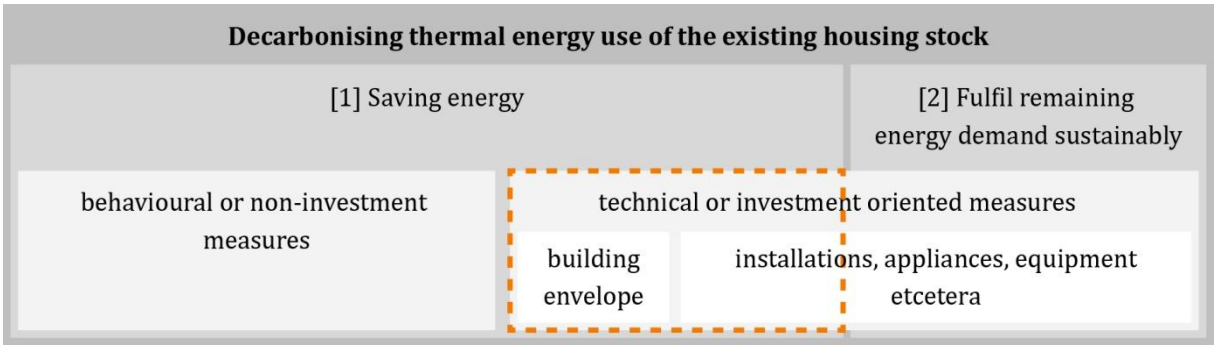

Figure 1] *Schematic representation of the decarbonisation process*

This study is limited to the investment measures in the energy saving step as framed in **Figure 1** for several reasons. First, especially investment measures can contribute significantly to the decarbonisation process. Second, factors that influence whether or not measures are adopted by owner-occupiers may differ substantially between the investment and non-investment measures and thus require a different theoretical framework. The same is true for investment measures in step two. Because no money can be saved as a result of energy savings these investments may be based on different considerations. More efficient heating systems can however save energy and be sustainable at the same time. So an overlap between step one and two exists. Finally, the study is limited to owner-occupiers of existing houses in the Netherlands.

2.2. Literature review

Many studies have been done on the incentives, barriers and factors of influence on owner-occupiers' decision to invest in energy saving measures. It is now tried to compose a conceptual model that aggregates the insights of the different studies reviewed. As we are interested in factors of influence that apply to Dutch owner-occupiers, several studies on the Netherlands are included (Murphy, 2014; Poortinga et al., 2003; Tuominen et al., 2012). Further, only western

developed countries were included so that the insights are more likely to be applicable to the Netherlands as well. **Table 3** in the appendix gives an overview of the reviewed literature.

2.2.1. Factor analysis

Some authors (e.g. Tuominen et al., 2012) use the barrier model to explain what keeps people from not investing in energy saving measures. This model assumes that owner-occupiers act as rational economic agents making decisions in the area of energy consumption (Murphy, 2014). As a consequence many policies in this field are designed to overcome the two most prominent barriers in literature, i.e. the information deficit and the financial barrier (Hoicka et al., 2014). Murphy's study (2014) on the – apparently not significant – influence of energy audits substantiates that overcoming these barriers is not enough to persuade owner-occupiers to make investments. Also, many of the other studies reviewed show significant correlations and variations between more soft or non-rational factors. Hence, this paper will identify the factors of influence on the decision-making process and not take the barrier perspective.

2.2.2. Dependent variable

Although the potential energy savings may be different for every house, a successful policy should be able to persuade owner-occupiers to invest as much as needed to exploit the full savings potential. The success of policies depends however on the ambitions set by politicians. Hence, the dependent variable in the conceptual model is defined as *the extent to which Dutch owner-occupiers invest in thermal energy saving measures.*

2.2.3. Independent variables: seven types of factors

For many factors their influence on making energy saving investments has been studied. Some studies only consider a couple of factors where others consider a broad range of factors. No generally used categorisation of the different factors is available. Therefore a new categorisation of seven types of factors was constructed based on the reviewed literature, i.e. regulatory factors, financial factors, informational factors, contextual factors, household characteristics, building characteristics, and social factors.

2.2.3.1. Regulatory factors

Tuominen et al. (2012) are the only authors who address regulatory factors and they approach them as barriers. Their study is a multi-stakeholder study that includes, amongst others, homeowners. Only two identified factors may be relevant in the decision-making process of owner-occupiers: the **clarity and consistency of regulations**. If regulations are unclear or change frequently, they may act as barriers.

2.2.3.2. Financial factors

Investment oriented measures do ask for a significant investment up to tens of thousands of euros (Minnesma, 2014). People are less likely to invest the higher the **investment costs** get because they simply cannot afford greater investments (Achtnicht & Madlener, 2014). Also, if **energy costs** of the house are high, perceived as such or are expected to rise in the near future, it is more likely that the owner-occupier invests (Achtnicht & Madlener, 2014; Hoicka et al., 2014; Nair et al., 2010). Associated with this factor is the **energy savings potential**. The greater the potential, the more money can be saved, the more likely people are willing to invest. The same effect stems from **funding and rebating**. If the government (partially) funds the investment or promises rebates, people become more eager to invest their own money as well (Achtnicht & Madlener, 2014; Gamtessa, 2013). Summarising, owner-occupiers act economically considering the financial factors mentioned so far: though people are willing to invest, they want to invest as less as possible and save as much as possible.

Nevertheless, also a less rational **payback uncertainty** factor is of influence. Investments in energy saving measures tend to have a relatively long payback period up to several decades (Achtnicht & Madlener, 2014; Minnesma, 2014). People may consider these periods too long (Murphy, 2014) and a longer payback period has a negative effect on the

likeliness of investment (Achtnicht & Madlener, 2014). If people are given guarantees on the lifetime of their investments, willingness to invest increases (Achtnicht & Madlener, 2014). The payback uncertainty may also be caused by uncertainty about the length of residence. If people move before the payback period expires, they might not naturally recover their remaining investment through the selling price of the house (Murphy, 2014).

2.2.3.3. Informational factors

Awareness of energy use and efficiency is an important factor in the information deficit observed with many owner-occupiers. Those who are unaware of too high energy consumption and assume their house to be adequately energy efficient will not easily invest to improve energy performances (Achtnicht & Madlener, 2014; Hoicka et al., 2014; Murphy, 2014). Even if owner-occupiers are aware of underperforming energy efficiency they may not be **aware of available measures** to improve (Nair et al., 2010). Independent expert recommendations on what measures to invest in might have a positive effect on actual investments made (Achtnicht & Madlener, 2014).

2.2.3.4. Contextual factors

An important contextual factor is the **accessibility of a measure**. This refers to the easy and local availability of the measures and a contractor to execute them (Hoicka et al., 2014). It resembles what Tuominen et al. (2012) describe as the organisational barrier that occurs when the coordination and organisation of measures, for example at a building company, is not smooth. Murphy (2014) also recognises that some people may consider it a hassle to implement measures. Easy accessibility of investment measures can lower this threshold.

Further, people may have other **competing priorities** that make them unlikely to take interest in saving energy (Hoicka et al., 2014). If owner-occupiers invested in energy saving measures before, they are more likely to invest again in additional measures. Although this was the result from the study by Nair et al. (2010), the authors recognise that **previous investments** can also negatively influence new investments because the owner-occupier might think the house is adequately energy efficient or has invested all available resources.

2.2.3.5. Household characteristics

Achtnicht and Madlener (2014)**,** and Hoicka et al. (2014) state that people concerned about the environment and sympathetic towards reducing energy use are more likely to invest in energy saving measures (Nair et al., 2010). This effect is not unambiguous according to Poortinga et al. (2003) since **environmentally aware** people are more likely to take non-investment measures than investment measures. For example, these people will easier turn down the heat than invest money in a new efficient heating system. Poortinga et al. (2003) think this might be the result of the fact that these behavioural changes are, unlike investment measures, socially expected from environmentally aware people.

Higher **education** results in more investments according to Nair et al. (2010), Mills and Schleich (2012). The study of Gamtessa (2013) finds a reverse effect, namely: the higher the education the less likely people are to invest. It is suggested that high educated people have a higher **income**, whereby energy costs comprise too small a share of expenditures to incentivise investments. This is also contradicted by the studies of Achtnicht and Madlener (2014), Nair et al. (2010), and Poortinga et al. (2003) that all show a positive correlation between income and investments made.

Nair et al. (2010) conclude that those households with a **technically skilled member** are more likely to invest in energy saving measures. Moreover, the **household composition** in general is of influence: the more family members the less likely an investment; the more members over 19 the more likely an investment gets (Gamtessa, 2013); and people with children under 12 are more likely to invest than singles and elderly (65+) (Achtnicht & Madlener, 2014; Poortinga et al., 2003). The **age** may have to do with payback uncertainty. Older people might not expect to live long enough to recover their investment.

Finally, the **geographic location** seems to play a role in the decision-making process. This effect was observed in Sweden and Germany by Nair et al. (2010) and Achtnicht and Madlener (2014) respectively. The authors try to explain this by differences in local accessibility of measures and differences in information provision by local authorities. Also, investments were lower in the Stockholm area which might be caused by an urban lifestyle without time to go through the trouble of a retrofit (Nair et al., 2010).

2.2.3.6. Building characteristics

Owner-occupiers of older houses and houses with older heating systems are more likely to make investments (Achtnicht & Madlener, 2014; Nair et al., 2010). This **age of the building or equipment** factor may be connected with a **need for renovation**. If such a need was detected, people were more likely to invest. In addition, if residents have a **need for more thermal comfort**, thermal energy saving measures like insulation become more attractive (Achtnicht & Madlener, 2014). At last, Gamtessa (2013) also found that the **architecture** of the house plays a role. Owners of larger houses, multi-floor houses and houses with a complex shape (more than six corners) are less likely to invest.

2.2.3.7. Social factors

Bollinger and Gillingham (2012) show in their study that the installation of photovoltaic panels significantly increased the probability of adoption of photovoltaic panels for homes in the same region. The simulation study by Bale et al. (2013) indicates that this social network effect exists for insulation measures as well, although it is less strong due to the fact that insulation is not visible whereas photovoltaic panels are. Behavioural science recognises that people are sensitive to the **social norm** and are more likely to take energy saving measures when they underperform compared to their peers. For non-investment measures these social norms are even more determinative for peoples' behaviour than any other factor (Nolan et al., 2008).

2.3. Conceptual model

The conceptual model is shown in **Figure 2** and includes all factors discussed above clustered in the seven categories. All factors influence the central dependent variable positively or negatively as indicated by green or red respectively. Literature is not unequivocal about the influence of income, education, environmental awareness and previous investments. Therefore these factors are indicated by both red and green. For the social norm, geographic location, household composition and architecture no simple correlating relation exists. Moreover, the applicability of the architecture factor to the Netherlands is doubted since it was only found in a Canadian study (Gamtessa, 2013) where architecture and building traditions are quite different. Architecture may however be of influence indirectly through investment costs, because more complex and larger buildings might require a larger investment.

Further, more relations between individual factors exist. Education might influence environmental awareness and income. Income might influence household composition and will probably control the strength of the financial factors, i.e. a higher income might make financial factors less important. Age can increase payback uncertainty especially in the older age group. The geographic location may partially determine how well informed people are and how easy measures can be accessed. At last, the age of a building or equipment may positively correlate with the need for renovation.

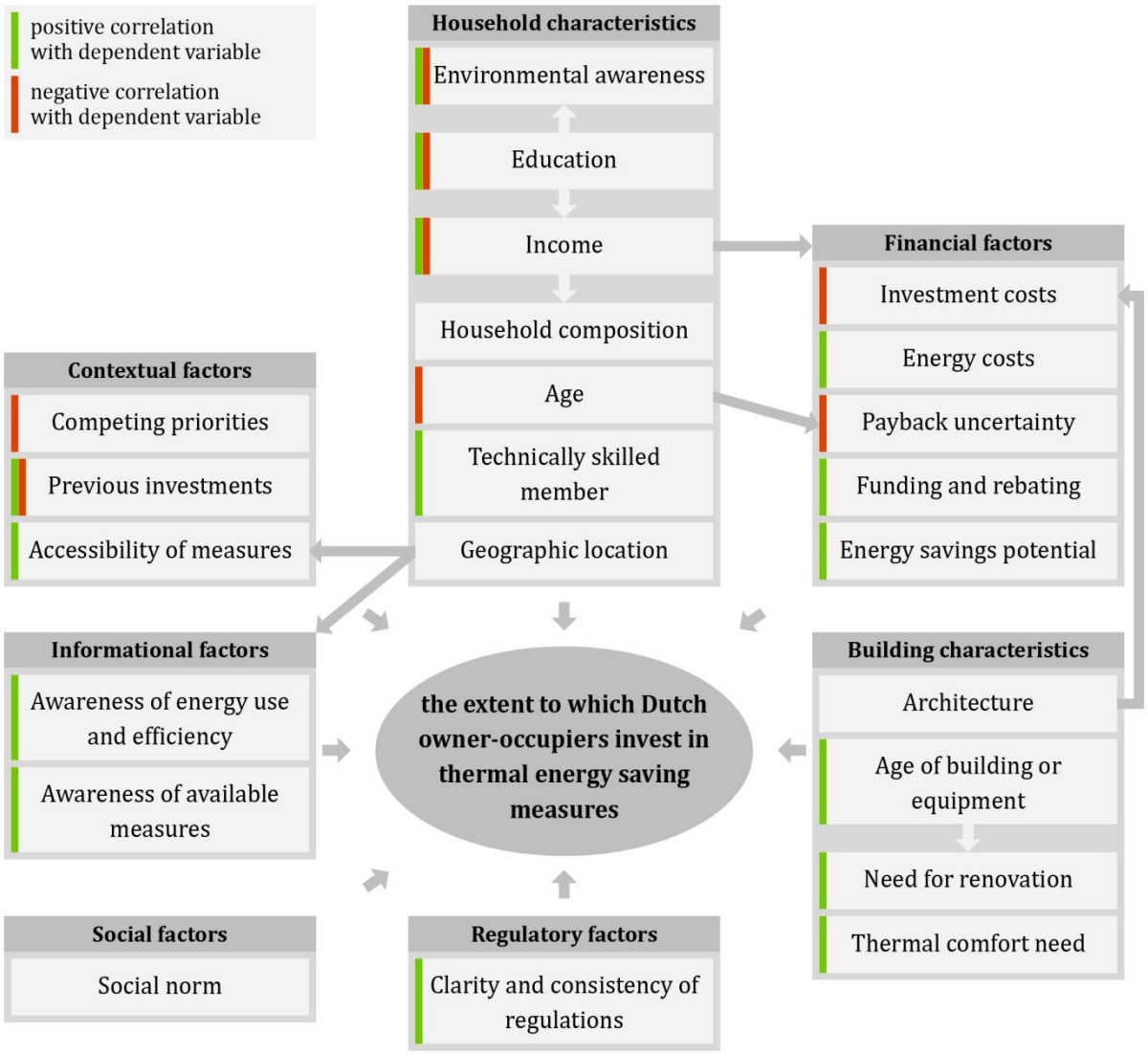

Figure 2] *Conceptual model*

3. Methodology

Now that all factors of influence are identified their occurrence in Dutch policies has to be assessed. Therefore a qualitative content analysis has been performed including policy documents from the Dutch national government and the local governments of the four largest cities in the Netherlands, i.e. Amsterdam, The Hague, Rotterdam and Utrecht. The policy documents included from the national government are agreements with other parties from society and industry. The national targets, ambitions and guidelines set are elaborations of the EU directives. Subsequently, these national policies have to be elaborated, executed and possibly extended by local governments who have a major role in energy and housing policy. The four largest cities are most likely to have a detailed policy on this matter and are together the residence of over 9% of Dutch owner-occupiers (Centraal Bureau voor de Statistiek, 2014). They are therefore included in this study.

Stimulation of thermal energy saving investments with owner-occupiers is without exception just a small part of a larger policy on energy, climate, housing or sustainability. First, for each government the relevant policy documents on these overarching topics were identified. The total of nine documents analysed are publicly available and retrieved from the authorities' websites. A list of documents that are included is presented in **Table 1**.

National policy documents		
Short reference	**Title**	**Reference**
Koepelconvenant	*Koepelconvenant: energiebesparing gebouwde omgeving*	(Rijksoverheid, 2012)
Energieakkoord	*Energieakkoord voor duurzame groei*	(Sociaal-Economische Raad, 2013)
Meer met minder	*Meer met minder: convenant energiebesparing bestaande woningen en gebouwen*	(Rijksoverheid, 2013)
Local policy documents		
Short reference/city	**Title**	**Reference**
Amsterdam	*Wonen in de metropool: woonvisie Amsterdam tot 2020*	(Gemeente Amsterdam, 2009)
Amsterdam	*Jaarverslag 2013: klimaat en energie*	(Gemeente Amsterdam, 2014)
The Hague	*Bestaande woningen: duurzame woningen!*	(Gemeente Den Haag, 2010)
The Hague	*Klimaatplan Den Haag: op weg naar een duurzaam Den Haag*	(Gemeente Den Haag, 2011)
Rotterdam	*RCI actieplan energie: Rotterdamse uitwerking van het nationale energieakkoord voor duurzame groei*	(Rotterdam Climate Initiative, 2013)
Utrecht	*Programma Utrechtse Energie: 2011-2014*	(Gemeente Utrecht, 2011)

Table 1] *List of policy documents included in the analysis*

To limit the amount of text to be included in the analysis, those parts relevant for this study were identified by either the tables of content or a quick document search for 'energy savings' ('energiebesparing'), owner-occupiers ('particulieren') and similar terms. In the remaining parts of the policy documents, measures or phrases are linked to the relevant factor in the conceptual model. The qualitative data analysis software NVivo is hereby utilised to structure the data in accordance with the individual factors and their categories. **Table 4** in the appendix specifies for each policy document what sections were analysed and what factors were found within these sections.

It has to be noted, that active measures cannot be taken for all factors. Some are just given conditions of the intended investments or the target group (e.g. age), i.e. the contextual factors (except accessibility of measures), building and household characteristics (except environmental awareness), energy savings potential, investment and energy costs. No realistic instruments exist for government to actively influence these factors. Nevertheless, the importance of these factors can be recognised and reckoned with in policies. Therefore a distinction is made in the analysis between the mere recognition of factors and the actual dealing with factors by taking measures. For each factor it is then counted by how many governments – from the total of five (one national and four local) – it is either recognised or a measure is taken. This is shown in **Table 2** both numerically and by means of colour for a quick overview of the results. Four categories are thereby used, i.e. no government (none), some governments, most governments and all governments.

4. Results

The results of the content analysis will now be presented. Since the study does not aim to identify what factors are considered by what particular governments, but the considered factors in Dutch policy in general, the results are structured according to the seven factor categories. **Table 2** gives an overview of the factors and in how many governments' policy documents they were found. Details about what factors were found in what policy documents are shown in **Table 4** in the appendix.

4.1. Regulatory factors

In the 'Koepelconvenant' the importance of communicating **consistently** to citizens by the involved parties is acknowledged. The Hague and the 'Meer met minder' agreement point out that initiatives from local government should strengthen other governmental and societal

initiatives and not counteract them. In addition, The Hague acknowledges that the clarity of governmental services to citizens – e.g. subsidies – is not always **clear** and should be improved. Rotterdam aims to identify regulatory issues that impede large scale implementation of energy saving measures. Nevertheless, none of the governments seems to have taken measures to assure clear and consistent regulations.

Factors	Recognised	Measures taken*
Regulatory factors		
Clarity and consistency of regulations	3	0
Financial factors		
Investment costs	3	n/a
Energy costs	5	n/a
Energy savings potential	0	n/a
Funding and rebating	5	5
Payback uncertainty	3	3
Informational factors		
Awareness of energy use and efficiency	5	5
Awareness of available measures	5	5
Contextual factors		
Accessibility of measures	4	2
Competing priorities	1	n/a
Previous investments	0	n/a
Household characteristics		
Age	0	n/a
Education	0	n/a
Environmental awareness	1	0
Geographic location	0	n/a
Household composition	0	n/a
Income	1	n/a
Technically skilled member	0	n/a
Building characteristics		
Age of building or equipment	1	n/a
Architecture	1	n/a
Need for renovation	2	n/a
Thermal comfort need	4	n/a
Social factors		
Social norm	2	2
Other factors		
Legal instruments	2	1
Owners association	5	n/a

Legend				
Number of governments	0 none	1-2 some	3-4 most	5 all

Table 2] *Overview of factor inventory*

** Governments that take measures automatically recognise that factor as well which results in double counting in the second and third column.*

4.2. Financial factors

Payback uncertainty is recognised by all the governments analysed except for Amsterdam and Rotterdam. It is perceived to be caused primarily by the length of the payback period and uncertainty about the length of residence. Governments recognise the difficulty of a large **initial investment**. National policy documents all plan to provide quality guarantees that assure owner-occupiers energy savings will actually be realised and investments are paid back. The

national 'Energieakkoord', Utrecht and The Hague see providing profitable funding constructions – such as a house-related loan – as a way to reduce uncertainty.

All governments took measures to **fund or rebate** owner-occupiers by subsidies (Amsterdam, Utrecht, The Hague), subsidised loans (Amsterdam, The Hague, Koepelconvenant), revolving funds (Utrecht, Koepelconvenant, Energieakkoord), funding constructions with third parties – e.g. banks (Utrecht, Rotterdam, Energieakkoord), and tax rebates (WOZ) for more efficient houses (The Hague). Some of these measures are for thermal retrofits in general where others are for specific investments such as floor insulation only. In addition, several governments point out that besides national and local also provincial and European funding options are available.

Some governments use the **energy savings potential** to prioritise their approach, but it is not explicitly recognised as a factor of influence to individual owner-occupiers. Nevertheless, all governments recognise the possibility for owner-occupiers to save on **energy costs** and possible rising costs as a incentive to invest.

4.3. Informational factors

The EU increasingly requires energy labels for houses. This label provides information and hopefully creates awareness about energy efficiency. All Dutch governments have to deal with energy labels, but some take additional measures to raise owner-occupiers' **awareness of energy use and efficiency**. Utrecht and Amsterdam inform owner-occupiers directly about the energy performance of their house with help of thermal scans. Also, in the 'Energieakkoord' the ambition is set to implement smart meters on a large scale. These can provide insight in energy use.

All governments underscore the importance of providing information about **available measures** people can invest in. This is done by communication in general – e.g. through websites (all), providing free or easy accessible energy advice (Amsterdam, Meer met minder, Energieakkoord), example homes (Amsterdam, The Hague), energy information centres (Utrecht, The Hague, Energieakkoord), and even cooperation with construction stores (The Hague).

4.4. Contextual factors

Only The Hague explicitly recognises that investing in energy saving measures is most likely not a **priority** for owner-occupiers. Apart from Amsterdam, all governments speak of unburdening ('ontzorging') the owner-occupiers in the investment process. This does fit the **accessibility of measures** factor since the less an investment process is experienced as a burden, the more accessible a measure gets. Making information accessible and provide advice is one way of doing this. Additionally, national policies and Rotterdam want to develop an integrated standard package for thermal retrofits. In such a package different stakeholders in the supply chain, government and society work together to compose a cost effective package of measures that can be applied to many dwellings. This not only makes measures more accessible since owner-occupiers only have to deal with one complete package, it also reduces building time, investment costs and start-up troubles. In addition, the 'Energieakkoord' says that providing easy ways of funding and loan repayment – e.g. through the energy bill –increases the accessibility of investment measures as well.

4.5. Household characteristics

Household characteristics are underrepresented in Dutch policies compared to other factors. Although owner-occupiers are often approached as a separate group (e.g. Gemeente Den Haag, 2010), within this group little distinction is made. The Hague is the only one that considers income and environmental awareness as criteria to target neighbourhoods. The Hague assumes that higher income and higher environmental awareness increase the likeliness of an investment.

4.6. Building characteristics

The Hague explicitly recognises the relation between the **age of the building** and a **need for renovation**. Like The Hague, Rotterdam sees an opportunity to combine a need for renovation with investments in energy saving measures. Both cities see, like Utrecht and the 'Energieakkoord' do, the possibility for owner-occupiers to increase the **comfort** of living by investing in energy saving measures. Finally, The Hague recognises that **architecture** affects investment measures. It does not directly influence owner-occupiers' decisions, but it affects current energy efficiency and investment costs.

4.7. Social factors

The Hague wants to be an example for citizens by making public buildings more sustainable. Although this can have a positive effect on owner-occupiers, it is not the same effect that stems from the **social norm**. The Hague also wants to realise example homes that show people what an energy efficient house can be like. This is more like the social norm already, however, the most powerful will probably be example homes that are realised by owner-occupiers themselves. The Hague wants to work with these frontrunner owner-occupiers that can function as an example for people in the neighbourhood. Also Utrecht tries to work with ambassadors and ecoteams that are mainly meant to inform and inspire people. The focus is, however, not necessarily on investment measures. The Hague also invests in the 'klimaatstraatfeest' a national competition where streets can compete for a street party by saving as much energy as possible.

4.8. Other factors

Besides the factors from the conceptual model several governments were found to take into account additional factors of influence. First, The Hague wants to explore the possibilities of **legal instruments**, i.e. forcing owner-occupiers to invest in energy saving measures. Associated with this is the ambition set in the 'Koepelconvenant' to enhance energy performance requirements in Dutch building regulations ('bouwbesluit'). For existing houses these would first apply during renovations.

Second, all governments consider **owners associations** ('verenigingen van eigenaren') to be a different target group than individual owner-occupiers and thus requiring a different approach. For example, The Hague expects measures to be easier implemented by not associated owners, while, at the same time, owners associations provide opportunities for collective investments and different funding constructions.

5. Conclusion and discussion

This paper started by underscoring the importance for governments to stimulate owner-occupiers of the existing Dutch housing stock to invest in thermal energy saving measures since thermal energy consumption comprises a large share of the total national energy consumption and CO_2 emissions. From literature multiple factors of influence on the owner-occupiers' decision-making process were identified and aggregated into a conceptual model categorised as follows: regulatory, financial, informational, contextual and social factors, and building and household characteristics. The data was collected through a qualitative content analysis of policy documents of Dutch national government and the municipal governments of Amsterdam, The Hague, Rotterdam and Utrecht. From the results the research question *to what extent the identified factors are considered in Dutch policy* can be answered. In short, governments primarily focus on financial and informational factors. Additionally, the importance of clear and consistent regulations, accessible measures and the need for thermal comfort were recognised by the majority of governments. Other factors, especially household characteristics, are underrepresented in Dutch policies.

The observation that existing Dutch policies have a prime focus on providing information and funding to owner-occupiers is in accordance with the observations of Hoicka et al. (2014). Other financial factors, apart from the energy savings potential, are also widely recognised. Conversely, recognised factors were not restricted to financial and informational factors only.

Most governments were found to recognise the importance of clear and consistent regulations, accessible measures and the need for thermal comfort as well. Two governments even actively try to improve the accessibility of energy saving measures. The social norm is recognised as well, but only by some governments. Even then, the nature of social effects seems not to be fully understood as neighbours are primarily deployed for informational purposes only (e.g. through example homes).

Particularly underrepresented at all governments are household characteristics of which only income and environmental awareness are recognised. The same holds for competing priorities, previous investments and building characteristics other than thermal comfort need. An explanation for this lack of recognition may be the fact that, as discussed in section 3, governments cannot actively influence these factors. It is hard to imagine that any government would deny the importance of a sufficient income for owner-occupiers in order to invest in energy saving measures. It is thus likely that at least a part of these underrepresented factors are in fact recognised, but just not explicitly mentioned in policy documents.

The general impression from the policies analysed is that policy specifically aimed at stimulating owner-occupiers to invest in thermal energy saving measures comprises only a small part of larger policy programmes. Only The Hague (2010) stands out with a rather elaborate policy document that recognises more factors than any other document analysed. For all governments it is recommended to further elaborate policies and consider a broader range of factors. This study could hereby be of help.

Even with some interesting findings, this study has its limitations. First, the scope is limited to just one, yet significant, part of the decarbonisation of the thermal energy use in the housing stock. Additionally, this study is only relevant for the privately owned part of the Dutch existing housing stock (>56%). Although these set limitations were justified earlier, it might prove useful to conduct a more integrated study into the entire set of factors of influence on all parts of the decarbonisation process and housing market. In such a study also investments in sustainable energy should be included as well as social housing corporations, other rental houses and the construction of new houses. Other studies have tried to include multiple parts of the decarbonisation process or the housing market, but have not yet managed to include all aspects in a single research. This study could be valuable input for such a study.

Second, despite the clear scope of this paper it was not always possible to find the same demarcations in the policy documents evenly clear. Some governments (e.g. Rijksoverheid, 2012) do not always noticeably make a distinction between investment measures and non-investment measures or between their approach towards owner-occupiers at one hand and, for example, housing corporations at the other. In these cases, whether or not to attribute a factor to a government had to be inferred from the context of the respective phrase.

Further, the conceptual model has its own limitations. It is not yet clear for every factor what its effect on owner-occupiers' decisions is – especially those indicated by both red and green in the model. Some factors are only found in a single study and therefore still contestable (e.g. technically skilled member). Furthermore, two additional factors were found in the policy documents, i.e. legal instruments and owners associations. It is however debatable whether these factors should be incorporated in the conceptual model. The model aims to visualise the factors of influence on owner-occupiers' decision-making process on energy saving investments. Legal instruments would however make a decision-making process obsolete since no choice remains to be made. As the legal instrument factor seems to eradicate the role of all other factors it seems unreasonable to include it in the conceptual model. The distinction made in policies between individual owner-occupiers and owner-occupiers associated in owners associations, is probably justified and to be maintained as dynamics in such associations may be different from individual owner-occupiers' decision-making process. It is not reasonable to include owners associations as a factor in the conceptual model – thus only applicable to individual owner-occupiers – either.

This study provides a first insight into the extent to which Dutch policies consider the factors of influence. It would be useful to extend this research with more local governments for a more complete result. The four largest Dutch cities included in this study all embedded policy on

owner-occupiers' energy saving investments in large policy programmes on climate, energy, housing or sustainability. Smaller local governments are unlikely to have such ambitious programmes and hence unlikely to have a policy on owner-occupiers' energy saving investments other than what is imposed from the national level. Moreover, it is likely that not all factors recognised are explicitly mentioned in policy documents. A more nuanced and more complete impression from Dutch policies may be obtained by extending the analysis with interviews with policymakers and including a broader range of local governments.

Besides extending this study with more local governments and embedding it in an integrated research on the decarbonisation of thermal energy consumption, some other recommendations for future research can be done. First, further research is needed to consolidate the conceptual model and test its applicability to the Netherlands. In the current model the different factors are considered of equal importance. In reality this might not hold true and a certain hierarchy of factors might exists. More factors of influence and relations between individual factors might exist as well. Conducting a Dutch study including all factors aggregated in this paper's conceptual model with special attention to mutual relations between factors might gain insight into some of these matters.

Second, especially social factors require more research. The social norm is known to be particularly strong in behavioural changes. Bale et al. (2013), Bollinger and Gillingham (2012) have shown that the effect may exist for investment measures like insulation and photovoltaics as well, but more research is needed to confirm the effect and increase the understanding of how it works and how it can be employed by governments. Bale et al. (2013) observe for example that even the presence of a certain amount of randomly spread thermally retrofitted houses in a neighbourhood can result in an increase in investments by other neighbours. There might be opportunities for governments to use building and household characteristics to target the most promising owner-occupiers for first investments in order to reach a critical mass of retrofitted houses in a neighbourhood after which more investments by other neighbours will take place without further governmental intervention. Though promising, the feasibility of this opportunity needs more research before concrete policies in this direction can be designed. Altogether, much more remains to be done by both researchers and governments to make owner-occupiers spend in order to save.

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Appendix

Article reference	Country(ies)	Details
Achtnicht & Madlener (2014)	*Germany*	*Data from 2009* *> 400 respondents* *Owner-occupiers of single-family detached, semidetached, and row houses*
Bale, McCullen, Foxon, Rucklidge, & Gale (2013)	*UK, Leeds*	*Data from May-June 2011* *1068 respondents* *Domestic households*
Gamtessa (2013)	*Canada*	*Data from 2003-2008* *> 181.000 homeowners*
Hoicka, Parker, & Andrey (2014)	*Canada*	*Data from 1999-2011* *13429 homeowners*
Mills & Schleich (2012)	*EU (Belgium, Bulgaria, The Czech Republic, Denmark, France, Greece, Hungary, Portugal, Romania and Germany) and Norway*	*Data from 2007* *4915 households*
Murphy (2014)	*The Netherlands*	*Data from March 2012* *3737 + 1779 Private owner-occupied households*
Nair et al. (2010)	*Sweden*	*Data from 2008* *1054 Home owners of detached houses*
Nolan, Schultz, Cialdini, Goldstein, & Griskevicius (2008)	*California, USA*	*Data from October 2003 – January 2004* *810 + 981 households*
Poortinga et al. (2003)	*The Netherlands*	*Data from October and November 1999* *455 respondents*
Tuominen, Klobut, Tolman, Adjei, & De Best-Waldhober (2012)	*Bulgaria, the Czech Republic, Denmark, Finland, Germany, Latvia, the Netherlands, Portugal, the United Kingdom and Belgium*	*Diverse data* *Homeowners*

Table 3] *Overview of the reviewed literature*

Policy document title	Relevant section(s) analysed	Factors identified
Koepelconvenant: energiebesparing gebouwde omgeving	*Artikel 1 Inhoudelijke afspraken; inspanningen van de partijen*	*- Accessibility of measures* *- Awareness of available measures* *- Awareness of energy use and efficiency* *- Clarity and consistency of regulations* *- Energy costs* *- Funding and rebating* *- Legal instruments* *- Owners association* *- Payback uncertainty*
Energieakkoord voor duurzame groei	*3.2 Energiebesparing in de gebouwde omgeving*	*- Accessibility of measures* *- Awareness of available measures* *- Awareness of energy use and efficiency* *- Funding and rebating* *- Owners association* *- Payback uncertainty* *- Thermal comfort need*
Meer met minder: convenant energiebesparing bestaande woningen en gebouwen	*Artikel 4 Versterken van het Meer Met Minder-actieplan*	*- Accessibility of measures* *- Awareness of available measures* *- Awareness of energy use and efficiency* *- Clarity and consistency of regulations* *- Funding and rebating* *- Owners association* *- Payback uncertainty*
Wonen in de metropool: woonvisie Amsterdam tot 2020	*7. De duurzame stad*	*- Awareness of energy use and efficiency* *- Energy costs*

Jaarverslag 2013: klimaat en energie	*2.2 Energiebesparing gebouwde omgeving*	*- Awareness of available measures* *- Awareness of energy use and efficiency* *- Energy costs* *- Funding and rebating* *- Owners association*
Bestaande woningen: duurzame woningen!	*2. De duurzaamheidsopgave van de bestaande Haagse woningvoorraad (except 2.2)* *4.1 Dialoog met de stad* *4.2 Doelgroepenaanpak (except 4.2.2 and 4.2.3)* *4.3 Gemeentelijke sturing: een optimale mix van beleidsinstrumenten* *5.1 Particulier bezit* *6. Acties*	*- Accessibility of measures* *- Age of building or equipment* *- Architecture* *- Awareness of available measures* *- Awareness of energy use and efficiency* *- Clarity and consistency of regulations* *- Competing priorities* *- Energy costs* *- Environmental awareness* *- Funding and rebating* *- Income* *- Investment costs* *- Legal instruments* *- Need for renovation* *- Owners association* *- Payback uncertainty* *- Social norm* *- Thermal comfort need*
Klimaatplan Den Haag: op weg naar een duurzaam Den Haag	*6. De strategie* *8.2. CO2-reductie bij particuliere eigenaren* *8.4. Duurzame relatie gemeente, markt en burgers* *9.1. Energiebesparing*	*- Accessibility of measures* *- Clarity and consistency of regulations* *- Funding and rebating* *- Need for renovation* *- Owners association* *- Payback uncertainty* *- Social norm*
RCI actieplan energie: Rotterdamse uitwerking van het nationale energieakkoord voor duurzame groei	*Speerpunt 3: Energiebesparing in de gebouwde omgeving en MKB, 'Versnelling010'*	*- Accessibility of measures* *- Awareness of available measures* *- Awareness of energy use and efficiency* *- Clarity and consistency of regulations* *- Energy costs* *- Funding and rebating* *- Investment costs* *- Need for renovation* *- Owners association* *- Thermal comfort need*
Programma Utrechtse Energie: 2011-2014	*5.1 De Utrechtse woningvoorraad* *5.3 Particuliere woningen* *13 Inzet van middelen*	*- Accessibility of measures* *- Awareness of available measures* *- Awareness of energy use and efficiency* *- Energy costs* *- Funding and rebating* *- Investment costs* *- Owners association* *- Payback uncertainty* *- Social norm* *- Thermal comfort need*

Table 4] *Details of the analysis*