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This project has received funding from the European Union's Horizon 2020 research and innovation Programme under grant agreement No 101022317.

Executive summary

This deliverable concerns the case study of Dutch neighbourhoods, transitioning towards being natural gas-free, with a specific focus on the 64 natural gas-free neighbourhoods that are the chosen as pilot sites. The Dutch national Programme on natural gas-free neighbourhood started in 2018, after the Dutch government has decided to gradually reduce the extraction of natural gas from the Groningen gas fields, which has repetitively caused damages and injuries due to subsidence accompanied by earthquakes. Municipalities are given the responsibility to ensure this sustainability transition. Even though municipalities are in charge concerning this transition, different actors play an important role in making it a success. Citizens (i.e., homeowners), local initiatives (i.e., often united homeowners), policy-makers (i.e., the Dutch government and municipalities) and suppliers (i.e., businesses who provide and install the technical solutions for this transition) are depending on each other in this process.

This deliverable is part of WP3 and based on D1.1 and D1.3 of WP1. The aim of WP3 is to summarize and evaluate the GRETA case studies to understand the structural factors that affect the emergence and development of energy citizenship. The current deliverable provides an overview of the qualitative results we collected among the Dutch government, municipalities, local energy initiatives, homeowners and suppliers as part of T1.3. We examine their behaviours, goals, expected positive and negative outcomes, norms, agency and relationships with each other. Our findings are summarized and analysed by looking for notable patterns. More specifically, similarities and difference among stakeholders (i.e., actors) are examined, and potential frictions among actors are identified. Furthermore, we describe the role of local initiatives, social justice and finally, discuss implications for policy-makers. The results of the current deliverable, together with the findings of other cases studies within GRETA, serve as input for the design of a multinational survey (Task 3.3), with which quantitative data to explain energy citizenship is collected.

This report is structured into five sections. The first section presents an introduction describing the case study and explaining the research design. This section is mainly based on the background study report of T1.3. Section 2 describes the methods used to analyse the main research question. Section 3 provides an overview of our findings, collected by conducting expert interviews as part of T1.3 and results from studies conducted by TNO during recent years. In section 4, we analyse these findings by looking for notable patterns. Section 5 concerns a discussion and reflection of our analysis, with an additional focus on the role of local energy initiatives (i.e., energy communities), social justice and the policy context. Finally, in section 6 we cover the main conclusions.

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Summary (for dissemination)	The Dutch transition towards being natural gas-free started in 2018 after the Dutch government has decided to gradually reduce the extraction of natural gas from the Groningen gas fields which repetitively has caused damages and injuries due to subsidence accompanied by earthquakes. Even though municipalities are in charge concerning this transition, different actors play an important role in making this transition a success. Citizens (i.e., homeowners), local initiatives (i.e., often united homeowners), policy-makers (i.e., the Dutch government and municipalities) and suppliers (i.e., businesses who provide and install the technical solutions for this transition) are depending on each other in this process. This report summarizes the behaviours, goals, expected positive and negative outcomes, norms and agencies of these actors and examines their relationship. Similarities and differences between actors and cause for friction are discussed. Based on the findings policy implications are formulated.
Keywords	energy citizenship, energy transition, natural gas-free neighbourhoods, Netherlands, energy policy, innovation and behaviour, sustainable behaviour, behavioural insights

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Abbreviations and acronyms

BZK = Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (engl. Ministry of the Interior and Kingdom Relations of Netherlands)

ECW = Expertise Centre for Heat

EZK = Ministerie van Economische Zaken en Klimaat (engl. Ministry of Economic Affairs and Climate)

PAW = Natural Gas-Free Neighbourhoods Programme

RES = National Regional Energy Strategy

RVO = Netherlands Enterprise Agency

TVH = Transition Vision for Heat

1 Introduction

1.1 Towards being natural gas-free

1.1.1 Case study description

In 1959, the largest natural gas field in Europe and the tenth largest in the world was discovered near Slochteren in Groningen province in the north-eastern part of the Netherlands (De Boer, 2020, p.18). Based on this discovery, the entire built environment in the Netherlands was connected to natural gas, replacing coal, wood, peat and urban gas. Within 10 years, three quarters of the Dutch households switched to natural gas and in the decades after, the Netherlands became a 'gas country', which means that the built environment mainly ran on natural gas. In 2020, over 93% of Dutch houses were connected to natural gas.

However, the extraction of Groningen's natural gas turned out to have down-sides, such as subsidence, that is often accompanied by earthquakes. After an especially heavy earthquake in 2018, the Dutch government announced that the Groningen gas fields would be closed and the Dutch built environment would have to embark on a massive Programme to make it natural gas-free. Hence, in the same year, the Dutch national Programme on natural gas-free neighbourhood (PAW) was founded. The PAW provided subsidies to 27 pilot neighbourhoods to develop natural gas-free heat infrastructures in order to learn how to upscale to other neighbourhoods. In October 2020 and in March 2022, respectively 19 and 14 additional pilot neighbourhoods were chosen to be supported and subsidized with more than €50 million. In total, there are currently 64 pilot neighbourhoods that are supported by the PAW towards being natural gas-free (see Figure 1. Overview of all pilot neighbourhoods in the Netherlands. Source: https://aardgasvrijewijken.nl/proeftuinen+op+de+kaart/default.aspx.).

Figure 1. Overview of all pilot neighbourhoods in the Netherlands. Source: https://aardgasvrijewijken.nl/proeftuinen+op+de+kaart/default.aspx.

1.1.2 Socio-economic features

This report takes all the natural gas-free neighbourhoods as one case study. As this is a large scale project set-up nation-wide, we focus on residents (as in homeowners), policy-makers, local energy initiatives as well as suppliers from different neighbourhoods. Since there are no socio-economic features available across all the natural gas-free neighbourhoods, in the following, we describe the socio-economic features of the neighbourhood Overwhere-Zuid in Purmerend, as an example. The neighbourhood Overwhere-Zuid in Purmerend is a municipality in Noord-Holland (see Figure 2), which is a pilot neighbourhood that is part of the gas-free neighbourhoods Programme since 2018 (round 1). Since the neighbourhood Overwhere-Zuid in Purmerend is used as an example within this report, the data

should not be generalized to the case study of the natural gas-free neighbourhoods as a whole.

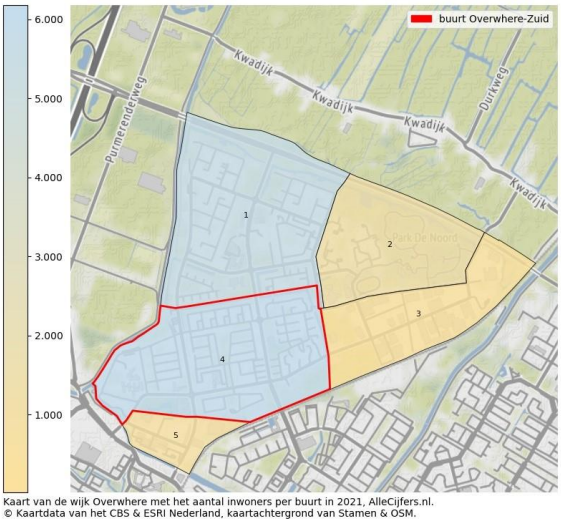


Figure 2. Map of Overwhere-Zuid in Purmerend. Source: https://allecijfers.nl/buurt/overwhere-zuid-purmerend/.

According to the population register, in 2022 the neighbourhood Overwhere-Zuid has 6210 inhabitants.[1] 48% (n = 3000) of the residents are men and 52% are women (n = 3215). Most inhabitants are between 25 and 45 years old (see Table 1) and are Dutch (69%). 32% of the inhabitants have a western background and 68% have a non-western migration background with the majority coming from non-western countries (27%), such as Turkey, Africa, Latin America and Asia, minus Morocco, the Netherlands Antilles and Aruba, Suriname and Turkey.

Table 1. Age distribution in Overwhere-Zuid. Source: https://allecijfers.nl/buurt/overwhere-zuid-purmerend/.

Age range	Number of inhabitants
0 - 15 years old	950
15 - 25 years old	655
25 - 45 years old	1670
45 - 65 years old	1590
> 65 years old	1315

[1] Source: https://allecijfers.nl/buurt/overwhere-zuid-purmerend/

In 2022, roughly half of the inhabitants were single (51%), 31% married, 11% divorced and 7% widowed (see Figure 3).

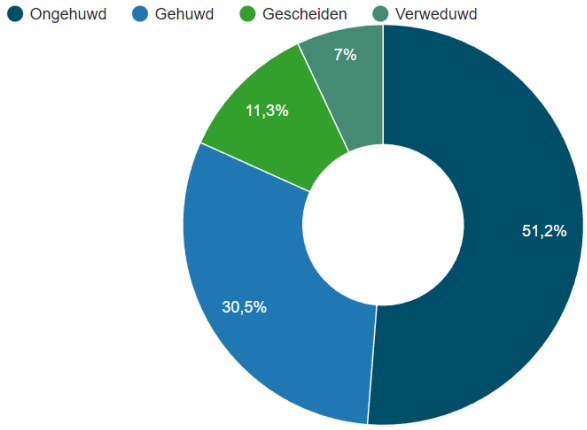


Figure 3. Marital status in Overwhere-Zuid, Purmerend. Source: https://allecijfers.nl/buurt/overwhere-zuid-purmerend/.

Around half of the inhabitants have a secondary education level (48%), 19% have a high education level and 33% have a low education level (see Figure 4).

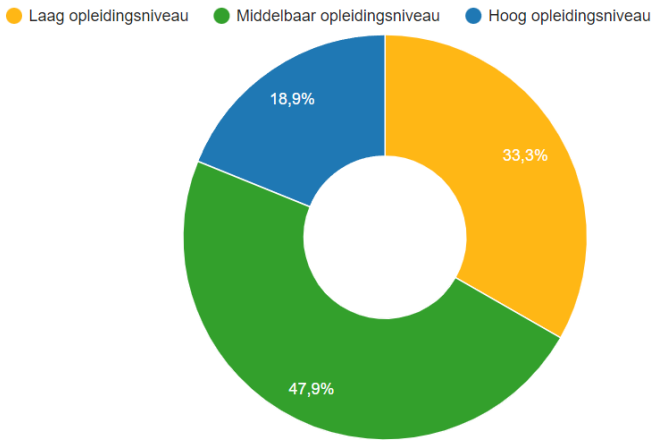


Figure 4. Education level in Overwhere-Zuid, Purmerend. Source: https://allecijfers.nl/buurt/overwhere-zuid-purmerend/.

The average gross annual income per inhabitant is 23400€. When it comes to housing, there are 1231 buildings that are part of the pilot neighbourhood, whereas 547 buildings are owner-occupied houses, 684 buildings are rental properties (housing

corporations and private) and 35 are non-residential buildings.[2] The latter are mainly offices, shops or have a function for health care, education, meetings or sports. The construction period of the neighbourhood was between 1945 and 1959, which makes it a post-war residential area with mainly row-houses and flats.

1.1.3 Relevant actor and policy landscape

In the following, an overview of the actor and policy context relevant to energy citizenship emergence and development for this specific case study is provided.

Actor landscape

A rich network of actors on the local, regional as well as national level shapes the conditions for energy citizenship emergence in our case study that transitions towards being natural gas-free in 2030. This includes actors from the fields of policy, society and businesses (see Figure 5 for an overview).

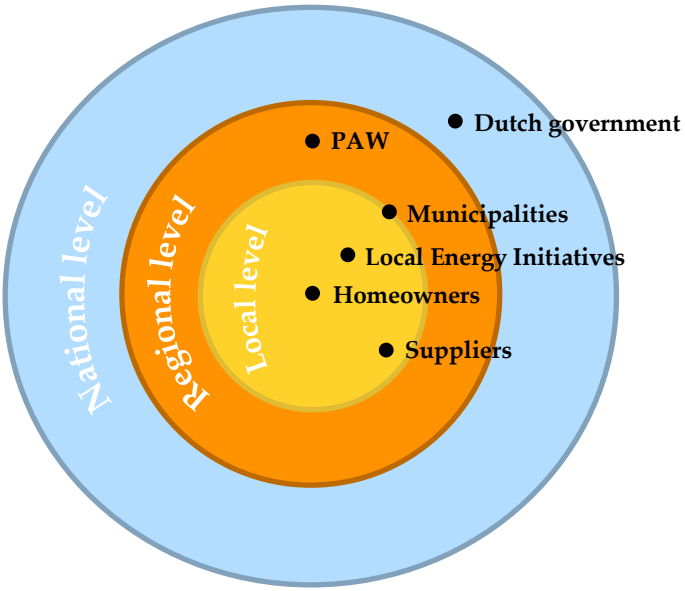


Figure 5. Overview of the actor landscape of the natural gas-free neighbourhoods case study.

On a national level, an important actor is the **Dutch government**, specifically the ministry of the Interior and Kingdom Relations of Netherlands (Dutch: BZK) and the ministry of Economic Affairs and Climate (Dutch: EZK), that is responsible for the energy transition in the Netherlands in general. The Dutch government has founded PAW to support other actors in becoming natural gas-free on a regional and local level. An important business actor on the regional and local level are **energy suppliers**. These are businesses that provide equipment, install services and share their

[2] Source: https://www.aardgasvrijewijken.nl/proeftuinen+op+de+kaart/overwhere-zuid+purmerend/default.aspx

knowledge about technical solutions with municipalities, homeowners and local energy initiatives.

On a local level, multiple actors from different fields can be identified. An important policy actor on the local level are **municipalities** which are responsible for the energy transition in their municipality. They take in a mediating role between the Dutch government and the societal actors, since they receive (financial) support by the Dutch government and have to abide their policies and regulations, but at the same time have to take into account local energy initiatives as well as homeowners. Finally, there are two societal actors: **homeowners** and **local energy initiatives**. The latter consist of citizens (as in homeowners) that are engaged in a local energy initiative and are often more intrinsically motivated to engage in the energy transition than other homeowners. Local energy initiatives often act as intermediaries, since they support municipalities and other homeowners, at the same time. Homeowners are citizens that make decisions about their home and are therefore responsible for implementing new solutions in their home to replace natural gas. In general, they are dependent on the guidance and support by all other actors.

Policy landscape

This subsection provides an overview of the most relevant policies that shape the conditions for the emergence and development of energy citizenship in the specific case of natural gas-free neighbourhoods on a European, national, regional and local level.

European level

- After the *Paris Climate Convention* in 2015, 195 countries, including the Netherlands, agreed to limit the increase in the average global temperature to well below 2 degrees Celsius, and if possible 1.5 degrees Celsius, by 2050 (i.e., *Paris Agreement*).
- In 2020, the *European Green Deal* was approved, with the overarching aim of making the European Union climate neutral in 2050.

National level

- In 2017, the *Dutch Coalition Agreement* stated to make 200,000 homes natural gas-free each year starting in 2021 (VVD, CDA, D66 and ChristenUnie, 2017).
- After an especially heavy earthquake in January 2018, the Dutch government announced the *historic decision to close the Groningen gas fields* (De Boer, 2020, p.18).
- In 2018, the Dutch government founded the Programme of Natural Gas-Free Neighbourhoods (PAW) and made €435 million available between 2018 and 2030 in order to reach the goal of at least 49% less CO2 emission than in 1990. In total, approximately €380 million is earmarked for pilot projects with natural gas-free neighbourhoods.
- In 2019, the *Dutch Climate Agreement* was approved by companies and (government) organisations with the aim to reduce carbon dioxide (CO_2) emissions and thus limit the Dutch contribution to global climate change. The

Dutch Climate Agreement is an important part of the Dutch implementation of the Paris Climate Convention. More specifically, the climate-related goals of the Netherlands are (Rijksoverheid Nederland, 2019, p.4):
  - By 2050, the Netherlands will be climate neutral.
  - By 2030, CO_2 emissions must be at least 49% less than the CO_2 emissions in 1990.
- In 2021, a new *Dutch Climate Agreement* was approved with the aim to face out gas extraction in the province of Groningen as quickly as possible and to further support sustainable homes. Part of this agreement is a long-term *National Insulation Programme* to insulate homes faster, smarter and affordably.

Regional and local level

In 2018, the subsidies were given to 27 pilot neighbourhoods to develop natural gas-free heat infrastructures. In October 2020, 23 additional pilot neighbourhoods were subsidized and in 2022, 14 neighbourhoods were chosen to be financially supported.

Besides that, there are other financial support systems that can be applied for, such as:

- Rental tax relief scheme for preservation: Tax relief for the preservation of rental housing throughout the Netherlands.[3]
- Incentive scheme for natural gas-free rental homes: Subsidy for the connection of rental houses to an external heat network.[4]
- Investment subsidy for renewable energy and energy saving (ISDE): Subsidy for sustainable energy and energy saving, whereby homeowners and business users can apply for subsidies for the purchase of a solar boiler, a heat pump, connection to a heat network and insulation measures.[5]
- Home energy saving grant (SEEH) for association of owners: Subsidy for energy-saving measures or energy advice for an association of owners (Dutch: VVE).[6]
- Energy investment allowance (EIA) for entrepreneurs: Energy investment allowance for companies.[7]
- Renewable Energy Transition (HER+): Renewable energy subsidy for projects that lead to CO2 reductions by 2030, thus help to achieve the climate goals.[8]

[3] https://www.rvo.nl/subsidies-financiering/rvv/verduurzaming/2019
[4] https://www.rvo.nl/subsidies-financiering/sah
[5] https://www.rvo.nl/subsidies-financiering/sah
[6] https://www.rvo.nl/onderwerpen/subsidie-energiebesparing-eigen-huis-seeh-voor-vve
[7] https://www.rvo.nl/subsidies-financiering/eia/ondernemers
[8] https://www.rvo.nl/subsidies-financiering/her

An overview of other subsidies concerning energy saving, alternative sustainable heat technologies or innovation can be found on the website of the Netherlands Enterprise Agency (RVO)[9] and in the following Dutch report "Financing instruments", published by the PAW.[10]

Next to subsidies by the government, there are several Programmes that help municipalities or regions to achieve the transition to natural gas-free:

- **National Regional Energy Strategy** (RES) Programme[11]: within this Programme, 30 energy regions are investigating together where and how sustainable electricity can best be generated on land (wind and sun), in order to generate 35TWh sustainable energy on land by 2030. Specifically, the RES includes establishing how the sustainable generation of energy can be fitted into the spatial planning and how it fits into the electricity network, but also how support for the measures can be created in society. The RES Programme, in turn, supports the regions in creating these RESs by developing and sharing knowledge, offering process support and facilitating a learning community. In addition, it connects parties, puts bottlenecks on the agenda and identifies linkage opportunities to achieve the ambitions.
- **Expertise Centre for Heat** (ECW)[12]: an expert knowledge centre that supports municipalities in the heat transition of homes and buildings in Dutch districts and neighbourhoods. It deals with issues in the fields of technology, finance, market organisation and sustainability.
- **Natural Gas-Free Neighbourhoods Programme** (PAW):[13] an inter-governmental Programme, where solutions for bottlenecks in practice are being found. Various ministries and umbrella organizations are working together in this Programme. Municipalities and parties involved are given the best possible assistance in their natural gas-free task. By learning from experience, the district-oriented approach can be better designed and scale up.

In addition to these Programmes, municipalities and regions are also offered a newsletter in order to stay up to date with the latest developments (e.g., Natural Gas-Free Neighbourhoods Programme/ Expertise Centre for Heat Newsletter or National Programme Regional Energy Strategy Newsletter).

[9] https://www.rvo.nl/onderwerpen/aardgasvrij
[10] https://www.aardgasvrijewijken.nl/documenten/HandlerDownloadFiles.ashx?idnv=2211227
[11] https://www.regionale-energiestrategie.nl/default.aspx
[12] https://www.expertisecentrumwarmte.nl/default.aspx
[13] https://www.aardgasvrijewijken.nl/default.aspx

Last but not least, there is support offered to citizens to make their home natural gas-free step by step. A few examples are a websites called the "Home Energy Savings Explorer"[14], which has been developed for citizens to explore opportunities to make their homes more economical, more comfortable and/or more energy neutral. Similarly, there are guides and roadmaps developed by Milieu Centraal to support homeowners on their way towards a sustainable and energy-efficient home.[15]

[14] https://www.verbeterjehuis.nl/

[15] https://www.milieucentraal.nl/energie-besparen/aardgasvrij-wonen/stappenplan-aardgasvrij-wonen/

2 Design and methods

Within the case study of the natural gas-free neighbourhoods, several qualitative data collection methods were utilized in order to gain an understanding of the following research questions:

How does energy citizenship work in the natural gas-free neighbourhoods?

In order to find out more about the role of municipalities, members of energy initiatives, homeowners and suppliers and their behaviours in the transition towards being natural gas-free until 2030 or max. 2050, semi-structured interviews were conducted with natural gas-free neighbourhood experts within TNO and previous research conducted by TNO was examined. These interviews were part of T1.3. Specifically, in the case study of natural gas-free neighbourhoods, we consulted four experts from TNO with broad knowledge on the perceptions of homeowners, energy initiatives, municipalities and suppliers (see Annex A: Example expert interview protocol (homeowners) for an example of an expert interview protocol, in this case for homeowners). The interviews entailed questions about the following four topics:

1. *Past behaviour and planned actions*: The past behaviours and planned actions of homeowners, energy initiatives, municipalities and suppliers in the transition towards being natural gas-free.
2. *Potential outcomes*: The perceived advantages/ benefits and disadvantages of the engagement of homeowners, energy initiatives, municipalities and suppliers in the transition towards being natural gas-free.
3. *Norms*: The perceived norms (i.e., pressures and norms by other people, organisations or institutions) that influence homeowners, energy initiatives, municipalities and suppliers in their engagement in the transition towards being natural gas-free.
4. *Agency*: The perceived agency (i.e., factors or circumstances that make it easier or more difficult) in the engagement of homeowners, energy initiatives, municipalities and suppliers in the transition towards being natural gas-free.
5. *Relational model*: The relationship with other stakeholders (i.e., homeowners, energy initiatives, municipalities, the Dutch government and suppliers) in the transition towards being natural gas-free.

The interview protocols of the four semi-structured interviews with experts from TNO, who have extensive knowledge on the perceptions of homeowners, energy initiatives, municipalities and suppliers can be found in Annex B: Expert interview protocols (translation).

Besides that, the outcomes of the following research projects previously carried out by TNO were examined and used to answer the main research question:

1. *de Koning, N., Kooger, R., Hermans, L., Tigchelaar, C. (2020). Natural Gas-Free Homes: Drivers and Barriers for Residents; Report P12006; TNO: The Hague, The Netherlands.*
   This research entails fieldwork that was conducted in two comparable neighbourhoods in the Netherlands: Overwhere-Zuid in Purmerend and Wijk 03 Noord in Zwijndrecht. In this project, multiple interviews were held: 7 interviews were held with employees of the municipalities, 79 street interviews were conducted with residents, and 12 more extensive interviews were conducted with residents. Based on these interviews, a client journey of residents was developed, including their drivers and barriers per stage.
2. *Klösters, M., de Koning, N., Kort, J., Kooger, R. (2020). De kracht van het collectief. Report P12079. TNO: The Hague, The Netherlands.*
   This research entails desk-research and interviews with 10 participants of different collectives, distributed over 7 provinces in the Netherlands. Based on the results of these various research methods used, a client journey of collectives was developed, including possible drivers and barriers of collectives per stage.

3 Results

Based on the interview results and two TNO research projects, the behaviour and goals per actor were analysed as well as summary tables of positive and negative outcomes, norms, agency and the relationship between actors, associated with engaging in becoming natural gas-free by 2050 were developed.

3.1 Behaviour and goals per actor

The main societal goal of the natural gas-free neighbourhoods is becoming natural gas-free by 2050 (see 1.1). To reach that goal, each of the five main actors (see 1.1.3) performs certain behaviours, which are described in the following:

- **Homeowners** replace natural gas for another solution (such as individual electrical heating pumps, collective heat networks, green gas and/or hydrogen) within the households until 2030 or max. 2050. Examples of their individual motivation are the reduction of earthquakes in Groningen, climate change mitigation, improvement of personal situation (De Koning, Kooger, Hermans, & Tigchelaar, 2020).
- **Local Energy Initiatives** explore and implement feasible sustainable solutions for the entire neighbourhood and engage/involve local citizens in this until 2030 or max. 2050. Their likely individual motivation is the improvement of personal situation by making use of benefits of the initiative, climate concern (sustainable and green environment), concern for neighbourhood welfare, economic motivation.
- **Municipalities** support (e.g., inform, involve, facilitate; important for that are e.g., the Transition Vision for Heat (TVH), district implementation plans) their residents to replace natural gas in their households for another solution until 2030 or max. 2050. Examples of their professional motivation are following measurements by the government, climate change mitigation, identifying opportunities to combine certain activities and parties ("koppelkansen"), improvement of health of citizens, and liveability of neighbourhoods.
- **The Dutch government** aids municipalities and citizens in performing the transition towards being natural gas-free (e.g., financial support system and policies such as the new energy law) until 2030 or max. 2050. Their likely professional motivation is to act according to political benefits (meaning votes and support of Dutch population) by reducing the earthquakes in Groningen. Other professional motivations are to act according to the Climate Agreement and to improve of health of citizens.
- **Suppliers** provide equipment and installation services and advice on a new solutions in all Dutch households to make them natural gas-free until 2030 or max. 2050. Their professional motivation is likely economic benefits, but also climate change mitigation and (the enjoyment of) innovation. Important to

mention is that the motivation may differ between founders of businesses and the employees of businesses.

3.2 Positive and negative outcomes associated with engaging in becoming natural gas-free by 2050

By means of previously conducted TNO research and expert interviews (see Annex B: Expert interview protocols (translation)), the following table (see Table 2) of positive and negative outcomes has been developed.

Table 2. Positive and negative outcomes of engaging in becoming natural gas-free by 2050.

Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
Environmental benefits[16]**:** Ultimately, we have to get rid of the gas Environmental considerations Wanting to become climate-neutral	Environmental benefits	Environmental benefits	Environmental benefits	(Environmental benefits)
Personal benefits[16]**:** Rectify bad decisions in the past Natural gas-free is safer Health Alternative must be at least as good District heating is the only option for poorly insulated homes Opportunity to improve the neighbourhood No concerns about broken central heating Refurbishing and making homes more future-proof Net metering Street is only opened up once	**Professional benefits:** Feeling of purpose Contributing to safety and control[17] Providing means for pleasure and stimulation[17] Providing a feeling of influence[17] Providing a feeling of relatedness[17] Providing a feeling of competence for members[17] Providing autonomy and independence[17] Improving the local labour market[17]	**Professional benefits:** Involvement/ empowerment of citizens Support among citizens for proposed solution/ scenario Efficiency and speed through acceptance	**Professional benefits:** Empowerment of municipalities Support of (Groningen) citizens to phase out gas	**Professional benefits:** Attraction of new employees
Financial benefits[16]**:** Higher gas price in future Attractive investment Increasing value of a home Cost savings through energy saving	**Financial benefits:** Providing financial means and security[17]	**Financial benefit:** acceptance of change leads to more initiative by citizens and less investments by municipality	**Economic benefits:** Innovation, export solutions	**Economic/ commercial benefits**: Growing market and even obligation Image Interest in broadening their portfolio through innovation (e.g., heat pump, ..)

[16] de Koning, N., Kooger, R., Hermans, L., Tigchelaar, C. (2020). *Natural Gas-Free Homes: Drivers and Barriers for Residents*; Report P12006; TNO: The Hague, The Netherlands.

[17] Koirala, B., de Koning, N., Kort, J., Iannone, A., Bisconti, P., Claessens, B., Bellesini, F., Mancinelli, E., Tribbolati, G., Boijn, E. (forthcoming). *Deliverable D3.1 Overview of barriers and drivers for consumer engagement in demand response*. In: Boosting DR through increased community-level consumer engagement by combining Data-driven and blockchain technology Tools with social science approaches and multi-value service design (BRIGHT). EU Horizon 2020 innovation Programme, Grant agreement No 957816.

Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
Environmental disadvantages[16]**:** CO2 is good for nature Natural gas is a clean fuel Natural gas-free alternatives are also polluting District heating is not sustainable		**Financial disadvantages:** possible disbalance between investment in participation versus in transition itself		**Financial disadvantages**: Investment in new know-how necessary
Personal disadvantages[16]**:** Uncertainty about why we're getting rid of gas Heat pump makes a lot of noise in the home Leads to polarization Limit natural gas-free to new construction Electric cooking is sub-optimal Uncertainty about costs Uncertainty about what it means for the home (especially in flats) No real participation is possible New way of heating is less comfortable Being confronted with the amount of work and inconvenience Uncertainty about net metering Municipality must first clean up the neighbourhood Don't want to take out a loan One's own input on technical (im)possibilities are not heard Renovations were noisy Lots of people passing through Feeling of not having a choice The decision has already been taken	**Personal disadvantages**[18]**:** Not being taken seriously enough by parties	**Personal disadvantages**: Dependency on political parties: alternating coalition could mean changes in plans and delays		**Professional disadvantages:** Scarcity of experts and workers in general Pioneering means hit and miss

Looking at Table 2, it is striking that all stakeholders expect that engaging in becoming natural gas-free by 2050 has environmental benefits as well as personal/ professional benefits. However, local energy initiatives associate the engagement with more positive outcomes than homeowners do (e.g., rectify bad decisions in the past, alternative must be at least as good). For both municipalities and the Dutch government, the professional benefits of involving and empowering other actors (i.e., homeowners, municipalities) are important positive outcomes. All actors also expect that engaging in becoming natural gas-free by 2050 has financial benefits. However, it seems contradicting that homeowners aim to save money and increase the value of their home, while municipalities and the Dutch government (i.e., policy-makers) aim for homeowners to invest themselves.

[18] Klösters, M., de Koning, N., Kort, J., Kooger, R. (2020). *De kracht van het collectief*. Report P12079. TNO: The Hague, The Netherlands.

Concerning the personal/ professional disadvantages of engaging in becoming natural gas-free by 2050, it seems that most actors (i.e., homeowners, municipalities and suppliers) experience uncertainty (e.g., uncertainty about costs; uncertainty about what it means for the home, especially in flats; alternating coalition could mean changes in plans and delays; pioneering means hit and miss). Besides that, local energy initiatives and municipalities feel depend on other parties, both financially (e.g., from the Dutch government) and regarding know-how (e.g., from suppliers about new technical solutions). Suppliers, on the other hand, have problems finding experts/ professional staff. Finally, homeowners lack information and knowledge on various topics (e.g., costs, metering, consequences of the energy transition for their home).

3.3 Norms associated with engaging in becoming natural gas-free by 2050

By means of previously conducted TNO research as well as expert interviews (see Annex B: Expert interview protocols (translation)), the following table (see Table 3) of dominant social norms and values has been developed.

Table 3. Norms associated with engaging in becoming natural gas-free by 2050.

Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
Intrinsic motivation[16]: No intrinsic motivation or scepticism about natural gas-free plans Openness to renewal	**Intrinsic motivation[18]:** Enthusiasm and perseverance Common goal			
Experience of peers (i.e., family, friends, colleagues)[16] Experience of a like-minded individual	Experience of peers (i.e., other local energy initiatives)	Experience of peers (i.e., other municipalities)	Experience of peers (i.e., other countries' governments)	Experience of peers (i.e., other suppliers)
Solidarity with Groningen[16]	Support by municipalities and private homeowners	Support by energy cooperations (information by cooperation and resources by municipality) and housing cooperations		Support by building users (incl. local energy initiatives), municipalities, government, energy advisers, energy offices (Energieloketten)
Pressure from above (i.e., municipality, elite, government)[16] The elite is imposing it on us Natural gas is imbued with (geopolitical) interests A faith-based assignment Bigger countries hardly do anything, so why must a small country like the Netherlands?	Barriers in laws and regulations[18]		**Pressure from above (i.e., EU):** Fulfilling Dutch and Europeans goals/ norms	
Pressure by the market/ economy[16] District heating is a monopoly	Negative influence from (social) tenants, and private landlords that do not have the incentive to invest	Pressure from VVE's (want support), network operators (want security), citizens with less trust. Parties that want to work together more often (e.g. water companies) and residential areas (e.g. commercial properties) that are against new obligations		Negative influence from builders and contractors of new building: less benefit from more expensive and sustainable products

Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
	Influence from large housing cooperations, depending on their own interest or whether they are forced to by (municipal) legislation	Influence from coalition, council		Pressure from norms by the government (e.g., from 2026 onwards, the hybrid heat pump will be the new standard for each household[19])
Dependency on others: Dependency on a housing association[16] Dependence on single supplier (heat grids)		**Dependency on others:** On heating companies/ suppliers (and their know-how) Open-minded citizens		Dependence on suppliers of parts of products
				Dependence on global events: Gas-/ electricity prices COVID-19 Scarcity of materials

Looking at norms (see Table 3), it is important to note that local energy initiatives are generally intrinsically motivated, while homeowners are often not intrinsically motivated and feel pressured by external parties to engage in the energy transition (see also **Error! Reference source not found.**). In general, EU pressures seem to drive the n ational Dutch government, which in turn influences municipalities that have an impact on homeowners. Another important norm across actors is the experience of peers that can be a supporting mechanism to gain knowledge about what goes well and what does not in such an energy transition. Finally, we see that homeowners as well as municipalities depend on heating suppliers, and, in turn, suppliers depend on other suppliers that provide necessary parts of the new products.

3.4 Agency associated with engaging in becoming natural gas-free by 2050

By means of previously conducted TNO research as well as expert interviews (see Annex B: Expert interview protocols (translation)), the following table (see Table 4) of types of institutional (public policy) support, resources, skills, knowledge and networks that are available to (or are mastered by) each actor has been developed.

[19] https://www.rijksoverheid.nl/actueel/nieuws/2022/05/17/hybride-warmtepomp-de-nieuwe-standaard-vanaf-2026

Table 4. Agency associated with engaging in becoming natural gas-free by 2050.

Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
Time[16]: Fitter indicates that it will take a long time Does not fit in with phase of life (too little time) Able to free up enough time	Time	Time		Time
Trust in municipality/ government/ suppliers/ solutions[16]: The real story isn't being told Feeling fooled No confidence that heat networks can become profitable The heat pump is not mature Questions about the feasibility in types of homes No trust in suppliers Trust in team/approach of natural gas-free	Trust in municipalities, Dutch government and suppliers	Trust of citizens (local energy initiatives/ homeowners), government and suppliers	Trust in municipalities and suppliers	
Financial means[16]: Insufficient financial resources Does not fit in with phase of life (too little money) Can absorb financial setbacks All costs reimbursed by the municipality (pilot neighbourhood) or probably covered to a large extent by the municipality (testing ground)	**Financial means[18]:** Insufficient (structural) funding	Financial means	Capacity to implement taxation on usage gas, provide subsidies on technology replacement	Financial means to innovate/ invest in new solutions
Knowledge and experience[16]: Natural gas-free is not the most important problem Clumsy approach of natural gas-free (at the start of the project) Negative experiences with heat networks in the past People choose the wrong solutions Knowing what's ahead Misunderstandings and limited knowledge about the chosen alternative No/insufficient information from the municipality Insufficient knowledge Negative experience with heat pump	**Knowledge:** Knowledge of technical interventions Knowledge of municipal transition vision/ district energy plan Knowledge of appropriate tools/ approach to achieve (sub)goals Right mix of knowledge and competences[18] Knowing how to find your way around the municipality[18] Insufficient technical knowledge[18] Insufficient knowledge sharing among collectives[18]	**Knowledge about…** …technical and social interventions …transition vision for heat …implementation plans at district/ neighbourhood level …how to support long-term	**Knowledge about…** …technical and social interventions	**Knowledge about…** …necessary alternative technical solutions
Social network (e.g. for support)[16]: Honest communication Personal approach Going along with initiatives Finding somebody to listen Nice and informative resident evenings Facing it alone (as an elderly individual) Involving reliable professionals in the process Taking steps collectively	**Social network/ staff:** Close to residents[18] Responding to what is happening and fostering social cohesion[18] Professional network[18] Limited contribution of board and workgroup members[18] Clear own role and external positioning[18] Volunteers	**Social network/ staff:** Staff (often shortage of staff) Influential citizens	Staff	**Social network/ staff:** Staff (often shortage of capable experts) Suppliers of parts Trainers
Opportunity to explore alternatives[16]: No room to explore solutions other than heat network Good examples of induction cooking Freedom of choice regarding their own home	Cooperation with municipality[18] Little room for collective from the municipality Different interests of collectives and municipalities Good cooperation with the municipality Little continuity within the municipality	Capacity to coordinate or delegate (e.g., residents' evenings or kitchen table discussions)	Capacity to coordinate, delegate, legislate (to phase out gas)	Capacity to advise on subsidies

Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
	Insufficient integral cooperation within the municipality			
		Capacity to inform and provide tools (e.g., transition vision, consistence in policies)	Capacity to inform and provide tools (e.g., "guidelines")	

Looking at the necessary agencies (see Table 4), time is mentioned by each of the five actors involved in the natural gas-free neighbourhoods. Besides that, results show that all actors, except for suppliers, indicate that trust among each other is very important. Homeowners indicate uncertainty and have questions (e.g., financially and technically) that are still unanswered. Then again, a social network or staff as well as knowledge is needed by all actors. At the same time, by taking a mediating role, local energy initiatives are in special need of extra knowledge to communicate with both, homeowner as well as municipalities. Local energy initiatives, municipalities and the Dutch government are also in need of knowledge concerning social and technical interventions. Besides that, financial means are insufficient for all actors to fund the transition towards becoming natural gas-free by 2050. Specifically, from the interviews, we gather that homeowners experience the high costs of making their homes natural gas-free as the most pressing factor on their satisfaction. Finally, capacity to coordinate or delegate as well as continuity is important both within the municipality and the Dutch government in order to engage other parties in becoming natural gas-free by 2050 (see also Table 2).

3.5 Relational model associated with engaging in becoming natural gas-free by 2050

By means of the previously conducted TNO research as well as expert interviews (see Annex B: Expert interview protocols (translation)), the following table (see Table 5) about interactions and relationships between the main actors has been developed.

Table 5. Relational model towards becoming natural gas-free by 2050.

Actors	Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
Homeowners		Good relationship Most interested and generally well-informed: elderly/retired male homeowners	Reactance (political views on participation) and often not much trust from citizens expectations that municipality takes charge (may differ per citizen and over time)	Often not much trust from citizens in governments.	Economic relationship Dependent on skills and knowledge

Actors	Homeowners	Local energy initiatives	Municipalities	Dutch government	Suppliers
Local energy initiatives	LEIs communication focused on this group, who are also those that attend the meetings. Particularly elderly/ retired males		Less issues with trust, but anticipation necessary (timings and tasks) otherwise reactance; expectations that mu nicipality takes charge (may differ per citizen and over time)	No data	Economic relationship Supported by initiatives' skills and innovative mindset; option for pilot
Municipalities	Prefer not to speak to everyone individually, but rather through initiative (more focused, else too many different wishes). In general, municipalities involve homeowners too little in sustainable plans.	Mixed relationship Policy-makers are supportive, but cannot provide all necessary support (e.g. money)		No data	Knowledge exchange necessary, but often not done enough Economic relationship through local subsidies
Dutch government	No data	No data	Dependent on legal and financial support		No data
Suppliers	Economic relationship Trust is important	Mostly economic relationship, but sometimes suppliers are invited to neighbourhood meetings	Most complex relationship dependent on knowledge Economic relationship (business case has to be profitable for supplier)	No data	

When it comes to the relationship between the different actors (see Table 5), we see positive (e.g., support, trust), neutral (e.g., economic relationship) as well as rather negative relationships (e.g., mistrust). Especially for homeowners, their relationships with other actors differ. Their relationship with local energy initiatives is good, which is mostly due to the fact that local energy initiatives are groups of active, interested and well-informed homeowners that want to help other homeowners in the energy transition. The relationship with municipalities and the Dutch government is often negative, which is related to mistrust and not being involved enough in sustainability plans. With suppliers, the relationship is rather neutral, since it is economical and depends on the skills and knowledge of suppliers. Local energy initiatives are focused on homeowners and are mostly representing elderly and retired males. They have less trust-issues with municipalities, but expect an effective work relationship. At the same time, municipalities rather have local energy initiatives being the point of contact for homeowners, since tending to individual wishes is not possible for most municipalities due to capacity issues. This makes their relationship rather co-dependent. Another co-dependent relationship is between municipalities and suppliers. While suppliers are in need of a profitable business case, municipalities are often in need of technological solutions as well as information and knowledge exchange. However, both cost time and money for the suppliers, which means that, in reality, knowledge exchange is often not prioritized and realized.

3.6 Asymmetries analysis across actors

3.6.1 Similarities across actors

When looking at the goal setting across actors within the natural gas-free neighbourhood, it is clear that homeowners have a similar goal as local energy initiatives. This is inherent to the fact that local energy initiatives are groups of homeowners that are more engaged and involved in the energy transition. The goals of local energy initiatives are also partly similar to municipalities, since both of their roles involves guidance and support of homeowners in their transition towards being natural gas-free. This means that local energy initiatives are mediating between homeowners and the municipality. At the same time, municipalities also have an intermediary role, since they are mediating between residents (as in homeowners within their municipality) and the Dutch government. Finally, since providing services and installing equipment is mainly motivated by economic reasons, suppliers are the most unique actor within the natural gas-free neighbourhoods. However, similar to local energy initiatives, they also have a supporting role for citizens as well as for municipalities.

As mentioned in **Error! Reference source not found.**, it stands out that almost all actors (except for suppliers) value the environmental benefits of engaging in becoming natural gas-free by 2050. In regards to professional benefits, local energy initiatives, municipalities and the Dutch government are complementary to each other. They all expect to increase the involvement and empowerment of citizens and/or the mediating parties (i.e., municipalities and local energy initiatives), which creates less reactance from these parties to the process of becoming natural gas-free by 2050. Another observation is that homeowners, municipalities and suppliers experience uncertainty, whether about the consequences for their homes, about their strategy to engage other actors, or about pioneering in the market. Besides that, homeowners, local energy initiatives and suppliers all expect to financially benefit from the transition and the Dutch government benefits economically from the increase of innovation that the transition towards being natural gas-free will cause.

When it comes to norms (see **Error! Reference source not found.**), the experience of p eers is mentioned as important across actors and used as a tool to gain knowledge. Besides that, however, multiple actors also feel pressure from above: the EU influences the Dutch government, which influences municipalities, which in turn affects homeowners. Suppliers also feel pressured by the norms of the Dutch government (e.g., hybrid water pump as standard from 2026 onwards). It is further striking that homeowners as well as municipalities are dependent on suppliers, while suppliers themselves are dependent on other suppliers that provide necessary parts of the new products.

As described in **Error! Reference source not found.**, time is mentioned as a necessary a gency for homeowners, local energy initiatives, municipalities as well as suppliers. Another necessity for homeowners, local energy initiatives, municipalities and the

Dutch government is trust in each other, for example when it comes to reasons behind actions, participation and taking actions. At the same time, a social network or staff as well as more information and knowledge is needed by all actors. Specifically, local energy initiatives, municipalities and the Dutch government are in need of knowledge concerning social and technical interventions. Besides that, within municipalities and the Dutch government, the capacity to coordinate or delegate is important for other parties to engage in becoming natural gas-free, while continuity within both institutions is relevant for them to cooperate easily and enable a smooth transition. Finally, another similarity is the lack of financial means. The Dutch government, municipalities and homeowners do not want to fully finance the transition towards becoming natural gas-free by 2050 themselves.

3.6.2 Differences between actors

There are, however, differences and friction between actors within the natural gas-free neighbourhoods which may lead to difficulties in terms of encouraging behavioural changes. Looking at the goals of the different actors, we see that the goal setting of municipalities and the Dutch government seem similar. However, the execution of the energy transition is mainly done by the municipalities, while the Dutch government primarily takes a supporting role. Even though municipalities carry the responsibility, they also have to abide the regulations and policies from the Dutch government, which may cause friction. Besides that, local energy initiatives are intermediaries between homeowners and the municipality, while the members are being homeowners themselves. This can cause friction, since they have to balance their own personal needs, the needs of their community as well as the policies and regulations of municipalities at the same time. The same accounts for municipalities, which have to balance the needs of their community, but at the same time have to abide policies and regulations from the Dutch government and the EU. Having to balance multiple needs may cause friction and difficulties within as well as between these actors.

As discussed in **Error! Reference source not found.**, we see differences between the m otivation of local energy initiatives, which is mainly intrinsically versus the motivation of homeowners. The latter are not engaging in climate actions by choice but are rather urged by their municipality, which can cause resistance and unwillingness to participate. This is also prominent in the fact that local energy initiatives associate the engagement in the energy transition with more positive outcomes than homeowners do (e.g., rectify bad decisions in the past, alternative must be at least as good). On top of that, homeowners experience a lack of information and knowledge on various topics (e.g., metering, what it means, costs). This can cause reactance among homeowners and may lead to them not willing to participate in the transition towards becoming natural gas-free. Besides that, initiatives and municipalities depend on suppliers, who experience problems with finding technical staff. This may cause delays in the implementation of new solutions.

Looking at norms (see 3.2), we see a potential problem regarding ownership and taking responsibility. Both homeowners and municipalities feel pressured by the government

to achieve climate goals. Although they want to move forward as quickly as possible, they depend on suppliers, while suppliers in turn depend on other suppliers that provide necessary parts of the new products. Being pressured from above, but at the same time being dependent on other parties may lead to reactance and entail the risk that, in the end, no party feels fully responsible for becoming natural gas-free by 2050.

Regarding agency (see 3.3) we gather that trust is an important issue which can cause friction between the actors within the natural gas-free neighbourhoods. Specifically, suppliers do not mention the importance of trust, while all other actors explicitly mention the importance of trust in the suppliers. Homeowners indicate uncertainty and have mainly financial and technical questions that are still unanswered. This again has a negative influence on their trust in other actors, particularly in local energy initiatives and their municipality. Finally, we see friction due to financial means. Municipalities and the Dutch government aim for homeowners to invest in alternative solutions, but homeowners often do not have the financial means to invest in the first place (even though they will receive their investment back by the Dutch government later on).

Regarding the relationships between the different actors (see **Error! Reference source n ot found.**), difficulties may emerge between homeowners and municipalities as well as the government. As mentioned before, this is mainly caused by trust issues and the top-down approach of the energy transition. The latter being evident by the criticism of municipalities by homeowners, who complain about not being involving enough in sustainability plans. Also, the relationship between local energy initiatives and the municipality is rather complex. On the one hand, local energy initiatives have high expectations of municipalities, regarding their collaboration and the amount of support they provide to homeowners. Municipalities, on the other hand, often want local energy initiatives to be the point of contact for homeowners. Finally, the co-dependent relationship between municipalities and suppliers may cause friction as well. While suppliers are in need of a profitable business case, municipalities are often in need of technological solutions as well as information and knowledge exchange. However, both cost time and money for the suppliers, which means that, in reality, knowledge exchange is often not prioritized and realized.

4 Discussion and reflection

In this chapter, we discuss the findings of the current report, by specifically focusing on the role and agencies of all the actors involved in the natural gas-free neighbourhoods, their main barriers and drivers, being part of local energy initiatives (i.e., energy communities), social justice and the policy context. Based on this reflection, policy recommendations will be formulated at a later stage in the GRETA project.

4.1 What role do the actors play and what kind of agency do they have in the natural gas-free neighbourhoods?

In the following, we will explain the role and highlight the most important agencies of each actor. This information is based on interviews with four experts from TNO and two research projects, carried out by TNO. For more detail, please see chapter 3.1 and Table 4 in chapter 3.4.

Each actor plays an essential role in the energy transition of the natural gas-free neighbourhoods towards being natural gas-free by 2050. The Dutch government, for instance, determines the funds and establishes laws and regulations to stimulate the transition. Also, governmental policy-makers inform and provide tools to municipalities as well as homeowners (e.g., by establishing the PAW as supporting entity). They are guided by EU regulations and policy frameworks, such as the Paris Agreement and the European Green Deal.

Municipalities carry the main responsibility for the energy transition on the local level. For that, knowledge about technical and social interventions and how to access and effectively use financial means, is crucial. Also, the human capacity to coordinate, delegate and legislate is important. However, there is often a shortage of staff and/ or influential citizens. Policy-makers are currently supported by the PAW providing information on technical and social interventions, and guided by the Dutch law and Dutch regulations, such as the Dutch Coalition Agreements of 2017 and 2019. Besides that, policy-makers of municipalities depend on suppliers and the cooperation of local energy initiatives as well as homeowners.

Local energy initiatives have an intermediary role between homeowners and municipalities. For that, smooth cooperation as well as trust in the Dutch government, municipalities and suppliers are essential. Beyond that, volunteers and a professional network are crucial for local energy initiatives. Also, determining a clear role and external positioning is necessary.

For suppliers to be able to take in a supporting role for municipalities, local energy initiatives and homeowners, financial means to innovate or invest in new solutions are

necessary. Besides that, staff and trainers as well as knowledge about alternative technical solutions are important agencies.

In the transition towards being natural gas-free, homeowners are dependent on other parties and the financial support and guidance of their municipalities as well as the Dutch government. Therefore, trust in the municipality, Dutch government, but also in suppliers and the solutions that are offered, as well as financial means are necessary agencies. Since especially trust is not always a given, a social network with knowledge and experience is very important for homeowners to engage in the natural gas-free neighbourhoods.

In general, all actors are in need of time, financial means, a social network and/or staff, knowledge (e.g., about technical and social interventions or technical solutions) and trust in each other to work properly towards being natural gas-free. These agencies are often still missing and should be taken into account when establishing new policy frameworks or when revisiting existing policies.

4.2 What are the main drivers and barriers for the actors to become natural gas-free?

In this subsection, we highlight the main drivers and barriers for each actor to become natural gas-free. This reflection is based on interviews with four experts from TNO and two research projects, carried out by TNO. For more detail, please see chapters 3.1-3.6.

The main drivers to engage in the energy transition are quite different for each actor within the natural gas-free neighbourhoods. For the Dutch government EU regulations, such as the Paris Agreement and the European Green Deal, environmental and economic benefits for the Netherlands are drivers to engage in the transition towards becoming natural gas-free. Similarly, municipalities are driven by the pressures from the Dutch government and EU regulations, while environmental benefits for their community are also important. Members of local energy initiatives are mainly driven by intrinsic motivations and the environmental benefits for themselves and their community. The main driver for homeowners are economic benefits. They are influenced by pressures from above, as in the regulations from municipalities and the Dutch government. Clear and regular information by other parties has a positive impact on homeowners' satisfaction. For the more intrinsically motivated homeowners, engagement is also motivated by the expected environmental benefits of the energy transition. Finally, suppliers are prominently driven by economic benefits to engage in the transition towards being natural gas-free by 2050.

There are various barriers for each actor within the natural gas-free neighbourhoods. Most actors are restricted by time, financial means, a social network and/or staff, knowledge (e.g., about technical and social interventions or technical solutions) and trust in each other. More specifically, the Dutch government is restricted by the

pressures of EU regulations, such as the Paris Agreement and the European Green Deal. Next to a shortage in experienced/ skilled staff and lack of funding, municipalities experience reactance from homeowners in their willingness to change. Besides that, regulations from the Dutch government are often too complex to understand, act on and benefit from. Local energy initiatives are mainly restricted by the lack of knowledge concerning new solutions as well as social interventions and experience issues in receiving access to sufficient funding. Similarly, suppliers are mainly restricted by financial means to innovate or invest in new solutions as well as technical experts and knowledge about alternative technical solutions. Finally, most homeowners have a lack of knowledge and experience when it comes to new technical solutions. They also often lack financial means and experience difficulties requesting financial support due to the complexity of the support systems and regulations available. Besides that, trust issues in municipalities and the Dutch government can restrict homeowners in engaging in the transition towards being natural gas-free.

Therefore, when designing policy frameworks on the local/national/regional level to foster engagement in becoming natural gas-free, policy-makers should take into account the importance of financial means, skilled and experienced staff, trust between actors, and knowledge about for example technical solutions and/ or social and technical interventions. When establishing policies, the focus should therefore be on developing a financial support system and on spreading clear information among all actors.

4.3 What role does being part of a local energy initiative play in the transition towards being natural gas-free?

In the following, we reflect on the role of being part of a local energy initiative in the transition towards being natural gas-free. This information derives from the interview with our expert on local energy initiatives and the paper by Klösters, de Koning, Kort, and Kooger (2020).

The presence of local energy initiatives plays an important role in the engagement of citizens. First of all, local energy initiatives are set up by homeowners – mostly intrinsically motivated homeowners – because they want to take matters into their own hands to make their homes future-proof. It gives them a feeling of purpose, influence, autonomy and independence. By joining forces homeowners share the workload and try to find solutions that fit the entire neighbourhood, which often also comes with financial benefits when concluding an agreement with a supplier. We see that mostly pensioners are leading local energy initiatives, which is probably because they often have more time available to tackle the challenges that come with the energy transition. Hence, they indirectly support neighbours who do not have the time to dive into technical and financial details. Furthermore, local energy initiatives have a voice on behalf of the residents towards the municipality and suppliers. For the municipality it becomes easier to connect with the homeowners, because local energy initiatives

generally spread important news amongst neighbours and have sometimes even individual contact with homeowners. Finally, in some neighbourhoods, we see that people who are unemployed become active in local energy initiatives. These members of local energy initiatives get the chance to work for the transition and/or undergo training to support the Dutch transition towards being natural gas-free.

4.4 What role do social justice considerations play in the transition towards being natural gas-free?

In this subsection, we reflect on social justice considerations in the transition towards being natural gas-free, meaning whether each actor has the same rights and opportunities economically, politically and socially. This reflection is based on research conducted by TNO looking into energy poverty.[20]

To take part in the transition towards being natural gas-free, homeowners often need to invest in home insulation measures and new technical solutions (e.g., install solar panels). Many houses in the Netherlands are of low energy-quality: most of the houses are poorly insulated. We also see an overrepresentation of low-quality homes among low-income households.[19] They do not have the financial means to invest in sustainable solutions. Even though there are subsidies in place, for example to receive a major discount, households often need to invest in the home improvement first. After the execution of the improvements, households submit the invoice and reclaim a part of the budget invested. Hence, households with no buffer or savings do not have access to the initial budget required. Due to this issue the government is now (since November 2022) also providing loans. If the household's income is less than € 45,014 gross, these households do not have to pay interest. Nevertheless, one group is still excluded: homeowners with a negative BKR listing (i.e., you are listed when you have arrears in payment with other creditors).[21]

Another group that is often excluded from the transition are tenants. Even though there are subsidies in place to stimulate private landlords and housing corporations to connect homes to heat networks, many tenants still live in a home depending on natural gas. The tenants are completely dependent on the private landlord or housing corporation. Furthermore, now energy (especially gas) prices are rising due to the energy crisis, these households are hit even harder compared to households that have the means to invest in their home.

Lastly, many municipalities apply to become one of the PAW pilot neighbourhoods.

[20] https://www.tno.nl/nl/newsroom/2021/09/tno-brengt-energiearmoede-gedetailleerd/
[21] https://www.warmtefonds.nl/particulieren

Once being a frontrunner in the transition, these neighbourhoods are less affected by the energy crisis than other Dutch neighbourhoods. Due to strict selection criteria and a limit on available funds, a group of neighbourhoods receive a rejection. Hence, the rejected neighbourhoods are lacking behind in saving energy, and therefore, still have relatively high energy bills. More emphasis should therefore be put on social justice considerations, when establishing new policy frameworks.

4.5 What role do policies play in the transition towards being natural gas-free?

In the following, we highlight the most important policies that affect the actors and the transition towards being natural gas-free. This reflection is mainly based on the subsection on the "Policy landscape" in 1.1.3.

For the transition towards being natural gas-free, EU regulations and policy frameworks, such as the Paris Agreement and the European Green Deal play a central role. They specifically have an impact on the course and actions of the Dutch government as well as the municipalities in the Netherlands. Based on these regulations, the Dutch government developed policy frameworks for the Netherlands (i.e., the Dutch Climate Agreements), established the National Insulation Programme and founded the PAW. These regulations and Programmes, in turn, have an impact on the actions of municipalities, local energy initiatives, homeowners, as well as suppliers.

On a regional and local level, financial support systems, such as tax reliefs and subsidies, are central for municipalities, local energy initiatives, homeowners in order to make them able to invest in new energy solutions. These financial incentives, meaning the creation of the possibility to invest, are essential to promote engagement in the Dutch energy transition, especially on a local level. Besides that, Programmes such as the RES and PAW are important for specifically municipalities to share knowledge and receive guidance and process support. However, policies and regulations are often too complex for policy-makers on a regional or local level and homeowners to understand. Therefore, we suggest that the policy landscape should be made easy for policymakers and citizens to understand, act upon and benefit from.

5 Conclusion

Based on previously conducted TNO research and multiple interviews of experts as part of T1.3, in the current report, the five main actors within the Dutch energy transition towards being natural gas-free (i.e., the Dutch government, municipalities, local energy initiatives, homeowners and suppliers), their goals, expected outcomes of engagement, agency, norms and relationship with each other were examined and discussed. Our findings show that each actor plays an important role in the energy transition towards being natural gas-free: the Dutch government has a coordinating role; municipalities are main responsible to guide homeowners in the transition towards being natural gas-free; local energy initiatives mediate between municipalities and homeowners; and suppliers play a supporting role for municipalities, local energy initiatives as well as homeowners by providing equipment, installation services and advice about new solutions. However, since homeowners are the ones that have to take action to replace natural gas in their household with alternative solutions, they are the main actors, who are dependent and influenced by the other actors within the Dutch transition of becoming natural gas-free (see Figure 5 for a visual representation).

Each of these actors seem to be driven and/or restricted by their expected outcomes of engagement in the transition, their sense of agency and (social) norms. Some of these drivers and barriers are similar across actors (e.g., environmental benefits and trust in other actors as drivers; financial means as barriers) and some may cause friction between different actors. For instance, the cause of motivation differs between actors: while local energy initiatives are motivated intrinsically, the Dutch government, municipalities and homeowners are influenced by regulations and policies, mostly from top-down. Although municipalities have the main responsibility for this transition, homeowners actually have to implement alternative solutions in their homes. Furthermore, homeowners and the municipality depend on other actors, such as funding from the Dutch government and the installation of the new technology by suppliers. Being pressured from above and, at the same time, depending on others may cause friction and reactance in municipalities as well as homeowners. The risk here is, that in the end, reactance takes over and no party feels fully responsible for becoming natural gas-free by 2050.

Besides that, homeowners often do not trust policy-makers of the Dutch government and/or the municipality, which also causes reactance to engage in the energy transition. In contrast to the other actors, homeowners also experience a lack of knowledge on various topics (e.g., metering, costs, consequences of the transition for household). On top of that, while municipalities and the Dutch government aim for homeowners to invest in alternative solutions themselves, they often lack the necessary financial means or feel like the government or their municipality is responsible and therefore should finance the transition. This again causes friction and poses another barrier for their engagement in the energy transition. For these reasons, resistance and unwillingness to participate is mainly found amongst homeowners.

Further, our findings show that there are differences in expectations between local energy initiatives and municipalities as well as municipalities and suppliers. While local energy initiatives have high expectations of municipalities in regards of working together as well as giving sufficient support to homeowners, municipalities lack the staff and rather want the local energy initiatives to be the point of contact for homeowners. Similarly, while municipalities want suppliers to provide technological solutions as well as exchange information and knowledge about these alternative solutions, suppliers often cannot or do not prioritize and realize the necessary knowledge exchange.

Based on these findings, the following implications for policy-making should be considered:

- A special focus should be put on bottom-up approaches, such as co-creation sessions in which multiple types of actors are present. Currently, multiple parties (i.e., Dutch government, municipalities and homeowners) feel pressured from above to act fast, but at the same time are dependent on each other and other parties (e.g., suppliers), which often causes trust issues between actors. If they work closely together, they can tailor their plans to the needs and issues applicable for the local situation.
- Especially among homeowners, more information about the technical solutions is needed. Currently, PAW is supporting municipalities in taking on the directing role in this transition. They share information, tools and examples on how to orchestrate the transition. PAW is sharing tips and tricks on how to involve residents (i.e., citizen participation). However, homeowners stress that municipalities involve them too little in their sustainability plans. Therefore, when designing policy frameworks and support systems, tailored information (e.g., about technical solutions and consequences of the transition for households) should be provided to homeowners and local initiatives.
- For homeowners, financial means are often limited, and the financial support system is quite complex and hard to understand. When designing policy frameworks, the Dutch government should focus on simplifying regulations and support mechanism, so that municipalities as well as homeowners can understand and benefit from them properly.
- Local initiatives claim that they expect more support from the municipality. Investments should be made in increasing available capacity at municipalities to better support local initiatives as well as homeowners individually in the transition towards being natural gas-free.
- Besides providing technological solutions, suppliers are asked to provide information and knowledge about the available technical alternatives to municipalities and homeowners. When designing financial support systems, policy-makers should invest in technical jobs and training so that more technical suppliers are available.

References

VVD, CDA, D66, & ChristenUnie. (2017). *Vertrouwen in de toekomst, regeerakkoord 2017-2021*. Den Haag: Rijksoverheid

de Boer, S. (2020). *De energietransitie uitgelegd*. De groene Waterelie (2020). ISBN: 9789083083018.

de Koning, N., Kooger, R., Hermans, L., Tigchelaar, C. (2020). *Natural Gas-Free Homes: Drivers and Barriers for Residents*; Report P12006; TNO: The Hague, The Netherlands.

Klösters, M., de Koning, N., Kort, J., Kooger, R. (2020). *De kracht van het collectief*. Report P12079. TNO: The Hague, The Netherlands.

Koirala, B., de Koning, N., Kort, J., Iannone, A., Bisconti, P., Claessens, B., Bellesini, F., Mancinelli, E., Tribbolati, G., Boijn, E. (forthcoming). *Deliverable D3.1 Overview of barriers and drivers for consumer engagement in demand response*. In: Boosting DR through increased community-level consumer engagement by combining Data-driven and blockchain technology Tools with social science approaches and multi-value service design (BRIGHT). EU Horizon 2020 innovation Programme, Grant agreement No 957816.

Rijksoverheid Nederland, (2019). *Klimaatakkoord*. Report available online in pdf format: https://www.klimaatakkoord.nl/klimaatakkoord

Annex A: Example expert interview protocol (homeowners)

The following example interview protocol is based on the interview protocol which was proposed in D1.3.

Preamble: The aim of this interview is to find out more about your thoughts on replacing natural gas for another solution within your household. There are no right or wrong answers; we are merely interested in your personal opinion.

Part A - General Information

- Name of interviewee
- Demographics:
  - Age
  - Gender
  - Household composition

Part B - Past behaviour and planned actions

- Have you replaced natural gas for another solution within your household in the recent past?
  - How did you experience this?
- Have you plans to replace natural gas for another solution within your household in the near future?
- How about in the long term?
- What were/are the reasons to (NOT) replace natural gas for another solution?

Part C - Potential outcomes

- What do you see as the advantages/ benefits of (NOT) replacing natural gas for another solution within your household?
- What do you see as the disadvantages of (NOT) replacing natural gas for another solution within your household?
- [What else comes to mind when you think of (NOT) replacing natural gas for another solution within your household?]

Part D - Norms

When it comes to replacing natural gas for another solution within your household, there might be individuals or groups who would think you should or should not perform this behaviour.

- Are there people, organisations or institutions that influence you to (NOT) replace natural gas for another solution within your household?
  - Who are these people, organisations or institutions?
  - How did these people, organisations or institutions influence you to replace natural gas for another solution within your household?

- Are there any people, organisations or institutions who you think are in favour of you replacing natural gas for another solution within your household?
  - Who are these people, organisations or institutions?
  - Why are they in favour of you replacing natural gas for another solution within your household?
- Are there any people, organisations or institutions who you think are not in favour of you replacing natural gas for another solution within your household?
  - Who are these people, organisations or institutions?
  - Why aren't they in favour of you replacing natural gas for another solution within your household?

Part E - Agency

- What do/ did you need to replace natural gas for another solution within your household?
  - What factors or circumstances would make it easy or enable you to replace natural gas for another solution within your household?
  - What factors or circumstances would make it difficult or prevent you to replace natural gas for another solution within your household?
- Are there any people or institutions from which you need help to replace natural gas for another solution within your household?

Part F - Relational model

- What is/ How would you describe your relationship with:
  - citizens who are part of an initiative
  - local policy-makers (municipalities)
  - suppliers?

Annex B: Expert interview protocols (translation)

Homeowners

Preamble: The aim of this interview is to find out more about your thoughts on replacing natural gas for another solution within your household. There are no right or wrong answers; we are merely interested in your personal opinion.

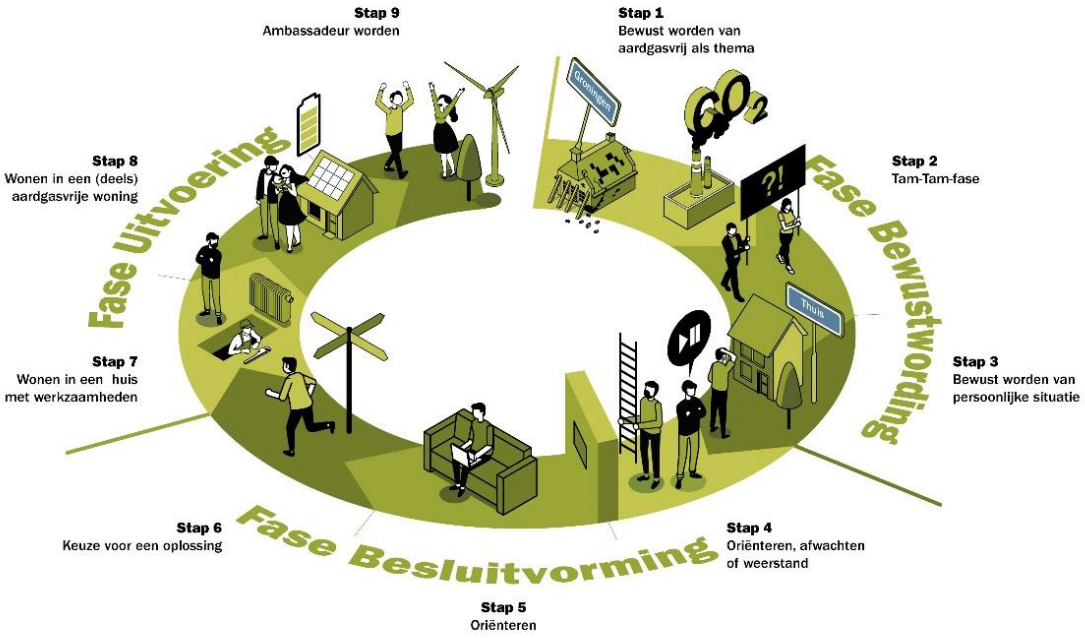
Part A – General Information

- Interviewee: *senior scientist at TNO with an expertise in the natural gas-free neighbourhoods*

Part B – Past behaviour and planned actions

- Have you replaced natural gas for another solution within your household in the recent past?
  - How did you experience this?

  In the KIP "The customer journey complete", we are now researching how residents experienced the last three steps of the customer journey; the Implementation phase



- Have you plans to replace natural gas for another solution within your household in the near future?

  See this survey commissioned by the Home Owners Association (VEH):
  "Almost half of homeowners say they want to set aside time and money for the heat transition. Homeowners from Groningen, Friesland and Drenthe are more likely to plan

to make their homes more sustainable within two years than homeowners from the Randstad. Among them, owners in the north are thinking of 'going completely off the natural gas' and installing solar boilers. While owners in Overijssel, Gelderland and Flevoland prefer small energy-saving measures such as draught strips and Led lighting. Solar panels are mentioned as the most popular sustainability measure."

Municipalities involve homeowners too little in sustainability plans – VEH Transitievisiewarmte (eigenhuis.nl)

- How about in the long term?
- What were/are the reasons to (NOT) replace natural gas for another solution?
  Replace: you can give the overview of drivers from the study "Natural gas-free living: drivers and barriers of residents"
  Not replace: you can give the overview of barriers from the study "Natural gas-free living: drivers and barriers of residents"

  You can also use the resident satisfaction survey "Resident Satisfaction Living Labs Natural Gas-Free Neighbourhoods Report - June 2021".
  Page 7:
  "The most pressing factor on resident satisfaction: high costs. The financial side of making homes natural gas-free is central to residents. It is frequently mentioned as a point for improvement and hardly ever as a reason for satisfaction. Consequently, about half of residents say they have no money to spare for making their homes natural gas-free."

  Page 8:
  "Other pressing factors on satisfaction: low reliability of the proposed techniques and lack of freedom of choice regarding one's own home. There is clearly still a lot of discussion and also lack of clarity about the alternatives to natural gas. This makes residents uncertain and they lack this (independent) knowledge in the process. This results in doubts or sometimes explicit distrust towards the proposed techniques. It creates dissatisfaction with the approach. Finally, freedom of choice is an important determining factor. In particular, freedom of choice regarding one's own home (owner-occupiers). When people get the feeling that something is being imposed on them when it comes to their own home and they experience no (or insufficient) advantages and mainly see disadvantages (costs, nuisance with a detrimental effect on their enjoyment of life), this results in dissatisfaction. These findings from the study are confirmed by the desk research and also the interviews with the municipalities."

  "Factors that work positively on resident satisfaction: clear and regular communication from living labs and involving residents. There is a clear need among residents for clear (as concrete as possible) and regular information provision within the living lab approach. Residents who are satisfied with the living lab approach specifically cite the provision of information and also the extent to which they are involved as reasons for their satisfaction."

Part C – Potential outcomes

- What do you see as the advantages/ benefits of (NOT) replacing natural gas for another solution within your household?
  Do replace: Here you can mention from the study "Natural gas-free living: drivers and barriers of residents" the drivers related to potential outcomes. Examples: Natural gas-free is good for the environment, gas prices will go up in the future, etc
  Not replace: Here you can mention from the research "Natural gas-free living: drivers and barriers of residents" the barriers related to potential outcomes. Examples: "The new way of heating is less comfortable", "Electric cooking is not a good alternative to gas".

- What do you see as the disadvantages of (NOT) replacing natural gas for another solution within your household?
- [What else comes to mind when you think of (NOT) replacing natural gas for another solution within your household?]

Part D – Norms

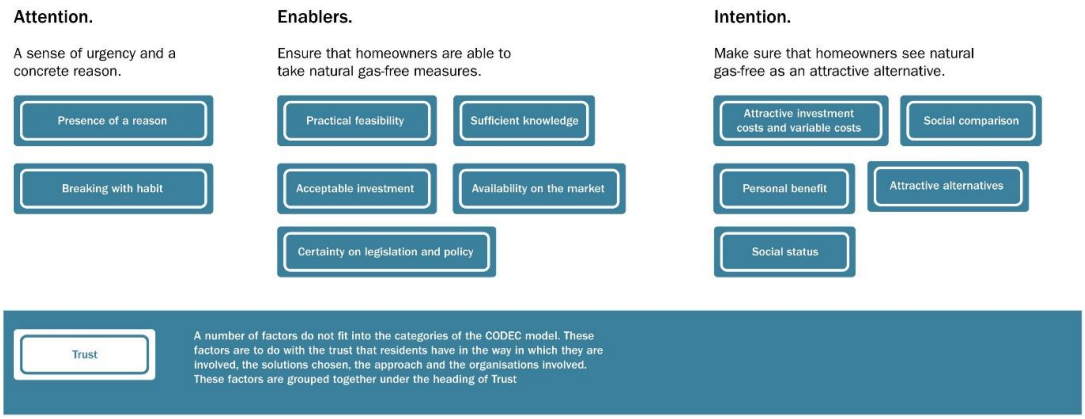
When it comes to replacing natural gas for another solution within your household, there might be individuals or groups who would think you should or should not perform this behaviour.

- Are there people, organisations or institutions that influence you to (NOT) replace natural gas for another solution within your household?
  - Who are these people, organisations or institutions?
  - How did these people, organisations or institutions influence you to replace natural gas for another solution within your household?
- Are there any people, organisations or institutions who you think are in favour of you replacing natural gas for another solution within your household?
  - Who are these people, organisations or institutions?
  - Why are they in favour of you replacing natural gas for another solution within your household?
- Are there any people, organisations or institutions who you think are not in favour of you replacing natural gas for another solution within your household?
  - Who are these people, organisations or institutions?
  - Why aren't they in favour of you replacing natural gas for another solution within your household?

Part E – Agency

- What do/ did you need to replace natural gas for another solution within your household?
  - What factors or circumstances would make it easy or enable you to replace natural gas for another solution within your household?

- What factors or circumstances would make it difficult or prevent you to replace natural gas for another solution within your household?
  Here you can also refer to the CODEC model - section "Possibility" ("Enablers"). Within possibility, we have distinguished a number of factors regarding natural gas-free. We then linked the drivers and barriers back to those factors. => if this is useful, I can look up the Excel for you because the report only shows the numbers and not which drivers/ barriers they are.
  See the ENG version of the report (p56)



- Are there any people or institutions from which you need help to replace natural gas for another solution within your household?
  This is a somewhat older survey by Feenstra (supplier), 2019: "Almost all residents (87%) think the government should at least 'up to the front door' to make sure we can use renewable energy. One in three respondents even thinks the government should regulate everything."

Part F – Relational model

- What is/ How would you describe your relationship with:
  - citizens who are part of an initiative
    Perhaps interesting to note how many energy cooperatives there are in NL: "By the end of 2021, the Netherlands has a total of 667 energy cooperatives. The cooperatives now have a total of about 112,000 members and/or participants in projects, a growth of 15%. The number of local energy cooperatives is not growing much anymore, but the quality is. They are also broadening more and more."

    Perhaps more interesting to mention success factors of energy cooperatives, see thesis below: Succesfactoren van energiecoöperaties (Interview met dr. Beau Warbroek, Universiteit Twente)

  - local policy-makers (municipalities)
    Perhaps you could comment here on the state of trust in the government, following the impact of the corona policy. See Erasmus University Rotterdam

survey. Side note: this is probably about the central government. If so, please state this.

"The Netherlands has the character of a low-trust society by September 2021. There has been a sharp decline in trust in the government over the past 18 months: from almost 70 per cent in April 2020 to less than 30 per cent in September 2021. There has also been a slight decline in mutual trust between people. People mostly trust relatives (family and friends) and people with whom one can maintain a personal relationship, such as the family doctor."

SCP works with the model below (see page 20, Op weg naar aardgasvrij wonen by Samantha Scholte, Yvonne de Kluizenaar, Tim de Wilde, Anja Steenbekkers en Christine Carabain)

- suppliers?

Local Energy Initiatives

Preamble: The aim of this interview is to find out more about your thoughts on replacing natural gas for another solution within your neighbourhood. There are no right or wrong answers; we are merely interested in your personal opinion.

Part A – General Information

- Interviewee: *scientist integrator from TNO with an expertise in the natural gas-free neighbourhoods (based on interviews with the initiative's representatives)*
- Name of initiative: *De Groenste Buurt (Noorderplantsoenbuurt, Groningen)*
- Description of initiative: *De Groenste Buurt (GB) aims to convert the Noorderplantsoenbuurt neighbourhood to an energy-neutral neighbourhoood, which entails that the total energy usage equals the amount of energy generated. This is accomplished by making locals enthousiastic for our plans and to both save energy and generate as much energy ourselves as possible. In addition, we buy sustainable energy from the cooperative energy company EnergieVanOns. We also would like to make our neighbourhood greener (literally) in order to protect ourselves against the increasingly hotter, dryer and wetter seasons.*

Part B – Past behaviour and planned actions

- Have you had any experience in replacing natural gas for another solution within your neighbourhood in the recent past?
  - How did you experience this?

  Yes, in the sense that GB has worked together with the municipality of Groningen to write a district energy plan (wijkenergieplan) for the neighbourhood. There was some

friction during the collaboration, however. Reasons for this were the frequent changes in personnel at the municipality, which gave GB the impression that they had to start from scratch every time. There were also some tensions due to the expectations that GB had put on the municipality regarding funding, which also had negative impact on the speed of the process. However, this was due to the fact that municipal elections took place, which resulted in budget cuts for in particular areas, including this project, which was disappointing for GB, whose members already had invested significant time and effort

- Does your initiative have plans to replace natural gas for another solution within your neighbourhood in the near future?
  From the study that has been done together with the municipality, the solution for the Noorderplantsoenbuurt was a hybrid one, meaning that energy will be generated through hybrid heatpumps (regular air heatpumps in combination with green/bio gas). District heating was not deemed to be possible as a short-term solution, due to the types of residences in the neighbourhood. However, in the long term, GB keeps an open mind for future alternative solutions as technology progresses (for example, hydrogen).
  → Knowledge about technical interventions, appropriate tools/ approach to achieve (sub)goals

- What were/are the reasons to (NOT) replace natural gas for another solution?
  The types of residences (mostly built after WWII) are ill-suited for district heating or an all-electric solution. Therefore a hybrid solution was the most efficient one for the time being.

Part C – Potential outcomes

- What do you see as the advantages/ benefits of (NOT) replacing natural gas for another solution within your neighbourhood?
  Making our neighbourhood gasfree is one of the main aims of the initiative, which actually has an even a wider scope of becoming energy neutral and green (literally). The members of the initiative believe that they can also contribute to combatting climate change by starting at a local level; this is also why the initiative exists.

- What do you see as the disadvantages of (NOT) replacing natural gas for another solution within your neighbourhood?
  The costs involved are high and are not affordable for many, particularly (social) tenants. It's also quite a hassle, because no one really wants to think about it. There has to be a solution for these people as well.

- [What else comes to mind when you think of (NOT) replacing natural gas for another solution within your neighbourhood?]

Part D – Norms

When it comes to replacing natural gas for another solution within your neighbourhood, there might be individuals or groups who would think you should or should not perform this behaviour.

- Are there people, organisations or institutions that influence you to (NOT) replace natural gas for another solution within your neighbourhood?
  - Who are these people, organisations or institutions?
    Perhaps (social) tenants or private landlords, they might not have an incentive to invest in sustainable measures. Similarly, large housing corporations might or might not be interested, depending on their own interests or whether they are forced to by (municipal) legislation.

  - How did these people, organisations or institutions influence you to replace natural gas for another solution within your neighbourhood?
    The groups described above did not really influence our decision to make our neighbourhood gas-free, since they are usually absent in our meetings.

- Are there any people, organisations or institutions who you think are in favour of you replacing natural gas for another solution within your neighbourhood?
  - Who are these people, organisations or institutions?
    Most likely the municipality and private homeowners.

  - Why are they in favour of you replacing natural gas for another solution within your neighbourhood?
    The municipality wants to be CO2 neutral by 2035, so they have an interest in helping us making our neighbourhood gas-free. The private homeowners usually will do so because of environmental concerns and/or because they can afford to.

- Are there any people, organisations or institutions who you think are not in favour of you replacing natural gas for another solution within your neighbourhood?
  - Who are these people, organisations or institutions?
    There will probably not be people who are against it, but rather those who have no incentive to participate. These are the aforementioned social tenants, which includes (international) students, private landlords and housing corporations.

  - Why aren't they in favour of you replacing natural gas for another solution within your neighbourhood?
    The tenants have no ownership of the residence, so they will not be able to make decisions. Landlords will most likely only be incentivized if there is some financial gain for them and the same goes for housing corporations.

Part E – Agency

- What do/ did you need to replace natural gas for another solution within your neighbourhood?

- What factors or circumstances would make it easy or enable you to replace natural gas for another solution within your neighbourhood?
  Financial support from the municipality, professional (hired) expertise, large support base from residents (would make it cheaper to buy in bulk), a fixed contact person at the municipality

- What factors or circumstances would make it difficult or prevent you to replace natural gas for another solution within your neighbourhood?
  The opposite of the factors named in the previous question. In addition, lack of manpower (as we are all volunteers) and lack of professionalism (so no one can be held accountable)

- Are there any people or institutions from which you need help to replace natural gas for another solution within your neighbourhood?
  The municipality, professional experts, suppliers of sustainable solutions and of course the people in the neighbourhood, they are the most important.

Part F – Relational model

- What is your relationship with:
  - homeowners
    Our meetings are generally frequented by a specific group of people, mostly elderly/retired male homeowners. They are the most interested and seem to be generally well-informed about what we do. I would say we have a good relationship.

  - local policy-makers (municipalities)
    The municipality has been supportive of what we do, and although we do expect some things from them in terms of money and support, we realise that they cannot provide everything. We have had some frictions in the past, but our relationship now is good.

  - suppliers?
    We are in contact with many different suppliers for sustainable solutions, such as solar panels and e-mobility and we often invite them to our neighbourhood meetings.

Municipalities

Preamble: The aim of this interview is to find out more about your thoughts on supporting residents of municipalities to replace natural gas in their households for another solution until 2030 or max. 2050. There are no right or wrong answers; we are merely interested in your personal opinion.

Part A – General Information

- Interviewee: *scientist innovator from TNO with an expertise in natural gas-free neighbourhoods (based on research with municipalities supporting residents to replace natural gas in their households with another solution)*

Part B – Past behaviour and planned actions

- Did your municipality provide support to residents to become natural gas-free, in the recent past? (e.g., policies, activities). If yes:
  - What type of support (e.g., activities/policies)?
  - What was your role in this?
  - How did you experience this?
- Are there plans to provide support to residents to become natural gas-free in the near future? If yes, what type of support?
- How about in the long term?
- What were/are the reasons to (NOT) support residents to become natural gas-free?
  - *Heat visions/ transition vision heat (at municipal level)*
    - *Translate vision into what kind of projects and infrastructure*
    - *What are potential sources and how will we link them to transition demand*
    - *Definition changes that have impacted municipalities' actions*
    - *Outsourcing transition vision heat possible*
    - *No legal consequences but obligation from the government*
  - *Neighbourhood implementation plans*
    - *Linked to environmental plans (especially participation, health)*
    - *Challenge: getting this done by 2030*
  - *Collective heat supply: the Ministry of Economic Affairs wants heat supply to become public*
  - *New energy law: cooperation of gas law, which will also result in some activities; you will see more and more overlap*

Part C – Potential outcomes

- What are positive implications for the municipality of (NOT) supporting residents to become natural gas-free?
  - *Support for change (differences between private/owners vs. tenants), especially commitment*
    - *As a municipality, how will you achieve this willingness?*
    - *How do you use VVEs or local energy cooperatives?*
    - *Leads to financial benefits (the more support, the more initiative by citizens themselves and less financial input by municipality needed)*
    - *Leads to speed/ efficiency as less misinformation will happen*
    - *Leads to environmental benefits*

- What are negative implications for the municipality of (NOT) supporting residents to become natural gas-free?
  - *Possible imbalance between what is invested in participation pathways and really in the transition itself*
  - *Change from e.g. left-wing coalition (focusing on participation) to right-wing coalition. This could result in plans being upended and lead to delays.*

- [What else comes to mind when you think of (NOT) supporting residents to become natural gas-free?]

Part D – Norms

When it comes to supporting residents to become natural gas-free, there might be individuals or groups who would think you should or should not do this.

- Are there any people, organisations or institutions who you think are in favour of you supporting residents to become natural gas-free?
  - Who are these people, organisations or institutions?
  - Why are they in favour of you supporting residents to become natural gas-free?
    - *Energy cooperatives and municipalities always work well together: information by cooperatives and resources by municipality*
    - *Housing associations and municipalities work well together: information input*
    - *Grid operator benefits from more certainty by municipality: what to expect e.g. pressure on grid*
    - *VVEs are very keen on the municipality, want municipality to support them*

- Are there any people, organisations or institutions who you think are not in favour of you supporting residents to become natural gas-free?
  - Who are these people, organisations or institutions?
  - Why aren't they in favour of you supporting residents to become natural gas-free?
    - *Heat companies/ suppliers: challenging, important partners, but make themselves indispensable to the municipality because of the knowledge they have in-house*
      - *Get involved in projects early on*
      - *Are becoming increasingly powerful, which is a challenge*
      - *Plan of collective networks have impact on heat companies, but what impact is unclear*
      - *Are named by municipality as advocates but still prove to be difficult partners*
    - *Also groups of residents who have less confidence in municipalities*

- Are there people, organisations or institutions that (try to) influence you to (NOT) support residents to become natural gas-free?
  - Who are these people, organisations or institutions?
  - How did these people, organisations or institutions influence you to (NOT) support residents to become natural gas-free?
    - *Coalition: They are responsible and therefore want to have control/understand what the plans are*
      - *Key question: what are political risks?*
    - *Council: for decision-making, every law has to pass the Council*
      - *This makes the blending between political and civil service increasingly close*
    - *Parties wanting to cooperate even more: water companies*
      - *Importance of playing a greater role*
    - *Residential areas, such as commercial real estate and local entrepreneurs opposed to new obligations*

Part E – Agency

- What do/ did you need to support residents to become natural gas-free?
  - What factors or circumstances would make it easy or enable you to support residents to become natural gas-free?
    - *Capacity needed to support residents (e.g. residents' evenings or kitchen table meeting)*
      - *How to support residents to help each other?*
      - *Identify influential residents and enthuse them to help*
    - *Knowledge: how to effectively/efficiently engage in the transition? How do municipalities support citizens over time (long-term)?*
    - *Certainty/ consistency in policy: how and what do you communicate? This affects citizen trust.*
    - *Residents open to change*

  - What factors or circumstances would make it difficult or prevent you to support residents to become natural gas-free?
    - *Change in coalition: implementation stands still because new coalition wants to know what the plans are; different knowledge and skills needed in new phase of implementation*
    - *Capacity/knowledge is the biggest challenge*
    - *Trust from residents towards the municipality is a problem in many big cities/ projects*
    - *Timing/ dynamics with stakeholders and residents*
    - *Often resistance by citizens*
      - *Risk aversion based on experiences/ resistance from citizens*
    - *Upcoming legislation may contradict each other*
    - *From vision, to planning to implementation, techno-economic needs (infrastructure and technology) and later socio-economic needs are important*

        - *Implementation is a huge challenge*

- Are there any people or institutions from which you need help to be able to support residents to become natural gas-free?

Part F – Relational model

- What is/ How would you describe your relationship with:
  - Homeowners
    - *Often resistance because they are alone in the investment, do not want participation due to political preferences or often have less trust towards governments*
    - *Expectation that there is someone who takes direction, but this can differ between parties and residents and over time*

  - citizens who are part of an initiative
    - *Enthusiastic people, less trust issue than homeowners*
    - *Municipality must respond to initiative (timings/ tasks), otherwise resistance will arise*
      - *Rules of play must be clear (e.g. precondition at temperature level, etc.) if control is left to initiative within neighbourhoods*
    - *Expectation that there is someone who takes direction, but this can differ between parties and residents and over time*

  - suppliers?
    - *Most complicated relationship because suppliers are in a powerful position*
      - *Knowledge*
      - *For a heat supplier, the business case must be positive but the risk lies with the municipality*
      - *Financial interests are at the forefront: e.g. favoured by municipality if they can cater for the whole municipality*

Suppliers

Preamble: The aim of this interview is to find out more about your thoughts on providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free until 2030 or max. 2050. There are no right or wrong answers; we are merely interested in your personal opinion.

Part A – General Information

- Interviewee: *scientist innovator from TNO with an expertise in natural gas-free neighbourhoods (based on surveys with installers and suppliers)*

Part B – Past behaviour and planned actions

- How did you experience providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free in the recent past?
- How do you see your role as provider of equipment and installation services of new solutions in all Dutch households to make them natural gas-free in the near future?
- How about in the long term?
    - *Providing equipment and installation services*
    - *Knowledge suppliers, so they also have an advisory role. This does pose a problem because not all installers have knowledge about these alternatives, but demand is very high.*
        - *They are in demand during maintenance*
    - *Helpers in the implementation/ realisation of energy transition*

- Besides economic benefits, do you **as a supplier** have other reasons to provide equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
    - *Making time and money available to train people*
    - *Faith and conviction, motivation to leave the world more beautiful and cleaner (climate change mitigation)*
    - *Often family businesses or companies engaged in innovation*
    - *Having fun in the field/ tinkering with modern techniques (innovation)*
    - *Engineers may have a different motivation than the founder*

Part C – Potential outcomes

- What do you see as the advantages/ benefits of you as a supplier that is providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free in comparison to suppliers that do don't?
    - *Growth market (financial benefits)*
    - *Scarcity in the market to get new people*
    - *Attract new employees: important issue so young generation wants to work in the field*
    - *Fun work atmosphere: innovative, family/ friendly atmosphere*
    - *For a small group: environmental benefits*

- What do you see as the disadvantages of you as a supplier that is providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free in comparison to suppliers that do don't?
    - *Investment in knowledge, free up money for it*
    - *Pioneering means more things go wrong and that generates more work*
    - *So time, effort and money while too busy*
    - *There are too few suppliers*
    - *Easier to stick with traditional products/services*

- *Material scarcity (e.g., China)*
- *Chain suppliers, so that means there is a contractor in between so the supplier itself has no direct contact with customers*
  - *The contractor has the power*

- [What else comes to mind when you think of providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free?]

Part D – Norms

When it comes to providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free, there might be individuals or groups who would think you should or should not perform this behaviour.

- Are there any people, organisations or institutions who you think are in favour of you providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
  - Who are these people, organisations or institutions?
  - Why are they in favour of you providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
    - *Building users (including citizen initiatives), municipalities, the government*
    - *Why? Payback models, long-term effects, comfort, user benefits, climate impact*

- Are there any people, organisations or institutions who you think are not in favour of you providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
  - Who are these people, organisations or institutions?
  - Why aren't they in favour of you providing equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
    - *Those who want low investment costs due to financial reasons and convenience*

- Are there people, organisations or institutions that influence you to (NOT) provide equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
  - Who are these people, organisations or institutions?
  - How did these people, organisations or institutions influence you to provide equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
    - *Builders and contractors (coordination) have a bigger role. These benefit less from more expensive systems. This is to the detriment of installers.*

- *Parties that e.g. make batteries (need more storage and become independent of the grid), i.e. component suppliers*
- *Energy consultants, who do house scans and make recommendations based on knowledge; they can be lead generators*

Part E – Agency

- What do/ did you need to provide equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
  - What factors or circumstances would make it easy or enable you to provide equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
    - *Knowledge*
    - *Component suppliers (storage capacity)*
    - *Professionals*
    - *Disappointment in training → own training in-house*
    - *Explain and try out techniques on own premises*
    - *Time and capacity*
    - *Financial resources for advance ordering*
    - *High gas/electricity prices*

  - What factors or circumstances would make it difficult or prevent you to provide equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
    - *Disappointment in training*
    - *Not enough staff*
    - *Corona: you are not allowed to visit everyone's home during a lockdown*
    - *Material scarcity especially for heat pumps*

- Are there any people or institutions from which you need help to provide equipment and installation services of new solutions in all Dutch households to make them natural gas-free?
  - *Knowledge/training*
  - *Parties providing the components*
  - *Information on subsidies, you need to know forms, offer to fill in those forms*
  - *Energy offices, hired by municipalities, are a lead generator so they can bring in customers (but right now suppliers/installers have enough customers)*

Part F – Relational model

- What is your relationship with:
  - homeowners
    - *Economic relationship*
    - *For homeowners don't know much and thus depend on suppliers/installers*
    - *Trust is important*

- citizens who are part of an initiative
  - *Same as homeowner, but even more steering and thinking along*
  - *Bring in new ideas (e.g., Gulpener)*
  - *Can offer pilot or demonstration and advertising platform*

- local policy-makers (municipalities)?
  - *Knowledge exchange (but does this happen enough? At Eneco this does not happen enough e.g.)*
  - *Local subsidies*
  - *Municipalities should not have preferences for certain installers/suppliers*