

The motives of social tenants in the transition towards non-natural gas housing and the effect of information provision

A research into "Programma Aardgas Vrije Wijken"

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Preface

This thesis is the result of my graduation research which is carried out in collaboration with Atriensis. The graduation research finalizes the master Construction Management and Engineering at the Eindhoven University of Technology. Additionally, it also marks the end of my student career. During my student career I went through an inspiring personal and professional development. I look back with pleasure on the past years. I am grateful for the opportunities offered by the TU/e to develop myself outside the educational curriculum.

At the start of my bachelor I planned to become an architect. However, during the following years I became more interested in a broader spectrum of the built environment. For this reason I choose to start with the master CME. My interest in the energy and heat transition has grown in the last couple of years. I am convinced that this transition is important to prevent further climate change and protect the environment. Many plans have been made, but it is now time to implement them. Housing associations are assigned as the starting engine of the heat and energy transition in The Netherlands. Housing associations have to motivate tenants to give consent for the off-gas transition. Their task is complex and comprehensive. My interest in social housing and the off-gas transition led me to research this topic. Hopefully, this study can contribute to future off-gas transitions of social housing complexes.

I would like to thank my supervisors from the TU/e, Dajuan Yang and Theo Arentze. They have supported and guided me during this graduation research. Especially I would like to thank Dajuan for her critical feedback and our motivational meetings. This result would never have been possible without the guidance of Dajuan and Theo.

Furthermore, I would like to thank Atriensis for welcoming me and introducing me into the social housing sector. Linda Groenen supported me throughout this project. She helped me establish contacts within the Proeftuin wijken. Linda have made a lot of time to discuss the research and results with me and to provide feedback. Thanks to Linda, housing associations 'thuis and Intermaris were willing to cooperate in this research. I also want to thank them for their contributions, in particular Sonja Kamp, Rachida Achhoud and Angela van Hardeveld.

Finally, I would like to thank my family and friends. They all supported me during my study, they motivated me to shape and realize my ambitions. Special thanks to Annika Van Den Heuvel, Sanne de Vries and Luc Gerlings for reading my thesis and giving feedback.

I am delighted to finish my student career with this thesis and am ready to start my professional career.

I hope that reading this report will inspire you and provides you with new knowledge and insights.

Neeltje Voesenek
Eindhoven, August 2020

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Table of contents

Preface	5
Table of contents	7
Summary	13
Samenvatting	17
Abstract.....	21
Glossary.....	23
List of figures.....	29
List of tables	31
1. Introduction	35
1.1 Background	35
1.2 Context and problem statement	37
1.2.1 Neighborhood-oriented approach.....	37
1.2.2 Problem statement	39
1.3 Research questions	40
1.4 Research design and reading guide	40
2. Literature review.....	43
2.1 Behavioral models.....	45
2.1.1 Types of behavioral models	45
2.1.2 Goal-framing theory.....	46
2.2 Motives to exhibit pro-environmental behavior	47
2.2.1 Hedonic motives	47
2.2.2 Gain motives	49
2.2.3 Normative motives.....	51
2.2.4 Motives of tenants	53
2.3 Intervention strategies.....	54
2.3.1 Antecedent interventions	56
2.3.2 Information provision as an intervention strategy	57
2.3.3 Effect of information on tenants	59
2.4 Research methods to study pro-environmental behavior.....	61
2.5 Conclusion.....	63
3. Methodology.....	67

3.1	Conceptual model.....	67
3.2	Case study	70
3.3	Semi-structured interviews.....	70
3.4	Coding and analyzing of data	71
3.5	Conclusion.....	72
4.	Data collection	75
4.1	Case study data collection	75
4.1.1	Case selection	75
4.1.2	Documentation	76
4.2	Semi-structured interview data collection	76
4.2.1	Design of semi-structured interview	76
4.2.2	Data collection	77
4.3	Conclusion.....	78
5.	Case studies	81
5.1	Introduction into the social rental sector	81
5.1.1	Tenants of housing associations	81
5.1.2	Role and tasks of housing associations.....	82
5.2	Renovation strategies of the heat and energy transition of the built environment	83
5.3	Case 1: Overwhere-Zuid in Purmerend.....	87
5.4	Case 2: 't Ven in Eindhoven.....	88
5.5	Conclusion.....	89
6.	Analysis and results.....	93
6.1	Coding process.....	93
6.2	Results of case 1: Overwhere – Zuid Purmerend.....	96
6.2.1	Gain motives	96
6.2.2	Hedonic motives	98
6.2.3	Normative motives.....	102
6.2.4	Information process.....	104
6.2.5	Renovation experiences.....	108
6.2.6	Focal goal	109
6.3	Results of case 2: 't Ven Eindhoven	111
6.3.1	Gain motives	111

6.3.2	Hedonic motives	113
6.3.3	Normative motives.....	114
6.3.4	Information process.....	116
6.3.5	Renovation experiences.....	119
6.3.6	Focal goal	122
6.4	Comparison of case results	123
6.4.1	Gain motives	123
6.4.2	Hedonic motives	124
6.4.3	Normative motives.....	125
6.4.4	Focal goals.....	126
6.4.5	Information process.....	127
6.5	Reflection upon the conceptual model.....	129
6.6	Conclusion.....	131
7.	Conclusion, discussion and recommendations.....	135
7.1	Conclusion.....	135
7.2	Discussion and limitations	137
7.3	Recommendations	138
8.	References	141
	Appendix 1	155
	Overview of the Climate Agreement	155
	Appendix 2	157
	Summary of five green consumer profiles.....	157
	Appendix 3	159
	Overview of expert interviews.....	159
	Appendix 4	161
	Overview of documentation	161
	Appendix 5	163
	Interview protocol Dutch.....	163
	Interview protocol English	165
	Appendix 6	167
	Letters for recruiting participants.....	167
	Appendix 7	169

Teams instruction	169
Appendix 8	171
General information about the interviews and participants	171
Appendix 9	173
Codes and definitions	173
Code group - Experience	173
Code group - Focal goal.....	174
Code group - Gain motives	174
Code group - Hedonic motives.....	175
Code group - Hedonic motives regarding heat network	176
Code group - Information	176
Code group - Normative motives.....	178
Code group - Renovation motives	179
Appendix 10	181
Overview of the natural gas-free strategies and variants of PBL	181

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Summary

Housing associations face the task to sustainably renovate almost a third of the total Dutch housing stock and to shape the energy and heat transition, also called the off-gas transition (Georgius, 2019; Ministerie van Economische Zaken en Klimaat, 2019). In the Dutch law it is defined that tenants must agree to renovation works (Jager, 2018). In a residential complex the agreement of 70% of the tenants is needed to execute the work. Therefore a crucial aspect for housing associations is the participation of tenants. More knowledge and research are needed to gain insight into how to increase the support rate from the tenants for the execution of the energy and heat transition of social rental properties. Additionally, it will be interesting to know how to influence these barriers and triggers by the usage of information provision. So, the main research question of this research is: *What motives affect tenants' decision to accept a natural gas-free renovation of their home and how can these motives be influenced by information provision?*

To answer this questions, firstly, literature is reviewed to gain insight in the behavioral models that explain pro-environmental behavior and motives to exhibit pro-environmental behavior. Numerous of studies are discussed in this research to identify individual drivers and barriers to behave pro-environmental. The goal-framing theory proposes an integrated framework to explain and understand environmental behavior (Lindenberg & Steg, 2007). This theory focuses on the hedonic (emotions and pleasure), gain (personal resources) and normative (behave appropriate conform social norms) goals as motives to behave in a certain manner. Literature suggests that financial or economic motives are often determinative in the decision-making process to change behavior into pro-environmental behavior. In several studies it is also indicated that there often occur conflicts between the different goals, because hedonic and gain motives are often not compatible with normative goals. Most discussed studies are carried out into the motives of residents or homeowners regarding energy efficiency renovations. However, there is limited research into the motives of tenants

Moreover, antecedent intervention strategies are discussed in the literature review. It is learned that each person has its own concerns, needs and information preferences. The effect of information provision on actual behavior is difficult to measure. However, in several studies it is concluded that knowledge, access to (additional) information, origin and form of information have effects on actual behavior. Additionally, it should be borne in mind that the relative strength of the hedonic, gain and normative goal influence and determine someone's attention to information and information processing. Based on this literature review a conceptual model is proposed, which serves as a base for the rest of this study.

To gain in-depth knowledge and understanding of the motives that affect the willingness to participate in off-gas renovation projects, a case study research combined with the conduction of semi-structured interviews was conducted. Two cases were selected, which are neighborhood 't Ven in Eindhoven and Overwhere-Zuid in Purmerend. For these two cases, different renovation strategies are applied. In 't Ven, the all-electric renovation strategy is applied. In Overwhere-Zuid, the off-gas transition will be conducted separately following an energy efficiency renovation which was executed in 2018. Due to the different characteristics of the applied strategies, it is expected that other behavioral motives may play a role in tenants' decision-making. An interview protocol is developed based on the conceptual model. In total 19 interviews were conducted in the period between the 18th of May and 3rd of June 2020. The transcriptions of the interviews were coded by the usage of Atlas ti. Coding of the data was

used to organize the data into categories, themes and patterns of motives and experiences, in order to be able to analyze and examine the results.

The results of the case study research confirm that the behavioral motives of tenants to give consent for the off-gas transition can be divided into gain, hedonic and normative motives. Firstly, gain motives of tenants are mainly focused on the financial consequences of the off-gas transition. Secondly, the most occurring hedonic motives of tenants are comfort, disturbance and inconvenience, electrical cooking and considering the transition as necessary maintenance. An expected increase of comfort is identified as an important trigger to give consent. Additionally, the results show that hedonic motives are partly specific for a certain off-gas transition strategy. More negative feelings and emotions are associated with the proposed heat network in Purmerend. These specific hedonic motives regarding the heat network are for example related to doubts about the sustainability of the heat source and the monopoly position of the heat supplier. Thirdly, the majority of participants indicated to value biospheric values and have feelings of personal responsibility to contribute to the mitigation of climate change. Seventeen out of nineteen participants consider climate change as a problem for our society and future generations. These results show that there is a solid base of normative motives among tenants to change their behavior for pro-environmental reasons. Lastly, the focal goals are different in these two cases due to the different renovation strategies. Comfort and considering the transition as necessary maintenance are the most occurring focal goals in the Eindhoven case. In Overwhere-Zuid the consequences for monthly housings costs and biospheric values are found to be the main focal goals. All interviewed participants of the Eindhoven case did give consent for the execution of the off-gas transition. In Purmerend only one out of eleven participants is willing to give consent. From these results it can be concluded that tenants are more willing to give consent for the off-gas transition if it is executed in combination with other measurements, like comfort improvements. The total package of measurements has to offer enough advantages in order to motivate tenants to give consent for the off-gas transition.

The information process and subsequently how information is processed by tenants does influence the behavior and behavioral motives of tenants. How and which information is processed are influenced by the applied antecedent intervention strategy, personal information needs, access to (additional) information and information and behavior of peers. The information processing process is influenced by tenants' own focus for certain information, as a result of their behavioral motives. Additionally, it is shown that tenants experience the information process as negative if they have a high need for additional information. If this is the case, tenants indicate that they need additional information in order to be able to decide to give or give not consent for the off-gas transition. It is learned from the Overwhere-Zuid case that the social debate about the off-gas transition could cause more reluctance against the transition. The debate reinforces feelings of doubt and uncertainty. Based on the results and quotations, it turns out to be important to be aware of the personal situation of tenants and, if possible, to provide customized support. Attention needs to be paid to the fact that all tenants have different behavioral motives and (information) needs. Personal contact and support are necessary in order to gain enough support for the execution of the off-gas transition. The conceptual model is adjusted based on the results of this study. This model explains the relation between behavioral motives, antecedent intervention strategies, information processing and actual behavior of tenants regarding the off-gas transition.

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Samenvatting

Woning corporaties zijn belast met de taak om grofweg een derde van de Nederlandse woningvoorraad te renoveren en de warmte en energie transitie vorm te geven. Naar deze transitie wordt ook wel gerefereerd als van-het-gas-af. In de Nederlandse wet is vastgelegd dat huurders instemming moeten verlenen voor de uitvoering van renovatie werkzaamheden (Jager, 2018). 70% van de bewoners van een complex moeten instemmen met werkzaamheden voordat deze kunnen worden uitgevoerd. Deze instemming van huurders is cruciaal voor woningcorporaties. Meer kennis en onderzoek is nodig om inzicht te verkrijgen in hoe huurders gemotiveerd kunnen worden om in te stemmen met de warmte en energie transitie. Het is daarnaast interessant om te weten hoe deze factoren kunnen worden beïnvloed. De hoofdonderzoeksvraag van dit onderzoek is: *Wat zijn de beweegredenen van huurders om wel of niet in te stemmen met een van-het-gas-af renovatie van hun woning en hoe kunnen deze redenen worden beïnvloed door informatie voorziening?*

Om deze vraag te kunnen beantwoorden is ten eerste een literatuur studie uitgevoerd om inzicht te verkrijgen in de modellen die klimaatvriendelijk gedrag verklaren en in klimaatvriendelijke gedragsmotieven. In deze studie komen vele onderzoeken aan bod om individuele triggers en barrières voor het vertonen van klimaat vriendelijk gedrag te onderscheiden. De goal-framing theorie stelt een integraal framework voor dat klimaatvriendelijke gedrag verklaart (Lindenberg & Steg, 2007). Deze theorie richt zich op hedonische (emoties en plezier), winst (persoonlijke middelen) en normatieve (gedragen conform sociale normen en waarden) doelen als motieven om zich op een bepaalde manier te gedragen. Literatuur impliceert dat financiële of economische motieven vaak bepalend zijn in het besluitvormingsproces van mensen om gedrag te veranderen in milieuvriendelijker gedrag. Daarnaast wordt in verschillende onderzoeken geconcludeerd dat er veelal conflicten voorkomen tussen de verschillende gedragsmotieven, omdat hedonistische en winst motieven vaak niet verenigbaar zijn met normatieve doelen. De meeste onderzoeken zijn uitgevoerd naar de motieven van bewoners of huiseigenaren met betrekking tot energiezuinige renovaties. Er is echter beperkt onderzoek gedaan naar de motieven van huurders.

Daarnaast wordt in het literatuuronderzoek dieper ingegaan op antecedente interventiestrategieën die gericht zijn op het veranderen van gedragsmotieven. Hieruit blijkt dat elke persoon zijn eigen zorgen, behoeften en informatievoorkeuren heeft. Het effect van informatievoorziening op feitelijk gedrag is moeilijk te meten. Toch blijkt uit meerdere onderzoeken dat kennis, toegang tot (aanvullende) informatie, herkomst en vorm van informatie wel degelijk effect kunnen hebben op gedrag. Daarnaast wordt benadrukt dat de sterkte van de hedonische, winstgevende en normatieve motieven van een persoon, de verwerking van en de focus voor bepaalde informatie beïnvloed. Op basis van dit literatuuronderzoek wordt een conceptueel model voorgesteld, dat als basis dient voor de rest van dit onderzoek.

Om kennis en inzicht te verkrijgen over de motieven van huurders die hun bereidheid tot deelname aan van-het-gas-af projecten beïnvloeden, wordt een case study onderzoek gecombineerd met semi-structureerde interviews. Twee cases zijn geselecteerd voor dit onderzoek, 't Ven in Eindhoven en Overwhere-Zuid in Purmerend. In 't Ven wordt de all-electric renovatiestrategie toegepast. In Purmerend is in 2018 een energiezuinige renovatie uitgevoerd en de komende jaren volgt de van-het-gas-af transitie van deze wijk. Vanwege de verschillende kenmerken van de toegepaste van-het-gas-af strategieën, wordt verwacht dat andere gedragsmotieven een rol spelen in het besluitvormingsproces van huurders. Op basis van het conceptuele model is een interviewprotocol

ontwikkeld. In totaal zijn 19 interviews afgenomen tussen 18 mei en 3 juni 2020. De transcripties van de interviews zijn gecodeerd met behulp van software programma Atlas ti. Het coderen de data is gebruikt om data te ordenen in categorieën, thema's en patronen van motieven en ervaringen. Op deze manier kunnen de resultaten worden onderzocht en geanalyseerd.

De resultaten van het casestudy-onderzoek bevestigen dat de gedragsmotieven van huurders om toestemming te geven voor de van-het-gas-af transitie kunnen worden onderverdeeld in winst, hedonistische en normatieve motieven. Ten eerste, de winstmotieven van huurders zijn voornamelijk gericht op de financiële gevolgen van de transitie. Ten tweede, de meest voorkomende hedonistische motieven van huurders zijn comfort, overlast en ongemak, elektrisch koken en het beschouwen van de transitie als noodzakelijk onderhoud. Als huurders een toename van comfort verwachten blijkt dit een belangrijke trigger te zijn om toestemming te geven. Daarnaast laten de resultaten zien dat hedonische motieven deels specifiek zijn voor een bepaalde transitiestrategie. Meer en andere negatieve gevoelens en emoties belemmeren huurders uit Purmerend ervan om in te stemmen met de aanleg van het warmtenet. Deze specifieke motieven zijn bijvoorbeeld twijfels over de duurzaamheid van de warmtebron en weerstand tegen de monopolypositie van de warmteleverancier. Ten derde, de meerderheid van de deelnemers heeft aangegeven veel waarde te hechten aan natuur en milieu en het gevoel te hebben een persoonlijke bijdrage te kunnen leveren aan de beperking van klimaatverandering. Zeventien van de negentien deelnemers zien klimaatverandering als een probleem voor onze samenleving en toekomstige generaties. Deze resultaten laten zien dat er een solide basis is van normatieve motieven onder huurders om hun gedrag te veranderen om milieuvriendelijke redenen. Ten slotte, de voor- en nadelen van beide strategieën zijn dermate verschillend dat andere gedragsmotieven bepalend blijken te zijn in het besluitvormingsproces. Comfort en het beschouwen van de transitie als noodzakelijk onderhoud, zijn de meest voorkomende leidende motieven in de Eindhoven. In Overwhere-Zuid blijken de gevolgen voor de maandelijkse woonlasten en waarden gerelateerd aan natuur en milieu, de belangrijkste leidende gedragsmotieven te zijn. Alle deelnemers uit Eindhoven hebben toestemming gegeven voor de uitvoering van de van-het-gas-af transitie en bijbehorende renovatie. In Purmerend is slechts één van de elf deelnemers bereid toestemming te geven. Uit deze resultaten kan worden afgeleid dat een voorgesteld pakket aan maatregelen een balans moet bieden tussen voor- en nadelen, om huurders te motiveren toestemming te geven voor de van-het-gas-af transitie.

Het informatieproces en de manier waarop informatie door huurders wordt verwerkt, heeft invloed op het gedrag en de gedragsmotieven van huurders. Hoe en welke informatie wordt verwerkt wordt beïnvloed door de toegepaste antecedent interventiestrategie, persoonlijke informatiebehoeften, toegang tot (aanvullende) informatie en informatie en gedrag van mensen uit de eigen omgeving. Het informatieverwerkingsproces wordt beïnvloed door de persoonlijke focus voor bepaalde informatie. Deze focus is het gevolg van hun gedragsmotieven. Tevens blijkt dat het informatieproces als negatief wordt ervaren door huurders indien zij een grote behoefte hebben aan aanvullende informatie. Tot slot blijkt uit de resultaten van de Overwhere-Zuid case dat het felle maatschappelijk debat over biomassa voor meer weerstand ten aanzien van de aanleg van het warmtenet zorgt. Het versterkt gevoelens van twijfel en onzekerheid. Uit de resultaten blijkt dat het belangrijk is om oog te hebben voor de persoonlijke situatie van huurders en waar mogelijk maatwerk te bieden. Er moet aandacht worden besteed aan het feit dat alle huurders verschillende gedragsmotieven en (informatie) behoeften hebben. Persoonlijk contact en ondersteuning zijn nodig om voldoende draagvlak te krijgen voor de uitvoering van de warmte en energie transitie, inclusief het van het gas af gaan.

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Abstract

Housing associations face the task to sustainably renovate almost a third of the total Dutch housing stock and to shape the energy and heat transition of the built environment. More knowledge and research is needed to gain insight into how sufficient support from the tenants can be created for the execution of the energy and heat transition of social rental properties. Additionally, it will be interesting to know how to influence these barriers and triggers by the usage of information provision. Therefore, the aim of this study is to explore and identify the behavioral motives of tenants' that affect the decision process regarding an off-gas transition projects and how can these motives be influenced by information provision. A case study research is combined with the conduction of semi-structured interviews with tenants. Two cases, where different off-gas strategies are applied, are studied. In total 19 interviews are conducted. The results of the case study research confirm that the behavioral motives of tenants to give consent for the off-gas transition can be divided into gain, hedonic and normative motives. Firstly, gain motives of tenants are mainly focused on the financial consequences of the off-gas transition. Secondly, most occurring hedonic motives of tenants are comfort, disturbance and inconvenience, electrical cooking and considering the transition as necessary maintenance. Additionally, the results show that hedonic motives are partly specific for a certain off-gas transition strategy. Thirdly, the majority of participants indicated to value biospheric values and have feelings of personal responsibility to contribute to the mitigation of climate change. Lastly, the advantages and disadvantages of both strategies are so different that other behavioral motives are determinative in the decision-making process of tenants. From these results can be deduced that a package of measurements has to offer a balance between advantages and disadvantages, in order to motivate tenants to give consent for the off-gas transition. The information process and subsequently how information is processed by tenants does influence the behavior and behavioral motives of tenants. How and which information is processed is influenced by the applied antecedent intervention strategy, personal information needs, access to (additional) information and information and behavior of peers. Additionally the information processing process is influenced by tenants' own focus for certain information, as a result of their behavioral motives. Lastly, it is learned from the Purmerend case is that the social debate could cause more reluctance against the transition.

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Glossary

Aedes	<p>Aedes represents the interests of housing associations in politics and provides knowledge and expertise exchange in its network. Nowadays Aedes is the umbrella advocacy organization for all housing associations in the Netherlands. Since 1913 several advocacy organizations for housing associations have existed. Previously there were known different organizations divided per region or religious belief (Aedes, n.d.; Vereniging Canon Sociaal Werk, 2016).</p>
Appropriate allocation	<p>Appropriate allocation ensures that people with the lowest incomes are assigned a house with a rent which is affordable to them. The allocation of housing is done according to the so-called 80-10-10 rules (Aedes, 2019; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-e).</p>
Authority of Housing associations	<p>Supervision institution of housing associations by the government. This institution assesses the policy and management of housing associations on various points, such as financial continuity (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-a) <i>Dutch Translation: Autoriteit Woningcorporaties.</i></p>
Climate Agreement	<p>National climate policy of the Netherlands. This national climate agreements targets all forms of GHG emissions in all sectors, from agriculture to industry, from housing to mobility (Ministerie van Economische Zaken en Klimaat, 2019). Appendix 1 presents an overview of the Climate Agreement. <i>Dutch Translation: Het Klimaatakkoord.</i></p>
DAEB and non-DAEB activities	<p>Since 2018 housing associations are obligated to separate their activities of general economic interest (DAEB) and of other more commercial activities (non-DAEB) (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-f). The DAEB branch consists of residential properties with a rental price up to and including a limit of € 710, 68 per month (price level January, 2018). Social real estate is also part of DAEB. <i>Dutch Translation: Diensten van Algemeen Economisch Belang.</i></p>
Energy Agreement	<p>Covenant between the government, businesses and environmental organizations. The agreement contains agreements on energy saving, clean energy technology and climate policy (Sociaal-Economische Raad, 2013). <i>Dutch Translation: Energie Akkoord</i></p>

Energy transition	A major change of the energy system. The aim is an energy system that emits much less CO ₂ . That means using less energy, extracting energy from renewable sources as much as possible and, insofar as this is not possible, using fossil energy sources as cleanly as possible (Planbureau voor de Leefomgeving (PBL), n.d.).
Energy and heat transition	Transition in the built environment towards the use of more reusable energy resources for the generation of electricity and heat. In this report often used to refer to the disconnection from the gas network and the usage of renewable energy resources for electricity and heating of residential complexes and houses.
Energy label	An energy label shows how energy efficient a home is. Residential properties with an A label are the most energy-efficient. The least energy-efficient houses receive a G-label. The energy label is based on the Energy Index (EI) score. This score is determined with a calculation method. (Rijksdienst voor Ondernemend Nederland, n.d.-a) <i>Dutch Translation: energie label.</i>
Environmental psychology	A subfield of psychology that studies the interplay between individuals and the built and natural environment (Steg & De Groot, 2019).
Gain goal	The gain goal is focused on the maintaining and improvement of personal resources (monetary and non-monetary). The time horizon of this goal is middle or long-term (Lindenberg & Steg, 2007).
GHG	Greenhouse gasses.
Heat transition	A major change of the heat system. The aim is an heat system that emits much less CO ₂ . That means using less energy for heating, extracting energy for heating from renewable sources as much as possible and, insofar as this is not possible, using fossil energy sources for heating as cleanly as possible (Planbureau voor de Leefomgeving (PBL), n.d.; RVO, n.d.).
Heat Transition Vision	Vision prepared by municipalities and other stakeholders. This vision consists of the proposed direction of the neighborhood approach. The vision includes a time planning and a proposal for the alternatives for natural gas for each neighborhood. The Heat Transition Vision must be ready by the end of 2021, so that it can be used by all stakeholders in the neighborhoods (Rijksdienst voor Ondernemend Nederland, n.d.-d). <i>Dutch Translation: Transitievisie Warmte.</i>

Hedonic goal	The hedonic goal is to improve the way one feels. This goal is focused on increasing one's own mood, emotions, energy level and pleasure. The time horizon is very short and focused on right now (Lindenberg & Steg, 2007).
Natural gas-free neighborhood	Neighborhood in which no natural gas is used for heating houses or cooking food. Alternative heat sources or installations and electricity provide the houses with energy and heat. Electricity is often not yet (fully) generated from renewable sources (PAW, 2019a).
Natural gas-free house	House in which no natural gas is used for heating the house or cooking food. Alternative heat sources or installations and electricity provide the home with energy and heat. Electricity is often not yet (fully) generated from renewable sources (PAW, 2019a).
Natural gas-free ready house	House in which natural gas is used for heating the house and / or cooking food. The installations of the house have been made ready to be disconnected from the gas network and to be connected to an alternative infrastructure without major interventions (Rijksdienst voor Ondernemend Nederland, n.d.-b).
Nederlandse Woonbond	A non-profit organization that represents the interests of tenants. They support tenants' organizations and provide information about the rights of tenants (Woonbond, n.d.).
Normative goal	The normative goal is to behave appropriate conform social norms and to what one observes other people do (Lindenberg & Steg, 2007). The time horizon is the long-term, norms of people do not change often and easily (Steg & De Groot, 2019).
Off-gas transition	Part of the heat and energy transition, specific focused on the disconnection of the gas network. This transition consist of the disconnection from the gas network and the installation of new heat supplying installations. Several strategies could be applied in order to execute the off-gas transition.
PAW	Program of natural gas-free neighborhoods. Governmental program for learning and knowledge exchange about natural gas-free neighborhoods. The program consist of a website and a knowledge and learning program. PAW is an intergovernmental cooperation between the Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs and Climate Policy, the union of Water boards, interprovincial consultation and the Association of Dutch Municipalities (PAW, 2019a). The intergovernmental cooperation of PAW provides subsidies to the first 100 natural gas free neighborhoods. These neighborhoods form a pilot. The first 27

neighborhoods have received a subsidy. The next application will close in April 2020 (Ministerie van Binnenlandse Zaken en Koninkrijks, 2018).

Dutch Translation: Programma Aardgasvrije Wijken

PAW neighborhood	Neighborhood that is part of the Program of natural gas-free neighborhoods (PAW, 2019a).
PBL	Netherlands Environmental Assessment Agency <i>Dutch translation: Planbureau voor de Leefomgeving</i>
Performance agreements	These agreements are made between housing corporation, municipality and a representation of residents (tenants organization) (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-d). This also includes objectives with regard to sustainability, living environment and new construction of social residential properties. The contribution of the housing corporation to the municipal housing assignment is laid down in performance agreements (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-d). <i>Dutch translation: Prestatie afspraken.</i>
Rental property tax	Landlords or housing associations who own more than 50 rental properties pay a rental property tax on the WOZ value of the rental properties. This concerns rental properties for which the rent does not exceed € 720.42 per month (2019 price level) (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-h). <i>Dutch Translation: Verhuurdersheffing.</i>
RES	Regional energy strategy. The RES is an instrument to jointly make choices regarding the generation of sustainable electricity, the heat transition in the built environment and the required storage and energy infrastructure. The National Program RES provides knowledge sharing and support for the development of these regional energy strategies (Nationaal Programma RES, n.d.). <i>Dutch Translation: Regionale Energiestrategie.</i>
Revised Housing Act of 2015	Dutch law regarding housing. In the revised Housing Act of 2015 the housing associations have been restricted. Housing associations are forced to focus on their core tasks and they are placed under the supervision of Authority Housing associations.
RVO	The Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, n.d.-d). <i>Dutch Translation: Rijksdienst voor Ondernemend Nederland.</i>

Spotted possession	Indication of the present ownership situation within a residential complex, residential block or neighborhood. A housing corporation or other major real estate owner owns a part of the properties. Other properties are owned by owner-occupiers. Often this situation has arisen because corporations have sold houses over time. In some cases the current owners are former tenants of the property.
Startmotor	Plan of municipalities and parties from the rental, construction and energy sectors. Together they want to transform 100.000 homes towards natural gas-free in the period 2019-2022. The government has made available a € 500 million subsidy. This subsidy is partly made available through the Renovatie Versneller (€ 130 million) and the accelerated connection of residential complexes to existing heat networks. The Renovatie Versneller focuses primarily on the joint procurement by housing associations of heat pumps and insulation measures (Hellebrekers, 2018; Penders, Neilen, & Georgius, n.d.). The subsidy of the Startmotor is part of the Climate Agreement.
SVP	Heat network of Stadsverwarming Purmerend (SVP) (Stadsverwarming Purmerend, n.d.). All new-build homes in Purmerend have been connected to this heat network since the 1980s (Gemeente Purmerend, n.d.). VP uses three heat production installations (Stadsverwarming Purmerend, n.d.). The two natural-gas fired heat plants are mainly used to support the third heat plant. This third heat plant is a biomass heat plant. The biomass plant was put into use in 2014. Wood chips from Staatsbosbeheer are used to produce warmth.
Total housing costs	In this thesis are the total housing costs defined as a sum of the rent (including service costs) and the costs for water, gas and electricity. The monthly housing costs represent the monthly expenses for rent (including service costs), water, gas and electricity.
WSW	Social Housing Guarantee Fund. The government offers guarantees for housing associations by the WSW. The national government and municipalities are financially guarantee the WSW (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-g). <i>Dutch Translation: Waarborgfonds Sociale Woningbouw.</i>

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List of figures

Fig. 1.1. Policy levels and corresponding climate policies or regulations which apply in the Netherlands.

Fig. 1.2. Infographic sector Built Environment (Ministerie van Economische Zaken en Klimaat, 2019)

Fig. 2.1. Model of the innovation diffusion theory of Rogers (2003). Adopted from Nijssen & Wouters (2019).

Fig. 2.2. Schematic representation of the TPB. Adopted from (Ajzen, 1985).

Fig. 2.3. (right) Overview of intervention strategies adopted from (Han, Nieuwenhijzen, de Vries, Blokhuis, & Schaefer, 2013).

Fig. 2.4. Overview of barriers and triggers per goal as identified by literature.

Fig. 3.1. Conceptual model of goal-framing theory.

Fig. 3.2. Conceptual model of the influence of an antecedent intervention strategy on behavioral motives.

Fig. 3.3. Conceptual model of characteristics of information provision that influence the effectiveness of the intervention strategy.

Fig. 3.4. Conceptual model of the factors that have an influence on the process of information processing.

Fig. 3.5. Complete conceptual model of this study.

Fig. 5.1. Four renovation scenarios of Aedes (Aedes, 2018).

Fig. 5.2. Overview of potential scenarios towards CO₂ neutral heating of residential properties by Atriensis (Groenen, 2020).

Fig. 5.3. Financial renovation strategies (Haytink & Valk, 2017).

Fig. 5.4. Measurement renovation strategies (Haytink & Valk, 2017).

Fig. 6.1. Overview of code groups and codes.

Fig. 6.2 Framework that represents the relation between behavioral motives, antecedent intervention strategies, information processing and actual behavior regarding the off-gas transition.

Fig. A10.1. Overview of strategies and variants towards natural gas-free heating of properties by PBL (Hoogervorst et al., 2020).

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List of tables

Table 2.1. Overview of qualitative studies.

Table 6.1. Gain motives of tenants of the Purmerend case associated with monthly financial consequences (FCM) of the off-gas transition.

Table 6.2. Gain motives of tenants of the Purmerend case associated with one-time financial consequences, financial motivation to save energy to save costs, the valuation of the investment of time and energy, and the participation of neighbors.

Table 6.3. Hedonic motives of tenants of the Purmerend case associated with comfort, disturbance and inconvenience and necessary maintenance.

Table 6.4. Hedonic motives of tenants of the Purmerend case associated with electric cooking, safety, monopoly position of heat network company and limited freedom of choice.

Table 6.5. Hedonic motives of tenants of the Purmerend case associated with doubt about the technique, the heat source, preferences for other heat sources and the feeling to be forced by the municipality.

Table 6.6. Altruistic motives of tenants of the Purmerend case.

Table 6.7. Biospheric motives of tenants of the Purmerend case.

Table 6.8. Being environmental responsible and feelings of personal responsibility of tenants of the Purmerend case.

Table 6.9. Information provided by housing association or municipality, trust in and relation with housing association (HA) or municipality.

Table 6.10. Co-occurrence table information origin and information form valued as few, enough, too much and valuation of the information process as positive or negative.

Table 6.11. Additional information needs and sources where additional information is searched/found.

Table 6.12. Motives and experiences of energy efficiency renovation of 2018 in Overwhere-Zuid.

Table 6.13. Financial motives and expectations of energy efficiency renovation of 2018 in Overwhere-Zuid. Financial consequences (FC).

Table 6.14. Feeling of tenants of the Purmerend case associated with the heat network, proposed off-gas transition and the off-gas transition in general.

Table 6.15. Focal goals of tenants of the Purmerend case.

Table 6.16. Gain motives of tenants of the Eindhoven case associated with monthly financial consequences (FCM) of the off-gas transition.

Table 6.17. Gain motives of tenants of the Eindhoven case associated with one-time financial consequences, financial motivation to save energy to save costs, the valuation of the investment of time and energy, and the participation of neighbors.

Table 6.18. Hedonic motives of tenants of the Eindhoven case associated with comfort and expected disturbance and inconvenience.

Table 6.19. Hedonic motives of tenants of the Eindhoven case associated with the technique, necessary maintenance and electric cooking.

Table 6.20. Altruistic motives of tenants of the Eindhoven case.

Table 6.21. Biospheric motives of tenants of the Purmerend case.

Table 6.22. Being environmental responsible and feelings of personal responsibility of tenants of the Eindhoven case.

Table 6.23. Information provided by housing association, trust in and relation with housing association (HA) and experience of the information process.

Table 6.24. Co-occurrence table information origin and information form valued as few, enough, too much.

Table 6.25. Additional information needs and sources where additional information is searched/found.

Table 6.26. Experiences of tenants during the off-gas renovation of in Eindhoven.

Table 6.27. Experiences of tenants during the off-gas renovation of in Eindhoven.

Table 6.28. Focal goals of tenants of the Purmerend case.

Table A1.1 Overview of the theme's, proposed CO2 reduction and main issues of the Climate Agreement (Ministerie van Economische Zaken en Klimaat, 2019).

Table A4.1. Overview first round of expert interviews.

Table A4.2 Overview of attended congresses.

Table A4.3 Overview second round of expert interviews.

Table A9.1 General information about the interviews and participants of the Purmerend case.

Table A9.2 General information about the interviews and participants of the Eindhoven case.

Table A9.3 General information about the renovation of the properties in the Eindhoven case: replacement of kitchen, bathroom and toilet, start and end date.

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1. Introduction

1.1 Background

In the last decades climate change has become a topic of global interest. The effects of the changing climate are becoming visible all over the world. The weather is becoming more extreme, the temperature and therefore the sea level is rising, and other areas are drying up. Slowly, people have realized that the climate is also changing due to human actions. Human activities cause the emission of Green House Gasses (GHG). The GHG have a direct effect on climate change. Our lifestyle and economy need to be adjusted in order to mitigate climate change. However, change in people's lifestyle and the economy does not happen automatically. From the 1980s onwards climate change is receiving increasing attention in science and politics. The United Nations organizes climate conferences to reach joint agreements between countries. During several worldwide climate conferences, a variety of objectives have been set, which are established in a few global climate agreements. The most far-reaching and best-known agreements have been made in Paris in 2015 (United Nations, 1998, 2015). The main aim is to start reducing the emission of GHG on a global scale and to keep the global temperature rise at a maximum of 2 degrees Celsius (United Nations, 1998, 2015). Many of the international climate agreements of Paris (2015) must be achieved on a regional scale. Therefore European, national and even municipal climate policies are created (European Commission, 2019; European Parliament and Council of the European Union, 2009; Ministerie van Economische Zaken en Klimaat, 2019; Sociaal-Economische Raad, 2013). In fig. 1.1. the coherence between the climate policies of different levels is shown.

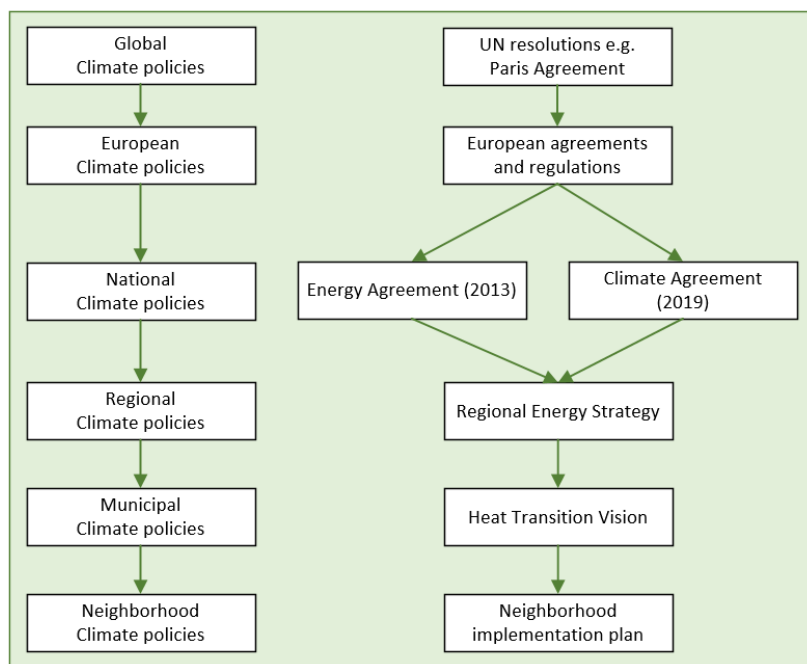


Fig. 1.1. Policy levels and corresponding climate policies and regulations which apply in the Netherlands.

As shown in fig. 1.1., the European Union has set its own objectives for her Member States (European Commission, 2019; European Parliament and Council of the European Union, 2009). By 2050 the GHG emissions have to be cut by 40% compared to 1990 and at least 32% of the total energy consumption will be produced by renewable energy resources. Besides this, energy efficiency has to be increased

with 32,5%. In 2017 the European Union has reported, that France and the Netherlands are the furthest away from the set 2020 goals (Eurostat, 2019). In the Netherlands more speed has to be made with the implementation of the climate agreements in order to be able to achieve the targets.

Following the global and European climate agreements, the Dutch government has developed national climate policies. The results are the Energy Agreement and the more generic Climate Agreement (Ministerie van Economische Zaken en Klimaat, 2019; Sociaal-Economische Raad, 2013). These national climate agreements target all forms of GHG emissions in all sectors, from agriculture to industry, from housing to mobility. Coordination and agreement between sectors are necessary to make sure that the total transition towards a more sustainable society with low emissions of GHG is realized by 2050 (Ministerie van Economische Zaken en Klimaat, 2019). Appendix 1 presents an overview of the main targets of the Climate Agreement. The Built Environment has to realize the smallest reduction in the emission of CO₂, though the stated task will have an effect on all residents of the Netherlands. Homeowners have to adapt their houses into more sustainable properties and even tenants will face adjustments in and around their homes. This sounds like a daunting task, but such transitions have occurred before. Housing has undergone a major quality improvement in the last two centuries. The connections to the sewer, electricity and gas network, and later to the telephone and internet network, have made our houses more comfortable and adapted to our personal and modern needs (Beekers, 2012; Hölsgens, 2019; Vereniging Canon Sociaal Werk, 2016).

Nowadays we face a new transition, a complex and extensive energy transition of the built environment. Large-scale energy transitions have occurred frequently over the last 150 years, due to changing circumstances within the fields of technology, geopolitics and risk perception (Hölsgens, 2019). One of the most important transitions in the Netherlands is the large-scale exploration of natural gas. In 1959 natural gas was discovered by Shell and Esso in the province Groningen, in the north of the Netherlands. This discovery started the energy transition towards natural gas as the main energy resource in the Netherlands (Hölsgens, 2019). The fast executed extraction resulted in a rapid increase of the use of natural gas in the Netherlands. Since the 1970s almost half of the Dutch energy consumption has consisted of natural gas exploited in Groningen and Friesland (Hölsgens, 2019). In the period 1960 – 1970 most households and industrial sites were connected to the gas network. Natural gas became the dominant energy source in the Netherlands. From the start onwards the Dutch government was intimately involved in the exploitation of natural gas. The state has earned a lot of money from the exploitation of natural gas.

In 2015 Groningen was startled by the first earthquakes. The earthquakes turned out to be a direct result of the extraction of natural gas that had been going on for decades in the North of the Netherlands. As the Dutch government is strongly involved in the exploitation of natural gas, she was therefore held responsible for the earthquake damage. Since the last two years the political willingness has grown to reduce the exploitation of natural gas in Groningen (Rutte, Haersma Buma, Pechtold, & Segers, 2017). One of the first taken measures is that the so called “aansluitplicht” (obligation to connect) to the gas network for newly built homes has been expired since July 2019 (Rijksdienst voor Ondernemend Nederland, 2018). In the North of the Netherlands the earthquakes continued with growing frequency, increasing the damage to houses and other properties. Some properties were even declared uninhabitable (Berg, 2018; Dagblad van het Noorden, 2019; Ekker, 2016). Firstly it was announced that the extraction would be reduced over a longer period of time until 2030. At the end of March 2018, the Minister of Economic Affairs and Climate has announced that

the extraction of natural gas in Groningen and Friesland will be ended in the shortest timeframe possible. In order to minimize further damage due to earthquakes (Wiebes, 2018). Very recently, in September 2019 the cabinet announced that the extraction and exploitation of natural gas from Groningen will be cut off by 2022 (Wiebes, 2019).

Alternative energy solutions have to be provided due to the stop of the exploitation of natural gas in the Netherlands. An option is to import natural gas from other countries. Hereby the Netherlands will be increasingly vulnerable and dependent on other countries, as previous energy crises have shown (Hölsgens, 2019). Other countries are not always reliable suppliers of (energy) resources. Therefore, the support for this alternative is little. Another option is to shift from the natural gas network as main heating network, to another heating network or system. Applicable substitutions are not available for all applications of natural gas at this moment. However, there are currently several technologies and products available for the heating of houses.

Both the problems in Groningen and the concerns about climate change amplify the importance of the heat and energy transition of the built environment. The shift to non-gas fired heating systems is an opportunity to introduce more sustainable alternatives on a large scale in the Netherlands. In 2018 only 7.4% of the total energy production consisted of renewable energy (CBS, 2020). As stated in the Dutch Climate Agreement the main target in the built environment is the transition towards alternative heating systems to ensure the decrease of the use of natural gas and more efficient use of energy (Ministerie van Economische Zaken en Klimaat, 2019). The ambition is to accelerate the pace of the off-gas transition from 50.000 houses in 2021 till 200.000 existing residential properties in 2030. In order to be able to reach the set targets an increased pace is necessary (Filippidou, Nieboer, & Visscher, 2016, 2017)

1.2 Context and problem statement

1.2.1 Neighborhood-oriented approach

As stated in the Climate Agreement, each region has to create a Regional Energy Strategy (RES). The Netherlands is divided in 30 RES-regions. In each region the province, municipalities, social partners, companies and residents jointly prepare a RES. The RES is a document describing which strategy the RES region uses to determine and achieve regional energy objectives (Nationaal Programma Regionale Energiestrategie, n.d.). The RES is followed by the Heat Transition Vision. Every municipality must establish a Heat Transition Vision before the end of 2021. With this Heat Transition Vision, municipalities provide insight into the time path and will roughly propose an alternative heating strategy (Rijksdienst voor Ondernemend Nederland, n.d.-c; VNG, n.d.). This vision gives direction to the neighborhood-oriented approach for further definition of the transition. The execution strategy is then formalized in the neighborhood implementation plan. This neighborhood-specific plan is drawn up in consultation with residents and other stakeholders in the district (Rijksdienst voor Ondernemend Nederland, n.d.-c).

An overview of the main tasks within the built environment regarding the Climate Agreement are shown in the infographic (fig. 1.2). In the figure five colours represent the different tasks and approaches. The neighborhood-oriented approach (see the purple boxes) is proposed as the course of action to realize the Climate Agreement. The aim of the neighborhood-oriented approach is to create a financial feasible and realistic strategy for the transition of the built environment into a more sustainable and energy efficient environment. A suitable solution is sought for each neighborhood.

Additionally, the transition can offer opportunities to address other problems within the neighborhood. Gaining knowledge and experience is necessary to make this large-scale transition a success. In order to be able to gain knowledge, experience and create volume, the Dutch housing associations (see the green boxes) are designated as the starting engine of the energy and heating transition (Hellebrekers, 2018; Penders et al., n.d.). The housing associations jointly own approximately 2,4 million houses, that is about one third of the total Dutch housing stock (Georgius, 2019).

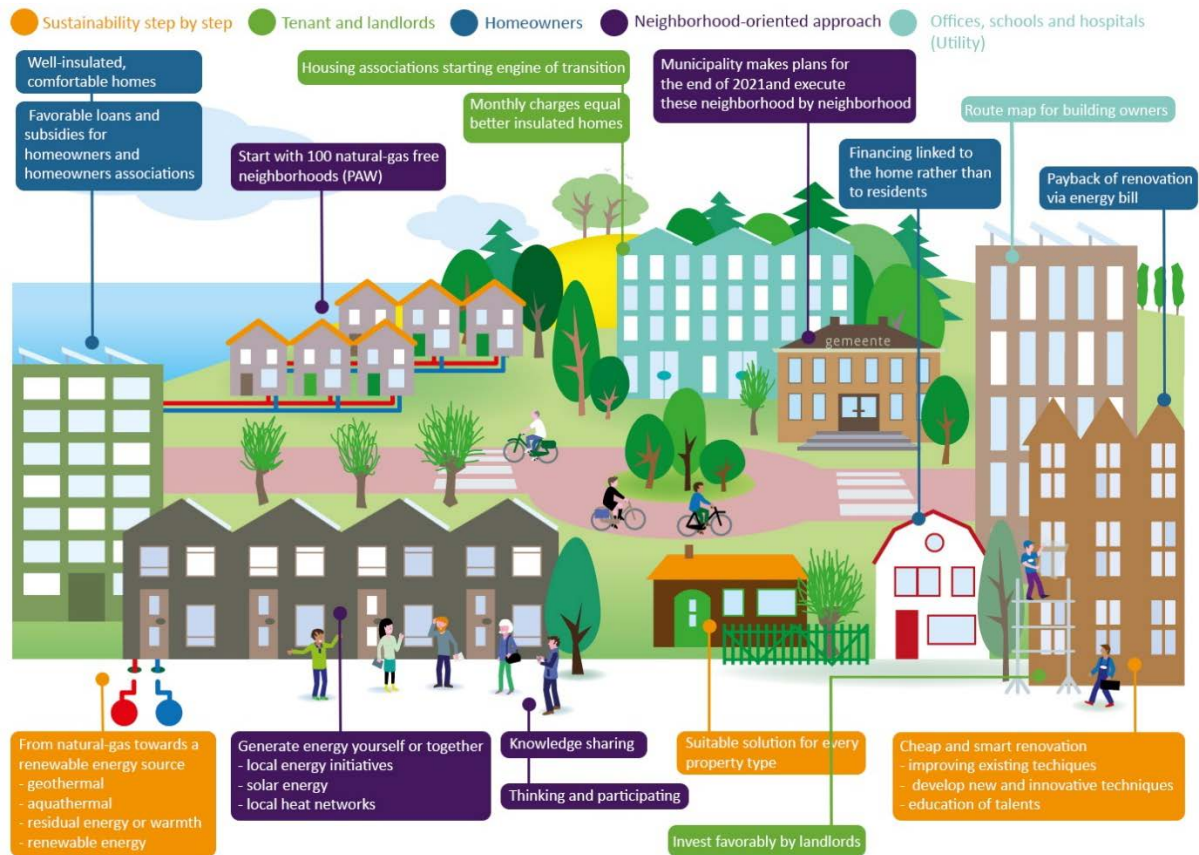


Fig. 1.2. Infographic sector Built Environment (Ministerie van Economische Zaken en Klimaat, 2019)

The subsidy program Proeftuinen is introduced as a kick-start for the neighborhood oriented approach. Purpose of each Proeftuin neighborhood is that natural gas is no longer used for the heating of houses and water, in order to learn how to develop and implement the neighborhood oriented approach. The aim of the government is to allow 100 neighborhoods to participate in this learning experiment. In October 2018 subsidies with a total of 120 million euro have been granted to the first 27 neighborhoods (Ministerie van Binnenlandse Zaken en Koninkrijks, 2018). Currently these neighborhoods have started the transition process. Housing associations with possessions in these 27 neighborhoods are actively involved in these transitions processes. Mid 2020 the second round of subsidies for these Proeftuin neighbourhoods will be granted (PAW, 2019b, 2020a). The Proeftuinen subsidy is part of PAW. The natural gas-free neighborhoods program (PAW) was established to share knowledge and experience. The program consists of a website and several events (e.g. lectures and a congress) where information, knowledge and experiences are shared. The PAW is an initiative of the

Dutch government, the association of Dutch municipalities, the interprovincial consultation and the union of regional water authorities (PAW, 2019a). Learning from the PAW and the Proeftuin neighborhoods will make it possible to scale up the neighborhood approach eventually. Ultimately in 2050, the energy and heat transition must be completed in all neighborhoods of the Netherlands (Ministerie van Economische Zaken en Klimaat, 2019).

It should be noted that before the Energy (2013) and Climate agreement (2019) were published, a start had been made with the sustainability task in the built environment. The government and housing associations have made previous agreements about making the social housing stock more sustainable: the covenant energy saving rental sector (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2012). In this covenant it was agreed that on average all social rental properties will have an energy label B in 2020. Energy label B equals an energy index (EI) of 1,21 – 1,40 (Rijksdienst voor Ondernemend Nederland, n.d.-a). The most recent figures indicate that social rental properties currently have an average EI of 1,57 (label C) (Aedes Datacentrum, 2019). The heat and energy transition as proposed in the Climate Agreement, will not start from a zero point. However, an acceleration of the renovation pace is necessary in order to attain the set targets (Filippidou et al., 2016, 2017).

1.2.2 Problem statement

Participation of residents is an essential component of the neighborhood-oriented approach. Therefore a crucial aspect for housing associations is the participation of tenants. In the Dutch law it is defined that tenants must agree to renovation works. In a residential complex the agreement of 70% of the tenants is needed to execute the work (Jager, 2018). The housing associations face the task to sustainably renovate almost a third of the total Dutch housing stock and to shape the energy and heating system transition (Georgius, 2019; Ministerie van Economische Zaken en Klimaat, 2019). Research by Jager (2018) shows that the law which regulates the participation of tenants can cause obstruction of renovation projects. It is important to create a sufficient support base for the energy transition among tenants in order to be able to execute the Climate Agreement.

Existing studies about the interest, motives and considerations of homeowners to execute an energy efficiency renovation, can help to get an insight in the possible motives, barriers and drives of tenants (Abreu, Oliveira, & Lopes, 2017; Mortensen, Heiselberg, & Knudstrup, 2016; Nair, Gustavsson, & Mahapatra, 2010; Wilson, Crane, & Chryssochoidis, 2015; Wilson, Pettifor, & Chryssochoidis, 2018). Very few research has been conducted specific for the motives and willingness of tenants to participate in energy efficiency renovations (DellaValle, Bisello, & Balest, 2018; Hoogenraad, 2019; Hoppe, 2012; Kerperien, 2019; Reuvekamp, 2013). Among other things, residents indicate mess, comfort, financial considerations, new way of cooking (electrical instead of gas-fired), the effect and interruption on daily and domestic life as important factors in the decision process regarding energy efficiency renovations. In addition, the conviction of people in the necessity of the energy transition seems to have a major influence on the willingness to participate (Nair et al., 2010).

In the light of the energy transition task that is ahead of the Netherlands, there is a lack of information about the willingness of tenants to participate. More knowledge and research is needed to gain insight into how sufficient support from the tenants can be created for the execution of the energy and heat transition of social rental properties.

1.3 Research questions

The participation of tenants in the energy transition is a necessity. They have to agree with the execution of renovation works in their homes and can contribute by being more aware of their own energy consumption. However, limited research is conducted to identify the main barriers and triggers for tenants to participate in such projects. The research that has been carried out is mainly focused on the barriers and triggers of homeowners related to the execution of energy efficiency renovations. Some research that has been carried out specifically into the social tenant perspective is focused on energy efficiency renovations. In the Netherlands an important part of the energy transition is the shift from gas-fired heating installations towards more sustainable alternative heating techniques. As mentioned before, the housing associations are entrusted with the task to shape the energy transition for one third of the total Dutch housing stock. Their role as starting engine aims to enable private homeowners to take advantage of the experience gained, price decreases and innovations developed. It will be useful to learn more about the triggers and barriers of tenants that influence the willingness to participate in off-gas projects. Additionally, it will be interesting to know how to influence these barriers and triggers by the usage of information provision. So, the main research question is:

What motives affect tenants' decision to accept a natural gas-free renovation of their home and how can these motives be influenced by information provision?

In order to be able to answer the main question, several sub-questions need to be answered:

1. Which motives that affect tenants' decision to accept energy efficiency renovations may have an impact on tenant's decision process to accept a natural gas-free renovation?
2. How can information provision influence the motives of tenants' to accept a natural gas-free renovation?
3. Which motives affect tenants' decision to accept a natural gas-free renovation?
4. How are the motives of tenants' to accept a natural gas-free renovation influenced by information provision?

1.4 Research design and reading guide

This study can be described as an explorative qualitative research. Aim of the study is to gain in-depth knowledge and understanding of the motives that affect the willingness to participate in off-gas renovation projects and how these motives can be influenced by information provision. The situation as studied in this research is quite new and has barely been studied. Therefore a qualitative research approach is used in order to gain an in-depth understanding of the situation.

In the first phase of this research, a literature review is conducted to understand pro-environmental behavioral models and identify behavioral motives that could have an effect on the willingness of tenants to give consent for the off-gas transition (chapter 2). At the start of chapter 3, in section 3.1, will be proposed a conceptual model based on the literature review. This model serves as a base for this study.

In the second research phase, two cases are selected in order to be able to compare the results and to explore if the differences between the approaches of the off-gas transition have an influence on the motives of tenants. Semi-structured interviews were applied with tenants from the two cases. In chapter 3 the methodologies used in this research are discussed and in chapter 4 the data collection is elaborated.

In chapter 5 an introduction is given about the social rental housing sector and off-gas renovation and transition strategies, in order to provide more context to the cases. Afterwards in section 5.3 and 5.4, the two cases studied in this research are presented.

The coding process, analyzing of the interview transcriptions and results are discussed in chapter 6. Subsequently, the results of the cases are compared with each other (section 6.4) and the proposed conceptual model (section 6.5). As a result of this analysis, an adopted conceptual framework is proposed. Finally, in chapter 7 conclusions are drawn, results and limitations of the study are discussed and recommendations for further research are formulated.

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2. Literature review

Nowadays improving the energy efficiency of our human activities in order to mitigate climate change is receiving great attention. Additionally the Netherlands is confronted with the task to stop the exploitation of natural-gas from the provinces Groningen and Friesland due to earthquakes. An energy and heat transition is necessity in order to be able to achieve set climate objectives. The Climate Agreement indicates how this energy and heat transition will be executed in the whole country. In the last decades there has been a growing awareness that improved energy efficiency of the built environment can make an important contribution to achieve the set climate objectives. An important step will have to be made by the social rental housing sector. Housing associations are assigned as the starting engine of the energy and heat transition in the Netherlands (Penders et al., n.d.).

The social rental housing sector is the biggest residential real-estate owner of the Netherlands. Renovating and improving the sustainability of this large housing stock can contribute to the acceleration of the reduction of energy demand, lower the cost price of insulation products and installations, and boost innovation in energy efficiency renovation products and processes. However, housing associations do not have unlimited resources to invest and execute renovations. Housing associations have to deal with several limiting factors. Three main limiting factors are: financial resources, limited return on investments and the 70% consent law. Firstly, financial resources are limited due to the high fixed costs of housing associations. In 2013 an additional rental property tax for housing associations and landlords was introduced, in order to improve the functioning of the housing market (Martens, 2019b; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-h; Rijksdienst voor Ondernemend Nederland, n.d.-b). Following on the economic crisis of 2008-2013, the tax was established to supplement the state treasury. Housing associations indicate that the rental property tax impedes them from continuing to invest in the maintenance and construction of social rental properties (Aedes, 2016; Bos, 2019; Martens, 2019a; Woonbond, 2019). The tax limits housing associations' investment capacity (Paling, 2019). Secondly, in the Covenant Energy Saving Rental Sector it is agreed that as a result of energy efficiency renovations the total housing costs have to decrease for tenants (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2012). The tenant benefits the lower housing costs thanks to the investment of the housing association. This is called the split incentive (Monteiro, Causone, Cunha, Pina, & Erba, 2017). Additionally, only a limited rent increase is permitted by law. Therefore the payback time of the investments will be very long or even longer than the lifetime of the building (Ástmarsson, Jensen, & Maslesa, 2013; Monteiro et al., 2017). In the current climate agreement, cost neutrality or cost reduction for tenants has remained a goal for which housing associations have to aim. The third factor is the previously mentioned required permission from tenants in case of a renovation project (Jager, 2018; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-c; Rijksoverheid, n.d.-g). The landlord or housing association must make a renovation proposal to all tenants of the residential complex. Tenants in a complex of more than 10 homes must give permission to carry out the proposed work. If 70% of the tenants agree, the renovation work can be carried out in the whole complex (Rijksoverheid, n.d.-b). A renovation is considered as an improvement of the house, therefore a (limited) rent increase may be asked (Rijksoverheid, n.d.-g). For large and small maintenance work, tenants' consent does not have to be collected. This work is seen as necessary for the preservation and maintenance of the property (Rijksoverheid, n.d.-b).

This study focuses on the motives of tenants to give consent for the execution of renovation work in their homes related to the heat and energy transition. A decision making processes is influenced by

multiple factors. Wilson & Dowlatabadi (2007) suggest a distinction between contextual and psychological factors that affect decision making. The contextual determinants include for example available choices, technologies and economic incentives. Studying the contextual factors seems to be less relevant for this study, because the proposed off-gas renovation plan does not include much freedom of choice for tenants. There is a limited freedom of choice because of the fact that the tenant is not the property owner. For this reason this study focuses on psychological determinants, like values, attitudes, and personal norms. In most behavioral studies an individual is considered as the decision maker. As described above, social housing associations require permission of tenants to carry out renovation work. The tenant has to decide if he or she is willing to give permission for the execution of the work. In case of the energy and heat transition this decision can be regarded as pro-environmental behavior. The definitions of environmental behavior and pro-environmental behavior in this study are adopted from Steg & De Groot (2019, pp. 165-166).

Environmental behavior

“Any behavior that has an impact on the environment (good or bad).”

Pro-environmental behavior, also referred to as environmentally friendly behavior

“Behavior which harms the environment as little as possible or even benefits it. This is behavior that is beneficial for the environment but is not necessarily (or exclusively) motivated by environmental goals. According to this definition people can act pro-environmentally without any intention to do so, for instance, because the behavior is habitual (e.g. you always turn the tap off when brushing your teeth) or because the behavior is motivated by other goals (e.g. not driving to work because cycling is cheaper and healthier).”

As stated by Steg & De Groot (2019) environmental behavior or the impact of environmental behavior could be studied in research. The impact of environmental behavior depends partly on factors that are beyond the control of individuals, such as technological or weather factors. In this study it is more relevant to study environmental behavior and not its' impact.

In this chapter, first, an overview will be given of the most researched behavioral models regarding pro-environmental behavior. Afterwards, in the second section, it is narrowed down to research into the motives of people to exhibit pro-environmental behavior. Subsequently, special focus will be placed on the identification of the barriers and triggers that influence the willingness of tenants to give consent for the execution of energy efficiency measurements. In the third section it is focused on research into intervention strategies to change behavior and the influence of information on pro-environmental behavior. The fourth section will provide an overview of how pro-environmental behavior has been studied. Finally, conclusions will be drawn.

2.1 Behavioral models

As explained by Wilson & Dowlatabadi (2007) decision models are created by researchers in order to understand human behavior and to identify behavioral drivers and barriers. Decision models can help to design and evaluate interventions. The intent of this section of the literature review is to provide an overview of the most used and researched behavioral and decision models regarding (pro-) environmental behavior. At first several types of behavioral theories which are often researched in environmental behavior studies are briefly discussed. Afterwards an introduction is given into the goal-framing theory. This theory provides an integrated framework to understand environmental behavior.

2.1.1 Types of behavioral models

Since the energy and oil crisis of the 1970s residential energy use is a growing research field in social science. Across all fields of social sciences researchers have studied the drivers of individual behavior. This has resulted in a diversity of decision models, with variations in basic assumptions, independent variables, structure and scale.

Firstly, utility-based decision models are based on the assumption that individuals make rational decisions based on the maximalization of the utility (Borgers, 2019; Karatasou, Laskari, & Santamouris, 2014; Wilson et al., 2018). Utility-based decision models and econometric models can quite accurately describe the distribution of preferences in a population, even if the individual preferences are varied. Often proposed utility-based models of individual behavior are tested by the usage of discrete choice or stated preference methods. There is a variety of this type of research into several types of pro-environmental behavior of people (Kerperien, 2019; Michelsen & Madlener, 2012). Secondly, technology adoption and diffusion theories are based on the assumption that social networks and technological attributes are the main influencers of the decision making process (Nijssen & Wouters, 2019; Wilson & Dowlatabadi, 2007). This type of theories explain how and why innovations are adopted by people. A very well-known example of a technology adoption and diffusion theory is the innovation diffusion theory (Rogers, 2003). Below in fig. 2.1. is shown a visual representation of this theory. Another example is the Domestication Theory, which explains how new technologies become part of peoples' daily life (Sovacool & Hess, 2017). Thirdly, another type of behavioral models are attitude-based decision models. A well-known example is the Theory of Planned Behavior, in which attitudes and social norm define individuals behavior (Wilson & Dowlatabadi, 2007; Yuriev, Dahmen, Paillé, Boiral, & Guillaumie, 2020). Some of the above discussed theories serve as a theoretical basis for the studies as discussed later on in this literature study. Although the theories are based on other assumptions and variables, they are often overlapping and can be applied to study or explain the same behavior.

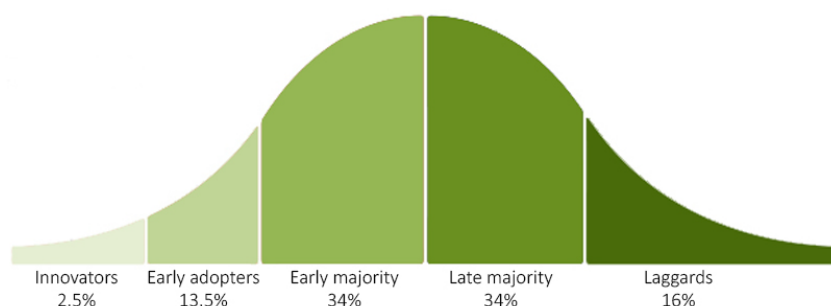


Fig. 2.1. Model of the innovation diffusion theory of Rogers (2003). Adopted from Nijssen & Wouters (2019).

In addition, pro-environmental behavior has also been extensively studied in sociology. In this research field the individual is not considered as an individual decision maker but as a part of a complex relationship between external factors and their influence from a higher societal scale (Karatasou et al., 2014). The usage of technologies or energy is seen as a tool that enable to live a normal and socially acceptable life (Wilson et al., 2018). This type of behavioral models and corresponding research studies are not further discussed. The tenant is considered as an individual decision maker in this study.

2.1.2 Goal-framing theory

A growing research field is environmental psychology. The aim is to understand environmental behavior and how to influence environmental behavior. The ultimate aim of environmental psychology is to identify the most effective manner to change people's environmental behavior (Steg & De Groot, 2019). In this research field it is suggested that four types of values are relevant for environmental behavior. Hedonic values (focused on feeling and pleasure), egoistic values (focused on one's personal resources), altruistic values (focusing on the well-being of other people and society) and biospheric (focusing on nature and the environment) values (Perlaviciute & Steg, 2015). Which values people prioritize influences how people act (Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Perlaviciute, van der Werff, & Lurvink, 2014). Lindenberg & Steg (2007) have developed an integrated framework, the goal-framing theory. In this theory various theoretical frames are combined to explain environmental behavior. By combining several theories in the goal framing theory, it is possible to deeply understand environmental behavior (Steg & De Groot, 2019). In the goal-framing theory it is assumed that three general goals control the manner in which people process information and (re)act upon it: hedonic goals, gain goals and normative goals (Lindenberg & Steg, 2007).

The hedonic goal is aimed at improving the way one feels. This goal is focused on increasing one's own mood, emotions, energy level and pleasure. The factors that influence the hedonic goal have a central role in theories on affect. Acting pro-environmental can be pleasurable, but in most cases it is considered as unpleasant or less comfortable. The time horizon of the hedonic goal is very short and focused on right now. The gain goal is focused on the maintaining and improvement of personal resources (monetary and non-monetary). These resources can be scarce things like money, time and relations. People make an estimation of the costs and benefits of behavior, this estimation effects their behavior. The time horizon of this goal is middle or long-term. The normative goal is to behave appropriate conform social norms and to what one observes other people do. The time horizon is long-term, norms of people do not change often and easily.

One of the three goals is dominant for each person. This goal determines how information is processed and called the goal frame. The other two "background" goals increase or decrease the strength of the focal goal. All goals influence a person's behavior, but each to a different degree. Additionally the goals influence one another. Gain and hedonic motives can strengthen or weaken normative motives and vice versa. The gain and hedonic goal are more aligned with personal interests and benefits. The normative goal is focused on doing the appropriate for society and environment. The goals can be in conflict with each other. Acting according hedonic or gain goals is more attractive for individuals on the short-term. For society it is more attractive if individuals act following the normative goal, this implies acting pro-environmentally. The hedonic goal is appointed as likely being focal in most cases. This due to the fact that fast and short-term benefits are attractive to people. Ultimately, behavior is determined by the coherence and influence between the three goals.

2.2 Motives to exhibit pro-environmental behavior

In this paragraph are discussed existing studies into motives to exhibit pro-environmental behavior. Numerous research studies are discussed following the proposed goals of the game-frame theory. It should be borne in mind that the different goals influence each other and each goal does influence the final behavior of people to a greater or lesser degree. For the sake of readability and overview, literature is discussed for each goal separately.

Research specific into the motives of tenants is limited. Therefore studies into the motives of homeowners are discussed, for the reason that tenants can have similar motives (Abreu et al., 2017; Mortensen et al., 2016; Nair et al., 2010; Wilson et al., 2015, 2018). Additionally several studies into values and emotions that influence people's behavior and focal goal are discussed (Perlaviciute & Steg, 2015; Perlaviciute, Steg, Contzen, Roeser, & Huijts, 2018; Steg, Perlaviciute, et al., 2014). The strength of goals depends on how people prioritize values (Steg, Perlaviciute, et al., 2014). So, people with strong hedonic goals will be focused on the hedonic aspects of alternatives. Motivaction has conducted several studies into the attitude of Dutch people with regard to climate change (Grient & Vos, 2019; Thijssen, van Duist, Bot, van der Werf, & Verheggen, 2018). In these publications are researched the motives of Dutch people. In the white paper "Vijf tinten groener" five consumer profiles specified for sustainability and pro-environmental behavior are explained. Shown is that other goals are focal for different consumer types. In Appendix 2 these five consumer profiles are briefly explained.

2.2.1 Hedonic motives

Hedonic motives are focused on personal feelings, mood and pleasure. The factors that influence the hedonic goal have a central role in theories on affect (Lindenberg & Steg, 2007). The role of feelings on behavior are mostly studied in consumer behavior and risk perception studies. Often is assumed that people make rational choices, but that is not always true. People make choices or act in a certain manner because it feels good. Emotions influence how people behave. As described by Steg & De Groot (2019) there can be emotional motives to engage in behavior.

Steg, Perlaviciute, et al. (2014) have conducted an extensive study, which proves that hedonic values and motives are significantly and negatively related to pro-environmental behavior. In the research article are discussed the results of four studies. In each study is used a questionnaire to gather data. In the fourth study are verified the results of the three previous studies. 468 respondents participated in this study. The relation between values and environmental behavior is tested. Respondents were asked to indicate how often they exhibit specified environmental behavior, like showering time and meat consumption. Hedonic values positively correlated with egoistic values ($r = 0.39$, $p < 0.001$), and less with altruistic ($r = 0.20$, $p < 0.001$) and biospheric values ($r = 0.25$, $p < 0.001$). Altruistic values positively correlated with biospheric values ($r = 0.68$, $p < 0.001$). Proven is that hedonic values have an opposite effect on pro-environmental behavior than altruistic and biospheric values. Hedonic values do predict pro-environmental behavior in the prior expected direction. Strong hedonic values are associated with less pro-environmental behavior and a higher energy consumption. People with strong hedonic values seem to be less likely to reduce comfort or pleasure in favor of a reduction of their energy consumption. Personal sacrifices negatively affects the willingness to act in a pro-environmental manner. Hedonic consequences of behavior could be a barrier for behavior change. Therefore the study concludes that hedonic values need to be included in environmental studies and interventions. The same kind of results are found in a research of van der Werff & Steg (2016). Data

was collected through a questionnaire among 205 participants. The predictive power of the Value-Belief-Norm theory and the Value-Identity-Personal norm model of participation in a smart energy system projects is compared by regression and mediation analysis. There is not found a significant difference in the predictive power of both models. It has been demonstrated that strong hedonic values decrease the likelihood that a person will participate in a smart energy system project. These results are likely to apply also to other pro-environmental behavior.

As mentioned before hedonic motives are linked to personal pleasure, emotions, mood and comfort. Risk perception does strongly influence the mood of people. In a questionnaire study into the risk perception and related negative emotions regarding the energy production by the usage of natural gas among citizens of the province of Groningen, is found that participants prefer measurements that reduce the risks of the earthquakes and improve the quality of life (Perlaviciute, Steg, Hoekstra, & Vrieling, 2017). Respondents have indicated to feel powerless. These negative emotions were stronger in areas that are more exposed to earthquakes. This corresponds to the hedonic goal of striving for a pleasurable life and a reduction of negative feelings.

In the literature review of Venhoeven et al. (2013) is suggested the distinction between hedonic and eudaimonic well-being. The eudaimonic view of well-being focuses on deeper positive emotions such as feeling meaningful and doing the right thing. This view of well-being does correspondent to the normative goal. In contradiction the hedonic view of well-being is focused on the maximization of one's own preferences and pleasure. This form of well-being corresponds with the hedonic motives and values as discussed in this chapter. Venhoeven et al. (2013) discusses that hedonic well-being can be derived from consumption and achieving goals. This has been confirmed in other review studies (Steg, 2016; Steg, Shwom, & Dietz, 2018). Worldwide is considered consumption and economic growth as an important incentive of well-being. However, Venhoeven et al. (2013) argued that the consumption of goods can be replaced by consuming climate-friendly goods. Additionally is suggested that dividing big and abstract goals into small and attainable goals will help people to get motivated to actually achieve the set overall goal. So, pro-environmental behavior does not necessarily have to result in a reduced hedonic well-being. People estimate the impact of exhibiting certain behaviors. This estimation is based on previous experiences in comparable circumstances. Acting pro-environmental can be pleasurable, but in most cases it is still considered as unpleasant or less comfortable. Pro-environmental behavior is often associated with a reduction of comfort and an increase of effort. Suggested by some researchers is to add hedonic aspects to specific pro-environmental behavior to increase its attractiveness (Venhoeven et al., 2013). Stress existing hedonic aspects of pro-environmental behavior and mitigating the effects of uncomfortable and unpleasurable aspects will be more useful and realistic (Werff & Steg, 2016).

Often renovation decisions of homeowners are not based on the intrinsic motivation to increase the energy efficiency of their house (Abreu et al., 2017). During the analysis of 18 in-depth interviews is found that the reason to renovate mostly origins from aesthetic and lifestyle issues or the need for repair. The results suggest that the motivation to reduce energy consumption and save costs is of less influence on the decision to incorporate energy efficiency measurements in the renovation plans, than the skills, knowledge and habits of homeowners. Financial reasons are more directive in the decision process if resources are limited. Similar results are found in a quantitative study among 883 homeowners in Denmark (Mortensen, Heiselberg, & Knudstrup, 2014a). On a 7-point scale are graded eight parameters. As most important is valued indoor climate (4.9), interior lay-out/functionality (4.6),

indoor environment (4.4) and operating costs (4.4) (costs for heating, water, electricity and maintenance). As in the study of Abreu et al. (2017), this research showed that economic aspects are critical in order to conduct an energy efficiency renovation. The energy efficiency improvements are seen as an unforeseen extra advantage of the comfort, aesthetic of lay-out improvements (Abreu et al., 2017; Mortensen et al., 2014a). Path analysis of quantitative survey data of 1028 homeowners in the UK emphasized that energy efficiency measurements are often part of broader home improvement (Wilson et al., 2018). The results of a literature review of Wilson et al. (2015) show that finances and appearance are indicated to be of greater importance than energy saving by homeowners. Wilson et al. (2015) suggests that by the coupling of other motivation factors, like comfort improvement, with decreasing the household energy consumption can help to motivate homeowners to execute an energy efficiency renovation. Mortensen et al. (2016) have conducted another study with the same survey data as used for their study in 2014 (Mortensen et al., 2014a). This study investigated the key parameters that determine the willingness and motivation for energy renovations of Danish homeowners. In this study Mortensen et al. (2016) concluded that the point where homeowners are in their life cycle is the most crucial aspect that influences homeowners' interest in and willingness to perform energy renovations. The older generation (60+ years old) is more often valuing the condition of their property as good. Expected is that improvements in lay-out and comfort will motivate these older homeowners. The importance of hedonic motives (like comfort and quality of life) in the decision making process regarding home renovations is confirmed by the analysis of the dataset of the Dutch WOON survey (Ebrahimigharehbaghi, Qian, Meijer, & Visscher, 2019). Additionally, having to put in extra effort to understand complex subsidy procedures and to gather knowledge about energy efficient renovations is perceived as a main barrier by homeowners. In the results of the consumer survey of Motivaction are identified some other factors that influence the motivation of people to adopt pro-environmental behavior (Grient & Vos, 2019). Convenience and hassle are indicated as co-determining in the decision-making process. If a measure causes little hassle and does improve comfort, people are more likely to implement the measure. To summarize, the decision to renovate is primarily not motivated by motives regard the reduction of energy consumption. Circumstances in the domestic and household life are particularly influential on renovation decisions. Hedonic motives, like comfort, highly influence peoples willingness to adopt pro-environmental behavior.

2.2.2 Gain motives

The gain goal is to maintain and improve one's personal resources. This resources can be scarce things like money, time and relations (Lindenberg & Steg, 2007). In research rational choice and utility-based decision models are often used to certify gain motives. However these theories can also be used to study hedonic or normative motives. In these types of decision models is assumed that people make an estimation of the costs and benefits of certain behavior. This focus on costs and benefits corresponds to the focus of the gain motive on personal resources. One of the most commonly known rational choice models is the theory of planned behavior (TPB) (Ajzen, 1985). From an extensive scoping review study is learned that TPB is often used to study pro-environmental behavior and the intention to adopt behavior (Yuriev et al., 2020). In the TPB is assumed that behavior is the result of the intention of behave. In fig. 2.2 is a schematic representation of the TPB shown. The attitude towards behavior is based on the estimation of the costs and benefits of the behavior. The social costs and benefits are reflected by the subjective norm. Evaluated is if the behavior is compatible with the expectations of relevant reference groups. The perceived behavior control represents how one is perceiving the ability to perform the behavior. In the TPB is assumed that other factors influence

behavior indirectly via the attitude, subjective norm and perceived behavioral control. The stronger the intention, the more likely it will be that one will engage in the behavior.

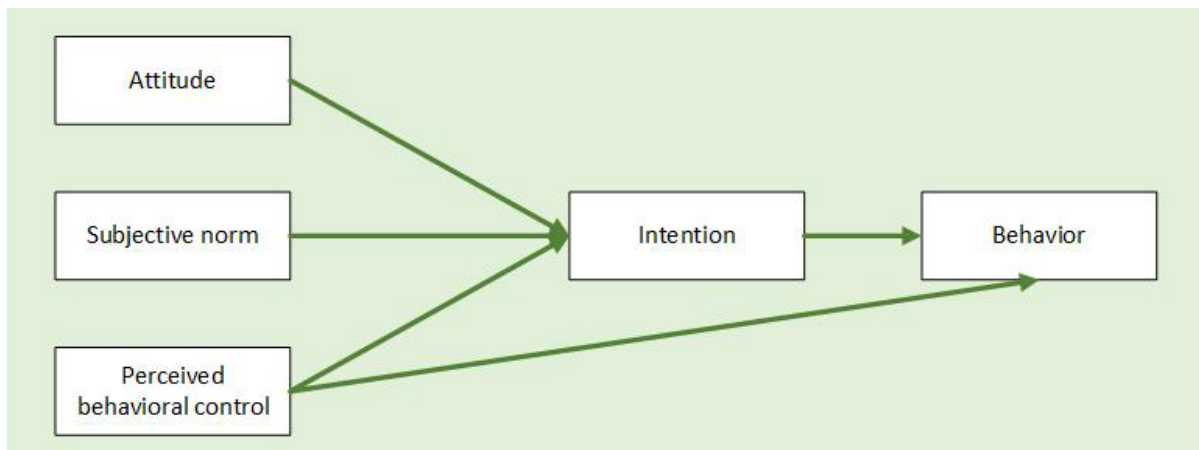


Fig. 2.2. Schematic representation of the TPB. Adopted from (Ajzen, 1985).

As discussed before, values do influence the perception and behavior of people. Stronger egoistic values are associated to less positive evaluation of the consequences of renewable energy solutions. Among Dutch people were distributed two questionnaires to gather data about the effects of values on the evaluation of nuclear (study 1, n=279) and renewable energy (study 2, n=143) (Perlaviciute & Steg, 2015). Both studies used the same analysis method in order to be able to compare the results. The hypotheses were tested by using Pearsons' correlations. It is found that the stronger egoistic values and thus gain motives, the more important are considered the individual consequences of energy alternatives. Subsequently, this has an effect on people's attitudes towards energy resources and the perception of the consequences of the adoption of behavior. People with stronger egoistic values evaluate the individual and environmental consequences of nuclear energy as more positive. The opposite is observed for the valuation of the consequences of renewable energy.

The TPB is based on the relation between intention and actual behavior. Meta-analysis of 77 studies is used to study differences between drivers of intention and actual behavior (Arts, Frambach, & Bijmolt, 2011). Consumers show higher levels of adoption intention for innovations that are more complex, better match their needs, and involve lower uncertainty. However, consumers are found to actually adopt innovations with less complexity and higher relative advantages. So, gain motives are of more influence on adoption behavior than on adoption intention. The effect of the believe that significant others consider adoption of the same behavior, relations and personal image on the willingness to adopt behavior is proven to be positively significant by analysis of the bivariate correlations between adoption norms, adoption likelihood and evaluation of instrumental, symbolic and environmental attributes (Noppers, Keizer, Milovanovic, & Steg, 2019). Otherwise explained, adopters evaluate the attributes of sustainable innovations favorably when they expect that significant others would also consider adoption. Comparable results are found by using a meta-analysis method to study the results of 29 researches (Abrahamse & Steg, 2013). These findings are supported by the evince that people with stronger egoistic values are more likely to participate in smart energy projects (Werff & Steg, 2016). These people are more focused on gaining influence on others, social power and authority.

As described by Abreu et al. (2017) the considerations of homeowners are often based on the need for adjustments in the property. The need for new roof tiles which creates the opportunity to insulate the roof or the need to solve discomforts like condensation which creates the opportunity to replace the poorly insulated glazing for HR++ glazing. Some homeowners confirm that they value energy efficiency improvements as important but that financial resources are leading in their decision process. Financial or economic benefits and the size of investments seems to be critical aspects that influences the willingness of homeowners to perform an energy renovation (Mortensen, Heiselberg, & Knudstrup, 2014b; Wilson et al., 2015). If the project is not financial feasible an energy renovation project will not be carried out. In a recent study of Broers, Vasseur, Kemp, Abujidi, & Vroon (2019) is suggested that different motives are relevant in several stages of the decision making process. In the first phases are environmental concerns and knowledge recognized as more important. However, it is concluded that financial and economic factors are particularly important in the final decision phase. Comparable results of the study by Mortensen et al. (2014) show that other factors have more influence on the motivation of homeowners, but financial factors are determinative. Lappegard Hauge, Thomsen and Löfström (2013) have carried out one of the few studies into the factors that influence the chance that residents or owners in a housing cooperatives agree on sustainable energy efficient renovation. The identified influencing factors on individual level are: the time frame and organization of the process, understanding and attention for the residents' needs, economy (housing costs), the provided information, and the existence of available exemplary projects and role models. Concluded is that pro-environmental or energy efficiency measurements are seen as a bonus, personal economy aspects (the monthly housing costs) are of main influence. Comparable results are found in a field study of Sommerfeld, Buys, & Vine (2017). 22 semi-structured in-depth interviews are conducted. Learned is that economic factors are more important than environmental factors during the decision making process to purchase solar PV. Koch & Christ (2018) have held 18 interviews with (non-)participants of a community PV project. Non-participants have indicated that a lack of financial resources are the main reason to not participate. By participants is the usage of regional generated renewable energy indicated as main driver to participate. Qualitative research has shown that the gain motive is often the focal goal in the decision process regarding participation in a renewable energy production and investment community (Dóci & Vasileiadou, 2015). Main driver is to reduce energy costs. Normative motives, like protection of the environment, were less important but still of great value in the decision-making process. Grient & Vos (2019) have studied the knowledge, attitude and behavior of Dutch people (homeowners and tenants) regarding climate change and energy transition. For most Dutch people it is important that the measures deliver something for them. It appears that costs are a more important consideration than the climate. Additionally, a lack of knowledge about the benefits and costs of measures is indicated as an obstacle to adopt pro-environmental behavior. It is assumed that the costs are high. People are not feeling capable to determine whether the measure can be applied in the personal situation. Each of these studies endorses the effects of financial and economic factors on the ultimate behavior of homeowners. Gain motives seem to have an important and maybe even determinative effect on the behavior of residents.

2.2.3 Normative motives

To recapitulate, the normative goal is focused on social norms in order to behave appropriate. Altruistic values and biospheric values corresponds with normative motives (Perlaviciute & Steg, 2015). Normative motivations are often studied by the usage of the norm-activation model (NAM) and by its extension the value-belief-norm (VBN) theory (Lindenberg & Steg, 2007). The NAM suggest that the activation of personal norms to behave morally appropriate will result in pro-environmental

behavior (Steg & De Groot, 2019). Four factors activate personal norms: problem awareness, ascription of responsibility (feeling personally responsible for problems), outcome efficacy (believing that personal actions will contribute to mitigate the problem) and self-efficacy (feeling to be able to engage in mitigation actions). The VBN theory is an extension of the NAM (Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). In the VBN is suggested that awareness of the climate problem depends on relative stable values and ecological worldview (believe in human effect on environment). The willingness to take pro-environmental action is determined by problem and consequence awareness and subsequently feelings of personal responsibility. Therefore a strong normative goal is associated with acting with more environmental concern. The goal-framing theory proposes that the endorsement of biospheric values is related to strong pro-environmental beliefs, norms and feelings to be personally responsible to adopt pro-environmental behavior and being able to contribute to mitigate climate change (Lindenberg & Steg, 2007). Normative motives to act pro-environmentally are focused on the society and environment around us, in contradiction to hedonic and gain motives which both are focused on personal consequences.

In a study executed in Japan, the VBN theory is used to analyze and test the effects of hedonic, egoistic, altruistic and biospheric values on car use (Hiratsuka, Perlaviciute, & Steg, 2018). A significant effect for altruistic values was not found. Concluded is that hedonic values do negatively affect the consequence awareness and personal norms and thus are less likely to induce pro-environmental behavior. Additionally egoistic values do negatively affect the sense of personal responsibility. These findings underline the previous discussed studies about hedonic and gain motives. Biospheric values do positively affect consequence awareness, sense of responsibility and personal norms. Strong biospheric values are likely to result in pro-environmental behavior. In a study of Onel (2017) the TPB is extended to study the effect of personal norms on pro-environmental purchase behavior. Pro-environmental personal norms are added as a predictor of the behavioral intention. The studied data was part of a larger consumer behavior study ($n=281$). The structural equation model was used to analyze the data. The standardized regression coefficient for the effect of pro-environmental personal norms on intention is found to be significant ($\beta = 0.56$, $p < 0.01$). These results confirm the above described research conclusions that the higher one's own concerns regarding the climate, the greater the intention to behave pro-environmental. Additionally, in the study is shown that the intention to behave is a good predictor of actual behavior ($\beta = 0.88$, $p < 0.01$).

The society as an important motivational factor of pro-environmental behavior is supported by the statistical analysis of data from three questionnaire studies distributed in 29 Dutch neighborhoods which are involved in an energy related neighborhood initiative (Buurkracht) (Sloot, Jans, & Steg, 2019). Found is that communal (altruistic) motives are positively related to actual participation in such an initiative. However communal motives are not indicated as important motivational factors by the respondents themselves. It appears that financial motives are indicated as important motivational factors to participate by the participants, but are actually of less influence. These results suggest that communal motives are underrated and financial motives are overrated. Additionally in this study is proven that environmental (biospheric) motives are indicated as and actually are important motivational factors for participation in a pro-environmental neighborhood initiative. Viewed in a broader perspective these results can be considered as prove that biospheric and altruistic, thus normative, values do have an important influence on pro-environmental behavior. In the earlier discussed study of Perlaviciute & Steg (2015) are found similar results. The stronger one's biospheric values, the more important are valued environmental consequences of behavior and subsequently

are valued renewable energy sources higher. Additionally is suggested that people with strong biospheric values do evaluate individual consequences of renewable energy more positive. How people value environmental protection and think that acting pro-environmental is the right thing to do, is highly affecting eudaimonic well-being (Venhoeven et al., 2013). So, people who are intrinsically motivated to behave pro-environmental will feel more fulfilled and will be able to meet their normative goals.

In December 2019 a public opinion monitor report is published that provides insight in the development of climate awareness and sustainable behavior among Dutch people (Grient & Vos, 2019). The research was commissioned by the Ministry of Economic Affairs and Climate. In this report are described the results and conclusions of a quantitative research among 2.478 Dutch people. The majority of Dutch citizens is worried about the current situation of the climate and how we will leave the world behind for future generations. 72% recognizes that there is climate change and 67% thinks that climate change is (partly) caused by human activities. Only 7% of Dutch people denies climate change. Almost three quarters of the respondents see an important role for large companies and the government in taking climate measures. The Dutch therefore mainly point to the government to take climate measures. However, about half of the respondents believe that citizens themselves are also responsible. If these results are considered in the view of the TPB, it could be argued that the Dutch are aware of the climate problem and feel responsible to contribute. Looking back on the studies discussed, this could result in the intention to behave pro-environmental. However, this is not always the case. As explained before, behavior is influenced by different factors and motivations. The interplay between all those factors determines actual behavior. Normative, gain and hedonic motives influence each other and jointly result in specific behavior. As indicated before, most renovation decisions are not motivated solely by energy-saving or environmental motives (Abreu et al., 2017; Mortensen et al., 2014a; Wilson et al., 2015).

2.2.4 Motives of tenants

There have been executed some studies specific into the motives of tenants to adopt pro-environmental behavior. Research institution TRIME has conducted a qualitative study into the purchasing of energy efficient appliances and technologies by social tenants (TRIME, 2015). The institute has conducted 14 interviews with tenants at home. The interviewed tenants exhibit pro-environmental behavior to a certain extent. In this study it is observed that most tenants do turn off the lights in unattended rooms. The participant are already taking measures to save energy because they want to save money, not for pro-environmental reasons. The gain motive is decisive in this case. In 2016 TRIME has conducted another study to identify barriers for carrying out energy renovations by social housing associations in Europe (TRIME, 2016). Emerged is that tenants fear a rent increase (gain motive), disturbance and inconvenience of the household life (hedonic motive), and that there is a lack of trust in the social housing association. The valuation of housing costs as one of the most important influencing factors, is also found in the research executed by Glumac, Reuvekamp, Han, & Schaefer (2013) and Spank (2013). These results are supported by a report commissioned by the Ministry of Internal Affairs. In this report it is stated that tenants indicate four main reasons to accept an offered energy renovation proposal: 1. Rent remains the same (gain motive), 2. Total housing costs decrease (gain motive), 3. Increase of living comfort (hedonic motive), 4. Increase of indoor climate (hedonic motive) (Claessens & Groenland, 2014). It is also indicated that the tenant's confidence in the housing association can have a major impact on the tenant's response, approachability and expectations. This has been confirmed in other studies (Blomsterberg & Pedersen, 2015; Hoogenraad,

2019; Hoppe, 2012). In addition, various studies indicate that if tenants can influence the measures implemented in the renovation project, they will be more willing to agree upon the proposed measurements (Lappegard Hauge et al., 2013; Spank, 2013). Comparable results are derived from analysis of eight case studies into the influencing factors of the adoption of innovative energy systems in social housing (Hoppe, 2012). The case studies were studied by conducting 53 interviews and analyzing additional documentation. Hoppe has found three reasons why tenants hesitate to adopt innovative energy systems. Firstly, tenants were restrained to adopt the system if their monthly rent was increased, even if the net housing costs were decreased (gain motive). Secondly, if tenants are faced with project delays this often results in impatient tenants that demand for compensation (combination of hedonic and gain motives). Lastly, tenants fear that new technologies would suffer startup problems (hedonic motive). This is caused by general lack of knowledge of their benefits, which subsequently causes fear of unequally distribution of costs and benefits among others (if a collective system is applied).

In the above studies, tenants are mainly considered as a homogeneous group. As stated in several discussed studies, the motives of people are different because they pursue different values or they are on a different point in the life course. However, large numbers of respondents are required to demonstrate these differences. Unfortunately, such large-scale studies are hardly carried out among tenants. It is striking that especially gain and hedonic motives are identified as determinative motives. The role or influence of normative motives on the decision process is not exposed.

2.3 Intervention strategies

Most pro-environmental behavioral studies provide insight in the emergence of environmental behavior. In the previous sections is extensively explained which factors influence environmental behavior. However, most people need to change their behavior to behave more pro-environmental and to reduce their impact on the environment. Behavior can be influenced or changed by applying intervention strategies. Intervention strategies can influence knowledge, motivation, attitude, ability or contextual factors of behavior (Kang, Cho, & Kim, 2012; Steg, 2008). Some scientific studies suggest how this could be done.

Steg & Vlek (2009) consider two categories of intervention strategies. Information strategies aim changing perceptions, motivations, knowledge and norms of people. Structural intervention strategies aim to change contextual factors such as the actual costs and benefits of behavior. Indirectly can be influenced motivational factors. Abrahamse, Steg, Vlek, & Rothengatter (2005) have conducted a literature review on intervention strategies that target household energy conservation. In this study are distinguished two categories of intervention studies, respectively antecedent (influencing underlying behavioral determinants) and consequence (influencing positive and negative results of behavior) interventions strategies. Han, Nieuwenhijzen, de Vries, Blokhuis, & Schaefer (2013) have created an overview of intervention strategies to stimulate energy saving behavior. This overview combines the categories of intervention strategies as proposed by Abrahamse et al. (2005) and Steg & Vlek (2009). In the overview of Han et al. (2013) is made a distinction between antecedent (influencing underlying behavioral determinants), consequence (influencing positive and negative results of behavior) and structural interventions (influencing contextual factors). In fig. 2.4 is shown an overview of the three categories of intervention strategies and the main sub-interventions.

Several studies argue that the use of a mixture of intervention strategies will be more effective in changing environmental behavior (Abrahamse, Steg, Vlek, & Rothengatter, 2007; Han et al., 2013; Stern, 1999). Groups of citizens have different backgrounds, norms, values, and concerns (Lindenberg & Steg, 2007; Thijssen et al., 2018). Therefore they have different information or intervention needs and preferences. A mixture of intervention strategies can help to target a larger group of citizens. Effective intervention strategies have to address all main barriers and triggers of the targeted behavior in the perspective of the target group (Stern, 1999). Attention has to be triggered and skepticism overcome.

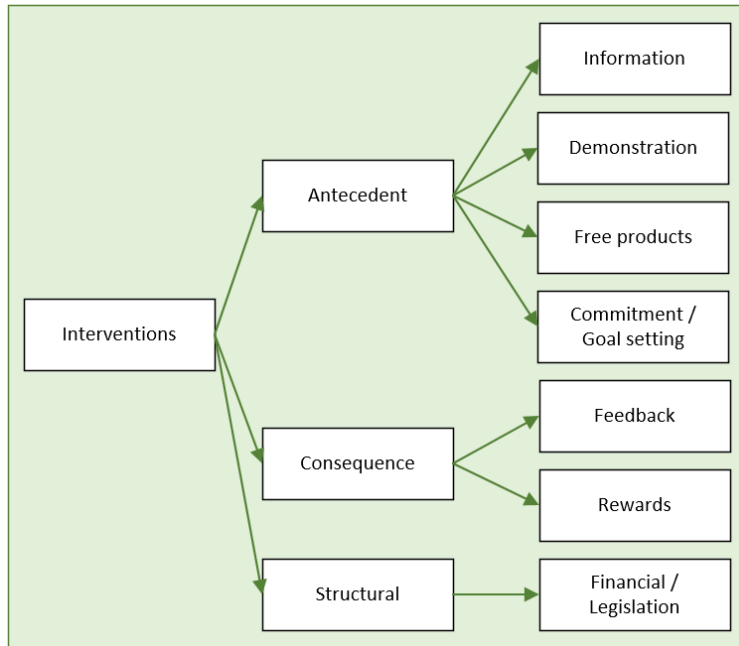


Fig. 2.3. Overview of intervention strategies adopted from (Han et al., 2013).

Structural interventions are focused on subsidies, loans, regulations and price policies. This type of interventions are mainly initiated by the national or local government. Therefore housing associations have limited ability to influence and use this type of interventions. In the studied situation the housing associations are the owners of the properties and are mostly affected by structural strategies like the rental property tax. Consequence interventions aim to change the results of behavior with the application of feedback and rewards. It is hardly possible to apply this strategy before tenants have given their consent. However, after the renovation work has been carried out tenants can take advantage of rewards, like reduced housing costs. Convincing tenants of reduced housing costs is upfront only possible by information provision. Providing feedback on current behavior can help to give tenants insight in their energy saving potential. The feedback, as a consequence intervention, is found to be effective if feedback is provided on a regular basis and the feedback can be easily related to household behavior (Abrahamse et al., 2005). In a review article Steg (2016) validates the effectiveness of feedback systems as a tool to tempt people to act pro-environmental and as a tool to socially influence people's behavior. Feedback about a household's own behavior and the behavior of others can motivate people to act appropriate and to behave more pro-environmental. In a meta-analysis study is concluded that feedback about other persons or groups could be positively effective if the characteristics of the people or households are comparable (Abrahamse & Steg, 2013). The application of consequence interventions in the studied situation seems to be limited. It is assumed

that in the studied cases, antecedent intervention strategies are mainly applied to motivate tenants to give their consent for the off-gas renovation.

2.3.1 Antecedent interventions

Antecedent interventions influence determinants of behavior, like problem awareness, feelings of responsibility, personal motives and perceptions by increasing knowledge and motivation. The effect of knowledge and motivation is included in several behavioral theories. In the TPB the attitude towards behavior is seen as an important factor that determines behavior (Ajzen, 1985). This attitude is influenced by the estimation of the costs and benefits of behavior. This estimation is based on knowledge and information. As explained before, problem awareness, ascription of responsibility, outcome efficacy and self-efficacy are considered as influencers of social norms in the NAM (Steg & De Groot, 2019). These four factors are established by one's knowledge and values. In the VBN theory it is suggested that the willingness to take pro-environmental action is determined by problem and consequence awareness and subsequently feelings of personal responsibility (Stern, 2000; Stern et al., 1999). Both types of awareness depends on personal values and ecological worldview. Information provision and other intervention strategies can influence personal values, ecological worldview, attitude towards behavior ascription of responsibility and problem and consequence awareness. These factors can only be influenced if people have sufficient access to information. People need information and knowledge in order to be able to choose how to behave and to estimate what is appropriate to do. Limitation of most studies into the effect of information on intention and actual behavior is that it is really hard to measure the actual effect of the information provision on intention and behavior in the end. Most studies do show that information provision does have an effect on intention and actual behavior but not how big this influence is.

In the NAM and VBN theory it is assumed that problem awareness do influence the activation of personal norms. Van Der Werff & Steg (2015) have used the NAM to study the effect of knowledge about environmental problems on people's sense of responsibility and intention to behave pro-environmental. A varied sample of 468 respondents completed a questionnaire about different forms of energy related behavior, climate problem awareness, outcome efficacy and personal norms. The collected data was analyzed by the application of a series of regression analyses. Concluded is that the more knowledge people have about environmental problems caused by (energy) consumption, the more responsibility people feel and the more convinced they are to personally contribute. Additionally is found that the intention to act pro-environmental does predicted actual behavior. Similar results are found in another study using the VBN theory. Problem awareness is proven to be positively related to actual participation in smart energy system projects (Werff & Steg, 2016). Additionally is pointed out that higher problem awareness resulted in higher interest in smart energy systems. From this it can be learned that problem awareness does influence people's behavior and can contribute to strengthen normative motives. The study of (Steg et al., 2018) confirms that the increase of knowledge is necessary to be able to change behavior. In this study additionally is suggested to use tailored approaches to target various groups of people.

Most antecedent intervention strategies are about informing and stimulating people to adopt pro-environmental behavior. In fig. 2.4 are shown the main sub-interventions as suggested by Han et al. (2013). Commitment or goal setting intervention strategies are used to stimulate households step by step to behave more pro-environmental. The provision of free energy saving product can help households to overcome the first barriers of adopting pro-environmental behavior. The third main

sub-category of antecedent interventions is demonstration. The consequences of the behavior are demonstrated to the target group by the usage of a model, previous example projects or presentation of the experiences of a comparable person or group. Lappegard Hauge et al. (2013) have found that the a demonstration is an effective manner to inform citizens. It clarifies the proposed plans and consequences. The last antecedent intervention that is identified is the provision of information. This intervention can be applied in many forms and through different channels. As a result, the effect of this intervention can vary widely.

2.3.2 Information provision as an intervention strategy

Providing information and start to motivate currently not interested homeowners is considered as necessary in order to be able to increase their willingness to execute an energy renovation if they improve their home for other reasons. Circumstances in the domestic and household life are particularly influential on renovation decisions. Wilson et al. (2018) point out that for these reasons it is better to focus incentives on the underlying reasons why homeowners decide to renovate. Linking energy efficiency measures to broader home renovations can help motivate homeowners to also implement these measures. Mortensen et al. (2016) recommend to create differentiated motivation campaigns in order to better match the target group. Expected is that it will help to increase interest and willingness to perform energy renovations among the two generation of homeowners.

The three goals of the goal-framing theory influence and determine someone's attention and information processing (Lindenberg & Steg, 2007). The goals have an effect on which information is recognized and what knowledge is most accessible. One of the three goals is focal and mainly determines how information is processed. Steg, Bolderdijk, et al. (2014) propose an integrated theoretical framework to encourage pro-environmental behavior in the view of the goal-framing theory. In the framework are suggested two routes to achieve this. The first route is focused on changing the expected consequences of pro-environmental behavior. Aim is to minimize the conflict between hedonic and gain goals versus the normative goal. Aim of the second route is to strengthen the normative goal and to mitigate the influence of the hedonic and gain goal. The conflict between the goals is not reduced or solved, but made less important. An enhanced focus for the normative goal will create an increased attention for the environmental consequences of personal behavior. The normative goal can be strengthened by activation of biospheric and altruistic values. Argued is that the first route may not result in acting consistently pro-environmental. It is stated that the first route strengthens the focus for the hedonic and gain goal, causing that people will only act pro-environmental if the behavior fits these goals. It is argued that the second route, strengthening of the normative goal, may result in more sustained pro-environmental behavior. In several studies is proven that strong hedonic values are not likely to result in acting pro-environmental (Steg, Perlaviciute, et al., 2014; Werff & Steg, 2016). These results confirm the suggested disadvantages associated with the first route. Hedonic and gain barriers need to be addressed in intervention strategies, however at the same time there should be avoided that these goals get the upper hand and overrule normative motives. Other studies also make suggestions to strengthen normative goals (Venhoeven et al., 2013; Werff & Steg, 2015). Venhoeven et al. (2013) suggests that emphasizing the positive effect of acting pro-environmental on personal eudaimonic well-being can contribute to strengthen the normative goal. It is important to understand the human and personal dimension of environmental problems. Steg & De Groot (2019) argue that information is needed to inform people about what is appropriate to do. The normative goal is focused on acting appropriate. Thus, a person has to know what behavior would be appropriate in the given situation. What is considered as appropriate is based on personal

experiences, memory, norms, values and knowledge. Therefore, information about the consequences of behavior is needed to make an estimation of what is appropriate to do. People need an intelligent effort to translate the available information into behavior. It is argued that if this information is not available, it is likely that the influence hedonic and gain goals will become stronger. The importance of knowledge within the decision-making process is underlined by the results of the qualitative interview study conducted by Abreu et al. (2017). It is concluded that skills and knowledge shape decision-making around home renovations. Stern (1999) suggest that information as intervention strategy is not enough to encourage behavioral change if the targeted behavior is more complex and associated with conflict between motives. In contradiction he also states that information can be effective to stimulate behavior change if it is presented in a context where it is relevant and where the target behavior occurs. The intervention has to remind people which personal norms are supported by the behavior change. A mixture of interventions is suggested to overcome all barriers and to effectively motivated people to change their behavior in favor of the environment. This suggestions are supported by Steg & Vlek (2009). Antecedent intervention strategies have to target various motivational factors of behavior in order to be effective. In the literature review of Abrahamse et al. (2005) are drawn similar conclusions. The provision of information as only intervention strategy seems not to be very effective. It will increase the knowledge and problem awareness of people, but it is not proven that actual energy use decreases. The usage of the intervention commitment or goal setting is presented as a proven intervention to decrease actual energy use. In a survey study among resident in 2 complexes is shown that promotion and information provision of pro-environmental behavior and its consequences can help to raise awareness, knowledge and motivation (Kang et al., 2012). Proven is that this can even result in actual energy behavior. Additionally is shown that collective information activities about energy saving did contribute to the establishment of a community within the studied complexes. In short, in literature is suggested that a mixture of antecedent interventions can help to increase knowledge and motivation and positively influence attitude towards pro-environmental behavior.

In the field experiment study of Delmas & Lessem (2014) is studied the difference between the effect of detailed private information and public information. Concluded is that public information helps to motivate people but as a single intervention it is only effective for above median energy users. Provision of detailed personal information is not an effective method for encouraging energy saving behavior. A combination of both information strategies is proven to result in the highest energy reduction. The results of this study demonstrate that different forms of information provision can reinforce each other. Other studies also support the provision of information as an effective intervention to stimulate pro-environmental behavior. In a meta-analysis of experimental studies is shown that information based strategies can be an effective strategy to reduce the overall energy use of the targeted audience (Delmas, Fischlein, & Asensio, 2013). Information in the form of individual audits seems to be most effective. Hafner, Elmes, Read, & White (2019) has tested in a choice-experiment (n=599 participants) which intervention strategy is most effective in promoting new pro-environmental technologies. It is found that information about the behavior of peers and regular financial feedback about on behavior stimulates people to adopt the new technologies. An internet-based tool was used to study the effect of tailored information, goal setting and tailored feedback on household energy use (Abrahamse et al., 2007). The results show that a combination of the approaches has led to a reduction of 5,1% on household energy use. The provision of tailored information as expected to be effective and reduce energy use, is endorsed in earlier research. Lindenberg & Steg (2007) suggest that the usage of volunteers can help to inform people about what

the consequences of certain behavior are. The assumption is made that the usage of existing social networks will increase the effectiveness of the information provision, because the information will reach a specific group and the information is valued as trustworthy as it comes from a person from the own social network. Additionally, it is expected that people who observe certain behavior are more likely to adopt the behavior themselves. Therefore, if the volunteers already have adopted the behavior their effectiveness can be increased.

In addition, the origin of information and the type of information has an influence on pro-environmental behavior (Stern, 1999; Thijssen et al., 2018). Some groups of people prefer information that contains facts and examples, others prefer a focus for personal consequences (costs and benefits). Responding to the information needs and wishes of residents can help to convince them of the importance of their own contribution. Trust in information providers seems to have an effect on the evaluation of information. From a questionnaire study it is concluded that higher trust in responsible stakeholders does affect the acceptability of the proposed plan (Liu, Bouman, Perlaviciute, & Steg, 2019). Stated is that ambiguous information can encourage a weakening of the strength of normative goals (Steg & De Groot, 2019). Although it seems that most people in the Netherlands recognize that the climate is changing due to human action and our lifestyle, the debate about the measures to be taken is fierce. In the extensive social debate a lot of contradictory information is disseminated. First of all is publicly discussed the necessity of phasing out natural gas in the built environment (Dongen & Mersbergen, 2020; Ekker & van der Parre, 2020; NPO Radio 1, 2020). Secondly, the available alternatives are extensively discussed in the media (Ekker, 2019b). Some parties consider hydrogen or other forms of (biogas) as an important energy carrier within the energy and heat transition of residential properties (Buijs, 2020; Leeuw, 2020; Noy, 2018; TNO, n.d.; Vogels, 2020). Other parties consider the installation of heat networks as the most suitable alternative for large and medium-sized cities (Ministerie van Economische Zaken en Klimaat, 2019; NPO Radio 1, 2020). All kinds of experts extensively discuss a variety of aspects of heat networks, such as the construction costs, the running costs, the monopoly of heat companies, the sustainability of the heat source and practical objections (Beekhuis, 2018; Ekker, 2019a; Ekker & Hofs, 2019; Huiskes, 2019; Lomme, 2020; Markus, 2019; Noy, 2019a, 2019b; Redactie De Gelderlander, 2019; Seghers, 2019; Sienot, 2019; Vattenfall, 2019). The alternative to renovate homes according to the all-electric concept has been discussed no less (Godfroij, 2019, 2020; Kassa, 2018). Investment costs that are too high, major behavioral changes and the indoor climate are frequently discussed topics (Cobouw, 2019; Groot, 2019; Winter, 2019). Lastly, a variety of facts about climate change are circulating on social media. For most people it is hard to estimate the truthfulness and reliability of presented facts. It can be imagined that this large amount of information may cause uncertainty and confusion among citizens. It can create distrust in institutions and the alternatives for heating and energy provision as offered.

2.3.3 Effect of information on tenants

There has been carried out some research into the effect of information on tenants and their willingness to participate. In the research of TRIME they studied the barriers for energy renovation regarding social housing (TRIME, 2016). Identified as organizational barrier is the difficulty to reach 70% consensus among tenants. Mentioned as an important causality of this barrier is a lack of trust in the housing association. Suggested to overcome these barriers is to combine the energy efficiency renovation with an upgrade of the neighborhood and to emphasize the increased indoor comfort as a result of the renovation. These suggestions follow the first route of Steg, Bolderdijk, et al. (2014).

Tenants have indicated that a personal approach by a person they know and trust, could help to overcome barriers to give consent. It seems like that generic information for all tenants is not effective and informative enough to convince tenants to participate. In another study of TRIME, participants have indicated that they mostly talk to family, friends and experts about energy or climate friendly gestures (TRIME, 2015). Neighbors are less often speaks partner. Information is mainly obtained from one's own social environment. Comparable results are found by Claessens & Groenland (2014). Concluded is that an communication strategy with attention for tenant's personal concerns is effective to inform tenants about the consequences of the renovation and overcome barriers. Information need to be clear and understandable. Kerperien (2019) has studied the different effects of a hedonic focused information treatment and a gain focused information treatment. Proven is that a hedonic information treatment does increase the preferences of tenants for insulation. For the gain treatment is shown that it increases the preferences for energy saving measurements but also for not renovating. So it seems that the focus of the information does influence the perception and preferences of tenants.

Hoppe has emphasized that a lack of trust between stakeholders can have a delaying effect (Hoppe, 2012). In extreme cases of distrust between the tenant and the housing association, this can even lead to insufficient support. Recommended is that a steady and motivated project management group, who are in touch with all actors, could help to overcome trust related barriers. Hoogenraad (2019) additionally indicated that the process satisfaction is influenced by the satisfaction with the communication by the housing association, discomfort and nuisance and influence on the process. In response to these findings are made a number of recommendations with regard to the communication process at the start of a renovation project. It is advisable to communicate clearly about the measures and to indicate what can be expected. By using a personal approach, it is possible to let every tenant make his wishes and concerns known. Responding to this and, if possible, providing customized solutions can increase the satisfaction of tenants. Similar recommendations are made by (Lappegard Hauge et al., 2013).

The recommendations of various studies indicate that a personal approach is important to reach all tenants. Until now, tenants are in most cases considered as one homogeneous group with the same need for information. However, in this literature study it is learned that each person has its own concerns, needs and information preferences. The discussed results of the studies focused on the tenant's perspective are aligned with the earlier discussed literature. It is striking that trust in the housing association appears to have a major influence on the tenants' decision-making process. This can be caused by the unique role of housing associations in-between the government and residents (Beekers, 2012). In section 5.1 is further elaborated on this unique role. The role and organizational patterns of housing associations have changed over time under the influence of the government, politics and the commercial real-estate market. These changes are a grateful subject for various media (Aedes, 2020; KRO-NCRV, 2019; NTR, 2020). Media can create a picture of housing associations that influence the perception of tenants. This can also influence the relation of tenants with their housing association. Expected is that news coverage has a significant impact on the trust of tenants in housing association.

2.4 Research methods to study pro-environmental behavior

In the previous discussed literature a variety of research methods are used to study different aspects of pro-environmental behavior. Both quantitative and qualitative research methods are applied to study pro-environmental behavior. Quantitative research approaches are mostly applied to study or measure facts. Large amounts of data is analyzed statistical. The aim of the research is focused on the relations between variables and the strength of these relations. Questionnaire studies are an effective method to gather data among large groups of people. Aim is to learn more about people's preferences, opinions, beliefs and perceptions. Analysis of the results can provide insight in relationships between variables. Disadvantage is that it cannot be excluded that a not observed variable does influence the researched relationship. In a structured interview is gathered quantitative data. This method is comparable with the questionnaire method. The difference is that the questions are asked and answered orally instead of by means of a survey on paper or online (D. B. Baarda, Goede, & Meer-Middelburg, 1996). Quantitative research methods are very widely used to study pro-environmental behavior. Most aforementioned studies are quantitative studies that analyze data gathered by surveys.

Qualitative research methods are used to understand processes and situations (Neuman, 2014). Smaller samples are used, but data is rich. To gather a deeper understanding of people's behavioral motives can be conducted interviews (D. B. Baarda et al., 1996). Open-interviews provide the researcher with qualitative data. This research method is mainly used when there is little known about the investigated situation. Interviews can be used to explore the situation. New influential factors or relationships can be identified. A smaller sample of participants is needed, but disadvantage is that the method is time consuming. The information gained can possibly serve as a starting point for quantitative follow-up research. Another method to explore a relative new or complex situation is to observe behavior in a field study (Wilson & Dowlatabadi, 2007). For example this method is used to study how new technologies are adopted by society. A well spread method to in-depth study a contemporary situation is conducting a case study (Yin, 2018). A case study is used to explore and understand a contemporary situation within its real-world context. It is a time demanding method and the results are often not generalizable for other situations. However, the rich data can provide enough valuable knowledge that can contribute to science. Some qualitative studies are part of the above described literature review. These researches study a specific or relative new situations, others study the extensively existing literature within a specific research field to identify new research gaps and directions. An overview of some of these researches is provided in table 2.1.

Table 2.1. Overview of qualitative studies.

Author (date)	Title	Method	Aim of study
Abreu et al. (2017)	Attitudes and practices of homeowners in the decision-making process for building energy renovation	Interviews (n=18)	Identification of individual motivations of homeowners to execute energy efficiency renovations.
Broers et al. (2019)	Decided or divided? An empirical analysis of the decision-making process of Dutch homeowners for energy renovation measures	Online questionnaire (n=91) with additional semi-structured interviews (n=52)	Understanding the decision making process of homeowners concerning energy efficiency renovations.
Delmas et al. (2013)	Information strategies and energy conservation behavior: A meta-analysis of experimental studies from 1975 to 2012	Meta-analysis of 59 literature papers	Providing overview of information based energy conservation experiments.
Dóci & Vasileiadou (2015)	“Let's do it ourselves” Individual motivations for investing in renewables at community level	Case study of 3 cases with semi-structured interviews (n=41)	Identification of individual motives to participate and invest within a community in local renewable energy projects.
Hoppe (2012)	Adoption of innovative energy systems in social housing: Lessons from eight large-scale renovation projects in The Netherlands	Case study of 8 cases with interviews (n=53) and additional document analysis	Identification of factors that influence the adoption of renewable energy systems in social housing renovation projects.
Koch & Christ (2018)	Household participation in an urban photovoltaic project in Switzerland: Exploration of triggers and barriers	Semi-structured telephone interviews (n=18)	Understanding the barriers and triggers to participate in a community energy project.
Lappegard Hauge et al. (2013)	How to get residents/owners in housing cooperatives to agree on sustainable renovation	Case study of 3 cases with interviews (n=30)	Identification of factors that influence residents to give consent for energy efficiency renovations in a housing cooperative.
Sommerfeld et al. (2017)	Residential consumers' experiences in the adoption and use of solar PV	Field study with interviews (n=22)	Understanding how customers purchase and use solar PV, and the effect on energy use behavior.

2.5 Conclusion

In the introduction of the literature review is discussed that housing associations are assigned as the starting engine of the energy and heat transition in the Netherlands. The renovation and improvement of the sustainability of their large housing stock can contribute to achieving the set climate objectives. However, housing associations have to deal with several limiting factors. Social housing associations require permission of tenants to carry out renovation work. The tenant has to decide if he or she is willing to give permission for the execution of the work. Therefore this study focuses on the motives of tenants to give consent for the execution of renovation work in their homes related to the heat and energy transition. In this study the decision to give consent is considered as environmental behavior.

The literature review provides an overview of behavioral models that explain pro-environmental behavior, motives to exhibit pro-environmental behavior and various antecedent intervention strategies to change behavior into pro-environmental behavior. The goal-framing theory proposes an integrated framework to explain and understand environmental behavior. This theory focuses on the hedonic (emotions and pleasure), gain (personal resources) and normative (behave appropriate conform social norms) goals as motives to behave in a certain manner. In this study the goal-framing theory is used as a basis to understand and explain pro-environmental behavior of tenants.

Discussed are numerous of studies that study individual drivers and barriers to behave pro-environmental. In these researches, a number of corresponding motives can be recognized per goal (fig. 2.4). Hedonic motives are focused on short term benefits, egoistic values and personal disadvantages. It is based on the easiness and enjoyability of behavior, like comfort. Personal sacrifices, such as a reduction in comfort due to disturbance and inconvenience are considered as an important barrier to behave pro-environmental. In literature is stated that strong hedonic motives will result less likely in pro-environmental behavior. Gain motives are focused on the consequences of behavior for scarce personal resources like money, image and time. Goal of the gain motives is to maintain or improve the availability of resources. Literature suggests that financial or economic motives are often determinative in the decision making process to change behavior into pro-environmental behavior. Normative motives explain the motivation to behave appropriate based on social norms, biospheric and altruistic values. Normative motives are focused on the long-term consequences of behavior for the society and environment. Feelings of personal responsibility to contribute to the mitigation of climate change are related to the normative goal. In several studies it is indicated that there often occur conflicts between the different goals. In general pro-environmental behavior is considered as costly or less comfortable. Therefore concerning pro-environmental behavior hedonic and gain motives are quite often not compatible with normative motives.

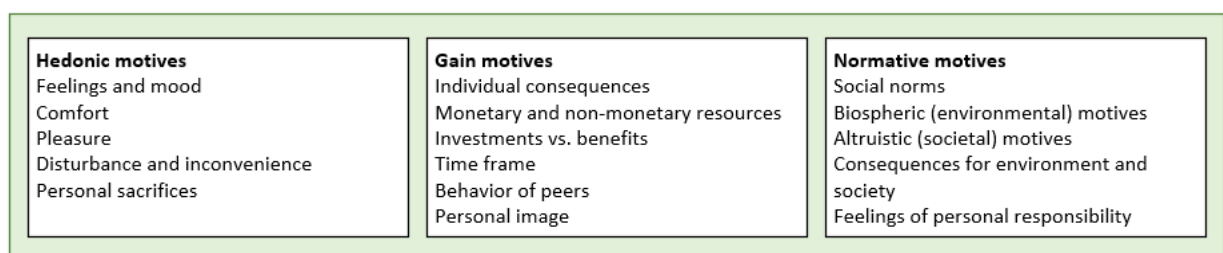


Fig. 2.4. Overview of barriers and triggers per goal as identified by literature.

Most people need to change their behavior to behave more pro-environmental and to reduce their impact on the environment. In literature several intervention strategies to change environmental behavior are studied. Antecedent interventions influence determinants of behavior, like personal motives and problem awareness by increasing knowledge and motivation. An often used antecedent intervention strategy is the provision of information. People need information and knowledge in order to be able to choose how to behave and to estimate what is appropriate to do. Additionally, in literature it is argued that the effectiveness of the intervention strategy is influenced by several factors of the information, like access to (additional) information, origin and form of information. Responding to the information needs and wishes of residents can help to convince them of the importance of their own contribution. Trust in information providers seems to have an effect on the evaluation of information. Stated is that ambiguous information can encourage a weakening of the strength of normative goals. Finally, it should be borne in mind that the relative strength of the hedonic, gain and normative goal does influence and determine someone's attention to information and information processing.

In the literature review is shown that pro-environmental behavior is extensively studied. Most studies are carried out into the motives of residents without any distinction between homeowners and tenants, and of specific groups of homeowners regarding (energy efficiency) renovations. Less research has been carried out into the motives of tenants regarding (energy efficiency) renovations. However, the results of the discussed literature specifically focused on the tenants' perspective are comparable with the results of the other discussed studies. In addition, no scientific research has been conducted specific into the motives regarding off-gas renovations. Therefore, this study will try to identify the motives of tenants to give consent for an off-gas renovation of their home.

In the literature review are discussed antecedent intervention strategies that aim to change determinants of behavior and subsequently actual behavior. Learned is that each person has its own concerns, needs and information preferences. The effect of information provision on actual behavior is difficult to measure. However, in several studies it is concluded that knowledge, access to (additional) information, origin and form of information does have an effect on actual behavior. A limited amount of research has been conducted into the effect of information provision on tenants. Therefore, it will be interesting to learn more about the effect of information provision regarding off-gas renovations on tenants.

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3. Methodology

In this chapter methods which are applied in this study are explained and examined. First, a conceptual model is presented. Subsequently, a general explanation of the used methods is given. The research is an exploratory research, that aims to identify the motives of tenants to give consent for the off-gas transition of their home and how these motives are affected by antecedent intervention strategies. In this study a case study research is combined with the conduction of semi-structured interviews. The transcriptions of the interviews are coded, in order to be able to analyze the results.

3.1 Conceptual model

Based on the literature review a conceptual framework has been developed. This framework serves as a base to study the relation between behavioral motives, antecedent intervention strategies, information processing and actual behavior.

From the literature review it can be concluded that the motives to behave in a certain manner originate from the hedonic, gain and normative goal. The motives of tenants to give consent for an off-gas renovation can be divided into one of these three categories of motives. One of a persons' behavioral motives is decisive, the focal goal. In addition, it is argued that the three goals influence how information is processed. The information processing process subsequently affects actual behavior. A framework that represents the goal-framing theory has not yet been proposed in literature. Therefore, firstly a conceptual framework based on the literature review is designed in order to explain the above described relationships (fig. 3.1).

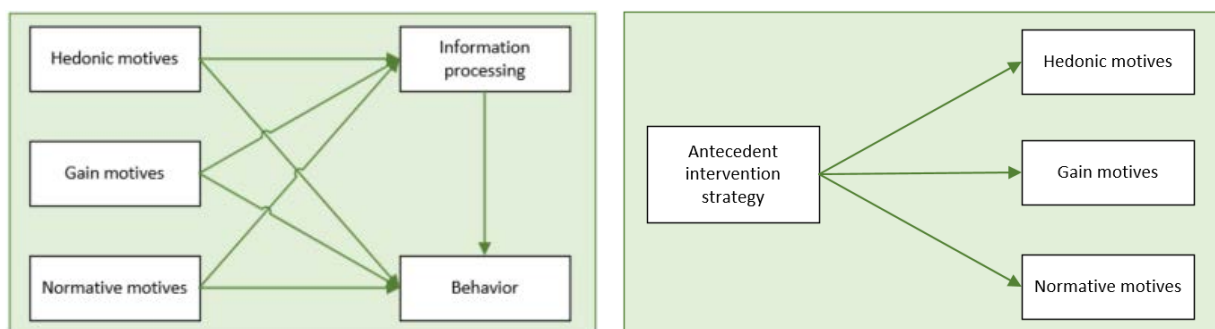


Fig. 3.1. (Left) Conceptual model of goal-framing theory.

Fig. 3.2. (Right) Conceptual model of the influence of an antecedent intervention strategy on behavioral motives.

In the literature review antecedent intervention strategies to influence and change environmental behavior have been discussed (section 2.3). Antecedent interventions aim to change the determinants of behavior. In this study it is assumed that behavior is determined by hedonic, gain and normative motives. In fig. 3.2 this relationship is presented in a conceptual framework.

One type of an antecedent intervention is information provision. It is expected that this strategy is mostly applied by housing associations in the period before tenants give their consent. A combination with other antecedent intervention strategies is possible. Information provision is often an important part of the overall strategy. Literature identifies two characteristics of provided information that have an influence on the effectiveness of the intervention, respectively the form/type of information and the origin of information (trust in source). The influence of these characteristics is represented by a conceptual model (fig. 3.3.).

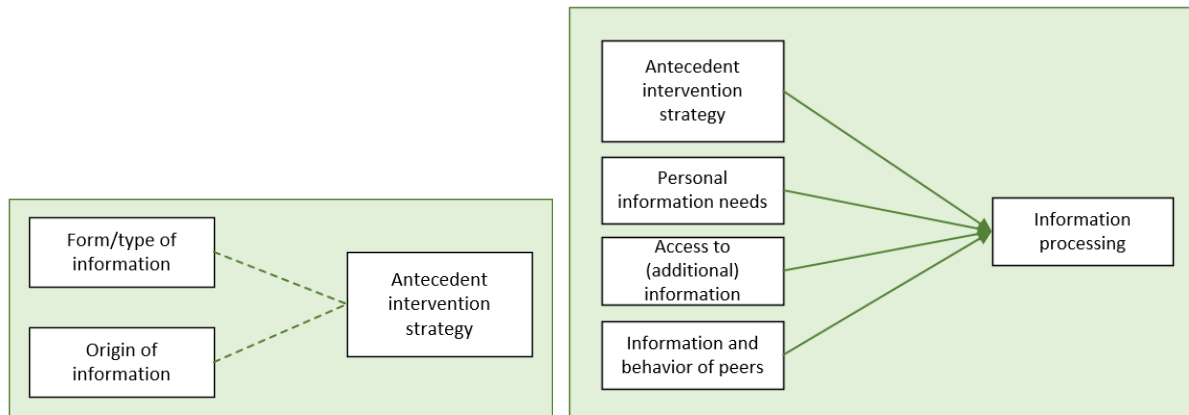


Fig. 3.3. (Left) Conceptual model of characteristics of information provision that influence the effectiveness of the intervention strategy.

Fig. 3.4. (Right) Conceptual model of the factors that have an influence on the process of information processing.

In literature it has been argued that the provided information has an influence on how information is processed by an individual. Additionally it has been pointed out that some other factors influence the information processing process as well, respectively access to (additional) information, information and behavior of peers and personal information needs (fig. 3.4.). Firstly, access to (additional) information represents all forms of information that people need or search for in order to be able to understand or judge the provided information. This can be information from scientific sources, the news, social media and experts. Secondly, in literature it is argued that the behavior of peers (neighbors, relatives and friends) does influence how information is processed. Additionally, peers may be sparring partners in order to discuss the provided information or to gather additional information. Thirdly, everyone has personal information needs and preferences. Subsequently this influences how the information is processed.

The four above proposed conceptual models can be combined into one conceptual model to study pro-environmental behavior of tenants regarding giving consent for an off-gas renovation of their home. This combined conceptual model is shown in fig. 3.5 and serves as a basis for this study.

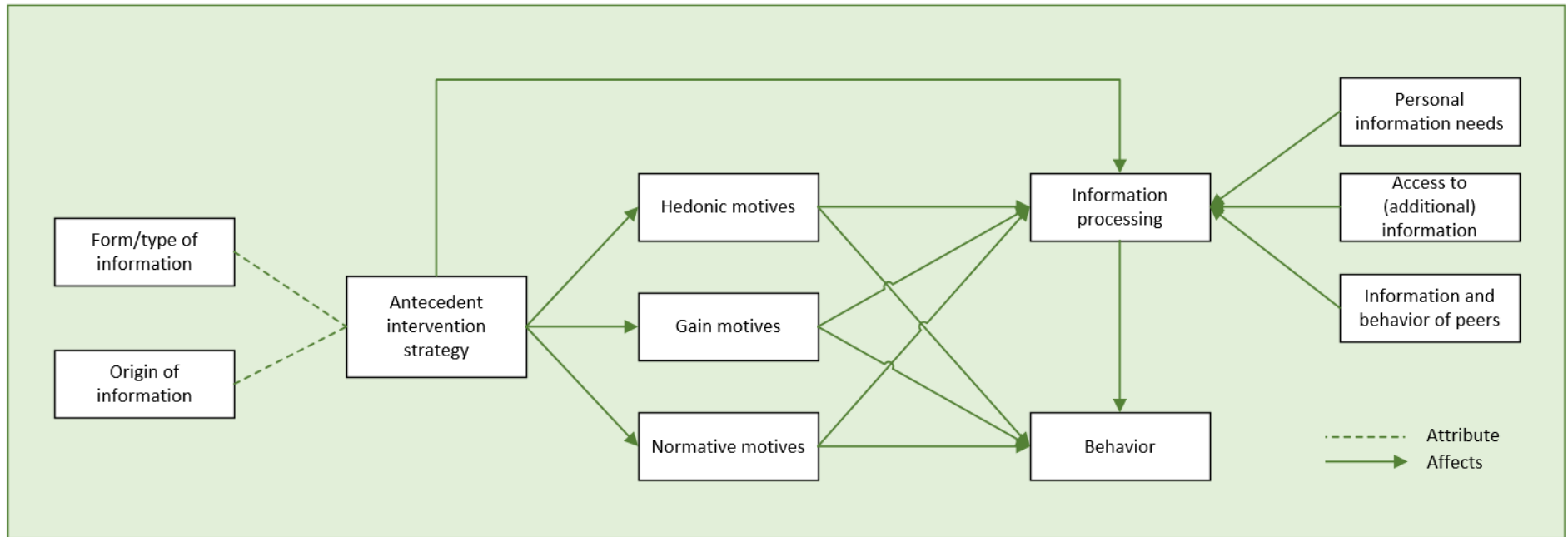


Fig. 3.5. Complete conceptual model of this study.

3.2 Case study

A case study is a qualitative research method which is used to study a particular phenomenon or situation in-depth (Yin, 2018). This method can be used when “[1] your main questions are “how” or “why” questions, [2] you have little or no control over behavioral events, and [3] your focus of study is a contemporary phenomenon – a case” (Yin, 2018, pp. 2). Case studies are often used as a research method in exploratory or theory developing studies (B. Baarda et al., 2018).

In this study we are examining the behavioral motives of tenants to give consent for the off-gas transition of their home and how these motives are affected by antecedent intervention strategies. The case study method fits the aim of this research. For the following reasons. The off-gas transition is a complex, contemporary phenomenon. Therefore it is not possible to control or simulate the behavior of all stakeholders than could influence the motives of tenants. The case study method fits the aim of this research.

Advantage of a case study is that the researched phenomenon (the case) is examined in its real-world context, which makes it possible to explain a complex contemporary situation. Rich data can be gathered and provide valuable insights for a specific scientific field. Disadvantage is that the boundaries between the case and its context can be blurred. In this study a conceptual framework is developed in order to define the boundaries of the case to be studied. Additionally this framework can help to keep the amount of gathered data manageable.

Another disadvantage of the in-depth examination of a case is that the results and conclusions cannot be generalized for other situations. The generalization of the results can be improved by studying multiple comparable cases within the same research. Therefore, the choice was made to use two cases with a different off-gas transition strategy. By comparing the two cases it is possible to explore differences and similarities, in order to be able to provide more generalizable insights and knowledge.

3.3 Semi-structured interviews

Data need to be gathered to be able to fulfill the aim of the study. The case study research is combined with the conduction of interviews. Mixed-method research enables to study more complex situations (Yin, 2018). In this study two qualitative research methods are combined, in order to be able to explore and understand the motives of tenants regarding the off-gas transition (Neuman, 2014). Case study research is often combined with interviews in the environmental psychology (see section 2.4)

To gather a deeper understanding of people’s personal behavioral motives interviews can be conducted (D. B. Baarda et al., 1996). Three types of interviews can be distinguished: open-interviews, semi-structured interviews and structured interviews (B. Baarda et al., 2018). In case of a structured interview, all questions and the order of the questions are prepared in advance. The interviewee answers these questions. No follow-up questions are asked. This form of interviewing is usually used when the researcher has a lot of prior knowledge about the subject and has specified which information should be collected (B. Baarda et al., 2018). A structured interview can be used as a quantitative research method. An open interview is more like a normal conversation with someone. During the conversation certain topics are discussed. The interviewer aims to understand how the interviewee views these topics. The interviewer asks follow-up questions if this is needed. Advantage of an open-interview is that a lot of information can be collected on various subjects. New topics can also be discussed spontaneously. These methods are often used to explore or understand people’s

views or experiences. In addition, the method is often used to explore relatively new or complex situations (D. B. Baarda et al., 1996). The data derived from open interviews can serve as a basis for quantitative follow-up research. Semi-structured interviews are a mix of the above described forms. In a semi-structured interview all the topics that will be discussed are pre-defined and a couple of main and partial questions have been drawn up (B. Baarda et al., 2018; D. B. Baarda et al., 1996; Kvale, 1996). The sequence in which the main and partial questions are discussed, results from the conversation. This form of interviewing offers the opportunity to let participants tell their own story, in which new insights can be obtained. Additionally, it also offers the opportunity to define the scope of the interview and guide the conversation. Open and semi-structured interviews are qualitative research methods. The main task of the interviewer is to understand and interpret the meaning of what the interviewee describes (Kvale, 1996).

The semi-structured interview method suits best the purpose of this research. The conceptual model is used to define two main questions and some partial questions. The topics to be discussed are based on the literature review, the sequence is determined by the answers of the interviewees. The freedom to ask additional questions offers the opportunity to gain new insights and discover the underlying motives of participants. Disadvantage of the semi-structured interview is that it is time consuming.

Semi-structured interviews can be conducted online and offline. However, it is preferred to visit participants at home. By interviewing the participants in their own environment, a more complete understanding of the context can be formed. In addition, during a face-to-face conversation it is easier to observe the participant's mood, feelings and intonation through body language and facial expressions. Unfortunately, home visits were not possible due to the covid-19 crisis. Therefore it was decided to conduct the interviews by either telephone or videocall. It is important that participants feel comfortable and at ease, so that they can properly explain their motives and dare to speak freely. Participants were allowed to choose how they wanted to be interviewed, as video calling is not a familiar way of communication for every participant.

The data collection is complete when data saturation has been reached. Data saturation is reached if no new behavioral motives or relations emerge in the interviews. In qualitative research the data saturation is more important than the actual sample size. It is more important to gather a better understanding and insight in the studied phenomenon (Neuman, 2014). In section 2.4. is provided an overview of qualitative studies and the sample size of these studies (table 2.1). Based on this information it is expected that approximately 20 participants will have to be interviewed in order to reach data saturation. However, attention needs to be paid to the results of the study, since these may not be generalizable due to the limited sample size.

3.4 Coding and analyzing of data

Data is collected by conducting semi-structured interviews. After the data collection, the data will be explored and analyzed (Neuman, 2014). The interviews are recorded and transcribed, which results in the raw data for this research. Coding of the data is used to organize the raw data into categories, themes and patterns of motives and experiences (B. Baarda et al., 2018; D. B. Baarda et al., 1996; Kvale, 1996; Rubin & Rubin, 1995). Codes are labels that are assigned to a specific part of the text, a quote. Each code represents a specific motive or experience, which is mentioned by the interviewee in the quote. The coding process is conducted in the software package Atlas ti (version 8.4, student semester license).

The coding process consist of three techniques: open coding, axial coding and selective coding (B. Baarda et al., 2018). Open coding is an explorative and spontaneous process which is focused on what has been said exactly. No attention is paid to main categories or patterns. New codes are created based on the transcriptions. The phase of open-coding ends when code saturation is reached, so no new codes are created. Another name for this phase is the exploration phase (B. Baarda et al., 2018). During and after the open-coding phase is reflected upon the created codes. There is checked for overlapping codes, missing definitions and typing errors. Another aim of this first phase of coding is to divide the data into preliminary categories. In the next phase these categories are reviewed and possible relations are examined (Merriam, S. B., & Tisdell, 2016; Neuman, 2014). Axial coding focuses on the development of main and sub categories of codes. Aim of this phase is to create overview and coherence (B. Baarda et al., 2018; D. B. Baarda et al., 1996; Rubin & Rubin, 1995). This phase does not consist of assigning codes to quotes but consist mainly of the comparison of quotations linked to the same code. The search for similarities and differences should lead to unambiguity in the coding process. Lastly, selective coding is applied. In this phase the search focusses on relations and patterns, such as when codes occur simultaneously. The analysis and interpretation of the data starts. During this phase, the data is translated into results.

Coding of data is an iterative process, the different phases of coding alternate. Codes are added and removed, the different phases alternate and the coding process is reflected in the meantime. This is necessary in order to arrive at unambiguous coding of the various interviews.

After the coding process, the data is further analyzed. Tables per code category are created in Atlas ti. These tables present which codes have been assigned to each interview. In this way overview of the large amount of data is created. In these tables only the binary results are shown. It is only important to know that a code has been assigned, not how often a code has been assigned. Subsequently, the binary results are further analyzed based on the corresponding quotations. The quotes illustrate the opinions and thoughts of the participants. This provides in-depth insight into the different behavioral motives of tenants.

3.5 Conclusion

The situation as studied in this research is quite new and has barely been studied. Therefore a qualitative research approach is preferred in order to gain a deeper understanding of the situation. A literature review is conducted to understand pro-environmental behavioral models and identify behavioral motives that could have an effect on the willingness of tenants to give consent for the off-gas transition. Based on this literature review a conceptual model is proposed, which serves as a base for this study.

To gain in-depth knowledge and understanding of the motives that affect the willingness to participate in off-gas renovation projects, a case study research is combined with the conduction of semi-structured interviews with tenants. The interviews are recorded and afterwards transcribed. The transcriptions of the interviews are coded. Coding of the data is used to organize the data into categories, themes and patterns of motives and experiences, in order to be able to analyze and examine the results. Coding of data is an iterative process that consist of multiple phases. After the coding process the data is further examined by the creation of tables and the analyzing of corresponding quotations.

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4. Data collection

This chapter explains how data has been collected. In this research are studied two cases. Information about the cases is collection from the involved housing associations, experts and publically available information sources. The semi-structed interview approach is used to collected data about the behavioral motives of tenants.

At first, the selection of the cases and the collection of case information is described. Subsequently, the design of the interview protocol is elaborated on. Next, the recruitment of participants and the sample will be explained. Finally, is elaborated on the collection of the data.

4.1 Case study data collection

4.1.1 Case selection

27 neighborhoods have received the PAW subsidy in October 2018 (Ministerie van Binnenlandse Zaken en Koninkrijks, 2018; Ollongren, 2018). These neighborhoods are working on the development and execution of the energy and heat transition. The aim of this study is to identify the motives of tenants to give consent for the off-gas transition of their homes. Therefore a selection of suitable cases for this research had to be made out of the 27 PAW neighborhood. The selection of cases consisted of multiple steps. The first selection step was focused on the amount of social rental properties within each of the 27 neighborhoods. This initial selection is made on the basis of data provided by Atriensis and the publicly available information about these 27 PAW neighborhoods (PAW, n.d.; Rijksoverheid, n.d.-a). In the second selection step is focused on the progress of the transition in the neighborhoods. In order to be able to carry out the research, it is required that the tenants already have been informed about the upcoming off-gas transition. Preferably they have given or are about to give their consent. This is only possible if the off-gas transition plans are (almost) ready for implementation. The progress of the transition within the PAW neighborhoods is not publicly available. To be able to determine the progress of the transition, contact was made with the Ministry of Internal Affairs, Aedes and Woonbond. A selection of potential cases has been made in collaboration with experts of the Ministry of Internal Affairs. As a result of the first two selection steps, seven out of the 27 neighborhoods have been selected as a potential case: 't Ven (Eindhoven), Palenstein (Zoetermeer), Overwhere-Zuid (Purmerend), Van der Pekbuurt (Amsterdam), Dukenburg (Nijmegen), Dauwendaele (Middelburg) and Sliedrecht-Oost (Sliedrecht).

During the third selection step, for each of these seven neighborhoods, an attempt was made to contact the concerned housing association. For some neighborhoods, both the municipality and the concerned housing association were unwilling to cooperate with the research or contact could not be established at all. As a result, the local housing associations of four neighborhoods were visited to discuss the suitability of the neighborhood as a case for the research. Appendix 3 provides an overview of the meetings with experts of the heat and energy transition in social housing and employees of housing associations of the four pre-selected neighborhoods. During these meetings with experts of housings associations is learned that almost all PAW neighborhoods were still planning and developing the heat and energy transition. Two of the four visited neighborhoods were not far enough in the transition process to be suitable for this case study. The previous received and examined information provided by the Ministry of Internal Affairs about the progress of the off-gas transition within the PAW neighborhoods, turned out to be incomplete and inaccurate. This was later confirmed by the PAW congress and the progress report on the subsidy program (Knops, 2020; PAW, 2020c, 2020b).

Finally two neighborhoods were selected as cases for the execution of this research: Overwhere-Zuid (Purmerend) and 't Ven (Eindhoven). Housing associations Intermaris and 'thuis are willing to cooperate with this research. In both neighborhoods the aim of the energy and heat transition is to disconnect the rental properties from the natural gas network and to improve the energy efficiency. The two cases use different approaches in order to achieve the set goals.

4.1.2 Documentation

Several sources of information are commonly used in case study research. Six frequently used sources are: documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts (Yin, 2018). As discussed in chapter 3 interviews are used as the main information source in this study. However, to be able to prepare the interviews and in order to understand the studied cases and its context some documentation is analyzed. A major part of the documentation is provided by Intermaris and 'thuis. The case was introduced during the introductory meeting. Subsequently, there was intensive email exchange and contact with both housing corporations. Additionally newspaper articles and related websites have been studied. This allowed to obtain a complete as possible picture about the case. In Appendix 4, an overview is provided of all documentation obtained from 'thuis and Intermaris.

In case study research is mostly used documentation as an information source and as complement and confirmation of other information sources (Yin, 2018). Disadvantage of documentation as a source of information is that the information has another purpose than being part of a case study. Besides it is possible that an overload of documentation is available, therefore it is important to carefully select and review information (Yin, 2018). In this study documentation - abstained from 'thuis and Intermaris - is used as a tool to get acquainted with the cases and its context. It serves as an orientation to the cases.

4.2 Semi-structured interview data collection

4.2.1 Design of semi-structured interview

The semi-structured interview approach is used to gather qualitative data about the motives of tenants to give consent for the off-gas transition of their homes, and to understand the influence of antecedent intervention strategies, like information provision, on these motives. The proposed conceptual model (see section 3.1) is used as the basis for developing the semi-structured interview.

In the conceptual model it is proposed that behavior, in this case giving consent for the transition, is affected by the three categories of behavioral motives and the information processing process. Therefore, the interview consists of two main parts. One to identify tenants' behavioral motives to give consent for the off-gas transition and the other to discuss the information provision and processing process. A main question has been drawn up for each of these two parts. The aim of the questions is to learn more about the personal motives of the tenants. It is expected that the tenants will explain and describe their own feelings, ideas, reasons and decision process. After the main questions, follow-up questions are asked to get a better understanding of the tenants' motives. The sub-questions are intended to support the researcher, so that reasons and subjects, previously identified in literature, are discussed. Appendix 5 shows the interview protocol. The original protocol

is in Dutch, because the interviews are conducted in Dutch. An English version is also provided in Appendix 5. Below the main questions for both parts are presented.

Main question part one, about the behavioral motives of tenants:

What were your initial thoughts on the proposed off-gas transition? What advantages and disadvantages did you see?

Main question part two, about the information provision and processing process:

How were you informed about the upcoming transition? How did you experience this?

At the start of the interview some general information has been collected, such as gender and amount of years living in the property. The participants in the Eindhoven case was asked if they had chosen to replace their kitchen, toilet and bathroom, and when the off-gas renovation has been started and ended. Based on the literature review, it is expected that the replacement of kitchen, toilet and bathroom could be a trigger for tenants to give consent for the execution of the proposed renovation. The interviewees of the Purmerend case are additionally asked whether they have installed solar panels during the energy efficiency renovation in 2018.

In the first part of the interview the behavioral motives of the participants are discussed. The sub questions follow the three categories of behavioral motives as identified in the literature review. For each of the three categories some specific motives have been derived, such as comfort and disturbance (see fig. 2.4). The sub questions of each category address these specific motives. For example, questions are asked about the expected financial consequences and personal biospherical values. In the second part of the interview the information provision and processing process is discussed. It is discussed in what forms information has been provided and by whom. Additional is discussed how the information provision is experienced and valued. Finally, it is addressed whether tenants had a need for additional information and where this additional information was sought.

The interview protocol serves as a guide and reminder to the interviewer. Participants' answers are leading in determining the order of topics for discussion. Attempts were made to ask as few predetermined questions as possible, so that the interview could be spontaneous and new motives could be discovered.

4.2.2 Data collection

The participants were recruited in consultation with housing associations 'thuis (Eindhoven) and Intermaris (Purmerend). In the Purmerend case a letter was sent to 100 tenants of Intermaris living in the neighborhood Overwhere-Zuid (Appendix 6). The letter invited tenants to participate in this research. Subsequently, 11 tenants have registered for participation. In the Eindhoven case 10 tenants have been recruited by the housing association to participate in this study. After a pre-contacting by the researcher, ultimately 8 tenants were willing to participate in this study. These participants received a letter explaining the research (Appendix 6). The letters were written in language level B1, following the guidelines of 'thuis and Intermaris (Rijksoverheid, n.d.-d).

In total 19 interviews have been conducted, 11 with tenants from Purmerend and 8 from Eindhoven. Among these respondents, 11 participants are female, while 8 are male. All participants are living in a single family home. All interviews were conducted in the period between the 18th of May and 3rd of

June 2020. The interviews have an average duration of 40 minutes. Due to the covid-19 crisis the interviews were held online or by telephone. The participants have chosen the manner in which the interview was conducted. An instruction was made for the participation via Microsoft Teams (Appendix 7). In Appendix 8 a table of participants, manner, duration and date of the interview is presented, along with some basic information.

The interviews were recorded, only audio, and later transcribed. These transcriptions are used for the coding process. This coding process is described in the next paragraph (section 4.3). The transcription were anonymized and stored in a folder of the TU/e storage during 2020 - 2030. The transcriptions are available on request.

4.3 Conclusion

The cases are selected based on the amount of rental homes presented in the neighborhood, the progress of the transition and the willingness of housing associations to cooperate in this research study. Finally two cases are selected, neighborhood 't Ven in Eindhoven and Overwhere-Zuid in Purmerend. Housing associations 'thuis and Intermaris are the local active housing associations and involved in this research.

The interview protocol is based on the conceptual model as proposed in section 3.1. This protocol serves as a guide and reminder to the interviewer, in order to direct the conversation and gather qualitative data. In total 19 interviews are conducted, 11 with tenants from Purmerend and 8 from Eindhoven. The online or telephone interviews were conducted in the period between the 18th of May and 3rd of June 2020. The interviews are recorded and later transcribed.

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5. Case studies

This chapter the cases of 't Ven and Overwhere-Zuid are elaborated. First, an introduction is given about the social rental housing sector and off-gas renovation and transition strategies, in order to provide more context to the cases. Afterwards the two cases studied in this research are presented.

5.1 Introduction into the social rental sector

In order to understand the context of this study it is necessary to have insight in the role of housing associations in the Netherlands, the effect of social debates on this role, the composition of the tenant population and some current regulations that have effect on their capability to execute the energy and heat transition. The aim of this introduction into housing associations is to provide background information into the context of the research.

The first official housing associations were established and approved by the government in 1904. Since 1901 2,5 million social rental properties have been built in the Netherlands, which is unique in the world. In the Netherlands the task of housing associations is seen as taking care of sufficient and affordable qualitative public housing. Elsewhere in Europe similar initiatives are focusing specific on the housing of workers.

Housing associations are so called social enterprises (Beekers, 2012). They reinvest the profit made in their core social tasks. Conceptual frameworks and organizational patterns of housing associations have changed over time under the influence of the government and the commercial real-estate market. These developments within the social housing sector influence the image of housing associations. Between 2013 and 2014, a parliamentary committee investigates fraudulent cases at a number of housing associations. In addition, this committee looks for the right to exist and the identity of housing associations in today's society (Beekers, 2012). In particular, the abuses in the first decade of this century influence the image of these organizations. In the revised Housing Act of 2015 the housing associations have been restricted. Housing associations are forced to focus on their core tasks and they are placed under the supervision of Authority Housing associations.

5.1.1 Tenants of housing associations

From the founding of housing associations onwards at the beginning of the 20th century, social housing was primarily focused on the housing of families. Since the 1970s also other groups of citizens are qualified to get assigned a social rental house. An example of these new target groups are students. Extremely urgent cases have always been given priority. However the last decades more people have been assigned as an urgency case and given priority to get assigned a house. Such a municipal urgency statement can help several vulnerable groups of citizens to find a house. There is a large variation among these urgency cases, examples are people in social relief, elderly, labor migrants or permit holders, former prisoners, homeless people, divorced parents, people with problematic debts, people in need of care and people who are forced to leave their house (e.g. due to demolishing) (Hulten, n.d.; Rijksoverheid, n.d.-e). Especially in the bigger cities of the Netherlands almost 25% of the available properties are assigned to urgency households. The main target group of housing associations are households with an income lower than € 39.055,- (prive level 2020) (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-e; Rijksoverheid, n.d.-c).

In the dissertation of Beekers (2012) the continuous tension between the housing associations as a professional organization and the influence of residents in it is described. The participation of

residents was a given in the early days of the housing associations. The earlier housing associations were associations with members, fully run by volunteers. However, this changed dramatically during the following years. Housing associations became professional organizations with paid employees. Nowadays we see a new period of increasing resident participation rise. Public participation of tenants is regulated in the revised Housing Act and Landlord Tenants Consultation Act (Wet op het overleg huurders verhuurder) (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-c). A tenant organization is an association or foundation that aims to represent the interests of tenants of one or more landlords. A residents' committee is a committee of tenants in a residential complex that represents the interests of the tenants of that residential complex. Tenant organizations and residents' committees have information, consultation and advisory rights. Resident committees have slightly fewer rights than tenant organizations (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-c). Tenant organizations are involved in the performance agreements between housing association, tenant organization and municipality (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-b).

5.1.2 Role and tasks of housing associations

The core task of housing associations is to offer and manage affordable, high-quality homes for low-income households (Aedes, 2019; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-e). In addition housing corporations also house target groups that for some other reason need extra help in finding a home and sometimes need guidance in living (see subsection 5.1.1). In addition to the core tasks, housing associations are socially involved in neighborhoods. They fulfill a certain care task for their tenants, despite their limited resources. Especially in disadvantaged neighborhoods housing associations deploy neighborhood managers and social workers. Aim is to increase the quality of life, safety and social involvement in neighborhoods (Aedes, 2020). Examples to reach this goal are the organization of neighborhood activities and the offering of financial assistance to tenants.

Housing associations receive support from the state in different forms. For example, the government offers guarantees by the WSW (Waarborgfonds Sociale Woningbouw) and benefits in obtaining land holdings (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-g). The government also supervises housing associations through the Authority of Housing Associations. This institution assesses the policy and management of housing associations on various points, such as financial continuity (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-a). In addition, the contribution of the housing corporation to the municipal housing assignment is laid down in performance agreements. These yearly agreements are made between housing corporation, municipality and a representation of residents (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-d). This also includes objectives with regard to sustainability, living environment and construction of new social residential properties.

Since 2018 housing associations are obligated to separate their activities of general economic interest (DAEB) and of other more commercial activities (non-DAEB). This ensures that socially designated assets are actually used for the social tasks assigned to housing associations. Housing associations receive state support only for DAEB-activities (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-f). The DAEB branch consists of residential properties with a rental price up to and including a limit of € 737, 14 per month (price level 2020). Social real estate is also part of DAEB. All real estate in the DAEB branch is part of the core tasks of the housing association.

The core task of housing association is to accommodate housing for people with a low income. Appropriate allocation ensures that people with the lowest incomes are assigned a house with a rent that is affordable to them (Aedes, 2019). Housing associations must allocate 80% of the released social rental housing to households that earn less than € 39.055,- (price level 2020). 10% of the homes released must be allocated to households with an income up to € 43.574,- (price level 2020) (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-e; Rijksoverheid, n.d.-c). Housing associations have more freedom to allocate the remaining 10% of the available homes. However, they must give priority to certain households that have received a proof of urgency from the municipality (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-e). These allocation rules apply to DAEB residential properties (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-f).

In 2013 the rental property tax was introduced, in order to improve the functioning of the housing market (Martens, 2019b; Rijksoverheid, n.d.-f). The tax was established to supplement the state treasury following the economic crisis of 2008-2013. Landlords or housing associations who own more than 50 rental properties pay a property tax on the WOZ value of the rental properties. This concerns rental properties for which the rent does not exceed € 737, 14 per month (price level 2020). It is possible to request a tax reduction for investments in sustainability or energy efficiency measurements or in demolition of properties in shrinking areas (Martens, 2019b; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-h; Rijksdienst voor Ondernemend Nederland, n.d.-b). The property tax generates around € 1,5 billion a year for the state. Since its introduction, housing associations indicate that the property tax impedes them from continuing to invest in the maintenance and construction of social rental properties. The tax limits housing associations' investment capacity (Paling, 2019). In view of the energy transition, these legal regulations impede the effectiveness and investment capacity of housing associations. The resistance to the rental property tax is increasing within the social housing sector. Research commissioned by the Ministry of Internal Affairs and Aedes has recently shown that the available financial resources are not sufficient for the tasks assigned to housing associations (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2020b, 2020a; Noy, 2020; Penders, 2020).

Tenants are protected against powerful landlords and housing associations by law. Excessive rent increases are not permitted and tenants also have to agree to major renovation work in their rental properties. The landlord or housing association must make a proposal to all tenants of the residential complex. If 70% of the tenants agree, the renovation work can be carried out in the whole complex (Rijksoverheid, n.d.-b). Disputes between landlord and tenant concerning renovation work can be submitted to the court. The judge assesses whether the proposal made is reasonable, after which one of the parties is upheld. A renovation is considered as an improvement of the house, in which case a rent increase may be asked (Rijksoverheid, n.d.-g). For large and small maintenance work, tenants' consent does not have to be collected. This work is seen as necessary for the preservation and maintenance of the home (Rijksoverheid, n.d.-b).

5.2 Renovation strategies of the heat and energy transition of the built environment

The climate agreement refers to the heat and energy transition as an important target, but ultimately the main objective is a CO₂- and energy-neutral housing stock. These complex objectives have been set for 2050. In order to achieve these goals, the existing housing stock has to be renovated. Therefore, a brief introduction is given about the renovation strategies that are available.

The Trias Energetica forms the basis for most energy efficiency and energy neutral renovation concepts and strategies. The Trias Energetica strategy consist of three main steps (RVO, 2013): 1. Limiting the energy demand, 2. Using energy from renewable energy sources, and 3. Efficient use of fossil energy sources. First, step 1 must be completed, so that the energy demand is optimally decreased. Subsequently, as many measures as possible based on step 2 are taken. Only if necessary the energy demand is supplemented with step 3.

Aedes has developed a route map CO₂ neutral for housing associations (Aedes, 2017). In the route map four renovation scenarios are included. These four scenarios provide a base for the renovation strategies of housing associations (Aedes, 2018). In fig. 5.1 the four scenarios are shown. As can be seen the scenarios of the Aedes route map are based on the principles of the Trias Energetica.

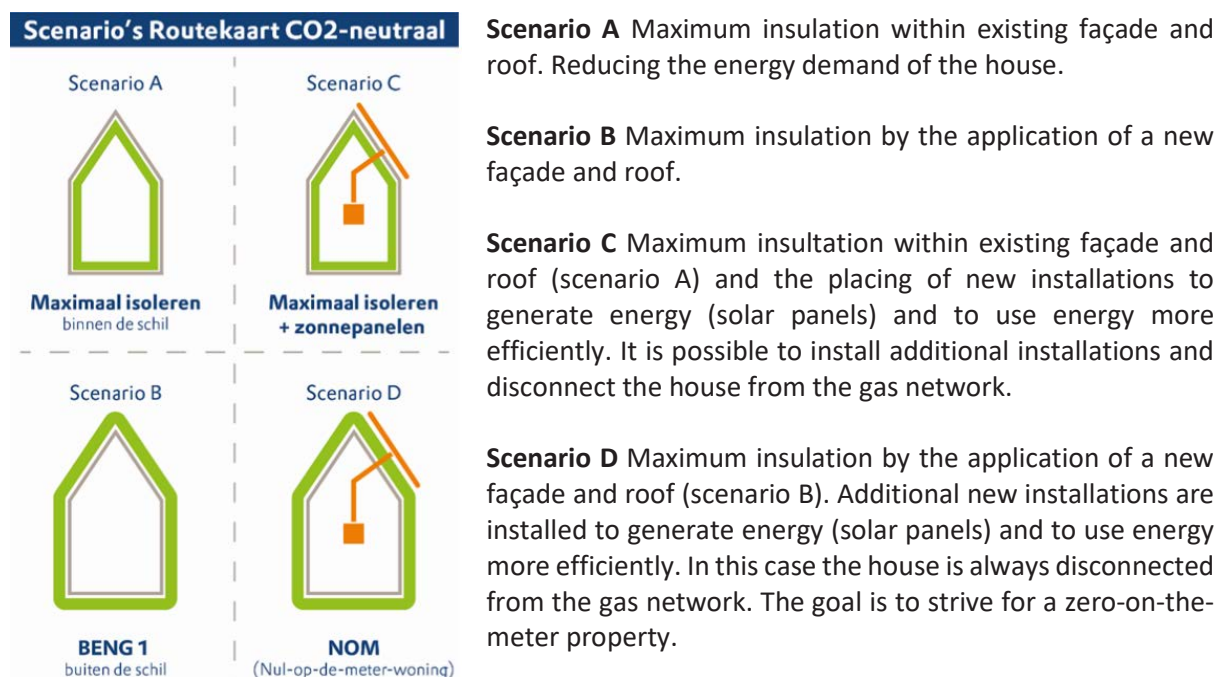


Fig. 5.1. Four renovation scenarios of Aedes (Aedes, 2018).

Aim of the route map is to provide scenarios that will result in a CO₂ neutral energy provision of the social housing stock. The scenarios are a tool for housing associations to shape their own sustainability policy. Only scenario D achieves the goal of CO₂ neutrality at house level. In the other scenarios is the house still dependent of an external energy sources. The CO₂ neutrality of these external sources will determine if the property is CO₂ neutral at house level (Aedes, 2017). This route map only includes the disconnection of the gas network in scenario D. This is not an explicit part of the other scenarios. However, it is possible to add the decoupling of the gas network to other scenarios as proposed by Aedes.

PBL (Netherlands Environmental Assessment Agency) has developed an overview of five scenarios for the decoupling of the gas network (Hoogervorst et al., 2020). It is assumed that an insulation level corresponding to energy label B will be sufficient for the application of alternative heat systems with a release temperature of 70 °C. In case of a lower release temperature it will be desirable to insulate towards a level corresponding to energy label A+. These insulation measurements will require higher

investments, so will not be financially feasible for all residential properties. These scenarios can be found in Appendix 10. The scenarios as developed by PBL have been split in different options per scenario. Roughly three main alternatives for heating by neutral gas can be distinguished: A. synthetic or green gas, B. heat network (high, middle and low temperature), C. all-electric. These three main alternatives and its mutual cohesion is presented by Atriensis in a fig. 5.2 (Groenen, 2020).

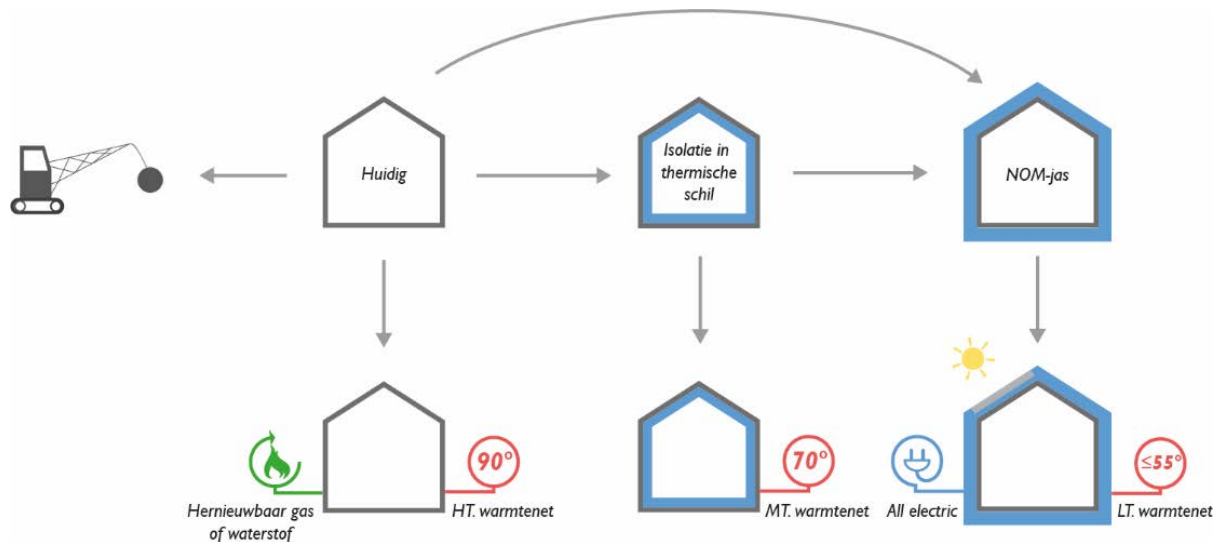


Fig. 5.2. Overview of potential scenarios towards CO₂ neutral heating of residential properties by Atriensis (Groenen, 2020).

In the overview of Atriensis several possible scenarios are shown. The first one (top left fig. 5.2) is demolition of the property. This can be a financially feasible option if the quality of the property for further exploitation is low and the required investments are too high to improve its quality. Secondly, no additional insulation measurements are technically needed if a high temperature heat network or synthetic gas is applied to replace the gas fired central heating system (bottom left fig. 5.2). In this scenario the CO₂ neutrality is completely dependent of the heat network or the renewable gas source. Following the principle of the Trias Energetica strategy it would be better to reduce the energy demand as well by applying insulation. This strategy is shown in the middle of fig. 5.2. The scenario shows that the existing façade and roof are insulated, in order to reduce the energy demand. The house can be decoupled of the gas network and coupled to a medium temperature heat network at a natural moment. Additionally, a couple of solar panels are usually installed. This scenario can be executed at once or in multiple steps. Lastly, in the scenario shown at the right of fig. 5.2, the façade and roof are packed with a new shell, in order to achieve a high insulation level. Additionally the house can be decoupled from the gas network. Alternative heating sources are all-electric techniques or a low temperature heat network. Additionally a large amount of solar panels are installed. This last strategy is mostly executed at once.

The above described scenarios and strategies focus on the technical alternatives and possibilities. Haytink & Valk (2017) have written an advising report commissioned by FLOW and Aedes, which describes three financial scenarios (fig. 5.3). These scenarios provide extra insight into the possibilities and consequences of planning renovation work in a specific sequence or stepwise. The first financial scenario (left in fig. 5.3) consists of one investment to completely renovate the house towards an CO₂ neutral property. The needed investment is high. The second scenario (middle in fig. 5.3) is focused on ad hoc decisions and measurements, based on short-term needs. However, there is a risk that

unnecessary investments will be made. In the third scenario (right in fig. 5.3) the end goal is taken as reference. This reference is used to plan the needed measurements stepwise. The investment per renovation moment is lower and the same end goal is reached.

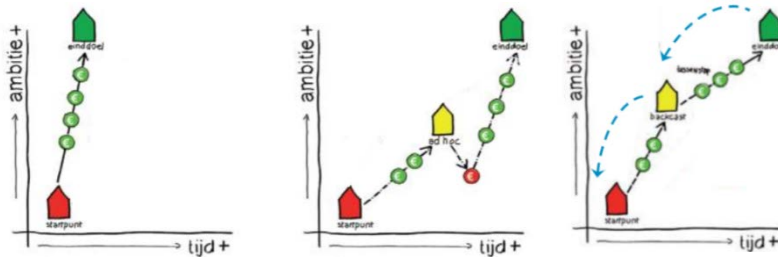


Fig. 5.3. Financial renovation strategies (Haytink & Valk, 2017).

Each of the discussed financial and technical strategies is associated with specific advantages and disadvantages. Housing associations have to take into consideration the technical alternatives and the financial possibilities, in order to develop a CO₂ neutral renovation strategy for their housing stock. The financial planning is very important to determine which measurements should be taken. Combining of energy efficiency or off-gas measurements with periodical maintenance of the property is therefore desirable. However, the government expects housing associations to accelerate the renovation of their housing stock. So, to increase energy and heat efficiency, on top of that the usual maintenance planning. The ambitions require high investments that cannot be settled in a rent increase due to legal restrictions. Additionally, the scheduling of the execution of measurements depends on the Heat Transition Vision of the municipality (see subsection 1.2.1). This vision gives direction to the neighborhood-oriented approach for further definition of the transition. Housing associations are obliged to integrate this vision in their own renovation and off-gas transition plans. The decision-making process regarding the Heat Transition Vision and difficulties with the alignment of the construction planning can delay the implementation of the plans of housing associations or force to implement the off-gas transition strategy in several steps. As a result, housing associations are not always able to choose how, in which sequence and when the off-gas transition is executed.

Housing associations often combine energy efficiency renovations and/or the off-gas transition with other maintenance measurements, like the replacement of the kitchen or bathroom. A total package of measurements is proposed to the tenants. As explained earlier, they must give consent before the work can be executed. This package of measurements has to offer enough advantages to outweigh the associated disadvantages. The tenants should be triggered to give consent for the total renovation package.

The above discussed renovation strategies are also applicable for homeowners and other residential property owners. The government advises them to combine energy efficiency or off-gas measurements with periodical maintenance.

5.3 Case 1: Overwhere-Zuid in Purmerend

In the province of Noord-Holland the neighborhood Overwhere-Zuid is located in Purmerend. The neighborhood consists of 1276 residential properties, 571 owner-occupied and 668 (social) rental properties. Most of the rental properties are owned by housing association Intermaris. There are 37 utility buildings present in this neighborhood. The properties within this neighborhood are built in the period 1945 - 1960.

In Purmerend 75% of all buildings are connected to the heat network of Stadsverwarming Purmerend (SVP) (Stadsverwarming Purmerend, n.d.). All new-build homes have been connected to this heat network since the 1980s (Gemeente Purmerend, n.d.). These properties were not connected to the natural-gas network. Therefore, electrical cooking and warmth from the heat network are already the norm in most parts of Purmerend. The municipality of Purmerend is the full owner of SVP. Aim of the Proeftuin is to connect even more properties to this heat network and to uninstall the gas network. SVP is the local heat supplier and is completely owned by the municipality of Purmerend. SVP uses three heat production installations (Stadsverwarming Purmerend, n.d.). The two natural-gas fired heat plants are mainly used to support the third heat plant. This third heat plant is a biomass heat plant. The biomass plant was put into use in 2014. Wood chips from Staatsbosbeheer are used to produce warmth. Almost 70% of the total heat production of the heat network originates from biomass. Innovative manners of heat production are currently being investigated in order to realize an even more sustainable heat supply.

Intermaris owns quite a large amount of rental properties in Overwhere-Zuid. In 2018 major maintenance and an energy efficiency renovation for these properties has been executed. The houses were drafty and poorly isolated. They no longer met the current standard. Below an overview is given of the works executed during this renovation. As a consequence of this renovation a monthly rent increase of € 12,52 was passed on. The combination of major maintenance with an energy efficiency renovation had the consequence that 70% of the tenants had to give consent for the proposed renovation before it could be executed. This percentage has been achieved, so the renovation has been carried out in all homes. At that time it was not yet known how and when the off-gas transition would take place. Because of the condition of the houses, it was nevertheless decided to carry out these activities.

Overview of standard renovation works in 2018

- Application of roof and floor insulation
- Check of façade insulation (cavity wall), if necessary the insulation is supplemented
- Replacement of single glass windows for isolated glass
- Replacement of central heating system if older than 10 years
- Installation of mechanical ventilation system
- Remove asbestos residues
- Remove chimneys from the roof

Tenant were given the option to have solar panels installed. An additional monthly rent increase had to be paid for this. The choice consisted of no solar panels, 4 solar panels (+ € 8,55), 6 solar panels (+ € 12,83) or 8 solar panels (+ € 17,10). Tenants who have not chosen to install the solar panels will nevertheless be given the opportunity to have them yet installed in the coming months.

At the moment Intermaris is exploring how to form the off-gas transition for the houses in their possession. The tenants have been informed about this. It is not yet known how and when the off-gas transition will be executed. Intermaris, the municipality of Purmerend and SVP are negotiating about how to disconnect the social rental properties from the gas-network and how to finance this. Despite that the transition plans are not definitive for the social properties, the municipality has informed the tenants about the obtained Proeftuin subsidy and the plans to expand the heat network as an approach in the off-gas transition. The tenants do know that the off-gas transition is imminent, but not when exactly.

The combination of a recently executed energy efficiency renovation and upcoming off-gas transition makes this case very interesting to study. Little is currently known about triggers and barriers that occupy tenants in regard to these changes.

5.4 Case 2: 't Ven in Eindhoven

Neighborhood 't Ven in Eindhoven is located in the south of the Netherlands. Out of the 526 houses in the neighborhood, 90 are owner occupied and 436 are (social) rental residential properties. The rental properties are owned by three different housing associations, Wooninc., 'thuis and Woonbedrijf. There are 12 utility buildings present in the neighborhood. The properties are built between 1945 and 1960.

The municipality of Eindhoven has obtained the PAW subsidy for the construction of a heat network in 't Ven. This heat network will be connected to a biomass heat plant. However, these plans are not yet ready for implementation and it is not known when this will be the case. This will take too long for about 300 residential properties owned by housing association 'thuis. These properties have all been in need of a large-scale renovation for a long time. This renovation has been postponed several times for various reasons. The houses no longer meet current standards. These are very damp and barely isolated. 'thuis has decided to demolish and new-build approximately 120 houses and to extensively renovate about 180 properties. This case focused is on these 180 rental homes.

The houses are and have been renovated according to the all-electric concept. The renovation is still in progress, for this case only tenants of houses where the renovation has been completed have been interviewed. The renovation package is very extensive and partly consists of necessary maintenance. The necessary maintenance does not require the consent of the residents, but it is required for the other activities. Therefore it was decided to seek for 70% approval of the tenants for the complete renovation package. A summary of the renovation package is given below. The renovation comes with a monthly rent increase of € 30,-.

Summary of the renovation package

- A new façade including insulation and insulating frames, windows and doors
- Replacement of the roof, insulation of the roof and installation of solar panels
- Remove of balcony and chimney
- Placing the soundproof wall in the house, in order to limit noise nuisance
- Deinstallation of the central heating system and installation of an electrical heat and ventilation system
- Disconnection of the natural-gas network
- Residents can optionally have the kitchen, bathroom and toilet replaced if it is older than ten years.

The all-electric renovation strategy is very different from the strategy applied in Purmerend. The strategy of the Eindhoven case is executed at once and required a high investment. This strategy corresponds to the most right scenario as presented in fig. 5.2. In Purmerend is applied a stepwise approach. In 2018 periodical maintenance is combined with the energy efficiency measurements. Additionally is given the opportunity to install solar panels. At this moment is discussed how the properties can be disconnected from the gas network and very likely will be connected to a high to middle temperature heat network. Due to the different characteristics of the applied strategies, it is expected that other motives may play a role in tenants' decision-making. The contrast between the cases enriches the research.

5.5 Conclusion

Housing associations are so called social enterprises (Beekers, 2012). They reinvest the profit made in their core social tasks. The core task of housing associations is to offer and manage affordable, high-quality homes for low-income households (Aedes, 2019; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, n.d.-e). In addition housing corporations also house target groups that for some other reason need extra help in finding a home and sometimes need guidance in living.

In 2013 the rental property tax was introduced, in order to improve the functioning of the housing market (Martens, 2019b; Rijksoverheid, n.d.-f). This tax limits housing associations' investment capacity (Paling, 2019). In view of the energy transition, these legal regulations impede the effectiveness and investment capacity of housing associations. However, housing corporations are expected to make major investments in their housing stock for the purpose of increased energy efficiency and the heat and energy transition.

A number of basic strategies can be distinguished in the heat and energy transition of the built environment. Aim of these strategies is to effectuate an CO₂ neutral housing stock by 2050. Aedes proposed four renovation scenarios: A. maximum insulation within existing façade and roof, B. maximum insulation by the application of a new façade and roof, C. maximum insulation within existing façade and roof and the placing of new installations to generate energy, D. maximum insulation by the application of a new façade and roof, new installations are installed to generate energy, and the house is disconnected from the gas network. Additionally (stepwise) strategies for execution of the off-gas transition are proposed by PBL and Atriensis. Four main alternatives can be distinguished: 1. synthetic or green gas, 2. heat network (high, middle and low temperature), 3. all-electric, 4. demolishing and building new properties.

Each of the discussed financial and technical strategies is associated with specific advantages and disadvantages. Housing associations have to take into consideration the technical alternatives and the financial possibilities, in order to develop a CO₂ neutral renovation strategy for their housing stock.

In this research the motives of tenants to give consent for the off-gas transition are studied within two cases, 't Ven and Overwhere-Zuid. In both cases a different off-gas renovation strategy is applied in order to execute the heat and energy transition. In 't Ven the all-electric renovation strategy is applied, a strategy performed at once. In Purmerend another strategy is applied. In 2018 an energy efficiency renovation was executed and this will be followed up by the off-gas transition. Due to the different characteristics of the applied strategies, it is expected that other motives may play a role in tenants' decision-making. The contrast between the cases enriches the research.

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6. Analysis and results

In this chapter results are presented and analyzed. At first the coding process is discussed. Subsequently, the results of both cases are presented per coding category. Tables show the occurrence of a code per participant, subsequently are discussed corresponding quotations. Only binary results are shown, since it is of no value to indicate how often a specific subject is appointed. The quotations represent the mindsets of participants. In this way, different views and motivations are expressed. Some participants did not discuss all topics or could not describe their thoughts about a certain topic, in this case no results are presented. In the fourth section of this chapter the case results are compared. Afterwards, the results are reflected upon the proposed conceptual model. Finally, in the sixth section, conclusions from the analysis of the results are drawn.

6.1 Coding process

The coding process started with transcribing the interviews. The transcriptions of the interviews are uploaded as a text document in Atlas ti. This software package is used to code the interviews. As explained in section 3.4, coding is an iterative process, the different phases of coding alternate. Coding of the data is an extensive and time-consuming process. All interviews were read and reread several times, each time adjustments were made to the coding and quotations. Additionally, codes were added, deleted or redefined during this process. In Atlas ti several code reports are created in order to monitor the coding process and reflect upon it. It is not feasible to discuss each alteration that has been made. The codes are broadly explained below, a brief overview is presented in fig. 6.1. All codes, including their definition, are added in Appendix 9.

Eight groups or categories of codes have been created. These groups are based on the proposed conceptual model (section 3.1) and are derived from the interviews. At first there are three main groups of behavioral motives: gain motives, hedonic motives and normative motives. The codes in these groups are used for coding interviews of both cases. The behavioral motives mentioned by the interviewees are categorized into one of these groups. So, motives regarding feelings and pleasure are assigned to code group of hedonic motives, motives regarding earning and resources are assigned to the code group of gain motives, and motives regarding the (social) environment are assigned to the code group of normative motives.

Secondly, there is a group of codes that represent focal goals. The focal goals are separately encoded, in order to be able to analyze them. Many motives are discussed in the interviews. However, it is not the case that the most discussed motives are the focal goals. How often a code is assigned within an interview or within all interviews indicates nothing about the importance of a goal. The focal goal has been identified by literally asking participants which motive is most important to them.

Third, this group of information codes consists of all codes that are associated with the information provision and processing processes. These codes are for example linked to information origin, trust in the information origin, form of information and valuation of information.

Fourth, there are three groups of codes created specific for each of the cases. Due to the different applied approaches and context within the cases, other motives affect the behavior of tenants. Separate coding groups have been created for these case specific motives, so that they can be easily analyzed. In the case of Eindhoven the off-gas transition recently has been executed. Interviewees have told a lot about their experiences during this process. These experiences seem to be outside the

scope of this study. However, these experiences provide a proper insight in the gap between the expectations of the tenants and their actual experiences. From this, valuable lessons can be learned about what is important to tenants before, during and after the off-gas transition. A code category is created to group the codes related to the experiences of tenants. For the Purmerend case, two extra categories of codes were created. The first code group is closely linked to the group of hedonic motives. However, this extra code category only consists of codes linked to hedonic motives regarding the heat network. The heat network evokes strong emotions and other kinds of motives, like a limited freedom of choice or doubts about the heat source of the network. These kinds of behavioral motives are not identified in the Eindhoven case. Grouping these codes into a different category makes it easier to analyze and compare the results between the cases. Lastly, in 2018 an energy efficiency renovation has been conducted in Purmerend. The experiences during this renovation seem to influence the current motives of tenants regarding the off-gas transition. All codes associated with the renovation of 2018 are grouped in the last category of codes.

The code groups are only a manner of organizing the codes. These groups are created in order to be able to analyze the codes in a clear and manageable manner. Due to the large amount of codes on various topics, it is important to create order and develop a structure. This makes it possible to achieve a consistent coding of all interviews and to compare the results with each other.

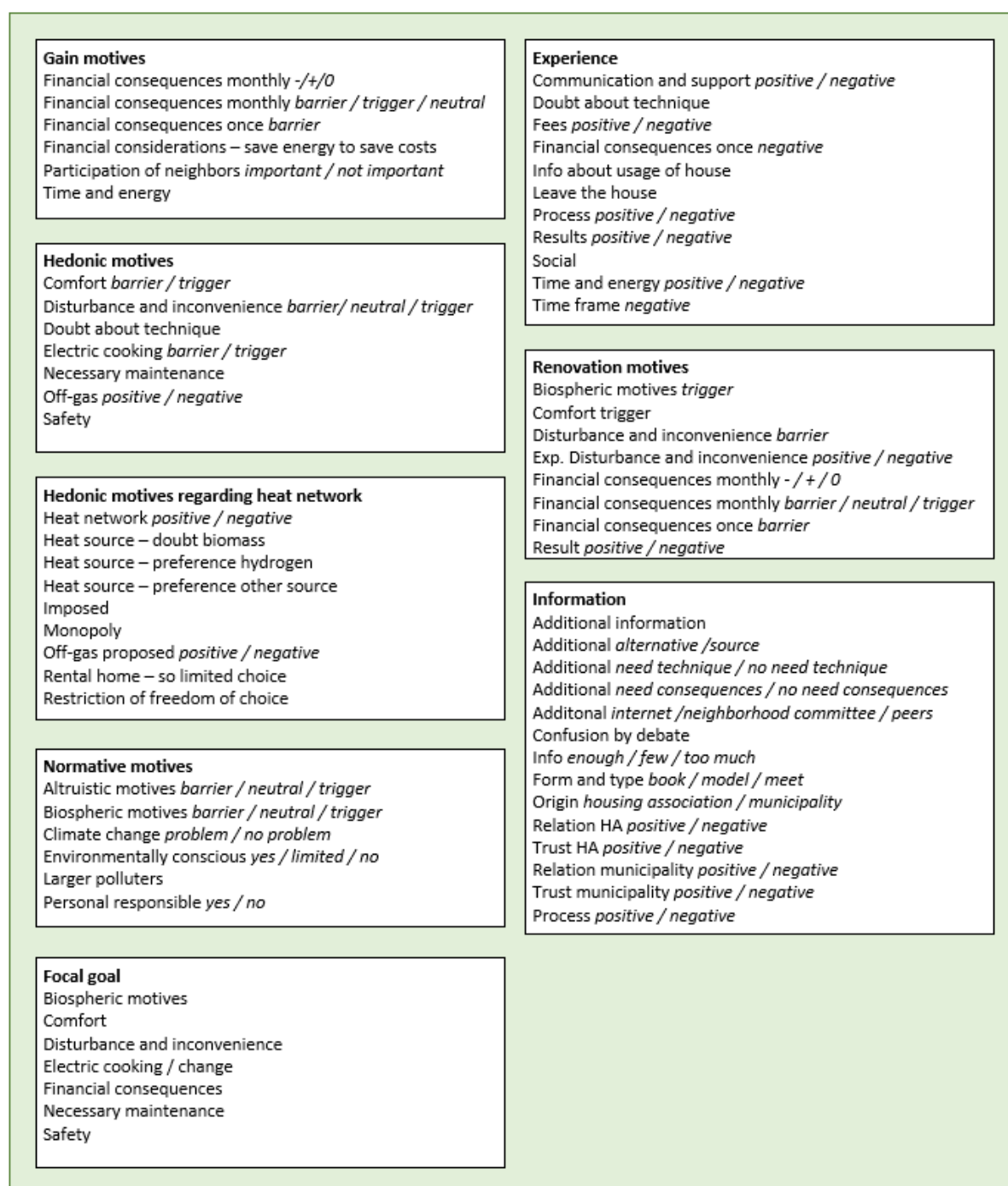


Fig. 6.1. Overview of code groups and codes.

6.2 Results of case 1: Overwhere – Zuid Purmerend

6.2.1 Gain motives

Table 6.1. Gain motives of tenants of the Purmerend case associated with monthly financial consequences (FCM) of the off-gas transition.

	FCM barrier	FCM neutral	FCM trigger	FCM increase	FCM equal	FCM decrease
P1		X				
P2	X			X		
P3	X			X		
P4	X			X		
P5	X			X		
P6	X			X		
P7	X			X		
P8						
P9	X			X		
P10	X			X		
P11	X			X		
Totals	9	1		9		

The results of table 6.1 show a quite monotonous picture. Nine out of eleven participants expect that the monthly housing costs will increase due to the off-gas transition. Additionally, the expected increase of housing costs is considered as a barrier by the same group of participants. Intermaris has not yet informed the tenants about the financial consequences of the off-gas transition, because it is not yet decided how and when the off-gas transition will be implemented. The expectations of tenants are based on other information sources. Participant P8 didn't indicate how and if the monthly costs influence the decision process to give consent. The consideration of participant P1 is marked as neutral. Quote 9.37 demonstrates that the effect on the monthly housing costs is not clear to this participant.

Quote 9.37:

"... Ze zeggen het is goedkoper. Maar daar zijn totaal nog geen bewijzen van. Dus daarom willen wij als bewoner daar dus eerst duidelijkheid in hebben." (Voeselek, 2020, pp. 1)

"... They said it is cheaper. There is no evidence of that at all. So that's why we as residents firstly want to have confirmation about the costs."

The results in table 6.2 show that five tenants expect to have one-time costs as a consequence of the off-gas transition. The corresponding quotations show that the interviewees are reluctant to give consent for the transition due to the costs for the purchase of new cookware and an electrical stove. Some participants fear that they may get limited compensation fees for the replacement of kitchenware (quote 11.7). Through a closer look it is learned that participants P6 and P8 are mainly reluctant to the transition because they think they are too old to make such kind of an investment (quote 14.5 and 16.3).

Quote 11.7:

"Ja en dan heeft het voor mij alleen maar nadelen omdat ik weer op kosten wordt gejaagd. Mijn kookplaat gaat er dan uit, ik zal weer op andere pannen moeten. Wie gaat dat betalen, wie gaat dat allemaal voor me opknappen?" (Voesenek, 2020b, pp. 3)

"Yes, for me there are only drawbacks, because I will be forced to incur costs. My stove has to be replaced, I have to buy new pans. Who is gonna pay that, who is gonna fix that for me?"

Quote 14.5

"... Als je over gaat van het aardgas moet je alles opnieuw aanschaffen, zoals nieuwe pannen en ik wil hieraan geen cent aan gaan spenderen op mijn leeftijd, want ik ben half 80." (Voesenek, 2020c, pp. 2)

"... If you are cut off the natural gas network, you have to replace your kitchen stuff, like new pans, and I don't want to spend any money on this transition at my age, I am in my mid 80's."

Quote 16.3

"Ja, maar ook de kosten. Je moet nieuwe pannen, je moet een nieuw kookstel. Nou zeg, daar begin ik niet aan. Ik ben al op hoge leeftijd." (Voesenek, 2018, pp. 8)

"Yes, but also the costs. You have to purchase new pans, you have to purchase a new stove. O no, I won't do it. I am already old."

Table 6.2. Gain motives of tenants of the Purmerend case associated with one-time financial consequences, financial motivation to save energy to save costs, the valuation of the investment of time and energy, and the participation of neighbors.

	Financial consequences once - barrier	Financial considerations - save energy to save costs	Time and energy	Participation of neighbors - important	Participation of neighbors - not important
P1					X
P2					
P3	X	X			X
P4		X		X	
P5	X		X		X
P6	X				
P7				X	
P8	X				
P9				X	
P10	X			X	
P11				X	
Totals	5	2	1	5	3

Additionally these results (table 6.2) show that two out of eleven participants save energy in order to save costs. The financial situation of the participants is not part of this research due to privacy considerations, but it is commonly known that the target group of housing associations consist of low-income households. Another type of investment that can be imagined is the investment of time and energy during the execution of the renovation. Participant P5 indicated that she expects that the investment of time and energy will be low due to the limited installation works in the house. For most participants the investment of time and energy is hard to estimate upfront.

Three interviewees (P1, P3 and P5) describe that they have the feeling that they cannot influence the opinion of neighbors, therefore they do not value the participation of neighbors as an influencer of

their personal decision process. Five out of eleven participants appreciate the engagement of neighbors in renovation and transition projects. Participants P4, P7, P9, P10 and P11 emphasize the importance of the neighborhood committee. This committee represents the opinion of the tenants in conversations with the housing association, municipality and heat network company, in order to prevent the execution of an undesired off-gas transition (quote 15.9).

Quote 15.9:

"... We hebben dus een bewonerscommissie en die werkt nu nog hoor. We hebben daar een voorzitter van en die gaat dan dingen op papier zetten. Dat gaat dan naar Intermaris toe. Dan krijg je een lijn, in plaats van dat iedereen dingen zegt. Dan krijg je verschillende dingen, dat werkt ook niet." (Voesenek, 2020d, pp. 3)

"... We have established a neighborhood committee, which is currently active. We have a chairman who writes down stuff. That is communicated with Intermaris. Then you get one view, instead of different opinions. That will cause ambiguity, that will not work."

6.2.2 Hedonic motives

The result of table 6.3 show that most participants do not consider comfort as a barrier or trigger to give consent for the off-gas transition. This may be caused by the fact that most tenants consider the comfort as improved, as a result of the energy efficiency renovation of 2018. Additionally, it can be caused due to that the heat source will change from natural gas to water, but this will not change the availability of warmth in the house. Participants P4 and P3 indicate that the indoor climate and comfort will not increase due to the installation of the heat network. A lack of comfort improvement is regarded as a barrier to give consent for the off-gas transition for them.

Disturbance and inconvenience during the off-gas transition are considered as a barrier for seven out of eleven interviewees. These tenants expect or even concern disturbance and inconvenience in and around their house. For some of them this fear is related to the energy efficiency renovation of 2018 (quote 10.33). They experienced a lot of disturbance during this renovation. For some others it is related to their old age and health, making it more difficult to deal with disturbance in and around the house.

Quote 10.33:

"Straks als ze op een gegeven moment als al die leidingen uit de straat moeten en die leidingen van de stadsverwarming erin, dan is de impact misschien wel groter dan nu met de renovatie. Ja dat denk ik wel. Leidingen eruit en erin. Leidingen in het huis gebracht worden. Dat is misschien wel grotere impact dan het isoleren van de woning." (Voesenek, 2020b, pp. 3)

"If the gasnetwork has to be demolished and the heat network has to be installed, I expect that the impact will be greater than during the renovation. Yes I think so. Pipes get in and out. The pipes need to be installed in the house. That could be of greater impact than the insulation of the property."

Participant P5 and P11 expect that the disturbance and inconvenience will be limited, therefore they do not regard it as a barrier for giving consent for the off-gas transition. None of the participants of the Purmerend case does reckon the off-gas transition as necessary maintenance. This can be explained by the fact that the energy efficiency renovation is already executed in 2018, as this moment it only concerns the off-gas transition.

Table 6.3. Hedonic motives of tenants of the Purmerend case associated with comfort, disturbance and inconvenience and necessary maintenance.

	Comfort barrier	Comfort trigger	Disturbance and inconvenience barrier	Disturbance and inconvenience neutral	Disturbance and inconvenience trigger	Necessary maintenance trigger
P1						
P2			X			
P3	X		X			
P4	X		X			
P5				X		
P6			X			
P7			X			
P8			X			
P9			X			
P10						
P11				X		
Totals	2	0	7	2	0	0

Table 6.4. Hedonic motives of tenants of the Purmerend case associated with electric cooking, safety, monopoly position of heat network company and limited freedom of choice.

	Electric cooking barrier	Electric cooking trigger	Safety trigger	Monopoly barrier	Rental home so limited choice barrier	Restriction of freedom of choice barrier
P1				X		X
P2		X	X		X	
P3	X					
P4				X		X
P5	X			X		X
P6	X			X		
P7				X	X	X
P8	X					
P9	X			X		
P10				X		X
P11				X		X
Totals	5	1	1	8	2	6

Electrical cooking is considered as barrier by five participants and as a trigger by one participant. The other participants do not value electrical cooking as of influence on their decision process to give consent. Participant P3, P5, P6 and P8 do also regard the one-time financial consequences as a barrier, see previous subsection. These one-time costs are mainly related to the installation and purchase of a new stove and pans. Nevertheless P3, P5, P5 and P8 mention other barriers related to electrical cooking, e.g. the expectation that it is hard to get used to a new manner of cooking influenced by personal experiences or the experience of peers with electric cooking (quote 17.11).

Quote 17.11:

"Toch noem ik mijn persoonlijke dingen. Ik vind elektrisch koken verschrikkelijk. Mijn moeder had het, die moest er ook eindeloos aan wennen. Met gas zet je het aan en je doet het zacht of hard punt. Daar heb je wat meer grip op is mijn ervaring. Dus dat vind ik ook niet echt fijn." (Voesenek, 2020f, pp. 5)

"Still I mention my personal considerations. I think electric cooking is terrible. My mom did it, she has to get used to it for a long time. You can switch on the gas stove and turn it up or down. You have more control over it is my experience. So I do not like it."

Participant P2 considers electric cooking as safer than cooking with natural gas. P2 associates the natural gas network with more risks, like explosions, than the heat network (quote 10.8). P2 sense of security will increase due to the demolishment of the gas network in and around his house.

Quote 10.8:

"Als kind zijnde heb ik een keer wat meegemaakt. Een buurtbewoner rook een beetje gas en die ging op onderzoek uit met een vlammetje. ... De leidingen kunnen poreus worden, de aansluiting kan poreus worden. ... Mensen die minder bedreven daarin zijn die gaan dat onderzoeken, dan krijg je problemen." (Voesenek, 2020b, pp2)

"As a child I experienced it. A neighbor smelled gas and tried to find the problem with the help of a flame. The pipes and connection can become or may be porous. ... If unprofessional people are trying to fix or investigate this, you will get serious problems."

The heat network company has a monopoly position as heat supplier. At this moment it is not possible to choose between heat suppliers. So the residents of Overwhere-Zuid are forced to purchase the heat of the municipal heat company of Purmerend. For eight interviewees this monopoly position is a barrier to give consent for the off-gas transition. Six of these eight participant indicate that the limited freedom of choice for a heat supplier is part of their hesitation against the heat network company and its monopoly position (quote 9.12). Participant P2 and P7 indicate that they have a limited influence on the selection of a new heat source due to the fact they are tenants. The property is not their possession, so they have to follow the policies of the housing association (quote 10.25).

Quote 9.12:

"Maar die keuzevrijheid heeft weer te maken met het feit dat het er maar eentje is. We zijn alleen maar voor het blok gezet door de gemeente Purmerend. Zodra je keuzevrijheid hebt kun je de kosten vergelijken." (Voesenek, 2020a, pp. 3)

"The limited freedom of choice is associated with the fact that there is only one supplier. We are forced by the municipality of Purmerend. If you have freedom of choice you have the ability to compare costs."

Quote 10.25:

"... Ik heb geen keuze. Wij huren die woning ... Ik denk dat ik als huurder geen instemming heb, dat denk ik niet. Als ik een eigen huis had gehad, dan had ik misschien een warmtepomp kunnen nemen. ..."

(Voesenek, 2020b, pp. 6)

"... I have no choice. We rent this house ... I think that as a tenant you have no right of consent, I do not think. So if I owned my own house, I could have purchased a heat pump. ..."

As shown in table 6.5, participant P7 has doubts about the proposed technique and wonders if other alternative techniques are carefully considered. Nine of the eleven participants in the Purmerend case have doubts about the sustainability of biomass as a heat source (quote 12.24 and 19.2). Three of them prefer hydrogen as heat source and believe that it is a more sustainable alternative. Three others prefer other heat sources, but did not specify their preference.

Table 6.5. Hedonic motives of tenants of the Purmerend case associated with doubt about the technique, the heat source, preferences for other heat sources and the feeling to be forced by the municipality.

	Doubt about technique barrier	Heat source doubt biomass barrier	Heat source pref. hydrogen barrier	Heat source pref. other source barrier	Imposed barrier
P1		X	X	X	X
P2		X			X
P3					
P4		X	X		X
P5		X			X
P6		X			
P7	X	X	X		X
P8					
P9		X			X
P10		X		X	X
P11		X		X	X
Totals	1	9	3	3	8

Quote 12.24:

“Over de biomassa die ze gebruiken. Waar dat vandaan komt en wat voor kaalslag dat zal geven. Ik zie het als we verstoken bomen. ... Ze zeggen dat alles komt van Staatsbosbeheer en alles is kapafval. Takken en rommeltjes die uit het bos komen. Dat zou dan milieuvriendelijk zijn, want anders blijft het in het bos liggen en komt het toch vrij. Maar als ik kijk naar hoeveel ton ze gebruiken en hoeveel ton Staatsbosbeheer kan leveren, dan kloppen die cijfertjes niet. En Purmerend is niet de enige die biomassa gebruiken in Nederland. Dus als ik dat allemaal bij elkaar optel dan twijfel ik daaraan.” (Voesenek, 2020d, pp. 7)

“About the biomass they use. Where it origins from and the deforestation that will cause. I see it as the burning of trees. ... They say that everything is cutting waste from Staatsbosbeheer. Branches coming out of the forest. It should be sustainable, otherwise it will compost and digest the green house gasses will be released anyway. But if you take a look at how many kilos they use and how many kilos Staatsbosbeheer can deliver, these numbers do not match. Additional Purmerend is not the only biomass central in the Netherlands. If I compare everything, I doubt it.”

Quote 19.2:

“Ten eerste is dat het verbranden is van fossiele brandstoffen betreft in de centrale. ... En ik vind het ook een probleem dat de aanvoer van die houtsnippers gebeurt met vrachtwagens. Er komen elke dag tussen de 14 en 16 vrachtwagens die houtbrokjes brengen. Die vrachtwagens rijden ook niet op lucht. Dus dat vind ik ook bezwaarlijk. En ik vind het feit dat als ze niet genoeg houtbrokjes hebben, dat deze worden geïmporteerd dat vind ik ook een probleem. Dan komen ze uit het buitenland met een boot op stookolie naar de haven en dan moeten ze alsnog met vrachtwagens naar de centrale vervoerd worden. Ik zie de milieuvoordelen er niet van in.”

(Voesenek, 2020b, pp. 1)

“Firstly it is the burning of fossil fuels in the power plant. ... I think it is a problem that the biomass is supplied with trucks. Everyday 14-16 trucks bring the biomass. These trucks drive not on air. So, I find that objectionable. If there is not enough local biomass, the biomass is imported, that is another problem. In that case the biomass will come from abroad with cargo ships powered by fuel oil and then further distributed by diesel trucks. I do not understand the environmental benefits.”

Eight participants have the feeling they are forced by the municipality to accept the construction of the heat network. The attitude and information provision of the municipality causes people to feel that consultation and involvement is not possible and they do not have a choice. A large number of interviewees feel like the transition is imposed by the municipality (quote 18.8).

Quote 18.8:

“... De gemeente Purmerend en de regering die subsidieert al die toestanden, maar al vanaf het begin zijn we daar al niet goed over ingelicht en is dat helemaal niet goed geweest. Ze stoppen er maar subsidie in, en ook de gemeente Purmerend heeft ook heel veel subsidie gehad van de regering. Dat moet natuurlijk wel gebruikt worden. En dan gaan we hier maar mee door tegen beter weten in. ...” (Voesenek, 2020b, pp. 3)

“... The municipality of Purmerend and the national government subsidizes all these projects, but from the beginning we were not well informed about it, that has not been good at all. They put subsidy in it, the municipality of Purmerend received a lot of subsidy from the national government. It must be used. That they will continue with this for better and worse.”

6.2.3 Normative motives

Table 6.6. Altruistic motives of tenants of the Purmerend case.

	Altruistic motives barrier	Altruistic motives neutral	Altruistic motives trigger
P1			
P2			X
P3			
P4			X
P5			
P6			
P7			
P8			
P9			
P10			X
P11	X		
Totals	1	0	3

In most interviews participants were not able to indicate the influence of altruistic motives or social involvement and problems. Three participants have indicated that they appreciate to be socially involved, a couple even pointed out the importance of the off-gas transition because of the problems in Groningen. Participant P11 indicated that the feeling to be forced to give consent for the heat network construction and a lack of participation opportunities was the reason to establish the neighborhood committee. Based on involvement with the neighborhood and vulnerable tenants, in P11's view it is his task to represent the opinion of all neighborhood residents. This involvement creates resistance to the proposed off-gas transition.

As shown in table 6.7 and 6.8, most participants value the natural environment and consider climate change as a problem within and for our society. Only two participants consider climate change not as a social problem. Eight of the eleven participants in the Purmerend case consider their biospheric values as a barrier to give consent for the off-gas transition. By comparing the results with the results of the feelings regarding the heat source and preferences for other heat sources, it is learned that doubts about the sustainability of the heat source are related to biospheric values. So, people with doubts about the sustainability of biomass consider their biospheric values as a barrier to give consent for the off-gas transition (quote 18.9 and 19.6). The participants do not believe that the biomass power plant is a more climate friendly heating source than natural gas or an innovative source like hydrogen.

Table 6.7. Biospheric motives of tenants of the Purmerend case.

	Biospheric motives barrier	Biospheric motives trigger	Climate change no problem	Climate change problem	Larger polluters
P1	X			X	
P2	X			X	X
P3			X		
P4	X		X		
P5	X			X	
P6	X			X	X
P7				X	X
P8				X	X
P9	X			X	X
P10	X			X	
P11	X			X	X
Totals	8	0	2	9	6

Table 6.8. Being environmental responsible and feelings of personal responsibility of tenants of the Purmerend case.

	Environmentally conscious - no	Environmentally conscious - limited	Environmentally conscious - yes	Personal responsible - no	Personal responsible -yes
P1			X		X
P2			X		X
P3	X				
P4		X		X	
P5		X			X
P6					
P7		X			X
P8			X		
P9			X		X
P10			X		X
P11			X		X
Totals	1	3	6	1	7

Quote 18.9:

"Ja, want wat kost het allemaal wel niet als ze al die bomen uit Letland en Amerika halen. En voor die mensen daar is dat toch ook niet goed? Die bomen moeten daar toch ook blijven? Ik vind het heel slecht dat Nederland het uit het buitenland haalt, want ze scheppen dan daar eigenlijk ook weer een probleem. Die bomen zijn daar net zo hard nodig als bij ons." (Voesenek, 2020j, pp. 4)

"Yes, what costs it if they ship all those trees from Latvia and America. It isn't good for those people there. Those trees should stay there too, right? I think it is very bad that the Netherlands gets the biomass from abroad, because they actually create a problem there. Those trees are just as much needed there as they are here in the Netherlands. "

Quote 19.6:

"Daar hecht ik wel veel waarde aan. Wij zijn er erg tevreden mee dat de woning verduurzaamd is. Gewoon het feit dat er houtbrokjes verbrand worden heb ik moeite mee. Het mooiste is eigenlijk, dat wij zo ver van de centrale afzitten dat het water opnieuw moet worden verwarmd door het tussenstation. Dit station werkt op gas. Dat vind ik echt een bezwaar." (Voesenek, 2020k, pp. 2)

"I do attach great importance to that. We are very pleased that the house has been made more sustainable. I just have trouble with the fact that wood chips are burned. The best thing is, in fact, that we are so far from the power station that the water has to be reheated by the intermediate station. This station works on natural gas. I really find that an objection. "

Despite the high valuation of the sustainability of the source, six participants consider other sectors as larger polluters. They think that the contribution to the mitigation of climate change by a sustainable way of heating and the execution of the off-gas transition in the built environment, is limited compared with making the industry and transportation activities more sustainable.

Additionally six participants are aware of the consequences of their behavior and purchases with respect to the environment and the climate. They separate waste, consciously save energy and try to make climate-friendly choices when purchasing appliances. Remarkable is that participant P8 is behaving environmentally conscious but cannot describe his feelings regarding personal responsibility to contribute to the mitigation of climate change. Based on the interview, it can be deduced that P8 behaves environmentally conscious out of habit (quote 16.10). Habit-based behavior is very decisive in their climate-friendly people behavior. Especially older participants have habitual energy and water saving behavior in order to combat waste, a kind of learned economy.

Quote 16.10:

"Dat zal ik wel vanuit mezelf doen, want dat vind ik allemaal zonde van het milieu." (Voesenek, 2020r, pp. 4)

"I will do that from myself, because I think that is all a waste of the environment."

6.2.4 Information process

All participants have received information from the municipality of Purmerend about the off-gas transition. Four interviewees describe their relationship with the municipality as negative. Six participants have limited trust in the municipality. Eight of eleven participants indicate that they have received information from the housing association about the off-gas transition. Six interviewees describe their relationship with the housing association as positive and have trust in the housing association. Four interviewees consider their relationship with the housing association as negative and have limited trust in the housing association. From the interviews, it can be deduced that the relation with and trust in the municipality and housing association are based on previous experiences associated with information provision and/or renovation projects (quote 13.23). Some participants with limited trust in the information source indicate that they receive and view new information from the same source with suspicion.

Table 6.9. Information provided by housing association or municipality, trust in and relation with housing association (HA) or municipality.

	Housing association	Relation HA positive	Relation HA negative	Trust HA positive	Trust HA negative	Municipality	Relation municipality positive	Relation municipality negative	Trust municipality positive	Trust Municipality negative
P1	X	X		X		X		X		X
P2	X	X		X		X				
P3	X		X		X	X				
P4	X	X		X		X		X		X
P5	X		X		X	X				X
P6		X		X		X				
P7			X		X	X				
P8		X		X		X				
P9	X		X		X	X		X		X
P10	X	X		X		X				X
P11	X					X		X		X
Totals	8	6	4	6	4	11	0	4	0	6

Quote 13.23:

“Nee, mijn eerste ervaring was al dat het veel duurder werd. ... De vorige keer is het bijna verdubbeld. En ik geloof ook niet, dat was in 2005, en ik geloof ook echt niet dat stadsverwarming nu zoveel goedkoper is geworden relatief gezien. ... Ja en ik moet zeggen in 2005 kregen we een keurige tabel met een voorberekening. Maar daar kun je ook je kont mee afvegen, want daar klopte niets van. ...” (Voesenek, 2020g, pp.8)

“No, my first experience was that it became much more expensive. ... Last time it almost doubled. That was in 2005 and I don’t believe that the district heating has become so much cheaper now. ... Yes and I must say in 2005 we receive an overview table with a pre-calculation of the costs. But it was useless, nothing in it was right. ...”

Table 6.10. Co-occurrence table information origin and information form valued as few, enough, too much and valuation of the information process as positive or negative.

	Origin Housing association	Origin Municipality	Form and type book	Form and type meetings	Form and type Model house
Few	5	9	0	6	0
Enough	3	3	0	3	2
Too much	0	1	0	0	0
Process negative	1	7	-	-	-
Process positive	1	0	-	-	-

Nine out of eleven participants indicated that they have received few information from the municipality and five have received few information from the housing association. Additionally is the information process experiences as negative by 7 interviewees. From these results it can be deduced that there is a strong need for additional information. This is confirmed by the table 6.11. Ten participants have a need for extra information.

In the Purmerend case a printed information package is not provided. During information meetings in the neighborhood information is provided by the municipality. Later some letters and flyers were distributed by the municipality and housing associations. The municipality has established a model house. The information meetings are experienced as negative. Six participants describe the shared information during these information meetings as little. The model house seems to provide a better quality of information, however only two participants have given their opinion about this.

It is not possible to give a full assessment of the information strategy and process, but the results show that there is an evident need for more information. Additionally the information provision process is perceived as negative.

Table 6.11. Additional information needs and sources where additional information is searched/found.

	Additional information	Need consequences	No need consequences	Need technique	No need technique	Need source	Need alternatives	Source internet	Source neighborhood committee	Source peers	Confusion by debate
P1	X	X		X		X	X	X		X	
P2	X	X		X		X			X		
P3	X		X		X					X	
P4	X					X		X	X	X	
P5	X	X				X		X		X	X
P6	X					X					X
P7	X					X		X	X		X
P8										X	
P9	X	X		X		X	X		X		X
P10	X	X				X	X		X	X	X
P11	X	X		X		X	X	X	X	X	X
Totals	10	6	1	4	1	9	4	5	6	7	6

Ten of the eleven interviewees have a need for additional information. From this result it can be deduced that not enough information has yet been provided to the tenants, but there is a need for this. Different participants have different information needs. In addition, the previous discussed results show that interviewees value various information types and forms. In order to meet the information needs of the participants, the information provision will have to be adapted to specific needs and preferences. Most participants would like to know more about biomass as a heat source. Half of the participants indicate that they become confused by the social debate about biomass. This makes it more difficult to assess information and sources (quote 18.13 and 19.35). The extensive and fierce social debate increases feelings of doubt about biomass. This doubt prevents tenants from giving consent for the off-gas transition through the connection to the heat network.

Quote 18.13:

"... ik zit zelf niet in die bewonerscommissie, maar die is hier wel opgericht. Mijn buurman zit daar wel in en ik steun hun. Dat wij daar dus tegen zijn, want wij willen dat dus eigenlijk tegen houden. Want iedereen gebruikt nu zo weinig gas, dat wij denken waarom moeten we er eigenlijk van af. En het punt is als de stadsverwarming niet genoeg biomassa heeft dan schakelen ze zelf terug naar het gas. ..." (Voesenek, 2020b, pp. 4)

"... I'am not part of the neighborhood committee myself, but it is established. My neighbor is part of the committee, and I support them. We are against it, we actually want to stop it. Everyone uses a small amount of natural gas, that why we doubt why we should execute the off-gas transition. And the point is that if there is a shortage of biomass, the powerplant will switch to natural gas itself. ..."

Quote 19:35:

"Daar hebben we best veel vragen over moeten stellen en informatie moeten zoeken. De berekeningen die we kregen en de voorlichting daarover was erg eenzijdig. We hebben er best veel werk in moeten steken om dat goed te kunnen onderzoeken. ... van internet ook door te kijken bij andere steden die al dat soort houtbrokjes of snippers stoken. Ook bekijken waar die dingen eigenlijk vandaan komen, hoe het werkt en hoe dat gaat. Een ander aspect is ook dat stel dat heel Nederland van het gas af gaat en we gaan allemaal over op houtsnippers centrales dan kunnen we over 10 jaar onze meubels erin gaan gooien want dan staat er geen boom meer."

(Voesenek, 2020c, pp. 10)

We had to ask a lot of questions about that and have to search for information. The calculations we received and the information provided by them was very one-sided. We had to put quite a lot of energy in it to be able to investigate it properly. ... from the internet and by taking a look at other cities that use a biomass powerplant. We also took a look into where those things come from and how it works. Another aspect is that if in the whole Netherlands the off-gas transition is executed and we all will shift to heat networks with biomass as heat source, we have to burn our furniture in 10 years' time, no tree will be left. ..."

Secondly, there is a strong need for additional information about the consequences of the off-gas transition. Tenants are curious about what the financial consequences will be, they want clarity about this. Thirdly, about one third of the participants would like to know more about the available alternative heat sources and more about the heat network itself, the technique.

Participants indicate that they have sought and shared additional information within or received from the neighborhood committee. About one third of the interviewees is member of the neighborhood committee, they all are sceptic about the application of a heat network with biomass as a heat source. It cannot be deduced from the results that the opinion of the committee feeds the information needs and doubts of other local residents, however it is conceivable that the opinion of the neighborhood committee influences local residents. Other important sources for additional information are peers, mainly children or neighbors, and the internet. Participants P6 and P10 indicated that they have found additional information in newspapers and at television (quote 18.7). So all participants have sought for additional information.

Quote 18.7:

"... Ik heb er heel erg mijn twijfels over en daarin ben ik niet alleen. ... Maar ik lees er regelmatig stukken over in de krant, maar de gemeente Amsterdam wil dat dan ook allemaal in Diemen. ... Ik zat televisie te kijken over een vrouw in Zuid-Amerika die zich afvroeg of wij in Nederland wel goed bij ons hoofd zijn, omdat ze daar het bos omkappen voor ons. Weet je dus daar wordt ik gewoon heel boos over. Aan de ene kant hebben we Frans Timmermans, wat ik goed vind, we moeten zoveel duizend bomen planten en wij gaan maar door met die bomen kappen." (Voesenek, 2020b, pp. 3)

"... I'am very much in doubt about it and I'am not alone. ... I regularly read about it in the newspaper, the municipality wants the same in Diemen. I watched television about a woman in South America, who was wondering if we are crazy in the Netherlands, because they were cutting down the forest for our biomass. You know, I just get really mad about that. On the one hand we have Frans Timmermans, with his plans to plant thousand trees, on the other hand we keep cutting trees down for biomass."

6.2.5 Renovation experiences

In 2018 Intermaris has executed an energy efficiency renovation in Overwhere-Zuid. Expected is that previous experiences do have an influence on the current motives of tenants regarding the off-gas transition.

Table 6.12. Motives and experiences of energy efficiency renovation of 2018 in Overwhere-Zuid.

	Biospheric motives trigger	Comfort trigger	Disturbance and inconvenience barrier	Experience disturbance and inconvenience negative	Experience disturbance and inconvenience positive	Result positive	Results negative
P1	X	X			X	X	
P2	X	X			X	X	
P3			X				X
P4	X	X				X	
P5	X	X	X	X			X
P6	X	X			X		
P7		X	X				X
P8		X			X	X	
P9		X		X			X
P10	X	X	X		X	X	
P11		X	X			X	
Totals	6	10	5	2	5	6	4

Table 6.13. Financial motives and expectations of energy efficiency renovation of 2018 in Overwhere-Zuid. Financial consequences (FC).

	FC one time investments barrier	FC monthly barrier	FC monthly neutral	FC monthly trigger	FC monthly expected decrease	FC monthly expected increase	FC monthly expected remain
P1			X				X
P2				X	X		
P3	X		X				X
P4				X	X		
P5				X	X		
P6				X	X		
P7		X				X	
P8				X	X		
P9		X				X	
P10			X				X
P11				X	X		
Totals	1	2	3	6	6	2	3

The expected effect of the energy efficiency renovation on the monthly housing costs determines if this effect is considered as a barrier, trigger or neutral. Understandable and unambiguous information provision about the financial consequences is important to motivate tenants to give consent for an energy efficiency renovation. This is endorsed by participants P7 and P9, they were not able to judge the financial consequences of the installation of solar panels (quote 17.1). As a result, they did not

give consent for the installation of solar panels. Other frequent indicated motivational triggers are the expected improvement of comfort and biospheric motives.

Quote 17.1:

“Nee. Dat had een financiële reden. Ik kon niet overzien of ik dat bedrag per maand kon betalen.” (Voesenek, 2020k, pp. 1)

“No. It was financially motivated. I couldn't judge whether I could pay that amount per month.”

6.2.6 Focal goal

10 out of eleven participants have negative feelings associated with the heat network and with the off-gas transition as proposed in Purmerend. These participants are not willing to give consent. These negative feelings are a sum of all types of motivational triggers and barriers. Some tenants even indicated that there are only disadvantages associated with the proposed off-gas transition (quote 12.35). Disadvantages that have frequently been mentioned by participants: expected increase of monthly housings costs, necessary one-time investments due to electrical cooking, disturbance and inconvenience, monopoly position of heat supplier, doubts about the sustainability of biomass due to ambiguous information and strong biospheric values, and the feeling of being imposed to give consent. Only one participant is positive about the construction of a heat network, even in its proposed form. As described participant P2 highly prefers the smaller risk of a heat network.

Table 6.14. Feeling of tenants of the Purmerend case associated with the heat network, proposed off-gas transition and the off-gas transition in general.

	Heat network - negative	Heat network - positive	Off-gas proposed - negative	Off-gas proposed - positive	Off-gas - negative	Off-gas - positive
P1	X		X			X
P2	X	X		X		X
P3	X		X		X	
P4	X		X		X	
P5	X		X			
P6	X		X		X	
P7	X		X		X	
P8	X		X			
P9	X		X		X	
P10	X		X			X
P11	X		X			
Totals	11	1	10	1	5	3

Quote 12.35:

“Nee, ik ben daar niet blij mee. Het heeft voor ons absoluut geen voordelen. Het aardgasvrij dan he, heeft voor ons geen voordelen.” (Voesenek, 2020f, pp. 4)

“No, I am not amused. It has absolutely no benefits for us. The off-gas transition then has no advantages for us.”

Peculiar is that almost five participants are against the off-gas transition in general. Participants P3, P6 and P9 concern change, they want everything to remain the same. Especially the disturbance and the purchase of new kitchen stuff have major effects on their attitude regarding the off-gas transition. Interviewee P7 has a preference for hydrogen as an alternative and sustainable heat source. This

participant has the opinion that the off-gas transition can be better be postponed until hydrogen is available as a heat source. Participant P4 does not believe that the off-gas transition will have a positive influence on the environment. Both participant P3 and P4 do not consider climate change as an important social problem.

Only three participants do believe in the positive effect of the off-gas transition for the environment. They consider the off-gas transition as an appropriate method in order to mitigate climate change. Participants P1, P2 and P10 are environmental conscious and do feel personal responsible to contribute to the mitigation of climate change. Additional they are positive about the result of the energy efficiency renovation. All three of them have indicated biospheric values as a major trigger to give consent for the renovation. Regarding the proposed off-gas transition their doubt about the sustainability of biomass as a heat source is determinative. Remarkable is that the resistance of all participants mainly focuses on the heat network with biomass as heat source.

Table 6.15. Focal goals of tenants of the Purmerend case.

	Biospheric motives	Comfort	Disturbance and inconvenience	Electric cooking	Financial consequences	Necessary maintenance	Safety
P1	X						
P2							X
P3					X		
P4					X		
P5					X		
P6					X		
P7	X						
P8				X			
P9	X						
P10	X						
P11	X						
Totals	5	0	0	1	4	0	1

The indicated focal goals illustrate that biospheric motives and financial consequences are the main barriers to give consent for the off-gas transition as proposed. Five of the eleven participants indicated that their biospheric motives determine their decision process to give consent for the off-gas transition. The financial consequences of the off-gas transition are determinative in their decision process for four tenants. Only one participant has indicated an increased sense of safety as most important motive to give consent for the execution of the off-gas transition. Another person declared electrical cooking as determinative barrier to give consent.

In comparison with the motives regarding the off-gas transition appear similar determinative motives. The expected financial consequences and biospheric motives are in both cases frequent motives to give or give not consent for the execution of the renovation or off-gas transition. None of the tenants does expect an improved comfort or indoor climate as a result of the off-gas transition. However, this was a reason for almost all tenants to give consent for the execution of the energy efficiency renovation. This could indicate that the other motives outweigh the consideration of tenants. The environmental and financial benefits seem to be even more important for tenants' decision-making.

Finally the effect of the information strategy and process on the motives of tenants is analyzed. The results show that almost all participants have a need for additional information. The received information is valued as little and the information process is considered as negative. The information provided during information meetings is valued as few by six interviewees. Additionally they indicated that there was a limited ability to ask questions and receive additional information. All participants have sought for additional information on the internet, in other media, shared with peers or the neighborhood committee. Where tenants search for additional information cannot be influenced, however, the need for additional information can be influenced.

6.3 Results of case 2: 't Ven Eindhoven

6.3.1 Gain motives

Table 6.16. Gain motives of tenants of the Eindhoven case associated with monthly financial consequences (FCM) of the off-gas transition.

	FCM barrier	FCM neutral	FCM trigger	FCM increase	FCM equal	FCM decrease
E2	X				X	
E3		X		X		
E5			X			X
E6	X			X		
E7		X			X	X
E8			X			X
E9	X			X		
E10			X			X
Totals	3	2	3	3	2	4

Table 6.17. Gain motives of tenants of the Eindhoven case associated with one-time financial consequences, financial motivation to save energy to save costs, the valuation of the investment of time and energy, and the participation of neighbors.

	Financial consequences once - barrier	Financial considerations - save energy to save costs	Time and energy	Participation of neighbors - important	Participation of neighbors - not important
E2	X	X			
E3	X		X		X
E5		X			
E6			X		
E7			X	X	
E8	X			X	
E9		X			
E10				X	
Totals	3	3	3	3	1

Participant E2, E3, E6 and E9 considered the financial consequences for the monthly housing costs as a barrier or neutral (quote 7.9). They expected that the total housing costs would increase or remain equal. Interviewees E5, E8 and E10 were convinced that the total monthly housing costs would decrease, so this triggered them to give consent for the execution of the off-gas renovation (quote 6.19). It was unclear for participant E7 whether the monthly housing costs would decrease or remain the same, so the considerations regarding the monthly financial consequences are considered as neutral. The consequences of the renovation for the monthly housing costs are assessed very differently by the participants. 'thuis has informed the tenants about the financial consequences of the all-electric renovation. They have indicated that, for most households, the rent increase will be compensated by the lower gas and energy bill.

Quote 6.19:

"Ik had daar wel vertrouwen in. Ik had een beetje zitten googelen en ook geïnformeerd bij mijn eigen energiemaatschappij. Dus ik dacht wel dat dat goed zou komen. Je betaald 19 euro per maand als vastrecht voor gas. ... Dat vervalt dus, want je hebt geen gas meer. Dus ik dacht van nou van de €30 euro dat ik meer huur moet gaan betalen, is het nu nog maar €11,-. ... Je hebt nog zonnepanelen, die stroom op wekken. ... En wat ook het feit is dat het nu veel minder tocht. ... Dan moet het wel allemaal gaan opleveren. Ik maakte me daar niet zo veel zorgen over." (Voesenek, 2020a, pp. 11)

"I had confidence in it. I googeled a bit and checked it with my energy supplier. So I thought it would be okay. You pay € 19,- per monthh as a fixed charge for natural gas. ... This fixed charges expires, because you are no longer connected to the gas network. So of the €30,- rent increase, only € 11,- is left. ... You got the solar panels that generate electricity. ... And also the fact that there is less draught due to the insulation. It has to work out positively. I was not concerned about that.

Quote 7.9:

"Ik vind het eigenlijk niet kloppen, het is eigenlijk achterstallig onderhoud. Zo zie ik het. Dat je daarvoor huurverhoging krijgt, nee." (Voesenek, 2020b, pp. 3)

"I actually don't think it's right, it's actually overdue maintenance. That's how I see it. That you get a rent increase for that, no."

Three interviewees considered the needed one-time investments as a barrier. By looking specifically at the motivation for this in the quotes, it becomes clear that the purchase of a new stove has a major impact on their budget. The financial situation of many social tenants is limited. However, some households are more financially vulnerable than others. The purchase of new cookware can therefore be an important barrier for these households. A couple of participants wanted to save energy in order to save costs, however not all of them were convinced that the total housing costs would decrease as a result of the off-gas transition.

During the interviews the participants told a lot about their experiences during the off-gas renovation process. Consequently follow-up questions were asked about how the required investment of time and energy had been estimated in advance. The answers from participants E3, E6 and E7 show that the tenants had not anticipated how much time and energy had to be invested in the renovation (quote 4.10).

Quote 4.10:

"... Nee, daar heb ik absoluut vooraf niet over nagedacht. ..." (Voesenek, 2020a, pp.3)

"... No, I definitely didn't think about that beforehand. ..."

Three participants appreciate it if neighbors give consent and participate in the renovation project, in order to run the project smoothly and no additional delay or nuisance is caused by a refusing neighbor. It is a consideration of self-interest.

6.3.2 Hedonic motives

Table 6.18. Hedonic motives of tenants of the Eindhoven case associated with comfort and expected disturbance and inconvenience.

	Comfort barrier	Comfort trigger	Disturbance and inconvenience barrier	Disturbance and inconvenience neutral	Disturbance and inconvenience trigger
E2					
E3		X	X		
E5		X	X		
E6			X		
E7		X		X	
E8					
E9		X			
E10		X	X		
Totals	0	5	4	1	0

Five out of eight participants indicated the expected comfort increase indoors as a trigger to give consent for the execution of the off-gas renovation. The participants indicate that the houses were very drafty and humid (quote 2.7). A couple of residents had mildew in the house (quote 7.7). Additionally it is numerously indicated that the house was difficult to heat in winter. The house was not comfortable. Participants E3, E5, E7, E9 and E10 expected an improvement of comfort based on the information provided by 'thuis.

Quote 2.7:

"Wij zitten op een hoekhuis en wij zitten al bijna 20 jaar te vechten over een natte kelder, een natte wc en een koude buitenmuur die niet was geïsoleerd en allemaal." (Voeselek, 2020a, pp. 1)

"We rent a corner house and for almost 20 years we have been complaining about over a wet basement, a wet toilet and a cold outside wall that was not isolated."

Quote 7.7:

"... Nou dat was heel hard nodig, want de schimmel stond op de muur in de kamer. ..." (Voeselek, 2020d, pp. 2)

"... Well, it was necessary, because the mildew was on the wall in the living room."

Upfront participants E3, E5, E6 and E10 expected quite a lot disturbance caused by the renovation works, they considered this as a barrier. Some participants indicate that they fear that self-made adjustments in the house will have to be removed. Other participants did not know what to expect in terms of disturbance in and around the house during the renovation. Therefore, it had no influence on their decision process and expectations.

As shown in table 6.19, a couple of participants has doubts about the applied all-electric technique. Participant E2 does not like to be completely dependent on electrical power, due to possible power failures. Other considerations play a role for interviewee E3. This participant has the expectation that a sustainable substitution of gas will become available at some term, so that the gas network can be preserved. E3 wonders if other solutions have been sufficiently researched.

Table 6.19. Hedonic motives of tenants of the Eindhoven case associated with the technique, necessary maintenance and electric cooking.

	Doubt about technique barrier	Necessary maintenance trigger	Electric cooking barrier	Electric cooking trigger	Safety trigger
E2	X			X	X
E3	X	X	X		
E5					
E6		X			
E7		X		X	
E8				X	X
E9		X	X		
E10				X	
Totals	2	4	2	4	2

Remarkable is that half of the participants considers the renovation as necessary maintenance. This can be caused by two reasons. Firstly, for a long time little to no maintenance has been carried out on the rental properties. The houses were in poor condition, especially the indoor climate had to be improved. Secondly, the housing association has indicated in its information provision that part of the renovation work is considered as necessary or major maintenance. It is expected that this manner of communication has influenced the opinion of tenants.

Two participants regard the switch to electrical cooking as a barrier, they fear the change and are reluctant to get used to it. Four others prefer electrical cooking because it is user-friendly, easy to clean and adjust the temperature. Two interviewees appreciate it as a safer way of cooking and heating, especially for children (quote 1.33).

Quote 1.33:

"Ik ben er altijd bang voor geweest, voor koolmonoxide en van die verwarmingsketels enzo, dat vindt ik enge dingen." (Voesenek, 2020a, pp. 5)

"I've always been scared of it, carbonmonoxide and those boilers and central heating systems, it is scary stuff."

6.3.3 Normative motives

Table 6.20. Altruistic motives of tenants of the Eindhoven case.

	Altruistic motives barrier	Altruistic motives neutral	Altruistic motives trigger
E2		X	
E3			
E5			X
E6			
E7			
E8			X
E9			
E10			
Totals	0	1	2

It is hard to interpret the influence of altruistic motives. Recognizing altruistic motives is found to be challenging in qualitative research. In most interviews participants were not able to indicate the influence of altruistic motives or social involvement and problems. Participant E5 indicated to appreciate to be socially involved. Interviewee E8 pointed out the importance of the off-gas transition because of the problems in Groningen.

Table 6.21. Biospheric values of tenants of the Purmerend case.

	Biospheric motives barrier	Biospheric motives neutral	Biospheric motives trigger	Climate change no problem	Climate change problem	Larger polluters
E2			X		X	
E3					X	X
E5			X		X	
E6		X			X	
E7			X		X	
E8			X		X	
E9					X	X
E10			X		X	
Totals	0	1	5	0	8	2

Table 6.22. Being environmental responsible and feelings of personal responsibility of tenants of the Eindhoven case.

	Environmentally conscious no	Environmentally conscious limited	Environmentally conscious yes	Personal responsible no	Personal responsible yes
E2		X			X
E3		X		X	
E5			X		X
E6		X			
E7			X		X
E8			X		X
E9		X		X	
E10			X		X
Totals	0	4	4	0	5

All participants of the Eindhoven case consider climate change as problem for our society (quote 8.10). Five interviewees state biospheric values as a trigger to give consent for the off-gas renovation and feel personal responsible to contribute to the mitigation of climate change (quote 6.13). Four of them are conscious of the effect of their activities and choice on the environment. They are actively saving energy, purchasing energy-efficient appliances and limiting water consumption. The other participants are limited aware of the effect of their behavior on the environment, but all participants indicate that they separate waste and try to limit energy consumption. A certain degree of environmental awareness is present with all participants.

Quote 6.13:

“Ja dat meen ik echt. Ik denk echt dat het scheelt, dat hoe meer mensen van het gas af gaan. Dat dat gewoon echt veel beter is voor het milieu. ...” (Voesenek, 2020d, pp. 8)

“Yes I am serious. I really think it makes a difference that the more people get off-gas. I think that is really much better for the environment.”

Quote 8.10:

"... Het is een probleem voor de volgende generatie denk ik, het is iets waar wij iets aan moeten doen zodat zij niet in de problemen komen met opwarming en dat soort dingen. ..." (Voesenek, 2020a, pp. 4)
"... It's a problem for the next generation, I think, it is something we need to do about so they don't get in trouble with global warming and things like that."

Firstly, it is striking that participant E2 is not conscious about the effect of behavior on the environment despite feelings of personal responsibility and strong biospheric values. It can be deduced from the interview that this limited environmental consciousness is caused due to the fact that participant E2 is not willing to change personal behavior and consumption. Secondly, two tenants are not feeling personally responsible to contribute to the mitigation of climate change. Both participant E3 and E9 consider other sectors, like mobility, agriculture and industry, as larger polluters than households. This belief influences their sense of responsibility to make a personal contribution. Both interviewees do not clearly indicate what role biospheric values had in their decision-making process. Therefore this information has not been entered in the results.

6.3.4 Information process

Table 6.23. Information provided by housing association, trust in and relation with housing association (HA) and experience of the information process.

	Housing association	Relation HA positive	Relation HA negative	Trust HA positive	Trust HA negative	Process positive	Process negative
E2	X	X		X			X
E3	X		X		X		X
E5	X	X		X		X	
E6	X	X		X			X
E7	X						X
E8	X	X			X	X	X
E9	X		X		X		X
E10	X	X				X	
Totals	8	5	3	3	3	3	6

All participants confirm to have received information from the housing association. Five participants describe their relation with the housing association as positive. Participants struggled to describe their initial confidence and trust in the housing association before the renovation. A couple of interviewees, e.g. participant E6 (quote 4.38), indicated that the relationship and confidence in the housing association is declined as a result of the renovation. As the results show, six participants experienced the information process as negative. This and other experiences during the renovation process have likely affected the current relation and trust in the housing association.

Quote 4.38:

"... Ja absoluut een hele grote deuk. De communicatie en de hulp is heel slecht. Ik zei al ik ben al drie/vier maanden bezig over die zonnepanelen. Moet dat zo lang duren? ..." (Voesenek, 2020d, pp. 10)
"... Yes, absolutely a very big dent. Communication and support is very poor. I've been working on those solar panels for three or four months. Should that take so long? ..."

It is remarkable that six participants have indicated the information process as negative. By analyzing the corresponding quotes, it emerges that tenants felt that they had no choice and had to agree to the renovation. A number of tenants felt imposed to give consent (quote 4.19 and 5.31).

Quote 4.19:

".... In eerste instantie was er best wel veel tegenstand, maar je beseft op een moment ook wel van ja ik kan wel moeilijk doen maar het moet gebeuren, dus. Dat was inderdaad wel een issue. We moesten met zoveel procent tekenen voordat ze mochten starten. Daar werd wel heel erg op aangedrongen die avond dat je maar tekende. Terwijl je maar amper had kunnen laten doordringen wat het allemaal in hield." (Voesenek, 2020d, pp.5)

"...Firstly there was quite a lot of resistance, but at some time you realize I can make it difficult, but it has to be done. Indeed that was an issue. A certain percentage of tenants had to sign for consent before they were allowed to start. That night it was very much urged that you would sign. While you could barely have realized the consequences of the renovation."

Quote 5.31:

"Hier begonnen ze allemaal te schelden en te doen. Ze kwamen op een gegeven moment na die vergadering met een papier. Ik ga niet tekenen als ik niks weet of heb. Dat doe ik niet. ... Maar ze moeten niet op het einde van de vergadering vragen of ik wil tekenen. Daar was ik wel op tegen, daar ben ik eerlijk in." (Voesenek, 2020e, pp. 9)

"Some started to shout and scold. At some point during the meeting they came with a paper. I won't sign if I don't know or have anything. I won't do that. ... They shouldn't ask me to sign at the end of the meeting. I was not amused about it if I'm honest."

In the Eindhoven case information is provided in three different forms: information books and letters, information meetings and a model house. Not all three forms are discussed with all participants in this case. Still the results give an impression about the valuation of the information forms. Participant E2 indicated the information provided in the book as too much (quote 3.30). On the other hand, participant E7 valued the same information book as unusefull (quote 5.35). If we more closely analyze the quotes related to the information guide it can be derived that many different aspects of the renovation are outlined in one information book. A lot of information seems to have been provided, but for many tenants this has not been assessed as such. An explanation could be that there was provided so much information that it was no longer clear to people where which information could be found.

Table 6.24. Co-occurrence table information origin and information form valued as few, enough, too much.

	Origin Housing association	Form and type book	Form and type meet	Form and type model
Few	4	4	4	
Enough	3		1	2
Too much	3	2		1

Quote 3.30:

"... Het was te veel informatie, waarvan veel niet van toepassing was op onze woning." (Voesenek, 2020d, pp. 6)

"... It was too much information, many of it did not apply to our house."

Quote 5.35:

"... Je kon er eigenlijk niks mee. Als je een planning hebt over het hele huis, dan het eerste boekje. Dan hou je het eerste in de gaten, maar de rest ben je dan nog niet mee bezig. Dat vergeet je dan weer. Je legt het boekje aan de kant en dan zie je wel wat er allemaal gebeurd." (Voesenek, 2020e, pp.8)

"... You couldn't use it actually. The first book and a schedule of the renovation work. You keep an eye on this, but you do not thinking about the next phases. You forget it. You put the book aside and see what happens. ..."

Table 6.25. Additional information needs and sources where additional information is searched/found.

	Additional information	Need consequences	No need consequences	Need technique	No need technique	Need source	Need alternatives	Source internet	Source neighborhood committee	Source peers	Confusion by debate
E2			X		X					X	
E3	X							X		X	
E5			X		X				X	X	
E6			X		X				X		
E7			X		X					X	
E8	X	X		X				X		X	
E9	X	X							X	X	
E10	X	X			X					X	
Totals	4	3	4	1	5	0	0	1	3	7	0

The information meeting at the start of the renovation project is experienced as negative, as illustrated by quotes 4.19 and 5.31. The results show that four tenants value the presented information during the meeting as too little (quote 2.3). Despite the information, tenants experienced it as difficult to estimate what exactly would happen and what impact this would have on their daily household life (quote 7.6).

Quote 2.3:

"Nou aangekondigd? Het werd verteld maar de uitleg was maar heel summier. Het werd gepresenteerd alsof er geen keuze was. Ik vond het in ieder geval geen goede uitleg." (Voesenek, 2020c, pp. 1)

"Announced? It was told, but the explanation was very brief. It was presented as if we had no choice. At least for me it was not a good explanation."

Quote 7.6:

"Dat was 's avonds hier in de buurt ergens, daar was dan zo een avond dat je kon praten over van alles en nog wat met de renovatie. Maar daar werd niet gesproken over de herrie en de rommel. Daar werd niet over gepraat, alleen maar het wordt zo mooi." (Voesenek, 2020h, pp. 2)

"There was an information evening in the neighborhood, you could talk about everything regarding the renovation. There is nothing mentioned about the disturbance and hassle. Nothing was told about it, just about how beautiful it was going to be."

A couple of interviewees indicate that they enjoyed visiting the model house. They were able to see what the result of the renovation will be, how their house will become look like. However, not all residents have visited the house.

Four of eight participants indicated that they had a need for additional information. The others expected to be consistently and completely informed. E3 and E8 searched for more information on the internet. E8 even contacted the energy supplier to discuss the effect of the renovation on the total housing costs. Participant E9 needed more information about the consequences of the renovation process. This interviewee did not feel well informed. Tenant E10 visited the neighbors to see the result of the renovation, in order to better estimate the consequences.

There was limited need for additional information about the applied all-electric technique. Though most participants indicated that they discussed the renovation with peers, mainly family members and neighbors (quote 3.35). They mainly discuss whether the renovation would improve the living situation. During the renovation process is searched for additional information and support by the neighborhood committee (quote 7.19).

Quote 3.35:

“Ik heb het niet met de kinderen overlegd maar wel verteld wat er gaande was en wat er ging gebeuren. Zij zeiden ook moeder dat moet je echt doen, je gaat er echt op vooruit?” (Voeselek, 2020d, pp. 7)

“I did not discuss it with the children but I did tell what was going on and what was going to happen. They told me that I really had to do this, they believe the house would be improved.”

Quote 7.19:

“Nou in de straat was ook iemand van de klankbordgroep, dus als er iets was dan ging ik daar naar toe. Hij legde mij dan uit hoe het zat. Maar bij ‘thuis nee. Die hoefde mij niks meer te vertellen, echt niet.” (Voeselek, 2020h, pp. 7)

“Well, in the street someone was part of the neighborhood committee. So if there was something wrong I told my neighbor. He explained it to me. But not from ‘thuis, no. They did not have to tell me anything at this moment, no.”

Finally, it is striking that many tenants are negative about the information process, but did not indicate a need for additional information. This may be caused by the fact that tenants did not know what to expect during the renovation. In addition, a number of tenants indicate that they fully trusted the information from the housing association (quote 4.27).

Quote 4.27:

“Nee, ik ging er vanuit dat het allemaal wel goed zou zijn. Daar heb ik nu wel mijn twijfels over.”

(Voeselek, 2020e, pp. 6)

No, I expected that everything would be good. At this moment I have doubts.”

6.3.5 Renovation experiences

Table 6.26. Experiences of tenants during the off-gas renovation of in Eindhoven.

	Time and energy negative	Time and energy positive	Time Frame negative	Process negative	Process positive	Prefer to leave the house	Communication and support negative	Communication and support positive
E2	X		X	X		X	X	
E3			X		X		X	X
E5	X		X	X		X		X
E6	X		X	X		X	X	
E7			X	X	X			X
E8	X		X	X		X	X	X
E9	X		X	X			X	X
E10		X	X	X		X		X
Totals	5	1	8	7	2	5	5	6

Table 6.27. Experiences of tenants during the off-gas renovation of in Eindhoven.

	Doubt about technique	Info about usage of house	Increased social cohesion	Financial consequences once negative	Fees negative	Fees positive	Result negative	Result positive
E2		X	X	X	X		X	X
E3								X
E5		X	X					X
E6	X	X	X					X
E7				X	X			X
E8			X	X	X			X
E9		X			X		X	
E10		X	X			X		X
Totals	1	5	5	3	4	1	2	7

The result show that all participants have experienced the time frame of the off-gas renovation project as negative. The scheduling of the renovation works are experienced as negative, because the work partly was executed during winter (quote 8.18). Interviewees indicated that the process took longer than expected and the communicated planning was often incorrect (quote 2.34). Additionally seven interviewees have experienced the process as negative, they experienced way more disturbance and hassle during the process than expected upfront (quote 6.2). Following this five participants have indicated that the process took a lot of personal effort. They experienced it as a time and energy consuming period. Because of these afore mentioned reasons five interviewees state it would have been better if the tenants had to leave the house during the main renovation works.

Quote 8.18:

“Ja, maar ze hebben alleen niet overal over nagedacht als ze dan beginnen. Ze hebben bijvoorbeeld in november de verwarming beneden in de gang weggehaald en die is pas in januari of februari weer aangesloten. Nu was het al koud en ik had het niet vaak aan staan maar wel een beetje. Dan kun je het gewoon helemaal niet meer bij verwarmen. ...” (Voeselek, 2020a, pp. 7)

“Yes, but they haven’t thought about everything before they started. For example, they removed the central heating system in the hallway in November. It was reconnected to the new electrical heating system in January or February. Before it was already cold in the house and that heating unit was only turned on a little. But we were not able to heat the house anymore. ...”

Quote 2.34:

“Maar ja het ergste was wat ik wel heb gezegd zijn die twee maanden dat we stil hebben gestaan. Het was beter geweest als alles door was gegaan. Half december zouden we klaar zijn en dat was dus niet zo.”

(Voeselek, 2020c, pp. 6)

“The worst thing is, I already told it, the work has been suspended for two months. It would have been better if it was not suspended. We would be ready in mid-December, but that was not the case.”

Quote 6.2:

“Nee, ik had niet verwacht dat het zo erg was. Ze hadden het heel anders voorgespiegeld. Ik had gevraagd: ‘ik heb twee kinderen kan ik niet naar een tijdelijke woning?’ Nee dat kon niet.” (Voeselek, 2020g, pp. 3)

“No, I didn’t expect it to be that bad. They had imagined it very differently. I asked if I could go to a temporary house, because I have two children. That was not possible.”

Six participants experienced the communication and support as positive (quote 3.31), however three of them indicated this also as negative (quote 2.20 and 4.17). By a close analysis of the quotations can be derived the experiences vary over time. The experiences are different before, during and after the process, but also during the various phases of implementation and with different stakeholders, like

the housing association, the executor and construction workers. In general, it is noticeable that tenants would have liked to receive the work planning earlier. Secondly some interviewees did not feel heard and understood about certain problems. Lastly, it is indicated that a lot of help was offered by the construction workers.

Quote 3.31:

"Er was altijd iemand bereid om te praten. We hebben ook informatiedagen gehad van 'thuis, daar kon je met al je vragen en problemen terecht. Dat was fijn. ...'" (Voesenek, 2020d, pp. 5)

"There was always someone willing to talk. We also had information days from 'thuis, where you could ask your questions and discuss your problems. That was nice. ..."

Quote 2.20:

"Maar op een bepaald moment toen vroeg ik me af wanneer ze gingen beginnen. Toen werd het moeilijk. Want toen kreeg ik bericht dat ze bij ons in de rij op een bepaalde dag zouden beginnen. Maar daar stond een datum bij, maar niet waar ze aan gingen beginnen. Daar moest je wel een tijdje op wachten voor we ook die tekening kregen met wat ze wanneer gingen doen. 1 dag gingen ze dan de keuken, andere dag de douche en zo ging dat verder." (Voesenek, 2020c, pp. 3)

"But at some point then I was wondering when they were going to start. Then it got difficult. I received a message that they would start in our row on a certain day. There was a date on it, but not with what they were going to start. You had to wait for a while before we also got the drawing with what they were going to do when. One day they went to the kitchen, another day the shower and so on."

Quote 4.17:

"Ja maar ook hoe er met je omgegaan wordt en hoe er met je klachten omgegaan wordt. Ja absoluut." (Voesenek, 2020e, pp. 4)

"Yes, but also how you are dealt with and how your complaints are handled. Yes absolutely."

Four tenants describe the received fees as too less, they were not able to buy comparable kitchen stuff for the received amount of money. In addition, it is indicated that there were unexpected costs, for example for the replacement of curtains (quote 5.27). A positive consequence of the renovation is an increased social cohesion within the neighborhood. Confirmed by the results about information sharing with peers, mostly family members and neighbors. Neighbors have sought the support of each other.

Quote 5.27:

"... Dat was echt te weinig, want de meeste gordijnen paste niet meer. Dat kon je niet meer hier gebruiken. Je moest allemaal nieuwe gordijnen kopen. Het was allemaal te groot of te klein. ... Maar je kan er niks meer mee, of je moet een goede naaister hebben. ..." (Voesenek, 2020f, pp. 8)

"... That was really too little, because most curtains no longer fit. You couldn't use them anymore. You had to buy new curtains. It was either too big or too small. ... But you can no longer use it, or you must know a good seamstress. ..."

Seven participants are positive about the final result of renovation. The indoor climate and comfort is improved and most tenants expect a decrease of total housing costs. Two participants feel little difference in comfort. Mainly interviewee E2 is critical about the insulation part of the renovation, but very positive about the aesthetic improvement and the ventilation system. Tenant E9 is quite negative about the whole process, project and result. However, the relationship with the housing association has been seriously disrupted by miscommunication about the allocation of a new rental house that is better suited to the health conditions and age of this household. This negative experience strongly influences the motives of this participant (quote 7.12). These results show that expectations based on

information provision are very decisive for how a project is experienced. Ultimately, most tenants are positive about the end result.

Quote 7.12:

"... Ik ben wel zo kwaad op ze dat ik het nu met alles oneens ben. ..." (Voesenek, 2020h, pp. 4)
"I am so angry with them that I now disagree with everything. ..."

Finally, it is indicated by five tenants a need for additional information about the new techniques and use manner of the all-electric house. Only limited information has been provided about how to optimally use the applied techniques.

6.3.6 Focal goal

Table 6.28. Focal goals of tenants of the Purmerend case.

	Biospheric motives	Comfort	Disturbance and inconvenience	Electric cooking / change	Financial consequences	Necessary maintenance	Safety	Off-gas negative	Off-gas positive
E2					X				X
E3		X						X	
E5		X							X
E6						X			X
E7						X			X
E8						X			X
E9		X							X
E10		X							X
Totals	0	4	0	0	1	3	0	1	7

The identified focal goals illustrate that an expected comfort increasement and the consideration of the off-gas transition as necessary maintenance have been determinative in the decision making process of tenants. Four participants value the expected increase of comfort and indoor climate as most important motive to give consent for the renovation. Three of eight interviewees have indicated that they consider the transition as necessary maintenance. The houses were in very poor condition, it was cold, damp and drafty, mold occurred in several houses. This bad condition and indoor climate may be an explanation for the high willingness of tenants to give consent for the off-gas transition.

Participant E2 identified the financial consequences as focal goal. The financial situation of this participant is problematic due to debts. The household has little disposable income, causing the effect on the total housing costs is important.

Remarkably, none of the participants considered their biospheric values as the focal goal. Still, seven out of eight participants consider the off-gas transition is an appropriate method to mitigate climate change and/or to contribute to the reduction of the problems in Groningen. Five participants (E2, E5, E7, E8 and E10) do identify biospheric values as a trigger to give consent, but value other motives as determinative or more important.

6.4 Comparison of case results

The results of both cases show striking differences and similarities. Therefore, in this section the cases are compared with each other and with the previous proposed conceptual model, in order to be able to interpret the results and link them to existing behavioral theories.

6.4.1 Gain motives

Intermaris has not informed their tenants about the financial consequences of the off-gas transition, because how and when this transition will be executed is not yet decided. The results of the Purmerend case regarding gain motives are nearly unanimous, most tenants expect an increase of the total housing costs as a result of the execution of the off-gas transition. These expectations are based on self-retrieved additional information sources (like internet and news fora), own previous experiences, and experiences and opinions of peers. Despite the different backgrounds of the tenants, the processing of information has resulted in very similar expectations. In Eindhoven the tenants are informed about the monthly financial consequences of the all-electric renovation by 'thuis. 'thuis has indicated that, for most households, the rent increase will be compensated by the lower gas and energy bill. The results of the Eindhoven case show that the expectations regarding the consequences for the monthly housing costs of these participants differ person by person. By closer analysis of the results it is learned that the information provision underlies these differences. How people interpret and process the information forms and affects the expectations of tenants. Participants E5, E8 and E10 did expect that the total housing costs would decrease and have experienced the information process as positive. The participants who have indicated the financial consequences for one-time investments and the total housing costs as a barrier also indicated that their financial resources are limited. The information provision failed to convince them that the monthly housing costs would decrease as a result of the all-electric transformation. The influence of information provision on the expectations of tenants regarding the financial consequences is endorsed by the experiences of the participants of the Purmerend case. Regarding the previous energy efficiency renovation of 2018, six participants indicated that in advance they expected a decrease of the total housing costs. This was a trigger for them to give consent for this renovation. The expectations of tenants were mainly based on the information provision of housing association Intermaris. The results of both cases show that the information provision does influence the expectations of tenants regarding the financial consequences. This emphasizes the importance of clear and understandable information, especially regarding financial consequences.

The effect of information provision on tenants' expectations is also confirmed by the results related to time and energy. In both cases the results show that the needed investment of time and energy was hard to estimate upfront. A number of participants has indicated that there was too less information available to assess the needed investment of personal time and energy. Tenants had no expectation of the needed investment of personal time and energy. Therefore it had no influence on the decision process. However, the lack of information and expectations did have an effect on how the process was experienced. Both regarding the off-gas transition in Eindhoven and the energy efficiency renovation in Purmerend, tenants have indicated that they experienced the renovation process as negative, because they did not expect to have to invest time and energy. The importance of managing expectations is also endorsed by research of Hoogenraad (2019). This study shows that the difference between expectation and result influences the satisfaction of tenants.

In both cases the shift from gas-fired to electrical cooking is considered as a barrier by a couple of participants for two reasons: 1. the needed one-time investments for new kitchen stuff and cookware, 2. the reluctance to change and to adapt to electrical cooking (mainly indicated by elderly). Especially financially vulnerable households have indicated one-time investments as a barrier to give consent. They have too limited resources to buy new kitchen stuff, therefore these households are largely dependent on the fees provided by the housing associations. In contradiction, other tenants do consider electrical cooking as a trigger due to their personal persuasion that it is safer. The supporters and opponents of electric cooking have other behavioral motives, which are mainly based on personal experiences and those of peers. Based on the interviews, information provision seems to have little influence on this specific gain motive. The barrier, as experienced by some tenants, could possibly be lowered by the provision of higher fees or free stoves and pans. The financial resources of housing associations are limited, hence compensation measurements are restricted.

6.4.2 Hedonic motives

From the results it can be deduced that hedonic motives are partly specific for a certain off-gas transition strategy and are partly comparable for different strategies. It is striking that there are more negative feelings and emotions associated with the proposed heat network in Purmerend compared to the executed all-electric transition in Eindhoven. Eight of eleven participants of the Purmerend case feel to be imposed to give consent, have negative feelings associated with the monopoly position of the heat company and have more feelings of doubts regarding the proposed off-gas transition. Similar feelings have not been described by the participants from Eindhoven. The choice for a the execution of a heat network in Purmerend has as a results that tenants experience and indicate more barriers and less triggers to give consent for the off-gas transition, in comparison to the tenants of Eindhoven where an all-electric concept is applied. Based on these results it seems like that, the choice for a certain transition strategy does have an influence on the behavioral motives of tenants. Tenants have limited influence on which strategy will be applied. Subsequently they are forced to accept a proposed off-gas transition without considering other strategies. The current research indicates that the advantages and disadvantages associated with the chosen strategy can add or emphasize certain barriers or triggers in the decision-making process of tenants. In the case of Purmerend, the chosen off-gas strategy is mainly associated with additional disadvantages by the tenants. These barriers have to be overcome in order to encourage tenants to give consent. Tenants indicate that they expect to experience few benefits as a result of the off-gas transition.

There are some similarities between the hedonic motives of the participants of both cases. Almost half of all participants consider disturbance and inconvenience during the off-gas transition process as a barrier to give consent. For most of these participants this is related to personal circumstances, like old age or having (young) children. Nuisance during a renovation or transition process cannot be prevented. However, it is important to manage the expectations of residents. Some tenants from Eindhoven indicate that they experienced the process as less stressful due to the offered support. Based on the results and quotations, it seems important to be aware of the personal situation of tenants and, if possible, to provide customized support. By in advance offering support and help for vulnerable households, this barrier can be overcome or lowered. As discussed in section 5.1, the target group of housing associations consists of a variety of vulnerable households. It is important for these households to receive sufficient support throughout the entire transition process, so that barriers related to the personal situation can be lowered and the transition can be carried out. However, housing corporations have limited resources and are restricted in offering social support, which means

that attention to social aspects within a neighborhood and personal circumstances of tenants is often not possible. These results are confirmed by a recent published progress report of PAW by the Ministry of Internal Affairs (Knops, 2020; PAW, 2020c). The importance of personal contact with residents is emphasized. Personal contact and support are necessary in order to gain enough support for the execution of the off-gas transition. Municipalities are concerned that the current approach as applied in the off-gas transition will not be scalable due to capacity issues.

Another hedonic motive that can be of great influence on the decision process is the expected increase of comfort and indoor climate. The expectation that comfort improves is indicated by most participants as an important trigger to give consent for the execution of a renovation. Both the results of the Eindhoven case and the results regarding the energy efficiency renovation in Purmerend confirm this. In both cases, tenants indicate that the improvement of indoor climate and comfort is an important trigger to give consent for the renovation. The participants from Purmerend expect no comfort improvement as a result of the connection to the heating network. As a result that it is not considered as a trigger or barrier to agree to the off-gas transition.

Regarding the Eindhoven case, it was expected in advance that the replacement of kitchen, bathroom and toilet could be a trigger for tenants to give consent for the off-gas renovation. None of the tenants stated this literally. Nevertheless, the interviews show that some of the tenants believed that the interior of the house should also be maintained. It is therefore conceivable that these tenants regard these activities as part of necessary maintenance.

6.4.3 Normative motives

In literature normative motives are described as a long-term and solid basis for pro-environmental behavior and behavioral change. Seventeen out of nineteen participants consider climate change as a problem for our society and future generations. Biospheric values are valued as important by thirteen tenants and ten tenants do feel personally responsible to contribute to the mitigation of climate change. For a major part of the tenants, biospheric values are a trigger to change behavior in favor of the climate and environment. However, information provision, knowledge and personal beliefs influence the extent to which tenants assume that the made behavioral change contributes to the mitigation of climate change.

In the Eindhoven case the majority of the participants does believe that the off-gas transition makes a contribution to the reduction of energy use and subsequently the mitigation of climate change. However, none of the participants from Eindhoven considered biospheric values as focal in their decision process. Some tenants have indicated biospheric values as a trigger, but not as a determinative motivational factor. The strong biospheric values of tenants from Purmerend hinder them to give consent for the off-gas transition as currently proposed. The additional available and provided information, and the fierce social debate about biomass has affected their biospheric values. Eight participating tenants are convinced that biomass is not a climate-friendly source of heat and energy. The strong doubts, fueled by the social debate and information shared by the neighborhood committee, and strong biospheric values are decisive for a majority of the participants to be not willing to give consent for the proposed off-gas transition. Tenants indicate that there are too few advantages and too many disadvantages associated with the heat network. It is striking that the results of the Purmerend case show that biospherical values have a major role in the decision-making process of tenants.

6.4.4 Focal goals

It can be deduced from the results that the focal goals of tenants are associated with the applied off-gas strategy. The advantages and disadvantages of both strategies are so different that other behavioral motives are determinative in the decision-making process of tenants. The identified focal goals of participants in Eindhoven and Purmerend are diverse. The results show that comfort and considering the transition as necessary maintenance are the most occurring focal goals in the Eindhoven. The houses in Eindhoven were of poor quality and had a bad indoor climate, therefore these tenants appreciate the improvement of comfort. Some tenants consider the transition even as necessary maintenance, because this was not carried out for a long time. In Purmerend a comfort improvement is not realized as a result of the off-gas transition. Therefore other behavioral motives are of (more) influence on the decision-making process. In this case financial and biospheric values are the focal goals.

The focal goals of the participants of Eindhoven are triggers to give consent for all-electric renovation. The tenants were willing to give consent for the all-electric renovation because of comfort and maintenance reasons. In addition, they are also motivated to contribute to reduction of climate change. This is confirmed by the result that seven out of eight participants are positive about the off-gas transition. It seems that the willingness to give consent for the all-electric renovation, also results in a positive view of the off-gas transition part of this renovation. Electricity is considered as an environmental friendly energy and heat source. Since the off-gas transition is combined with a package of other measurements, the tenants were willing to give consent for the execution of the transition. The advantages of the total renovation package outweighs the disadvantages.

The results of the Purmerend case show that, barriers dominate the decision-making process. Due to the absence of important triggers, like comfort improvement, the disadvantages of the off-gas transition are over-represented in the decision making process of tenants. The proposed off-gas transition in Purmerend does not consist of a combination of measurements. It only consists the disconnection of the gas network and the connection to the heat network with biomass as main heat source. There are little to no benefits for tenants associated with the off-gas strategy as it is now proposed. There is a lot of resistance to the heat network because of, among other things, the expected higher monthly housing costs and doubts about the sustainability of the heat source. Ten out of the eleven participating tenants are not willing to give consent for the off-gas transition as currently proposed. The disadvantages associated with the heat network influence the opinion of tenants about the off-gas transition in general. Most tenants do not believe in the benefits of the off-gas transition. In Purmerend only three out of eleven participants consider the off-gas transition as positive for the environment and society.

As discussed in section 5.2, the off-gas transition is often combined with other maintenance measurements or energy efficiency improvements. From the results can be deduced that a package of measurements has to offer enough advantages to outweigh the associated disadvantages, in order to motivate tenants to give consent for the off-gas transition. In Eindhoven the total package of the all-electric renovation offers some important triggers. The advantages outweigh the disadvantages, which resulted in a majority of tenants that has given their consent for the all-electric renovation. The off-gas transition strategy of Purmerend is associated with too many disadvantages by the tenants. Ten of the eleven participants are not willing to give consent for the off-gas transition as currently proposed. These results confirm that the total package of measurements has a major influence on

tenants' willingness to give consent for the off-gas transition. By offering sufficient improvements and triggers to tenants, they are willing to overcome the disadvantages that are associated with the off-gas transition.

6.4.5 Information process

The information process and how information is processed by tenants does influence the behavior and behavioral motives of tenants, as proposed in the conceptual model (section 3.1). How and which information is process is influenced by the applied antecedent intervention strategy, personal information needs, access to (additional) information and information and behavior of peers.

At first, peoples' focus for certain information is determined, among other things, by people's experiences, beliefs and behavioral motives. This is confirmed by the fact that tenants with limited financial resources have indicated during the interviews that financial consequences are an important behavioral motive for them. A few participants indicated that they have specifically sought additional information about the financial consequences, in order to verify the information provided by the housing association. The personal characteristics and living context of tenants is of influence on their personal information needs and information focus.

Secondly, the antecedent intervention strategy, in the studied cases information provision, is of influence on how information is processed. The results show that information meetings are experienced as negative and tenants indicate that they have received few information during these meetings. The vibe and mood seem to be determinative how these information evenings are experienced. Other forms of information, like books and model houses, are valued as more informative. Though, the results show that it is important to dose information, in order to not overwhelm tenants with information. All tenants have received the same information, so not everything is relevant for every resident. Some tenants report that they have received too much information. Tenants also indicate that it is important for them to be able to ask questions and to address their concerns.

Additionally it is studied if the origin of information does influence the assessment and processing of information. During the study it appeared that participants find it difficult to describe the influence. Their relations with the housing association and whether they trust the housing association are mainly based on previous experiences and contact moments. Most participants were unable to indicate to what extent this affected the processing of the provided information. However, from the results of the Purmerend case it can be concluded that tenants do not have a very positive image of the municipality and municipal heat supplier. The results of the current study show that the origin does have an influence but it is unclear to what extent it influences the effectiveness of information provision. Further research is needed to study to what extent the origin does affect the effectiveness of the intervention strategy.

Fourthly, the results show that the information process is experienced as negative if people have a high need for additional information. This is mainly illustrated by the results of the Purmerend case. 10 tenants have a need for additional information. The information provided by the municipality and housing association is not sufficient to meet the information needs of the tenants. A couple of tenants even indicates that additional information is poorly accessible. The negative feelings regarding the information process fuels the feelings of tenants to be imposed to give consent for the off-gas

transition as currently proposed. Besides this, six participants indicate that they are confused by the social debate about biomass and the off-gas transition. The housing association is not able to influence this social debate, but they can provide additional information if there is a need for it. The housing associations have to adopt their information and communication strategy to the social debate and the information needs of tenants. It is learned from the results of the Purmerend case that, the debate causes more barriers and reluctance against the off-gas transition through the connection to the heat network of Purmerend. In Eindhoven tenants are provided with information by the housing association. The need for additional information is therefore lower. These results confirm the importance of making sufficient additional information available. The tenants also indicate that the option to ask questions contributed to their positive experience of the (information) process. It is impossible to provide all information about a transition process, but it is important to give tenants the opportunity to request or look up additional information if they have a need for additional information. Both groups of participants have sought additional information. Mainly internet, peers and neighborhood committee members are used as additional information sources. Housing association can not influence where tenants search for additional information. However, housing associations can gain insight into the information needs of tenants through for example the neighborhood committee. Housing associations have to adopt their information strategy in order to better meet the information preferences and needs for additional information of tenants.

The above discussed results regarding the information process show that information processing is influenced by personal information needs, access to (additional) information and information and behavior of peers. In both cases all tenants are provided with the same information, however the results show that they process information differently and have different information needs. In order to better meet the information needs of tenants tailored information could be applied. This tailored information can be adjusted to the personal context of tenants, the applied off-gas transition strategy and the work to be carried out in the house. At first, the personal context of tenants is partly known by housing associations. They have insight into information like age, household composition and financial situation. This information can be used in order to adjust the provided information package to the information needs and concerns of tenants. In addition, in practice regular surveys are conducted among tenants to explore and identify their needs, concerns and wishes. These surveys are mainly held at the start of a renovation or transition project. The conducted information can be used to adopt the antecedent intervention strategy to the information needs of tenants. Secondly, in the Eindhoven case not all measurements were executed in each property, because of the choice options (kitchen, bathroom and toilet) and differences between the houses. All tenants have received the information regarding the replacement of kitchen, bathroom and toilet, although this does not apply to all of them. Making a selection of the relevant information per household can help to limit the amount of information.

6.5 Reflection upon the conceptual model

In section 3.1 a conceptual model is proposed which is based on the literature review. In this section, the results are reflected upon this model.

The results regarding the behavioral motives of both cases are quite different, however both case studies confirm the same underlying pro-environmental behavioral theories. As elaborated in the literature review, behavioral motives of tenants do affect how information is processed. The results confirm this relation. The living circumstances of some tenants could cause a strong focus for certain behavioral motives, for example tenants with limited financial resources indicated that gain motives are an important factor in their decision making process. This subsequently results in a focus for information regarding the financial consequences of the off-gas transition and determines how this information is processed.

Secondly, it can be deduced from the results that the process of information processing can influence behavioral motives. The results of the Purmerend case show that biospheric values are indicated as a barrier to give consent for the off-gas transition as currently proposed. From the results it also appears that most tenants have sought additional information about the sustainability of biomass as a heat source. The need for and the additional information itself have led to a new perspective on the information provided by the municipality. The processing of the (additional) information have had as result that the biospheric values of these tenants have started to increasingly influence the decision-making process of tenants. The additional information has strengthened the objections against the proposed off-gas transition. These objections are based on strong biospheric values.

In the conceptual model it is proposed that the antecedent intervention strategy does directly influence behavioral motives. However, from the results it appears that the information processing process influences the behavioral motives of tenants. How and which information is processed, is affected by the personal behavioral motives, the antecedent intervention strategy, personal information needs, access to (additional) information and by the information and behavior of peers. Therefore, some adoptions are made to the proposed conceptual model. A new framework that represents the relation between behavioral motives, antecedent intervention strategies, information processing and actual behavior is presented in fig. 6.2. The orange and green arrows represent these relations. The grey arrows represent the relations that were proposed in the conceptual model of section 3.1, but that are deleted as a result of the current research.

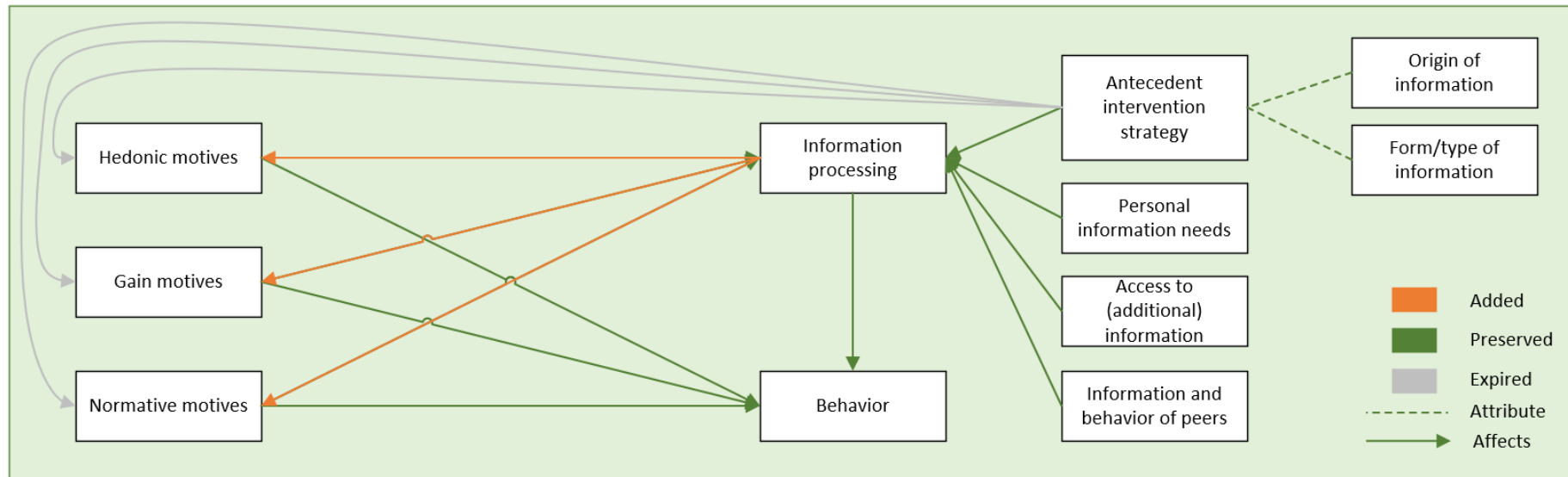


Fig. 6.2 Framework that represents the relation (in orange and green) between behavioral motives, antecedent intervention strategies, information processing and actual behavior regarding the off-gas transition. Grey relations are expired based on the results of the conducted research.

6.6 Conclusion

The results of the case study research show that the behavioral motives of tenants to give consent for the off-gas transition can be divided into three main categories: gain, hedonic and normative motives.

The gain motives of tenants are mainly focused on the financial consequences of the off-gas transition. The most occurring identified hedonic motives of tenants are comfort, disturbance and inconvenience, electrical cooking and considering the transition as necessary maintenance. An expected increase of comfort is identified as an important trigger to give consent. Additionally, the results show that hedonic motives are partly specific for a certain off-gas transition strategy. More negative feelings and emotions are associated with the proposed heat network in Purmerend compared to the executed all-electric transition in Eindhoven. These specific hedonic motives regarding the heat network are for example related to doubts about the sustainability of the heat source, the monopoly position of the heat supplier (SVP), feelings of being imposed to give consent and restricted freedom of choice. The last category of behavioral motives are normative motives. In literature normative motives are described as a long-term and solid basis for pro-environmental behavior and behavioral change. The majority of participants indicated to value biospheric values and have feelings of personal responsibility to contribute to the mitigation of climate change. Additionally, Seventeen out of nineteen participants consider climate change as a problem for our society and future generations. These results show that there is a solid-base among tenants to change their behavior in favor of the climate and environment.

One of the behavioral motives is determinative in the decision process, the focal goal. The advantages and disadvantages of both strategies are so different that other behavioral motives are determinative in the decision-making process of tenants. Comfort and considering the transition as necessary maintenance are the most occurring focal goals in the Eindhoven. In Purmerend the consequences for monthly housings costs and biospheric values are found to be the main focal goals. All participants of the Eindhoven case did give consent for the execution of the off-gas transition. In Purmerend only one out of eleven participants is willing to give consent for the imminent off-gas transition through the connection to the heat network with biomass as main heat source. From these results it can be deduced that the total package of measurements of the off-gas strategy has to offer enough advantages to outweigh the associated disadvantages, in order to motivate tenants to give consent for the off-gas transition.

Secondly, the effect of information provision, as an antecedent intervention strategy, on the behavior of tenants is studied. The information process and subsequently how information is processed by tenants influence the behavior and behavioral motives of tenants. How and which information is processed is influenced by the applied antecedent intervention strategy, personal information needs, access to (additional) information and information and behavior of peers. Additionally the information processing process is influenced by tenants' own focus for certain information, as a result of their behavioral motives.

Thirdly, the results show some points of interest regarding the antecedent intervention strategy, in the studied cases mainly information provision. The information needs of each person are unique. Some tenants have a need for a lot of information, others are overwhelmed and need more support. In both cases all tenants are provided with the same information, however the results show that it will be better to apply tailored information that meets the information needs of tenants. Additionally, it is

shown than the information process is experienced as negative if tenants have a high need for additional information or are not able to ask questions or discuss concerns. Both groups of participants have sought additional information. Mainly internet, peers and neighborhood committee members are used as additional information sources. These sources are difficult to influence and control by housing associations, though the housing association can facilitate the availability and accessibility of additional information and offer support. It is learned from the Purmerend case that the social debate could cause more reluctance against the transition. The fierce social debate about the sustainability of biomass, affects the information processing process and subsequently the biospheric motives of tenants. The housing association is not able to influence this social debate, but they can provide additional information and offer tenants to express their concerns and ask questions.

Based on the results and quotations, it turns out to be important to be aware of the personal situation of tenants and, if possible, to provide customized support. Housing associations have to pay attention to each tenant with personal different behavioral motives and (information) needs. Personal contact and support are necessary in order to gain enough support for the execution of the off-gas transition.

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7. Conclusion, discussion and recommendations

In the first section of this chapter, the results and conclusions of this research will be summarized and the main research question will be answered. In the second part, the applied methodologies and research limitations will be discussed. Lastly, recommendations for housing associations and further research are provided.

7.1 Conclusion

The earthquake problems in Groningen and the concerns about climate change amplify the importance of the heat and energy transition of the built environment. The off-gas transition is considered as an important part of the heat and energy transition. This transition offers the opportunity to decrease the CO₂ emission, to reduce the total energy consumption, to decrease the usage of natural gas, and introduce sustainable alternatives on a large scale in the Netherlands. Housing associations are designated as the starting engine of the heat and energy transition, in order to create volume and gain knowledge and experience. The subsidy program Proeftuinen, part of PAW, is introduced as a kick-start for the neighborhood oriented approach of this transition. 27 neighborhoods have received this subsidy in 2018. A crucial aspect of the execution of the energy and heat transition for housing associations is the participation of residents. Therefore, it is important for housing associations to create a sufficient support base for the energy transition among tenants. However, limited research is conducted to identify the motives and consideration of tenants regarding their willingness to give consent for the execution of the heat and energy transition. Most existing literature focuses on the motives of homeowners regarding energy efficiency renovations. A limited number of studies has been conducted into the motives of tenants related to energy efficiency renovations. However, the imminent heat and energy transition is more complex and requires more drastic measurements. Therefore, the aim of this research is to study the motives of tenants regarding the off-gas transition. Additionally, housing associations are required by law to receive consent of 70% of the tenants for the execution of renovation measurements. It will be useful for housing associations to know how information provision can influence the behavioral motives of tenants and can motivate them to give consent. Hence, is studied how the behavioral motives of tenants could be influenced by information provision. The main research question of this thesis is:

What motives affect tenants' decision to accept a natural gas-free renovation of their home and how can these motives be influenced by information provision?

In order to answer the main questions, several sub-questions are formulated. The research started by conducting an extensive literature review in order to answer the first two sub questions. First aim of the literature review is to gain insight into behavioral models that can explain tenants' motives to accept the off-gas transition. The decision to give consent for the execution of the off-gas transition is considered as environmental behavior. Environmental behavior models are studied in order to be able to understand and explain the decision process of tenants. Secondly, behavioral motives regarding energy efficiency renovations are studied, in order to gain insight in which behavioral motives may affect the decision process of tenants. Additionally, it is studied how these behavioral motives could be influenced by information provision. After the literature review a case study research is combined with the conduction of semi-structured interviews with tenants to be able to answer the fourth and fifth sub question. The case study is conducted in order to be able to identify the motives of tenants to give consent for the off-gas transitions and to explore how these motives could be influenced by information provision. Two of the 27 PAW neighborhoods are selected as a case for this study. In both

neighborhoods a different off-gas transition strategy is applied, so that the results could be compared and differences could be explored.

According to the goal-framing theory can be distinguished gain, hedonic and normative motives to behave in a certain manner (Lindenberg & Steg, 2007). The goal-framing theory is used as a basis to study and explain the behavioral motives of tenants regarding the off-gas transition. In literature a number of motives per goal are recognized. Firstly, gain motives are focused on the consequences of behavior for scarce personal resources. Literature suggests that examples of gain motives are consequences for monetary resources, time frame, behavior of peers and personal image. In several studies is suggested that financial motives are often determinative in the decision-making process regarding pro-environmental behavior. Secondly, hedonic motives are focused on feelings, easiness and enjoyability of behavior. In literature it is stated that strong hedonic motives will result less likely in pro-environmental behavior. Examples of hedonic motives identified in literature are comfort, personal sacrifices and disturbance and inconvenience. The third and last goal are normative motives, these motives are based on the long-term consequences of behavior for society and environment. Biospheric values, social norms, altruistic values and feelings of personal responsibility are identified in literature as normative behavioral motives. Concerning pro-environmental behavior, hedonic and gain motives are quite often not compatible with normative motives, there often occurs a conflict between different goals. In the goal-framing theory is assumed that one of the three goals will be determinative and decisive in the decision making process to behave in a certain manner.

Tenants have to change their behavior as a results of the off-gas transition. In the literature review several intervention strategies to change environmental behavior are studied. Antecedent intervention strategies, like information provision, can be applied to influence determinants of behavior, like personal behavioral motives and problem awareness. Each person has its own concerns, needs and information preferences. Knowledge, access to (additional) information, origin and form of information do have an effect on behavioral motives and therefore actual behavior. However, this effect is difficult to measure.

As a result of the literature review a conceptual model that represent the relation between behavioral motives, antecedent intervention strategies, information processing and actual behavior is proposed. This model serves as a base for the case study research. The case study research is combined with semi-structured interviews. Two cases are selected, neighborhoods Overwhere-Zuid in Purmerend and 't Ven in Eindhoven. In total 19 tenants participated in this study. Semi-structured interviews are conducted to gather a deeper understanding and explore the behavioral motives of tenants regarding the off-gas transition. The results of the case study confirm that the behavioral motives of tenants can be divided into hedonic, gain and normative motives. From the results can be deduced that the main gain motive of tenants is related to the financial consequences of the off-gas transition. The most occurring hedonic motives are comfort, disturbance and inconvenience, electrical cooking and considering the transition as necessary maintenance. The results show that tenants have quite strong normative motives. A majority of participants indicated to (highly) value biospheric values and have feelings of personal responsibility to contribute to the mitigation of climate change. However, only a small group of participants indicated that biospheric values are determinative in their decision process. Additionally, it is demonstrated that behavioral motives, especially hedonic motives, are partly specific for the applied renovation strategy. In the studied cases more negative feelings are associated with the proposed heat network in Purmerend compared to the all-electric transition in

Eindhoven. The advantages and disadvantages of both strategies are so different that other behavioral motives do influence and are determinative in the decision-making process of tenants. From these results can be deduced that the package of measurements regarding the off-gas transition, has to offer enough advantages to outweigh the associated disadvantages, in order to motivate tenants to give consent for the off-gas transition. However, the housing association has only limited influence on the package of measures that they can combine with the off-gas transition. As explained in subsection 1.2.1 and section 5.2, municipalities determine which off-gas transition will be implemented in which neighborhood and when. Therefore housing associations are dependent of the planning and decision making of the municipality for the execution of the off-gas transition within their housing stock. It is a challenge for housing associations to align the execution off-gas transition with other maintenance measurements in order to be able to propose a package of measures with sufficient benefits and limited disadvantages that triggers the tenants to give consent. Additionally, it is a challenge for housing associations to financially plan, align and distribute their resources between different projects and the off-gas transition.

Lastly, in the case study it is studied how the behavioral motives of tenants could be influenced by information provision. From the results can be derived that the information processing process does influence the actual behavior and behavioral motives of tenants. How and which information is processed is influenced by the applied antecedent intervention strategy (its form and its origin), personal information needs, access to (additional) information, and information and behavior of peers. Additionally, the results demonstrate that the processing of information is influenced by tenants' own information focus. This focus for certain information is a result of the personal behavioral motives. It also appears from the results that almost all participants have sought for additional information. Additional information sources are mainly internet and peers. Housing associations can facilitate the availability and accessibility of additional information and can adopt their information strategy to the additional information needs of tenants. Based on the results, it turns out the be important to be aware of the personal situation of tenants and their own information needs. Each person is unique. The information processing process, information needs and behavioral motives are personal. Personal contact and (customized) support are necessary in order to gain enough support for the execution of the off-gas transition.

7.2 Discussion and limitations

In this research the case study method combined with the conduction of semi-structured interviews is applied. Case study research is often applied to study a complex contemporary situation in-dept. Disadvantage of case study research is that the results and conclusions cannot be generalizable to other situations. In this study two cases are examined. Both with a different off-gas transition strategy, in order to be able to explore the differences and similarities between both cases. The results demonstrate that the behavioral motives in both cases differ as a consequence of the applied strategy. In order to validate and provide generalizable insights, these research could have been extended with two additional comparable cases. However, more comparable cases do not exists (at this moments) by the knowledge of the researcher.

Practice is required to properly conduct interviews. For the reliability of the results it is important that the researcher remains independent during the interviews. Asking open questions without implying answers requires special attention. An interview protocol has been drawn up that serves as a guideline and reminder during the interview. In addition, the interviews were scheduled spread over three

weeks, so that the researcher had time to reflect on the interview method and could make adjustments. It is preferred to visit participants at home, however the interviews were conducted by telephone or videocall due to the covid-19 crisis. Within the given circumstances this limitation cannot be overcome.

The coding process is conducted by one researcher, due to the fact that the graduation research has to be individually completed. Normally, it is preferred to conduct the coding process with a couple of researchers, in order to be able to review the coding process of each other and discuss irregularities. This would have enhanced the objectivity of the results. In order to compensate for the absence of other researcher to support the coding process, code reports are created which were discussed with the research supervisors.

The results and conclusions of this study are limited in their validity, due to the small sample size. On the other hand, the aim of this qualitative research is to explore and create a deeper understanding of the behavioral motives of tenants and how these could be influenced. The intention of the study is not to provide representative quantitative results that are generalizable for all off-gas transition projects in social housing. Additionally, the sample size and qualitative research approach enabled to gather rich data about the behavioral motives of tenants. The current available knowledge is limited, therefore the study offers valuable insights and knowledge for researchers, policy makers and housing associations.

Another important limitation of this study is that one third of the participants in the Purmerend case are members of the neighborhood committee. It is conceivable that this affected the representation of the results. The members of the neighborhood committee share their opinions and searched additional information, as a result they will influence each other's behavior. In Eindhoven the participating tenants are selected by the housing association and contractor. This could have affected the representation of the population of tenants in the neighborhood. However, all participants were willing to share their thoughts and concerns. They were able to speak freely, without consultation of household members, neighbors or others. For the reliability of the results, it is important that tenants have honestly shared their views and experiences with the researcher.

7.3 Recommendations

This explorative research into the motives of tenants regarding the off-gas transition offers valuable insights and knowledge than can be used as input for further research. From the results can be deduced that hedonic motives are partly specific for a certain off-gas transition strategy and are partly comparable for different strategies. So, it would be interesting to learn more about behavioral motives that are specific related to a certain off-gas strategy. The advantages and disadvantages of off-gas strategies seem to cause or stress specific behavioral motives. Further examining of the differences between behavioral motives of tenants and the application of strategies can offer new insight into the optimal planning and execution of the off-gas transition.

Secondly, it will be interesting to quantitatively study the behavioral motives of tenants. It would be interesting to gain better insight in the occurrence of behavioral motives and to identify main focal goals that are present among tenants. The target group of housing associations had become increasingly challenging due to governmental policies. The group of tenants consists for an increasingly part of people from the lowest income classes, residence status holders, urgency

placements and elderly. Currently there is no insight in the implications, but based on the results of this study it is expected that this will affect the willingness of tenants to give consent for the execution of the off-gas transition.

Additionally, this research offers valuable insights and knowledge for housing associations and municipalities. At first, the results have shown that it is important to propose a package of measurements that offers enough triggers to give consent for the execution of the off-gas transition. Examples of important behavioral triggers for tenants are comfort improvement and decreasing monthly housing costs. Secondly, it is learned that the expectations of tenants determine how the result and process is experienced. These expectations are mainly based on information provision and previous experiences. The expectations have to be managed and controlled so that they are aligned with the process and final result. Special attention needs to be paid to the needed investment of time and energy by tenants. By controlling the expectations upfront, the satisfaction afterwards will be higher. Thirdly, the information needs of each person are unique. In both cases all tenants are provided with the same information, however the results show that it will be better to apply tailored information that meet the information needs of tenants. Based on personal behavioral motives, each tenants has a focus for certain information. Tailored information has to be adopted to this focus. Fourthly, the information provision strategy has to be adopted to the social debate regarding the proposed off-gas transition. Provision of enough information about the strategy and its advantages and disadvantages can help to offer tenants enough insight and knowledge about the consequences of the off-gas transition. Additionally, it is important to offer tenants the ability to express and discuss their concerns, this contributes to the feeling of tenants to be heard and taken seriously. It is important not to impose tenants, this will decrease their willingness to give consent and results in negative feelings regarding the housing association. Lastly, it turns out to be important to be aware of the personal situation of tenants and, if possible, to provide customized support. Personal contact and support are necessary in order to gain enough support for the execution of the off-gas transition.

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Appendix 1

Overview of the Climate Agreement

The Climate Agreement is the 28th of June 2019 presented by the cabinet. More than 600 appointments are part of this national climate agreement to reduce the national emission of GHG. In the Climate Agreement are five themes distinguished. Each theme contains agreements related to a specific sector or field of interest. In table 1 is an overview given of the themes, the proposed CO₂ reduction and main issues per theme. Several themes are related or have corresponding problems and challenges. Coordination and agreement between the themes is necessary to make sure that the total transition towards a more sustainable society with low emissions of GHG's is realized by 2050 (Ministerie van Economische Zaken en Klimaat, 2019).

Table A1.1 Overview of the theme's, proposed CO₂ reduction and main issues of the Climate Agreement (Ministerie van Economische Zaken en Klimaat, 2019).

Theme	CO ₂ reduction	Main issues
Electricity	20,2 Mton	<ul style="list-style-type: none"> - 70% of total energy consumption from renewable energy sources - Wind turbines in sea, at land and PV-panels at roofs and in solar parks - Increasing demand for electricity - Reliable electricity network
Industry	14,3 Mton	<ul style="list-style-type: none"> - Circular industry in 2050 with almost no emission of GHG - Use of renewable energy sources (sun, wind, geothermic, hydrogen or biogas) - Residual heat will be used by industry or other sectors - Industry as a user, producent and buffer of energy
Mobility	7,3 Mton	<ul style="list-style-type: none"> - No emission of GHG by 2050 - High quality transport and mobility by 2050 for people and goods - Focus on electrical driving
Agriculture and Land use	3,5 Mton	<ul style="list-style-type: none"> - Climate neutral agriculture and land use by 2050 - Sustainable food production and consumption
Built Environment	3,4 Mton	<ul style="list-style-type: none"> - By 2050 are 7 million houses and 1 million buildings off-gas - Applying insulation, alternative heating systems and use of electricity of renewable sources - By 2030 are the first 1,5 million houses renovated - In an approach neighborhood by neighborhood at an increasing pace

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Appendix 2

Summary of five green consumer profiles

Dutiful (plichtsgetrouwen): This group is committed to traditional norms and values, and the family. They want to leave the world well for future generations. They are often socially involved and locally oriented. Show a lot of sustainable behavior based on the principles of economy and cleanliness. Consume less than average and do not like waste or superfluous luxury. This group is open to information, guidelines and knowledge about sustainability. This information must be provided to them, preferably by a government agency or institute. This group wants a clear explanation of the measurements, illustrated by examples. The lack of knowledge hinders them from making (even) more sustainable choices. This group is open to sustainability, step by step. The costs are always important here.

Structure seekers (structuur zoekers): Almost a third of the Dutch people belongs to this group. This group likes an easy and regular life. They are little concerned with sustainability and do not believe that personal behavior will make the difference. Often this group has limited knowledge about climate friendly alternatives and life style. By increasing attention to pro-environmental behavior, this group is now also beginning to see that personal choices can also make a positive contribution to combating climate change. Most choices that this group makes are based on quality, comfort and costs. They are not willing to pay for a more sustainable alternative. Only if a climate friendly measurement results in a cost reduction, this group is willing to apply it. This group is characterized by the following behavior. If neighbors or known exhibit certain pro-environmental behavior or take measures, this group will be more inclined to do the same. This group is focused on personal benefits. Unburdening and emphasizing guarantees, securities and the participation of others will help to increase the willingness to participate. This group believes that business and government are primarily responsible for climate change mitigation.

Status conscious (statusbewusten): Individualistic and often socially involved as entrepreneurship. Status and career oriented, looking for personal success and luxury. Interest in technological gadgets. Therefore is this group more willing to use electrical vehicles, like Tesla. This group wants to be well informed and is critical about the proposed measurements. Would like to have an equal conversation. Personal benefits such as comfort, convenience, innovative technology, win-win situation and smart investment make measures attractive to this group. The importance of sustainability or pro-environmental behavior plays a minimal role for status conscious people.

Responsible ones (verantwoordelijken): Are happy to contribute and are socially involved. People in this group strive for a conscious and sustainable lifestyle. They look for a balance between sustainability, comfort and enjoyment. They believe that citizens can and must make an important contribution. This group is well aware of sustainability policy and goals and is concerned about climate change. This group is already well informed but can be triggered by providing factual information and point out more possibilities. Appreciation for pro-environmental behavior that this group has already shown is important to keep them motivated. This group sees sustainable developments as a structural and necessary course of events. They are willing to pay more for sustainable energy.

Developers (ontplooiers): Personal freedom, pleasure and making independent choices is important for this group. They do not like to follow the masses. People are willing to make more sustainable choices as long as this does not hinder their own pleasure and freedom. Factors such as money, effort and time are decisive when deciding to make investments. Doing something new together is more important than the future.

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Appendix 3

Overview of expert interviews

Table A4.1 Overview first round of expert interviews.

Name	Organization	Position	Date
Joop Quist	Ministry of Internal Affairs	Project Manager PAW	25-11-2019
Dorris Derksen	Aedes	Representative department Public Good	29-11-2019
Lars Bouwman	Atriensis Projecten	Project advisor communication	3-12-2019
Arjan van Helvoort	Atriensis Projecten	Team manager projects	4-12-2019
Bastiaan van Perlo	Woonbond	Representative energy team	5-12-2019
Theo van Hoek	Buurkracht	Neighborhoods and project manager	28-11-2019
Lieke van Duist	Motivaction	Researcher Sustainability	19-12-2019

Table A4.2 Overview of attended congresses.

Congress	Location	Date
National Heat Congress	Eindhoven, Evoluon	28-11-2019
PAW Congress	Nieuwegein, NBC congress centrum	23-01-2020

Table A4.3 Overview second round of expert interviews.

Name	Organization	Position	Date
Eindhoven – 't Ven			
Anke Struijs	Wooninc.	Corporate advisor	6-01-2020
Rachida Achoud	Interm at 'thuis Works for FiksMW	Communication specialist	20-01-2020
Purmerend – Overwhere-Zuid			
Walter van Lübeck	Intermaris	Team manager Projects Director living	17-01-2020
Sonja Kamp			
Richard de Boer	Municipality Purmerend	Project Manager	19-12-2019
Zoetermeer – Palenstein			
Eelco Vink	Stedin	Area director Energy transition region Zuid-Holland	8-01-2020
Ronald Meijer	De Goede Woning	Policy advisor	14-01-2020
Alexander Paling	Vestia	Project Manager Development	14-01-2020
Nijmegen – Dukenburg			
Kim Kerckhoffs	Talis	Policy advisor	9-01-2020
Dico van Verseveld	Woonwaarts	Program manager sustainability	14-01-2020

A summary of the interviews can be provided on request by the researcher.

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Appendix 4

Overview of documentation

Overwhere-Zuid – Purmerend

- Complete subsidy documentation, as submitted by the municipality of Purmerend (Rijksoverheid, n.d.-a)
- Website Intermaris
- Article about tenant's experience (Intermaris, 2019)
- Information letter for tenants of 24th of October 2019
- Minutes of meeting neighborhood committee and Intermaris of 3rd of October 2019
- Overview of work performed during energy efficient renovation in 2018
- Website municipality of Purmerend about off-gas transition
- Website heat network Purmerend

't Ven – Eindhoven

- Complete subsidy documentation, as submitted by the municipality of Eindhoven (Rijksoverheid, n.d.-a)
- Implementation plan off-gas neighborhood 't Ven (Gemeente Eindhoven, 2018)
- Information book renovation work ('thuis, 2019b)
- Information book energy conscious living ('thuis, 2019a)
- Information book energy efficient house ('thuis, 2020)
- Information video off-gas transition (VB Groep, 2019)

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Appendix 5

Interview protocol Dutch

Hoofdvraag 1

Wat waren uw eerste gedachten over de aangekondigde veranderingen ten aanzien van aardgasvrij? Welke voor- en nadelen zag u?

Afhankelijk van het antwoord wordt een van de onderstaande subvragen als vervolg vraag gesteld.

Normatieve motieven

1. In welke mate hecht u waarde aan de natuur en het milieu?
(biospheric values)
 - a. Wat denkt of vindt u over klimaat verandering en beleid om deze verandering te vertragen/te stoppen?
 - b. In hoeverre vindt u klimaat verandering een belangrijk probleem voor onze maatschappij?
(problem awareness)
 - c. In hoeverre heeft u het gevoel dat u persoonlijk kan bijdragen aan het verminderen van klimaat verandering? En op welke manier? In hoeverre voelt u zich persoonlijk verantwoordelijk om bij te dragen?
(feelings of personal responsibility)
 - d. In welke mate bent u zich er van bewust dat uw gedrag en uw keuzes een effect hebben op het klimaat?
2. In welke mate hecht u waarde aan uw betrokkenheid bij uw omgeving (maatschappelijk)?
(altruistic values and social norms)
 - a. In welke mate bent u zichzelf sociaal maatschappelijk betrokken en actief?

Hedonische motieven

1. Welke gevoelens waren belangrijk tijdens het maken van een keuze om wel/niet in te stemmen?
(feelings, emotions and mood)
2. Wat vindt u in en om uw woning belangrijk?
(comfort, indoor climate, etc.)
3. In hoeverre verwachtte u voor- of nadelen ten aanzien van overlast, onrust en comfort?
(convenience and hassle)

Gain motieven

1. In welke mate spelen financiële overwegingen een rol in uw besluitvorming?
(financial resources)
2. In welke mate verwachtte u dat u tijd of moeite in de transitie moest stoppen? Vormde dit een belemmering voor u?
(other resources like time and effort)
3. In welke mate is de deelname van anderen (buren, familie, vrienden) belangrijk voor u?
(adoption by peers)

Conflicten en focal goal

1. Hoe bent u omgegaan met de verschillende voor- en nadelen van de transitie? Stond u voor een lastige keuze (dilemma)?
(conflict tussen motieven)
2. Welke redenen wogen het zwaarste voor u?
(focal goal, leidend motief)

Uiteindelijk gedrag

1. Heef u uiteindelijk ingestemd met de transitie? Denkt u te gaan instemmen met de transitie?

Hoofdvraag 2:

Hoe bent u geïnformeerd over de aanstaande transitie? Hoe heeft u dit ervaren?

Informatie voorziening

1. Van wie heeft u de betreffende informatie ontvangen? Wat is uw relatie met deze afzender?
(afzender van informatie (origin) en vertrouwen)
2. Heeft u vertrouwen in de expertise van de afzender?
(vertrouwen van bron)

Informatie verwerking

1. In hoeverre vindt u dat u voldoende of goed bent geïnformeerd over de transitie en de voor- en nadelen hiervan? Waarom?
(information needs)
 - a. Heeft u informatie gemist of had u behoefte aan meer of andere soort informatie?
2. Waar en waarom heeft u gezocht naar aanvullende informatie?
(access to additional information like: internet, social media, experts)
 - a. In hoeverre heeft u het gevoel dat u toegang had tot voldoende en bruikbare aanvullende informatie?
3. Heeft u gesproken met anderen over de transitie en uw keuze? Waarom met deze personen?
(information by peers, neighbors, family, friends, non-experts)
4. In hoeverre heeft u het gevoel dat de informatie voorziening uw oorspronkelijke gedachten over de transitie heeft veranderd?

Main question 1

What were your initial thoughts on the proposed off-gas transition? What advantages and disadvantages did you see?

Depending on the answer, one of the main questions below will be asked as a follow-up question.

Normative motives

1. To what extent do you value nature and the environment?
(biospheric values)
 - a. What do you think about climate change and policies to mitigate or even stop it?
 - b. To what extent do you consider climate change an important problem for our society?
(problem awareness)
 - c. To what extent do you feel personally responsible to contribute to the mitigation of climate change? And in what way?
(feelings of personal responsibility)
 - d. To what extent are you aware of the effect of your behavior and your choices on the climate and environment?
2. To what extent do you value your involvement in your social environment?
(altruistic values and social norms)
 - a. To what extent are you socially involved and active?

Hedonic motives

1. What feelings were important when making a decision to agree / disagree?
(feelings, emotions and mood)
2. What do you value in and around your home?
(comfort, indoor climate, etc.)
3. To what extent did you expect advantages or disadvantages with regard to nuisance, disturbance and comfort?
(convenience and hassle)

Gain motives

1. To what extent influence financial considerations your decision-making?
(financial resources)
2. To what extent did you expect to put time or effort into the transition? Was this an obstacle for you?
(other resources like time and effort)
3. To what extent is the participation of others (neighbors, family, friends) important to you
(adoption by peers)

Conflict and focal goal

1. How did you deal with the various advantages and disadvantages of the transition? Did you face a difficult choice (dilemma)?
(conflict tussen motieven)
2. What reasons weighed the most for you?
(focal goal)

Actual behavior

1. Did you finally agree to the off-gas transition? Do you intend to agree to the transition?

Main question 2

How were you informed about the upcoming transition? How did you experience this?

Information provision

1. From whom did you receive the relevant information? What is your relationship with this sender?
(origin of information)
2. Do you have confidence in the expertise of the information provider?
(trust in source)

Information processing

1. To what extent do you think you have been sufficiently or well informed about the transition and the advantages and disadvantages thereof? Why?
(information needs)
 - a. Have you missed information or did you need more or other information?
2. Where and why did you search for additional information?
(access to additional information like: internet, social media, experts)
 - a. To what extent do you feel that you had access to sufficient and useful additional information?
3. Have you discussed with others the off-gas transition and your choice? Why with these people?
(information by peers, neighbors, family, friends, non-experts)
4. To what extent do you feel that the information provision has changed your original thoughts about the transition?

Appendix 6

Letters for recruiting participants

Geachte heer/mevrouw,

U woont in de wijk Overwhere-Zuid te Purmerend en huurt uw woning van Intermaris. Uw wijk is één van de 27 Proeftuin wijken in Nederland. Dit betekent dat onderzocht wordt om de woningen in uw wijk van het gas af te halen. Een interessante ontwikkeling die uniek is in Nederland.

Onderzoek naar uw mening over het aardgasvrij maken van huurwoningen

Onder toezicht van de Technische Universiteit Eindhoven en met toestemming van en in overleg met Intermaris voert Neeltje Voesenek dit onderzoek uit. Het onderzoek is onderdeel van haar afstudeeronderzoek.

Mijn naam is Neeltje Voesenek

Op dit moment rond ik mijn studie af met een afstudeeronderzoek. In dit onderzoek bestudeer ik meerdere Proeftuinen in Nederland. De Proeftuin in Purmerend is één van deze proeftuinen.

Met dit onderzoek wil ik meer te weten te komen over waarom huurders (zoals u) wel of niet bereid zijn om in te stemmen met het aanpassen van de woning naar een aardgasvrije woning. De verzamelde informatie helpt woningcorporaties en gemeenten het proces rondom het aardgas vrijmaken van (huur)woningen beter aan te passen aan de wensen en behoeften van huurders. Dit onderzoek voer ik uit in overleg met Intermaris.

Wat houdt het onderzoek in

Tijdens het onderzoek wordt u persoonlijk geïnterviewd door Neeltje. Zij stelt u een aantal vragen. Uw antwoorden worden anoniem opgeslagen, voordat deze worden gebruikt voor het onderzoek.

Het interview vindt telefonisch of via een videoverbinding plaats en duurt ongeveer één uur. Nadat u zich heeft opgegeven voor deelname neemt Neeltje contact met u op om een afspraak in te plannen. Het interview vindt plaats op een moment naar uw keuze. Alle interviews vinden plaats in de periode tussen 18 mei en uiterlijk 5 juni 2020.

Wilt u mee te doen aan dit onderzoek? Geef uzelf op vóór 15 mei 2020

U kunt zich opgeven voor dit onderzoek via: n.p.voesenek@student.tue.nl. Deelname is eenmalig en vrijwillig. Uw deelname is klaar zodra het interview heeft plaatsgevonden. U kunt op ieder moment stoppen met uw deelname aan het onderzoek. Hieraan zijn geen consequenties verbonden. Ook hoeft u niet aan te geven waarom u uw deelname wilt beëindigen. Het gehele onderzoek is afgelopen als alle deelnemers zijn geïnterviewd.

Heeft u vragen over deze brief?

Dan kunt u contact opnemen met Neeltje Voesenek via bovenstaand e-mailadres. Mocht u vragen hebben voor Intermaris, dan kunt u contact opnemen met Sonja Kamp via ons Klantcontactcentrum op telefoonnummer 088 25 20 100.

Met vriendelijke groet,
Intermaris
Sonja Kamp
Regisseur Wonen

Met vriendelijke groet,
Technische Universiteit Eindhoven
Neeltje Voesenek
Onderzoeker

Geachte heer/mevrouw,

U woont in de wijk 't Ven te Eindhoven en huurt uw woning van woningcorporatie 'thuis. Uw wijk is één van de 27 Proeftuin wijken in Nederland. Dit betekent dat onderzocht wordt om alle woningen in uw wijk van het gas af te halen. Een interessante ontwikkeling die uniek is in Nederland.

Onderzoek naar uw mening over het aardgasvrij maken van huurwoningen

Onder toezicht van de Technische Universiteit Eindhoven en met toestemming van en in overleg met 'thuis voert Neeltje Voesenek dit onderzoek uit. Het onderzoek is onderdeel van haar afstudeeronderzoek.

Mijn naam is Neeltje Voesenek

Op dit moment rond ik mijn studie af met een afstudeeronderzoek. In dit onderzoek bestudeer ik meerdere Proeftuinen in Nederland. De Proeftuin in Eindhoven is één van deze proeftuinen.

Met dit onderzoek wil ik meer te weten te komen over waarom huurders (zoals u) wel of niet bereid zijn om in te stemmen met het aanpassen van de woning naar een aardgasvrije woning. De verzamelde informatie helpt woningcorporaties en gemeenten het proces rondom het aardgas vrijmaken van (huur)woningen beter aan te passen aan de wensen en behoeften van huurders.

Wat houdt het onderzoek in

Tijdens het onderzoek wordt u geïnterviewd door Neeltje. Zij stelt u een aantal vragen. Uw antwoorden worden anoniem opgeslagen, voordat deze worden gebruikt voor het onderzoek.

Het interview vindt telefonisch of via een videoverbinding plaats en duurt ongeveer één uur. Nadat u zich heeft opgegeven voor deelname neemt Neeltje contact met u op om een afspraak in te plannen. Het interview vindt plaats op een moment naar uw keuze. Alle interviews vinden plaats in de periode tussen 25 mei en uiterlijk 12 juni 2020.

Wilt u mee te doen aan dit onderzoek? Geef uzelf op vóór 22 mei 2020

U kunt zich opgeven voor dit onderzoek via: n.p.voesenek@student.tue.nl of door uw telefoonnummer door te geven aan 'thuis. Deelname is eenmalig en vrijwillig. Uw deelname is klaar zodra het interview heeft plaatsgevonden. U kunt op ieder moment stoppen met uw deelname aan het onderzoek. Hieraan zijn geen consequenties verbonden. Ook hoeft u niet aan te geven waarom u uw deelname wilt beëindigen. Het gehele onderzoek is afgelopen als alle deelnemers zijn geïnterviewd.

Heeft u vragen over deze brief?

Dan kunt u contact opnemen met Neeltje Voesenek via bovenstaand e-mailadres.

Met vriendelijke groet,
Technische Universiteit Eindhoven

Neeltje Voesenek
Onderzoeker

Appendix 7

Teams instruction

U heeft een e-mail ontvangen met daarin een link naar het videogesprek. Deze link ziet eruit zoals een van de onderstaande afbeeldingen. Bekijk de uitleg bij de afbeelding zoals u de link weergeven ziet.

Afbeelding 1

[Join Microsoft Teams Meeting](#)

[Learn more about Teams](#) | [Meeting options](#)

Klik op “Join Microsoft Teams Meeting”. U wordt doorgestuurd naar het volgende scherm, zie afbeelding 3.

Afbeelding 2

• Voorbeeld Interview

🕒 Ma 18-5-2020 09:45 - 10:15

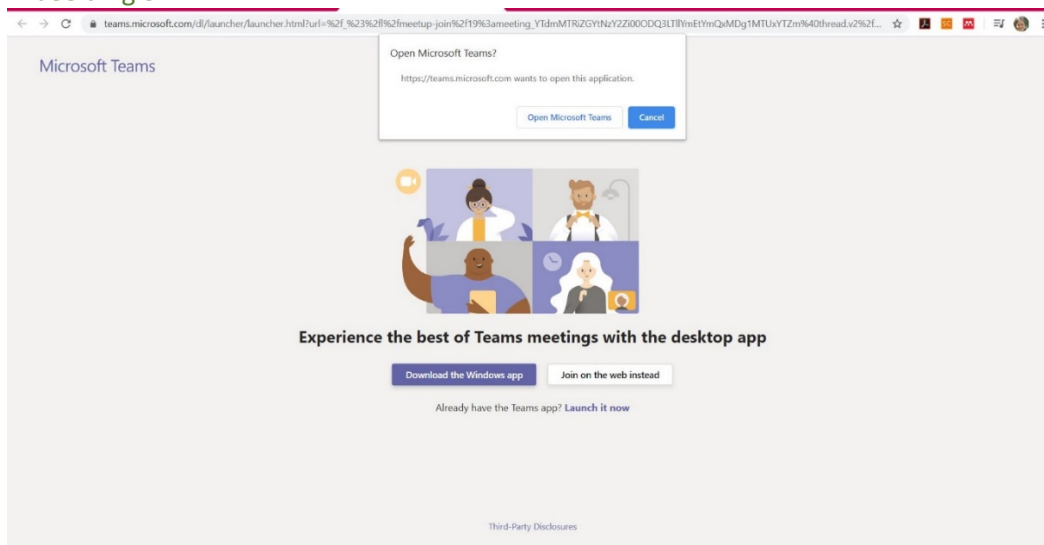
📍 Microsoft Teams Meeting

 Deelnemen ...

 Voesenek, N.P. heeft u uitgenodigd.
U heeft niet geantwoord.

Klik op “Deelnemen”. U wordt doorgestuurd naar het volgende scherm, zie afbeelding 3.

Afbeelding 3



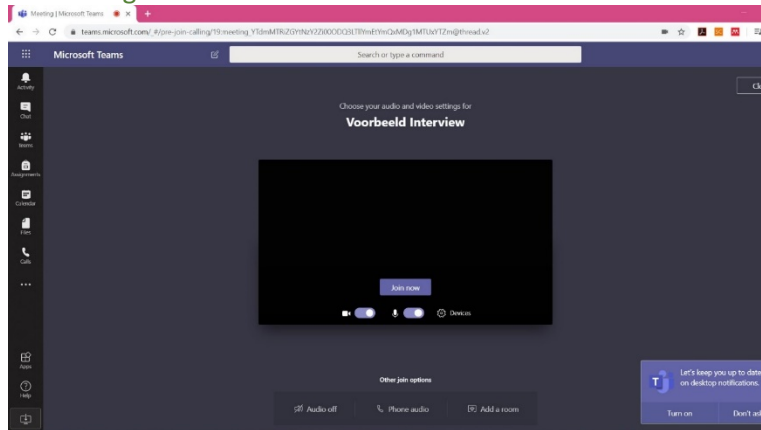
In uw webbrowser (internet op uw computer) opent bovenstaand scherm.

Klik eerst op de blauwe knop “cancel” bovenaan in uw scherm. Het kan zijn dat deze knop niet verschijnt. Dat maakt niets uit.

Klik op “Join on the web instead”. U opent nu de videoverbinding via internet, zodat u geen programma hoeft te downloaden.

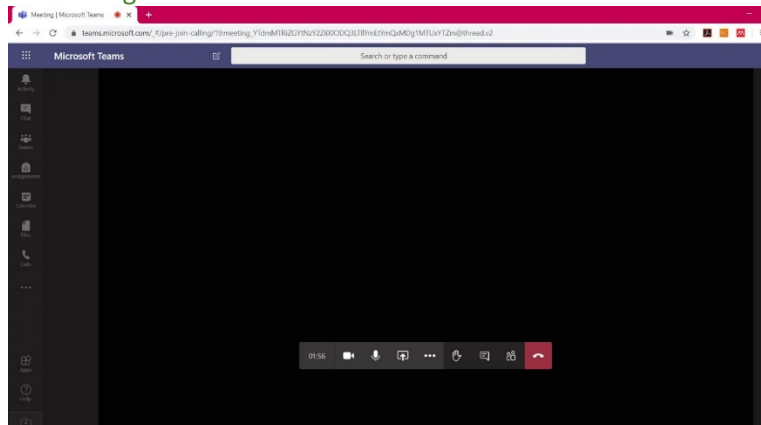
U wordt doorgestuurd naar het videogesprek. U ziet afbeelding 4.

Afbeelding 4



U bent nu in het videogesprek. Klik op de paarse knop “Join now”. U ziet nu afbeelding 5.

Afbeelding 5



Het videogesprek is gestart. In het midden ziet u zo direct Neeltje. U kunt met de knoppen onderaan uw camera en geluid instellen.

Appendix 8

General information about the interviews and participants

Table A9.1 General information about the interviews and participants of the Purmerend case.

	Male Female	Telephone Teams	Date of interview	Duration of interview	Number of years living in the house	Solar panels
P1	M	Teams	18/05/2020	00:29:06	47	Yes
P2	M	Teams	20/05/2020	00:49:16	15	Yes
P3	F	Telephone	28/05/2020	00:40:30	9	Yes
P4	M	Telephone	19/05/2020	00:56:09	42	Yes
P5	F	Telephone	02/06/2020	00:32:27	4	Yes
P6	F	Telephone	20/05/2020	00:36:18	61	Yes
P7	M	Telephone	26/05/2020	00:21:06	13	No
P8	F	Telephone	26/05/2020	00:26:25	60	Yes
P9	F	Telephone	01/06/2020	00:56:18	12	No
P10	F	Telephone	29/05/2020	00:49:33	50	Yes
P11	M	Telephone	19/05/2020	01:01:24	32	Yes

Table A9.2 General information about the interviews and participants of the Eindhoven case.

	Male Female	Telephone Teams	Date of interview	Duration of interview	Number of years living in the house
E2	F	Telephone	29/05/2020	00:49:04	8
E3	M	Telephone	28/05/2020	00:38:26	20
E5	F	Telephone	19/05/2020	00:28:20	50
E6	F	Teams	29/05/2020	00:42:53	20
E7	M	Telephone	25/05/2020	00:45:46	35
E8	F	Telephone	20/05/2020	00:59:06	1,5
E9	F	Telephone	28/05/2020	00:37:04	23
E10	F	Telephone	03/06/2020	00:34:47	3

Table A9.3 General information about the renovation of the properties in the Eindhoven case: replacement of kitchen, bathroom and toilet, start and end date.

	Kitchen	Toilet	Bathroom	Start	End
E2	No	Yes	Yes	Augustus	January
E3	Yes	Yes	Yes	Augustus	January
E5	No	No	No	September	February
E6	No	No	No	October	April
E7	Yes	Yes	Yes	November	April
E8	No	Yes	Yes	October	March
E9	No	No	No	November	May
E10	No	No	No	November	April

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Appendix 9

Codes and definitions

Code group - Experience

16 Codes

Exp - Communication and support - negative

Communication and support during the process is experienced as negative. The communication between executer and/or housing association and tenants did not go well. There was little support during the process for tenants.

Exp - Communication and support - positive

Communication during the process is experienced as positive. The communication and support was sufficient.

Exp - Doubt about technique

Doubt about the working of the applied techniques. One wonders whether the correct technique has been chosen to apply.

Exp - Fees - negative

The fees for convenience or new stuff, such as pans, was not sufficient.

Exp - Fees - positive

The fees for convenience or new stuff, such as pans, was sufficient.

Exp - Financial consequences once - negative

The one-time costs as consequences of the off-gas renovation were higher than expected.

Exp - Info about usage of house

Need for information about the usage of the house and installations after the renovation.

Exp - Leave the house

In retrospect, the resident would have preferred to leave the house during the renovation process.

Exp - Process - negative

Process is experienced as negative, more disturbance, convenience and hassle than expected.

Exp - Process - positive

Process is experienced as positive, less disturbance, convenience and hassle than expected.

Exp - Result - negative

The result is not considered as an improvement.

Exp - Result - positive

The result is considered as an improvement.

Exp - Social

During the process, more social contact has been established between the neighbors.

Exp - Time and energy - negative

Investment of own time and energy is experienced as negative. The investment of time and energy was more than expected.

Exp - Time and energy - positive

Investment of own time and energy is experienced as positive. The investment time and energy was as expected or even less.

Exp - Time Frame - negative

The time frame and planning of the renovation is experienced as negative. The renovation process took longer than expected and the communicated planning was often incorrect.

Code group - Focal goal

7 Codes

Focal goal - Biospheric motives

The focal goal are biospheric motives. The environmental consequences of the new heat source are determinative in the decision process.

Focal goal - Comfort

The focal goal is an expected increase of indoor climate and comfort. Increased comfort is determinative in the decision process.

Focal goal - Disturbance and inconvenience

The focal goal is the expected experience of hassle. The expected experience of disturbance and inconvenience is determinative in the decision process.

Focal goal - Electric cooking / change

The focal goal is the fair for changing cooking habits. The expected period that is needed to adapt to the new situation is determinative in the decision process.

Focal goal - Financial consequences

Comment: by s136926

The focal goal is an expected increase of monthly housing costs and/or high one time costs.

Focal goal - Necessary maintenance

The focal goal is that the renovation is valued as necessary, maintenance was overdue.

Focal goal - Safety

The focal goal is an expected increase of the safety. The new heat source is considered as safer than the gas network.

Code group - Gain motives

14 Codes

G - Financial consequences monthly

Monthly financial consequences as a result of the off-gas renovation.

G - Financial consequences monthly -

Expected decrease of monthly housing costs as a result of the off-gas renovation.

G - Financial consequences monthly - barrier

The consequences of the off-gas renovation for the monthly housing costs are a barrier to give consent.

G - Financial consequences monthly - neutral

The consequences of the off-gas renovation for the monthly housing costs are considered not important.

G - Financial consequences monthly - trigger

The consequences of the off-gas renovation for the monthly housing costs are a trigger to give consent.

G - Financial consequences monthly +

Expected increase of monthly housing costs as a result of the off-gas renovation.

G - Financial consequences monthly 0

No expected change of monthly housing costs as a result of the off-gas renovation.

G - Financial consequences once

The consequences of the off-gas renovation for one-time costs.

G - Financial consequences once - barrier

The consequences of the off-gas renovation for one-time costs are a barrier to give consent.

G - Financial considerations - save energy to save costs

Saving energy in order to save costs.

G - Participation of neighbors

Participation of neighbors in the renovation process.

G - Participation of neighbors - important

Participation of neighbors in the renovation process is considered as important.

G - Participation of neighbors - not important

Participation of neighbors in the renovation process is considered as not important.

G - Time and energy

Expected investment of time and energy by tenant.

Code group - Hedonic motives

26 Codes

H - Comfort

Indoor climate and comfort.

H - Comfort - barrier

The expected effect on the indoor climate and comfort as result of the off-gas renovation is a barrier to give consent.

H - Comfort - trigger

The expected effect on the indoor climate and comfort as result of the off-gas renovation is a trigger to give consent.

H - Disturbance and inconvenience

Disturbance and inconvenience.

H - Disturbance and inconvenience - barrier

The expected disturbance and inconvenience during the off-gas renovation is a barrier to give consent.

H - Disturbance and inconvenience - neutral

Disturbance and inconvenience during the off-gas renovation project is considered as not important.

H - Disturbance and inconvenience - trigger

The expected disturbance and inconvenience during the off-gas renovation is a trigger to give consent.

H - Doubt about technique

Feelings of doubt about the applied techniques.

H - Electric cooking

Change in way of cooking from gas to electric.

H - Electric cooking - barrier

Change in way of cooking from gas to electric is a barrier to give consent.

H - Electric cooking - trigger

Change in way of cooking from gas to electric is a trigger to give consent.

H - Necessary maintenance

Feeling that the maintenance was overdue, the renovation was necessary.

H - Off-gas – negative

The off-gas transition, as proposed by the Dutch government, is considered as unnecessary and associated with negative feelings.

H - Off-gas – positive

The off-gas transition, as proposed by the Dutch government, is considered as necessary and associated with positive feelings.

H - Safety

Natural gas is associated with feelings of insecurity. Increased sense of security is seen as a positive result of the renovation.

Code group - Hedonic motives regarding heat network

11 Codes

HN - Heat network - negative

Negative feelings regarding the heat network in Purmerend.

HN - Heat network - positive

Positive feelings regarding the heat network in Purmerend.

HN - Heat source - doubt biomassa

Feelings of doubt about the sustainability of the heat source (biomassa) of the heat network.

HN - Heat source - pref. hydrogen

Preference for hydrogen as an alternative heat source for the heat network.

HN - Heat source - pref. other source

Preference for an alternative heat source for the heat network.

HN - Imposed

Feeling that the heat network is being imposed by the municipality.

HN - Monopoly

Associated negative feelings with the monopoly position of the heat network company.

HN - Off-gas proposed - negative

The interviewee does not intend to give consent for the execution of the off-gas transition as currently proposed in Purmerend.

HN - Off-gas proposed - positive

The interviewee does intend to give consent for the execution of the off-gas transition as currently proposed in Purmerend.

HN - Rental home - so limited choice

Restricted freedom of choice because the house is a rental home. The majority or housing association will decide.

HN - Restriction of freedom of choice

Restricted freedom of choice in heat supplier.

Code group - Information

29 Codes

Info - Add. - alternatives

Need for additional information about the alternatives for heating.

Info - Add. - internet

Additional information is searched on the Internet.

Info - Add. - need cons

Need for additional information about the consequences off-gas renovation.

Info - Add. - neighborhood committee

Additional information is searched by/ shared with/ recieved from the neighborhood committee.

Info - Add. - no need cons

No need for additional information about the consequences off-gas renovation.

Info - Add. - no need tech

No need for additional information about the used techniques in the off-gas renovation.

Info - Add. - source

Need for additional information about the alternatives for the heat source, instead of biomass.

Info - Add.- need tech

Need for additional information about the used techniques in the off-gas renovation.

Info - Additional information

Additional information about the consequences off-gas renovation or about the used techniques.

Info - Confusion by debate

The social and scientific debate about climate change and suitable solutions causes confusion for tenants. It is hard to select information and filter for reliability.

Info - Enough

Received information was sufficient.

Info - Few

Received information was too less.

Info - Form and type - book

Information provided in book(s) and flyer(s).

Info - Form and type - meet

Information provided during the information meeting(s).

Info - Form and type - model

Information provided in the model house(s).

Info - From peers

Information and behavior of peers used as information source. Or sparring with peers about the renovation.

Info - Origin - HA

Information is provided by the housing association.

Info - Origin - Municipality

Information is provided by the municipality.

Info - Origin - relation HA negative

Negative relation with HA.

Info - Origin - relation HA positive

Positive relation with HA.

Info - Origin - relation municipality - negative

Negative relation with municipality and/or municipal heat company.

Info - Origin - relation municipality - positive

Positive relation with municipality and/or municipal heat company.

Info - Origin - trust HA - negative

Less trust in HA.

Info - Origin - trust HA - positive

Trust in HA.

Info - Origin - trust municipality - negative

Less trust in municipality and/or municipal heat company.

Info - Origin - trust municipality - positive

Trust in municipality and/or municipal heat company.

Info - Process - negative

The information process was experienced as negative.

Info - Process - positive

The information process was experienced as positive.

Info - Too much

Received information was too much.

Code group - Normative motives

19 Codes

N - Altruistic motives

Societal motives. Contribution to social interests.

N - Altruistic motives - barrier

Societal motives. Contribution to social interests is considered as a barrier to give consent.

N - Altruistic motives - neutral

Societal motives. Contribution to social interests is not considered as a barrier or a trigger. The interviewee is not able to indicate the influence of altruistic motives on the decision-making process.

N - Altruistic motives - trigger

Contribution to social interests is considered as a trigger to give consent.

N - Biospheric motives

Biospheric motives.

N - Biospheric motives - barrier

Biospheric motives are a barrier to give consent.

N - Biospheric motives - neutral

Biospheric motives are considered as not important.

N - Biospheric motives - trigger

Biospheric motives are a trigger to give consent.

N - Climate change

Degree to which climate change is seen as a problem.

N - Climate change - no problem

Climate change is not seen as a problem.

N - Climate change - problem

Climate change is seen as a problem.

N - Environmentally conscious

Degree of awareness of the influence of behavior and choices on the environment.

N - Environmentally conscious - limited

Limited awareness of the influence of behavior and choices on the environment. Willing to separate waste but adapts other behavior to a limited extent.

N - Environmentally conscious - no

No awareness of the influence of behavior and choices on the environment.

N - Environmentally conscious - yes

Certain level or high of awareness of the influence of behavior and choices on the environment.

N - Larger polluters

There are larger polluters than households that should first (or also) reduce their environmental impact.

N - Personal responsible

Degree to which one feels personally responsible to contribute to the reduction of climate change or the execution of climate policy.

N - Personal responsible - no

No feelings of personally responsibility to contribute to the reduction of climate change or the execution of climate policy.

N - Personal responsible -yes

Certain amount of feelings of personally responsibility to contribute to the reduction of climate change or the execution of climate policy.

Code group - Renovation motives

14 Codes

Reno - Biospheric motives - trigger

Regarding the renovation were biospheric motives a trigger to give consent.

Reno - Comfort - trigger

Regarding the renovation was the improvement of comfort a trigger to give consent.

Reno - Disturbance and inconvenience - barrier

Regarding the renovation was the expected experience of disturbance and inconvenience valued as a barrier.

Reno - Exp. Disturbance and inconvenience - negative

Regarding the renovation was experienced the disturbance and inconvenience as negative, it caused more hassle than expected.

Reno - Exp. Disturbance and inconvenience - positive

Regarding the renovation was experienced the disturbance and inconvenience as tolerable.

Reno - Financial consequences monthly - -

Regarding the renovation were considered the monthly housing costs as decreased.

Reno - Financial consequences monthly - +

Regarding the renovation were considered the monthly housing costs as increased.

Reno - Financial consequences monthly - 0

Regarding the renovation were considered the monthly housing costs as unchanged.

Reno - Financial consequences monthly - barrier

Regarding the renovation were considered the consequences for the monthly housing costs as a barrier to give consent.

Reno - Financial consequences monthly - neutral

Regarding the renovation were considered the consequences for the monthly housing costs not as a trigger or a barrier.

Reno - Financial consequences monthly - trigger

Regarding the renovation were considered the consequences for the monthly housing costs as a trigger to give consent.

Reno - Financial consequences once - barrier

Regarding the renovation were considered the one time costs as a barrier to give consent.

Reno - Result - positive

The result of the renovation is valued as positive.

Reno - Results - negative

The result of the renovation is valued as negative.

Appendix 10

Overview of the natural gas-free strategies and variants of PBL

	Bronnen	Temperatuur warmtebron	Aanvoer temperatuur ruimte verwarming	Collectieve installa- ties	Individuele in- stallaties
S1 - Individuele elektrische warmtepomp					
S1a	Elektriciteit + warmte uit buiten- lucht	15 °C	50 °C	-	Combiwarmtepomp + LT-radiatoren
S1b	Elektriciteit + bodemwarmte	15 °C	50 °C	-	Combiwarmtepomp + LT-radiatoren
S2 - Warmtenet met midden- tot hogetemperatuurbron					
S2a	Restwarmte + groengas voor piek- vraag	> 70 °C	70 °C	Warmtecentrale, MT-restwarmtebron, groengasproductie, MT-warmtenet (70 °C)	Aansluiting op warmtenet + HT- radiatoren
S2b	Geothermie + groengas voor piek- vraag			Warmtecentrale, geothermiebron, groengasproductie, MT-warmtenet (70 °C)	
S2c				Bio-WKK warmtecen- trale, groengasproductie, MT-warmtenet (70 °C)	
S2d	Groengas				
S3 - Warmtenet met lagetemperatuurbron					
S3a	Restwarmte + elektrici- teit	30°C	30 °C	LT-warmtenet (30 °C)	Aansluiting op warmtenet + combiwarmte- pomp + LT- radiatoren
S3b	Restwarmte + elektrici- teit		70 °C	Collectieve warmte- pomp, MT-warmtenet (70 °C)	Aansluiting op warmtenet + HT- radiatoren
S3c	Restwarmte + elektrici- teit		50 °C	Collectieve warmte- pomp, MT-warmtenet (50 °C)	Aansluiting op warmtenet + booster warmte- pomp + LT- radiatoren
S3d	Warmte uit buitenlucht + elektriciteit	15°C	50 °C	Collectieve warmte- pomp, WKO + MT- warmtenet (50 °C)	Aansluiting op warmtenet + boos- ter warmtepomp + LT-radiatoren
S3e	Warmte uit oppervlak- tewater + elektriciteit		70 °C	Collectieve warmte- pomp, WKO + MT- warmtenet (70 °C)	Aansluiting op warmtenet + HT- radiatoren
S4 - Hernieuwbaar gas met hybride warmtepomp					
	Groengas + elektriciteit	70 °C	70 °C	Groengasproductie, gasnet	Hybride lucht- warmtepomp + HT-radiatoren
S5 - Hernieuwbaar gas met hoogrendement ketel					
	Groengas	70 °C	70 °C	Groengasproductie, gasnet	HR-combiketel + HT-radiatoren

Fig. A10.1. Overview of strategies and variants towards natural gas-free heating of properties by PBL (Hoogervorst et al., 2020).