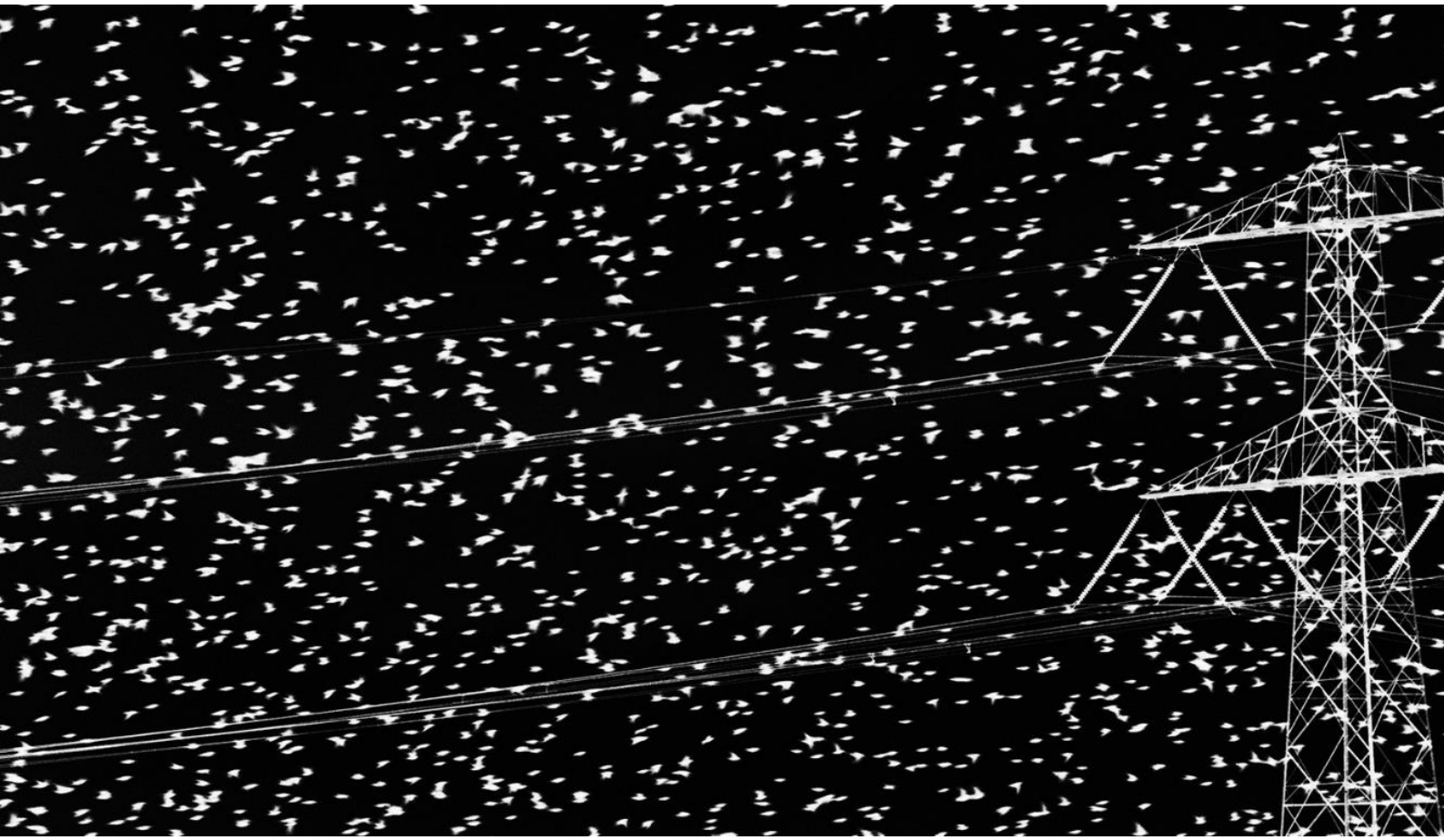
Game of power

The development of new institutional arrangements that contribute to the implementation of solutions proposed by national government for municipalities with dwellings nearby high-voltage connections.



L.G. Holland

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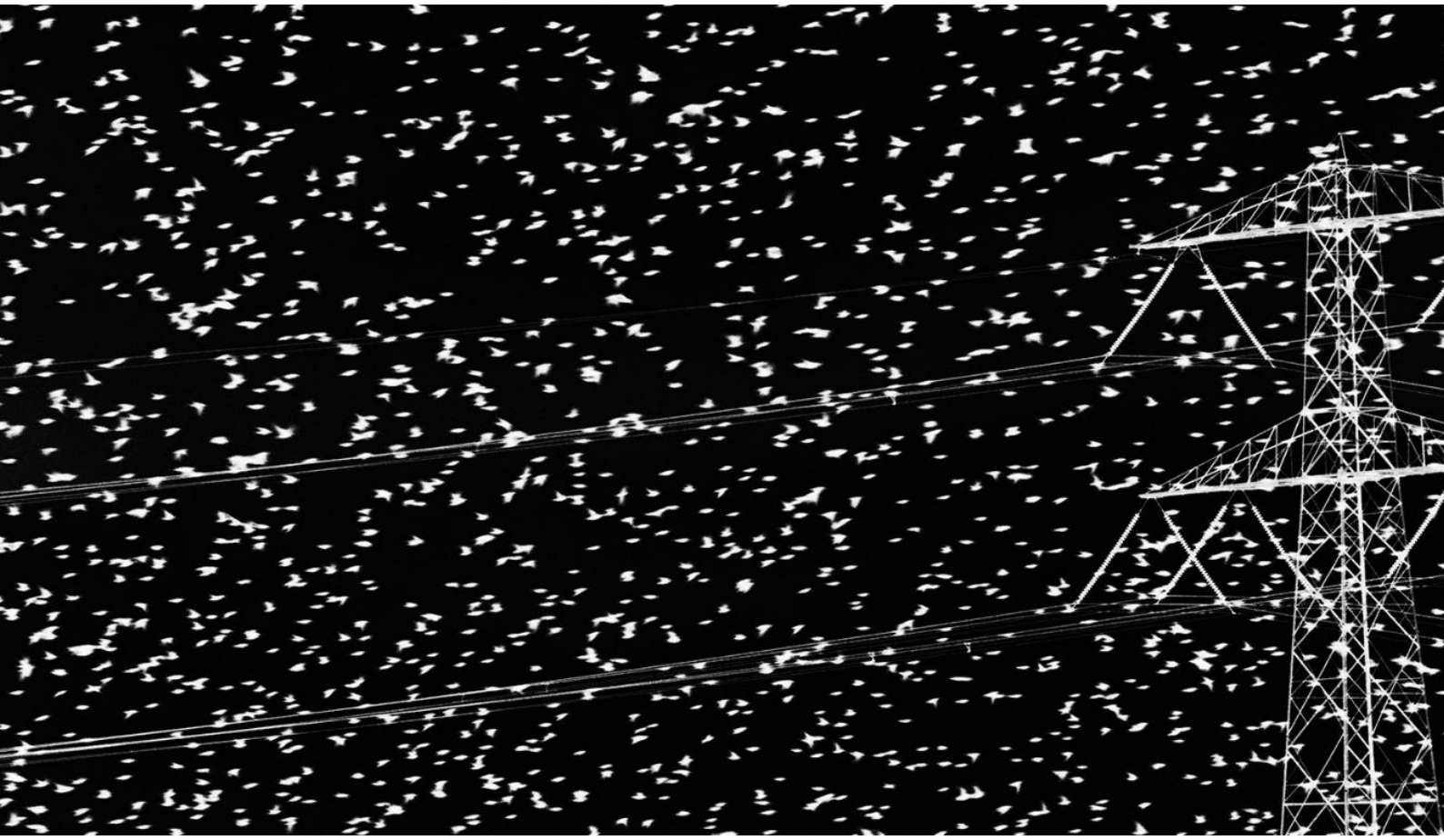

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Abstract

The aim of this research is to develop new institutional arrangements that contribute to the implementation of the undergrounding program and buyout regulation, drafted for situations where citizens live nearby overhead connections. In recent years the public debate on these situations emerged to a point where Ministers and other politicians eventually agreed on developing a substantial proposition (TK 2010/11, 31574, nr. 18; TK 2012/13, 31574, nr. 29). With the affordability of energy supply in mind, a structural solution was desired for urgent situations of citizens living nearby overhead connections. The Minister of Economic Affairs presented two options that will start from January 2017. Undergrounding is the first option and implies that overhead connections are placed underground. Hence this is not always possible due to technical or financial reasons, a second option is proposed. This is the buyout of dwellings directly underneath high-voltage tracks.

In this policy-making process there is a lot of uncertainty. The interests of the stakeholders have the potential to strengthen each other but due to lack of communication these opportunities for collaboration are not always taken. There is no clear agreement on expectations nor on meanings of different concepts and ideas (VGPH, 2014a). A better understanding is needed of influencing or determining factors on collaboration within this context. A change of institutions, the way things are organized, structured and arranged, might be important for the success of the options. Therefore, the following research question is asked:

Which institutional arrangements contribute to the implementation of the undergrounding program and buyout regulation in situations of citizens living nearby overhead connections in the Netherlands?

In order to answer this question, the possible settings of undergrounding and buyout are analyzed using Elinor Ostrom's theory. Ostrom developed a framework for Institutional Analysis and Development (IAD) that identifies several aspects that structure the 'action situation', where implementation takes place. Ostrom states that every situation is unique and deals with different stakeholders with various arguments. As the programs are planned to be implemented from 2017, this action situation can be influenced. Ostrom identifies three clusters of external variables that define the action situation. The most important and relevant cluster are the rules-in-use that define an element of the action situation. These elements are actors, positions, actions, information, control, net costs and benefits and potential outcomes. Rules that influence these elements are boundary rules, position rules, choice rules, information rules, aggregation rules, payoff rules and scope rules. These rules are used for designing new institutional arrangements for situations of undergrounding or buyout.

Through performing 10 expert interviews, desk research and document analysis, empirical data is gathered to gain a solid knowledge base. These empirical findings are used to describe the clusters of external variables, which are biophysical conditions, attributes of the community and rules-in-use. Based on this knowledge alterations are suggested that constitute new institutional arrangements for the implementation of the programs. These new sets of rules contain some important aspects. In both settings, interested and/or affected citizens are included in the new design more directly. The boundaries of entering a position in the action situations as a citizen is less narrow than it was. As the programs are drafted by the Ministry for providing a structural solution for citizens living nearby overhead connections, they are advised to have a strong influential position in the local implementation. Open and structural communication between municipalities and citizens is found to be important to improve collaboration and decrease the risk of possible conflicts. Local adjustments of the regulation are important to suit the preferences of actors in local settings. The institutional arrangements are thus more open in terms of participation and more flexible in providing a suitable solution for citizens living nearby overhead connections.

Samenvatting

Het doel van dit onderzoek is het ontwikkelen van nieuwe institutionele arrangementen die een bijdrage leveren aan de uitvoering van het verkabelingsprogramma en de uitkoopregeling. Deze beleids-programma's zijn gericht op burgers die nabij hoogspanningslijnen wonen. Ministers en andere politici zijn het uiteindelijk eens geworden in het publieke debat dat er een structurele oplossing moet komen voor deze situaties (TK 2010/11, 31574, nr. 18; TK 2012/13, 31574, nr. 29). Het Kabinet komt daarmee tegemoet aan de maatschappelijke wens om in bestaande situaties bewoners te ontlasten van hoogspanningsverbindingen. De Minister van Economische Zaken presenteerde twee programma's die vanaf 2017 kunnen starten. Het ondergronds brengen van verbindingen, verkabelen, is het uitgangspunt. Buiten bevolkingskernen en bij voltages boven 150kV is gekozen voor uitkoop. De uitkoopregeling is alleen van toepassing op woningen recht onder de kabels.

Er is veel onzekerheid rond dit beleid. De belangen van stakeholders kunnen elkaar versterken maar door een gebrek aan communicatie worden deze kansen niet altijd benut. Er is geen overeenstemming over verwachtingen noch over de betekenis verschillende concepten en ideeën (VGPH, 2014a). Een beter wederzijds begrip is daarom nodig om de samenwerking tussen partijen te verbeteren. Een verandering van instituties, hoe dingen zijn georganiseerd en gestructureerd, kan belangrijk zijn voor het succes van de beleidsprogramma's. De onderzoeksvraag is daarom als volgt:

Welke institutionele arrangementen kunnen bijdragen aan de implementatie van het verkabelingsprogramma en de uitkoopregeling in Nederland in situaties waar burgers nabij hoogspanningsverbindingen wonen?

Om deze vraag te beantwoorden worden de beleidsprogramma's onderzocht met behulp van de theorie van Elinor Ostrom. Ostrom ontwikkelde een raamwerk voor institutionele analyse en ontwikkeling (Institutional Analysis & Development, IAD) wat verschillende aspecten kan identificeren die de 'actie situatie' structureren, waar implementatie plaatsvindt. Volgens Ostrom is elke situatie uniek met unieke stakeholders, belangen en argumenten. Ostrom identificeert in haar raamwerk drie sets van externe variabelen die elke actie situatie definiëren en beïnvloeden. De belangrijkste set van variabelen zijn de huidige gebruikte regels (rules-in-use). Dit zijn een soort spelregels die elk een element in de actie situatie definiëren. De actie situatie bestaat uit actoren, posities, acties, informatie, controle, netto kosten en baten en potentiele uitkomsten. Regels die deze elementen beïnvloeden zijn afbakeningsregels, positieregels, keuzeregels, informatieregels, aggregatieregels, kosten-batenregels en omvangsregels. Deze regels worden gebruikt voor het ontwerpen van nieuwe institutionele arrangementen voor uitkoop en verkabeling.

Door het uitvoeren van tien expert interviews, bureauonderzoek en documentonderzoek wordt empirische gegevens verzameld om een stevige kennisbasis te ontwikkelen. De empirische gegevens worden gebruikt om de sets van externe variabelen te beschrijven: biofysische condities, attributen van de gemeenschap en de gebruikte spelregels. Gebaseerd op deze kennis worden aanpassingen gesuggereerd die samen de nieuwe institutionele arrangementen vormen. Deze kunnen ingezet worden tijdens de implementatie van de programma's. Deze nieuwe spelregels bevatten enkele belangrijke aspecten. In geval van uitkoop en verkabeling word geadviseerd ook geïnteresseerde bewoners mee te nemen in het proces, niet alleen hen die direct beïnvloedt worden. De afbakening van posities in de actie situatie is minder beperkt dan het nu is. Wanneer de programma's door het Ministerie zijn ontworpen om een structurele oplossing te bieden voor wonen nabij hoogspanning, dan zouden burgers sterker vertegenwoordigd moeten worden in de lokale implementatie. Open en regelmatige communicatie tussen gemeenten en burgers is daarbij belangrijk en kan samenwerking bevorderen en het risico op conflicten doen afnemen. Lokale aanpassingen en ruimte voor maatwerk binnen de programma's is daarbij essentieel. Dit om werkbare oplossingen te leveren die aansluiten bij het unieke karakter van elke situatie en de voorkeuren en karakter van stakeholders. De institutionele arrangementen zijn daarom meer gericht op participatie en zijn flexibeler, en daarmee hopelijk effectiever, in het bereiken van een oplossing voor wonen nabij hoogspanning.

Preface

My thesis is finished! This piece of paper scientifically reports my findings of the 'game of power'. My master thesis is written in order to graduate from the University of Twente and receive my Master Degree on Public Administration. The research is performed during an internship at APPM Management Consultants and the municipal association of electrical power transmission (VGPH). I found it very interesting and valuable to already make a connection with the 'real world' and discuss theories, methods and results with practitioners.

During this process there are several people who provided their contribution and support. The first to thank are my supervisors of the University of Twente. Maarten Arentsen, thank you for your advice and encouragement during the whole process. I highly value the ease and flexibility of our collaboration. This also applies to the second supervisor, Thomas Hoppe, who supervised my bachelor thesis and agreed upon supervising again. Thank you for your feedback and advice in the end stage of this master thesis and still remembering many details of my bachelor thesis.

I would also like to thank Matthijs Kok and Alexander Smal of APPM as external supervisors. Thank you for your feedback, advice and guidance in writing a practical piece and reaching my goals. It was a very valuable contribution to my education and made thesis-writing as good as it can be. And I am very happy to call you my colleagues after graduation!

Then at last, special thanks to my mom, dad, brother and sister. Tough seasons in life only made us stronger and I cannot thank you enough! There is a time for everything and a season for every activity. A time to study and a time to work. A time to weep and a time to laugh, a time to be silent and a time to speak. Whatever is has already been, and what will be has been before. Still, we know that the best is yet to come!

Amsterdam, November 6th, 2014

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1. Introduction

This research aims at analyzing and developing strategies for situations in municipalities with dwellings located near high-voltage connections of the national electricity grid. It is a complex topic with numerous perspectives, arguments, contradictions and uncertainties to solve. The focus lies on the 'game' stakeholders play in the field of electricity ('power') related to dwellings located in the direct environment of the grid. In this chapter several aspects of the research are introduced. The background of the research topic is addressed first. Second, the problem statement is made. Research questions are formulated and explained in section 1.3. Finally, the outline of the report is provided.

1.1 Background

In the Netherlands several situations emerged in which dwellings are located nearby or directly under high-voltage connections. There are several reasons for these situations. Net operator TenneT had a legal responsibility in providing an adequate and efficient electricity grid (Elektriciteitswet, 1998, art. 16.1), municipalities planned urban areas near high-voltage connections and citizens made a choice to live nearby high-voltage cables. In recent years the public debate on high-voltage connections in urban areas emerged to a point where politicians eventually agreed on developing a substantial proposition (TK 2010/11, 31574, nr. 18; TK 2012/13, 31574, nr. 29). The Minister of Economic Affairs presented two new policy programs as solutions for these situations: 'undergrounding' and 'buyout' which key characteristics are provided in Table 1 below. The policy programs will be implemented from 2017.

The proposed solutions started with the worries of citizens when several research publications appeared about the magnetic fields of high-voltage cables and a correlation with childhood leukemia or dementia (e.g. Ahlbom et al., 2000; Greenland, Sheppard, Kaune, Poole, & Kelsh, 2000). Despite the fact that there is no consensus nor significant causal prove of negative effects, national government

	Undergrounding program	*Buyout regulation*
Priority	Preferred option	Second option
Aim	To place high-voltage cables underground.	To buyout dwellings directly under high-voltage cables.
Scope *Not included:*	High-voltage cables up to 150kV with a length of ≥1km in urban areas. *Tracks crossing playfields, recreational, industrial and rural areas, lengths < 1 km, voltage >150kV*	Dwellings directly under tracks not included in the undergrounding program (220/380kV, 150kV >1km or outside urban areas). *Dwellings inside the magnetic field of 0.4 µT near the selected tracks.*
Budget National government Municipalities Citizens TenneT	 - € 110M, (25%) Increased energy rates[1] € 330M (75%, financed by increased energy rates)	 € 140M Administrative costs - -
Units	150 kilometer in 55 municipalities	377 dwellings in 83 municipalities
Average costs per unit	€ 3.25M per kilometer	> € 0.35M per dwelling
Result	Overhead cable is placed underground, magnetic field is decreased.	Citizens who live in dwellings under the high-voltage cable have an opportunity to move but their direct neighbors still live nearby the track.

Table 1: Overview of key characteristics of the undergrounding program and buyout regulation (TK 2013/14, 31574, nr.36).

[1] The increased annual energy rates are estimated to vary from € 1,30 - € 6,- per dwelling for 10 years (Handelingen II 2012/13, 88-3; Kroon, 2011).

defined new limits for magnetic fields in order to prevent any discussion concerning health risks (Ministerie van VROM, 2005; TK 2012/13, 31574, nr.35). These new limits serve as an advice and only apply to new situations. This was not accepted by citizens living nearby existing situations. Net operator TenneT started to experience increased resistance and anxiety among citizens in areas of maintenance and new tracks over the past few years. One of the situations is located in the municipality of Oostzaan where the voltage was raised from 150kV to 380kV. These citizens complained about increased noise disturbance, headaches and fire from burning particulates on the cables (Oostzaan380kV, 2006a). This caused concerns and social commotion. These citizens and local politicians played an important and game changing role according to several stakeholders (Interview Veenendaal; VGPH; Zaanstad; RTV N-H, 2011a, 2011b). They campaigned actively against the changing voltage and living nearby high-voltage cables in general and caught attention of national politicians and media (Oostzaan380kV, 2010). TenneT therefore urged parliament to take action and proposed various strategies as possible solutions based on the new limits for magnetic fields (Kroon, 2011). The Minister of Economic Affairs eventually adjusted these strategies based on limited financial resources and presented the programs as explained in Table 1 (TK 2010/11, 31574, nr.18).

1.2 Problem statement

This thesis is written to finish the master Public Administration at the University of Twente and addresses a question of the VGPH ('Vereniging Gemeentelijk Platform Hoogspanning'), the municipal association of electrical power transmission. This association represents several municipalities (see Appendix A) that are affected by the proposed program and regulation about citizens living nearby overhead connections (VGPH, 2014b). This research will be used in the future strategy of the VGPH. One of their main arguments against the undergrounding program and buyout regulation is that only a few citizens live nearby overhead connections while the whole Dutch population benefits from it. Municipalities should therefore not be fully responsible for solving problems that relate to small parts of the high-voltage grid (interview VGPH). Municipalities state that they cannot contribute 25% of the costs of the undergrounding program. In case of buyout the regulation is too narrow. It only applies to dwellings directly under the overhead connection. Some of the VGPH-members are also concerned that the municipality will be forced to stand between citizens and the Ministry and that they will become the 'bogeyman' (Interview Oostzaan; Kleijne, 2014). The municipalities want to maintain a healthy relationship with their citizens.

According to the VGPH, stakeholders do not always communicate about their actions which results in situations of misunderstanding (interview VGPH; VGPH, 2014a). The interests of the stakeholders have the potential to strengthen each other but due to lack of communication these opportunities for collaboration are not always taken. There are indications of frustration among some of the stakeholders and there is no clear agreement on expectations or on meanings of different concepts and ideas (VGPH, 2014a). The VGPH therefore strives to investigate local implications of the undergrounding program and buyout regulation and protect the interests of the VGPH, the municipalities and the citizens they indirectly represent (VGPH, 2012). A better understanding is needed of influencing or determining factors on collaboration within this context. A change of institutions, the way things are organized, structured and arranged, might be important for the success of the options presented to citizens living nearby overhead connections. Theories and methods that help analyze these specific institutions and can identify aspects that could be altered are needed in this research. It is useful to gather knowledge in the process of finalization of the program and regulation before it is finite and ready for implementation. The research results serve as an advice for municipalities and their citizens during preparation and implementation of the undergrounding program and buyout regulation. The results could also be useful in situations of new tracks because similar stakeholders are involved.

1.3 Research questions

The problem statement leads to the following research question:

Which institutional arrangements contribute to the implementation of the undergrounding program and buyout regulation in situations of citizens living nearby overhead connections in the Netherlands?

In order to answer this research question the Institutional Analysis and Development (IAD) framework of E. Ostrom is used to describe the external variables that influence the possible implementation of the undergrounding program and buyout regulation. Ostrom (2010) developed a framework for institutional analysis of natural resources and won in 2009 the Nobel Prize for Economics for her work on 'the commons' (The Nobel Foundation, 2009). The central statement is that in managing natural resources the interest of the individual and the interest of the collective can be contrary and can lead to 'the tragedy of the commons' if there is no appropriate management and coordination. The idea of one panacea for all situations is rejected but instead is shown in numerous publications that every local setting is unique and requires a tailor made arrangement for effective and sustainable natural resource management (E. Ostrom, Gardner, & Walker, 1994; E. Ostrom, 2005, 2010, 2011). This claim is interesting for this research. A general solution is proposed by the Ministry of Economic Affairs but municipalities and citizens are not content with the aim, scope and budget of the program as mentioned in Table 1. The municipalities and citizens want different solutions more fit to their needs. Every situation unique and deals with different stakeholders with various arguments. The IAD-framework identifies seven basic elements of situations in which stakeholders interact. E. Ostrom (2011) states that every element is defined by rules. For example, who participates in an interaction is defined by some sort of agreement on boundaries. The theory is explained further in the next chapter. Ostrom's framework can be used for designing modes of collaboration in situations of undergrounding or buyout. Several sub-questions are formulated to analyze these specific situations in order to propose new institutional arrangements. The first sub-question aims at describing the physical conditions in which the proposed undergrounding program and buyout regulation is implemented. Several policy documents, reports and other information is studied as well as information from expert interviews. A clear description of possible settings in which the policy is implemented will be provided through the following question:

1. *What are the biophysical conditions of the settings identified for implementation of the undergrounding program and buyout regulation?*

After establishing the biophysical conditions a precise description of the attributes of the community is the second step in determining external variables that affect preparations and future implementation. This sub-question provides a stakeholder analysis of the involved actors. Several documents and expert interviews are analyzed to describe the interest positions of the stakeholders, their actions, influence, expectations and preferences. The following sub-question is formulated:

2. *What are the attributes of the stakeholders involved in the settings of the undergrounding program and buyout regulation?*

The previous sub-questions analyze the different settings and stakeholders related to the policy programs. The next step is to describe the rules-in-use that affect the preparations of the undergrounding program and buyout regulation. With use of expert interviews and several documents the following sub-question is answered:

3. *Which rules are used by stakeholders in relation to the undergrounding program and buyout regulation?*

After establishing the external variables new modes of collaboration or 'institutional arrangements' can be developed for implementation of the undergrounding program and buyout regulation. The framework of Ostrom is used in combination with the information gathered so far to answer the fourth sub-question:

4. *What aspects should be altered to establish new institutional arrangements that fit within the settings of the undergrounding program and buyout regulation?*

Together, these sub-questions lead to an answer on the main research question of this thesis.

1.4 Outline

To answer the main research question in a structured manner, the outline of this thesis is as followed. First, the theoretical framework is established in the second chapter which forms the basis of the remainder of the research. The research method is discussed in the next chapter. This research is qualitative by construction and investigates the current setting and aid the design of new institutional arrangements to bring these settings a step further. Desk research, document analysis and expert interviews with representatives of several municipalities – representatives of Geertruidenberg, Helmond, Oostzaan, Veenendaal and Zaanstad – citizens and representatives of net operator TenneT, VGPH and the Ministry of Economic Affairs are methods for data collection. The instruments, procedures and data issues are also explained in the third chapter. The fourth chapter contains the results. First, a schematic overview of the results is provided through several versions of the IAD-framework. For the undergrounding program there are three types of settings: frontrunner, active and passive settings. For the buyout regulation two types of settings are identified: active and passive settings. These specific settings are ideal types of real life situations and are developed to represent more municipalities than the ones that are mentioned in these overviews. The ideal types are based on data from several expert interviews and documents. After this overview the sub-questions are answered. In chapter 4.2 the biophysical conditions of the settings in which the programs is implemented is explained. Next, a stakeholder analysis is performed that provides an overview of the attributes of the community in section 4.3. In section 4.4, the final section of the results chapter, two sub-questions are combined. The third sub-question is addressed which aims at describing the rules-in-use. The fourth sub-question aims at the development of new institutional arrangements. The rules-in-use are based on empirical findings from the expert interviews and documents and mentioned a table. This description is combined with the establishment of new sets of rules in the same tables based on the rules-in-use. These results form the basis for the conclusion and answer on the main research question in chapter 5. In the final and sixth chapter the discussion and recommendations for future research are provided. At the end of the report a bibliography and appendixes are added.

2. Theory

In this chapter the theoretical foundation of the research is explained. The undergrounding program and buyout regulation as explained in chapter 1 are not considered as a panacea for every worried citizen living nearby high-voltage connections with magnetic fields. A panacea is a universal solution, meant to fit all situations (E. Ostrom, 1999). The undergrounding program is not a solution for a municipality with dense (underground) infrastructures or buildings or narrow streets that complicate the technique and increase the financial resources needed for undergrounding. Municipalities might not see opportunities for financing 25% of the costs required for undergrounding. The buyout regulation only applies to dwellings directly under the overhead connection. The neighbors directly next to the overhead connection could experience similar effects but is not selected for buyout. When the Ministry of Economic Affairs wants to propose a solution for citizens who live nearby overhead connections, they should enable local solutions based on local conditions. The options are now limited by finances and are quite strict. The Minister of Economic Affairs states that he is receptive for localized adjustments (TK 2013/14, 31574, nr.36). The framework for Institutional Analysis and Development (IAD) of E. Ostrom can provide a framework for identifying specific localized adjustments and is therefore used in this research as starting point of analyzing the subject of this thesis in chapter 4. This analysis is aimed at developing new institutional arrangements for the implementation of the policy options. The IAD-framework is developed for analyzing and managing natural resources but is used here in the field of energy distribution. In this chapter the theory is explained and variables are conceptualized. In section 2.1 the IAD-framework is explained and its key concepts are defined. The elements of the action situation and external variables are central in this section. In the next section (2.2) is explained how the IAD-framework is applied and conceptualized in order to answer the research questions.

2.1 The Institutional Analysis and Development framework

In order to analyze and model diversity the Institutional Analysis and Development (IAD) framework is used in this research. Ostrom (2005) claims that there is an underlying unity below the immense variety of regularized social interactions in all kinds of situations humans encounter. In these situations individuals face rules or an absence of rules that structure that situation (E. Ostrom, 2005). When individuals interact in these rule-structured situations, they face choices regarding actions and strategies they take, leading to consequences for themselves and others. These rule-structured situations can be referred to as institutions. E. Ostrom (2005, p. 3) defines institutions as "*the prescriptions that humans use to organize all forms of repetitive and structured interactions including those within families, neighborhoods, markets, firms, sports leagues, churches, private* associations, and governments at all scales". So institutions are omnipresent and shape everything we do. The IAD-framework can be used to analyze these situations. The framework identifies the elements and general relationships one needs to consider for institutional analysis. The framework is shown in Figure 1. According to E. Ostrom (2011, p. 9) an analyst needs "*a common framework and family of theories in order to address questions of reform and transition*". The elements of the framework are viewed as building blocks for understanding human interactions and outcomes of diverse situations or settings. It is a cycle with continuous influences on different elements. The key element of the IAD-framework is the action situation with actors and their interactions. These action situations occur in a context of several external

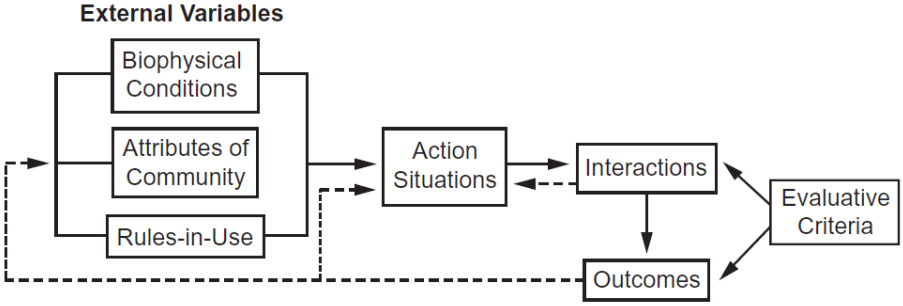


Figure 1: The framework for Institutional Analysis and Development (adjusted from E. Ostrom, 2011, p. 10)

variables that influence the action situation. The external variables are labeled as biophysical conditions, attributes of the community and rules-in-use (E. Ostrom, 2011). In this research is focused on the future action situation defined by the clusters of external variables and are explained below.

2.1.1 The action situation

According to Ostrom (2011) the action situation can be used to describe, analyze, predict and explain behavior in institutional arrangements. This action situation is shown in Figure 2. The action situation is defined as "*social spaces where individuals interact, exchange goods and services, solve problems, dominate one another, or fight*" (E. Ostrom, 2011, p. 11). There are seven elements in the action situation: actors, positions, actions, information, control, net costs and benefits and potential outcomes (uppercase). These seven elements are each defined by one of the seven rule types. The seven elements are explained by the seven rule types in this section.

First, the element actor is discussed. An actor is an individual, an organization or a representative of an organization that participates in a specific situation (E. Ostrom, 2011). Actors are defined by *boundary rules* that specify how actors were to be chosen to enter or leave positions. This decision is based on four clusters of variables that characterize actors: (1) the resources that an actor brings to a situation; (2) the valuation actors assign to states of the world and to actions; (3) the way actors acquire, process, retain, and use knowledge contingencies and information; and (4) the processes actors use for selection of particular courses of action (E. Ostrom, 2011, p. 11). These variables are necessary to determine by actual research or assumption when applying boundary rules.

Actors who participate in a situation imply action. Action is the behavior to which an actor attaches subjective instrumental meaning. These actions are determined by *choice rules*. Choice rules specify which actions are assigned to an actor in an action situation (E. Ostrom, 2010). In every action situation there are numerous possible actions which are often not all possible to analyze (E. Ostrom et al., 1994). Choices should be made in analyzing the most important or affecting actions of actors.

Actors are assigned to positions. A position is a 'status' that associates actors with an authorized set of actions in a specific process (E. Ostrom et al., 1994). These positions are defined by *position rules*. Position rules specify a set of positions and how many actors hold each one (E. Ostrom, 2010). There are situations in which all actors have the same position or different positions. An actor can also have several positions.

Information is the fourth element in the action situation. Information refers to the set of information available to or generated by an actor in a certain position on a specific point of time in the process. This element is defined by *information rules*. Information rules specify channels of communication among actors and what information must, may, or must not be shared (E. Ostrom, 2010). Due to these information rules, actors not always know the same information. Hence, it is not correct to assume that all actors act rational. The general assumption in many theories and professional situations is that individuals know (1) all possible strategies possible in a specific situation, (2) which outcomes are linked to each strategy given the likely behavior of others in that situation, and (3) the rank order for each of these outcomes according to the individual's preferences as measured by utility (E. Ostrom, 2010). In every situation, the rational strategy for the individual is to maximize his own expected utility. But according to Ostrom this assumption does not hold. Information and time are costly and the information-processing capabilities of individuals are limited. Individuals tend to be rational but do not fully succeed, their rationality is limited or bounded because many social dilemmas are uncertain and complex (E. Ostrom, 2011).

The amount of control expressed is the fifth element in the action situation. Control refers to the amount of influence actors exercise on their actions and potential outcomes (E. Ostrom, 2005). This is defined by *scope rules* that specify the outcomes that could be affected (E. Ostrom, 2010). The level of control or influence can vary from no control to absolute control in a specific situation. Actors need to be aware of negative aspects of control. One of these is opportunism which is considered as deceitful behavior with the intention to improve one's welfare at the expense of others (Scharpf, 1994). According to Williamson (1975) the threat of opportunism can rise which will not improve collective outcomes. This threat can be limited by formulating clear scope rules.

Potential outcomes are the results actors can achieve through their actions, control and information. These potential outcomes are defined by *aggregation rules*. These aggregation rules (e.g. majority or unanimity rules) specify how the decisions of actors at a node were to be mapped to

intermediate or final outcomes (E. Ostrom, 2010). In achieving a specific goal with several actors it is important to define how these decisions are made and which implications these decisions have in terms of outcomes. In the framework the positions and actions of actors are linked to potential outcomes, influenced by the information they possess or generate and the control they exercise over these potential outcomes. Net costs and benefits also play part in establishing potential outcomes.

The final element of the action situation are costs and benefits. This element also influences potential outcomes and is defined by *payoff rules*. Payoff rules specify how benefits and costs were to be distributed to actors in positions (E. Ostrom, 2010). Payoff rules thus assign costs and benefits to potential outcomes. Actors may have different preferences for in determining the final outcome manifested through the actor's control and information resources.

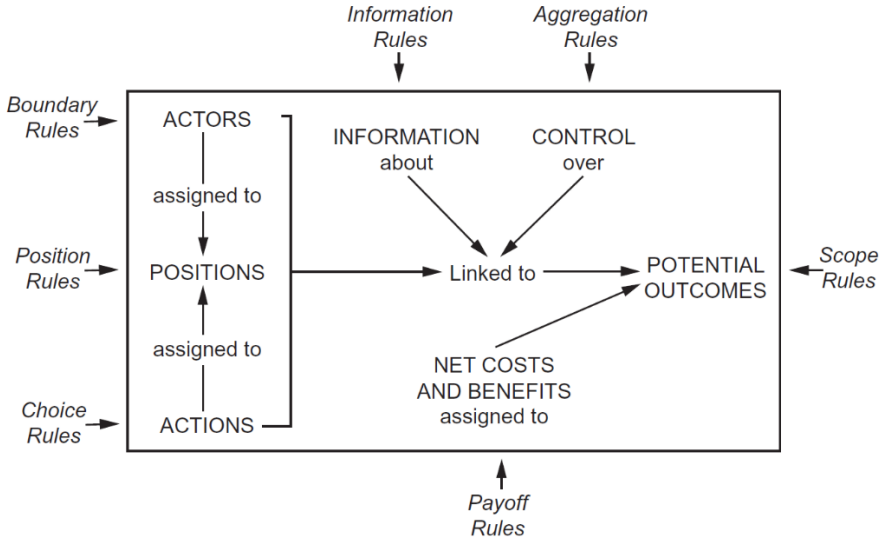


Figure 2: Rules as exogenous variables directly affecting the elements of an action situation (E. Ostrom, 2011, p. 20).

2.1.2 External variables affecting the action situation

In the previous section is explained how the seven rule types define the seven elements of the action situation. The action situation of this research is determined by the settings of the undergrounding program and buyout regulation. These policy options for citizens living nearby overhead connections are prepared for implementation in 2017. The undergrounding program and buyout regulation define the action situation during implementation. These programs are therefore analyzed and translated into the concepts of the theoretical IAD-framework. The IAD-framework embeds these settings in a broader composition of external variables which can change or revised over time (E. Ostrom, 2011). These external variables are the underlying factors of the action situation. These external variables are biophysical conditions, attributes of the community and rules-in-use. These clusters of variables are shown in Figure 1 under one of these general labels. Together these external variables are connected through the bigger picture of the external variables.

2.1.2.1 Biophysical conditions

Biophysical conditions are the characteristics of the type of good selected (E. Ostrom, 2010). In order to describe these biophysical conditions it is necessary to determine the type of good. In this research the high-voltage grid is identified as a common pool resource (CPR). "*Common pool resources yield benefits where beneficiaries are hard to exclude but each person's use of a resource system subtracts units of that resource from a finite total amount available for harvesting*" (E. Ostrom, 2005, pp. 23–24). CPR's are one of the four types of goods identified by V. Ostrom & Ostrom (1977). Other types of goods are public goods, private goods and toll goods. The goods are categorized based on two criteria: the degree of subtractability of use and the difficulty of excluding potential beneficiaries. Excludability refers to the difficulty of restricting individuals who benefit from the good or service. Subtractability of use refers to the extent to which an individual's use of a good or service limits the use of another (E. Ostrom, 2005). The high-voltage grid can be viewed as a CPR. It is difficult to exclude potential

beneficiaries from the resource because energy transport is regulated by law. Net operator TenneT has several obligations and tasks related to operating the grid and transportation of electricity by law (Aurtoriteit Consument en Markt, 2013). TenneT is obliged to operate and maintain the grids for safe and responsible transport of electricity in an effective and efficient manner. Towards consumers they have the obligation to provide information and efficient access and use of the grid (Elektriciteitswet, 1998, art. 16.1). These and other obligations make the high-voltage grid a resource with a high degree of difficulty excluding potential beneficiaries. The electricity delivered through the grid that one household or organization consumes cannot be consumed by another household or organization. Subtractability of use is therefore high is the other characteristic of a CPR. The high-voltage grid is viewed as a common pool resource and its biophysical conditions of undergrounding or buyout setting are addressed.

2.1.2.2 Attributes of the community

The second cluster of external variables that determine the future action situation are the attributes of the community. The attributes of the community include the history of interactions, homogeneity or heterogeneity of key attributes, and knowledge and social capital of those who participate or who are affected by the participants (E. Ostrom, 2010). These characteristics are also determined by the type of good that is studied. The history of interaction might be problematic because there are parts without appropriate coordination or management. CPR's have the difficulty that there is a gap between collective interests and individual interests. When there is no appropriate coordination or management this lead to the 'tragedy of the commons' (E. Ostrom, 2010). The problem is not overharvesting as this is one of the main issues with CPR's. The problem with this resource is that some citizens experience negative effects and that there are different situations with different arguments and preferred solutions. The Ministry of Economic Affairs provides a general solution but does not adequately deal with the concerns of citizens.

2.1.2.3 Rules-in-use

Rules-in-use can make a difference. The rules-in-use are the third cluster of external variables defining the future action situation of the undergrounding program and buyout regulation. Rules are sets of instructions that create an action situation in a specific environment (E. Ostrom, 2005). These rules specify the common understanding of the participants who must, must not, or may take specific often predetermined actions that affect others that are subject to sanctions (E. Ostrom, 2010). These rules may evolve or change over time during interactions or due to a decision to change these rules. This decision can be based on collective choice or by a constitutional or political choice setting. The rules-in-use have specific importance because this can be influenced and changed. A series of design principles can be described that characterize the institutions and identifies variables that are most likely associated with successful institutional change (E. Ostrom et al., 1994). The other components are more difficult to change. In the next section the application of the IAD-framework is explained.

2.2 The application of the IAD-framework

The IAD-framework is used in this thesis to analyze the possible undergrounding and buyout settings in several selected municipalities. Secondly, the framework is used to develop improved institutional arrangements for the various undergrounding and buyout settings. This section explains how the framework is used and conceptualized in order to answer the sub-questions and main research question.

2.2.1 Conceptualization of the action situation and external variables

The actors are the stakeholders involved in the implementation of the undergrounding program and buyout regulation. These are the Ministry of Economic Affairs, net operator TenneT, relevant municipalities and citizens living nearby overhead connections. The action situation is the local setting in the municipality selected for the implementation of the undergrounding program or buyout regulation. In some municipalities both policy options can be identified. This research chooses not to formulate combinations of both settings in a municipality, as these cases are limited. Even when they occur, there are only one or two dwellings selected for buyout, they are less problematic. The implementation of the proposed programs is planned to start in 2017. Therefore research on possible outcomes of current

developments as well as the development of future action situations is viable. For such research, the IAD-framework is used to identify the different settings of the undergrounding program and buyout setting. These settings are simplified and the characteristics are displayed in the framework. An overview of these figures is provided before the actual elaboration of these external variables in the results chapter. The first cluster of external variables are the biophysical conditions of the undergrounding and buyout settings. The biophysical conditions are defined to only apply on the actual resource system: the high-voltage cable for power transmission. The attributes of the community are viewed as characteristics that describe the identified settings. The community is examined in the context of the future implementation of the undergrounding program and buyout regulation. To answer this question is drawn on suggestions of Ostrom (2010) to analyze the history of interaction (conceptualized as duration and degree of social commotion). Furthermore, Agrawal & Gibson (1999) is used to identify key aspects of communities. Multiple interests of actors in the community are taken into account henceforth how these actors influence decision-making. These aspects are analyzed through stakeholder analysis. Finally, the degree of knowledge and social capital is analyzed. The rules-in-use are identified by using the seven rule types. The current rules-in-use are described per rule type. Each rule is formulated by humans in spoken words. As individuals are not always aware of the rules or strategies they follow there is a possibility this leads to misinterpretations and misunderstandings, while lack of clarity and change poses a threat in communication (V. Ostrom, 1997). Analyzing rules can therefore be a challenge but this is simplified by using the framework and seven rule types.

2.2.2 Development of new institutional arrangements

Complex action situations are subject to an immense amount of rules. To structure, simplify and focus this analysis to the most important aspects of the action situation the seven rule types are used to define elements of the action situation. Boundary rules for example determine which actors participate in the action situation. However in practice, it is very difficult to analyze such rules due to their quantity. In a specific research project 27 boundary rules were found along with 112 different choice rules (E. Ostrom, 1999). Scholars tried for years to aggregate specific rules related to success. E. Ostrom (2010) eventually accepted after years of work that this was not possible, nevertheless, not before proposing a set of design principles that can characterize broader institutional regularities. These regularities were found to appear in long surviving resource institutions as a contrast to failing cases and are improved over the years (E. Ostrom, 1990, 2005). These institutional regularities are defined as follows(Cox, Arnold, & Tomás, 2010; E. Ostrom, 2010, p. 563):

1. A. *User Boundaries*: Clear and locally understood boundaries between legitimate users and nonusers are present.
   B. *Resource Boundaries*: Clear boundaries that separate a specific CPR from a larger social-ecological system are present.
2. A. *Congruence with Local Conditions*: Appropriation and provision rules are congruent with local social and environmental conditions.
   B. *Appropriation and Provision*: Appropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits.
3. *Collective Choice Arrangements*: Most individuals affected by a resource regime are authorized to participate in making and modifying its rules.
4. A. *Monitoring Users*: Individuals who are accountable to or are the users monitor the appropriation and provision levels of the users.
   B. *Monitoring the Resource*: Individuals who are accountable to or are the users monitor the condition of the resource.
5. *Graduated Sanctions*: Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule.
6. *Conflict Resolution Mechanisms*: Rapid, low cost, local arenas exist for resolving conflicts among users or with officials.
7. *Minimal Recognition of Rights*: The rights of local users to make their own rules are recognized by the government.
8. *Nested Enterprises*: When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers.

This set of institutional regularities has a clear structure and is therefore useful when designing a robust institution. These broader institutional regularities provide a basis in designing new institutional arrangements for the undergrounding program and buyout regulation in section 4.4, answering the fourth sub-question. These new institutional arrangements are not meant as a panacea for one of the two policy options. Local users are better at developing rules than officials of a central agency (E. Ostrom, 1999). The new institutional arrangements are thus developed as a starting point for municipalities to define their specific, more elaborated institutional arrangement.

3. Methodology

The used research methodology for this thesis is elaborated consecutively. First the research design is explained followed with the used approach. The research approach is qualitative and has a descriptive and designing strategy. In this study two qualitative data collection methods are used: document analysis and expert interviews. These instruments and their procedures are explained in section 3.2. Section 3.3 addresses how the data is analyzed, while also explaining how the new institutional arrangements are designed. Finally, the validity and reliability of this research is addressed in section 3.4.

3.1 Research design

The overall research approach of this study is qualitative. The research focuses on the policy content, the policy processes that take place in around the realization of the undergrounding program and buyout regulation and the stakeholders involved. The undergrounding program and buyout regulation are new policy programs and will be implemented from 2017. There is hardly any experience or research on this specific subject and certainly not on a large scale. A qualitative research approach is therefore most suited in order to obtain a knowledge base for designing new institutional arrangements. The purpose of this research is to describe the characteristics that relate to the policy aimed at citizens living nearby overhead connections. With the establishment of this description a knowledge base is provided for designing new institutional arrangements that can serve collaboration between stakeholders in the implementation phase of the undergrounding program and buyout regulation. The research is therefore not specifically aimed at describing municipalities as cases or to determine the feasibility of the programs, it is not ex ante research. It develops possible institutional arrangements for ideal type settings in municipalities.

The research design is cross-sectional. The observations in this research are made at one point in time. This is a suitable research design for descriptive research (Babbie, 2007). The units of analysis in this study are the local settings in municipalities that are included in the undergrounding program or buyout regulation or both. Several qualitative research methods are used in this study. These instruments and their procedures for data collection are explained in the next section.

3.2 Data collection

Data is collected through document analysis and expert interviews. As this research is performed for the VGPH, access to its network is guaranteed. The VGPH has a network with many municipalities and other stakeholders that facilitate deliberation, data exchange, learning and collective action. The data collection instruments and their procedures are explained in the paragraphs below.

3.2.1 Desk research and document analysis

The first instrument for data collection is desk research and document analysis. There is an extensive record throughout the past years of political documents, reports, policy documents, news items and other writings that can be found online. Often these documents are statements of the different stakeholders of the undergrounding program and buyout regulation. These sources of information will be analyzed through desk research and document analysis. These will be categorized per stakeholder in chronological order to keep an overview which results in a stakeholder analysis. The expert interviews complement on the information found through desk research and document analysis to confirm and validate this information and vice versa. The undergrounding program and buyout regulation are not final yet. Not every aspect, reason or fact can therefore be found on paper because it is still a political sensitive subject. And even if the undergrounding program and buyout regulation would be final, not every aspect is documented. In-depth interviews with experts provide therefore a more complete and more current view on the subject.

3.2.2 Expert interviews

In this study 10 interviews are performed with experts on different aspects of the undergrounding program and buyout regulation. The main stakeholders are selected for the interviews. These experts are

individuals that represent an organization or an individual who has specific experience on a specific aspect relevant to this research. They are representatives of the Ministry of Economic Affairs, net operator TenneT, the VGPH, municipalities and citizen organizations are selected for the interviews. These representatives are chosen based on their expertise and knowledge related to the undergrounding program and buyout regulation. Only a few of the more than 120 municipalities are selected for the expert interviews. Interviewing all municipalities is not possible due to time restrictions, while on the other hand not every municipality is relevant to interview in this stage of the process of policymaking. This study does not use a questionnaire because many municipalities have no knowledge nor opinion about the programs, hence it would be a waste of time. Some municipalities have no interest in the undergrounding or buyout options. In other municipalities this is not perceived problematic or they only have a few dwellings that are selected for the buyout regulation. The municipalities were selected in consultation with the VGPH based on the type of policy (undergrounding, buyout or both), size of the municipality, attitude, experience and expertise. The latter three aspects constructed the classification 'frontrunner', 'active' and 'passive'. For each of these categories a municipality is selected, except in case of buyout where a frontrunner is not found. The full list of interviewees and selection basis can be found in Appendix B. A total of 10 interviews are performed. Many of the interviewees are managers or project leaders, responsible for the programs in their organization. Representatives of five municipalities – Geertruidenberg, Helmond, Oostzaan, Veenendaal and Zaanstad –, two interest groups – Oostzaan 380kV and Hoogspan –, net operator TenneT, the Ministry of Economic Affairs and two advisors who work for the VGPH are interviewed. The interviews are recorded on a mobile device and transcribed. These transcripts were send to the interviewees for revision and approval.

The interview questions are formulated in advance and based on theory of Ostrom. The interview schedule (Appendix C) is used in all interviews but is viewed as a guideline. The expert interviews can therefore be characterized as semi-structured and preserve flexibility because there is an interaction between the interviewer and the interviewee (Babbie, 2007). The interview with representatives of the VGPH is scheduled as the first interview to practice and have an opportunity to alter the questions. When there is something not mentioned in the test interview it is easy to sit down again and ask the new or altered questions as the research is commissioned by the VGPH. Some interviewees have more expertise on certain aspects and less on others. Also, not every question is equally relevant to each interviewee. Finally there are situations in which experts knew the answer but were not allowed to, or willing to answer because of strategic reasons. The data collection instruments are used to answer sub-questions 1-3 and serve as a knowledge base for the fourth sub-question and main research question.

3.3. Data analysis

In this research qualitative data analysis is used. In order to analyze complex empirical human situations a framework with a consistent and simple set of variables is preferred. Data is collected in the form of interview transcripts and a structured selection of documents. Qualitative research methods imply a continuing interaction between data collection and theory. As the IAD-framework is used during the expert interviews these interview transcripts can be categorized per variable. Babbie (2007) defines this as variable-oriented analysis, describing or explaining a particular variable. But at the same time it is also important to look at one stakeholder as a whole. Therefore a stakeholder analysis is performed. A stakeholder analysis identifies individuals, groups or institutions that influence or are influenced by the planned policy and explores the implications of their involvement (Hines, 2006). Varvasovszky & Brugha (2000, p. 338) provide a more elaborate definition of a stakeholder analysis: "*Stakeholder analysis is an approach, a tool or set of tools for generating knowledge about actors - individuals and organizations - so as to understand their behavior, intentions, interrelations and interests; and for assessing the influence and resources they bring to bear on decision-making or implementation processes"*. A stakeholder analysis can thus provide a clear overview of the key attributes. Qualitative data analysis tools are not used because the IAD-framework, interview schedule and stakeholder analysis are chosen to structure and analyze the data.

New institutional arrangements are designed based on this data to answer the fourth sub-question and main research question. The interview questions are structured across the elements of the IAD-framework and data can therefore be analyzed and compared easily. The institutional arrangements

are aimed to support an effective implementation of the undergrounding program and buyout regulation. The IAD-framework of E. Ostrom provide a guideline in designing these institutional arrangements. During the expert interviews interviewees are asked about their preferences, abilities and vision on the outcomes. Combined with theory on how to develop successful institutional arrangements this information is used to answer the fourth sub-question.

3.4 Validity and reliability

During research it is very important to keep criteria of measurement quality in mind. According to Babbie (2007) these criteria include precision, accuracy, validity and reliability. From the start of the research a clear structure is used in writing but also in gathering and organizing data. During desk research and document analysis interesting sections are marked and notes were made. Page numbers were always mentioned until the passage was used in the research. Important parliamentary documents and other letters were carefully organized and notes were made about the political context. The expert interviews are literally recorded, transcribed and used in order to be as accurate as possible. Important concepts were always explained to the interviewees in order to ensure their understanding and answers are comparable. The latter relates to validity. Validity refers to collecting results that accurately reflect the measured concept (Babbie, 2007). The operationalization of concepts is very important which is taken in account while constructing the interview questions. During the interviews interviewees are not always aware of their own behavior or motives which can threat validity. Questions should be about facts and not about impressions but this cannot always be evaded. Sometimes it is even reason to ask for impressions in order to get an idea of what the interviewee thinks the opinions of other stakeholders are, what they might do or are planning to do. Interviewees have a selective memory about the past (Baarda & de Goede, 1998). But in this research expert interviews are used with an open structure so the researcher can ask follow-up questions to prevent threats to validity to a minimum. Reliability reflects the consistency of the results. The same results should be discovered when another researcher repeats the study. Reliability is a difficult aspect of this research as the field changes rapidly and the research is cross-sectional. The other criteria of measurement were therefore monitored carefully as explained.

4. Results

The results of the research are provided in this chapter and structured according to the sub-questions. Through interviews and desk research information has been gathered about the proposed options for situations in which citizens live in proximity of overhead connections. Through consultation with the VGPH, it has been determined which municipalities are most suited to interview in order to provide a clear classification of the possible settings, the patterns of interaction and possible outcomes preferred. In section 4.1 the classification of settings is explained and a schematic overview is provided. In the sections that follow different parts of the schemes are explained further: the biophysical conditions, the attributes of the community and the rules-in-use. These empirical findings are the underlying factors that influence the action situation. The different theories, information from document analysis, desk research and expert interviews eventually led to the design of new institutional arrangements for the future implementation of the undergrounding program and buyout regulation in section 4.4. Following the results, an answer to the main research question has been provided in chapter 5.

4.1 Classification of settings

The classification of settings serves as an overview of the first three sub-questions. The IAD-framework is used to provide a schematic overview of the various settings of the programs in Figure 3-Figure 7. As explained in the introduction, the undergrounding program is the preferred option to implement. If not feasible, buyout is introduced. As explained in the previous chapter, the municipalities are selected on several characteristics. The attitude, degree of experience and expertise are used to label these different types of municipalities. In Table 2 an overview is provided of this classification based on data from the expert interviews and are discussed further in the sections below.

Characteristics	Frontrunner	Active	Passive
Definition	This type of municipality is ahead of the majority, overcomes many obstacles and is successful in striving towards the end goal.	An active municipality is interested and wants to act on the perceived problem but faces obstacles and is not sure how and if they will tackle them.	This type of municipality is indifferent to the programs or has not decided how and if they should act.
Attitude	Positive and pro-active	Positive and active in determining strategies and opinions but no action yet	Indifferent or neutral
Degree of experience	High	High-medium	Medium-low
Degree of expertise	High	Medium	Low
Example	Apeldoorn, Heerhugowaard, Maastricht, (Helmond).	Veenendaal, Oostzaan, Best, Nieuwegein, Amersfoort.	Helmond, Geertruidenberg, Zaanstad.

Table 2: The classification of municipalities

4.1.1 The undergrounding setting

The undergrounding program includes 50, 110 and 150kV overhead connections in urban areas with a length of at least 1 kilometer. Industrial areas, playing fields and rural areas are not included (see Appendix D and E). A total of 55 municipalities are identified to be included in the program according to the latest letter to parliament (TK 2013/14, 31574, nr. 36). Only 50 of them are mentioned, see Appendix F. These municipalities all have an overhead connection of at least 1 kilometer with a voltage of 50-150kV in an urban area within their jurisdiction. The costs for the undergrounding program are covered for 75% in the rates TenneT charges. 25% of the costs should be covered by municipalities (TK 2013/14, 31475, nr. 36). The total amount of costs is estimated € 440M. If the programs succeed depends on political will to aid the worries of citizens. In most municipalities this concerns a small group. Hence, a relative large investment is needed for an issue that is not scientifically proven (e.g. € 5M for 6 km

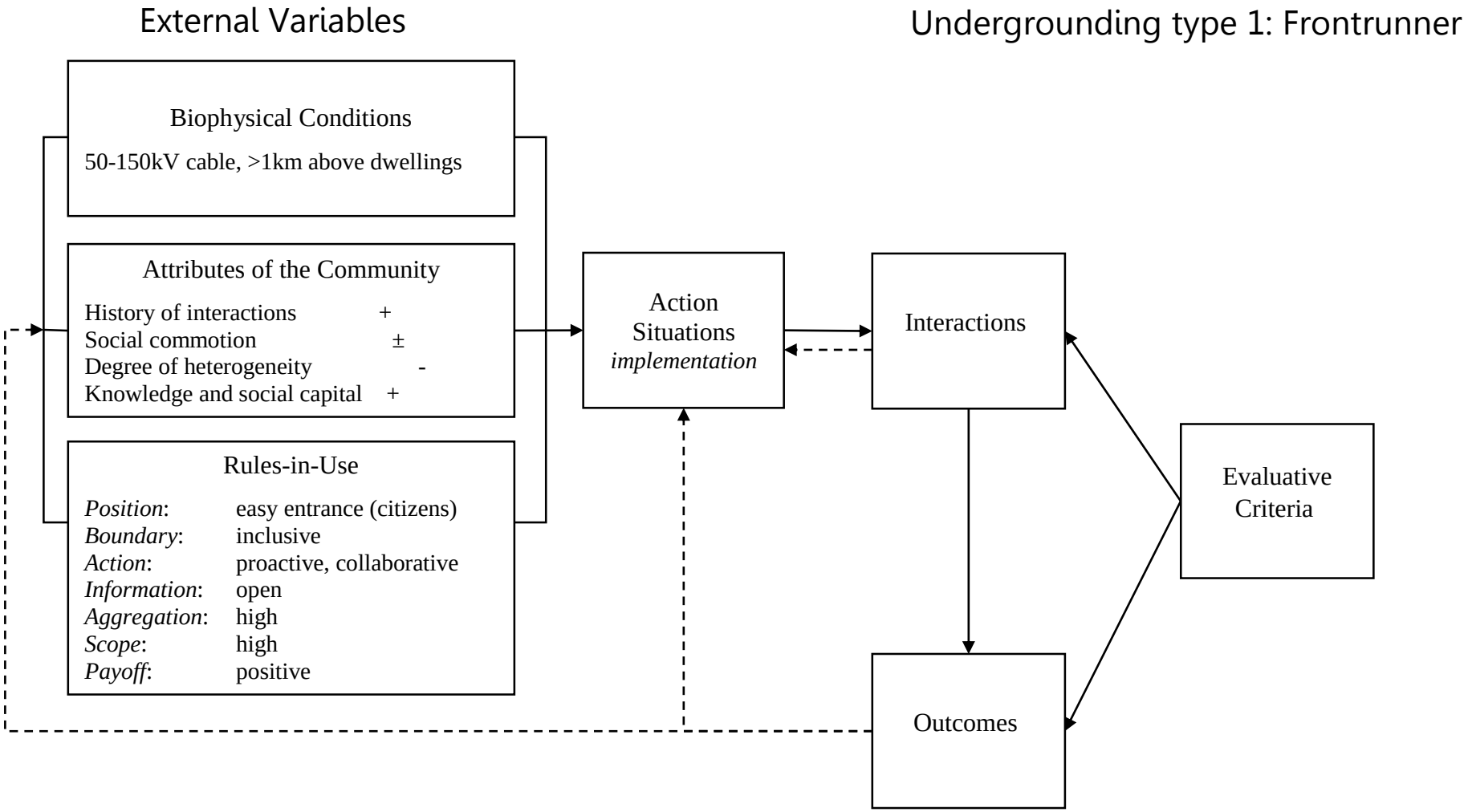
plus administrative costs). Based on the empirical findings, a general classification is drafted of three specific undergrounding settings in municipalities. First, the ideal type 'frontrunner' is discussed. This type of municipality sees the undergrounding program as an opportunity and is way ahead of other municipalities in preparations and implementation. An example of this type is the municipality of Apeldoorn. This municipality wanted to restructure and redevelop an old neighborhood but encountered some barriers: two overhead connections of 150kV. Plans for undergrounding were developed to abolish regulatory restrictions around these barriers for redevelopment of the neighborhood. At the same time they struggled with covering finances, the Ministry of Economic Affairs announced the undergrounding program. This provided an answer for their financial issues. With this program, a coverage of 25% is required and not the full 100% as Apeldoorn faced before which was estimated > € 10M (Tiecken & Goldewijk, 2014). This 25% can be covered by the revenue of redevelopment and land exploitation. According to the VGPH the municipality of Heerhugowaard is another example of a frontrunner (interview VGPH). Second, a municipality can be classified as 'Active'. An active municipality is considering preparations for the undergrounding program and is active in the public debate. An example of this type is the municipality of Veenendaal. These municipalities are investigating how they could cover finances and are looking into possible tracks for the undergrounding. Financial resources and technical possibilities are determining factors in this decision (interview Hoogspan; Veenendaal; VGPH). Third, a municipality can be classified as 'Passive'. This type of municipality thinks that this program is not necessary because people are not complaining or that their citizens want another use for the financial resources needed. Municipalities that can be classified as passive municipalities are Geertruidenberg and Helmond. Other reasons for this passive attitude are negative experiences with citizens on this subject, previous solutions and indifference of citizens (interview Geertruidenberg; Helmond).

4.1.2 The buyout setting

The buyout regulation is presented as a second option for citizens living nearby overhead connections, outside of urban areas or in case of 220 or 380kV overhead connections. There are 377 dwellings identified for this buyout regulation. The buyout regulation applies to the ones who own the dwelling on January 1st, 2017. The number of dwellings could increase when there is a final decision on some questionable dwellings that need further investigation. In Appendix G the municipalities with dwellings selected for the buyout option are shown. A dwelling is identified when it is located directly under the cable. The dwellings nearby the high-voltage cables are not selected. This causes discontentment and discussion with those dwellers and is one of the concerns of relevant municipalities and citizens. The buyout regulation is financed by the Ministry of Economic Affairs with a budget of €140M. Buyout cannot be allocated in the energy rates because the authority that controls TenneT does not approve this (TK 2012/13, 31574, nr.29). Based on the empirical findings a general classification is drafted of two specific buyout settings in municipalities.

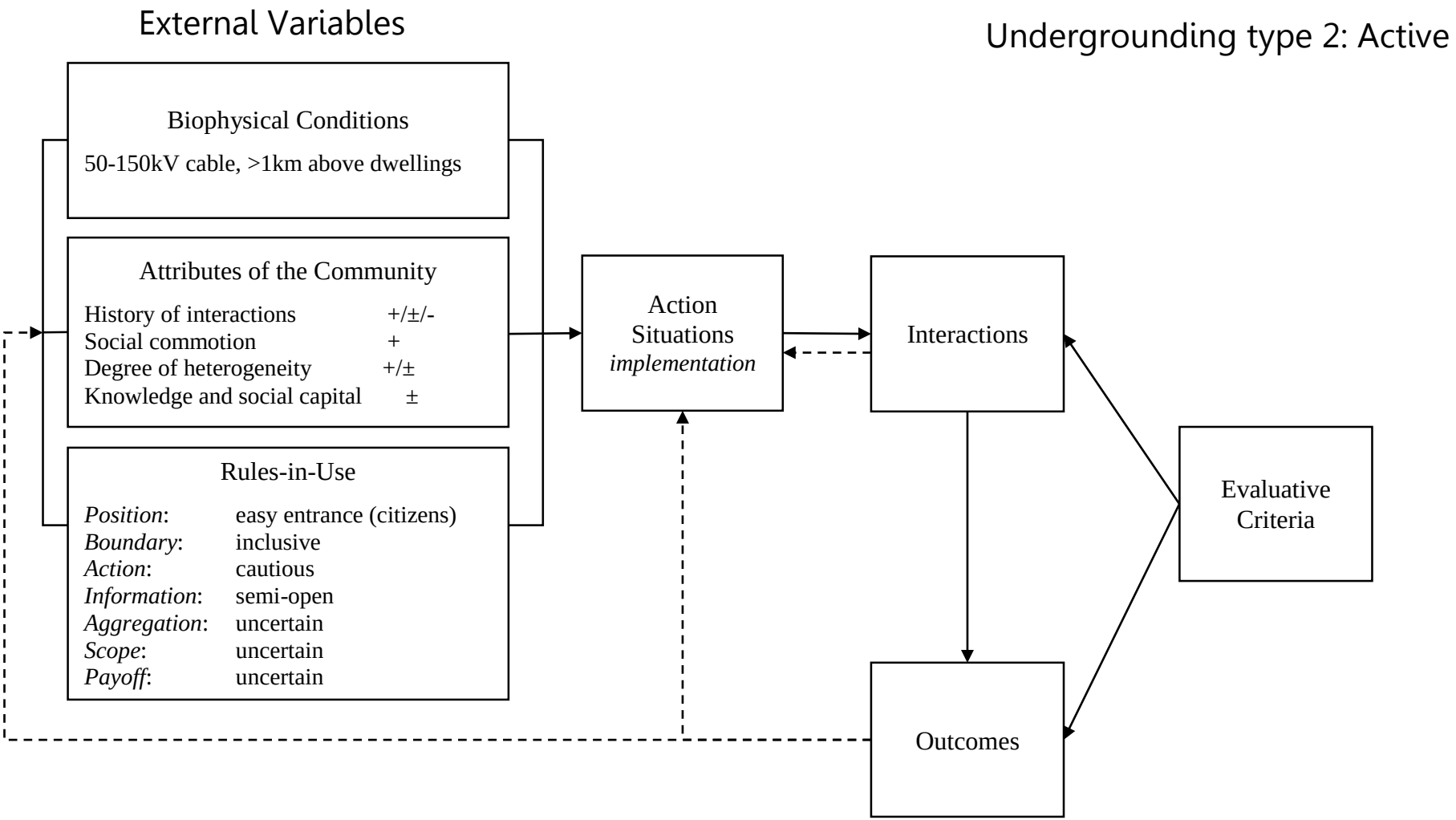
First, the ideal type 'active' is discussed in relation to buyout. This type sees the regulation as a good solution and want to cooperate, provide permits, and communicate with citizens. For example, the municipality of Oostzaan. But municipalities are not satisfied with the regulation. What they really want is another solution: undergrounding or move the high-voltage cables to a location without dwellings nearby (interview Oostzaan; Oostzaan 380kV). Second, a municipality can be classified as 'Passive'. In a passive buyout setting, municipalities do not see why this regulation is drafted because there are no complaining citizens. They see the high-voltage grid as national infrastructure and therefore state that national government should arrange this with the citizens and figure out what to do with the empty building. Municipalities do not want to pay for the permits, adjusted land-use plans or demolition. They do not support the regulation and propose that if national government or TenneT wants to do something, they should move the high-voltage cable to a location outside urban areas (Zaanstad).

On the next pages the five typical undergrounding and buyout settings are shown in a structured framework of empirical findings. The IAD-framework is applied on the five ideal types. The positions of the municipalities can change. Towards the end of the research they already have to some extent (see chapter 6). Some variables are indicated with +/±/- signs. This indicates the degree or strength of the concerning variable. This is also indicated in a line below the figures.



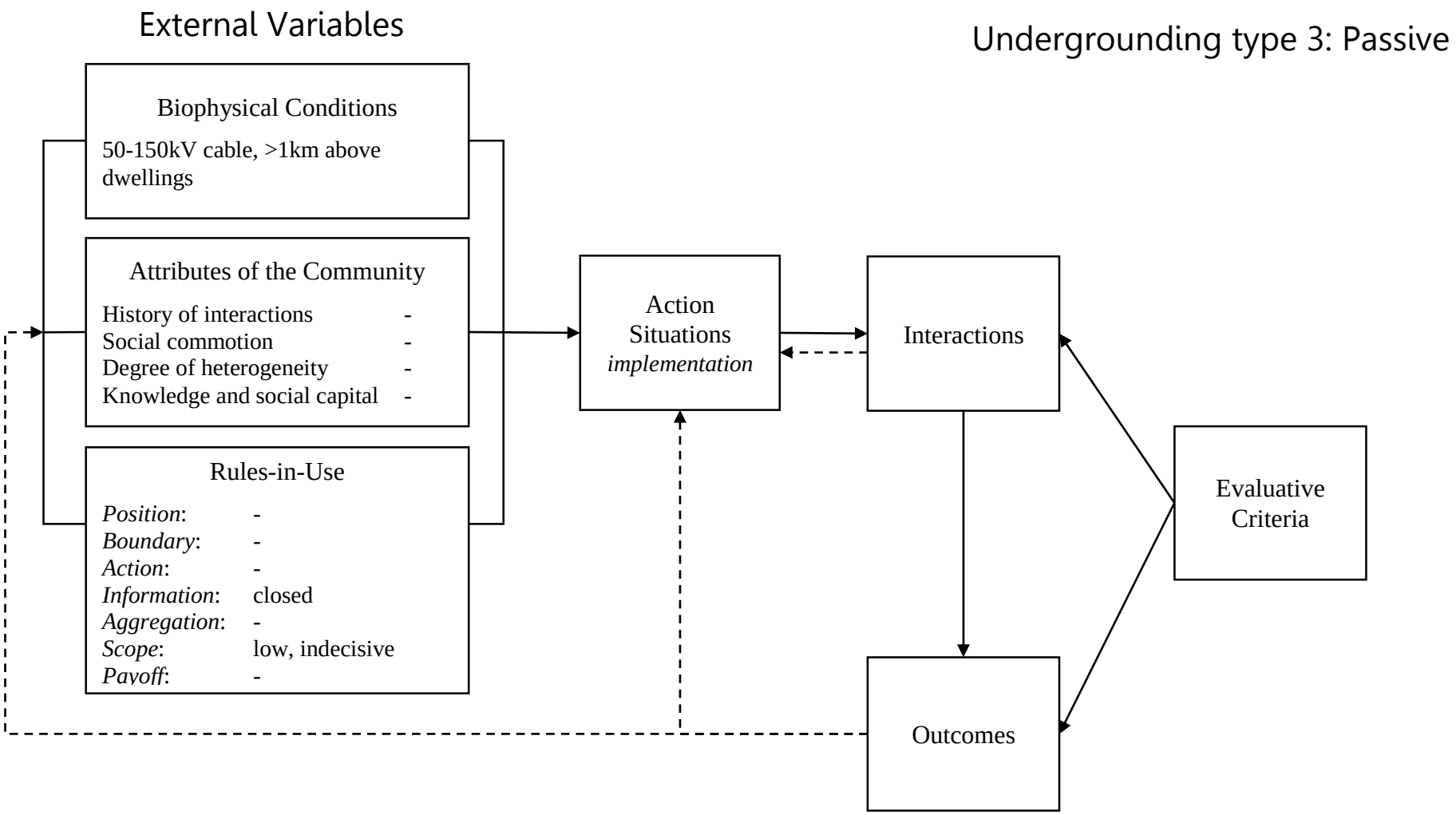
(++ very high, + high, ± medium, - low, - - very low/absent)

Figure 3: Undergrounding type 1: Frontrunner



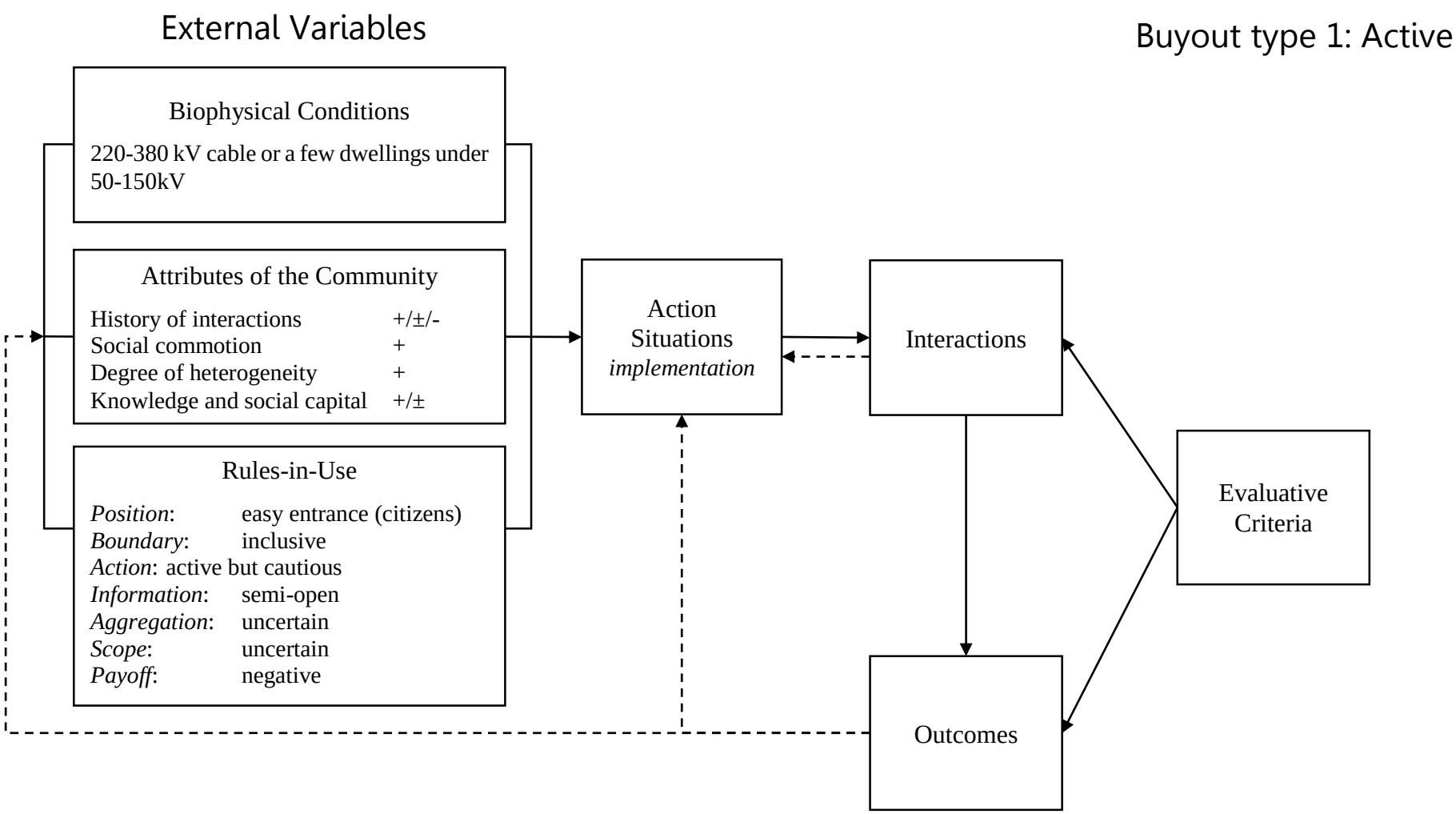
(++ very high, + high, ± medium, - low, - - very low/absent)

Figure 4: Undergrounding type 2: Active



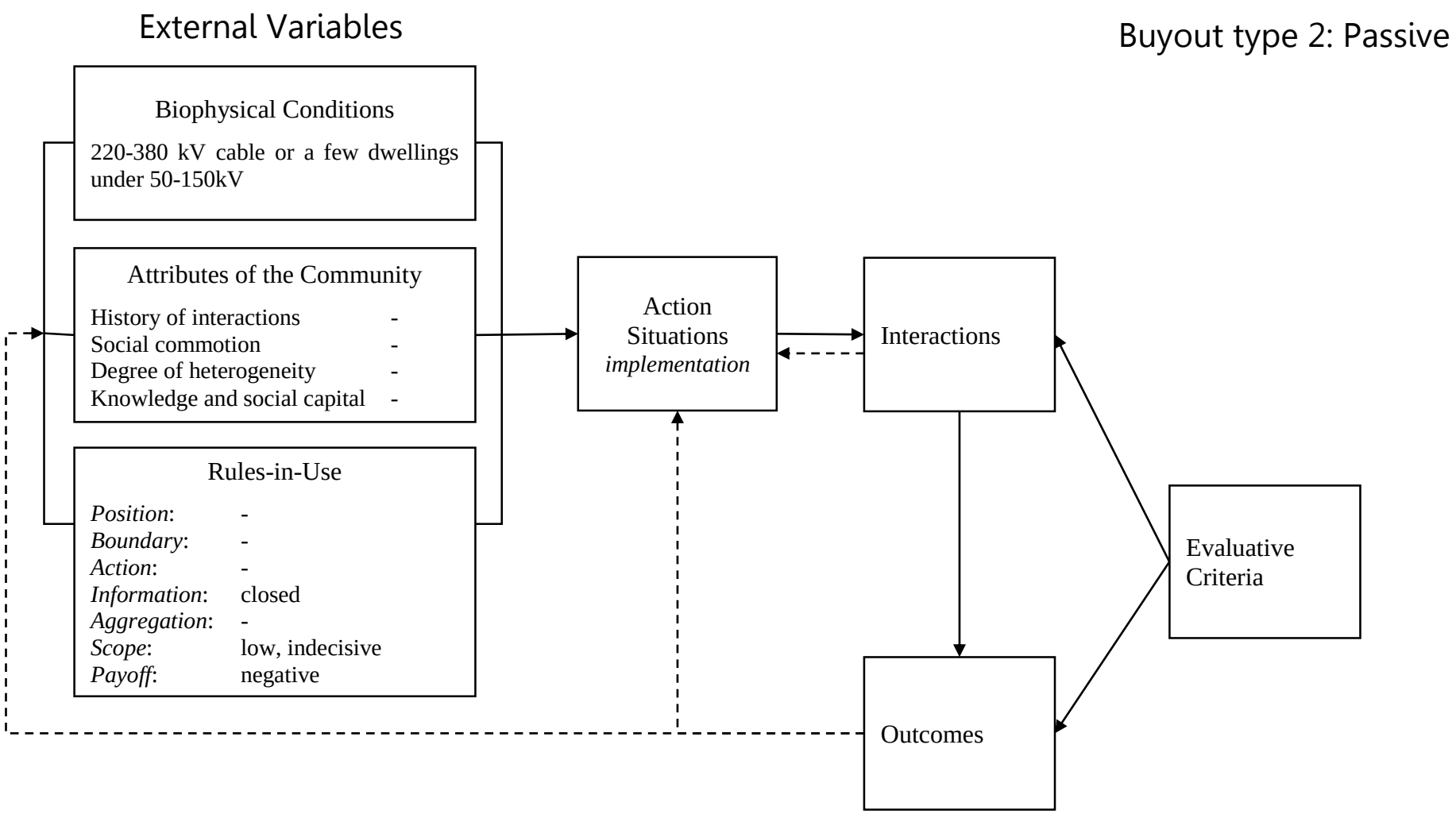
(++ very high, + high, ± medium, - low, - - very low/absent)

Figure 5: Undergrounding type 3: Passive



(++ very high, + high, ± medium, - low, - - very low/absent)

Figure 6: Buyout type 1: Active



(++ very high, + high, ± medium, - low, - - very low/absent)

Figure 7: Buyout type 2: Passive

4.2 Biophysical conditions

Sub-question 1: What are the biophysical conditions of the settings identified for implementation of the undergrounding program and buyout regulation?

The biophysical conditions in the settings of this research are the characteristics and related perceptions of the Dutch high-voltage grid, selected for undergrounding or buyout. The main characteristics are identified through data analysis of interviews and documents. The characteristics are explained and related to one of the settings. The high-voltage cable is basically the biophysical condition and has several physical forms.

4.2.1 The high-voltage grid

The high-voltage grid in the Netherlands is fully owned by the Dutch state through the ownership of net operator TenneT (Energiewet, 1998, art. 93; TK 2005/06, 28165, nr. 46; nr. 165). Besides building new tracks and maintenance activities, TenneT also performs reconstructions requested by external organizations (interview TenneT). An example of these external requests is the undergrounding program. TenneT implements these external requests to meet stakeholders' need to solve or avoid conflicts (TenneT, 2013, p. IV). Important to notice is the fact that the grid is not only important to the Netherlands. It plays an important role in the international transport of electricity, which underlines the importance of a stable and efficiently functioning grid.

4.2.2 Magnetic fields and different norms

In order to understand the concerns of citizens it is necessary to understand the concept of magnetic fields and related advices of governmental organs. Magnetic fields are produced by moving electrical charges (expressed in Voltage) and occur during the production, distribution and use of electricity (TK 2011/12, 31574, nr.24). See Appendix H and I for more information. In the Netherlands the overhead connections are charged with an alternating current which result in an electrical charge. This electrical charge is the potential difference between two points in an electrical circuit. Voltage is the unit that indicates the amount of voltages running through the circuit. In high-voltage cables kilo Voltage (kV) is used to indicate the amount of electrical charge. Micro Tesla (µT) on the other hand, indicates the strength of the magnetic field (TenneT, 2012). Until 2005 the European reference of 100 µT was generally advised in situations with magnetic fields (1999/519/EG). This is not exceeded in publicly accessible areas and the safety of civilians is nowhere threatened due to magnetic fields caused by high-voltage (TK 2011/12, 31574, nr.22; TK 2012/13, 31574, nr. 29). In practice, a maximum of 10 µT is measured around high-voltage in the Netherlands at ground level (TK 2012/13, 31574, nr.35). Since 2005, national government advises to prevent situations with a magnetic field strength above 0.4 µT (TK 2004/05, 28089, nr.7; Ministerie van VROM, 2005). This precautionary advice is based on an investigation of several scientific research publications. The Ministry wanted to know if they needed to act. They did not find significant results (Health Council of the Netherlands, 2000; Pruppers, 2003; van der Plas, Houthuijs, Dusseldorp, Pennders, & Pruppers, 2001). Nevertheless, the Ministry decided to prevent any discussion on magnetic fields and public health (interview EZ). The difference between the European reference and the Dutch advice is difficult to explain to citizens which probably led to the advice, together with the events in Oostzaan (Interview Oostzaan; Oostzaan 380kV; Veenendaal; VGPH; Zaanstad). Citizens started wondering what the effects could be of these overhead connections, especially effects on their health (Interview Hoogspan; Oostzaan; Oostzaan380kV Zaanstad; Geertruidenberg).

4.2.3 The biophysical conditions of the programs

Several types of transmission towers are used for high-voltage cables. In Figure 9 a regular type of transmission tower with corresponding magnetic field strengths is shown. Electrical charges of 110 and 220kV are often used in the north of the Netherlands whereas 150 and 380 are often used in the mid and south of the Netherlands. Voltages of 50kV are very rare and are often already raised to a higher voltage. Since a few years TenneT only builds 380kV tracks and upgrades the tracks that can be upgraded due

to an increasing demand and changing market (TenneT, 2013). In Figure 8 the latest type of transmission tower is shown with a narrower magnetic field. As several types of overhead connections exist in practice, only two categories are mentioned according to the undergrounding and buyout proposition (TK 2013/14, 31574, nr.36). In case of the undergrounding program overhead connections of 50-150kV are selected because they are technically and financially suitable for undergrounding (interview EZ; TenneT). The part of the track is only selected if it is located for at least 1km above a residential area. When it crosses recreation areas, industrial areas or agricultural fields, that part is not included in the undergrounding program due to disproportional financial demands. The Ministry communicated to the municipalities which part of their track is identified. Municipalities can object to or propose new parts of their track but it is up to the Ministry to decide if it is included based on the criteria of voltage and location (interview EZ; TK 2013/14, 31574, nr.36). Municipalities can still decide to independently underground parts of the track at their own expense, that is how it is arranged until the undergrounding program is final (interview TenneT).

In case of the buyout regulation, the biophysical conditions are overhead connections of 220-380kV or tracks of 50-150kV with only a few dwellings underneath. Overhead connections of 220-380kV are not technical suitable for undergrounding according to the Ministry of Economic Affairs and net operator TenneT, although they experiment with undergrounding in the west of the Netherlands (TK 2013/14, 31574, nr.36). According to the Ministry it is unique in the world, very expensive and not proven. The results will be clear within a few years (interview EZ). They specifically do not want to

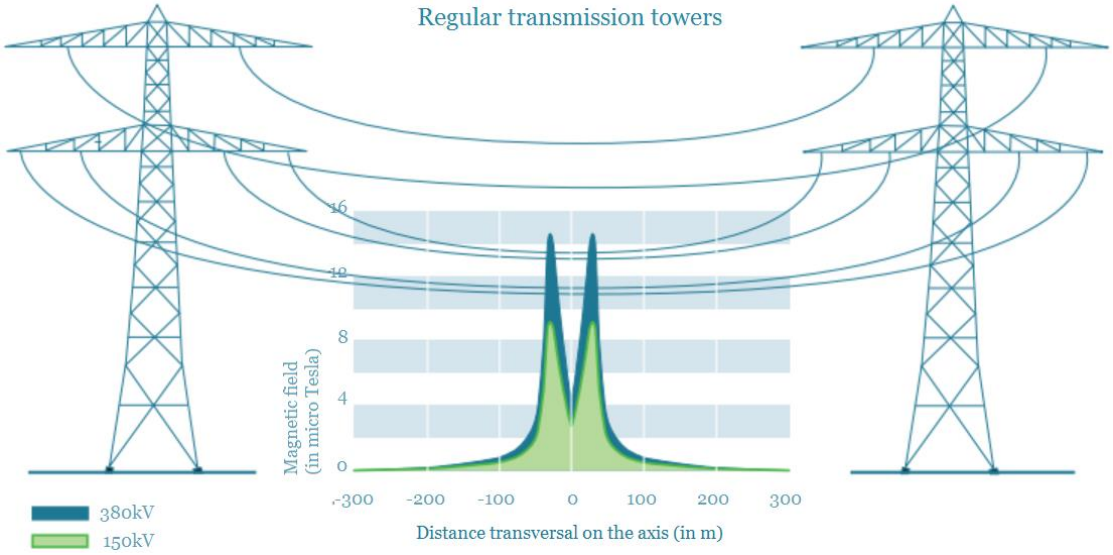


Figure 9: Magnetic field regular overhead connections (TenneT, 2012, p. 9)

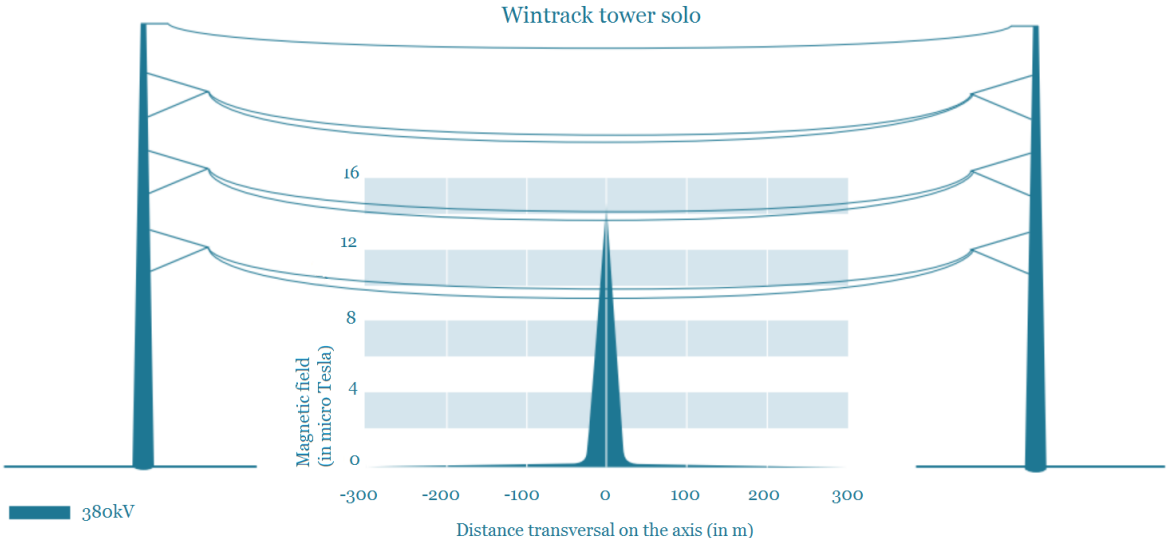


Figure 8: Wintrack Towers Solo (TenneT, 2012, p. 9).

include experimental techniques or take future innovations into account. Not everyone agrees on this. In 2003, the European Commission presented a paper about undergrounding projects throughout Europe (Commission of the European Communities, 2003). Back then, not many of the high-voltage cables above 220kV were placed underground. Norway is an exception. They undergrounded 36 km cable of 400kV in 2003. Nowadays the European Commission funds a modular development plan of the 'Pan-European Transmission System 2050 called 'e-Highway2050'. This plan is a long-term planning methodology used to assess the restructuring and expansion of the European power transmission system. The Commission expects that the undergrounding of 220kV and higher voltages will increase in the upcoming years (Commission of the European Communities, 2013; Zaccone, 2014). Although there are examples and expectations of undergrounding high-voltage cables, the Ministry still proposes to buyout the citizens who live directly under the overhead connection of 220 or 380kV because it is not proven and too expensive to take the risk (Interview EZ). In situations where there is a 50-150kV overhead connection with less than 1 km across residential areas, the buyout option applies as well.

4.2.3 Conclusion

The overall biophysical conditions in the undergrounding setting and buyout regulation is the overhead connection selected for implementation. For the undergrounding setting these are overhead connections of 50-150kV with a length of at least one kilometer above residential areas. In case of the buyout regulation dwellings are selected that are located under 220-380kV overhead connections or tracks of 50-150kV with only a few dwellings underneath. These conditions are linked to specific undergrounding and buyout settings in Table 3:

	The overhead connection	
Undergrounding	*50-150kV cable, >1km above dwellers*	*220-380kV cable or a few dwellings under 50-150kV*
Frontrunner	+	-
Active	+	-
Passive	+	-
Buyout		
Active	-	+
Passive	-	+

(+ present, - absent)

Table 3: Biophysical effects of the undergrounding and buyout settings

4.3 Attributes of the community

> *Sub-question 2: What are the attributes of the stakeholders involved in the settings of the undergrounding program and buyout regulation?*

The attributes of stakeholders have an effect on the outcomes of the undergrounding program and buyout regulation. In this section the attributes of the community are analyzed as the second cluster of external variables influencing the action situation. Attributes of the community refer to the history of interactions, homogeneity or heterogeneity of key attributes, knowledge and social capital of participants or those who are affected by participants (E. Ostrom, 2010). A stakeholder analysis is performed to determine the key attributes of the stakeholders and is shown in Table 4. Knowledge and social capital is a final aspect addressed in this chapter. Finally, a conclusion provides an answer to the sub-question.

4.3.1 History of interactions

The history of interaction of the programs is established here. First, the general history of interaction is explained. Then, the history of interaction is labelled in terms of character and duration. The Ministry of Economic Affairs states that the policy options of undergrounding and buyout are developed to meet

the desire of society to relieve the most urgent situations of citizens living nearby overhead connections (TK 2012/13, 31574, nr. 29). The political decision is based on several grounds (TK 2012/13, 31574, nr. 35):

- Worried citizens: the remarkable difference between the European reference of 100 µT and the precautionary reference of 0.4 µT Dutch national government, makes citizens anxious;
- Firefighting: when there is a dwelling on fire within 50 meters from an overhead connection restrictions apply for extinguishing the fire (EnergieNed, 2005);
- Noise disturbance: overhead connections produce noise, especially during rain;
- Glazed frost and icicles: glazed frost can stick to the overhead connections which can transform into icicles when the glazed frost melts. When these icicles fall off they cause dangerous situations.

Citizens state that these statements do not provide a complete set of reasons for their concerns. According to Oostzaan380kV, an interest group representing citizens in the municipality of Oostzaan, there are more reasons related to 'worried citizens'. When TenneT raised the voltage in Oostzaan from 150 to 380kV citizens in Oostzaan and Zaanstad heard a crackling sound and saw 'fireballs' falling down from the cable (interview Oostzaan; Oostzaan380kV; Zaanstad). These fireballs were particulates that caught fire due to the higher voltage. This caused concerns and social commotion because citizens were not aware of the fact that TenneT would raise the voltage (interview Oostzaan380kV). Citizens in several municipalities have concerns about the value of their dwelling and the ease to sell (interview Oostzaan; Oostzaan380kV; Zaanstad). Some state that the value of their dwelling decreased due to the debate on high-voltage and magnetic fields (Nolles, 2014; van Ruiten, 2014). The neighbors of selected dwellers are concerned about the effect of the buyout regulation on their neighborhood (Nolles, 2014). This concern is even more complex in apartment buildings where the high-voltage cable is only partly located above the building (de Haan, 2014). What happens to these very specific cases is still not clear. In the context of the history of interaction there are several attributes to define for settings of municipalities. First the duration of the history of interaction. In some municipalities there is a long history of interaction related to the topic of citizens living nearby overhead connections. In others this history is short and exists since the proposed programs. Another aspect of history of interaction is the character of the interaction. This is conceptualized as social commotion which varies from 'low' to 'medium' and 'high'. The perception of the overhead connection and its affects can be referred to as the degree of social commotion. Some citizens perceive the overhead connection nearby their dwelling as a problem, while others do not. The degree of social commotion per type of municipality is based on empirical findings from expert interviews and documents.

4.3.1.1 The history of interaction of the undergrounding setting

There are three ideal types identified in case of undergrounding. In municipalities characterized as frontrunner a medium degree of social commotion is found. In some municipalities the overhead connection is perceived as an obstacle for social planning as municipalities are advised not to build dwellings in the 0.4 µT zone, besides height restrictions under the cables. When the overhead connections are moved or placed underground the path for municipalities is free to develop new properties or to redevelop a neighborhood. This provides possibilities in terms of spatial planning. The adjustments to the grid can be financed by the profits of spatial planning. In Apeldoorn this is exactly the case (interview TenneT; VGPH). The municipality of Apeldoorn started with undergrounding in the end of 2013 but preparations already started in 2005. At first, a short track was planned in the neighborhood selected for redevelopment but citizens of the next neighborhood convinced the municipality to extend it (Municipality of Apeldoorn, 2014a, 2014b; Tiecken & Goldewijk, 2014). Other examples of frontrunners are the municipality of Heerhugowaard, Maastricht and to some extent Helmond. These municipalities already started implementing before the undergrounding program of the Ministry of Economic Affairs was announced. The motivation of the undergrounding in each setting is spatial planning. In a later stage, the municipalities also experienced medium social commotion (Interview TenneT; VGPH; Kleijne, 2014a). In the case of Helmond two overhead connections are combined to enable the development of a new neighborhood. The interactions with citizens were at the time so negative that they are afraid to enter this debate again (Interview Helmond). They are therefore

characterized as passive. In the active municipalities the history of interaction varies but the degree of social commotion is high. In the municipality of Veenendaal for example, an interest group 'Hoogspan' is campaigning against the overhead connections since 2003 (interview Hoogspan). Duration and social commotion are high. But that is not always the case. This type of municipality is assumed to have a high degree of social commotion but the duration varies. Some municipalities became active when the undergrounding program was communicated by the Ministry and decided to join the VGPH. For example the municipalities of Best, Nieuwegein and Amersfoort. There are also municipalities that only recently received information of the Ministry of Economic Affairs about their local track. Then the history of interaction is short and the social commotion apparently low because otherwise the municipalities would have had to deal with worried citizens and would be more active on this topic. Passive municipalities are characterized to have a short history of interaction and low social commotion. In the interviews with interviewees of Geertruidenberg and Helmond was indicated that they did not have a motivation for action or communicating the opinion of the municipalities because citizens were not asking for it. They stated that there was no social commotion. They also stated that if citizens started to worry they would react but they do not have a strategy yet. Both municipalities also stated that they would only execute the undergrounding in case of full coverage of costs (interview Geertruidenberg; Helmond).

4.3.1.2 The history of interaction of the buyout setting

Active and passive municipalities are identified in buyout settings. In active municipalities the duration of the history of interaction varies but the degree of social commotion is high. An example of an active municipality is the municipality of Oostzaan. In previous sections is already explained that they were highly active in the process to the formulation of the programs. Since the precautionary advice of 0.4 μT and the raise of the voltage in 2006 the social commotion in Oostzaan is high (Oostzaan380kV, 2006b). The municipality supports their citizens from the start but is now concerned how this develops when the municipality is the stakeholder that needs to implement the buyout regulation (Interview Oostzaan; Kleijne, 2014b). This buyout proposition is not a satisfying solution according to the Mayor of Oostzaan hence there are still a lot of citizens living nearby high-voltage cables. It is only a solution for the few citizens located directly under the track (interview Oostzaan). In passive municipalities the history of interaction is short and the degree of social commotion is low. A lot of municipalities that probably could be characterized as passive only have a few dwellings selected for buyout. In Appendix G is shown that 36 municipalities only have a single dwelling selected for buyout. For them the task is relative simple. For a municipality like Zaanstad this task is rather complex as there are 39 dwellings selected for buyout. The total budget for the buyout regulation is € 140M for 377 dwellings in 83 municipalities with an average of > € 0.35M per dwelling. The costs for each dwelling are reimbursed by national government. In Zaanstad this would still mean a continuous investment around € 0.35M with a total of € 13.65M. At the time of the interview (May 7, 2014) this municipality was rather passive, even as a member of the VGPH. At the time they did not receive complaints from citizens about living nearby the overhead connections and were only involved because they foresaw the possible effects of the buyout regulation (interview Zaanstad). Since the Ministry of Economic Affairs send a letter to its citizens, this municipality became more active and its citizens became more involved (de Haan, 2014).

4.3.2 Key attributes

In Table 4 a general stakeholder analysis is provided. Several stakeholders are involved in the implementation of the wiring program and buyout regulation. These stakeholders have several interests, positions and interrelations in light of the programs. In Table 4 statements about the position, objectives, interests and influence of stakeholders are provided. In section 4.3.3 resources in terms of knowledge and social capital are discussed as an aspect of the attributes of the community.

When applying this general stakeholder analysis to the undergrounding and buyout settings the homogeneity or heterogeneity of key attributes needs to be addressed. The general conclusion from Table 4 is that key attributes of stakeholders involved vary. The key attributes are thus heterogenic. Interesting to see is the fact that every stakeholder is assessed to have a high influence on some part of the proposed policies. Also applies to low influence, every stakeholder in this field has low influence on some part of the undergrounding program and/or buyout regulation. When asking stakeholders about

Stakeholder	Position	Objectives	Interests	Influence
The Ministry of Economic Affairs	Policy maker and source of financial resources.	To provide a solution for citizens living nearby overhead connections in existing situations (before 2005). It is a political decision.	There are no interests according to the interviewee because it is a political decision. They do have an interest in a fast, simple, effective and low-cost implementation.	The degree of influence is very high because of the political character. The influence in financial terms is also high as they can decide to raise the general budget or cost allocation. On local level they have limited influence once the programs are established.
Net operator TenneT	Operator of the national grid, executes the undergrounding program. No position in the buyout regulation. Monopolist and audited by the ACM (authority for consumer and market) and Ministry of Economic Affairs.	They are willing to respond to request from external organizations to adjust the current grid. Net stability needs to be ensured and the external organization pays the costs. The undergrounding program is not a part of the regular objectives.	The main interest of TenneT is ensuring an operating, stable and effective grid. They are willing to implement external requests to meet stakeholders' need to solve or avoid conflicts. So there lies an interest. Clear communication of their position and role is another interest (not responsible, just an executor).	The degree of influence on the undergrounding program is mediocre but high in local situations in terms of technical possibilities. Municipalities need to pay 25% of the costs and if they are not able to provide financial resources, TenneT will not underground. Monopolist. ACM and other experts could be asked for a second opinion on propositions. No influence on buyout.
Municipalities	Decision maker and executor of undergrounding and/or buyout. Often represent the interests of its citizens.	The general objective is to serve citizens in their needs. Active municipalities want to underground as soon as possible with full coverage of costs. In case of buyout municipalities want a less narrow criteria and options for specific local adjustments. The aim of the municipalities is minimal costs, maximal flexibility and maximal responsibility for the Ministry.	In case of undergrounding the main interests are aimed at worried citizens, providing clarity and increase comfortable living. In case of buyout interests are related to the effects on spatial planning, the effect of a decrease of uncertainty and worried citizens.	The influence of municipalities is limited. Recently the Ministry is more open for discussion about the programs but the proposal to develop a solution together is not accepted. From the second half of 2014 till 2017 more influence is promised in fine-tuning. The influence in execution is very high. A municipality is able to decide if they want to implement the programs or not.

Citizens in the undergrounding setting	Citizens who live nearby overhead connections and those that are affected when the undergrounding program is implemented.	To urge decision makers to underground the overhead connection as soon as possible and apply the precautionary advice of Van Geel of 0.4μT.	Minimize health concerns to the level of situations after 2005, obtain clarity, have a solution for unsalable or depreciated dwellings.	During the initiative to establish a solution the influence was very high. Citizens can use the media to influence the decisions and actions of the Ministry, TenneT or the municipality. During implementation they have opportunities similar to other spatial planning programs and can have a strong influence when they use these opportunities.
Citizens in the buyout setting	Owners, landlords and tenants who dwell in or own a dwelling, located directly under the overhead connection.	To minimize the amount of dwellings within the range of the precautionary advice of Van Geel. Often by altering the track instead of the buyout of dwellers.	Different and sometimes contrary interests: To keep living in the same dwelling but without a magnetic field >0.4μT. To have a solution for unsalable or depreciated dwellings. To receive money.	During the initiative to establish a solution the influence was very high. Citizens can use the media to influence the decisions and actions of the Ministry, TenneT or the municipality. During implementation they have opportunities similar to other spatial planning programs and can have a strong influence when they use these opportunities.

Table 4: Stakeholder analysis of the undergrounding and buyout settings.

interest or objectives some common ground can be found among them. The degree of heterogeneity can thus vary from low, medium and high. The degree of heterogeneity especially varies in the case of the undergrounding program. The undergrounding program is likely to be implemented when the municipality is able to contribute the required 25% of the costs. The municipality is then driven by high social commotion among its citizens and/or possibilities for spatial planning that can finance the costs for undergrounding. TenneT will then execute the undergrounding. The other 75% of the costs can be covered by the energy rates. Citizens are relieved because there is a solution that releases their concerns. A frontrunner therefore experiences probably low heterogeneity. When a municipality does not have the financial resources, there is a problem when some citizens campaign for undergrounding. They can convince other citizens and local politicians to find financial resources by decreasing other budgets, raise taxes or involve other organizations (provinces, companies or other organizations). They can also try to convince national government to provide a solution. Active municipalities probably find themselves in a setting with a mediocre till high degree of heterogeneity of key attributes. In passive municipalities degree of heterogeneity of key attributes is low. There is a low degree of social commotion so they feel not an urge to take action and therefore not have clear statement or opinions. In the case of buyout settings it is hard to find common ground among the Ministry, municipalities and citizens. They all want to provide a solution for citizens living nearby overhead connections but there is not an agreement on means. The Minister of Economic Affairs states that he is financially limited to provide a solution for all citizens within the 0.4 μT zone. There are only resources for dwellings directly under the overhead connections (TK 2013/14, 31574, nr.36). Avoiding the discussion about safety is thus not an issue, financial limits are. Several municipalities and citizens in the interviews disagree and state that the program is not a satisfying solution. Citizens (and some municipalities) state that the Minister should allow TenneT to charge higher energy rates or finance the buyout regulation as they make "high profits over the head of several affected citizens" (Oostzaan; Oostzaan380kV). In active buyout municipalities there is high heterogeneity of key attributes. In passive buyout municipalities the degree of heterogeneity is low or absent. This degree is low if municipalities do not have clear statements or not want to implement the buyout regulation but did put some thought into the subject. Citizens in these municipalities are not opinionated about living nearby overhead connections. Homogeneity or heterogeneity is sometimes difficult to assess if municipalities have not stated anything. The degree of agreement on key attributes is not manifest and is labelled absent.

4.3.3 Knowledge and social capital

Knowledge and social capital is an important aspect that relates to a final aspect of stakeholder analysis. Interviewees were questioned during expert interviews about their degree of information about the programs. Linkages with social capital were not always made as that was not the initial aim of this type of question unfortunately, but inferences can be drawn based on the amount of knowledge stakeholders indicate to possess. First, the Ministry of Economic Affairs. Public servants of this Ministry drafted the undergrounding program and buyout regulation. A lot of experts and organizations were consulted (interview EZ). Knowledge and social capital was found inside the organization and in its network. During the interview it was difficult to gain an insight on true motivations and opinions but the interviewee did make some statements about her personal opinion. Based on the expert interview, impressions and documents, the Ministry of Economic Affairs has a high degree of knowledge and social capital. Net operator TenneT obviously has a lot of knowledge and social capital related to its operating activities and the national grid. TenneT also gathered knowledge and experience in managing its stakeholders during development and reconstruction, especially citizens (interview TenneT; TenneT, 2013). In case TenneT does not possess the required knowledge internally, it can be accessed through other organizations in their network – suppliers of materials, specialized constructors and consultancy organizations (interview TenneT; TenneT, 2013). The degree of knowledge and social capital of TenneT is high. Municipalities have a different level of knowledge and social capital when compared to the Ministry and TenneT. Initially, they do not have specialized knowledge, social capital on undergrounding nor buyout in case of overhead connections in the middle of neighborhoods. Most municipalities do have knowledge and social capital on buyout due to other reasons (e.g. spatial planning). It is a complicated task for municipalities with a large number of selected dwellings. The VGPH is established as a platform that provides and exchanges information and represents the interests of its members.

When applying the level of knowledge and social capital to the types of municipalities, the following statements and inferences can be made. In case of undergrounding, frontrunners are assumed to have a lot of knowledge and social capital as these municipalities are ahead of many others. Apeldoorn is undergrounding a part of its overhead connections since the end of 2013 and in Maastricht and Heerhugowaard the undergrounding or reconstruction of the tracks is already completed (Kleijne, 2014a). Active municipalities are gathering knowledge and actively increasing their social capital. A municipality characterized as active is involved in the topic longer and has probably gathered more information and social capital (e.g. Veenendaal) than municipalities involved for a shorter period of time (e.g. Amersfoort). But this depends on more factors than only the duration itself. More research is needed to investigate this more in depth. Passive municipalities are likely to have a low degree of knowledge and social capital as they not feel the urge to take action and hence are not motivated to gather knowledge. In case of buyout settings, active municipalities like the municipality of Oostzaan gathered an extensive amount of information throughout the years (interview Oostzaan). Passive municipalities have a small amount of knowledge and social capital, although there are exceptions due to a previous history with reconstruction and dealing with citizens on this topic (e.g. Helmond).

4.3.4 Conclusion

The attributes of the community can be characterized as follows. The history of interaction can be long (originates before 2005), mediocre (around 2005), or shorter (after 2005, often originates around the announced undergrounding or buyout program). The character of the interaction is conceptualized as the degree of social commotion which can be high, medium or low. In some settings this cannot be characterized clearly as there are examples of several degrees of social commotion or duration. Key attributes of the stakeholders involved in the undergrounding and buyout setting are heterogenic, but in some settings a common ground for action can be found, which results in varying degree of heterogeneity. The degree of knowledge and social capital in municipalities in general is not high in general when comparing it with the Ministry of Economic Affairs or TenneT. But it does vary when comparing municipalities with each other. These attributes of the community are linked to the undergrounding and buyout settings in Table 55 and represented by symbols.

	History of interaction		Degree of heterogeneity of key attributes	Knowledge and social capital
Undergrounding	*Duration*	*Intensity social commotion*		
Frontrunner	+	+/-	-	+
Active	+/±/-	+	+/±	±
Passive	-	-	-	-
Buyout				
Active	+/±/-	+	+	+/±
Passive	-	-	-	-

(+ high, ± medium, - low)

Table 5: Attributes of the community of the undergrounding and buyout settings

4.4 The development of new institutional arrangements

Sub-question 3: *Which rules are used by stakeholders in relation to the undergrounding program and buyout regulation?*

Sub-question 4: *What aspects should be altered to establish new institutional arrangements that fit within the settings of the undergrounding program and buyout regulation?*

In this section the results of two sub-questions are combined. First, the rules-in-use of undergrounding settings and buyout settings are described. The empirical findings regarding biophysical conditions and attributes of the community are very important in describing and constituting the rules-in use. The three

clusters of external variables affecting the action situation are therefore combined, which creates a knowledge base to alter these rules and to establish new institutional arrangements. General adjustments are drafted for improvements of the rules-in-use that to a large extent shape the action situation during implementation as shown in Figure 2. The institutions in these settings have not changed for decades when looking at (national) government organs and the net operator. The situation and procedure described in a brochure with information for citizens about a new overhead connection in 1963, does not differ from the situation a few years ago, judging by the impression of several stakeholders (Verwoerd, 1963; interview TenneT; VGPH; EZ; Oostzaan380kV). But in recent years a change of institutions started and is still happening and is mainly found in external factors. The new institutional arrangements are designed to fit within the settings of the undergrounding program and buyout regulation. Ostrom's design principles are used to develop new institutional arrangements for implementation of both settings based on the theory and empirical findings. The two final sub-questions are combined in order to show this change in a clear and structured way. In the first section, the seven rule types are described that define the eventual action situation of the undergrounding settings and buyout settings with alterations in blue. Together these tables provide the new institutional arrangements for the undergrounding setting and the buyout setting in general. In the tables that follow specific rules-in-use are addressed for each type of setting. At the end of this section conclusions are drawn about the third and fourth sub-question.

4.4.1 Rules of the undergrounding setting

The rules stakeholders use during the preparations of the undergrounding program are shown in Table 6 below. Besides the rules-in-use alterations (in blue) are designed with help of the seven rule types. These tables are not shown per type of municipality but include all three types of municipalities (frontrunner, active, passive). After this table is explained to what extent this differs per type of municipality. The first column indicates the type of rule with a definition in the second column. Below the definition the **rules-in-use are described in black** and alterations in blue. An *arrow* (→) *indicates replacement* of the rule, a *plus symbol* (✚) *indicates an additive*. Then, the *broad institutional regularities* are mentioned as an advice or more specific guideline. These are often the starting point of further elaboration in specific settings.

Type of rule	**Rules related to undergrounding settings in municipalities**
Position (→ Positions)	Definition: Specify a set of positions or roles actors adopt, the number and type of positions actors hold: • *Ministry of Economic Affairs*: national government, policy maker and enables cost allocation through energy rates. After the law amendment they have not a position. • *Net operator TenneT*: Operator of the national grid who is allowed to execute the undergrounding program, source of knowledge, monopolist. • *Municipality*: Local government, decision-maker, implementer of the undergrounding program, financer (25%) and facilitator of permits and land use plans. ✚ *Municipality*: local government who takes the lead in the implementation provides permits and land use plans. • *Citizens:* 'dwellers' who live nearby overhead connections of 50-150kV. → *Citizens*: every Dutch citizen who is interested or feels affected can participate, as they are the reason for the policy programs. ❑ *Collective Choice Arrangements: Most individuals affected by a resource regime are authorized to participate in making and modifying its rules.*
Boundary (→ Actors)	Definition: Specify how actors were to be chosen to enter or leave these positions: • The Ministry of Economic Affairs is the governmental organ that is responsible on national level for the high-voltage grid. Through the ACM they regulate the high-voltage distribution and related effects for users.

- Net operator TenneT owns the grid and is appointed by law as the central organization for developing, realizing and managing efficient critical infrastructure for energy distribution.
  - ✚ TenneT is therefore also responsible for physical and technical aspects of the grid affecting citizens.
- Municipalities are selected by the Ministry based on information of TenneT to possess a part of a track of maximum 150kV with a length of at least 1km across residential areas within their municipal area.
  - ✚ Municipalities are chosen based on their responsibility for spatial planning and the safety of citizens. With at least 1 km of ≤150kV located in the municipal area.
- Dwellers are not specifically identified.
  - ✚ Citizens are chosen in this position because of 'collective choice', their interests are at stake. Not only the citizens living nearby overhead connections but all citizens in the municipality, as the municipality finances 25% of the costs.

❑ *User Boundaries: Clear and locally understood boundaries between legitimate users and non-users.*
❑ *Resource Boundaries: Clear boundaries that separate a specific CPR from a larger social-ecological system.*

Authority or Choice (→ Actions)

Definition: Specify which actions are assigned to an actor in a position:

- The Ministry made a political decision to draft the undergrounding program. The Ministry can deliberate with relevant actors and needs to prepare an amendment,
  - ✚ and enables adjustments according to local needs. Alternative use of the budget is made possible as long as it provides a structural solution to citizens living nearby overhead connections.
- TenneT provides information to the Ministry for preparations. TenneT is the only organization to execute the undergrounding. When the law is adjusted and financial resources are covered, TenneT is obliged to execute the undergrounding.
  - ✚ TenneT provides information to the Ministry and municipalities and is obliged to execute the undergrounding program when municipalities assign them.
- Municipalities can object to the selection of tracks and try to influence the finalization of the regulation. Municipalities can decide if they want to underground, how and when. They need to gather the required finances, agree with TenneT on costs and technical aspects, sign an agreement with TenneT and facilitate permits and land use plans during the implementation.
  - ✚ Municipalities decide and gather financial resources and knowledge and communicate during that process on a structural base with affected and interested citizens.
- Dwellers have the fundamental right to object and protest if they do not agree with decisions of national or local government.
  - ✚ Citizens communicate and decide with municipalities about their point of view and their desires in the process of reaching a structural solution. As the undergrounding program is designed for these citizens, they should have a strong position.

❑ *Minimal Recognition of Rights: The rights of local users to make their own rules are recognized by the government.*

Information (→ Information)

Definition: Specify channels of communication among actors and what information must/may be shared or not:

- The Ministry of Economic Affairs communicates with municipalities about the track they selected and the proceedings of the legislation.
  - ➔ The Ministry of Economic Affairs openly communicates about the proceedings and possibilities of the undergrounding program in specific municipalities.
- TenneT provides financial and technical information to the Ministry about tracks to select. TenneT provides information to municipalities about costs and technical aspects. This information is not publicly accessible.
  - ➔ TenneT openly communicates about technical and financial aspects in specific settings.
- Municipalities communicate with TenneT about financial and technical possibilities and with dwellers about the implementation and process of the undergrounding program.
  - ➔ Municipalities communicate with all actors about technical, financial and practical aspects.
- Dwellers do not have a specific role in sharing information.
  - ➔ Citizens communicate with municipalities and share their preferences for the plans.

❑ *Monitoring Users: Individuals who are accountable to or are the users monitor the appropriation and provision levels of the users.*

❑ *Monitoring the Resource: Individuals who are accountable to or are the users monitor the condition of the resource.*

Aggregation (→ Control)

Definition: Specify how the decisions of actors at a node were to be mapped to intermediate or final outcomes:

- The Ministry of Economic Affairs made a political decision to provide an undergrounding program and prepares an amendment of the energy law to enable this.
  - ✚ And, in case of many applicants, decides the order based on clear criteria.
- TenneT is obliged to execute the undergrounding program in selected municipalities if criteria from the side of the Ministry and the municipality are met.
  - ✚ TenneT needs to ensure that its organization is suitable for the upcoming projects.
- Municipalities need to prove their financial credibility in financing 25% of the costs and facilitate permits and land use plan. If they do not want to do or provide one of these it will not be implemented.
  - ➔ When municipalities agreed on financial and technical issues, the undergrounding can be implemented on local level.
- Dwellers have the fundamental right to object and protest if they do not agree with decisions of national or local government.
  - ➔ Citizens are involved in these decision processes and have influence on the outcomes.

❑ *Nested Enterprises: When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers.*

Scope (→ Outcomes)

Definition: Specify the jurisdiction and the finality of the outcomes that could be affected:

- The Ministry prepares the legislative process. If the bill is accepted then there is a legal ground for the allocation of costs through energy rates. The Ministry

	selected parts of the grid based on clear criteria for undergrounding (see boundary rules). ➔ The Ministry has influence on the general form of the undergrounding program, on which parts of the tracks to select and the order in case of many applicants. • If the law is amended, TenneT has a legal obligation to execute the undergrounding program if municipalities decide to implement. TenneT influences the technical and financial possibilities and the process of implementation and collaboration. • Municipalities are not obliged to implement the undergrounding program. They have permission to decide for themselves when they are selected. ✚ Municipalities influence the realization of a solution for citizens living nearby overhead connections. • Dwellers have the fundamental right to object and protest if they do not agree with decisions of national or local government. ➔ Citizens have influence on the selection of tracks and the execution of the undergrounding program. ❑ *Graduated Sanctions: Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule.* ❑ *Conflict Resolution Mechanisms: Rapid, low cost, local arenas exist for resolving conflicts among users or with officials.*
Payoff (→ Net costs and benefits)	Definition: Specify how benefits and costs were to be distributed to actors in positions: • The Ministry of Economic Affairs enables cost allocation through energy rates. • Net operator TenneT invests knowledge and social capital and renovates parts of the tracks through undergrounding, possibly in 55 different municipalities. The benefit for TenneT is that they can replace parts of the tracks and have less citizens in the 0.4 µT zone. • Municipalities invest 25% of the costs above their knowledge and social capital to implement the undergrounding. A benefit might be possibilities for land development as a source of financial resources, combine undergrounding with other infrastructural plans and improved environment. • Dwellers indirectly pay the costs through energy rates but directly benefit from the undergrounding. Citizens have a structural solution for living nearby overhead connections. ❑ *Congruence with Local Conditions: Appropriation and provision rules are congruent with local social and environmental conditions.* ❑ *Appropriation and Provision: Appropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits.*

Table 6: Rules-in-use and adjustments of the general undergrounding setting.

Most of the original rules-in-use (black) are defined according to the contents of the proposal of the Ministry of Economic Affairs and the amendment of the energy law. These are not likely to change without taking action. On a more specific level there are already differences identified. The main differences per type of municipality in the undergrounding setting are shown in Table 7. Per type of rule the differences are summarized with one or two words. These are also the terms mentioned in Figure 3-7 and based on the expert interviews. Entering positions can be easy or difficult. Boundary rules can be inclusive (everybody is allowed) or exclusive (strictly mentioned who has which position). Authority rules can be proactive, collaborative or cautious. Information rules can ensure an open, semi-open or closed character. Aggregation rules can be labelled as high, uncertain or low. Scope rules can have a high, uncertain or low nature. Payoff rules can be positive, neutral, uncertain or negative. When the rules are not yet manifest or there are no specific additional rules, the field is empty.

Type of rule	Frontrunner	Active	Passive
Position **(→ Positions)**	Easy entrance for citizens: important actor, every citizen that experiences the effects of undergrounding.	Easy entrance for citizens: citizens are referred to as people who are interested or concerned.	
Boundary **(→ Actors)**	Inclusive: interested or affected citizens can participate.	Inclusive: interested or affected citizens can participate.	
Authority or Choice **(→ Actions)**	Proactive & collaborative: municipalities hope to be included in the undergrounding program.	Cautious: everything actors do is under several conditions and carefully exploited.	
Information **(→ Information)**	Open: municipalities have extensive communication strategies and maintain solid and positive bonds with actors.	Semi-open: Municipalities gather information and explore financing possibilities.	Closed: municipalities are completely silent about the undergrounding program.
Aggregation **(→ Control)**	High: municipalities already implement undergrounding and hope to be included afterwards.	Uncertain: municipalities campaign to prevent the contribution of 25% of the costs, irrespective of local conditions.	
Scope **(→ Outcomes)**	High: undergrounding is implemented irrespective of the finalization of the undergrounding program.	Uncertain: active municipalities are preparing to be the first in line but several conditions are still uncertain.	Low, indecisive: Municipalities think of their arguments, position and strategy when citizens ask for it.
Payoff **(→ Net costs and benefits)**	Positive: municipalities are motivated by redevelopment and financial benefits. Citizens benefit in terms of improved living standards and increased value.	Uncertain: without gaining financial resources from land development, it is not likely that the undergrounding will happen if municipalities need to cover 25% of the costs.	

Table 7: Specific rules of the undergrounding setting.

4.4.2 Rules of the buyout setting

Rules stakeholders use during the preparations of the buyout regulation are shown in Table 8 below which has the same setup as the previous table. This table with rules-in-use includes the two types of buyout settings (active and passive) with relevant adjustments. After this table is explained to what extent this differs per type of municipality. The first column indicates the type of rule with a definition in the second column. Below the definition the **rules-in-use are described in black** and alterations in blue. An *arrow* (→) *indicates replacement* of the rule, a *plus symbol* (+) *indicates an additive*. Then, the *broad institutional regularities* are mentioned as an advice or more specific guideline. These are often the starting point of further elaboration in specific settings.

Type of rule	**Rules related to buyout settings in municipalities**
Position (→ Positions)	Definition: Specify a set of positions or roles actors adopt, the number and type of positions actors hold: • *Ministry of Economic Affairs*: National government, policy maker, financer. • *Municipality*: Local government, decision-maker and implementer of the buyout regulation. Facilitates and finances administrative tasks (permits, land use plans) • *Dwellers*: citizens who live in a dwelling directly under high-voltage cables. These people can be owners or tenants. In case of tenants a landlord decides about buyout.

➔ Citizens: every citizen who is interested of feels affected can participate as they are the reason for the policy options of undergrounding and buyout.

❑ *Collective Choice Arrangements: Most individuals affected by a resource regime are authorized to participate in making and modifying its rules.*

Boundary (→ Actors)

Definition: Specify how actors were to be chosen to enter or leave these positions.

- The Ministry of Economic Affairs is the governmental organ that is responsible on national level for regulating high-voltage distribution and its effects on users.
- Municipalities enter their position in this setting when there are dwellings selected for buyout within their municipal area.
  - ➔ Municipalities are chosen based on their responsibility for spatial planning and the safety of citizens. An overhead connection with a few dwellings underneath or with a higher voltage than 150kV, is located in the municipal area.
- Owners or tenants (and their landlord) are included if their living quarters of the dwelling are located directly under the high-voltage cables. January 1st, 2017 is used as the date of reference.
  - ➔ Citizens are chosen based on their location: the dwelling in relation to the overhead connection with January 1st, 2017 as date of reference.

❑ *User Boundaries: Clear and locally understood boundaries between legitimate users and nonusers.*

❑ *Resource Boundaries: Clear boundaries that separate a specific CPR from a larger social-ecological system.*

Authority or Choice (→ Actions)

Definition: Specify which actions are assigned to an actor in a position:

- The Ministry of Economic Affairs determined which dwellings are selected through GIS (geographical information systems) and local investigation by public servants in cases of uncertainty. The Ministry informs relevant owners and landlords that the relevant dwelling is selected for buyout. The Ministry determines the height of relocation allowance for tenants. The Ministry makes the final decision in determining the selection of dwellings. The Ministry reimburses municipalities for the completed buyouts.
  - ➔ The Ministry of Economic Affairs deliberates with stakeholders and enables adjustments according to local needs. Alternative use of the budget is made possible as long as is provides a structural solution to citizens living nearby overhead connections.
- Municipalities can validate or object to the decision of the Ministry. Municipalities can decide to apply or decline the buyout regulation. The municipality determines the offer based on the market value of the dwelling. The municipality pays the amount agreed upon and determines what to do with the building: demolish or amend the land-use plan for other usage.
  - ➔ Municipalities receive requests of citizens for buyout and decide based on local criteria which are created with citizens. Communicate during that process on a structural base with affected and interested citizens.
- Owners and landlords can object to the decision of the Ministry. Owners and landlords inform their municipality that they want to receive an offer for buyout. In case of ownership, dwellers can accept or refuse the offer for buyout.
  - ➔ Citizens deliberate and communicate with the municipality about providing a structural solution for them living nearby overhead connections. As the buyout regulation is designed for these citizens, they should have a strong position.

❑ *Minimal Recognition of Rights: The rights of local users to make their own rules are recognized by the government.*

Information (→ Information)

Definition: Specify channels of communication among actors and what information must/may be shared or not:

- The Ministry of Economic Affairs communicates with owners, landlords, and municipalities, about the selection of dwellings, the contents of the regulation, actions/information each actor must, may, or must not take/share.
  - ➔ The Ministry of Economic Affairs openly communicates about the proceedings and possibilities of the buyout regulation, and actions/information each actor must, may, or must not take/share.
- Municipalities can accept or refuse the decline the request for buyout. Municipalities communicate with owners and landlords about the height of the buyout.
  - ➔ Municipalities need to agree with the request for buyout and communicate with owners and landlords about the height of the buyout.
- Owners, tenants and landlords should turn to the Ministry for information about selection and buyout procedures. Owners and landlords inform the municipality that they want to invoke the buyout regulation. Owners and landlords need to agree with the municipality about the amount of the offer.
  - ➔ Citizens communicate with municipalities and share their preferences for the plans.

❑ *Monitoring Users: Individuals who are accountable to or are the users monitor the appropriation and provision levels of the users.*
❑ *Monitoring the Resource: Individuals who are accountable to or are the users monitor the condition of the resource.*

Aggregation (→ Control)

Definition: Specify how the decisions of actors at a node were to be mapped to intermediate or final outcomes:

- The Ministry decides which dwellings are included and compensates the municipality for buyout once the residential purpose of the land-use plan is changed when a structural solution is desired. In case of many applicants at the same time they decide the order.
- Municipalities can accept or decline the request of citizens living under overhead connections to place an offer.
  - ➔ When municipalities reach an agreement with citizens on the height of the buyout and/or local adjustments, implementation can start.
- If citizens accept the offer for buyout and move then there is a structural solution.
  - ✚ Citizens are involved in these decision processes and have influence on the outcomes.

❑ *Nested Enterprises: When a common-pool resource is closely connected to a larger social-ecological system, governance activities are organized in multiple nested layers.*

Scope (→ Outcomes)

Definition: Specify the jurisdiction and the finality of outcomes that could be affected:

- The Ministry of Economic Affairs decides which dwellings are included and reimburses municipalities for their buyout costs over a period of 5 years.
  - ✚ There is also a possibility to use the budget of these houses for alternative measures.
- The municipality decides whether to implement the buyout regulation or not.
  - ➔ Municipalities have influence on the local implementation of a solution for citizens living nearby overhead connections.

	• The buyout regulation is voluntary for owners and landlords. ➔ Citizens have influence on the local implementation of the solution for living nearby overhead connections. ❑ *Graduated Sanctions: Sanctions for rule violations start very low but become stronger if a user repeatedly violates a rule.* ❑ *Conflict Resolution Mechanisms: Rapid, low cost, local arenas exist for resolving conflicts among users or with officials.*
Payoff (→ Net costs and benefits)	Definition: Specify how benefits and costs were to be distributed to actors in positions: • The Ministry reimburses municipalities for the buyout. Citizens living directly under the overhead connections benefit, Dutch taxpayers pay the costs of the buyouts (€ 140M). ➔ The Ministry of Economic Affairs provides a budget for buyout or local solutions to municipalities. Dutch taxpayers eventually pay the costs (€ 140M). • Municipalities have a structural solution for citizens living directly under the overhead connection. They pay for administrative costs and disburse the buyout. Municipalities need to decide on the land-use plan for the dwelling they bought, they are the new owner. ➔ Municipalities are responsible the budget and need to report the usage based on local conditions. Financially responsible for enabling administrative tasks. Benefits are related to spatial planning, improved environment. • Owners, tenants and landlords have a structural solution for living nearby overhead connections. ➔ Citizens have a structural solution for living nearby overhead connections in their local situation. ❑ *Congruence with Local Conditions: Appropriation and provision rules are congruent with local social and environmental conditions.* ❑ *Appropriation and Provision: Appropriation rules are congruent with provision rules; the distribution of costs is proportional to the distribution of benefits.*

Table 8: Rules of the buyout setting.

In case of the buyout setting the same applies as with the undergrounding program. Most of the rules are defined according to the contents of the proposal of the Ministry of Economic Affairs. But in contrast with the undergrounding program, there is still a lot to determine in the specific implementation and how to handle specific and difficult dwellings (linked dwellings, apartments and dwellings linked to businesses). The main differences per type of municipality in the undergrounding setting are shown in Table 9. Per type of rule the differences are summarized with one or two words. These are also the terms mentioned in Figure 3-7 and based on the expert interviews. Entering positions can be easy or difficult. Boundary rules can be inclusive (everybody is allowed) or exclusive (strictly mentioned who has which position). Authority rules can be proactive, collaborative or cautious. Information rules can ensure an open, semi-open or closed character. Aggregation rules can be labelled as high, uncertain or low. Scope rules can have a high, uncertain or low nature. Payoff rules can be positive, neutral, uncertain or negative. When the rules are not yet manifest or there are no specific additional rules, the field is empty.

Type of rule	Active	Passive
Position **(→ Positions)**	Easy entrance for citizens: citizens are referred to as people who are interested or concerned.	
Boundary **(→ Actors)**	Inclusive: interested or affected citizens can participate. Citizens in the magnetic field zone of 0.4 µT want to be included in a solution for living nearby overhead connections.	
Authority or Choice **(→ Actions)**	Active but cautious: municipalities are campaigning for alternative solutions and are cautious towards citizens.	
Information **(→ Information)**	Semi-open: municipalities gather information and explore and deliberate with other actors about alternative solutions.	Closed: municipalities are completely silent about the undergrounding program.
Aggregation **(→ Control)**	Uncertain: municipalities want alternative options and view the buyout regulation as a narrow problematic option.	
Scope **(→ Outcomes)**	Uncertain: municipalities and citizens are investigating their options for altering or improving the buyout regulation.	Low, indecisive: Municipalities think of their arguments, position and strategy when citizens ask for it.
Payoff **(→ Net costs and benefits)**	Negative: municipalities do not want to receive ownership of the dwelling selected for buyout. Municipalities and citizens want a more broad solution and sooner than January 1st 2017.	Negative: If these municipalities have an opinion, they do not see the benefits of the buyout regulation and do not see an incentive to take action.

Table 9: Specific rules of the buyout setting

4.4.3 Conclusion

The seven rule types are identified in all settings. Therefore, a general description of the rules-in-use of the undergrounding setting and buyout setting is provided. This is mainly based on the proposition of the Ministry of Economic Affairs and additive information from the expert interviews. For each setting also specific rules-in-use are described. The key characteristics of these rules are shown in Figure 3-7 under rules-in-use. In case of the undergrounding program, frontrunners are proactive and inclusive because the degree and ease of participation is high. Active municipalities are a bit reserved. They communicate with citizens but are not proactively including or already taking action. They gather information and prepare but have not yet reached the point of decisions. Passive municipalities are reserved in terms of communication and action. Municipalities in active buyout settings are not content with the proposed regulation and are exploring possibilities in reallocation of the budget to provide a broader solution for citizens living nearby overhead connections. Citizens in these settings are not content that they are not included in the buyout program. Passive municipalities are reserved and do not see the benefits of the buyout regulation and see not an incentive for action.

After establishing the rules-in-use adjustments and alternatives are described that together can constitute new institutional arrangements. This refers to the fourth sub-question about aspects that should be altered to establish new institutional arrangement that fit within the settings of the undergrounding program and buyout regulation. These alterations are provided in the tables in blue to provide a clear overview. In both settings, interested and/or affected citizens are included in terms of positions and boundary rules. As the undergrounding program and buyout regulation are drafted by the Ministry for providing a structural solution for citizens living nearby overhead connections, they are advised to have a strong influential position in the local implementation. Open and structural communication between municipalities and citizens is found to be important. Local adjustments of the regulation are important to suit the preferences of actors in local settings. The institutional arrangements are thus more open in terms of participation and more flexible in providing a suitable solution for citizens living nearby overhead connections.

5. Conclusion

In this chapter concluding statements are made. First, conclusions are drawn on the sub-questions about external variables that influence the action situation. Some adjustments are suggested. These statements are used in the second part of this chapter that answer the main research question. After this chapter a discussion about the strength of the research and recommendations on findings follow.

5.1 The current game of power

The first part of this research described important factors that determine the situations in which citizens live nearby overhead connections. These factors are external variables that identify biophysical conditions, attributes or characteristics of the community and rules used by the actors in these situations. In case of the undergrounding program, three ideal types of settings are identified in municipalities: frontrunner, active and passive settings. In case of the buyout regulation two types of municipalities are found: active and passive settings. In Figure 3-7 a summary of the findings is shown. The biophysical conditions of these settings are quite simple, in each setting has an overhead connection that is located nearby or above dwellings. Overhead connections up to 150kV that cross residential areas for at least 1km are selected for undergrounding. Dwellings located directly under other parts of the high-voltage grid are included in the buyout regulation.

The attributes of the community relate to aspects that characterize a group of actors. In this research this is conceptualized to have four attributes. The first aspect is the duration of the history of interaction. Frontrunner settings have a long history of interaction whereas passive municipalities have a short history of interaction or have no history of interaction at all. This applies to both undergrounding and buyout. The character of the history of interaction is the second attribute. This varies from a high intensity of social commotion in a setting to a low intensity of social commotion. High degrees of social commotion are likely to be found in active settings. In the frontrunner setting a low degree of social commotion is found as this is a situation where municipalities started with plans for altering the situation with overhead connections to a situation in which they freely can redevelop a neighborhood or develop new dwellings. The third attribute of the community is a cluster of key attributes of actors involved. In most settings these key attributes are heterogenic, only the degree varies. In frontrunner settings common ground for action can be found where in passive settings there is at least a silent common ground for not taking action. In active settings of buyout the heterogeneity of key attributes of actors is high where in active settings of undergrounding the degree of heterogeneity varies from mediocre till high. Knowledge and social capital is the fourth and final attribute of the community. The knowledge and social capital in municipalities is not high in general when comparing with the Ministry of Economic Affairs or TenneT. But it does vary when comparing municipalities with each other. The degree of knowledge and social capital is high in frontrunner settings and low in passive settings. In active settings of undergrounding it is mediocre and in active settings of buyout it can be mediocre or high.

The third category of external variables are the rules-in-use. These rules are identified with the seven rule types of Ostrom and found and described in the five different settings. A general description is provided for the undergrounding setting and buyout setting. More specific or additional rules for each of the five settings were provided after establishing the general set of rules. Frontrunner setting are characterized as proactive and inclusive because the degree and ease of participation is high. In active settings, municipalities can act reserved. They communicate with citizens but are not proactively including or already taking action. They gather information and prepare but have not yet reached the point of decisions. In active buyout settings these active municipalities are trying to influence the rules of the Ministry of Economic Affairs as they see that buyout of dwellings directly under the overhead connection is not enough. According to these municipalities these rules are far from agreed upon. Citizens in these settings are not content that they are not included in the buyout program. Passive municipalities are reserved in terms of communication and action. Passive municipalities are reserved and do not see the benefits of the buyout regulation and see not an incentive for action.

Together these clusters of external variables create a knowledge base for an answer on the fourth sub-question and main research question. In other words, the development of new institutional arrangements. The fourth sub-question aimed at identifying aspects to adjust in order to establish new

institutional arrangements for the undergrounding and buyout settings. Biophysical conditions and attributes of the community are very important in describing and constituting the rules-in use. Theorists identified and improved broader institutional regularities over the years that were found to appear in long surviving resource institutions as a contrast to failing cases. Adjustments are based on the new institutional arrangements are based on the external variables and these institutional regularities. Together constitute new institutional arrangements. This is explained in the next section.

5.2 The future: new institutional arrangements

In the previous section an answer on the first three sub-questions is provided. The fourth sub-question identifies aspects to alter in order to achieve more effective implementation of the undergrounding program and buyout regulation. The rules in use described in sub-question three are adjusted into new institutional arrangements. This alteration is based on empirical data from the expert interviews and theoretical broad regularities found by Ostrom through years of research. Statements in this section lead to the answering of the following main research question:

Which institutional arrangements contribute to the implementation of the undergrounding program and buyout regulation in situations of citizens living nearby overhead connections in the Netherlands?

The institutional arrangements that contribute to the implementation of the undergrounding program and buyout regulation in situations of citizens living nearby overhead connections can be found in section 4.4. These new sets of rules contain some important aspects. In both settings, interested and affected citizens are included in the new design more directly. The boundaries of entering a position in the action situations as a citizen is less narrow than it was. As the undergrounding program and buyout regulation are drafted by the Ministry for providing a structural solution for citizens living nearby overhead connections, they are advised to have a strong influential position in the local implementation. This is also in line with theories about deliberation, participation and sharing power (Fischer, 2007; Fung, 2003; Rein & Schön, 1993; Stirling, 2008). Open and structural communication between municipalities and citizens is found to be important. Local adjustments of the regulation are therefore important to suit the preferences of actors in local settings. This is also found by Ostrom (2010) her research throughout the years. The expectation that these theories might be interesting for the topic of this thesis are met. The institutional arrangements designed in this research are more open in terms of participation and more flexible in providing a suitable solution for citizens living nearby overhead connections. They are supposed to have a better fit with the networked, flexible, informal and fast-changing society. Together these elements contribute to a better implementation of the undergrounding program and buyout regulation.

6. Discussion

In this research a description is made of several undergrounding and buyout settings based on a theoretical framework. These results are used to design new institutional arrangements for implementation of these programs. This research has a descriptive and design character. Important for design research is the knowledge this design is based on. The quality of this design depends therefore not only on the analytical skills of the researcher but also on the description of the current situation and preferences stakeholders have for future implementation. The strength of this description is discussed in this section and recommendations for future research are made. After this chapter a final chapter about the practical application of the findings follows.

6.1 Discussion

One of the strong points of performing expert interviews is the fact that it is face-to-face and, in this case, has an open structure. The interviewer can explain concepts and check if the interviewee understands them. The researcher is able to ask follow-up questions which what resulted in a rich amount of data. The structure of the IAD-framework is used during the expert interviews which made it very easy to answer the research questions in a structured way. With the development of new institutional arrangements in mind, the interviewees are questioned about their preferences for future implementation. This provided interesting directions for the development of the institutional arrangements. A point of discussion is the limited number of interviews and the fact that the interviews are performed in a phase where the programs are prepared and developed. When performing an expert interview with the municipality of Zaanstad (labelled as passive buyout) one might label them now as an active buyout setting. Municipalities can change their position. Still, this change of position was expected as this municipality already stated that they were waiting for the Ministry of Economic Affairs to communicate the latest version of the buyout regulation and that they would react if citizens started to worry or comment on a letter the Ministry send. So the developments in the field are uncertain but not random, possible scenarios are already thought through. Two citizen interest groups are selected for the research. This provides an impression of their viewpoint as they represent a larger group of citizens in Oostzaan and Veenendaal but is not representative for citizens in other municipalities. In the expert interviews with municipalities is specifically asked about citizens (opinions, interests and preferences) to cover this weakness for some extent but this number of municipalities is also limited. The aim to describe various settings is reached but in order to gather representative data to draw inferences for all municipalities, further research is needed. To gather information on all affected municipalities was not relevant at the time this research is performed, as a lot of these municipalities did not have an opinion about this quite complex subject. Since the latest letter in July 2014, more municipalities are formulating their position. Specifically in buyout settings where citizens in selected dwellings received a letter about the buyout regulation. Finally, an aspect that was not covered is information about social capital. During the interviews, interviewees are questioned about information and knowledge but not always about social capital. This was discovered during analyzing the results. By analyzing the answers about knowledge, inferences can be drawn about the social capital a stakeholder has in relation to the undergrounding program and buyout regulation. The research is a qualitative research with expert interviews and desk research and document analysis as key data collecting methods. These methods not always provided similar data. When data was inconsistent, the data was validated in terms of authority and legitimacy of the source.

6.2 Recommendations

This research is performed in order to apply the IAD-framework in a more technical common pool resource system. The IAD-framework is applied many times in situations with natural resources like forests, fish, grasslands and irrigation systems. One of the important arguments of this theory is that every situation is unique and needs therefore a unique approach. The latter was a trigger use this theory and to see the high-voltage grid as a common pool resource. But the intention to use this theory and actually apply can be difficult. When looking back at this process, this turned out pretty well. According to reactions of practitioners, the IAD-framework and related rule types affecting the action situation

could be very useful in other fields where coordination and agreement on rules is needed. The municipalities can apply these institutional arrangements in other situations where policy is developed to improve the environment in which citizens live. For example the redevelopment of neighborhoods, infrastructural issues, and settings where the action situation is problematic and agreement is needed on collaboration and the way stakeholders interact with each other. Often emotions of citizens are highly present and then it is very important to agree upon the rules-in-use. The interest groups of citizens argue that is important to them to feel understood and listened to (Interview Hoogspan; Oostzaan380kV). This is in line with the research of Stirling (2008) who argues that appraisal comes with informing citizens. Another important aspect is to build commitment which results from forming tangible social choices. These aspects are important because otherwise citizens can obstruct delay the process. It can aid the decision-making of the programs. The recommendations of this research can already be used. Another point to notice is the time dimension of the undergrounding program (15 years). It is important to take innovations in account. Undergrounding high-voltage cables up to 150kV was innovative and costly. Nowadays it is business as usual for TenneT in new developed neighborhoods. Undergrounding high-voltage cables >150kV is innovative and costly but technicians and researchers already developed the next generation of high-voltage cables and techniques that require a more narrow workspace for undergrounding. There are a lot of ideas to improve the effectiveness or efficiency of undergrounding but the Ministry of Economic Affairs chooses not an innovative path. The results can also help in situations where new tracks are added to the high-voltage grid. There can be parts where the high-voltage cable is placed underground or cases where dwellings receive an offer for buyout. Besides these specific rules, the seven rule types affecting the action situation can also help the development of new tracks in general to reach an agreement for effective coordination.

A recommendation in light of future research is evaluating the process of developing the programs. It might be interesting to use a theoretical framework with theories mentioned earlier about deliberation, participation and sharing power. The way the Ministry of Economic Affairs communicated at first and presented their position was quite hierarchic. There was and to some extent still is, a lot of frustration among other stakeholders about this attitude and position of the Ministry. The same frustration applies to TenneT but in a different way. TenneT was a company with little attention for interests of citizens living nearby overhead connections. Throughout the years something changed and they are more receptive for concerns from outside their organization. Research on these developments can provide interesting insights that can help organizations in other fields that think and act hierarchic but see growing resistance for their position. An example for this is the NAM (Nederlandse Aardolie Maatschappij) that explores and produces oil and gas in the Netherlands. In the province of Groningen on of the largest gas field is exploited but this also causes small earthquakes that damage buildings. Recently, the Ministry of Economic Affairs reached an agreement with worried and sometimes even angry citizens that wanted compensation for these effects but the outcomes are still not clear and might take years (TK 2014/15, 33526, nr.88). A final the compensation of distressing cases of citizens living nearby airport Schiphol by a foundation. This foundation is aimed at providing material support for citizens who experience disproportional and unique effects of the airport who live outside areas that are pointed for compensation. This support is usually in the form of extra isolation measures or support with relocating (Leefomgeving Schiphol, 2014). Something like this can be constituted in issues with overhead connections, especially in case of the buyout regulation.

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Appendices

Appendix A: Members of the VGPH

	Municipality	# buyouts	undergrounding
1	Best	-	Yes
2	Oostzaan	17	No
3	Sliedrecht	22	No
4	Zaanstad	39	No
5	Hattem	8	No
6	Zutphen	1	Yes
7	Diemen	1	No
8	Molenwaard	44	No
9	Nieuwegein	-	Yes
10	Amersfoort	-	Yes
11	Veenendaal	1	Yes
12	Dordrecht	9	No
13	VNG[2]	-	-

Table 10: Members of the VGPH

[2] The VNG is an organization for Dutch Municipalities.

Appendix B: Interviewees of the expert interviews

	Organization	Interviewee	Function	Reason
1	VGPH/APPM	Maartje Rieter Matthijs Kok	Advisor Advisor	General information, Involved with VGPH from the start - mid-2013 General information, involved with VGPH from mid-2013 till now
2	Municipality of Oostzaan	Paul Möhlman Lieneke Schipper	Mayor Project leader	Large buyout problem, one of the three VGPH initiators, small municipality
3	Municipality of Zaanstad	Lisette Bleeker	Project leader	Large buyout problem, one of the three VGPH initiators, large municipality
4	Municipality of Veenendaal	Jan van Manen	Project leader	Active undergrounding program preparations, one of the three VGPH initiators, mid-size municipality
5	Municipality of Geertruidenberg	Albert van der Linden	Project leader	Relative large undergrounding and buyout workload in relation to population numbers, small municipality
6	Municipality of Helmond	Koen de Vries	Project leader	Expertise with lobbying and proactive/critical attitude on overhead connections, mid-size municipality
7	Bewonersplatform Hoogspan (Veenendaal)	Jaap Schilperoort	Chairman of Hoogspan, retired general practitioner	Active role in public discourse in the municipality of Veenendaal
8	Oostzaan380kV	Gert Visser	Chairman of Oostzaan380kV	Active role in public discourse in the municipality of Oostzaan but also an influential role in national government
9	Net operator TenneT	Harry Kraus	Project leader	Information from point of view of the net operator who is responsible for executing the undergrounding program
10	Ministry of Economic Affairs	Marijke Reuver	Senior policy maker/advisor	Responsible for/expert on the undergrounding program and buyout regulation

Table 11: Interviewees of the expert interviews

Appendix C: Expert interview schedule

Introduction

Mijn naam is Lieke Holland en ik ben bezig met het afronden van mijn master Bestuurskunde aan de Universiteit Twente. Dit doe ik door een onderzoek uit te voeren in opdracht van Vereniging Gemeentelijk Platform Hoogspanning (VGPH) en APPM management consultants. Het onderzoek richt zich op de regeling over verkabeling en het uitkoopprogramma. Door interviews te houden met verschillende experts en belanghebbende partijen wil ik in kaart brengen hoe het speelveld van deze regelingen er nu uitziet en hoe dit speelveld zich kan ontwikkelen. Ik probeer met dit onderzoek adviezen en strategieën te schetsen die bruikbaar kunnen zijn in de uiteindelijke vormgeving van het beleid en de uitvoering daarvan. Deze adviezen wil ik in een later stadium graag weer aan de verschillende partijen voorleggen om hier feedback op te krijgen. Om deze adviezen te kunnen doen zou ik u graag interviewen. Ik heb een aantal vragen opgesteld als leidraad met ruimte om in te gaan op onderwerpen die vanuit uw positie belangrijk zijn.

Ik zou dit gesprek graag willen opnemen om het later zo goed mogelijk te kunnen verwerken in mijn onderzoek. Gaat u hiermee akkoord?

Dit interview wordt gebruikt voor mijn onderzoek. Als u wilt kan ik een verslag van dit gesprek toesturen ter verificatie.

Zijn er nog vragen?

Interview met [naam] van [organisatie]

Positie Actoren hebben een bepaalde positie/rol die hen verbindt met mogelijke acties die zij kunnen ondernemen binnen of ten behoeve van het beleid in het algemeen en beide regelingen in het bijzonder. Ik wil u nu een paar vragen stellen over de positie van [organisatie]:

1. Wat is de rol van uw organisatie binnen de uitkoopregeling en het verkabelingsprogramma? Hoe is dit ontstaan?
2. Wat zijn de doelen van uw organisatie binnen deze regelingen? (nastreven van resultaat met bepaalde middelen)
3. Welke belangen heeft uw organisatie bij deze regelingen? (welk voordeel/baat, waarom is het belangrijk)
4. Wat vindt u van de positie die uw organisatie heeft in het speelveld van partijen rondom beide regelingen?
    a. Tevreden/ontevreden, waar ziet u mogelijkheden voor verbetering van uw positie?

Acties en invloed/controle Elke organisatie heeft een positie in een bepaald beleidsveld. Zo ook bij beide regelingen. Bij deze positie horen verschillende acties of zijn verschillende acties toegestaan. Ook is er vaak de mogelijkheid acties van andere partijen te beïnvloeden en/of controleren. De volgende vragen gaan hierover:

5. Wat is op dit moment de inzet/actie van uw organisatie met betrekking tot beide regelingen?
    a. En in de toekomst?
6. Andere partijen leveren een bepaalde inzet. Wat zou u graag van andere partijen willen zien? (EZ-politiek, TenneT, gemeenten-VGPH, burgers)
7. Welke invloed oefent u uit op de regelingen of bent u van plan uit te oefenen?
8. Stel dat er weerstand komt tegen de regelingen vanuit … [EZ-politiek/TenneT/gemeenten-VGPH/burgers].
    a. Wat verwacht u in dat geval?
    b. Hoe denkt u hiermee om te gaan? (of is dit niet uw verantwoordelijkheid?)
9. Hoe denkt u om te gaan met de media? (is dit een middel of een barrière?)

Informatie De volgende vragen gaan over de informatie die u heeft over de verschillende acties en mogelijkheden binnen de regelingen:

10. Beschikt uw organisatie over voldoende informatie over mogelijke acties van u en andere partijen?
    a. Welke informatie ontbreekt er?
    b. Hoe zou deze ontbrekende informatie ingevuld kunnen worden?

Mogelijkheden en uitkomsten Acties leiden tot mogelijke uitkomsten. De waarschijnlijkheid van deze uitkomsten hangen af van informatie die u als partij heeft en de mate van invloed en controle. De volgende vragen richten zich op de mogelijke uitkomsten van de regelingen:

11. We hebben in het begin al even gesproken over de doelstellingen van uw organisatie. Sluit dit aan bij de doelstellingen van de andere partijen? (EZ-politiek, TenneT, gemeenten-VGPH, bewoners)
    a. Waar verwacht u samenwerking/versterking van doelstellingen?
    b. Waar verwacht u wrijving of conflicten?
    c. Ziet u mogelijkheden dit te voorkomen? (Wat zelf doen, wat andere partijen?)
12. We hebben in het begin ook gesproken over de belangen van uw organisatie. Sluit dit aan bij de belangen van de andere partijen? (EZ-politiek, TenneT, gemeenten-VGPH, bewoners)
    a. Waar verwacht u samenwerking/versterking van belangen?
    b. Waar verwacht u wrijving of conflicten?
    c. Ziet u mogelijkheden dit te voorkomen? (Wat zelf doen, wat andere partijen?)
13. Welke (andere) knelpunten of barrières ziet of verwacht u?
    a. Wat zou hiervoor een mogelijke oplossing zijn?
14. Wat vindt u van de baten en lasten verdeling van het uitkoopprogramma en het verkabelingsprogramma?
15. Hebt u nog andere suggesties voor verbetering?

Snow-ball actors and information

16. Hebt u suggesties voor mij om dit onderzoek te helpen in termen van:
    a. interviewees/interessante personen?
    b. informatie (documenten, rapporten, artikelen)?
17. Hebt u vragen of opmerkingen?

Bedankt voor uw tijd en antwoorden. Ik ga dit gesprek uitschrijven en verwerken in het onderzoek. Over een paar weken ben ik van plan een panel discussie te houden over mijn voorlopige adviezen naar aanleiding van de interviews. Zou u hieraan willen meewerken? Opnieuw bedanken en afsluiten.

Appendix D: Overview of the high-voltage grid

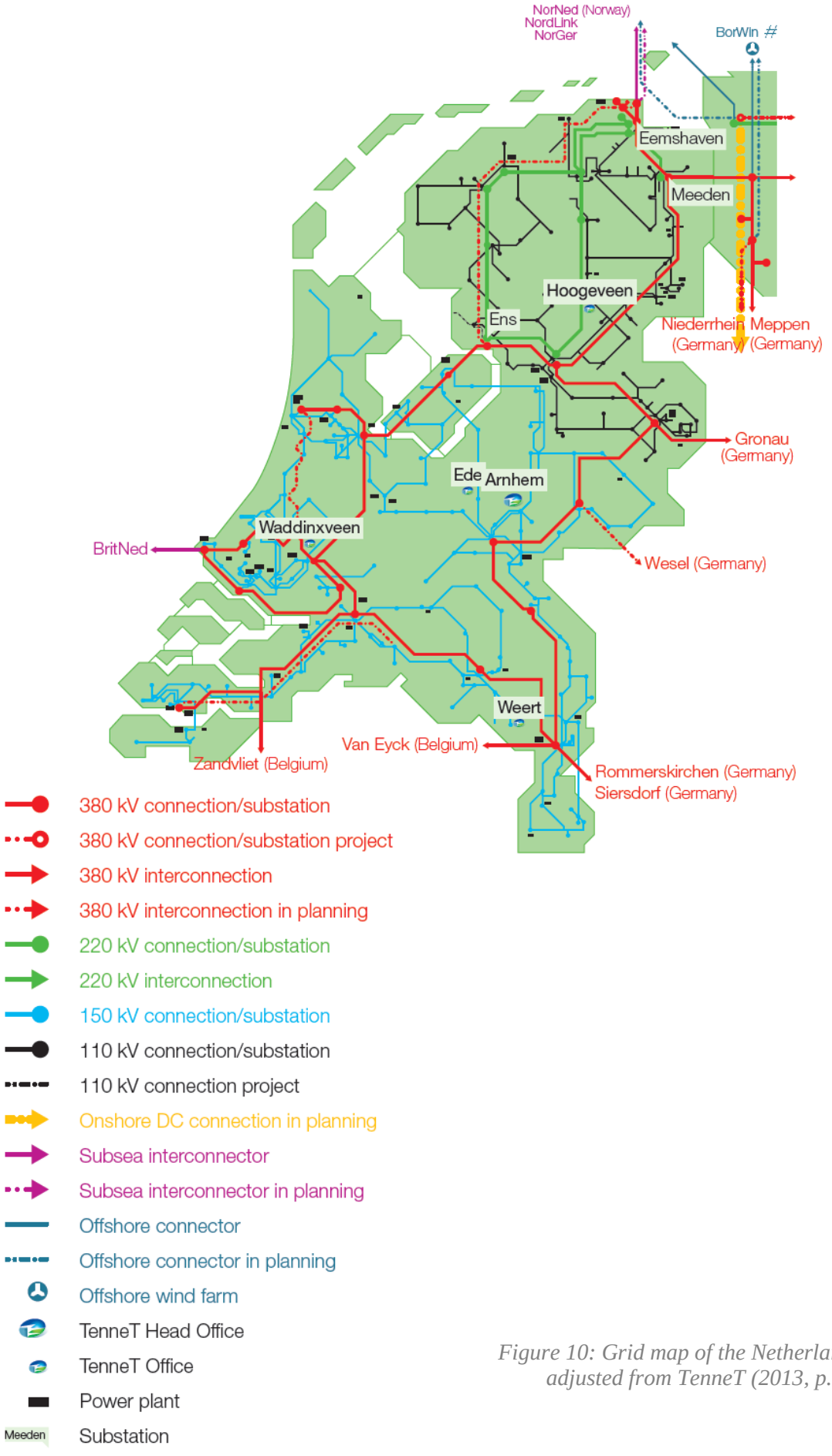

Figure 10: Grid map of the Netherlands adjusted from TenneT (2013, p. 3).

Appendix E: Overview of the grid in Europe TenneT operates

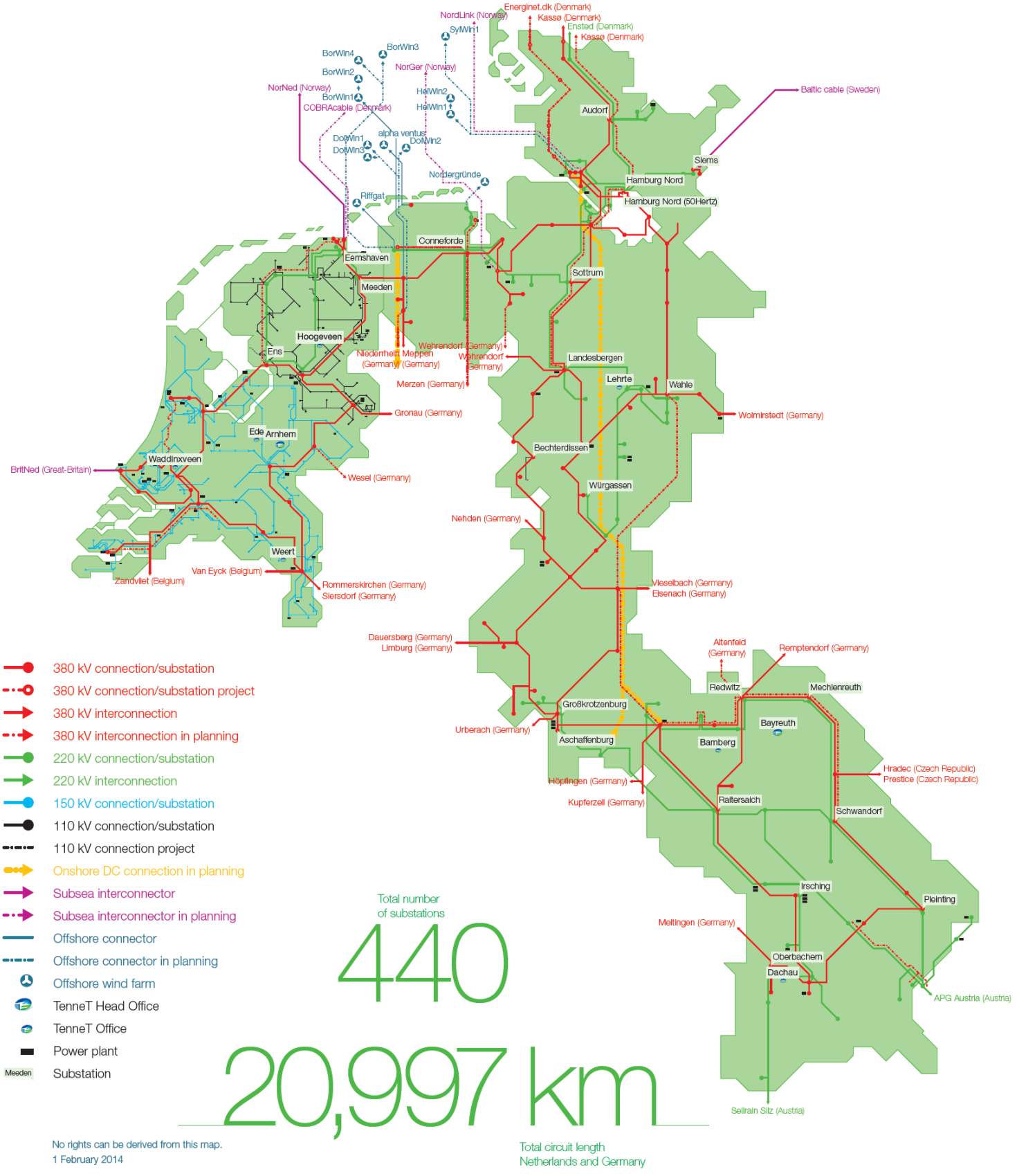

Figure 11: Grid map of the Netherlands adjusted from Tennet (2013, p. 3).

Appendix F: Municipalities selected for undergrounding

In this overview a total of 50 municipalities are shown that are identified for the undergrounding program. According to the Minister of Economic Affairs there are 55 municipalities that qualify for the undergrounding program. Which municipalities are missing or uncertain is not communicated.

Albrandswaard	**Heeze-Leende**	**Peel en Maas**
Almelo	Helmond	Raalte
Amersfoort	Hendrik-Ido-Ambacht	Ridderkerk
Apeldoorn	Hoogeveen	Sittard-Geleen
Arnhem	Hoogezand-Sappemeer	Smallingerland
Assen	Landgraaf	Spijkenisse
Best	Leeuwarden	Stein
Breda	Leidschendam-Voorburg	Súdwest-Fryslân
Den Bosch	Lingewaard	Uden
Deventer	Maastricht	Utrechtse Heuvelrug
Ede	Meppel	Veenendaal
Eindhoven	Nieuwegein	Venlo
Ermelo	Oegstgeest	Venray
Geertruidenberg	Oirschot	Voerendaal
Geldrop-Mierlo	Oss	Voorschoten
Groningen	Ouderkerk	Zutphen
Heerlen	Overbetuwe	

Table 12: The municipalities selected for the undergrounding program (TK II 2013/14, 31574, nr. 36, p.8).

Appendix G: Dwellings in municipalities selected for buyout

In this overview a total of 377 dwellings, or more specific, addresses are identified in 83 Dutch municipalities. According to the Minister of Economic Affairs there are approximately 375 addresses. There are a few cases not clear which need further investigation to determine if these dwellings should be included or not according to the selection criteria of the buyout regulation.

Municipality	##
Molenwaard	44
Zaanstad	39
Sliedrecht	22
Oostzaan	17
Nederlek	16
Westland	15
Heerhugowaard	11
Heerlen	10
Apeldoorn, Dordrecht, Hollands Kroon	9
Hattem, Overbetuwe	8
Den Bosch	7
Binnenmaas, Meerssen, Peel en Maas, Schiedam, Sittard-Geleen, Stichtse Vecht	5
Bernisse, Echt-Susteren, Enschede, Ermelo, Lochem, Neder-Betuwe, Venray, Wageningen	4
Amsterdam, Brielle, Doetinchem, Soest, Venlo, Voorst, Zuidplas	3
Albrandswaard, Barendrecht, Boxmeer, Horst en Maas, Loppersum, Menterwolde, Ouderkerk, Papendrecht, Renkum, Spijkenisse, Westvoorne, Zwolle	2
Almelo, Bedum, Beemster, Berkelland, Borne, Brummen, Cromstrijen, De Bilt, De Ronde Venen, Diemen, Duiven, Enkhuizen, Hengelo, Kampen, Koggenland, Landsmeer, Leudal, Meppel, Nederweert, Nijmegen, Nuenen, Oisterwijk, Ooststellingwerf, Oud-Beijerland, Pekela, Ridderkerk, Stadskanaal, Stein, Tiel, Utrechtse Heuvelrug, Veendam, Veenendaal, Vlagtwedde, Vlist, Weert, Zutphen	1

Table 13: Number of addresses selected for the buyout regulation per municipality (TK II 2013/14, 31574, nr. 36, p.7).

Appendix H: The electromagnetic spectrum

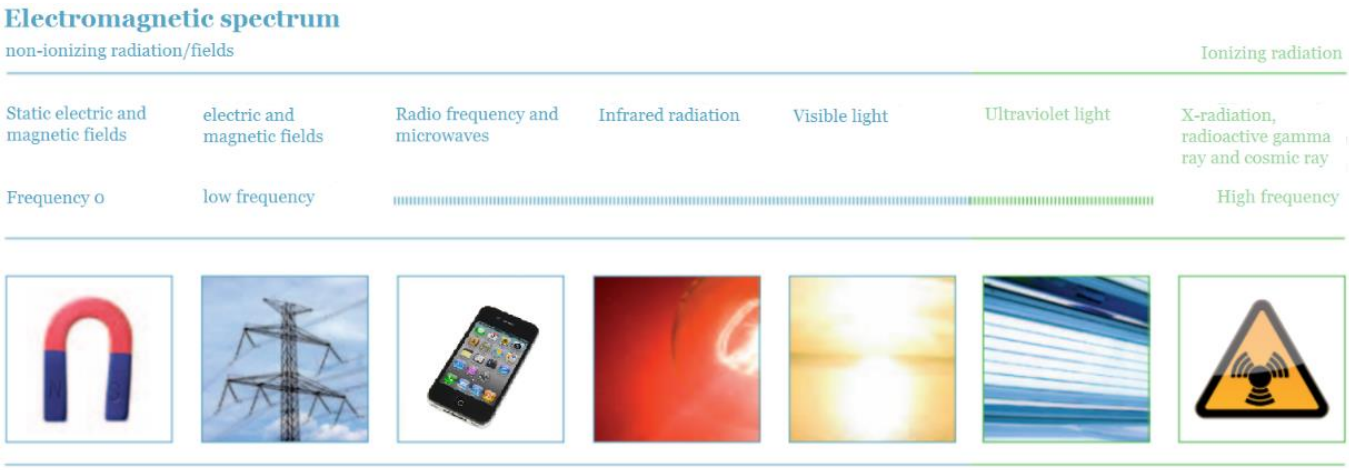

Figure 12: The electromagnetic spectrum (TenneT, 2012, p. 5).

Appendix I: Magnetic fields in daily life

Magnetic fields in micro Tesla

Device	(distance) 3 cm	30 cm	100 cm
 Electric shaver, trimmer, hairdryer	10-200	0,1-5	<0,3
 Microwave	10-100	1-10	<1
 Drill, circular saw, sander, vacuum cleaner, blender	10-100	0,5-5	<0,5
 Alarm clock	10-60	<0,4	<0,4
 Stove, cooker hood	1-50	0,1-5	<0,5
 Washer, tumble dryer, dishwasher	0,5-10	0,1-5	<0,5
 Reading lamp (halogen)	0,5-5	<0,5	<0,1
 TV (front side)	0,2-2	<0,5	<0,1
 Computer screen (front side)	0,2-2	<0,2	<0,1

Figure 13: Magnetic fields in daily life (TenneT, 2012, p. 6)