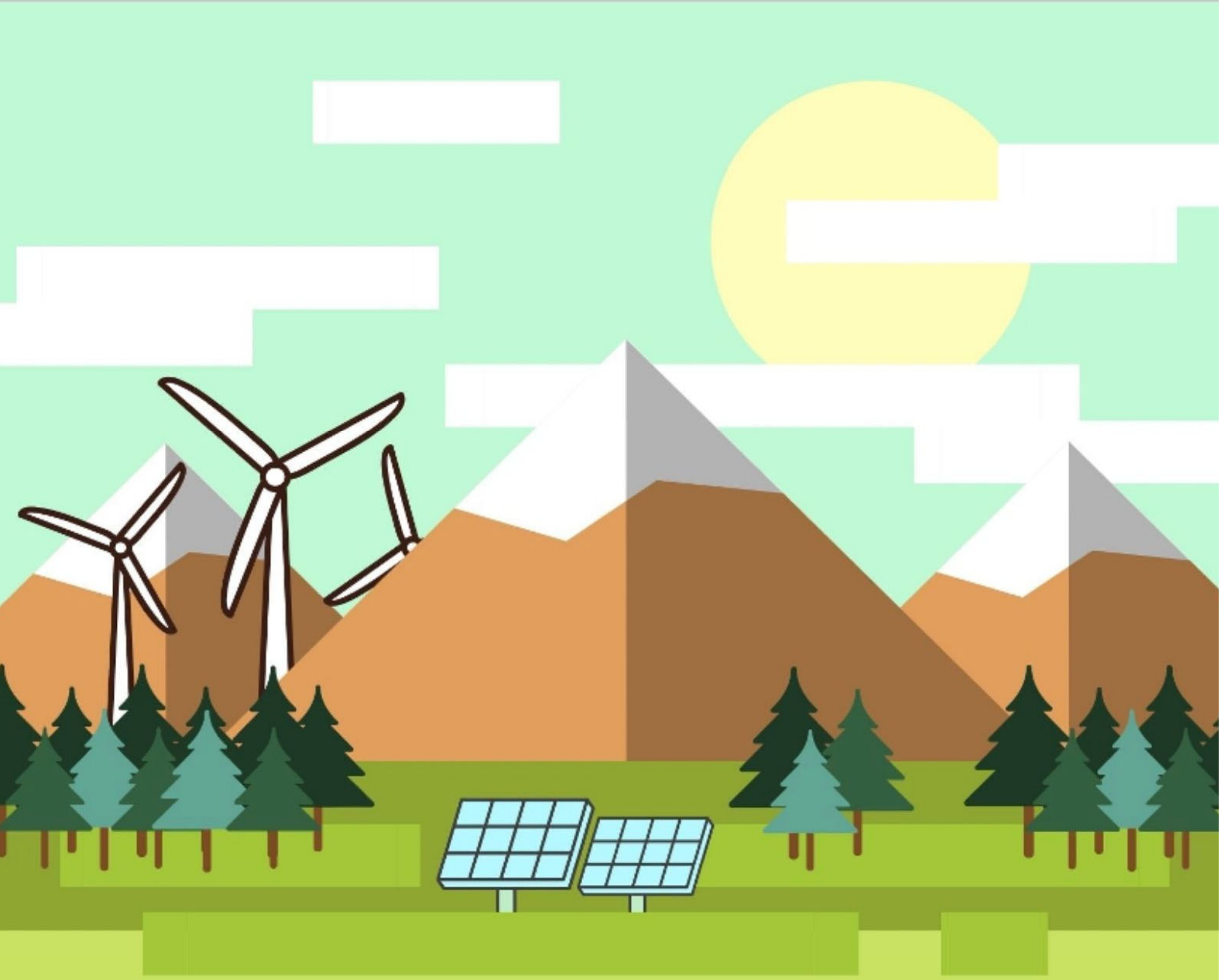

A MULTI-LEVEL PERSPECTIVE ON POLICIY RESISTANCE IN THE GAS TRANSITION

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Abstract

This study combines the framework of the Multi-Level Perspective (MLP) and System Dynamic (SD) to analyze the gas transition in the province of Gelderland. The data from two Group Model Building workshops map out the structure that is responsible for policy resistance and answer the following two research questions: *how is the system structured that is responsible for policy resistance in the gas transition among homeowners in the province of Gelderland?* and *what can explain the presence of policy resistance among homeowners in the gas transition in the province of Gelderland?* The results of the study show how insufficient presence of good information provision, lack of regulation from municipalities and financial attractiveness slow down the pace of the transition. The conclusions for both approaches used are different. The Multi-Level Perspective can be seen as a filter to apply on high leverage points identified using System Dynamics to increase the quality of the results and show if the high leverage points of a model can be changed, considering their level in the Socio-Technical System. Furthermore, the workshops resulted in feasible policy options generated by the participants to apply on high leverage points in the model. Further research can invite a larger and varied number of homeowners and build on the combination of the two approaches suggested.

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1. Introduction

The prospects for natural gas changed dramatically between 2012 and 2018 in the Netherlands due to rising concerns over climate change and earthquakes in the province of Groningen. This resulted in a shift in policy focus from financial to environmental and safety concerns (Beckman & van den Beukel, 2019). In October 2017 the government adopted greenhouse gas emission reduction targets which must decline the consumption of natural gas completely by 2050 and in March 2018 the government announced that production from the Groningen field will be phased out as quickly as possible and no later than 2030 (Beckman & van den Beukel, 2019).

Around the same time in 2017, the province of Gelderland came up with "het Gelders Energieakkoord". The goal of this agreement is to provide a hundred thousand households with locally generated sustainable energy by 2020 (van der Ploeg et al., 2015). This number of households will grow to about one and a half million by 2030. One of the twenty-three themes in this agreement is called "the Neighborhood of the Future", better known as the gas transition. The gas transition focusses on disconnecting natural gas from houses and constructing a new sustainable supply of energy and heat. The focus of the agreement lies on corporation across communities, municipalities and businesses to make the province climate neutral by 2050 (van der Ploeg et al., 2015). This requires a major transition that takes place per district and will have a major impact on residents according to Milieu en Klimaat (2019). The municipalities have most responsibilities in the district-oriented approach, with the support of the national government (van der Ploeg et al., 2015). Homeowners are expected to arrange the gas-freeing of their homes themselves.

Despite the political consensus on climate goals, there is still a lot of uncertainty about what the gas transition in Gelderland and the Netherlands should look like. According to Beckman & van den Beukel (2019) the progress has been slow and surrounded by controversy, such as a lack of coercive measures, where a single homeowner can hinder the neighborhood-oriented approach (Ministerie van Binnenlandse Zaken, 2017) or homeowners who lack the financial resources and / or the necessary knowledge to make their homes natural gas-free (TNO, 2019).

Previous research also pointed out that the support of municipalities from the national government and the communication between these two levels is not always effective (Wetenschappelijk Bureau GroenLinks, 2017) and current legislation does not allow certain parties, such as grid operators, to play an advisory role in the district-oriented approach

(Rijksoverheid, 2019), while these actors hold important knowledge to make the transition a success.

This seems disturbing; however, it is not the first time a sustainable transition faces resistance. Previous studies show some of the difficulties in moving towards a more sustainable energy system in the Netherlands (Kern & Smith, 2008) while Agterbosch et al. (2004) studied obstacles for wind power implementation. Negro, Hekkert, and Smits (2007) and Raven (2004) have analyzed the slow diffusion of biomass technologies and the Dutch renewable policies have been studied by van Rooijen & van Wees (2006) and Dinica (2006). Verbong & Geels (2007) also had their share in studying the transition of the Dutch electricity system.

Sustainability transition studies try to understand how transitions evolve and often generate policy recommendations to support the transition (de Gooyert et al., 2016). The sustainability challenges are often coupled with strong path-dependencies and lock-ins (Ahman and Nilsson, 2008; Markard, Raven, and Truffer, 2012; Safarzyńska and van den Bergh, 2010). This is why it is important that the right decisions are made in order to prevent regret of the chosen direction in the future. Repenning (2003, p. 23) mentions that our social systems today are "more complicated, more interconnected and likely more fragile than at any previous point in the history of human kind and there is a good reason to believe that the theories and ideologies dominating social discourse are becoming more short-sighted and individualistic". Schweiger et al. (2018, p. 15) add that "the complexity underlying resistance to change cannot be fully accounted for by either the traditional or the modern perspectives". This highlights the complex nature of the system we are living in today and points out why sustainable transitions face difficulties and are hard to manage. According to Repenning (2003, p. 325) social sciences are "in desperate need of an alternative to the growing number of theories and notions that focus on individual self-interest with little regard for the larger system in which those actions are embedded". The multi-level-, multiphase-, multi-pattern perspective and transition management are the dominant approaches used to study sustainable transitions (Lachman, 2013). However, de Gooyert et al. (2016) mentions in his article that policies developed with the use of these perspectives are meeting significant resistance. Kern and Smith (2008) add that transition management is commonly used for energy policies in the Netherlands but results of these policies have not met expectations.

Due to the lack of results from the previously used approaches, the field needs an alternative approach that can be used to study sustainable transitions and addresses policy resistance. This study combines one of the dominant frameworks, the Multi-Level Perspective

(MLP) in combination with System Dynamics (SD). According to de Gooyert et al. (2016) the SD approach has potential to support understanding and the overcoming of policy resistance. By combining these two methods, this study aims to use the strengths of these two perspectives while at the same time, also considering their limitations.

A lot of previous research has been done by experts in the field. The aim of this study is to map out policy resistance at its core, among homeowners who are or have to participate in the gas transition. Homeowners are important actors in the gas transition and have to persuade the policies in order to make their houses natural gas free. The focus lies on the private homeowners because they have to pay for the transition themselves and manage the transition for their own home. To make the transition a success, it is very important that all homeowners can, do and will participate. Due to the district-approach, policy differs per municipality and involving homeowners of different municipalities in Gelderland is needed to provide a representative view on how the system is structured that is responsible for policy resistance in the gas transition among homeowners in the province of Gelderland. This policy resistance can be analyzed and as such lead to suggestions for better policies (Franco & Rouwette, 2011).

The objective of this research is to *map out the structure of the system that is responsible for policy resistance among homeowners in the gas transition in province of Gelderland, thereby enabling the identification of high leverage points to overcome policy resistance in the gas transition*.

This study aims to achieve the objective by answering the following two research questions: *how is the system structured that is responsible for policy resistance in the gas transition among homeowners in the province of Gelderland?* and *what can explain the presence of policy resistance among homeowners in the gas transition in the province of Gelderland?*

Answers to these questions can contribute to decreasing the uncertainty and slow pace in what the energy transition in the Netherlands currently takes place and also has a more general contribution in resolving the difficulties that sustainability transitions faces in Gelderland (Beckman & van den Beukel, 2019). In addition, this study provides suggestions for good policies according to homeowners, which can help by making sustainable policies in the future and can be applied on the identified high leverage points. The research builds on and explores an alternative way of analyzing policy resistance in sustainable transformations by the combination of the MLP and SD approach, which can be continued by other scientists to gain a better understanding of sustainable transitions. In addition, the results of this study broaden the knowledge of energy transitions through the lens of System Dynamics modelling.

By conducting two different Group Model Building (GMB) workshops in Ede and a group of participants from various municipalities, this research collects the data needed to map out the structure that is responsible for policy resistance and to make recommendations on what appropriate policies look like according to homeowners in the province of Gelderland.

In the second chapter, concepts and previous research will be discussed resulting in a theoretical framework. After the theoretical framework, the methodology part is presented, and the different methodologic choices are being explained. Thereafter, results are analyzed by building two Casual Loop Diagrams step-by-step and combining them into one final model, analyzing them using the two approaches. After analyzing the final model, appropriate policy options for the identified high leverage points are being analyzed, again, using the two approaches. In chapter six a conclusion is drawn, and chapter seven discusses limitations and suggestions for further research.

2. Sustainability transitions

Sustainable transitions have been studied by various disciplines in science for a long time. These studies show that today's challenges are unpredictable and fundamental transformation processes are in place to deal with these challenges (Van Den Bergh, Truffer and Kallis, 2011). Previous studies into sustainable transitions aim to understand how transitions evolve over time. By studying sustainable transitions from the past, it is easier to respond to transitions in the future, because they all follow a certain pattern and behavior (Markard et al., 2012b). However, there are no solutions that fit all needs and it remains difficult for scientists to analyze such complex structures as sustainable transitions. Sustainable transitions are "long-term, multi-dimensional and fundamental transformation processes through which socio-technical systems shift to more sustainable phases of production and consumption" (Markard, Raven, and Truffer, 2012b, p. 956). Guidance and governance often play an important role (Markard et al., 2012b). Due to the long term-goals of these transitions, they are purposeful and intended and stakeholders have to work together in a well-structured, coordinated way (Markard et al., 2012b). According to Markard et al. (2012b) this is different compared to guided transitions where political actors, regulatory and institutional support play an major role.

In this chapter, further exploration of policy resistance and the System Dynamics (SD) framework will be done, by explaining characteristics of the system that are responsible for policy resistance. Subsequently, the transition frameworks will be explored to explain the dynamics in the process of policy making from the perspective of transition science. Finally, reflections on these insights will be made as a combination of the strengths of two methods: System Dynamics and the Multi-Level-Perspective.

2.1. System Dynamics

System dynamics has the potential to support the understanding of complex systems by identifying the relations between variables that together provide an explanation for the behavior of the system as a whole (Forrester, 1971). Social-technical transitions, like the gas transition, involve various dynamic processes, time delays and non-linear effects, such as archetypes and feedback loops (Papachristos, 2011). System Dynamics (SD) can be used to understand the behavior of a system that has these characteristics (Sterman, 2000). The gas transition is an example of a complex system consisting of several interacting processes, archetypes and feedback loops as mentioned by Papachristos (2011). By identifying feedback loops and archetypes as high leverage points in the system it is possible to steer the gas transition in the direction preferred by the policy makers. This makes SD a method to analyze and even overcome policy resistance. An example given by Herring and Sorrell (2008) is called the rebound effect. This rebound effect means that attempts to save energy can actually lead to various side effects that undo its original saving effect (Antal and Van den Bergh, 2014). When consumers buy a new car that is more fuel-efficient, they may start driving bigger distances than that they did with their old car. This will push the system back to its original state and might even increase emissions, an unexpected side-effect. The underlying archetype here is called fixes that fails. In chapter 2.1.2. these archetypes will be further explained.

According to the SD approach, two types of feedback loops can be identified. The first type of feedback loop is called balancing feedback loop, were the system pushes itself back to its original state or even worse (Sterman, 2000). The second type of feedback loop is called the reinforcing feedback loop. Path dependency is an example of a reinforcing feedback loop. Path dependency shows that investments in already successful technologies grow larger and larger and other technologies which did not have the attractiveness as these successful technologies before, are lacking behind, while they might have the potential to replace these older and outdated technologies (Roberts et al., 2018). Breaking this path dependency is critical for the acceleration of the transition. (Roberts et al., 2018).

2.1.1. Policy resistance in energy transitions

An area well-known for policy resistance is a complex environment in which problems arise and policies are made (Sterman, 2000). This happens when policies encourages feedback from the environment, undermining the policy, and sometimes making the original problem even worse (Ghaffarzadegan, Lyneis, and Richardson, 2011). Policy resistance is not uncommon in systems consisting of diverse feedback loops with long delays between action and result and is known for its difficulty to learn and its actors that fail to oversee the complexity of the system that they are trying to influence (Ghaffarzadegan et al., 2011). Even policies that bring numerous benefits, can later be erased by policy resistance (Ghaffarzadegan et al., 2011). This creates a very uncertain environment which is difficult to analyze and predict. Policy resistance often arises through feedback loops, as discussed in section 2.1. and known archetypes that exist in complex social systems. It is difficult to tackle policy resistance, because policy makers often do not keep an eye on the interests of the environment (Ghaffarzadegan et al., 2011).

There are several descriptions of policy resistance in the literature. Meadows (1982, p. 11) describes policy resistance as "the tendency for interventions to be delayed, diluted, or defeated by the response of the system to the intervention itself". Examples of policy resistance are people that live close to a wind park and see their view diminished as a result, or homeowners who see their energy bills go up because they switched to green energy.

Lachman (2013) describes policy resistance as a society that is often "locked-in" by unsustainable systems and also describes policy resistance as "persistent problems", which are problems built-in the systems' structure. Markard et al. (2012, p. 955) agrees with this definition and mentions that sustainability challenges are "aggravated by the strong path-dependencies and lock-ins we observe in the existing sectors". In addition, Van den Bergh et al. (2011) describe policy resistance as "fundamental barriers" that often plague sustainability transitions. While the definitions are slightly different, all describe policy resistance as a complex problem in a system.

Dealing with policy resistance is complex and difficult. According to Sterman (2000, p. 3) "many times, our best efforts to solve a problem actually make it worse". Scientist in the field agree (Lockwood et al., 2017; Meadowcroft, 2009) that sustainable transitions are complex, contingent, and vulnerable to side-effects. Geels (2014) mentions in his article that politics is important factor in explaining policy resistance and recommending ways to overcome this. The right way of doing politics even have the potential of accelerating the transitions (Roberts et al. 2018). However, these politics have to be in line with what the citizens of the country want and are able to do. This while taking into account policy resistance, which can as describe earlier, undo the good effects of a policy. Meadowcroft (2009) mentions that those trying to guide sustainable energy transitions might encounter large-scale political conflicts. Stefes (2020, p. 4) adds that the outcome of those conflicts is uncertain and that these contribute to "a reactive sequence that transforms or may even reverses the direction of the policy".

Institutions are crucial in directing main actors toward a sustainable energy future. However, institutions might contradict each other (Stefes and Hager, 2020). This results, according to Karapin (2020) in institutional effects that cancel each other out. There are different reasons on why this might happen. Karapin (2020) explains that institutions sometimes are not detailed enough or leave room for interpretation, which might result in institutional "gaps". According to Thelen (2012) these serve as windows that opponents of these sustainable policies can use for exploiting. This will result in policy resistance and might slow down, halt, or even reverse a sustainable energy transition (Stefes and Hager, 2020).

To broaden our view on these institutions, Stefes (2020) explains three interrelated paths in the energy transitions; the political and policy path, the economic and technological path and the legitimation path. Legitimization has been examined by many scholars before. The results show that the pace and success of energy transitions depends on the actors of the system (e.g., homeowners) to accept the costs they have to make before they can switch to an alternative energy system (Karapin, 2020). Karapin (2020) mentions that these costs can be quite significant and unequally distributed. According to two research agencies, TNO (2019) and Wetenschappelijk Bureau GroenLinks (2017) this hinders the Dutch energy transition since some homeowners may lack the financial resources and / or the necessary knowledge to make their homes natural gas-free. The fact that various policies have a compelling nature, or may not be what homeowners prefer, like increased prices for energy, can also results in more resistance to citizens.

Between institutions, positive and negative feedback loops shape the direction and pace of the energy transition (Karapin, 2020) and some actors are able to take advantage over these feedback loops. This can be seen as the “success to successful” archetype which illustrates the likelihood of succeeding of one person with more resources over a person with less resources (Kim, 1992). This continues as the person more resources becomes more and more successful at the cost of the person with less resources.

When policies cause exogenous factors, such as economic growth and technological development, the citizens who are against these policies can increase their political power and push for policy changes in their advantage (Karapin, 2020; Meadowcroft, 2009). This is called the “escalation” archetype whereas one actor is taking actions that are perceived by the other as a threat (Kim, 1992). This results in the second party also responding to this threat, which results in an even more threatening action from party one. However, when a policy causes new groups or coalitions who are against this policy, it may also result in dilution.

The best example of policy resistance can be found in the German “*Energiewende*” as given by Stefes & Hager (2020) in their article about policy resistance. When Germany’s energy transition started in 1990 with a reasonable pace, there was skepticism from citizens about the feasibility of the project. However, later the project received great support. The German citizens agreed that state intervention was required, however, as the costs of the energy transition became significant, which were carried by the lower income households, the opponents of the transition saw an opening to exploit the legitimacy of the transition (Stefes and Hager, 2020). These effects have failed to reverse the energy transition because the support for the project remained strong. However, efforts of the opponents to exploit the legitimacy of the energy transition is an example of policy resistance as the transition slowed down through attention for unintended effects of the policy (Stefes and Hager, 2020).

2.1.2. System archetypes

To analyze if and how policy resistance exists in the model resulting from the workshops, different system archetypes need to be identified. A system archetype refers "to a recurring, generic systemic structure that is found in many kinds of organizations, under many circumstances, and at different levels or scales, from internal personal dynamics to global international relations" (Kim and Anderson, 2011, p. 1). There are different system archetypes, the most common archetypes are briefly discussed.

The first archetype is called "**fixes that fail"** which describes a situation that needs a solution. When this solution is implemented, unintended consequences of the solution return the problem or make it even worse than before (Kim and Anderson, 2011).

The second archetype is called "**limits to success"** and shows efforts that improve the performance of the system (Kim and Anderson 2011). However, over time the system reaches a limit which causes the performance to slow down or even decline.

The third archetype is called "**success to successful**" which shows the likelihood of succeeding of one person with more resources over a person with less resources (Kim and Anderson, 2011) and this continues as the person with more resources becomes more and more successful at the cost of the person with less resources.

The last archetype is called "**tragedy of the commons"** and describes the persuade of an actors individually beneficial actions at the cost of the total system (Kim and Anderson, 2011). If the amount of activity grows too big, the system can collapse.

2.2. Energy transitions

Energy transitions involve a change in fuel, technology or prime mover in an energy system (Parag and Janda, 2014). Previous studies focusing on fuel sources are being criticized by their narrow frame of transitions (Laird, 2013). While other studies are hiding "the social and political dimensions of energy systems behind a veneer of limited technological choices" (Laird, 2013, p. 203). There are, however, studies that take a broader view and account for shifts in technology, energy inputs and outputs involving suppliers, distributors, consumers and institutions (Araújo, 2014).

There are numerous descriptions of the concept energy transition in the literature. Riahi, McCollum and Krey (2012) and Sovacool (2016) argue that energy transitions are similar to energy transformation or revolutions. According to Sovacool (2016) transitions should be measured over an amount of time, starting from point at which the energy system or technology occupies a 1% market share. Sovacool (2016) also points out that energy transitions are based on a single energy source or group of sources, which dominate the market and eventually are challenged and replaced by other sources (Sovacool, 2016). According to Miller, Iles, and Jones (2013) an energy transition refers to the period between the introduction of a fuel and its rise to 25% of the market share. However, some scientist argue that an energy transition only occurs when a fuel reaches a 50% market share (Grubler, 2011). A transition can be seen as a bundle of transformations and according to O'Connor (2010) large transitions are a sum of many small ones.

A lot is written about energy transitions, but it is still difficult to measure an energy transition. One of the reasons why this is difficult is because sometimes the rise of an energy system depends on another system, and this makes analyzing one single energy system in isolation difficult (Sovacool, 2016). Most of the time, two shifts in a system have to occur, which results in one combined effect according to Sovacool (2016), since one system is depended on the adoption of the other system. This makes it even more difficult to analyze using traditional frameworks because they cannot handle such an amount of complexity.

Analyzing a transition is not the only difficulty faced in studying energy transitions. Byrne and Rich (1983) mention in their article that many incumbent actors that try to coopt new innovation acknowledge the necessity for change, however, then try to direct resources back into existing systems for their own benefit. For example, energy companies suppressing patents of new disruptive energy technologies that might hurt their own business model.

2.3. Transition frameworks

Scholars have developed different frameworks to analyze sustainable transitions. There are four frameworks which have achieved quite some attention. These are Transition Management, Strategic Niche Management (Kemp, Schot and Hoogma, 1998; Kern and Smith, 2008a; Loorbach and Rotmans, 2010), the Multi-Level perspective (Geels, 2002; Smith, Voß and Grin, 2010) and Technological Innovation Systems (Bergek et al., 2008;

Hekkert et al., 2007; Jacobsson and Johnson, 2000). The frameworks originate from Technology Studies (STS) and evolutionary economics and share the concepts of the socio-technical system.

A socio-technical system consists of a network of multiple actors (e.g., firms, individuals and organizations) and institutions (e.g., regulations), together with material artifacts and knowledge (Geels, 2004; Markard, 2011), which interact provide services for society. According to Finger, Groenewegen, and Künneke (2005) these elements are interrelated and dependent on each which results in a complex system. This complexity has implications for the dynamics and transformations and changes of the system (Markard, 2011). In the next chapters four different frameworks will be discussed, with additional attention to the Multi-Level Perspective.

2.3.1. Technological Innovation System

The framework of *Technological innovation system* (TIS) focuses on the arise of new technologies and the institutional and organizational changes that belong to these new technologies (Markard et al., 2012b). According to (Markard et al., 2012b), TIS explains why and how sustainable (sustainable) technologies have or have not developed and how they are embedded in society. TIS is a network of actors that interact in an economic area under the governance of an infrastructure which is involved in the generation, diffusion and utilization of technology (Carlsson, 1991). TIS can be applied on three levels: technology as knowledge field, technology as product or artifact or technology as a set of related products that satisfy a particular function (Jacobsson and Johnson, 2000). This method can explain why or why not technologies have or have not developed over time, which is good for looking back at previous transitions to have a better response in the future. However, to map out the system that is currently responsive for policy resistance, this method is less useful, as we continue our exploration.

2.3.2. Transition management

Transition management (TM) combines the insights from technological transitions with insights from complex systems theory and governance approaches (Smith, Stirling and Berkhout, 2005). TM consist of instrumental and practice-oriented models to shape transitions that are more sustainable (Loorbach, 2010). TM has been developed through action research and participation in policy projects as a mix of problem structuring and assisting in multi-stakeholder arenas (Loorbach and Rotmans, 2010).

While TM provides a good participatory approach, which can be used to understand the opinions of the participants, it does not provide a field of knowledge as extensive as System Dynamics (SD). Nor does it show the underlying system in such an accessible way for participants as SD does.

2.3.3. Strategic Niche Management

Strategic niche management (SNM), which is the creation and support of niches, originates as a method to encourage shifts in a regime (Hoogma et al., 2005; Kemp et al., 1998). Through social learning processes across experiments, expectations and heterogeneous networking, innovations that are made in niches can gain momentum and compete with established technologies in regimes or landscapes (Geels and Raven, 2006). SNM is often characterized as learning-by-doing and doing-by-learning in order to gain insights from transition experiments (Geels and Raven, 2006). One point of critique regarding SNM, is that it has been difficult to assess whether SNM actually works (Geels and Raven, 2006). Furthermore, the weaknesses of the MLP also apply to SNM, since SNM builds on the foundations of the MLP. However, the MLP framework is more extensive and can be of better use for this study.

2.3.4. The multi-level-perspective

The *Multi-level perspective* (MLP) explains technological transitions by the interaction of macro, meso and micro levels. These levels consist of landscape, regimes and niches (Geels, 2002). The macro level, also called the landscape level, is a bundle of effects outside the level of niches and regimes (e.g., global events) which influences regimes and niches. It is difficult for regimes and niches (the lower levels) to influence the landscape level; however, the landscape can have impact the other way around. This might even result in systemic changes which changes the level of regimes and niches within the system (Lachman, 2013). Examples of landscape factors are: climatic, demographic, macro-economic, cultural and infrastructural developments (Geels and Schot, 2007). According to Geels (2002), landscape factors pressure already existing regimes and offer possibilities for niches to grow and contribute to transformations in socio-technical regimes, such as the energy transition. This depends on timing and the different niche-regime-landscape interactions (Geels, 2002).

The meso level, also called the regime level is a collection of dominant actors that co-evolve with each other but also evolve with the landscape (Geels, 2002). There are four kinds of interactions between regimes: competition, symbiosis, spill-over and integration (Raven and Verbong, 2009). The regime concept refers to “the rule-set or grammar embedded in a complex of engineering practices, production process technologies, product characteristics, skills and procedures, ways of handling relevant artifacts and persons, ways of defining problems; all of them embedded in institutions and infrastructures” (Lachman, 2013, p. 272). The regime consists of three linked elements according to Geels (2004), the first is a network of actors and social groups changing as time passes. The second is a set of formal and informal rules that guide the network of actors who reproduce and maintain the system, and as third element, Geels (2004) mentions the material and technical elements.

Regimes tend to resist systemic change and thus also niches, because niches aim to replace regimes (Geels, 2004). When regimes are stable and the landscape is favorable for the actors in the network, the regime creates a strong alignment between the elements of the system (Geels, 2004). This can be seen as an good thing, however, this may also result in path dependency and “lock-ins” (Raven and Verbong, 2007) as discussed in chapter one. Changes within a regime are incremental and follow a certain path. When a change is significant, it leads to systemic change and this is called a regime transformation (Lachman, 2013).

The third and last level, micro, also called niches, are protected spaces in which radical innovations take place (Geels, 2004). Niches are present in regimes. These niches have their own rules and norms, as well as their own material and technological elements (Geels, 2004). Niches are different in comparison to regimes and they are able to replace regimes (Lachman, 2013). They are more flexible and are less bound by rules than regimes and landscapes (Berkhout et al., 2010). There are two kinds of niches: technological and market niches. Technological niches are protected space in which actors can experiment with techniques, rules and connections between elements that are different from the regime (Geels, 2004). Subsidies and R&D investments give the opportunity to experiment (Geels, 2004). There is, however, a lot of uncertainty in the area of designs, supplier and buyer relationships, institutional aspects and user markets (Pierick & Mil, 2009; Geels, 2004). In market niches the technological rules are more stabilized but the market relationships and rules are still under development (Geels, 2004). Niches provide locations for learning processes, learning by doing, learning by using and learning by interacting (Geels, 2002). They also provide ways to acquire social networks that support innovation (Geels, 2002). The market transactions create the conditions and means for the survival of the niche (Geels, 2005; Raven, 2005), which is not guaranteed and unstable.

While the MLP is a widely adopted method used in numerous studies. There are three apparent weaknesses regarding the MLP. First, the MLP uses metaphors and vague concepts, which may create ambiguity. Besides that, it is also possible to categorize phenomena too easily due to vague boundaries of concepts framework (Smith et al., 2010). The second weakness, according to Smith et al. (2010), suggests that the MLP is highly complex of nature where a lot of actors and networks need consideration, especially when applying the MLP at a transition as large as the energy transition. As a third weakness, Schweiger et al. (2018) mentions that MLP cannot fully account the complexity underlying resistance to change. This makes it complicated to understand the dynamics and capture those dynamics in (computer) models and unsuitable to use as standalone framework for this study.

2.4. Proposed framework: System Dynamics and Multi-Level Perspective

Both methods have their strengths and limitations. Traditional tools, such as the Multi-Level Perspective (MLP) lack a feedback approach and may therefore fail to deliver the best policy actions. While SD may be better at identifying policy resistance, it does not yet shed light on the various levels at play in the transition to sustainable energy sources. By acknowledging the fact that both perspectives have their limitations, a combination of the two approaches has the possibility to build a better set of analysis tools to identify policy resistance.

As described above in chapter 2.3.1., the MLP is widely used to understand transitions. Despite its ability to separate niche, regime and landscape level influences and dynamics, its main weakness of becoming too complex to be understood creates a difficulty in translating the understanding of transitions to concrete policy advice or transition management. According to Zolfagharian et al. (2019) MLP often results in ambiguity in definitions, boundaries and relationships between niches, regimes and landscapes. Therefore, using the insights to manage and direct transition, such as SNM aims to do, becomes difficult, if not impossible. On top of that, different social aspects of transitions are lacking in the perspectives, while the focus of the gas transition lies on cooperation across local instances and communities (van der Ploeg et al., 2015). The gas transition shows a lack of progress even though policy arrangements aim to facilitate the transition, as described in section 1.

Therefore, we need additional analysis to understand the dynamics of this transition. To understand policy resistance, we now turn our attention to System Dynamics, as discussed in chapter 2.1. which has proven its analytical use when it comes to policy resistance.

It is recommended to add social practice theory to conceptualize transition problems (Shove & Walker, 2010), such as policy resistance. Shove & Walker (2010) mention that this will change the analysis to practices rather than societal functions. Zolfagharian et al. (2019) add that MLP serves as a middle range theory "rather than a truth machine". Whereas Geels (2011) argues that studies on complex transitions is rather difficult when using models with detailed methodological procedures, which are frequently used in management studies. The SD approach can systematically asses the state of the field, whereas the MLP framework provides little guidance in how a system should be mapped out (Geels, 2011). SD also provides a procedure for determining which archetypes, systems are relevant, what it consists of and how this results in policy resistance (de Gooyert et al., 2016). Drawing a causal loop diagram also unravels the complexity of the system and recognizes the different actors and stakeholders. This makes SD able to improve the MLP frameworks' extent to deal with complexity (Loorbach, 2010). On top of that, the Group Model Building method can create a shared view on the transition by inviting multiple stakeholders of different municipalities of the province of Gelderland, not only representing the view and opinion of the researcher.

3. Methodology

To identify leverage points to overcome policy resistance in the gas transition, a model of the structure responsible for policy resistance among homeowners in the gas transition is required. Secondly, this model should be analyzed for the dynamics of policy resistance, as well as the various levels that are at play through the lens of the Multi-Level Perspective. Since policy resistance in the gas transition in Gelderland is a phenomenon that involves individual homeowners, data is collected through a series of two Group Model Building (GMB) workshops with individual homeowners. Thereafter, suggestions made by participants for better policies are being analyzed to find the characteristic of appropriate policies for the gas transition through combination of the two frameworks proposed in chapter two. In the following chapter, the data collection, data sample and model analysis are discussed, as well as the research ethics.

3.1. Data collection and model construction

This research uses a qualitative approach of deductive model analysis to analyze the results of the workshops through the lens of the Multi-Level Perspective (MLP). Two case studies of Group Model Building (GMB) workshops across different municipalities in the province of Gelderland will provide data to create two causal loop diagrams. Choosing for a participatory method of GMB in various municipalities provides a variety of viewpoints on how the system is structured that is responsible for policy resistance in the gas transition in the province of Gelderland.

GMB is a qualitative method which is aimed at involving stakeholders to collectively determinate the causes of a complex problem (Vennix, 1996, p. 5). GMB originates from System Dynamics (SD) and supports the understanding of complex systems by identifying the relations between elements that provide the explanation for the systems behavior (Forrester, 1971). By creating a Casual Loop Diagram (CLD) with the data collected from two GMB workshops, it is possible to identify the high leverage points of the system (Sterman, 1994).

GMB not only helps to eliciting stakeholders’ views and knowledge on the structure, but also helps to create commitment to policies and improve the quality of outcomes (Franco & Rouwette, 2011) This research analyzes the knowledge gained from the series of GMB workshops against the archetypes and structures of SD and the different levels at play in the framework of the MLP.

By inviting participants from different municipalities of Gelderland, this study tries to create a representative sample of Gelderland, however, because only two workshops were conducted, caution must be conserved. This will be further discussed in chapter 6.1.

The first part of the workshop resulted in a casual loop diagram and the second part of the workshops yields insight in homeowners view on policies and shows appropriate policies according to homeowners. These policies, resulting from the second part of the workshop, are a representation of what the participants think good policies look like. These could be new policies or existing policies, however not given by the researcher at forehand.

Workshops took place in May 2021 and were facilitated online. During and afterwards VENSIM was used to create the model structure via screenshare, and a university-licensed version of Zoom was used as the channel of communication. During the workshops a fellow student with experience in modelling was assigned as modeler to create the model in VENSIM. This made it easier to facilitate the discussion between the participants and prevent having too many tasks which can have a negative influence on the results of the workshops and especially on the discussion. The workshops were recorded on video with permission of the participants to make sure all elements made it into the analysis, for further details on the recording see chapter 3.5. These recordings were used in the analysis.

In preparation of the workshops two scripts were selected from Scriptapedia. "Building a CLD with paper" was used in the first part of workshops. For the second part of workshops the script "Initial Policy Options'' was used. The scripts were adjusted for an online facilitation following insights from the past year in the Covid-19 pandemic and the publication of Wilkerson et al. (2020). The scripts and modifications can be found in the Appendix 8.4. and 8.5 indicated with yellow.

The time duration of the workshops was around sixty to ninety minutes, were most of the session consisted of building a CLD. The workshops were no longer than necessary, and as soon as the productivity of the participants' decreased, they were ended. At the start of the first part of workshops the participants were asked how they think the transition to sustainable energy for their homes is structured. In the second part they were asked what an appropriate sustainable policy would look like.

Due to the online character of the session, it was important to manage the discussion more strictly and the facilitator had to make sure the participants were activated to talk. The facilitator made sure everyone had their say and brought their input to the discussion to make sure the sample is not representative to only a few participants.

Participants of the workshops registered through a registration form. An option to share anonymously was given, along with a brief description of the research. This data was then stored locally. On the day of the workshop an email was sent to the participants. The email was sent with the email addresses of the participants as BCC to keep their data safe. During the workshop, participants were asked whether they agreed to a recording.

At the beginning of the workshop, a short introduction to the research was given to the participants and the method was briefly explained using examples. After this, the script "building a CLD" started. The PowerPoint of the workshops can be found in the Appendix 8.6. During the workshop, a CLD was created using VENSIM and a whiteboard tool. In the second part of the workshop participants were asked to come up with two policies each, which brough the total to about fifteen policies each workshop. These policies can also be found in the Appendix 8.9. and 8.10. The policies were discussed, and the best policies, according to the participants, made it into the final model. After the session the CLD was reviewed for any inconsistencies or errors and two days after the session it was sent to the participants to check if the model represented their thoughts correctly, alongside with an evaluation. The responses to this evaluation indicate that the workshops were positively received by the participants. The evaluation also resulted in some feedback for the model which will be discussed in the analysis.

The workshops were transcribed using the software AmberScript and Microsoft Word. The discussions and quotes which lead to variables and feedback loops in the model were selected and coded using ATLAS-TI. These quotes were then used to support the structures of the models created in chapter 4.1. and 4.2. and ultimately used to create the final model in chapter 4.3.

3.2. Data sample and access to sources

A total of two workshops across municipalities in the province of Gelderland were held. The first workshop consisted of six participants from the municipality of Ede. The second workshop consisted of a group of five homeowners from different municipalities of Gelderland. Since there should be enough room for interaction and discussion in the workshops the number of participants is limited to six. However, different viewpoints should also be incorporated. The online nature of the session was also taken into account by inviting not too many participants to allow for an easy discussion (Wilkerson et al. 2020). To increase validation participants with different WOZ valuations[1] were selected to not under or over represent one part of the province. The participants were spread across different ages ranging from 35 up to 60. The minimum age of 35 was selected because it turned out finding homeowners under the age of 35 in the current market conditions is rather difficult. Besides, homeowners under 35 also have the benefit of different (starter) regulations on the home market which could hurt the representativeness of the sample. Participants who participated had to be living at least three years in their current homes, this because they had to be informed about the current developments in their municipality and district. Houses build after 2016 were considered newly constructed, these are represented in the sample. The invitations for the workshops were sent through social media and personal network resulting in twelve registrations, whereof one participant did not show up. Further details and a short summary on the sample data can be found in the Appendix 8.2 and 8.3.

3.3. Model analysis

In the first part of the analysis each individual workshop model will be discussed and build step by step with the knowledge given by the participants. The model of one workshop is a representation of the structure that is responsible for policy resistance among households in the energy transition in one of the municipalities. The final model is the representation of the structure in the province of Gelderland. The final model consists of the four most discussed variables and variables or feedback loops that overlap in both models. After creating the final model using VENSIM, the high leverage points were identified and with the help of secondary data documents the different archetypes, systems and feedback loops are analyzed by means of the System Dynamics (SD), explained in chapter two. Results of the SD analysis shows if and how policy resistance occurs in the model. After the SD analysis, the variables of the final model were analyzed by means of deductive coding based on the operationalization table (Appendix 8.11) drawn up from chapter 2.3.4. to gain more insight in the levels underlying the policy resistance by the means of the Multi-Level Perspective (MLP) framework. Results of the MLP part of the analysis show on what level policy resistance is embedded in the system. Finally, these two methods were compared and similarities and / or differences are discussed in the result chapter, where both methods complement each other.

[1] WOZ valuations are values based on the market price of a home, used to calculate how much tax a homeowner has to pay

The second part of the workshops resulted in a series of new or already known policy options generated by the participants. These were also analyzed against the SD framework to find effective policies which do have an impact on the identified leverage points. Afterwards, the six best policies of each session, which brough the total to twelve, were coded against the operationalization table (Appendix 8.11) of the MLP framework to indicate on which level these policy options have to be embedded and to check whether is it possible and feasible to implement these. At last, a comparison between the results of the two methods is made.

3.5. Research Ethics

This research is done in line with the research ethics defined by the American Pysychological Association (2020). However, for this research specific ethics have to be pointed out. All participants in the workshops were asked for permission beforehand and an option of anonymity was granted. Furthermore, all participation in the workshops was voluntary and had the right to withdraw at any time. At the start of the workshop's participants were asked if they agreed with the fact that workshops are being recorded. These recordings are only accessible to the researcher and stored locally. The workshops were recorded as video but without the faces of the participants in line with the AVG-legislation and regulations of Radboud University. These recordings are stored in an offline environment and were used for this research only. All the analyzing work is the result of the workshops and authenticity is guaranteed by recording, transcripts, and description of the procedures for other researchers to replicate the research. The data collected through the workshops is only being used for this research. When the workshops were finished, results were shared with the participants by email. The participants were granted an option to get the final research report send to them by email. Furthermore, participants were beforehand informed about the research topic and their data is kept safe on an external hard disk, which is not connected to the internet. This data will not be kept longer than necessary. The analyzing and interpretating of data was done unbiased and as objective as possible to avoid misconceptions or misunderstandings.

4. Results

Through the models created and the participatory exploration of policy resistance in the first part of two GMB workshops, the system structure that is responsible for the policy resistance will be illustrated using knowledge from the participants. First, the two separate workshops will be discussed, accumulating into one final model.

This final model results in the identification of high leverage points to overcome policy resistance in the gas transition using the System Dynamics (SD) approach. This is followed by an analysis with the Multi-Level Perspective (MLP) framework, to gain insight in the levels on which the variables, archetypes and feedback loop are embedded as discussed in chapter 3.3. After the analysis using the two approaches, the differences and similarities between the approaches are discussed.

The results of the second part of two workshops will identify the best policies generated by the participants which yield a greater commitment. These policies are also analyzed with the use of the SD approach to show where these policies have to be implemented in the system and by the MLP approach to show on what level these policies have to be implemented.

4.1. Workshop 1: municipality Ede

4.1.1. Part one: building a casual loop diagram

During the workshop, the participants often returned to the information provision in the transition. It soon became clear that the municipality could do more to disseminate information about the energy transition. The participants were often negative about the amount of information they received, which was most of the time low. If participants did receive sufficient information, this was from external parties with the aim of making as many sales as possible. Examples of this can be found in Table 1. According to the participants, it was difficult to find a company they trusted. Solar panels were a much-discussed topic, and the participants have all been informed about solar panels or other forms that can make their home more sustainable. However, the participants felt that every house is different and that every house therefore requires a suitable solution. There was no tailor-made advice on how to make their specific house more sustainable. They also had the feeling that each party was working separately and that the overall goal of sustainability was being forgotten. On top of that, the financial picture of making the home more sustainable was often missing.

Table 1: information provision

ik zie door de bomen het bos niet meer [..] welk bedrijf is goed, welk bedrijf is niet goed.
[..] het totaalplan dat mis je, je had ook een caravan in het dorp, kon je advies krijgen, maar dit is ook niet altijd ideaal
daarom is dat advies zo belangrijk, van wat is nou het beste [..]
[..] mensen missen voornamelijk informatie en duidelijkheid
[..] daarbij snijden ze zichzelf in de vingers want je moet nu bij een commerciële partij terecht voor informatie
die financiële rekeningen die krijg je als particulier weinig

The information about the energy transition, which was poorly received by the participants, leads to extra effort for homeowners. During the workshop it became clear that they want to make their house more sustainable, only because of a lack of information they are obliged to look up information themselves. This was seen as a barrier to entry and complicates the process towards a sustainable home as can be seen in table 2.

Table 2: looking up information yourself and entry barrier

[…] dan denk ik ja, je moet dus informatie altijd zelf ophalen. […]
Allemaal extra moeite [..]
ik wijs de adviseurs altijd de deur, foldertjes gaan naar het oud papier, ongelezen, ik ben er wel klaar mee [..] geen interesse? Wel, maar te veel partijen en te veel informatie. Ik durf de stap niet te zetten
het is voor mij onduidelijk, kom met iets duidelijks.

These three variables made up the first feedback loop called “information” together with the variable sustainable energy, which is a reinforcing feedback loop.

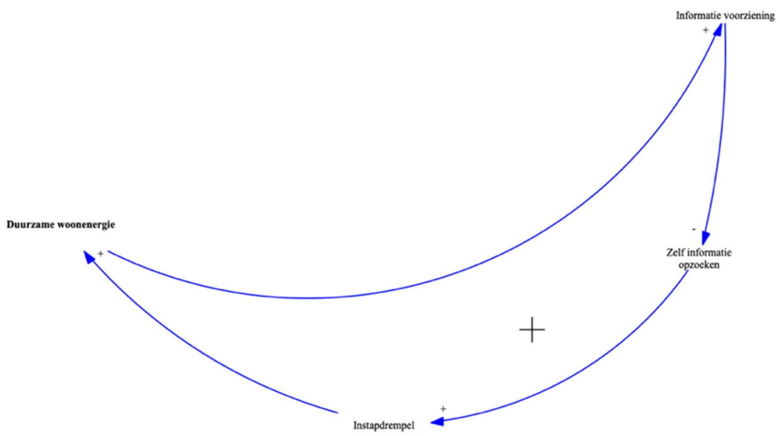

Figure 1: information feedback loop

The next variable included in the is the regulation of the municipality. According to the participants, there is still much to be done. An exception is made by the participants for the adoption of a drainage system, they thought this was well arranged, which shows that the municipality can manage the transition in the right direction. However, the regulations by the municipality are still unsatisfactory as can be seen in table 3.

Table 3: regulation municipality

volgens de energieprestatienorm moest ik eigenlijk zonnepanelen op mijn huis hebben, dat heb ik ook gedaan maar voor het verwarmen van mijn zwembad heb ik een cv-ketel opgehangen en daar kijkt niemand naar […]
[..] dat zie je vaak bij regelgeving en wetgeving. De regels worden verzonnen, en worden opgelegd maar er is niemand die controleert of verbeterd of in de geest van de regio meehelp om de regels na te leven [..]
huis moet na oplevering worden gecontroleerd of het klopt met een energie label. […] dit was in het verleden niet, als je een Quooker nam of ligbad erbij had zogenaamd geen invloed op je energiegebruik […]
als iets goed geregeld wordt dat zorgt er wel voor dat meer mensen willen verduurzamen
gemeentes en overheden zijn gewoon erg slecht in het aanbesteden of uitbesteden van zulk soort trajecten en eigenlijk niet overzien of niet het doel voor ogen houden. [..]

People's behavior was mentioned as an important factor in making residential energy more sustainable, as can be seen in table 4. According to the participants, it was up to people to learn new habits and become aware of their unstainable habits. In addition, they mentioned that sustainability starts with yourself. Although, good information and the right regulations from the municipality can make a difference in this.

Table 4: behavior of people

als iets goed geregeld wordt dat zorgt er wel voor dat meer mensen willen verduurzamen
het begint bij je eigen huis en niet bij plannen van de gemeente [..] je gaat het niet bij het huis van de buurman doen
[…] als de zon schijnt dan moeten mensen eigenlijk hun was gaan doen, wacht dan niet tot de avondstroom maar ga het nu doen, dat scheelt.
veel mensen realiseren het zich niet dat het ook afhankelijk is van hun gedrag
[zie je toch weer dat gedrag van mensen ook bepalend is [..] het is ook een stukje bewustwording

According to the participants, good behavior, and awareness lead to a reduction in energy consumption, which in turn leads to more sustainable residential energy. This also leads to more adoption of green energy. Examples that were given can be found in table 5.

Table 5: energy consumption and adoption of sustainable energy

ik denk dat voornamelijk energie verbruik verminderen belangrijk is, begin met isoleren, isoleren, isoleren… dat vergeten mensen nog wel eens [..]
[..] je kunt beter energie vasthouden dus dat is isoleren
het is dus ook een kwestie van gedrag van mensen, goed gedrag om energie verbruik te verminderen en duurzaam te maken
[…] waarschijnlijk moet je ook niet maar 1 ding doen

This completes the second feedback loop in the model called “adoption behavior”.

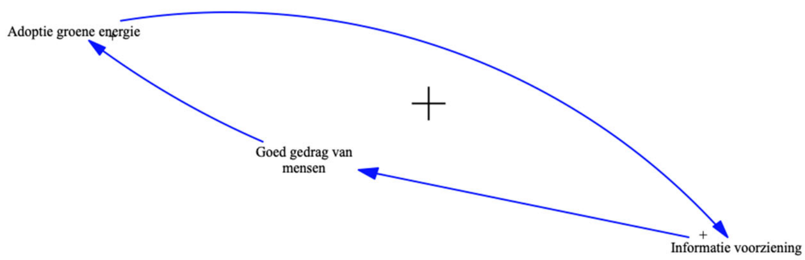

Figure 2: adoption behavior

During the workshop, the participants also agreed that the efficiency of external selling parties needed to be improved. These parties are now measured on the number of energy scans and sales they make and not on the number of houses that they made more sustainable. The selling parties are also described by the participants as "cowboys" and youngsters who have to make sales. The participants made it clear in the session that they are not interested in a good sales pitch. According to them, it is therefore important that the criteria against which these external selling parties are assessed must change. In addition, these parties often refrain from organizing a follow-up with the customers and, according to the participants, this ensures that the customers lose their interest and do not proceed to make their homes more sustainable. Table 6 shows the supporting quotes for this variable.

Table 6: efficiency external selling parties

[..] 3 zei dat er geen opvolging is, er zijn veel externe partijen die worden aangesteld door de gemeente, die krijgen opdracht om energie scans te maken.
[..] je ziet dat veel bedrijven als belang zien dat ze die scans kunnen maken, niet het verduurzamen
[..] er moet een follow-up komen die ook een soort van prestatie norm voor deze externe partijen geeft die niet afhankelijk is van het aantal energie scans dat wordt uitgevoerd, maar hoeveel mensen er daadwerkelijk verduurzamen
het is eigenlijk iemand achter een bureau die zich bezighoudt met energie scans verkopen en dat doet hij dus [..] dat is niet de bedoeling maar de bedoeling is het verminderen van energieverbruik.
[..] dit is natuurlijk ook zo bij adviseurs die zonnepanelen verkopen, die hebben baat bij het verkopen van zonnepanelen en niet het gehele doel van het verduurzamen
willen niet van de commerciële jongeren die even laten weten hoe het precies moet

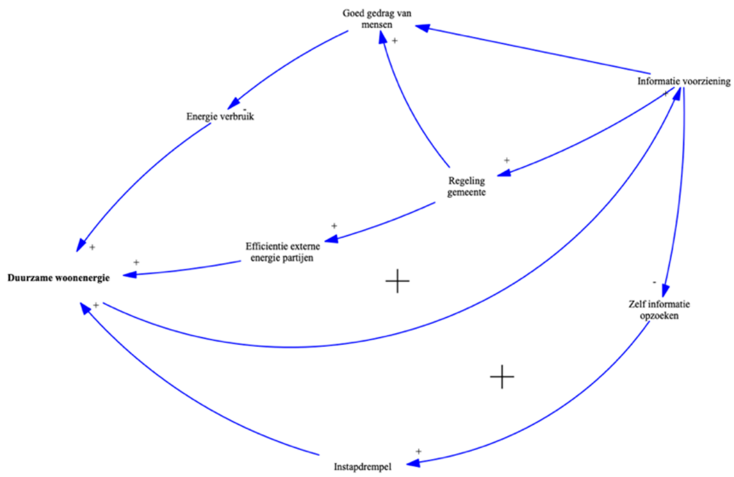

Figure 3: selling sustainable energy

In addition to the information provision, the guidance from the municipality is insufficient. Participants speak of no guidance, poor coordination, and no active involvement. Although, there are few handles and guidance for the rules made by the municipality. A proper follow-up on various sustainability practices is missing. According to the participants, the guidance that is available is not appropriate and they believe that every house needs individual guidance, because these houses also differ from each other. The guidance provided by the municipality does not go further than testing calculations and sending advisors for an energy scan. Table 7 shows the supporting quotes for the variable.

Table 7: Guidance

Wat ik heel raar vind is dat er echter helemaal geen begeleiding vanuit de gemeente is […]. Daarnaast mist het aan coördinatie vanuit de gemeente, ze bemoeien zich er niet actief mee. […]
als een iemand het verzamelt en de gemeente verplicht het om presentatie normen te halen, geef dan ook wat handvatten en begeleid dan bijvoorbeeld
er is geen navolging, ja, dan levert dat natuurlijk helemaal niks op
kijk naar welke oplossing past het beste bij mijn huis, individuele begeleiding is nodig [..] ieder huis is anders, financieel etc.
[..] de adviseurs van de gemeente toetsen alleen of de berekening klopt

This results in the following feedback loop called "guidance".

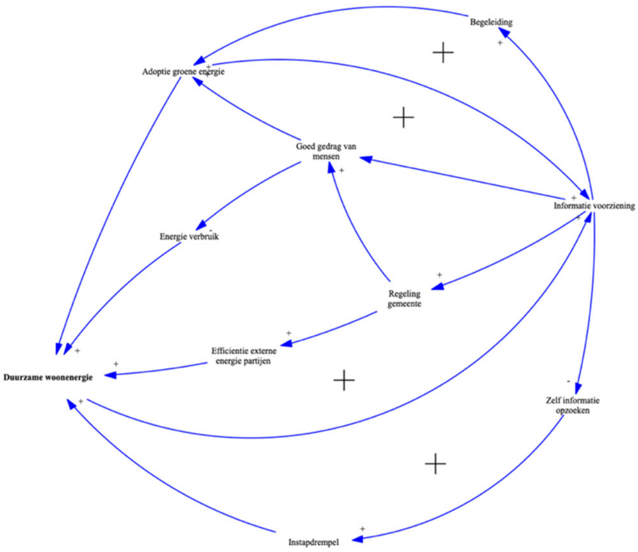

Figure 4: guidance loop

The participants found financial attractiveness to be an important motive for making their homes more sustainable, as can be seen in table 8. They mentioned that by investing in sustainable energy, you could achieve a good return. It should be noted that this is not always clear to homeowners according to the participants. The higher the financial attractiveness, the more willing the participants were to use green energy. This results in a reinforcing feedback loop, the higher the financial attractiveness, the more willing homeowners are to adopt forms of sustainable energy.

Table 8: Financial attractiveness and subsidy

het was te duur en het leverde te weinig op […] als het wel wat had opgeleverd dan had ik het wel gedaan
ook financieel want mensen kijken naar rendement en terugverdientijd op de lange termijn [..]
[..] ik heb 8 procent rendement, dat krijg ik niet op de bank. Win win, voor de planeet en voor de portemonnee.
[..] aanschafkosten heb je ook veel subsidies op of eindelijk had je veel subsidies op
deze subsidies worden wel minder [..] ik weet nog uit eigen ervaring dat ik destijds redelijk wat subsidies kreeg […]
5: [..] de subsidies op groene energie zoals zonnepanelen, zijn nu minder dan eerst [..]

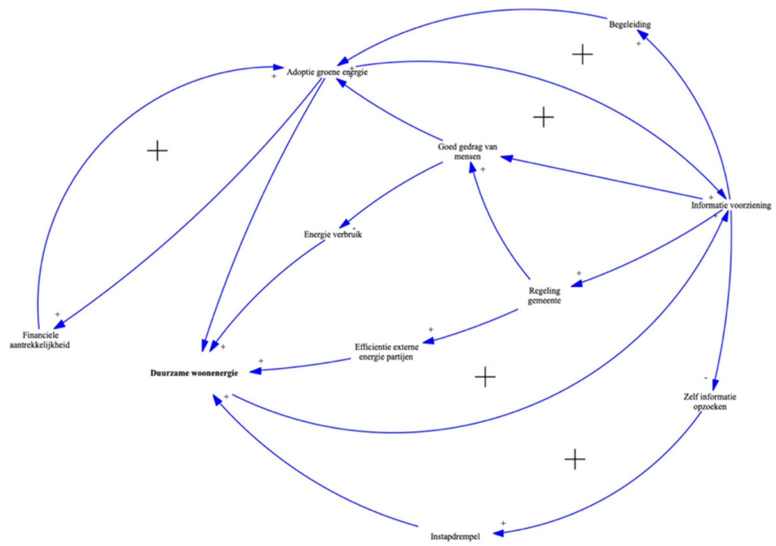

Figure 5: financial feedback loop

Subsidies are a nice bonus and contribute to the financial attractiveness of making homes more sustainable. It was noted, however, that these subsidies are phasing out and that their attractiveness is decreasing. This results in a balancing feedback loop, which slows down as time continues. This loop is called “subsidy” and can be found in figure 6.

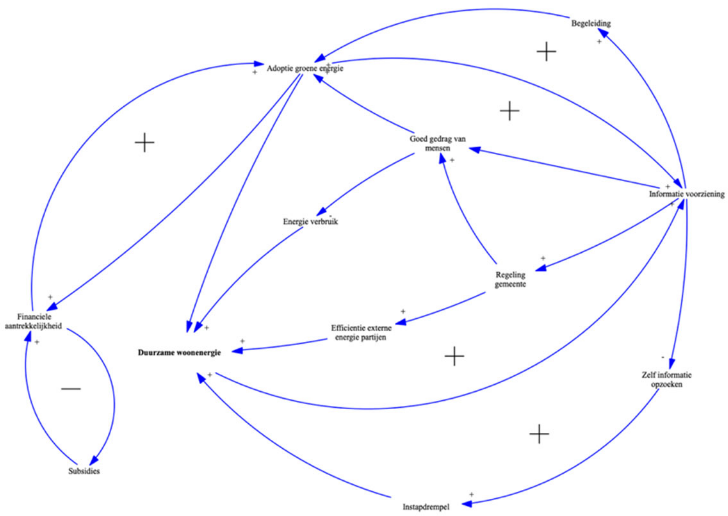

Figure 6: subsidy loop

Finally, the participants raised the quality of sustainable forms of energy, which can be found in table 9. They thought it was important that these were of good quality and, above all, safe. The better the quality, the less maintenance would be required and the higher the return on their sustainable investments would be. Some participants in the session were afraid that maintenance and quality will affect their return and therefore the financial attractiveness of sustainable energy. It should be noted that for many people the information about quality, efficiency and maintenance is quite unclear. This results in our final reinforcing feedback loop called “quality” as can be seen in figure 7.

Table 9: quality of alternatives, maintenance, and return

en een stukje veiligheid vind ik ook een groot issue bij mijzelf [..] als ik kijk naar hoeveel branden er komen door zonnepanelen dan schrikt dat mij ook wel af [..]
en je hebt een eigen accu, als je stroom van zonnepanelen niet meer terug kunt leveren
zonnepanelen bijvoorbeeld, als die er straks liggen, leuk, wie gaat dat onderhouden, wat kost dat, wanneer?
Allemaal extra moeite, deze gaan ook kapot, lukt dat dan wel met mijn rendement.
[..] als jij een rekensommetje krijgt, zou je het dan doen? Als alle financiële baten duidelijk zijn, zou je dan over te halen zijn, 3?

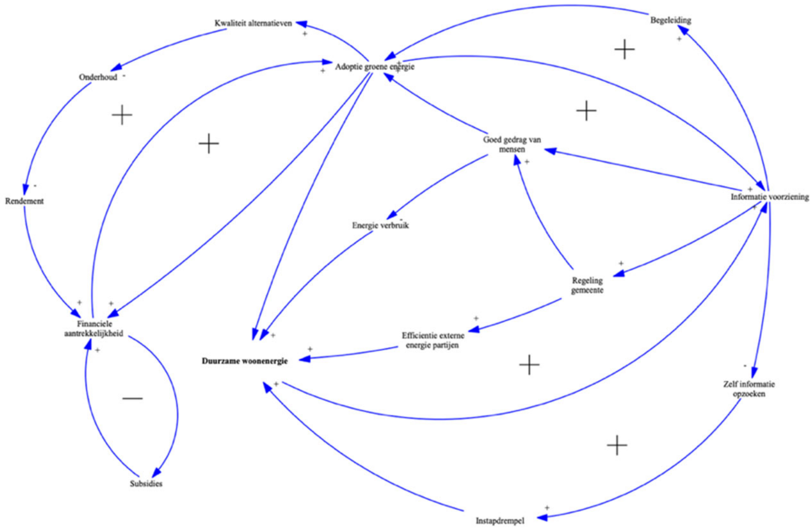

Figure 7: quality loop

4.1.2. Part two: initial policy options

After the model was built, the participants were asked to come up with, what they consider as good and feasible policies. This resulted in a list of twenty-four policies. These policies can be found in the Appendix 8.9. The respondents were asked which policies from the list they found most attractive and most appropriate. The best six policies out of the twenty-four were then embedded into the model (figure 8) and are discussed in the section below.

According to the participants*, offering a tailor-made plan for a home* was essential for making a home more efficient. In addition, it was desirable for *external energy selling parties to remain more involved with their customer*. The lack of follow-up was perceived as disturbing for the participants as mentioned in chapter 4.2. The participants also mentioned a policy that should *oblige architects to comply with sustainability laws when building a house*. Another option mentioned by the participants was a *check from the municipality*. This check should indicate whether new and existing houses comply with different laws regarding sustainability. A fifth option mentioned by the participants was to *change the assessment criteria of external energy parties*. These parties are currently judged on their sales, such as sellers, but the participants would rather see these assessment criteria changed in, for example, the number of houses that have been made more sustainable. The last policy selected from the list of fifteen was *making homes more sustainable step-by-step*. Not immediately to the highest energy label, since according to the participants this is too expensive and inefficient but making houses more sustainable step by step.

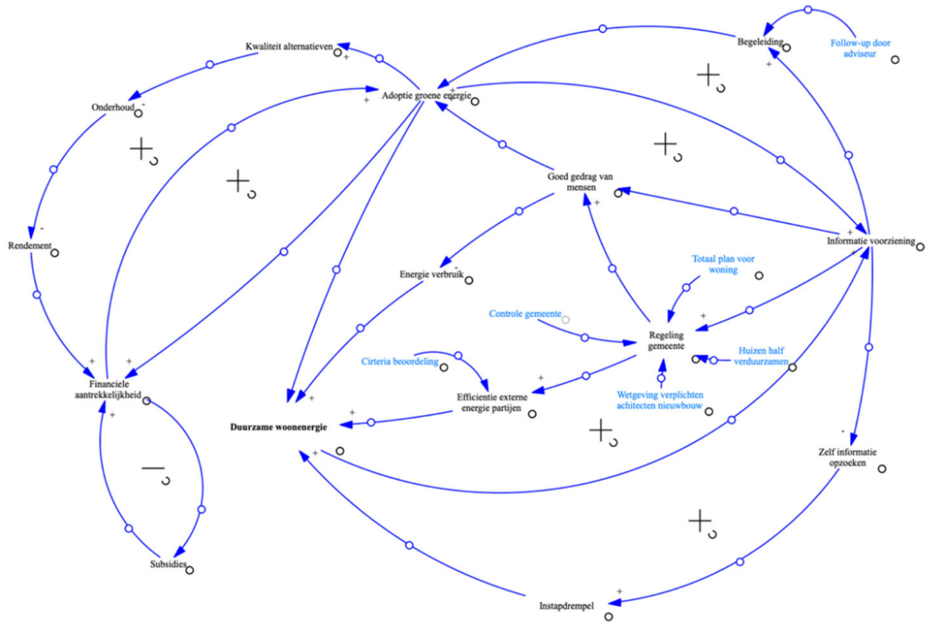

Figure 8: model workshop 1 with policy options

4.2. Workshop 2: various municipalities

4.2.1. Part one: building a casual loop diagram

At the start of the second workshop, it became clear that the participants were not satisfied with the information provision of the municipalities in which they lived. Examples of this are given in table 10. They felt that there was a lot to on this variable. According to the participants, it is difficult to find the right information, sometimes there is an abundance of information and in some cases, there is no information at all.

Table 10: information provision

[..] ik denk wel dat er meer informatie kan worden gegeven door de gemeente
voor veel mensen is het lastig om aan deze informatie te komen zonder dat ze door de bomen het bos niet meer kunnen zien
[..] meer gokken dat de subsidie zodanig was dat we het er in een jaar of 7/8 wel uit hadden
[..] ik heb dat helemaal niet en helemaal geen kijk, geen verstand

According to the participants, spreading information leads to better behavior of people. This is called "green behavior" in the model and supporting quotes can be found in table 11. The homeowners need to become aware of energy consumption according to the participants. Remarks should be made that it was difficult for a few participants to understand this. The handling of money of people was also mentioned as a point of improvement.

According to the participants, people need to understand that they can also make a good return by investing money, as is possible with solar panels or other sustainable energy sources.

Table 11: green behavior

ook van die koppen op kranen, van die zuinige koppen. [..] let op je verbruik [..] het gedrag van mensen is belangrijk
gedrag van mensen [..] doe bijvoorbeeld allemaal een dikke trui aan in de winter of zorg dat je alleen stookt als nodig
[…] dus waarom zou je het doen? Je kunt een keer minder uit eten ofzo [..]
het gedrag van mensen met geld, de ene vindt dat moeilijker dan de andere [..]

The participants agreed that with good behavior of homeowners, energy consumption could and should be reduced. Isolation was mentioned as an important step and in addition, adjusting your central heating boiler was also mentioned as a creative but good form of reducing energy consumption as can be seen in table 12.

Table 12: energy saving

maar dat komt omdat we al goed geïsoleerd zijn [..]
isoleren is daarom ook erg belangrijk denk ik [..] nieuwe huizen kan je bijna op een kaars warm houden
we kunnen wel allemaal kijken naar hoe we verduurzamen maar we kunnen ook bezuinigen
ik ken iemand die zijn cv heeft getuned waarmee hij ook zeker 100 euro bespaard [..] dat betekent dus dat je ook energie bespaart

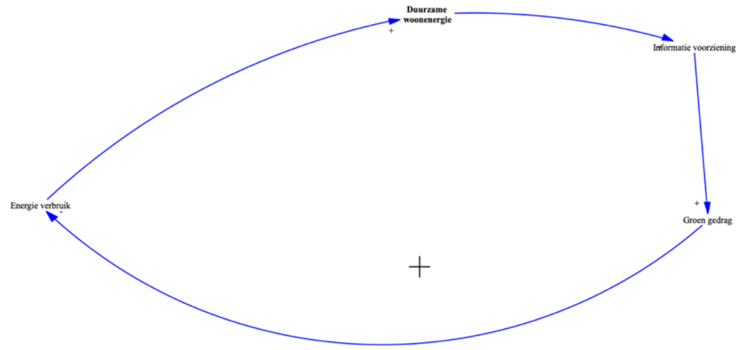

Figure 9: green washing loop

According to the participants, there is certainly still something to be achieved at municipal level when it comes to management and policy, which can be seen in table 13. They think that good regulation is also responsible for good information provision. It is important that money used to invest in sustainable energy, is used properly and efficiently. They agreed that the easier investments should be made first. In addition, participants though it was strange that some residents had to adhere to certain rules, and some did not.

Table 13: Regulation of municipality and investment efficiency

dus daar ligt juist de uitdaging voor de gemeente, of nou ja, de subsidieverstrekkers, of weet ik veel [..] het is aan hen om mensen over de streep te trekken [..]
misschien moet ik geld apart zetten [..] hier valt nog heel veel aan te doen, beter begeleiding en informatie vanuit de gemeente denk ik
de gemeente kan hier veel beter kijken van hoe zetten wij ons geld het beste in [..] waar kun je het best in investeren in plaats van alles in een keer te doen. Dat kost te veel geld [..]
de gemeente heeft een bepaalde pot geld en moet daarmee eerst het laaghangend fruit plukken, daarna pas investeringen doen die duurder zijn
wat ik gek vind is dat wij dat dan allemaal niet hoeft te doen, er was toen totaal geen beleid omtrent dit onderwerp

This makes our second feedback loop called "good regulation" and is a reinforcing loop.

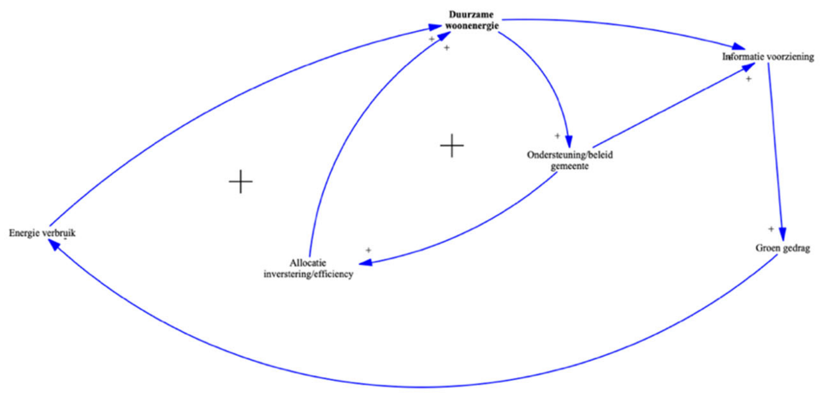

Figure 10: good regulation loop

Participants agreed that the more information that was available, the more people would adopt renewable energy and the more sustainable residential energy eventually became. This is a third reinforcing feedback loop in the model called “adoption” and can be found in figure 11.

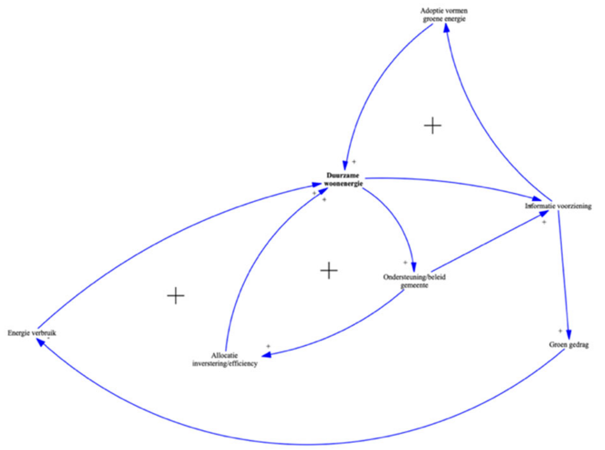

Figure 11: adoption loop

According to the participants, renewable energy technologies are often perceived as ugly. They prefer to look for alternatives that have a better appearance. Solar panels and wind poles are perceived as ugly and reduce the appearance of the house and the neighborhood. Examples are given in table 14.

Table 14: living quality

[..] zonnepanelen in vorm van dakpan is voor mij veel interessanter, waarom zou je dan nu zonnepanelen op je dak zetten [..] daar moet je wel naar toe, dat het minder zichtbaar wordt maar toch energie neutraal
ik heb zo'n mooi huis uit 1920 en dan moet ik daar zo'n spuuglelijk ding op zetten
[..] helaas dat ze ook nog wat zonnepanelen en windmolens moeten plaatsen

In combination with the adoption of green energy, this results in a negative feedback loop, called "living quality".

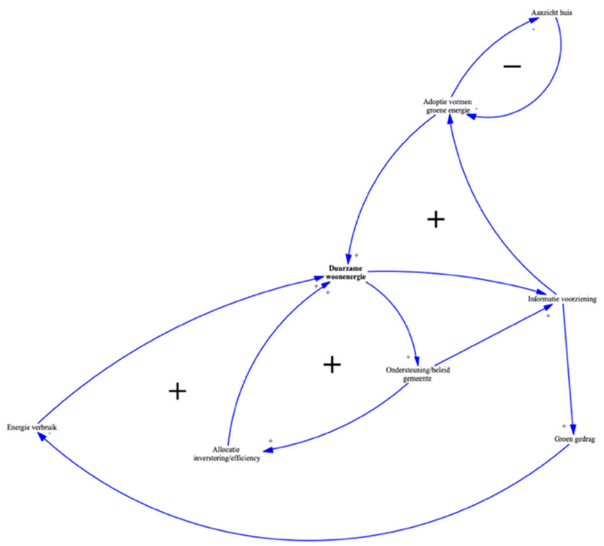

Figure 12: living quality

The participants agreed that when purchasing sustainable energy sources, you could often receive financial benefits such as subsidies or VAT deductions, as can be seen in table 15. They also agreed that these financial benefits are being phased out and that subsidies and financial benefits are decreasing.

Table 15: financial benefits

de subsidie was toen nog iets ruimer dan dat hij nu is […]
[..] wij leveren ook energie terug aan de maatschappij
subsidie aanvragen, deze zijn nu wat 2 al zei, lager
mogelijk en er was een saldering regeling [..] deze regeling zorgt ervoor dat alles wat je te veel produceerde en terugleverde, je een bruto/netto voordeel

Together with the financial attractiveness of green energy, this forms a balancing feedback loop, called "financial benefits".

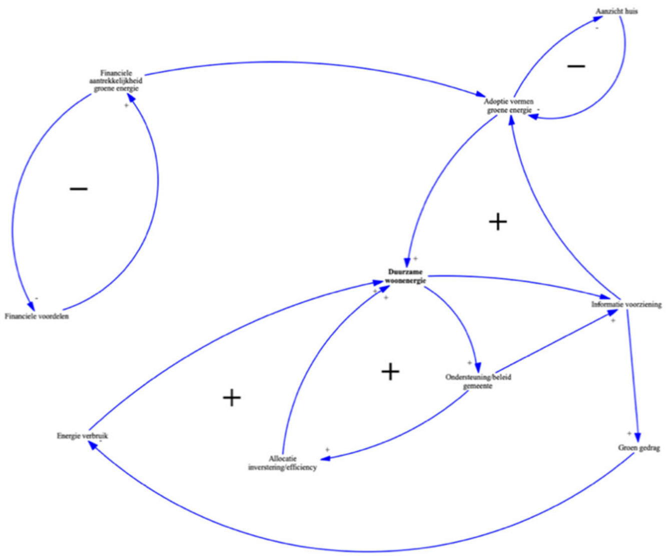

Figure 13: financial benefits loop

According to the participants, the financial attractiveness of green energy increases if the price of this energy decreases, as can be seen in table 16. However, this has consequences for the financial benefits such as supplying energy back to the grid. According to the participants, the price of green energy is going down as more green energy becomes available to the grid.

Table 16: energy price

[..] maar goed, de stroomprijs is ondertussen wel wat gaan zakken hoor, dat speelde toen al een beetje van
Nou, de verwachting was dat de elektriciteitsprijs heel erg ging zakken, dat valt volgens mij nog wat tegen
[…] energieprijs is ook een ding, erg onvoorspelbaar en lastig te berekenen, maar hoe meer energie er wordt opgewekt, hoe goedkoper het uiteraard wordt

This results a balancing feedback loop, called "energy prices".

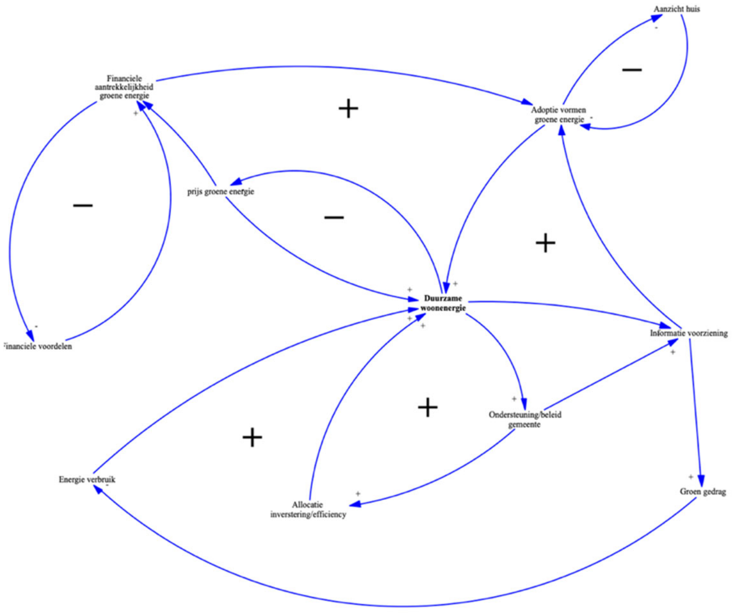

Figure 14: energy prices loop

The last variable, called interest is fueled by good information provision and good financial attractiveness, as can be seen in table 17. According to the participants, homeowners still need to create an urge to become more sustainable. They acknowledge that there are many homeowners who are not and will not be interested enough in making their homes more sustainable and therefore these homeowners need to be informed correctly.

Table 17: interest

en misschien geen interesse. Dat is misschien niet zo netjes… nou nee ik heb eigenlijk geen interesse.
[..] ik heb echt geen idee hoe ik mijn huis zou moeten verduurzamen en ben daar ook niet echt mee bezig eigenlijk
het is een ver van je bed show, je weet niet waar je moet beginnen, jij bent daar denk ik echt niet de enige in [..]
wie geeft het juiste advies, wat bespaar ik echt, etc. zijn allemaal dingen mij afschrikken

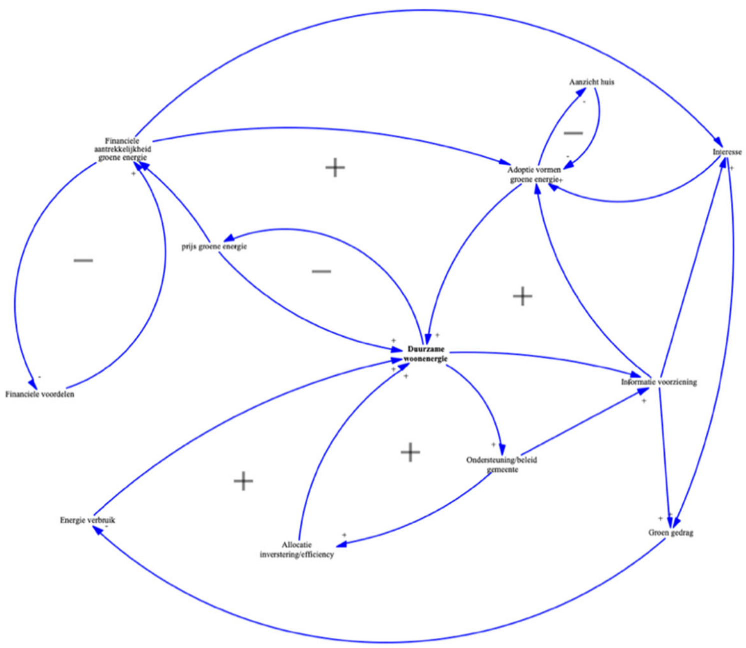

Figure 15: interest loop

4.2.2. Part two: initial policy options

The second part of the workshop resulted in eighteen policy options generated by the participants, which were brought back to six of the best policy options.

The participants agreed that *homeowners with a high energy label should receive various financial benefits*. This way, according to the participants, the attractiveness of a good energy label is enhanced. In addition, the participants agreed that *more information is needed from the municipality* for the transition to more sustainable houses. They felt that this was an important link, and this was often mentioned during the workshop. The participants mentioned that making houses more sustainable was not such a bad thing, provided you had the right information, and that this information can also demonstrate the benefits of making your house more sustainable. According to the participants, a policy that should *encourage homeowners to become more sustainable* is also a good way to promote sustainability. This has overlap with informing homeowners about making their home more sustainable. The next policy that the participants mentioned was to *reduce energy consumption*. The less energy you use, the more sustainable you are, according to the participants. Another policy that the participants came up with was *making sustainability more accessible*. According to the participants, this is still too complicated for many homeowners and more support should be provided from the government or municipality to make this more accessible for this group of homeowners. Finally, a policy was mentioned that ensures that *every homeowner receives a* *tailor-made sustainability plan for his or her home*. According to the participants, every house is different. For one house it was more attractive to purchase solar panels, while for another it was more attractive to improve isolation. They thought a tailor-made plan for a house would be an attractive option. The policy options of the second workshop embedded in the model can be found in figure 16 below.

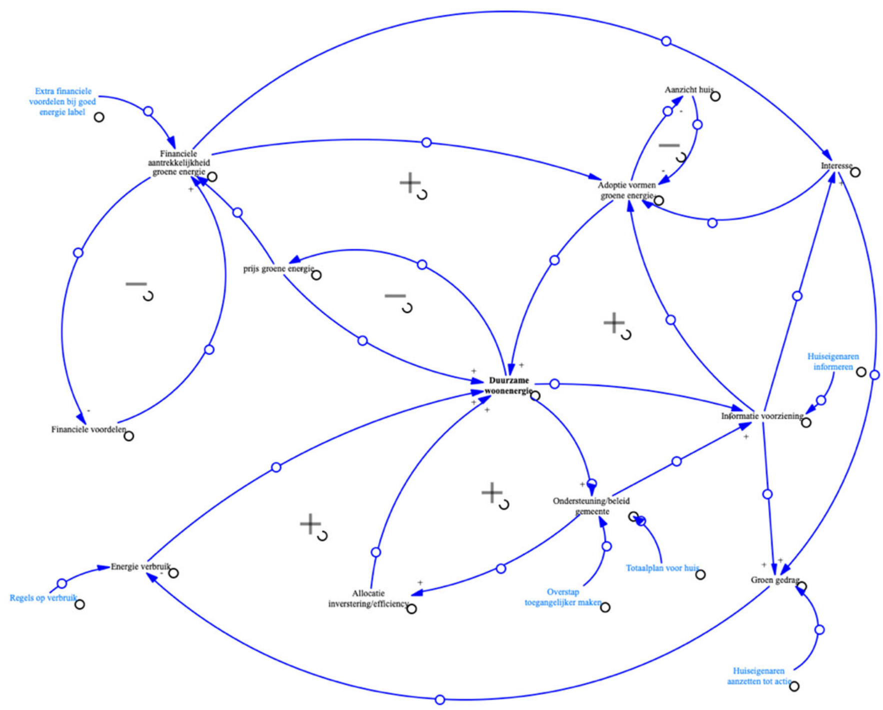

Figure 16: model various municipalities with policy options

4.3. Accumulating the final model

The results of ATLAS (table 18 and 19) are used to determine which variables and which feedback loops are included in the final model. First, we look at the four variables that occur most in the first workshop, then we look at the four variables occur most in the second workshop. Subsequently, it is checked whether there is overlap between the variables of the two models, these variables are also added into the final model.

4.3.1. Selecting variables and feedback loops

In the first workshop, "information provision" was the most discussed by the participants. The second most discussed variables were "regulation of municipality" and the "interest" of homeowners in making their homes more sustainable. This was followed by "support for switchers" and the "green behavior of homeowners", see table 18.

Table 18: most discussed variables workshop 1

Variable	No. of identifications
Interesse	10
Informatie voorziening	20
Groen gedrag	8
Beleid gemeente	14
Ondersteuning overstappers	9

In the second workshop, the variable "financial attractiveness" was mentioned the most. Followed by "guidance" and "information provision". The "efficiency of external energy parties", "regulation of municipality" and "good behavior of people" were also mentioned, as can be seen in table 19.

Table 19: most discussed variables workshop 2

Variable	No. of identifications
Begeleiding	18
Informatie voorziening	18
Regeling gemeente	14
Rendement/financiele aantrekkelijkheid	20
Goed gedrag van mensen	12
Efficientie externe energie partijen	12

By selecting the most variables and associated feedback loops, the final model is accumulated. The orange-colored variables correspond in both models and are therefore also included. In this section the different feedback loops are briefly discussed and analyzed by using the archetypes and SD concepts explained in chapter 2.1.1. The feedback loops are indicated with a R (reinforcing) or B (balancing) followed by a number.

4.3.2. System Dynamic analysis

First, the balancing feedback loop indicated by one (B1) and the reinforcing loop indicated by one (R1) as can be seen in figure 17 are analyzed. The various financial benefits such as subsidies and feeding energy back to the grid work to a certain extent. As more people adopt forms of sustainable energy and the financial attractiveness increases (e.g., because economies of scale can be achieved in production), the financial benefits decrease. The subsidies are being reduced and supplying energy back to the grid does not yield as much money as before. This ensures that the financial attractiveness of sustainable energy stagnates and may decrease as the transition progresses, indicated by a balancing feedback loop (B1). This largely corresponds to the "limits to success" archetype.

Reinforcing feedback loop two (R2) shows that the better the information provision, the better the guidance for switchers becomes, resulting in more adoption of green energy. This in turn leads to even more information provision.

Reinforcing feedback loop three (R3) shows that the better the information provision is, the better the municipality's regulation becomes, and the more sustainable residential energy there will be. The more sustainable residential energy there is, the more information becomes available to the public.

Reinforcing feedback loop four (R4) shows that the more information is available, the better the regulation and the better the efficiency of external parties. This in turn results in more sustainable residential energy.

Reinforcing feedback loop five (R5) shows that the better the information provision is, the greener people's behavior is, the less energy they consume and the more sustainable residential energy houses there are.

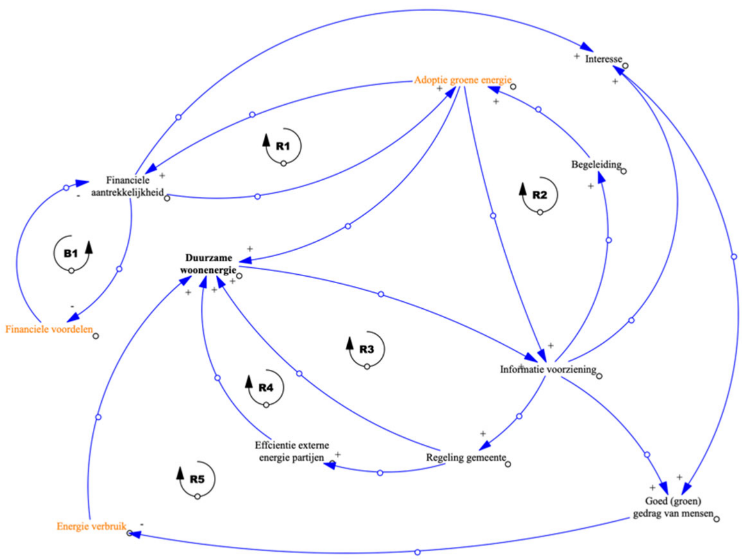

Figure 17: final model

“Information provision” was an important point of discussion in both workshops. This clearly indicates the importance of the variable in the model. Information provision is at the center of reinforcing feedback loops R2 up to R5. This makes the variable important in the model. However, the information provision was often experienced as poor by the various participants from the workshops. This has consequences for the feedback loops, which according to the model are reinforcing. The poor information provision therefore has major consequences for the transition to sustainable residential energy. Thus, information provision can be seen as a high-leverage point in the model. Changing this variable will have a major impact on the transition to sustainable residential energy in the model. This also applies to the variable “regulation of the municipality”, which still needs, according to the participants, a lot of improvement. Successfully adjusting this variable affects the “efficiency of external energy parties” and “sustainable housing energy” in itself. The results from the evaluation of the workshop also emphasize the importance of information provision and guidance for the transition, the second mentioned in the evolutions of both workshops.

The variable “financial attractiveness” and the corresponding archetype “limits to success” is also a high leverage point in the model and is highlighted with B1 and R1.

4.3.3. Multi-Level Perspective analysis

By deductive coding the variables in the model, it becomes clear at which level these variables are embedded in the Multi-Level Perspective (MLP). The table can be found in the Appendix 8.12. In section 4.3.2. the variable “information provision” was indicated as a high leverage point. According to the MLP, this variable is imbedded in the regime level. This makes it difficult for the variable “information provision” to influence the variable "green behavior" and "interest" as they are imbedded in the level of landscape according to the operationalization table. The landscape level has more influence on the regime level than the other way around. Therefore, loop R5 cannot be improved with an increase in information provision. It is, however, possible to influence the “guidance” and “regulation of municipality” variable as these are embedded on the same regime level as “information provision”. These two variables are in a reinforcing feedback loop (R2, R3, R4) and thus an important link in the system.

The variable “financial benefits” from the archetype in section 4.3.3. occurs at a niche level and can thus be influenced by the variable “financial attractiveness” and “adoption of green energy” that is embedded in the regime level.

4.3.4. Comparing the results

According to the System Dynamics (SD) approach it is possible to influence feedback loops three to six (R3, R4, R5, R6) by increasing the variable “information provision”. However, if the MLP approach is being used, it is difficult to influence the variables “interest” and “green behavior” because these variables are embedded at the higher landscape level than “information provision” which is embedded at the regime level. This results in different results for the SD and Multi-Level Perspective (MLP) approach.

As mentioned in section 4.3.4. it is possible to influence “financial benefits” because this variable is embedded in the niche level, while the other variables are embedded at the higher regime level. The MLP shows no different results than the SD does when comparing for B1 and R1, and the correspondent archetype “limits to success”.

4.4. Exploring appropriate policy options

The policies the participants from the two workshops came up with are analyzed in this chapter with the System Dynamics (SD) and Multi-Level Perspective (MLP) framework to arrive at effective and feasible policies that yield a greater commitment according to the participants. The policies that affect a high leverage point in the final model are discussed, because these are the most effective.

4.4.1. System Dynamics policy analysis

Making switching more accessible, a *total plan for the home* (mentioned in both workshops) and *informing homeowners* (mentioned in both workshops) are policies that improve the information provision about the energy transition. In the eyes of the participants, these options are the most appropriate and they also apply on a high leverage point in the model, namely the variable “information provision”.

The policy options resulting from workshop 2, *control*, *legislation by architects* and *making houses more sustainable step by step* also affect a high leverage point in the model, namely the "regulation of municipality". The policy “advantages for homeowners with a good energy label does have an influence on the identified archetype mentioned in chapter 4.3.2., which can also be perceived as high leverage point. These seven policies, whereas two policies were mentioned in both workshops, are the most appropriate according to the System Dynamics approach. The other three policies do not influence a high leverage point in the model and are therefore less effective according to the SD approach. They are however, added in figure 18.

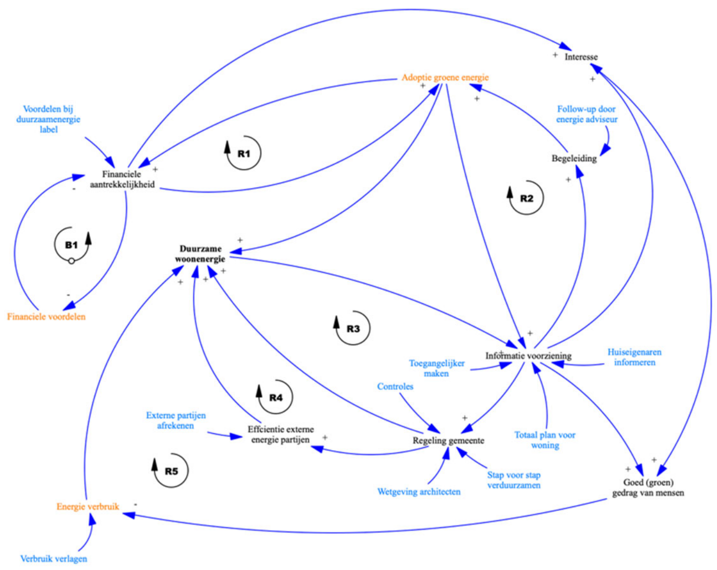

Figure 18: final model with policy options

4.4.2. Multi-Level Perspective analysis

This section examines the level at which the various policies have to be implemented. Then the results are compared with those from the previous section. The coding table can be found in the Appendix 8.13.

Making switching more accessible occurs at regime level, which makes it relatively easy to influence the variable "information provision" because they occur at the same level. The policies *a total plan for a home* and *informing homeowners* both occur at niche level which makes it harder to influence the variable "information provision", at a higher, regime level.

The policies *control*, *legislation by architects* and *making houses more sustainable step by step* have to implemented at niche level which makes it difficult to influence the variable "regulation of municipality" because this variable is embedded in the regime level.

4.4.2. Comparing the results

The System Dynamics approach resulted in the policies *making switching more accessible*, *a total plan for a home* and *informing homeowners* for the variable "information provision". Whereas *making switching more accessible* has to be implemented at regime level, which makes it more feasible for this policy to influence the variable "information provision" which is also embedded at regime level. The other two policies occur at niche level, which is a level lower, making it harder to influence the desired variable as can be seen in figure 18.

The variable “regulation of municipality” has the following policies, *control*, *legislation by architect* and *making houses more sustainable step by step*. Whereas the policy *control* has to be implemented on regime level. The other two policies have to be implemented at niche level, which makes it difficult to implement them because of the regime level of the variable “regulation of municipality”. According to the participants all policy options suggested are appropriate and do influence high leverage points according to the System Dynamics approach, however when analyzing with the Multi-Level Perspective (MLP) framework the results show that implementing the policies: *making switching more accessible* and *control* might be easier than the other four policies due to their level in the MLP framework.

4.5. Managerial and practical implications

According to the analysis the variables “information provision”, “regulation of municipality” and “financial attractiveness” are high leverage points in the system and can improve, decline or stagnate the speed of the transition to more sustainable homes in the province of Gelderland. It is therefore recommended to provide better information, improve the regulations in municipalities across Gelderland and improve the financial attractiveness to speed up the transition and not let it stagnate or even decline. These three variables and corresponding feedback loops (R2, R3, R4) all are embedded in the regime level of the MLP framework. This regime level is therefore the level on which policies need to be implemented. Using the data, we can conclude that the municipalities on regime level have an important task to make sure there is *enough and good information provision*, *regulation,* and *financial attractiveness* to speed up, accomplish the sustainable goals and make the various homes in the province of Gelderland more sustainable. This way they can make sure the transitions go accordingly.

It can also be said that several variables in the landscape level of the MLP need to be improved. Improving the variables “green behavior” and “interest” of homeowners ensures more sustainable residential energy. However, it is difficult to change factors in the landscape, as mentioned earlier in this research. This might be the result of years of change in public opinion and homeowners' values. Since the scope of this is so large, it is difficult to draw a conclusion or recommendation for these variables.

The results of section 4.4. consist of a few examples of policies that can help with the current policy resistance in the gas transition. This study recommends *making switching to* *sustainable energy forms more accessible to homeowner*s and *more control of municipality* as two feasible policies to implement. These two policies can be implemented on regime level, which is the same level as the high leverage point variable “information provision”. The other four suggested policies from 4.4.2. suggested by the participants currently occur at niche level which can be seen as a threshold that municipalities at regime level have to overcome. Therefore, these are not among the suggested policies.

5. Conclusion

The conclusions chapter summarizes the policy resistance among homeowners in the gas transition as analyzed in chapter 4.3. and suggests the two effective policies that yield greater commitment across homeowners analyzed in chapter 4.4.2. This is done by the help of the two research questions. Lastly, a reflection on the use of the MLP framework in understanding policy resistance in the gas transition is given, as well as the consequences for the quality of this study.

5.1. How is the system structured that is responsible for policy resistance in the gas transition among homeowners in the province of Gelderland?

Using the results from two workshops in chapter 4.1. and 4.2., the final model is accumulated in chapter 4.3. The casual loop diagram that has been drawn shows the system that is responsible for policy resistance in the gas transition among the homeowners in the province of Gelderland. The variables "information provision", "regulation of municipalities", the correspondent feedback loops (R2, R3, R4, R5) and the archetype consisting of feedback loop B1 and R1 are responsible for policy resistance in this system. These variables have the potential to slow down or even stagnate the gas transition. The structure of the model can be found below in figure 19. Further discussions on the generalization to the province of Gelderland can be found in chapter 6.1.

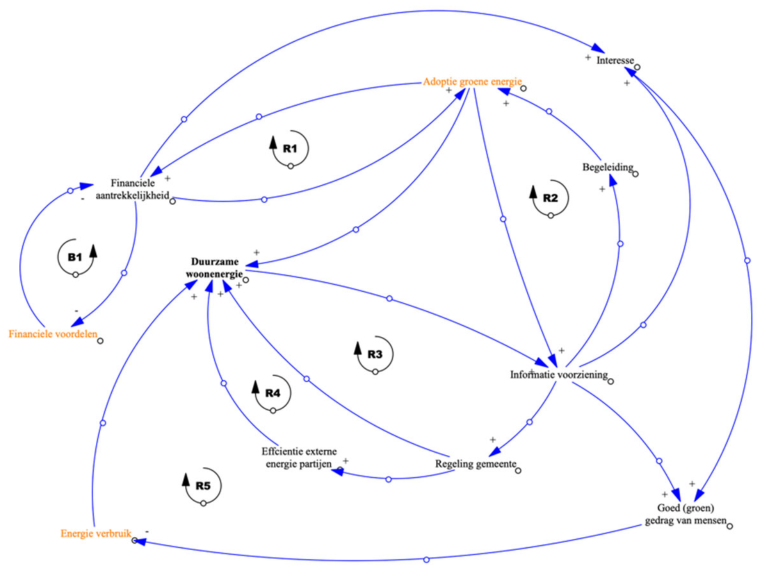

Figure 19: final model

5.2. What can explain the presence of policy resistance among homeowners in the gas transition in the province of Gelderland?

The variables “information provision” and “regulation of municipality” are two important high leverage points which should be sufficient to prevent the gas transition in Gelderland to stagnate. The participants from the workshops indicated that they experience these variables as insufficient which explains the policy resistance among homeowners in the gas transition in the province of Gelderland. The finalized model in figure 19, shows the structure that is responsible for policy resistance in the gas transition, including the high leverage points in feedback loop R2, R3 and R4. Increasing the following high leverage points, “information provision” and “regulation of municipality” as identified in chapter 4, has the potential to speed up the pace of the current gas transition in the province Gelderland and to overcome policy resistance according to the participants in two Group Model Building (GMB) sessions.

The archetype consisting of loop B1 and R1 and variable “financial attractiveness” is also identified as a high leverage point. By increasing the financial attractiveness of green energy, more homeowners will adopt these forms of energy which results in more homes with sustainable forms of energy, and this also has the potential in speeding up the gas transition. If no intervention will be made, the archetype consisting of loop B1 and R1 might stagnate or even decline the pace of the gas transition in the province of Gelderland. The three variables are currently embedded in the regime level, which makes it the task of the municipalities to come up with enough and particularly *good information, regulation, and financial attractiveness* to make sure the sustainable goals are accomplished, the pace of the gas transition will speed up and the policy resistance will be overcome.

5.3. Reflection on Multi-Level Perspective

The Multi-Level Perspective has shown that not all variables can be influenced by improving high-leverage points. The two variables "green behavior" and "interest" are embedded in the landscape level and can hardly be influenced by the variables that are embedded in the regime level (information provision and regulation of municipality). This has implications for the conclusion of this research. The variables and associated feedback loops (R5) consisting of the variables, "green behavior" and "interest" are not included as variables that can be influenced by the high leverage points “information provision” and “regulation of municipality” because they are embedded into the landscape level. As mentioned before in chapter 2.3.4., it is difficult to influence variables embedded in a higher level in the MLP framework. Since this is only a first step in combining MLP with the System Dynamics (SD) approach, some caution should be used. However, in future research the combination of the two methods can be further extended. The Multi-Level Perspective can be seen as a filter to apply on high leverage points identified using System Dynamics to increase the quality of the results and show if the high leverage points of a model can be changed, considering their level in the Socio-Technical System.

6. Limitations and further research

During this research, measures were taken to ensure that the research proceeds according to plan. However, during the research things could have been done differently and some things, outside the influence of this research, did not go as planned. These limitations are discussed in this chapter.

6.1. Generalization to Gelderland

Due to unfortunate circumstances this research could only use data of two of the three workshops conducted across municipalities in Gelderland. The online recording failed for one of the three workshops, and therefore the hard choice was made to not include this data in the results. This way the integrity of this research is guaranteed, however, generalization is lost. Without a recording it is impossible to provide the model with the corresponding quotes and discussions at this short notice. Therefore, some caution should be taken when generalizing the conclusions for the entire province of Gelderland. Extending the number of workshops for this research should increase the generalization.

6.2. Wider variety of participants

It was clear from the start of this study that some homeowners may not have the most knowledge about the subject. It was therefore also the intention to sketch the system through the eyes of these homeowners. They are the ones who have to undergo the transition. However, this has affected the conclusions. This research has therefore not been able to demonstrate all complex systems that experts with knowledge of the energy transition could have demonstrated and come up with in the workshops. Further research could also consist of more sessions across the province of Gelderland. Follow-up studies could invite a mix of experts and homeowners to different sessions to better show these more complex systems in the result.

6.3. COVID-19

Sometimes people call it the “new normal”, but this is not the case. COVID-19 also influenced this research. The online workshops influence the degree of discussion, the results, and the turnout percentage. Due to the online nature of the workshops, it was difficult to properly involve participants in discussions. During this research, measures were taken to prevent this, and it had an effect, but it would never be the same as a face-to-face workshop.

Interaction with participants is difficult and scripts have been adapted to match the online format. However, face-to-face contact and picking up a marker to write something on a whiteboard are missing. This has consequences for the results. It would be desirable to perform this study again if COVID-19 no longer exerts a significant influence on daily life.

6.4. Minimum age of the sample

The age of the participants was not sufficiently considered during the sampling. It is difficult to find homeowners under the age of 30. This was overlooked. More and more people under the age of 30 are waiting for a house or are unable to afford a house. As a result, the minimum age of the sample has become around 35 years. It is worth mentioning that the younger generation is often labeled as more sustainable. Follow-up studies could focus on younger participants, however, given the current housing market conditions, it remains difficult to find a home as a starter.

6.5. Changing variables in landscape level

Improving the variables “green behavior” and “interest” of homeowners increases the amount sustainable homes. These are currently embedded in the landscape level and as mentioned in section 4.5, it is rather difficult to assess the magnitude of a large project like this. It is therefore unwise to make statements or recommendations about something as complex as variables embedded in the landscape level within the Multi-Level Perspective. Further research could point out what appropriate policies consist of to improve public opinion on green energy, the transition of homes to sustainable energy and increase homeowners’ interest for the transition.

6.6. Focus on Socio-Technical framework

In chapter two this research zoomed in on the multi-level perspective. However, this does not mean that no other theories and or studies have been done. Numerous studies have been conducted into sustainable transitions and have led to choices having to be made. The extensive treatment of the MLP has implications for the research. Resulting in less focus on the other, also promising theories. In this research, transitions have been looked at as socio technical. This is also done by various authorities in the Netherlands in the form of transition management, while the success of this is not always maximal. Follow-up research could let go of this view of socio-technical transitions and start working with a different framework to challenge the results.

6.7. Relevance of the results

The variables in the model are very abstract. This research has shown where policy resistance occurs using high leverage points and the associated model. In addition, policy options are provided to provide an indication of direction. However, this study does not provide a 'plug and play' answer to the question of how policy resistance can be stopped. Therefore, this research can be seen as demonstrating a relevant problem, policy resistance in the gas transition. It is now up to policy makers to tackle this problem. The variables should be further developed into a plan of action. It is the task of policy makers to adapt the policy to improve the variables information provision, regulation of municipality and financial attractiveness in such a way that homeowners are able and motivated to make their homes more sustainable. Because the gas transition in the Netherlands has a focus on a district-oriented approach, it is important for the municipality to tackle any form of policy resistance and therefore also the results of this research. Municipalities and policy makers should convert the results into a plan for making and to ensure that these detected forms of policy resistance are not maintained. However, there is also a role for the homeowner in improving his behavior and interest, but this must also be encouraged by policy makers. If nothing happens from the policy makers, this will not change. When interpretating the results it should also be considered that municipalities have an important role in the gas transition, however they receive their money, partly, from higher central governments. It would be naïve to assume every municipality has the same high priority in the gas transition. If, due to various reasons, these municipalities do not have the money or priority in the gas transition, measures from the central governments are in place to make sure these municipalities also follow up with the same pace. Follow-up research could look at a way in which these high leverage points can be translated into a plan of action to tackle policy resistance.

The combination of the System Dynamics (SD) and Multi-Level Perspective (MLP) frameworks is a good filter and application to get started with by researchers. Using SD, the different feedback from the environment and thus the feedback approach can be identified within a system or model that is responsible for policy resistance. When analyzing this model using the MLP framework, the different levels can be identified at which policy resistance takes place. Based on this, it is not only possible to demonstrate whether, but also where policy resistance takes place in a CLD. This method can be further expanded by scientists in future research.

7. Literature

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8. Appendix

8.1. Register form workshops

Inschrijfformulier duurzame energie transitie gemeente Gelderland

Bedankt voor de interesse in deelname aan onze workshop(s). Met deelname aan deze workshop kan jij ervoor zorgen dat ik kan afstuderen. Daarnaast gaan we samen proberen meer begrip en duidelijkheid te krijgen over de huidige energietransitie in Nederland (meer info over de energietransitie in NL: https://bit.ly/2RiOHay).

De workshop is een online sessie via Zoom. Tijdens deze workshop gaan we met een groep van 5 a 6 personen de energie transitie uitwerken in een model. De workshop duurt ongeveer een tot twee uur. Bij deze workshop is het niet nodig om enige voorkennis te hebben. Wij zoeken mensen die huis bezitten (met of zonder een hypotheek) uit de volgende gemeenten: Ede, Nijmegen en daarnaast hebben wij een sessie met alle overige gemeenten (uit Gelderland).

De zoom link wordt toegestuurd via email.

Ede: sessie wordt gehouden op 17 Mei 19:00 - 20:30
Nijmegen: sessie wordt gehouden op 18 Mei 20:00 - 21:30
Overige gemeenten: sessie wordt gehouden op 20 Mei 19:30 - 21:00

Inschrijven en verzamelde data worden uitsluitend voor dit onderzoek gebruikt en er wordt met uiterste zorgvuldigheid mee om gegaan. Wij zullen uw gegevens nooit met derden delen. Inschrijven kan ook anoniem.

Vragen? Mail gerust: l.emmen@student.ru.nl

De wetenschap dankt u,

Lodewijk Emmen
Master student Business Analysis and Modelling
www.ru.nl

Question 1:
Do you have a (mortaged) house?

Question 2:
Do you have a newly constructed house? (at least 5 years old)

Question 3:
Name?

Question 4:
Age?

Question 5:
Email?