DELFT UNIVERSITY OF TECHNOLOGY

MASTER THESIS

# Acceleration of energy cooperation implementation on Dutch business parks in congested areas

## A comparative multiple case analysis

**Master thesis submitted to Delft University of Technology**

**in partial fulfilment of the requirements for the degree of**

**Master of Science**

**in Management of Technology**

**Faculty of Technology, Policy and Management**

**S.A. Wiesman**

**Student number: 4465709**

**To be defended publicly in Delft on 28 August, 2023**

| | | |
|---|---|---|
| First supervisor | Dr. ir. J.N. Quist | Energy and Industry |
| Second supervisor | Dr. T. Hoppe | Organisation and Governance |
| Chairperson | Dr. T. Hoppe | Organisation and Governance |
| External supervisor | L. Poldermans | Sweco |

TU Delft Delft University of Technology

**Monday 28th August, 2023**

# Acknowledgements

First of all , I want to thank my first supervisor dr. ir. Jaco Quist with guiding me through the iterative process of what a thesis project is. By giving feedback, and guidance, I was able to shape this thesis to its current form. An critical moment was the case selection. Switching from three quite similar cases to four more diverse cases yielded much more rich data, enhancing the outcomes of this study. If I needed clarity on anything, I could easily approach professor Quist and meetings could be scheduled quickly. Because of this, not much delay occurred, which I am grateful for.

I also want to thank dr. Thomas Hoppe for providing me with concrete and to the point feedback for my proposal and doing helpful suggestions.

Besides professors from the TU Delft, I would like to thank Sweco for giving me an opportunity to do my internship at a leading company in engineering consultancy. Specifically I would like to thank my supervisor Lisette Poldermans who always was available for anything I needed. Although I did not need much, she provided me with valuable contacts, which led to interviews I conducted. This was really helpful. I would like to thank all team members for the welcoming attitude that is present in the team.

As last, I would like to thank all interview respondents who immensely helped this thesis, for their time invested. Without them, this thesis would not have been possible.

# Executive summary

Currently, the energy transition is in full effect in the Netherlands, however, the problem of transmission congestion poses significant threads to this same energy transition. The fast rise of renewable energy sources, that are intermittent of nature, results in a transmission grid that is heavily strained. This problem is amplified by an increased electricity demand due to electrification of combustion processes. The consequences of this problem are far-reaching. For example, businesses cannot expand their electricity grid connection and thus cannot expand their business as they would like to. Also, many businesses cannot feed back their surplus generated energy. First, this situation wastes generated energy and second, it negatively influences the profitability of the companies' investments in renewable energy sources.

Many businesses share the above-mentioned problems. Business parks in particular are places where many businesses share these problems. Simultaneously, business parks are places where opportunities lie for solving individual businesses' congestion problems and beyond. Such solutions come in the form of energy cooperation, the cooperation of businesses and other relevant stakeholders to a business park on the topic of energy. Forms of energy cooperation go from collective purchasing of energy to an energy hub that serves as an important node in the regional energy landscape. The province of Overijssel houses two business parks that are in development of such energy hub.

The existing literature revealed there is a demand for research on the implementation on energy cooperation, where energy cooperation is seen as a sub stream of industrial symbiosis. Much research has been done on uncovering barriers for industrial symbiosis and energy cooperation, but little research focused on dealing with such barriers and the actual implementation of energy cooperation. Furthermore, usable and up-to-date methodologies for developing energy cooperation on business parks are almost non-existent. Besides the very thinly represented literature on energy cooperation in the Netherlands, no literature exists that combines the novel topic of transmission congestion with energy cooperation. Therefore, the main research question of this thesis study is:

*"How can implementation of energy cooperation be accelerated on four selected business parks in Overijssel dealing with transmission congestion, in order to support the Dutch energy transition?"*

To answer these questions, qualitative semi-structured interviews were used to collect empirical data. Four experts were interviewed, to carry out an environmental analysis that includes the key stakeholders and institutional context of energy cooperation in the Netherlands. The most influential stakeholders are the national government, the grid operators, the ACM, large companies and park managers. The institutional context most worth noting is the nitrogen crisis, the CDOKE regulation, Acceleration program Smart Energy Hubs and the Businesses Investing Zone. Next to the environmental analysis, a case study approach was chosen to answer the research questions, whereby four business parks were selected as case: Groot Verlaat in Steenwijk, Twentekanaal in Hengelo, Hessenpoort in Zwolle and A1 Bedrijvenpark in Deventer. The selection of cases happened along two dimensions: diversity of companies on the business park and whether a "Smart Energy Hub" is being developed on the park. Each case yielded three interviews with case-specific actors. In total, 16 interviews were carried out for this thesis project.

Subsequent to the case-data collection, a within-case analysis was carried out, where the results were structured along a conceptual framework based on Strategic Niche Management and factor categories as proposed by Rodin & Moser (2021). After the within-case analyses, a comparative multi-case analysis was carried out, where similarities and differences between cases were highlighted. Business park Hessenpoort proved to be a front-runner among the cases, as well in the Netherlands. Barriers, drivers and solutions for energy cooperation were structured along main and sub categories, whereby it became apparent that social/managerial factors appeared most frequent for most of the cases. The non-energy-hub parks yielded more park-specific factors than general factors. Energy-hub parks yielded more general factors. For all parks, barriers mostly originated from outside the park, whereas drivers and solutions mostly had a park-internal origin. Most influential actors for business parks are the companies, the park manager and municipality. However, case-specific actors expect a more active role from municipalities, the national government and the grid operator.

The most influential barriers for energy cooperation on business parks are existing knowledge gaps for businesses on laws and regulations, technical possibilities and possibilities. Furthermore, the current legal context obstructs businesses from exchanging grid capacity and the physical exchange of energy. Also, the lack of an organisational grade on a business park results in cumbersome development of energy cooperation. The fact that subsidies are hardly available for system innovations such as energy energy cooperation poses another important barrier. A significant driving factor for energy cooperation is the effect of transmission congestion and the energy crisis on businesses, as well as the economic benefits business achieve by participating in energy cooperation. Furthermore, large companies on business parks are driving energy cooperation by being an example. Also, a mandatory park management membership (BIZ) drives EC by increasing involvement and available capital.

Acceleration of energy cooperation can be achieved by establishing an organisational grade on a business park, together with large companies and municipality / province. Awareness should be created among businesses around transmission congestion and how participating in energy cooperation could relieve experienced problems. It is important that the park management collaborates with large companies and that their visions align. Furthermore, the business park should create clear plans for the future, which in turn can be assessed on feasibility by the grid operator. Businesses' needs, ambitions and (future) energy consumption are critical for these plans and should be assessed early on. When developing these plans, businesses should be informed about legal, technical and cooperation possibilities and solutions. Allocation of sufficient financial resources for the development of energy cooperation development is important as well.

Recommendations for specific actors entail that the national government should take on a more leading role in the energy transition, providing a clear vision, clear guidelines and policies, so that businesses are steered in the right direction. Such clear policies could include strict and rigorous measures. It is recommended to have more tolerant GDPR (AVG) policy, to stimulate quick energy consumption data sharing, leading to quicker energy cooperation development. For provinces it is recommended to use a bottom-up approach in supporting energy cooperation initiatives and to provide genuine subsidies without hidden drawbacks. The latter recommendation also applies to regional development agency OostNL. Grid operators should attract more human capital in order to account for the massive challenges they face in the coming years, and to support bottom-up energy cooperation initiatives. Municipalities should also use a bottom-up approach and support existing energy cooperation initiatives. Furthermore, municipalities should ensure they have clear vision and energy transition policy for the coming five years, so that businesses and business parks can anticipate.

# Contents

# List of abbreviations

| Abbreviation | Definition |
|---|---|
| ACM | Authoriteit Consument en Markt |
| AVG | Algemene verordening gegevensbescherming |
| BAL | Besluit Activiteiten Leefomgeving |
| BIZ | Business Investing Zone |
| BZK (Ministry) | Ministerie van Binnenlandse Zaken en Koningsrelaties |
| CDMC | Cooperation Development and Management Company |
| CDOKE | Tijdelijke regeling capaciteit decentrale overheden voor klimaat- en energiebeleid |
| CES | Cluster Energy Strategy |
| EC | Energy cooperation |
| EED | Energy Efficiency Directive |
| EIP | Eco-industrial park |
| EMS | Energy management system |
| ETP | Energy trading platform |
| EZK (Ministry) | Ministerie van Economische Zaken en Klimaat |
| Factor | Barrier or driver to EC |
| GDPR | General Data Protection Regulation |
| IS | Industrial Symbiosis |
| MOT | Master program Management of Technology from the TU Delft |
| NAL | Nationale Agenda Laadinfrastructuur |
| PVB | Programma Verduurzaming Bedrijventerreinen |
| RES | Regional Energy Strategy |
| RVO | Rijksdienst voor Ondernemend Nederland |
| SEH | Smart Energy Hub |
| SNM | Strategic Niche Management |
| SPUK | Specifieke Uitkering |
| V & E | Visions and expectations |

Table 0.1: List of abbreviations

# 1 Introduction

The energy transition creating it's own problems? The Netherlands is working towards its climate goals of 2030 and 2050, but prospects show that the goals of 2030 most probably will not be achieved (PBL, 2022). The energy transition that is needed to achieve those goals has created a problem that sabotages itself: transmission congestion. In large parts of the Netherlands, transmission grid congestion has become a serious problem. Overload of the transmission lines and transformers hampers the placement of renewable energy sources and the issuance of new electricity connections, for example in the Province of Overijssel (N. E. Overijssel, 2023).

Wind and solar power provide more and more of the Dutch electricity. Additionally, measures are taken to lower the use of fossil fuels for heating and mobility. More and more traditional gas powered boilers are substituted with electrical powered heat pumps and combustion cars start being substituted by electric vehicles. These developments result in the fact that there is an increasing demand for electricity. Also, there is a growing supply of intermittent electricity from renewable energy sources. Due to the latter developments, moments of extremely high electricity peaks emerge, a situation where the current electricity grid is not designed for. The installed cables in the grid are simply not designed for loads of this size.

As a result, already in 2019 the transmission capacity was not sufficient in three of the Eastern Provinces of the Netherlands (Groningen, Drenthe, Overijssel) for solar parks to be completed (NOS, 2019). The grid capacity could not handle the extra and intermittent supply of electricity, especially in lower populated areas, where - traditionally - demand for electricity has been relatively low. The latter resulted in the fact that the old installed transmission grid was designed for lower loads than that exist nowadays. Today, 4 years after the news article from NOS, the problem has only increased and expanded to other provinces (Friesland, Gelderland, Flevoland, Noord-Holland, Zuid-Holland).
Ultimate consequences of a "full transmission grid" can lead to outages of electricity and flickering lights (NOS, 2023a). Additionally, there exist waiting lists of companies and energy cooperatives that want to feed-in their generated electricity back to the grid. According to local grid operator Enexis, the growth of those waiting lists is higher than the rate at which the grid operator can expand the grid capacity by laying cables (NOS, 2023b).

Feed-in problems due to transmission congestion currently only apply to large-scale grid connections ( >3x80 Amperes). This means that households and businesses that have small-scale grid connections are currently not a victim of congestion problems and can feed back their produced electricity back into the grid. Businesses with large-scale connections however, cannot feed back their produced energy. Many practical examples show that transmission congestion is a significant bear on the road for entrepreneurs wanting to install renewable energy sources. In short, it can be said that current grid problems hinder the energy transition in the Netherlands. The firms that are obliged to or want to make the transition to sustainable energy are opposed by grid congestion. Additionally, due to waiting lists for new electricity connections, companies cannot grow and expand the way they would like to (Rooijers, 2023). The latter implies that the transmission problems indirectly and negatively influence the economic opportunities for companies that are located in congested areas.

Business parks hold a special case: an area where firms are located together that share the same problem. "Sharing" is the key word in the latter sentence, because sharing and collaboration between companies can be a solution to congestion problems. What if surplus energy can go directly from generation to a neighboring company in need of electricity? This would spare the transmission grid of the grid operator, and thus would allow for the placement of renewable energy sources, whereas individually, the firm would not have been able to place them. This practical problem and solution to this problem is the starting point of this research.

The collaboration of various commercial players within close proximity on energy exchanges in order to 1) reduce primary energy demand 2) increase firm's sustainability 3) generate economic benefits is called "Energy Cooperation", as (re)introduced by Rodin & Moser (2021). This term can be viewed a sub-stream of Industrial Symbiosis, focusing specifically on energy exchanges. Industrial symbiosis is often viewed as a sub-field of industrial ecology. A literature review showed that there is a demand for research that focuses on efficient implementation strategies for energy cooperation projects Rodin & Moser (2022). The authors of the study recommended to look into how successful implementation can be triggered by park-internal and third parties. Currently, there exists no particular literature on energy cooperation in the Netherlands. Also, no literature could be found that combines transmission congestion and energy cooperation or industrial symbiosis. These research gaps are utilized to define the objective of this research project. The main objective of this study is to find out how energy cooperation implementation can be accelerated on business parks in areas with transmission congestion.

This research project has been carried out in combination with a thesis internship at the engineering consultancy firm Sweco. In order to answer the main research question and generate data, interviews with multiple key stakeholders will be carried out. Interview subjects were collected via current projects of Sweco as well as their network. Due to the nature of active projects, this implies that interview subjects will be located in the Province of Overijssel.

This report is structured as follows. The first chapter will go into the research problem, relevance and objective. Chapter two covers the conducted literature review, highlighting literature relevant to this thesis. The third chapter will dive into the research design and methodologies used in this study. Subsequently, in Chapter 4, an environmental analysis is carried out. Chapter 5 will focus on the conducted cases studies and Chapter 6 will compare the cases in a comparative multiple case analysis. The seventh chapter will develop a methodology for energy cooperation implementation. Chapter 8 will discuss interpretation, limitations, contribution, relevance and future research. The second-to-last chapter, Chapter 9, will conclude the research project. Chapter 10 will give recommendations for specific actors.

## 1.1 Problem statement

### 1.1.1 Practical relevance

Section 1 highlighted the problem of transmission congestion. Upgrading the transmission grid is the ultimate solution, but the rate at which waiting lists for new feed-in connections grow is larger then grid operators can reinforce the grid NOS (2023b). However, there exist other and quicker solutions to these problems. One of them is exchanging (surplus) energy, generated by sustainable energy sources. Take for example the following situation: if a company with high electricity consumption is located next to a company with a large roof area, an exchange of energy between those companies can ensure that solar PV panels can be installed. Individually, the company with a large roof area could not have consumed all its generated energy itself, consequently having to feed the surplus energy back into the transmission grid. The latter is not possible nowadays, so individually installing PV panels would have been an unattractive choice for the company. Collaborating with neighbouring companies can turn the tide and ensure that in the midst of congestion problems, renewable energy sources can be installed, because these energy flows do not strain the electricity grid. For all collaborating companies, such configuration can lead to economical and sustainable benefits that could not have been achieved individually. This is one of many examples, others include: shared battery storage, collective wind turbine realisation, collective energy purchase, etc.

Business parks are a special case in the energy transition in the Netherlands. In the Dutch Climate Agreement, the word "business park" is mentioned zero times. This is fairly odd, because the potential for CO2 reductions on business parks could be as large as making residential areas gas free (TNO, 2022). Therefore, making business parks sustainable should receive a higher priority by governmental organisations (SolarMagazine, 2022). In the meantime, private initiatives for making business parks more sustainable are starting up, such as the national PVB program (Programma Verduurzaming Bedrijventerreinen ) that was started in 2022 (PVBNederland, 2022). Also, more regional initiatives emerge, such as Nieuwe Energie Overijssel, that assists companies and business parks in their energy transition (NieuweEnergieOverijssel, 2022). According to a project manager at PVB, collaborating is very important in energy projects between companies on business parks. Specifically, because for most companies, the energy transition is a secondary goal relative to their core business (SolarMagazine, 2022).

The emergence of above- mentioned initiatives shows upcoming importance of business parks and collaborative strategies in the energy field, in order to keep the build up momentum of the energy transition going. Additionally, in a orienting conversation with an expert on sustainable business parks, some interesting insights came along. 1) Politicians think to easily about collective energy projects on business parks. They think along the lines "Just make a flexible contract between grid operator and company, and you are done." In reality, it is not as simple as that (Employee consulting company, personal communication, March 13, 2023). 2) From experience, the interviewee knows that businesses want to collaborate on the topic of energy, the question is: how? It is difficult to determine the contract terms and ultimate objective of a collaborative energy project, certainly in the early phases of such project. In my opinion, these insights show that knowledge on the implementation of collaborative energy projects between businesses are more than welcome.

According to numbers of TNO (2021), in 2021 there existed around 3800 business parks in the Netherlands. Additionally, TNO (2022) indicate that the sustainable transition of all business parks in the Netherlands could reduce as much CO2 emissions as making all residential areas gas-free. If the latter would be true, the sustainable transition of business parks would be an important instrument for the Dutch government in reaching their climate goals.

Furthermore, current legislation makes sharing of energy data difficult. Although most of the times the needed energy data is available from companies, it cannot be shared on anti-competition grounds of the Electricity and Gas Law (Overheid.nl, 2021). Although most of the companies stimulate the sharing of data, it is simply not allowed (D'Agnolo, 2022). This makes realising energy cooperation projects even more complicated. Sharing energy data is an essential part of creating energy cooperation opportunities, thus finding ways around this problem is of great significance.

The novelty of the developments in making business parks more sustainable - especially in the light of transmission grid congestion - offers possibilities for consulting companies such as Sweco. Consulting companies are often asked to support the transition of a business park. Sometimes even the complete development is assigned to consulting companies. To gain a prominent position in reeling in projects, findings on the implementation of sustainable energy cooperation projects can be of great value to companies like Sweco.

### 1.1.2 Scientific relevance

Conducted literature review points out that literature on the topic of energy cooperation in business parks, especially in the Netherlands is poorly represented. In the light of the above described problem of net congestion, there is no literature available combining this problem with industrial symbiosis or energy cooperation. In general, cases studied in the literature are often not located in the Netherlands. Existing literature on energy-related industrial symbiosis and energy cooperation is mostly uncovering influencing factors. How to implement energy cooperation is a subject that is not much studied and is highlighted as direction for further research by Rodin & Moser (2022). These literature gaps are the starting point of this thesis project.

Therefore, the aim of this study is to contribute to the field of energy cooperation and energy related industrial symbiosis, by providing empirical findings on how to implement energy cooperation strategies on Dutch business parks.

### 1.1.3 Relevance to MOT

During the MOT program, the main goal was to understand how firms and organisations can use technology improve outcomes such as productivity, profitability, competitive advantage, customer satisfaction and sustainability. This research project is closely related to the latter, because knowledge will be developed about how firms can use energy and information technologies to achieve economic, social and environmental benefits.

This thesis consists of an analytical part as well, analysing the existing landscape around sustainable business parks, analysing barriers to energy cooperation and viewpoints of stakeholders. The complex nature of the investigated problem requires a multidisciplinary approach, where the disciplines of management, technology, finance and economics come together. The study takes place in the technological context where technological solutions are essential in achieving the desired outcomes, namely: finding ways around transmission congestion and achieving environmental, economic and social benefits on business parks.

Furthermore, the MOT program provided knowledge and practice on research methods (such as in the course "Research Methods") from which insights will be used in this research. Qualitative data will be collected with the help of interviews, whereby multiple perspectives on the matter will be collected. In several MOT courses and chosen electives (TPM959A, TPM408A, TPM414A, MOT1452) interviews were carried out as a means to collect qualitative data. The experience gained with carrying out these interviews will be used to collect qualitative data in this thesis. With the help of a framework based on scientific literature, these perspectives and findings from qualitative data collection will be analysed.

Electives I chose were in the field of entrepreneurship. I followed Corporate Entrepreneurship, Financing Technology Ventures and Idea to Startup, where a well-rounded perspective is gained on how entrepreneurs think, as well as investors. The topic of this research project requires stakeholders to think entrepreneurial: thinking in possibilities, not in barriers. Thus, the insights gained in these electives can contribute to a better empathy towards some of the interviewees, such as the business owners, in order to ultimately have a better understanding of the interviews.

In terms of managerial relevance, this study provides value to managers of businesses, park managers and facilitators managing energy cooperation projects on business parks. The findings contribute to understanding the barriers, drivers and solutions one can encounter while developing or initiating energy cooperation on business parks. The methodology developed in this study can guide managers in the process of developing energy cooperation, and will suggest actions that can be taken by managers in order to overcome encountered problems.

## 1.2 Research objective

In the literature, there is a demand for research on implementation of energy cooperation on Dutch business parks in areas with transmission congestion. This, due to the limited availability or absence of literature on energy cooperation in the Netherlands and implementation of energy cooperation in general. The link with the energy transition and novel problem of transmission congestion is not made in these literature streams. Therefore, the objective of this research is to determine how the implementation of energy cooperation can be accelerated on Dutch business parks in areas with transmission congestion.

### 1.2.1 Deliverable

The deliverable of this thesis consists of four case analyses, a comparative multiple case analysis and a methodology. In the individual cases, barriers, drivers and solutions to energy cooperation will be mapped for one business park. Consequently, the multiple case comparative analysis will compare the findings of the cases and yield similarities and differences between the cases. With the findings of the within-case and comparative analyses, a methodology will be developed for developers of energy cooperation, guiding them in accelerating the implementation on business parks.

### 1.2.2 Research questions

The main research question is as follows:

"How can implementation of energy cooperation be accelerated on four selected business parks in Overijssel dealing with transmission congestion, in order to support the Dutch energy transition?"

The sub-questions are the following:

1. What are the key stakeholders and institutional context influencing energy cooperation on business parks, what types of cooperation do exist and what is its significance to the Dutch energy transition in congested areas?
2. How do actors and factors constrain/enable energy cooperation implementation on business parks in congested areas?
3. How can barriers be circumvented and drivers be utilized in order to accelerate implementation of energy cooperation on business parks: which solutions exist?
4. How can the outcomes be merged into a usable method for developers of energy cooperation on business parks?

### 1.2.3 Focus

The focus of this research will be mainly determined by the available cases where energy cooperation has not yet emerged. There are a number of projects related to sustainable energy cooperation on business parks in the Netherlands. However, all of these projects have just started. The projects to be used as cases are situated in the province of Overijssel in the Netherlands. Focus will be on implementing sustainable energy cooperation projects on business parks, because the practical and scientific world shows a demand for developing knowledge on this topic.

As for the types of industrial parks presented in the literature, focus will be mostly on existing "mixed industrial parks" as proposed by Lambert & Boons (2002). Existing business parks are chosen, because these parks allow for better development of collaboration, as explained by Mainar-Toledo et al. (2022) in Section 2.1. Most of the Dutch "bedrijventerreinen" - the business parks that Sweco and the province of Overijssel focus on - can be characterized as mixed industrial parks, where mostly service-based companies are housed. In the existing literature, focus is mostly on industrial parks with heavier (process) industries, characterized as eco-industrial parks, thus literature on mixed industrial parks seems welcome.

To further delineate this thesis project, this research will only focus on electricity. This, because electricity transmission congestion is a problem that impacts the Dutch energy transition and energy cooperation on business parks could be a solution to it. Also, congestion appears to be a driver for energy cooperation in Overijssel. Making a contribution that can help relieve the transmission congestion problem and that consequently can help move the energy transition forward, seems like a goal worth striving for.

Furthermore, the thesis is limited to business parks with a park management in place. This, because these kind of parks are easier to approach and because insights from earlier research indicates that a existence of a park management is a success factor for energy cooperation (NCW & Nederlnad, 2021).

Finally, in terms of technical depth, this thesis project will stay on the surface. Technical possibilities will be evaluated along the functionality a solution brings. The technical details that are needed to understand the system and dynamics between stakeholders are considered, but further in-depth technical evaluation is outside the scope of this thesis.

# 2 Literature review

The second Chapter of this thesis will be a literature review. The literature review started off broad with search terms such as "industrial symbiosis", "sustainable business park", "eco-industrial park". After the practical problem became apparent, the focus of the literature search was narrowed down to energy exchanges only. The term "energy cooperation" was identified, which allowed the search to be further scoped. Furthermore, several typologies of industrial parks were found, which allowed the search for literature to be narrowed to "mixed industrial parks". In this process of narrowing the literature search, it became apparent that some subjects and search terms were not represented in the literature. The search terms used for this literature review can be found in Appendix A.1.

Some of these subjects include: industrial symbiosis or energy cooperation combined with transmission congestion. This could most probably be explained by the novelty of the problem of transmission congestion. Additionally, literature focusing specifically on energy related exchanges between companies (energy cooperation) in the Netherlands is almost non-existent. Furthermore, scholars identified that more research should be carried out on implementation of energy cooperation, which was indeed confirmed by the literature search. Also, literature linking the energy transition with energy cooperation or industrial symbiosis was thinly represented in the literature, especially for the Netherlands. The literature review below will review the most important terms, definitions and frameworks relevant to this research project.

## 2.1 Definitions

**Industrial Symbiosis (IS)**
Considering M. R. Chertow (2000) as a key article on IS, this definition of IS is highlighted. M. R. Chertow (2000) describe IS as the following: inter-firm exchanges of material, by-products, water and energy in order to achieve advantages that are greater than advantages that could have been achieved by individual efforts.

**Energy Cooperation (EC)**
Energy cooperation is the collaboration of two or more actors in an industrial park, that cooperate in multiple ways, such as energy exchanges in the form of electricity or heat, collective energy purchase, cooperative renewable energy plant operation. Also non-physical exchanges in the form of networking or joint organisation of various energy-related matters are part of it. All this, to reduce primary park energy demand, reduce costs and increase sustainability (Rodin & Moser, 2021).

**Types of parks**
As highlighted by Tellier et al. (2019), there can be made a distinction between different kinds of industrial parks, as originally published by Lambert & Boons (2002). The most common mentioned industrial park in the literature stream of industrial symbiosis is the before-mentioned "eco-industrial park". However, according to Lambert & Boons (2002), there exists two more types of industrial parks, being "mixed industrial parks" and "eco-industrial regions". Also, Lambert & Boons (2002) made the distinction between to-be developed and existing parks, "greenfield" and "brownfield" parks, respectively. Eco-industrial parks, eco-industrial regions and mixed industrial parks can all be categorized among these sub-categories.

**Eco-industrial Parks (EIPs)** According to M. R. Chertow (2000), eco-industrial parks are concrete realizations of IS. Anastasovski (2023) describes EIPs as "A community of businesses located together on a designated area in which companies try to achieve better environmental, economic, and social performance through working together in the management of environmental and resource problems.". Henriques et al. (2021) mention as well that a central authority may take the role of designer and manager in directing the several exchanges within the park. Neves et al. (2019) add that EIPs involve the use of sustainable energy sources. Lambert & Boons (2002) describe eco-industrial parks as " geographically concentrated industrial activities, mainly process industries, with tight couplings of a relatively small number of materials and energy intensive production processes.".

**Eco-industrial regions** According to Lambert & Boons (2002), eco-industrial regions are described as: "industrial activities in a larger geographical or administrative area, usually referring to a diversity of industries, but often with a definite specialisation."

**Mixed industrial parks** Lambert & Boons (2002) describe a mixed industrial park as a business park with lighter industries or solely service-based companies (mostly SMEs) with a diverse nature. Production processes are almost never coupled, this, because the businesses on the park are very diverse.

**Brownfield parks**
Brownfield projects refer to existing industrial parks or business parks that are being improved, and revitalised in order to accomplish reduction of environmental impact.

**Greenfield parks**

Greenfield projects refer to industrial parks or business parks that are being newly developed. With the design of such park, the reduction of environmental impacts is a main driver. In all stages of development of the park, ecological issues that arise are being addressed.

## 2.2 Background

**Industrial symbiosis**

It is stated that social relationships among actors can be improved and that it is not needed for the symbioses to happen within the limits of a park in order to be called industrial symbiosis. The authors present IS as a sub-field of industrial ecology, which is in turn a sub-field of the sustainability literature. However, is interesting to note that the term "circular economy" is not mentioned in this article, whereas Taqi et al. (2022), Domenech et al. (2019), Henriques et al. (2021) and Mendez-Alva et al. (2021) see industrial symbiosis through a circular economy perspective. In these articles, IS is presented more in terms of waste and material exchanges rather than naming other possibilities such as, energy or water exchanges. Also, some scholars suggest that firms should change their business models from linear to circular (Taqi et al., 2022), (Gregson et al., 2015). Neves et al. (2020), indicated that from all literature on industrial symbiosis 31 % was a case study and 48 % theoretical, so preferably future studies are in the form of case studies. Like stated earlier by Neves, 49% of case studies on IS originate from China, so future studies from Europe have the preference in order to maintain balance in the literature. In general, the reviewed literature has little focus on electricity exchanges, so I think that studies that do integrate electricity contribute to the literature on industrial symbiosis.

According to Mendez-Alva et al. (2021), 60% of energy-related IS cases represent heating and cooling exchanges, whereas 21% of the cases cover electricity synergies. The remaining cases are associated with alternative fuels and fuel gas. 21 % being electricity exchanges is not much and integration of renewables is even less common in the reviewed symbiosis cases. Butturi & Gamberini (2020) suggest that little integration of renewables in urban-industrial symbioses is caused by low maturity levels and high costs for storage solutions, due to the fact that storage is needed due to the intermittency of renewables and the differences in demand between urban and industrial areas. Except from Butturi & Gamberini (2020) and Grünewald et al. (2012), there was found no literature found including electricity storage in IS-related papers.

**Energy cooperation**

As presented by Rodin & Moser (2021), Rodin & Moser (2022) and Mainar-Toledo et al. (2022), energy cooperation is considered a distinct form of industrial symbiosis. This category covers synergies in the form of electricity exchanges, heat exchanges (e.g. heated waste water), steam exchanges, as well as collective buy-in of energy and collective investing in (sustainable) energy measures through cooperation among firms. Rodin & Moser (2021) give the following definition: "The cooperation of various industrial or at least commercial players within close proximity, ideally within the same industrial compound. Various forms of cooperation are possible, for example waste heat and other energy exchanges (physical cooperation), joint acquisition and/or operation of renewable power plants as well as networking on energy topics or joint organization of basic infrastructure or transport. The overall aim of each bilateral or multilateral cooperation should be to either directly or indirectly i) reduce the primary energy demand of the overall park, ii) increase its overall sustainability, e.g., in terms of reduced emissions and iii) ideally generate economic benefits for the companies, being also a driver for collaboration.". As mentioned earlier, non-physical exchanges such as exchanges of energy-related information on energy are also part of energy cooperation. Rodin & Moser (2022) for example, would have been more interesting if electricity storage integration had been included in the energy cooperation project, because the assumption is subconsciously made that surplus solar energy in the form of electricity can be supplied back to the electricity grid without any limitations (in Austria). In the Netherlands for example, quite some districts of the grid have suffer from transmission congestion, resulting in the fact that excess electricity cannot be fed back into the grid (Liander, 2022). Such limitations to the electricity grid exist in Austria as well (Enkhardt, 2022), so it is the question if these conditions are included in the paper of Rodin & Moser (2022). Such limitations have significant consequences for the installation of renewable energy sources and potential energy cooperation projects, because not being able to feed-in surplus energy to the grid will result in problems, technical and financial.

According to Mainar-Toledo et al. (2022), energy cooperation has the potential to reduce energy consumption and greenhouse gas emissions from the European industry sector. They give the following definition: "The mutualised generation, use and/or acquisition of energy by at least two companies." The authors do not include the condition that actors preferably should be located in the same industrial park. An important point mentioned by Mainar-Toledo et al. (2022) is that while “economically and environmentally desirable symbiotic exchanges are all around us”, attempts to “design and build eco-industrial parks” from scratch is less successful than building on already existing linkages between companies.". This indicates that improving existing industrial parks is more successful for realising symbioses than it is for newly developed industrial parks. The definitions of Rodin & Moser (2021) and Mainar-Toledo et al. (2022) were the only two definitions of energy cooperation that could be found in the literature.

**Information exchanges**

Although often not mentioned by scholars, I find information exchanges important to consider, as information sharing is frequently the first step to any symbiosis or synergy, which will be elaborated upon in the section about barriers. Ceglia et al. (2017) make the distinction for information transactions and indicate that this type of transaction is key for building trust among (potential collaborative) actors. Trust among (potential) symbiosis partners is often mentioned as a key driver for successful energy cooperation or industrial symbiosis (Lambert & Boons, 2002), (Susur et al., 2019), (Domenech et al., 2019), (Eilering & Vermeulen, 2004), (Pyakurel & Wright, 2021).

**Development phases**

Rodin & Moser (2021) present seven phases of energy cooperation on business parks. The phases are divided in stages and actions. The performance of an action leads to a next stage, until energy cooperation is implemented and in operation. The following phases are addressed:

- **Stage 1:** Status quo. In this phase, energy cooperation does not exist on the business park.
- **Action 1:** Generation of interest. In this phase, interest is generated from potential participants of energy cooperation on the business park. It is not indicated which party generates interest.
- **Stage 2:** Will for investing and cooperation. At this stage, interest is being generated and parties on the business park are willing to to invest and collaborate in an energy cooperation initiative.
- **Action 2:** Investigation / Data acquisition on inefficiencies and partners. The willingness to cooperate and invest is existent, now can be investigated what inefficiencies are and which parties can become partners. This is done by the acquisition and analysis of energy data.
- **Stage 3:** Knowledge of inefficiencies and EC opportunities. By now, the analysis of energy data from interested parties is completed and it is known in which areas gains can be made in terms of energy efficiencies. Also, it is known which specific opportunities for cooperation exist.
- **Action 3:** Investment analysis and intervention implementation. At this phase, the different opportunities are being analyzed in terms of investments. After this decision has been made, the intervention(s) are being implemented and realised.
- **Stage 4:** EC implemented and in operation. After the interventions have been realised, energy cooperation is now operational.

Golev et al. (2015) present five phases of industrial symbiosis projects. Although mostly focusing on waste-exchanges and bigger industries, rather than mixed industrial parks, I think this typology is valuable to be able to easily detect the phase the IS project is in. Especially when talking about barriers to IS, as will be later. The following stages are addressed:

- **Stage 1:** not recognized. This stage indicates that the idea of IS is not (yet) understood locally. However, there is a chance that eco-efficiency initiatives could be developed at the corporate or site level.
- **Stage 2:** initial efforts. This stage demonstrates improvements in industries' comprehension of the significance of environmental activities, especially the requirement for improved cooperation between various businesses. Some synergy initiatives may already be in place, or at the very least, some businesses are aware of the potential for positive waste reuse. However, unless there is an immediate need from the sector or a clear regulatory mandate, there are still considerable obstacles to implementing these initiatives.
- **Stage 3:** active. The third stage represents a turning point in the development of IS. There is evidence of prior successful collaboration across the industries, and there is a rising interest in doing so. An inter-industry organization or some such mechanism for inter-industry communication is currently in place. At this point, the development of IS may have progressed over a number of years, including the execution of new synergy initiatives, while a number of additional chances are being looked into.
- **Stage 4:** proactive. The local IS can be considered developed when it reaches the fourth (proactive) stage. It is common practice to conduct a thorough examination for new synergy prospects, and to continue looking for new projects. All of the relevant parties and industries in the area have effective and ongoing communication and information assistance. A regional industrial development strategy has been adopted and is being actively supported. This strategy includes long-term initiatives to further reduce the associated environmental impacts.
- **Stage 5:** forming the future. The situation where the industries and all other stakeholders in the area are able to create the desirable (sustainable) future through ongoing collaboration and trust is described as the highest stage of IS maturity. The primary force behind and objective of regional development are the long-term prospects and advantages achieved through industrial symbiosis.

As for relevance for this research project, the choice has been made to use the phases proposed by Rodin & Moser (2021). The first reason for this is that these phases are specifically focused on energy cooperation, as the stages proposed by Golev et al. (2015) are suitable for energy cooperation in general. Furthermore, the phases from Rodin & Moser (2021) are deemed clearer and mored distinctive compared to the other stages. The stages proposed by Golev et al. (2015) seem

somewhat multi-interpretable: "inter-industry", does that mean between companies, between clusters of companies or between industries industry type? The phases proposed by Rodin & Moser (2021) are segmented into phases and actions. Specifically the proposed actions are deemed useful, because such action very specifically display the activities that could be carried out in energy cooperation. With these phases, comparing the phase of energy cooperation for different business parks becomes understandable and clear. Below, a visual representation of the phases as proposed by Rodin & Moser (2021) can be seen.

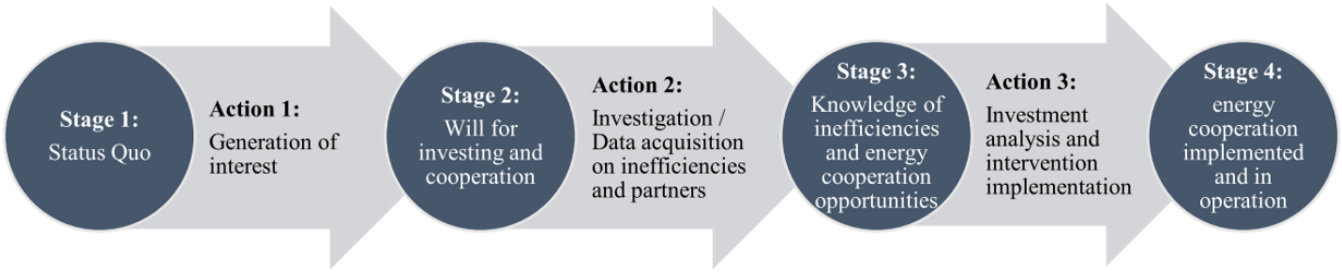



Figure 2.1: Different phases of energy cooperation on business parks, as proposed by Rodin & Moser (2021)

**Roles of actors in industrial symbiosis emergence**

Mortensen & Kørnøv (2019) wrote a paper on critical factors the the emergence of industrial symbiosis. In their analysis, they also incorporated roles of actors in this emergence process. Although this research project focuses on energy cooperation, the roles proposed for IS emergence are deemed relevant, as the emergence of IS and EC are comparable processes.

**Bridging actor**
A bridging actor plays a significant role in the emergence of IS, as they facilitate connections between partners to foster mutually beneficial relationships. Bridging actors can act as mediator between businesses and a facilitating actor and their influence is most beneficial in the initial stages of industrial symbiosis emergence (Mortensen & Kørnøv, 2019).

**Champion**
Champions, within the context of this research, are distinguished leaders knowledgeable in local society and culture, and experienced in industrial innovation. They are critical for the success of IS, as they connect different projects and stakeholders, and foster local support through a bottom-up approach. They cultivate social relationships and propagate their vision of symbiosis (Mortensen & Kørnøv, 2019).

**Facilitator**
Facilitators, employ more formal structures to foster interaction opportunities. They coordinate stakeholders' communication, manage relations, and moderate exchanges. By offering a nurturing environment for innovative ideas and securing regional funding, they play a key role in the collaborative process of IS and in the network formation. Their high level of engagement is vital for successful emergence of industrial symbiosis (Mortensen & Kørnøv, 2019).

**Organizational origin of industrial symbiosis**
Domenech et al. (2019) make a valuable contribution to the literature in my opinion, because I think the organizational origin is key to the development of industrial symbiosis projects. Their combination of desk-research and qualitative data collection classifies organisation of industrial symbiosis projects in three distinct groups: self-organised, facilitated and planned. In self-organised IS, firms or industrial players organised the synergy themselves. In facilitate projects, a third party or external facilitator arranged the symbiosis between actors. As last, planned industrial symbiosis activities are characterized by the fact that such activities are planned beforehand and coordinated along a central, top-down vision.

## 2.3 Influencing factors: barriers and drivers

There exists a vast amount of literature on drivers and barriers to industrial symbiosis. Most of this literature is focused on industrial symbiosis and not specifically on energy cooperation. However, as Rodin & Moser (2021) proposed, energy cooperation is a subarea of industrial symbiosis, the difference is the specific focus on energy. Barriers and drivers from industrial symbiosis literature are included only if these are relevant to energy cooperation. Some drivers and / or barriers only apply to certain forms of exchanges such as waste or material exchanges, thus are excluded.

**Barriers related to energy cooperation / energy-related industrial symbiosis**
With respect to barriers related to energy-specific activities of IS, Rodin & Moser (2021), Rodin & Moser (2022), Grünewald et al. (2012), Henriques et al. (2021) and Mainar-Toledo et al. (2022) provide valuable information. Rodin & Moser (2021) conclude from doing workshops and conducting interviews that energy cooperation barriers are not related to technical barriers and that barrier-types with most impact are social barriers and information barriers. This is validated by Henriques et al. (2021), where social barriers in the energy sector have most presence. Mainar-Toledo et al. (2022) conducted a combined literature-interview study on European industrial parks and concluded behavioural, social, cultural, organizational and historical barriers have most impact. To put it under my own typology of barriers: social and managerial barriers combined with a few geographical barriers. In terms of including storage into energy related projects, Grünewald et al. (2012) indicate that economic and financial barriers weight heaviest, because interviewed firms prefer others to take the (financial) lead. Though this study is from 2012 and in the meantime much has changed considering storage technologies and related costs, so it it the question if this finding still holds today.

**Types of strategies / recommendations to overcome energy-related barriers**
In order to overcome the proposed barriers for energy-related industrial symbiosis or energy cooperation, several strategies or recommendations were given by scholars. As explained in Section 2.3, social and managerial barriers combined with information barriers have most impact on the development of energy cooperation. Rodin & Moser (2021) indicate that (local) governments may be important in taking the role of gathering data and connecting firms. Furthermore, those governmental parties could act as neutral mediators to maintain track of difficult discussions and the sharing of data among companies. More or less the same is proposed by Rodin & Moser (2022), stating that external facilitators should identify customized solutions and that park managers should take the role of neutral mediator. The latter is also proposed in the framework by TNO (2016), where a park manager is the mediator between firms in the park and external parties. Rodin & Moser (2022) conclude that without continuously looking for energy cooperation possibilities, done by an external facilitator, a lot of projects wouldn't even have begun. Taking this into perspective, the recommendation would then be to ensure the park manager (or any other third party) is actively taking this role. These recommendations take a quite local perspective, whereas scholars such as Domenech et al. (2019) take a more zoomed-out perspective focused on policymakers. Although not specifically true for energy-specific symbioses, M. Chertow & Ehrenfeld (2012) suggested that for successful transformation to an eco-industrial park, it is important to ensure that companies in the park share the same norms and values. I think this finding can be applied to energy related symbioses as well. Although sounding obvious, with regard to overcoming social barriers, M. Chertow & Ehrenfeld (2012) indicate that actors with same levels of willingness to cooperate should be connected and that firms should have an open attitude. Ultimately, what seems to missing in the existing scientific literature is a detailed approach on how to overcome barriers. Recommendations stay on a high level, uncovering barriers, but it is not known how should be dealt - and by whom - with those barriers.

## 2.4 Frameworks for analysis

In order to analyse the findings of this thesis study, it is necessary to have a framework. The theoretical framework connects findings to existing literature. Also, Sekaran & Bougie (2009) state that a theoretical framework is the foundation on which a research is based and that it is essential to examine the problem that is being investigated. It is important to mention that the ultimate objective of this thesis is to develop a methodology. However, also a framework is needed for analysis of the findings. The to-be-developed methodology and analysis framework are two separate things. In order to have a suitable framework that can be used for the analysis of qualitative findings, existing frameworks are being reviewed in this Section. It should be noted that due to the limited availability of literature on energy cooperation implementation, not many frameworks could be found. Therefore, also some methodologies are included. This distinction will be clearly made.

**Framework of Susur et al. (2019)**

In their article Susur et al. (2019) apply a strategic niche management perspective on transitions from traditional industrial parks to eco-industrial parks. The study resulted out of the observation that many developers of industrial parks still develop traditional industrial parks, instead of the sustainable variant: eco-industrial parks. It is not specifically specified on what type of industrial park the researchers focus, though it shines through that focus is more on the heavy (process-based) industrial parks than on the lighter "mixed industrial parks". This article uses insights from literature streams of Sustainable Transitions and literature streams about Strategic Niche Management. Seeing eco-industrial parks (EIPs) as niches, the authors aim to learn from reviewed EIP cases. How can EIPs transition from a niche to mainstream?

The proposed framework distinguishes three processes of SNM that are key to understand and analyse EIPs as niche experiments. Ultimately, local projects are seen as EIP experiments, where local projects transition to global niches and from global niches to EIP development becoming the mainstream form of industrial park development. Additionally, the processes can be used to understand the continuation of regular industrial park development. These processes are:

- **Articulation of expectations and visions:** mapping motivations of stakeholders in order to identify expectations,

which in turn establish the foundation for engagement between stakeholders. Expectations influence both the learning process and niche protection.

- **Building of social networks:** networks develop platforms for dialogue between stakeholders and promotes learning
- **Learning activities:** which alter routines linked to the socio-technical system subject to transition. Learning activities also support the impact of niche experiments.

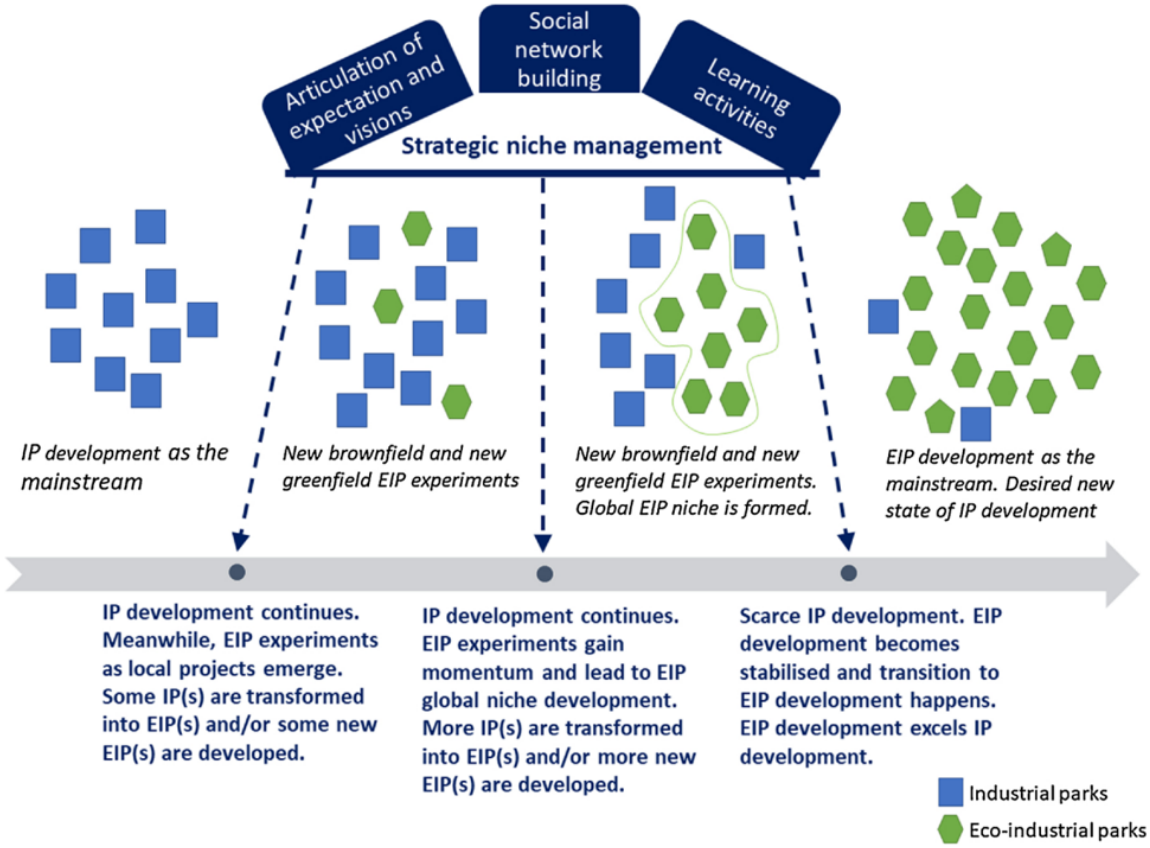



Figure 2.2: Schematic of framework developed by Susur et al. (2019)

Important to consider is the methodology of the study by Susur et al. (2019) and how their proposed framework came into existence. Based of findings resulting from the review of a multitude of EIP cases, the nature of the proposed framework is evaluative. A careful selection was made of materialised EIP cases and EIP cases that were in the phase of ideation or planning were excluded. This means that the proposed framework of Susur et al. (2019) is most usable as a method to evaluate existing and materialised EIP cases, and that it is not that suitable to review EIP cases that are in a planning stage. Further more, the used cases that are evaluated are distributed globally, with the largest part concentrated in the EU and UK.

**Framework of Eilering & Vermeulen (2004)**

Eilering & Vermeulen (2004) proposed a framework for analysis of "success factors" (drivers) for existing, front-running eco-industrial parks. The framework includes perspectives from natural sciences, industrial ecology, business administration and policy studies. An important statement made by the authors is that the absence of a specific success factor (driver) can imply a failure factor (barrier). The specific definition of type of eco-industrial park is not specified and is kept as broad as possible. The framework is based on a conducted literature review and progresses from the ambition of industrial park developers, via proposed measures, to performance (actual performance of the eco-industrial park) and identifies five factors influencing the process from ambition to performance. The authors specify three levels of ambition. A low level indicates that proposed measures are focused on individual firms. Proposed measures for an average ambition level are targeted on utility sharing. A high level of ambition indicates that proposed measures consist of realization of symbiosis and utility sharing. The five factors influencing the process from ambition to performance are:

- Vision of sustainability
- Location-specific features
- Business-specific features
- Policy instruments
- Organisation of decision-making

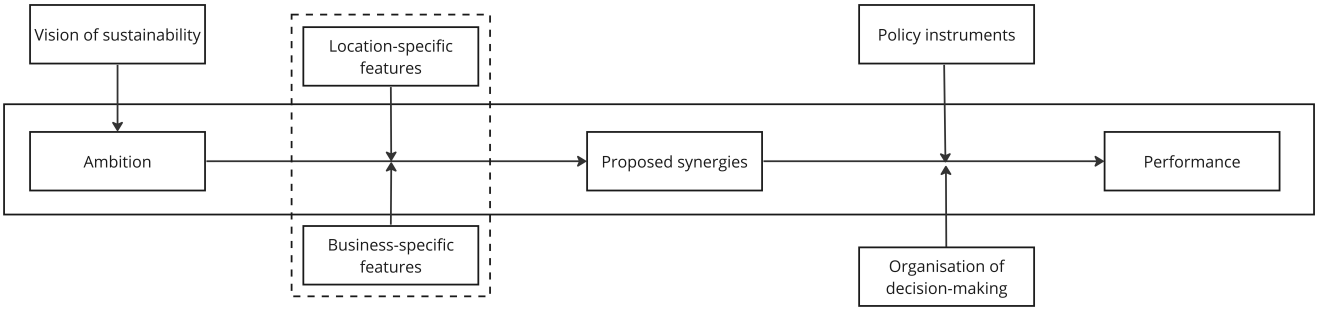



Figure 2.3: Schematic of framework developed by Eilering & Vermeulen (2004)

The performance of industrial parks is impacted by the location-specific characteristics of the industrial park and the specific characteristics of the businesses in the industrial park. These in turn influence the kinds of measures that can be implemented. To guarantee that the suggested solutions are implemented, policy tools may be used. The way the decision-making process is structured has an impact on every step of the conversion of ambition into success via the suggested measures. The framework is used to analyse eight cases, in 2004 being the most advanced industrial parks in the Netherlands in terms of symbiosis and utility sharing. The selected cases seem to be mixed industrial parks, with most companies being service oriented and / or lighter industries. For this framework it is important to consider that the framework is looking in retrospective. Something can be said about performance only if proposed measure have been realised.

A revision of the framework was proposed by Valladolid (2021). In his thesis, Valladolid gathered new data about influencing factors for industrial symbiosis implementation. Apart from the existing influencing factors, two were added: economic features and external context. The study by Valladolid (2021) highlighted the importance of a business case, which implies that firms will not implement synergies or exchanges if such project is not profitable. It is place between proposed measures and performance, because a potential synergy is not necessarily profitable, thus firms might not necessarily implement the measure that ultimately leads to performance. The study by Valladolid (2021) also highlighted the importance of external context for synergy projects. Market conditions, public opinion, human capital and the importance of sustainability perceived by society are all uncontrollable factors that do influence implementation of industrial symbiosis. Additionally, findings showed that the policy instruments do not only influence how proposed measures lead to performance. Policy instruments do also influence firm's decisions about sustainability and industrial symbiosis (e.g. compliance to emission limits). As well, a certain type of policy instrument - a facilitator - was found to influence proposed measures, because facilitators can propose new project ideas. The revised framework can be seen below.

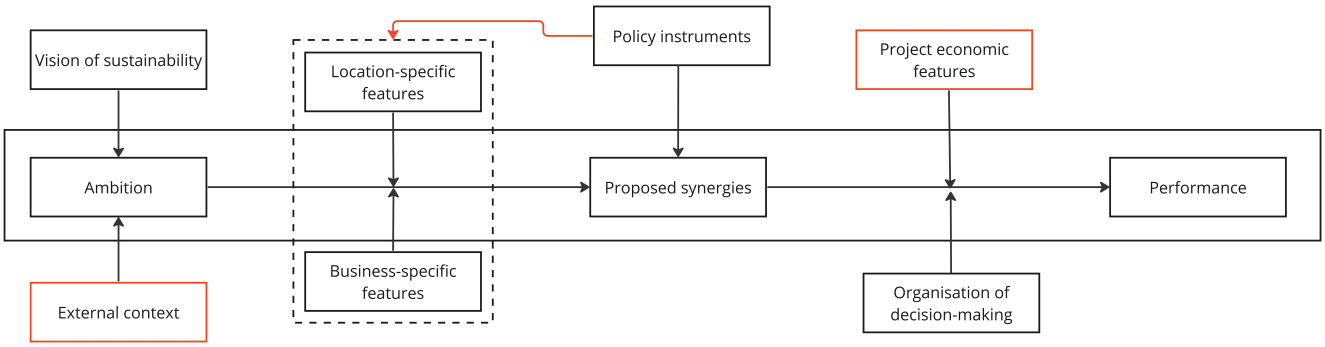



Figure 2.4: Schematic of framework from Eilering & Vermeulen (2004), revised by Valladolid (2021)

**Methodology from TNO (2016)**

In 2016, the Dutch research and consulting organisation TNO proposed a method to guide park managers or business associations of business parks in starting up sustainable energy measures on their park (TNO, 2016). It is not designed as a framework for analysis, but more as a They start with the need for a park management organisation, because they see the existence of such organisation as a key to success for realising sustainable energy measures on business parks. The park management organisation should support business for a longer period of time, while also being approachable for the entrepreneurs on the park. The goal of such park management organisation should be to help the businesses with realising sustainable energy solutions.

This methodology focuses on industrial parks without heavy industries, the "mixed-industrial parks" as in the industrial symbiosis literature, the typical Dutch business parks. The method works along six main steps, with a total of 19 sub-steps. The main steps are: organisation, demand, plan of action, preparation of solutions, defining solutions, execution.

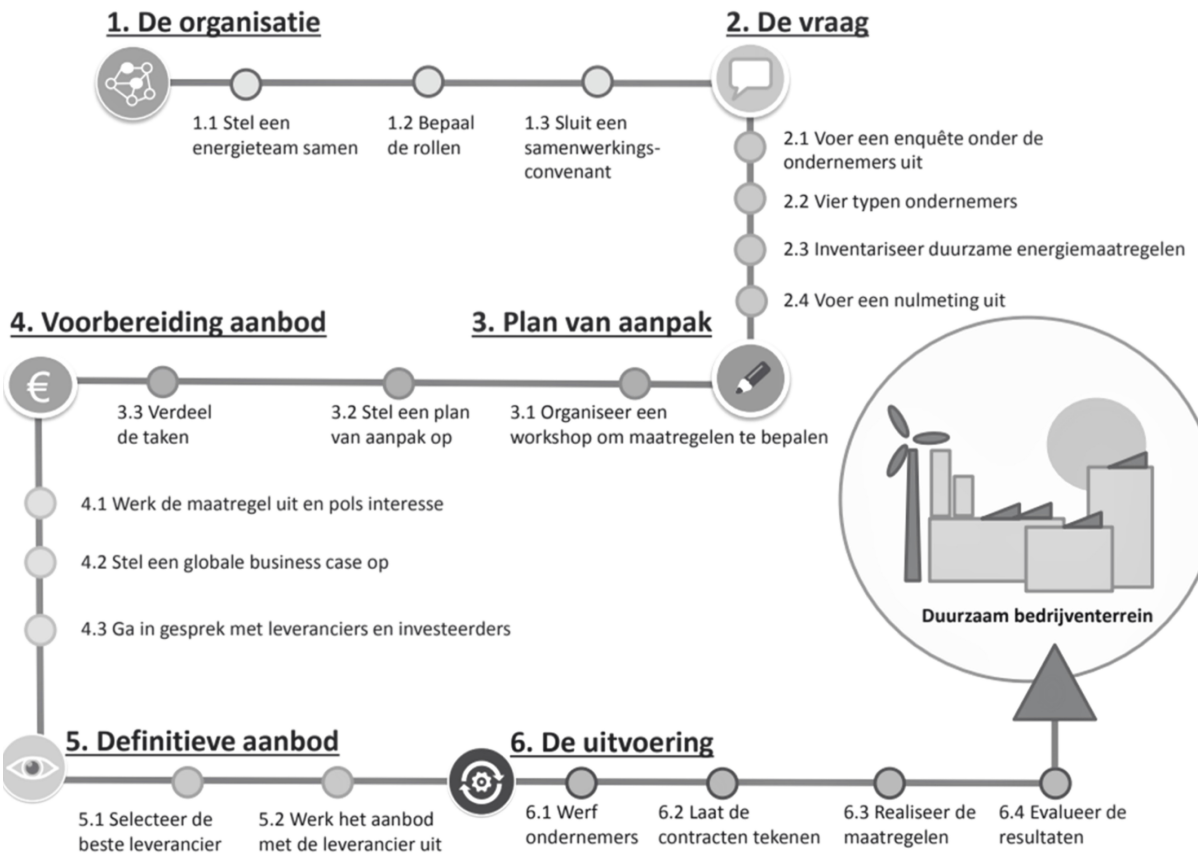



Figure 2.5: Schematic of framework developed by TNO (2016)

The organisation step (Step 1) is about forming an "energy team" with enthusiastic business owners and other relevant stakeholders. The goal of this team is to select the best solutions, cooperation with a proposed solution and gathering financial support. Roles are being divided among the members of the team and a cooperation covenant is being singed to ensure cooperation between the members of the team. This does not necessarily mean that members of the team will cooperate with energy, but for now at least cooperate in their roles of the energy team.

The second main step is about determining what business owners want and what drives them. They start with carrying out a survey under business owners to determine type of business, type of entrepreneur (four types according to TNO) and the sustainable energy measures that business owners already have. Business owners can be categorized as "the calculator", "waiting for a chance", "the pioneer" and "the societal concerned". Also in step two, a baseline measurement will be carried out that collects energy usage data and information about grid connections in order to map the energy usage of the park.

The third main step focuses on creating a plan of action. The goal of this step is to quickly realise energy measure in order to create enthusiasm and to broaden the platform for larger steps. Measures will be proposed on the basis of the demand of business owners. This will be achieved by organising a workshop, creating a concrete plan of action and dividing tasks among the members of the energy team.

Step four prepares a proposal where the proposed measures and business case of the previous step are worked out in more detail. Park management or the energy team will make the proposal and will approach other business owners on the park to probe interest. Potential suppliers and investors are being approached for and a global business cases is being worked out. The business case will also into different financing options.

In the fifth step, the proposal will be finalized. The best supplier of equipment and services will be selected with the help of a tender. A contract between park management and supplier will be signed. In turn the proposal will be worked out in more detail together with the supplier, in order to qualify for the demand of the business owners.
The last step will execute the plans made in the previous steps. With the final project plan, the business owners on the park that are not in the energy team will be approached to ensure more business owner will participate with the proposed measures. When a final selection of business owners is made, contracts will be signed. Then, the final proposal will be realized and equipment will be installed. After realization, results and the course of the project will be evaluated.
Related to energy cooperation, the order of the above-mentioned step seems not logical. With energy cooperation projects,

the outcome of a business case is dependent on the number of participants in that cooperation. Approaching additional firms after a final business case is proposed seems therefore not the right order and approaching additional businesses should come earlier in the process. Although the framework guides the facilitator in a detailed way, some key parts seem to be missing in the light of present-day energy cooperation in congested areas.

To start with, the framework is from 2016, however in 2018 the European Privacy Law has come into effect, which has also has influence on the sharing of energy related data. Sharing of energy related data is key in identifying possible symbiosis opportunities between companies. As explained by D'Agnolo (2022) in Section 1.1.1, companies often want to share data, but it is simply not allowed. A step in the framework dealing with this particular problem would be beneficial. Second, it does not become clear if the collaborating companies should raise a legal entity for their cooperation. If the latter is the case, it is also not clear which legal entity would be most suitable and why. The importance of a legal entity was raised by an expert on sustainable business parks (Employee consulting company, personal communication, March 13, 2023). Third, it could be that the business park houses some multi-national companies with decision makers located elsewhere then on the business park. This could have a hampering influence on the first steps of the framework.

**Methodology from Pyakurel & Wright (2021)**

Pyakurel & Wright (2021) proposed a methodology that can be used by a "Cooperation Development and Management Company"(CDMC), to promote mass implementation of energy and resources cooperation. Project facilitation by an CDMC is advised in order to overcome trust, policy and regulatory, technological and managerial barriers. The methodology is based on literature review and group discussions with Dutch, UK, French and Belgian companies that are participating in the EU-funded "Port Energy and Carbon Savings" project.

The first step of the method is project conceptualization. Here, the identification of potential energy cooperation projects takes place, as well as the identification of stakeholders that potentially can benefit from such projects. As the second step, the financial, technical, legal, institutional and social feasibility will be checked. Next, a project execution plan should ensure that the project is build, operated and maintained. Also, roles and responsibilities of the involved stakeholders should be determined. Project financing and division of (potential) profits are part of the third step as well.

Because lack of trust has been identified by Pyakurel & Wright (2021) as a barrier to energy cooperation, a security and risk management step is added to the method. The aim of the step is to ensure that set agreements are being sticked to and to have a plan for the situation where participants fail execute the agreed commitments. All of this should be fixed in a legal contract, signed by all participating companies and other stakeholders. This step should be done in parallel with the project execution step. After the latter two steps are completed, the cooperation project can be realized and actually be implemented. After a few years of operation, the projects should be evaluated in order to determine the success of the project. Three levels of success are named: environmental benefits realized by the project, sustainability of the project and financial benefits. In their article, Pyakurel & Wright (2021) call for research on the design and planning of energy and resources cooperation by analysing existing projects.

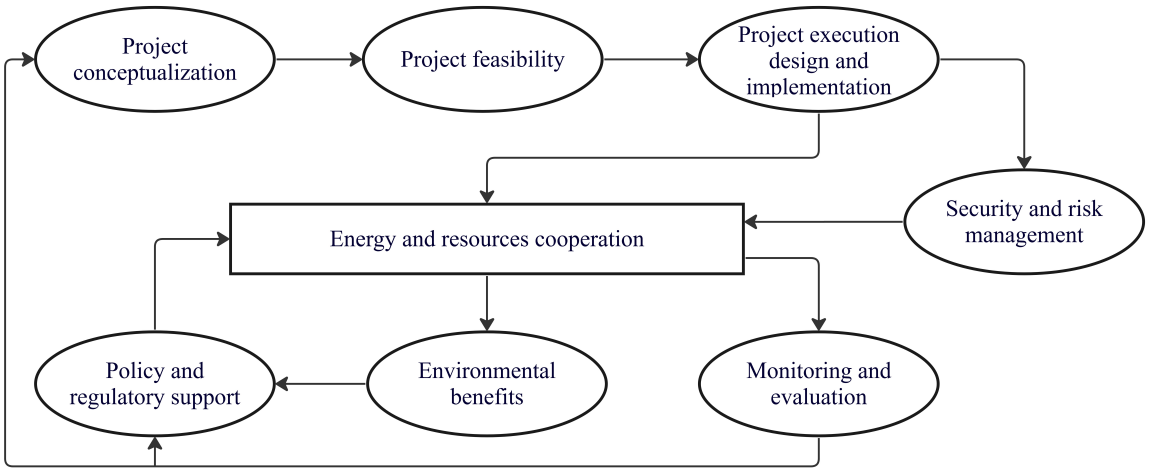



Figure 2.6: Schematic of framework developed by Pyakurel & Wright (2021)

The nature of this framework is very similar to the framework proposed by TNO (2016), it is only less detailed. Although the framework proposes logical steps, the high-level approach seems to be not that suitable for specific energy cooperation projects on business parks. For implementation of energy cooperation, context is of great importance. This framework

does not take into account context-specific features of companies that could influence the implementation of energy cooperation. Also, it is not clear how the framework deals with barriers encountered on the way to implementation.

## 2.5 Conclusions of literature review

### 2.5.1 Research gaps

The main research gap that was found and that matched the practical problem identified was proposed by Rodin & Moser (2022): more research should be carried out on how energy cooperation can be triggered and implemented. The carried out literature search yielded the same finding. Much of the literature on energy cooperation and industrial symbiosis is focused on uncovering drivers, barriers and influencing factors. However, how to deal with those barriers and drivers is often not in the scope of those studies.

Moreover, the literature search yielded another under-studied area. Energy cooperation or energy related industrial symbiosis in combination with transmission congestion. Literature combining these subjects is non-existent. The congestion problem can be an important driver for exchanges of electricity, because firms are not allowed to sell back their surplus energy to the grid. Furthermore, literature on energy cooperation in the Netherlands is thinly represented.

### 2.5.2 Framework / methodology evaluation

Scientific frameworks and methodologies were reviewed in order to evaluate the usability as an analysis framework for the findings from the data-collection, which will be explained in Section 3. In Section 2.6, insights of the frameworks and reviewed literature will be combined in order develop a usable analysis framework for this thesis. The framework proposed by Susur et al. (2019) is evaluative in nature and can in its original form only be used to evaluate existing cases of (eco) industrial park development. The framework proposed by Eilering & Vermeulen (2004) is used to identify success factors in the development of eco-industrial parks and is also evaluative, which means the full framework can only be used for completed developments of eco-industrial parks. Valladolid (2021) made a revision of the latter framework and added two influencing factors. The methodology from TNO (2016) is detailed and seems like a good guide in developing energy projects on business parks, but seems less suitable as an analysis framework. However, for analysis the categorisation of business owners seems valuable, because every type acts different. Nonetheless, the framework is not fully up to date. The effect of congestion is not included and sharing of data is difficult currently, something the framework does not cope with. Also, an interview with an expert on sustainable business parks highlighted the importance of forming a legal entity between cooperation partners. The latter is not included in the method from TNO. Pyakurel & Wright (2021) proposed a methodology that is fairly similar to the framework from TNO, it is only much less detailed. Due to this high-level approach, the usability of this method for specific energy cooperation projects on business parks seems somewhat limited. Nevertheless, the iterative nature of this framework seems usable, because in practice, no project progresses in a straight line from start to end.

## 2.6 Development of analysis framework for this study

Based on the reviewed literature and evaluation of the frameworks and methodologies, a conceptual analysis framework is chosen and the needed additional theory will be highlighted. The analysis framework will be used to analyse and structure the findings of the qualitative data collection. Eventually, with these findings, a methodology will be developed, but the framework discussed in this Section is not related to the to-be-developed methodology, and only meant as a way to analyse and structure findings.

The novel nature of energy cooperation on business parks in congested areas in combination with selected cases, results in the fact that it is not possible to review and evaluate completed cases of energy cooperation on business parks. For the to-be-reviewed cases, energy cooperation projects have not started yet or are in the early stages, as can be read in Chapter 5. The reviewed frameworks and methods from Susur et al. (2019), Eilering & Vermeulen (2004) and Valladolid (2021) from Chapter 2.4 are used to evaluate existing cases of industrial symbiosis and energy cooperation. The method from TNO (2016) is more of a project execution methodology, and is not suitable to map influencing actors and factors for energy cooperation in the energy transition.

In order to have a clear picture of what EC entails, which actors are involved, what barriers and solutions exist and what can be learned from those, the strategic niche management framework from Susur et al. (2019) is considered suitable. In their research, Susur et al. (2019) use the framework to map the process from eco-industrial parks (EIPs) as a local niche to eco-industrial parks as global mainstream. Local EIP experiments progress from local projects to global niches and ultimately from global niches to global EIP development as mainstream. What is currently happening in the Netherlands with energy cooperation in the light of the energy transition, can be viewed as a similar process, going from non-EC business parks to business parks with energy cooperation. The only difference is the scale. In the case of energy cooperation

in the light of the Dutch energy transition, local EC projects can be seen as niche experiments that progress to national niches and eventually to energy cooperation on business parks as mainstream in the Netherlands. The schematic of the proposed framework can be seen in Figure 2.7.

The framework from Susur et al. (2019) is originally used to evaluate existing cases of EIPs and to learn from completed cases. The latter is not possible, because none of the to-be-reviewed cases is a completed case of energy cooperation. Energy cooperation on business parks is a novel phenomenon and the novel problem of transmission congestion is added to the equation. Though, it is argued that this framework also can be used for cases in the developing phase. To move regular business parks to energy cooperation business parks, one should first learn about the barriers and solutions, before being able to successfully implement energy cooperation. Therefore, for this research project, emerging EC projects are conceptualised as strategic niche experiments, where knowledge is gained about existing problems and barriers to energy cooperation parks in congested areas. Also, proposed solutions to those barriers will be part of the learning activities.

The findings of this thesis can be put under the three "interrelated and mutually reinforcing" processes (Susur et al., 2019) of strategic niche management, being:

1. Articulation of expectations and visions
2. Building of social networks
3. Learning activities

**Articulation of expectations and visions**

According to Susur et al. (2019), the vision for developing eco-industrial parks plays a critical role by protecting niche experiments in terms of regulatory, policy and funding frameworks. They also state that protection measures (or the lack thereof) trigger or hinder EIP development and that those measures are often directed from the national political level. They argue that it is therefore critical to integrate top-down planning into EIP development (Susur et al., 2019). If we substitute EIPs for energy cooperation on business parks, the before-mentioned statements become relevant. The Dutch energy transition is national policy, which translates via regional policies into local energy cooperation projects on business parks: the integration of national top-down planning into local energy cooperation development. It is therefore important to map the institutional context for energy cooperation on business parks, on different levels, in order to be able to integrate top-down planning into energy cooperation development.

Susur et al. (2019) state that "expectations are strongly shaped by motivations of the involved actors". Motivations of industrial actors are mostly from economic nature and if a viable business case cannot be realised, those actors are not interested in industrial symbiosis and the potential social and environmental benefits of it. On the contrary, public and governmental motivations are often shaped by sustainable development and environmental gains (Susur et al., 2019). The categorization of motivations from business owners proposed by TNO (2016) will be included to identify the particular motivation of business owners on business parks. Business owners are the critical actors in energy cooperation on business parks, so it is valuable knowing what motivation shapes their expectations. The categorization will be explained later in this Section. Furthermore, Susur et al. (2019) state that having common expectations is crucial for the development of eco-industrial parks. It is argued that the same goes for developing energy cooperation projects on business parks, because different expectations may lead to unclear communication and misunderstandings, ultimately leading to unsuccessful development of energy cooperation.

According to Kamp & Vanheule (2015), expectations contribute to the development of niches if expectations become more robust, more specific and have a higher quality. Robustness means that the same expectation is shared by more actors. More specific expectations are better for guidance. Higher quality expectations entail that the expectations are validated with experiments. Kamp & Vanheule (2015) state that expectations can change over time due to external and internal factors, so-called "exogenous" and "endogenous" factors. They make this distinction in order to identify the origin of these expectations. The latter is valuable for this thesis, because how the motivations are influenced can come from within the niche experiment (energy cooperation on business park), or can originate outside of that boundary, e.g. in the form of national regulations, where actors are obliged to perform certain actions. Based on a Table on niche processes and indicators as provided by Kamp & Vanheule (2015), Table 2.1 shows the indicators of expectations and visions for this study.

**Building of social networks**

Susur et al. (2019) state that social networks facilitate learning and create the means for interaction between actors. Interaction between actors is crucial in business parks and especially for energy cooperation, because actors collaborate in multiple ways: socially, financially, legally and technically. With the findings of the first and partly the second sub question, all relevant stakeholders will be identified and a network will be created. Also, the roles of the different actors in barriers, drivers and solutions for energy cooperation - identified in sub question two and three - are part of this social network. The expectations and visions can be coupled with the social network, so that for every actor the vision

and expectation is also known. In turn, the social network can be coupled with learning activities. In this way, it will be known which actors are involved with which learning activities and which actor is involved in specific barriers, drivers and solutions to energy cooperation. Kamp & Vanheule (2015) present four indicators of the social network, being network composition, quality of sub-networks, network interactions and network alignment. For this thesis, the indicator "quality of sub-networks" was not included, because the scale of study conducted by Kamp & Vanheule (2015) was much greater, allowing for analysis of sub-networks. The included indicators of the social network can be observed in Table 2.1.

**Learning activities**

As explained earlier, emerging EC projects will be conceptualised as niche experiments in which learning activities will take place. Learned will be about barriers, drivers and solutions to acceleration of energy cooperation implementation. According to Kamp & Vanheule (2015), learning does affect the niche by influencing expectations and consequently aligning those expectations 2.7. The novelty of EC on business parks in congested areas only allows for ex ante analysis of existing barriers, drivers and solutions to energy cooperation. Barriers and drivers perceived by different actors will ensure learning about niche experiments. Also, the solutions to barriers and supporting measures for drivers, perceived by different actors, will make this learning more complete. Through these learning activities, the niche experiments of emerging energy cooperation on business parks can slowly expand and progress from local niches to national niches can be made. Ultimately, the national niches can transition to a situation where energy cooperation on business parks is the mainstream.

Kamp & Vanheule (2015) propose seven different field in which learning activities can take place, based on an article from Hoogma et al. (2005), namely: technical development and infrastructure, industrial development, social and environmental impact, development of the user context and government policy and regulatory framework. These learning fields hold for the niche of a specific technology such as a small wind turbine, but it does not hold for a process innovation such as energy cooperation on business parks. Two fields proposed by Kamp & Vanheule (2015) are relevant for this thesis: technical development and infrastructure, and government policy and regulatory framework. However, there are more fields in which learning can occur and the barrier/driver categorization proposed later in the Section seems suitable as well for fields in which learning can occur. The field "technical development and infrastructure" will be gathered under technical/engineering. This entails that learning can happen in the following fields:

1. Economic
2. Social/managerial
3. Technical/engineering
4. Regulatory
5. Policy

**Barrier/driver categorization from Rodin & Moser (2021)**

The second sub question goes into drivers and barriers. In order to allow for a thorough (comparative) analysis of these drivers/barriers, it is important to categorize them. Furthermore, for the third and fourth research question, it would be valuable to couple barriers and drivers in the same category, in order to construct solutions. The framework from Susur et al. (2019) does not offer a categorization of barriers and drivers. In order to make a valuable comparison between the analyzed cases, it is deemed important to categorize the barriers and drivers. The categories on energy cooperation barriers proposed by Rodin & Moser (2021) were chosen. Although the authors only use these categories to map barriers, it is argued that for this thesis, the categorization is also suitable to map drivers. Drivers and barriers are often related and in most cases the absence of a driver implies a barrier (Eilering & Vermeulen, 2004). Rodin & Moser (2021) propose main and sub categories. The main category consists of:

1. Economic
2. Social/managerial
3. Framework
4. Technical/engineering
5. Information provision

The sub categories proposed by Rodin & Moser (2022) consist of the following:

1. Origin of barrier/driver: within company/park or external
2. General or specific: does the barrier/driver influence energy cooperation in general or does it only apply to a specific solution/cooperation/technology?
3. Single-company or cooperative: does barrier/driver apply to single-company energy efficiency solutions or to cooperative solutions?
4. Phase of energy cooperation: in which phase of energy cooperation does the barrier/driver have influence?

5. Connection of driver/barrier to theoretical cooperative solution: the barrier might only be theoretical.
6. Matching barriers with instruments designed to overcome them: it might be the case that an instrument designed to overcome barriers to EC actually creates a barrier elsewhere.

**Modifications to categorization from Rodin & Moser (2021)**

Although the categorization from Rodin & Moser (2021) provides a good basis, there seem to be missing two key categories and not all proposed categories are deemed relevant. Adding the categories regulatory and policy is deemed required, because orienting conversations with field experts pointed out that regulations (e.g. about sharing electricity) stand in the way of smart energy cooperation solutions and consequently altering those regulations could be the solution itself. Also, Dutch policies on the energy transition - or the lack thereof - can in many ways drive energy cooperation projects on business parks, but can hamper energy cooperation as well. Policies exist on multiple levels: national, regional and local, thus knowing which policy and which level correspond to which driver of barrier is deemed usable. Therefore, it is valuable to include these categories of drivers and barriers. The "framework" category proposed by Rodin & Moser (2021) is left out, as the authors described this category as a combination between regulation and policy. It is deemed more clear to separate these categories. Furthermore, the category "information provision" is very broad and will be divided among the other main categories. The final main categories and thus indicators of the learning activities used in this thesis framework are displayed in Table 2.1, based on Kamp & Vanheule (2015).

| Niche process | Indicator | Analysis of |
|---|---|---|
| **Expectations & visions** | Expectations: long term and short term | Actor expectations on the energy transition on the BP and on EC |
| | Vision | Actor visions on the energy transition on the BP and on EC |
| **Social network** | Network composition | The composition of the network of relevant actors to EC on BPs, including roles |
| | Network interactions | Whether and how the actors in the network are interacting |
| | Network alignment | The degree to which actor expectations and visions are aligned |
| **Learning processes (drivers, barriers and solutions)** | Economic/financial | How EC implementation is being influenced by economic / financial factors |
| | Technical/engineering | How technical /engineering related factors influence EC implementation |
| | Social/managerial | How social and managerial factors influence EC implementation |
| | Legal/regulatory | How EC implementation is being influenced by laws and regulations on different levels |
| | Policy | How policy influences EC implementation on different levels |
| | Businessmodel | Learning about businessmodels that ensure fair collaboration and are succesful for EC projects |
| | Information | How (the absence of) information influences EC implementation |

Table 2.1: Visual explanation of the niche processes, its indicators and specification of the analysis

**Business owner motivation categorization from TNO (2016)**

As explained earlier, TNO (2016) proposed a categorization of the motivation of business owners. With the statement of Susur et al. (2019) that expectations are significantly influenced by the motivations of involved actors, this categorization fits nicely into the proposed framework. Business owners fulfill the largest part of interview respondents (explained in Section 3.4), so being able to compare motivations of business owners is deemed useful. With this distinction, things can be said about the role of the motivation of business owners in barriers, drivers and solutions. The proposed motivation categories of business owners are:

1. The calculator
2. The pioneer
3. The societal concerned
4. The chance-awaiter

TNO (2016) did not provide specific requirements for business owners to be placed in a certain motivation category. However, the names speak for itself and the carried-out interviews of this thesis will most probably reveal enough of the business owner to place him/her in one of the four categories.

**Visual representation of conceptual framework**

Below, Figure 2.7 shows the visual representation of the proposed framework that was developed before the data collection phase. On the left, the expectations and visions can be observed whereby the distinction is made between visions on three levels: national, regional and local. The business owner motivations as proposed by TNO (2016) are part of the expectations of actors. The middle block shows the elements of the social network: the network composition, the network interactions and the network alignment that will be identified. It is also indicated that per actor, the expectations and visions will be presented. The latter confirms the relation between the SNM processes of expectations & visions and the social network. Per actor, their role in barriers, drivers and solutions is also presented, which emphasizes the relation between the SNM processes social network and learning activities. The learning activities block lists the barriers, drivers and solutions, that will be collected in this thesis. It is indicated which main categories are chosen in the framework. The three blocks all contribute to the progression of EC on business parks, where regular BPs are mainstream at first, but BPs with EC will become mainstream under the influence of these three strategic niche management processes.

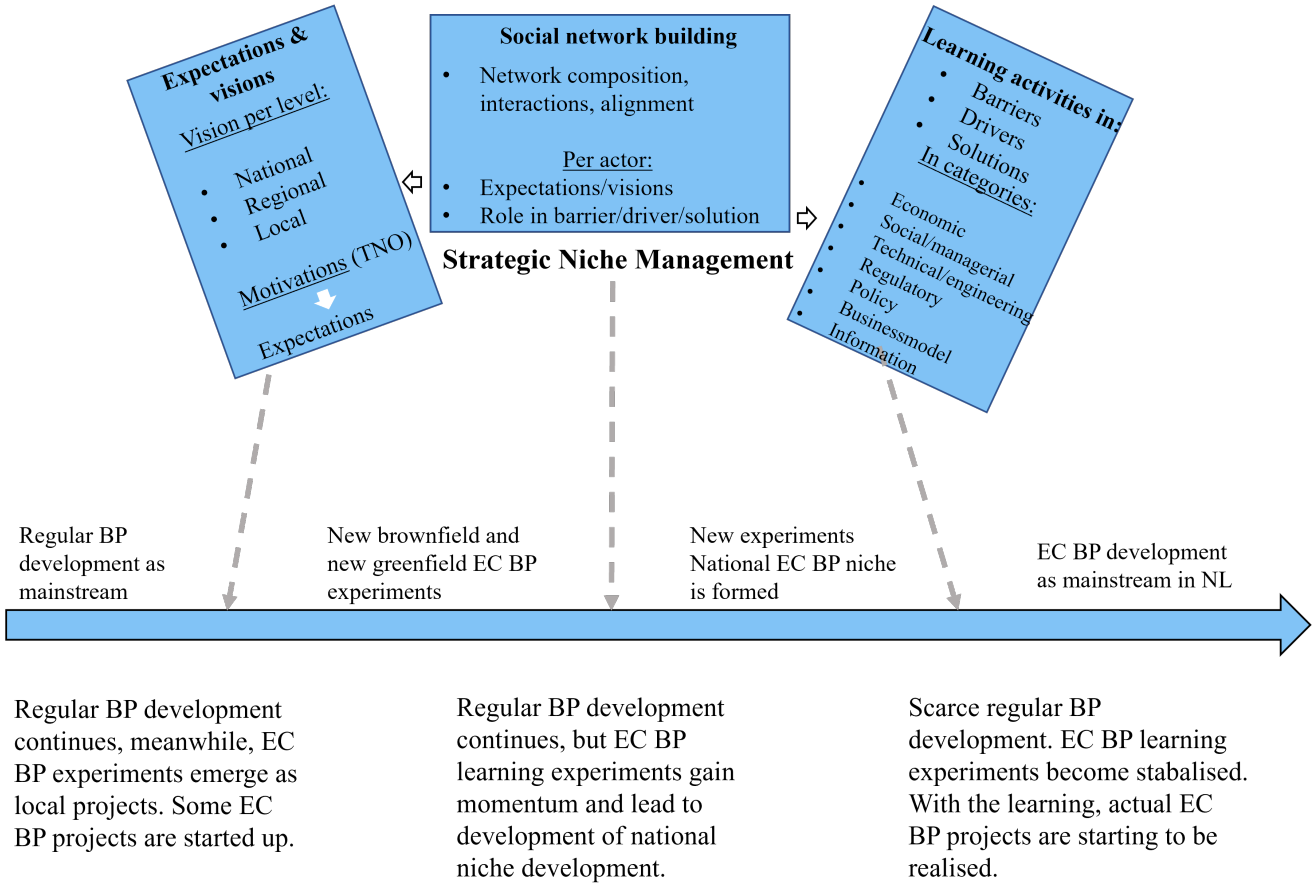



Figure 2.7: Schematic of the altered version from the framework of Susur et al. (2019) to fit this thesis project

# 3 Research design and methodology

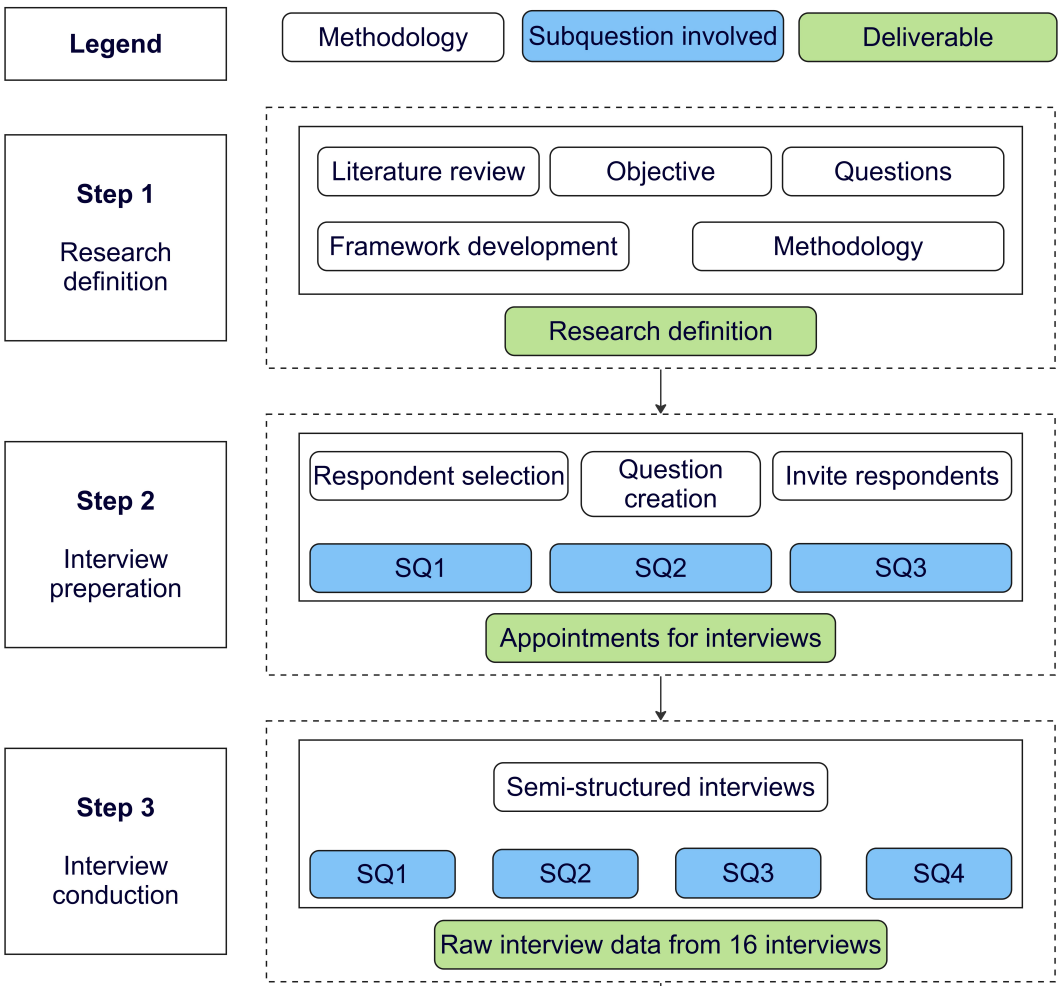
In this Chapter, the methodology that will be used for this research will be explained. The purpose of the research, the research design, the conceptual framework for analysis and how data is being collected will be explained.

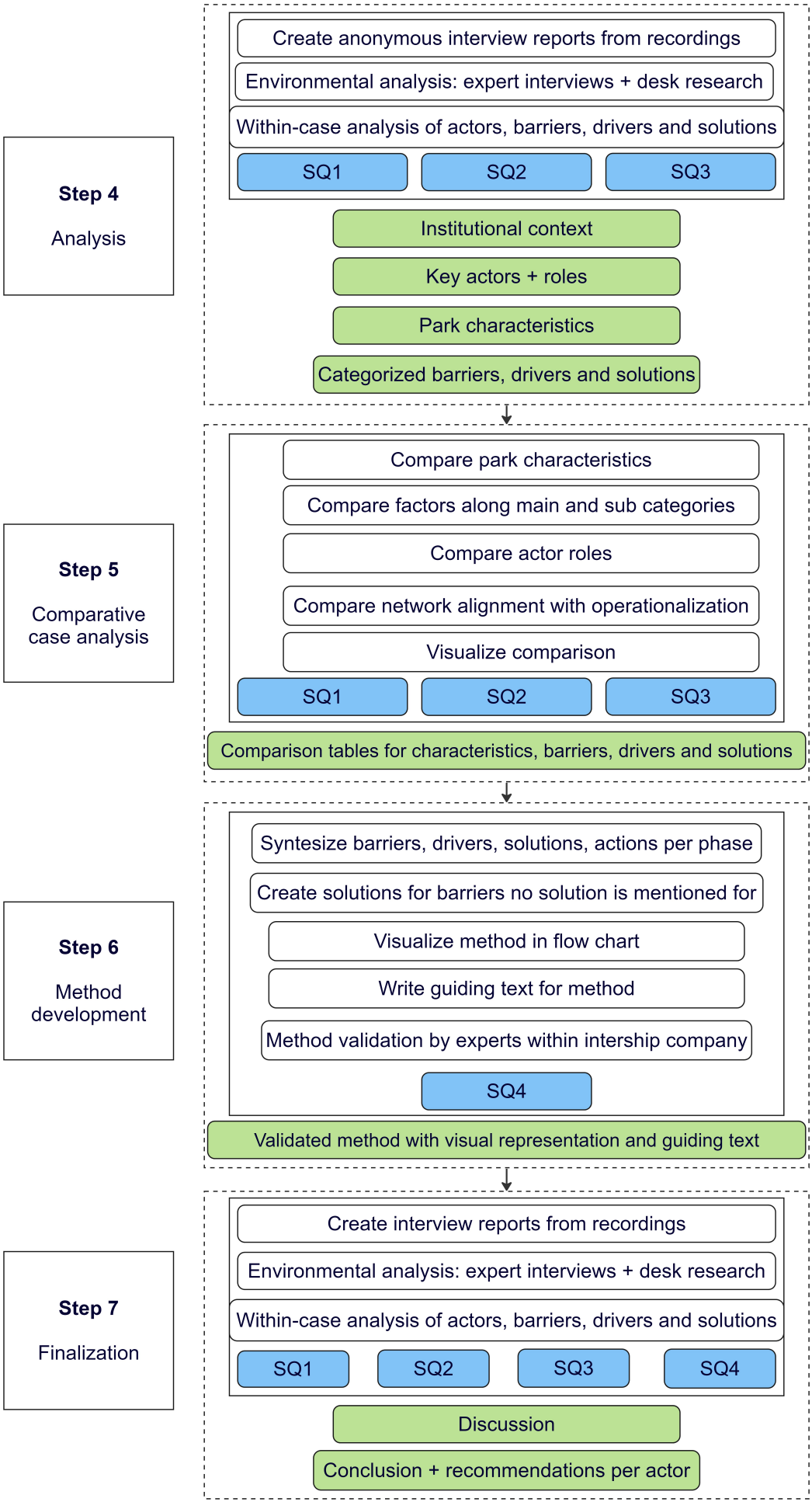
Sekaran & Bougie (2009) present three forms of research purposes: exploratory, descriptive and explanatory. The nature of the research questions in this thesis is exploratory. According to (Sekaran & Bougie, 2009, p. 43), exploratory studies are necessary if some facts are known, but more insights are needed to develop a feasible theoretical framework. Similarly, developing methodology is one of the objectives of this study and not all the needed data could be found in existing literature. For example, it is known what factors hamper and drive energy cooperation on larger industrial parks, however it is not known if these factors are different for mixed use business parks in congested areas. Also, it is not known how to deal with these barriers and drivers in order to successfully accelerate energy cooperation implementation.

To answer the research questions, the choice was made to use a case study research approach. Yin (1994) argues that a case study research approach is suitable if the researcher investigates the whys and hows of a contemporary set of events, which the researcher cannot control. This statement fits the main research question, which is: "How can implementation of energy cooperation be accelerated on business parks in congested areas in order to support the Dutch energy transition?". A multiple case design has been chosen because the opportunity to evaluate multiple cases is present, and because generalizability of findings is increased by repeating the analysis to various case studies (Bhattacherjee, 2012). Three cases will be chosen, that consist of mixed industrial parks (ordinary Dutch business parks with lighter industries and service-based companies). Business parks with a park management will be chosen as cases, because 1) stakeholders are more easily approachable through existing contacts of the park manager, 2) practice shows that having a park management in place has added value and can accelerate sustainable transitions on business parks (NCW & Nederlnad, 2021).

## 3.1 Research flow diagram

The build-up of the research will be as follows:




Step 4
Analysis
Create anonymous interview reports from recordings
Environmental analysis: expert interviews + desk research
Within-case analysis of actors, barriers, drivers and solutions
SQ1
SQ2
SQ3
Institutional context
Key actors + roles
Park characteristics
Categorized barriers, drivers and solutions
Step 5
Comparative case analysis
Compare park characteristics
Compare factors along main and sub categories
Compare actor roles
Compare network alignment with operationalization
Visualize comparison
SQ1
SQ2
SQ3
Comparison tables for characteristics, barriers, drivers and solutions
Step 6
Method development
Syntesize barriers, drivers, solutions, actions per phase
Create solutions for barriers no solution is mentioned for
Visualize method in flow chart
Write guiding text for method
Method validation by experts within intership company
SQ4
Validated method with visual representation and guiding text
Step 7
Finalization
Create interview reports from recordings
Environmental analysis: expert interviews + desk research
Within-case analysis of actors, barriers, drivers and solutions
SQ1
SQ2
SQ3
SQ4
Discussion
Conclusion + recommendations per actor

## 3.2 Case selection

To answer the research questions, a multiple case study approach was chosen in order to increase the generalizability of the findings. In this research, a case is a business park on which actors want to start with energy cooperation projects. Research questions will be answered for each case in order to compare cases on various criteria as determined in the conceptual framework of this study. Due to the exploratory nature of this research project, it was deemed important to have a diverse set of cases. Diverse cases are expected to yield diverse findings. The latter is valuable in exploratory research. Four cases were considered a reasonable amount of cases, where enough variability could be created to ensure diverse outcomes. The Netherlands houses around 3500 business parks (Duurzaam Gebouwd, 2023). Due to time limitations, only a small set of these business parks could be used as a case. In order to use the framework developed in Chapter 2.6 and to answer research questions, it was decided to choose business parks in one region (province). In such way, answers of sub question 1 could translate the national environment to the regional environment of the province where the cases are part of, into the local environment of the specific cases. During the start of this research project, the internship company performed multiple projects on business parks in the province of Overijssel. This opened possibilities to choose these business parks as a case, and use the existing network of the company to arrange interview respondents. Ultimately, these business parks have not been chosen, however, from that point in time, focus was on the Province of Overijssel and the network of the company could be used to find suitable business parks, as desk research proved to be insufficient to gather details about business parks.

In order to fill the research gap, it was important to use mixed use industrial parks as cases. Mixed use industrial parks can be described as typical Dutch business parks, where heavy process industries are non-existent and business activities consists mostly out of manufacturing or service-based companies. Furthermore, to account for the research gap, it was important to choose business parks where some form of energy cooperation existed. However, as stated earlier, through desk research it was found difficult to determine whether a form of energy cooperation existed on business parks. Hence, the network of the internship company was used to find business parks where energy cooperation existed in some form. This yielded a few business parks that were potentially suitable as case. During the case investigation, the researcher became acquainted with the existence of "smart energy hubs". This led to the idea of comparing "ordinary" business parks and business parks where a smart energy hub was being developed. Next to this dimension, another dimension was formulated, to be able to vary the case selection along two dimensions. This dimension was diversity of companies.

Thus, a total of four cases was chosen, varying along two dimension: grade of collective initiative and diversity of companies. With the grade of collective initiative is meant whether a so called "Smart Energy Hub" (SEH) is being developed or not. The diversity of companies entails the diversity in company size and sector. In Table 3.1, an overview is presented which displays the final selection of businessparks. It can be observed that business parks Groot Verlaat and Twentekanaal have a high diversity of companies compared to Hessenpoort and A1 Bedrijvenpark. The latter two house mostly companies in the transport and distribution sector. On Groot Verlaat and Twentekanaal no specific Smart Energy Hub is being developed with the help of the province of Overijssel and OostNL, on Hessenpoort and A1 Bedrijvenpark there is. In Figure 3.1, the geographical locations of the cases can be observed.

| | Groot Verlaat | Twentekanaal | Hessenpoort | A1 Bedrijvenpark |
|---|---|---|---|---|
| **Area (hectares)** | 75 | 231 | 300 | 129 |
| **Number of companies** | 72 | 320 | 56 | 30 |
| **Company diversity** | High | High | Low | Low |
| **Energy hub development** | No | No | Yes | Yes |

Table 3.1: Case selection, cases varied along company diversity and energy hub development


Figure 3.1: Map of locations of cases in the province of Overijssel

## 3.3 Respondent selection

For the general part, the respondents were deliberately chosen to gather as much information as possible about the institutional context, trends, and energy cooperation (and its role) in the Netherlands. The province was consulted to gain insights into regional initiatives, the role of the province, and the link between national and regional institutional context. The grid operator was selected to acquire knowledge about current regulations and possibilities concerning the transmission grid. PVB was chosen because it plays a significant role in the sustainable development of business parks, possessing substantial knowledge about the status of energy cooperation and its influencing factors. The initiators of the energy cooperative were included as respondents because they possess insights into the establishment of an energy cooperative, a crucial step towards successful energy cooperation in a business park. Initially, there was an intention to interview an organizer of Sprint Sessions to determine their role and potential. However, it proved to be impossible to schedule a meeting with him/her. Ultimately, the generic part yielded 4 interviews instead of the expected 5 interviews, which can be seen in Table 3.2 and Table 3.3.

| | **Generic** |
|---|---|
| **Province of Overijssel** | 1 |
| **PVB Nederland** | 1 |
| **Energy Cooperative Marslanden** | 1 |
| **Enexis** | 1 |
| **Organizer Sprint Sessions** | 1 |

Table 3.2: Expected interviews for the generic part

| | **Generic** |
|---|---|
| **Province of Overijssel** | 1 |
| **PVB Nederland** | 1 |
| **Energy Cooperative Marslanden** | 1 |
| **Enexis** | 1 |
| **Organizer Sprint Sessions** | 0 |

Table 3.3: Realised interviews for the generic part

For the cases, the respondents were chosen in a manner that reflects the current situation and provides a realistic representation of each business park regarding energy cooperation. Park managers know exactly what is currently happening on the business park and are the bridge between companies and the municipality and province. The municipality can play a significant role in energy cooperation development, however, whether this is the case can be investigated by interviewing them. Business owners are an interesting group to interview, because businesses can have different standpoints to energy cooperation. The park managers and municipal officials were actively approached via email or phone. The selection of companies was semi-random. An email was sent to all online searchable business parks, and the invitation email can be found in Appendix A.3. Many did not respond, but some companies found the topic interesting and willingly participated in the research. It is important to note that the interviewed companies do not represent a typical cross-section of businesses. Subsequently, contact was established, and dates were scheduled to conduct the interviews. In advance, the informed consent form was sent, and in most cases, it was signed and returned before the interview took place. In some instances, the researcher assisted the respondent in recalling and signing the interview later. Unfortunately, despite repeated reminders, it was not possible to speak with the Municipality of Steenwijkerland from Groot Verlaat. The park managers of the "energy hub parks" were also unable to participate in the interviews, as one was too busy and the other was unreachable. However, it was possible to interview a former hub manager from A1 Business Park A1. Therefore, the case studies ultimately yielded 12 interviews instead of the expected 14 interviews. This can be observed in Table 3.4, where a zero represents a planned interview that was not conducted. The contribution of respondents in answering the research questions is displayed in Table 3.5.The final list of respondents is displayed in Table 3.6. A unique ID identifies the respondents throughout the report. Statements made by respondents can be recognized by the following format (ID, 2023).

| | **Groot Verlaat** | **Twentekanaal** | **Hessenpoort** | **A1 deventer** |
|---|---|---|---|---|
| **Business** | 2 | 1 | 2 | 1 |
| **Park manager** | 1 | 1 | 0 | 0 |
| **Municipality** | 0 | 1 | 1 | 1 |
| **Hub manager** | | | | 1 |
| | | | | |
| **Total** | 3 | 3 | 3 | 3 |

Table 3.4: Realised interviews for the case part

| | Business owner (1 or 2 per case) | Park manager | Municipality (1 per case) | Province Overijssel | Enexis | Field expert | PVB |
|---|---|---|---|---|---|---|---|
| **Sub-question 1** | | 4 | 4 | 1 | | | 1 |
| **Sub-question 2** | 6 | 4 | 4 | | | | |
| **Sub-question 3** | 6 | 4 | 4 | | 1 | | |
| **Sub-question 4** | | | | | | 2 | |
| **Total number of interviews** | 19 (16) | | | | | | |

Table 3.5: Amount of interviews per sub question, most interviews collect data for multiple sub questions

| Participant | Job position |
|---|---|
| PROV | Project leader at Province of Overijssel. |
| GRID | Partner at local grid operator, focusing on energy transition. |
| PVB | Project leader at a national program designed to support the sustainable transition of business parks. |
| COLL | Two initiators and directors of energy collective on business park. |
| 1COM.A | Manager of company active in concrete industry. |
| 1COM.B | Owner of company active in recycling industry. |
| 1PM | Parkmanager on the business park. |
| 2COM.A | Director of company active in recycling industry. |
| 2MUN | Employee of Gemeente Hengelo, focusing on sustainable transition of businesses and business parks. |
| 2PM | Parkmanager on the business park (same as for Groot Verlaat). |
| 3COM.A | Manager of auxilarry branch of company in wholesale industry. |
| 3COM.B | CEO of company active in acquisition in metal- and tools industry. |
| 3MUN | Externally hired project leader for gemeente Zwolle. |
| 3COM.C | Co-owner of wholesaler in the floor industry. |
| 4COM.A | Owner of company active in distributing / wholesale industry of plastic products. |
| 4MUN | Externally hired project leader "Smart Energy Hubs" (marketing communication, acquisition) for gemeente Deventer |
| 4HUB | Formal "Hub Manager". Working at Province of Overijssel, started program SEHs together with OostNL and the Province of Gelderland |

Table 3.6: List of respondents

## 3.4 Data collection

It was chosen to use semi-structured interviews as method to collect qualitative data. According to Adams (2015), semi-structured interviews are suitable when open-ended questions require follow-up questions. The latter will most probably be the case to identify the exact barriers and solutions to energy cooperation implementation. Also, semi-structured interviews could be valuable if respondents might not feel comfortable talking with peers about certain topics Adams (2015). This could be the case with issues about cooperation between business owners, where some tensions may exist.

The interviews were held online with the help of Microsoft Teams. Before participating, the interviewees signed an informed consent form. The informed consent form informs the participants with the goals of the research projects, the potential risks related to data, information around publication, dissemination, application, storage, access and re-use of the collected data. After signing this agreement, the interview will be carried out.

When human research subjects are involved in the research, it is important to ensure their privacy and to protect the data they provided. Measures are taken to defend these goals. Firstly, before the interview, respondents will sign an Informed Consent form in which they will agree that the interview will be recorded. The Informed Consent form will also explain what the goal of the research project is, what possible risks are when participating and how these risks are mitigated. Personal information will be securely stored on the TU Delft WebDrive and only the research team will have access. The transcripts of the interviews will be anonymized and personal data will be destroyed after the end of this project. Furthermore, a Data Management plan was designed in which will be explained in detail how data is managed. Finally, an Ethics Checklist was constructed, identifying risks and proposing ways of mitigation. The three documents, Informed Consent form, Data Management Plan and Ethics Checklist are reviewed by the HREC (Human Research Ethics Committee) committee. When confirmed, the interviews were ready to be conducted.

## 3.5 Data processing & analysis

After the interviews were carried out, the recordings were be reported in text. This was done by replaying the recordings and writing down the everything that is in somewhat relevant to the research. The report excludes the specific name of the interviewee and the personal information that cannot be found on the internet (LinkedIn, information on company website, etc.) In general, the report was written from a third person perspective, because the exact structure of the sentences were deemed not of heightened importance to the research. The goal of the interviews is to identify influencing factors for energy cooperation and to identify general facts around the Dutch energy transition and the problem of transmission congestion. If exact wording was deemed relevant to the research, it is included in the report as a quote of the interviewee. In order to ensure the privacy of the respondents, the recordings and anonymous reports were stored on the secured TU Delft WebDrive during the thesis. After the completion of this research, the personal information that was collected is destroyed. The anonymous interview reports will be stored on the TU Delft Repository.

Subsequently, the interview reports were analysed by the researcher with the help of the web-version of software AtlasTi. AtlasTi is a software that is specifically designed for qualitative data analysis. With the help of coding, the researcher can interpret the findings of the interviews. It has been chosen to use a hybrid coding strategy, where inductive and deductive coding are combined, as described by Fereday & Muir-Cochrane (2006). The researcher started with a pre-defined set of codes, based on the framework developed in Chapter 2.6. This set of codes can be seen in Appendix A.6. During the thematic analysis of the anonymized interview reports, additional codes arose that were deemed relevant and were not included in the list of predefined codes. The list of predefined codes consisted of 63 codes. The final list of codes, after codes were inductively derived from the summaries, consists of 123 codes. 99% of all text in the interview reports were labeled with codes. Many sections of text had multiple codes, which would later in the analysis be attributed to only one code, due to progressive insight in the topic. After coding, the results were transferred into a structured Excel spreadsheet, which allowed the results to be incorporated in the report more easily.

The researcher chose for the approach to analyze the reports of the interviews instead of the full transcripts of the interviews. This, because of the nature of the research questions. The research questions aim to identify barriers, drivers, solutions and contextual information relevant to energy cooperation on business parks. To identify these factors, the exact wording of the interview participants is not deemed critical in most cases. However, in a few cases the exact wording is deemed important, because this wording reveals something about the standpoint or opinion of the participant. As explained earlier, when this is the case, this exact wording is quoted in the interview report. This means that on critical moments, the exact wording of the participant is used in the analysis, in the form of a quote. Another reason for not analyzing the full transcript is time constraints. With the amount of interviews of this research project, 17, this approach would take an excessive amount of time. The construction of the transcript, even with the help of an automatic transcription tool, would take at least 3 times the duration of the recording, as experience showed. Reporting the interview took between 1 and 1.5 times the duration of the recording. The average duration of the conducted interviews is around an hour, thus the transcription alone would have taken 57 hours. Per interview, such transcript is 9-12 pages of text with font size 11. In addition, applying codes to a full transcript, is deemed less efficient then applying codes to a more condensed report. A report is between 4 and 6 pages of text, thus the coding process with a report is twice as quick compared to coding a full transcript.

## 3.6 Within-case analysis

After the case interview reports were coded, the results underwent a subsequent round of analysis in order to answer sub question 2 and 3. First, all coded sections of text were copied into an Excel spreadsheet that had been categorized based on the pre-defined list of codes and the conceptual framework based on Susur et al. (2019), as developed in Chapter 2.6. The pre-defined and final code lists can be observed in Appendix A.6 and A.7, respectively. In the spreadsheet where all results were gathered, each different case had a different column, hence it was easy to implement the codes from the Excel spreadsheet into the report. The three "interrelated and mutually reinforcing" processes of the SNM framework are expectations & visions, the social network and learning processes (in this case learning about barriers, drivers and solutions). The first step was to map the social network. Per case, all relevant actors were listed, with the interviewed actors being reviewed first. Per interviewed actor, expectations and visions were highlighted. The expectations were divided into short term (within five years) and long term (beyond five years) in order to present them in a chronological order in Chapter 5. Furthermore, for every actor, their role in energy cooperation was presented. Roles were distinguished in current roles and roles actors are ought to have according to respondents. The roles that actors were ought to have were used to construct recommendations per actor, which can be read in 10. Furthermore, the social network composition and network interactions were presented in schematics, showing all relevant case-actors, their roles and their influence on the business park and energy cooperation. Red and green colors indicate if an actor exerts a driving or obstructing force to the business park, respectively.

As for the social network indicator "network alignment", Kamp & Vanheule (2015) did not present a way to measure the variable. During the case analyses, the researcher realized the importance of making the variable measurable. Since the

interviews had already been conducted, the researcher couldn't explicitly inquire about the network alignment on specific business parks. However, is was possible to utilize the existing interview reports and the expectations and visions from the respondents. The researcher questioned how network alignment could be quantified. In the context of energy cooperation on business parks, a high level of network alignment would indicate that all actors have high sustainability ambitions and a strong willingness to collaborate. Hence, the decision was made to map the two dimensions, ambition and willingness to cooperate, for each interviewed actor. An absolute number of network alignment was deemed to be not possible and also not needed, since the goal of the operationalization of this variable is to compare levels of network alignment between different cases. The two dimensions were ranked on three levels: low, medium, and high. To quantify the operationalization, levels were given values. A high level was valued at 5, medium at 3 and low at 1. This means that the minimum possible value for network alignment is 1 and the maximum value 5. For each actor, the two dimensions were ranked based on the interview reports and expectations and visions. Per case, for each dimension, the levels for all the respondents were averaged, resulting in a certain average number for sustainability ambition and willingness to collaborate. In turn, these dimension-averages were added and divided by 2, in order to arrive at a number for network alignment. Each case now has a number for network alignment between the interviewed respondents.

For the learning activities, a strict distinction was made between factors that influence energy cooperation on business parks and factors that influence the energy transition on business parks. Although both type of factors are closely related, respondents often mentioned factors that not specifically apply to energy cooperation, but to the energy transition of the business park in general. Since this research is specifically investigating energy cooperation, the factors influencing the energy transition were not included in the main analysis, however, the energy transition factors can be observed in Appendix A.13. After this first distinction, the factors influencing energy cooperation underwent another round of analysis in an Excel spreadsheet. All the factor descriptions were condensed into one sentence to maintain clarity in a vast amount of information. Subsequently, these condensed factors were categorized into the main and sub categories as proposed in the conceptual framework based on Rodin & Moser (2021). The main categories consisted of the following categories: economic/financial, technical/engineering, social/managerial, legal/regulatory, policy, business model and information. The sub factors distinguish the barriers, drivers and solutions between general/specific, internal/external, and the phase from which the factor exerts its influence. Per factor, it was also indicated which actor was involved. To enhance the comprehensibility of the results, the sub factors were color-coded, which can be reviewed in Appendix A.27. In order to derive meaning from the results, the occurring frequencies of the factors within the main categories were counted and displayed in Excel tables, which were ultimately used in the comparative analysis. Such presentation allows to quickly assess which type of factors are dominant in a case.

## 3.7 Environmental analysis

After the case analyses, an environmental analysis was carried out to answer sub question 1. A reverse order would have been ideal - environmental analysis before case analyses - however, a strict timeline did not allow this. The results from expert interviews were used to conduct the environmental analysis and identify the institutional context, national stakeholders, and general factors. Mentioned laws, policies, and regulations were further explored through desk research to gain a comprehensive understanding of the context and its impact on energy cooperation on business parks. On the institutional context was mapped on three levels: national, regional and local, such as proposed in the conceptual framework as can be observed in Figure 2.7. Differences can exist between institutional levels, which will become apparent when using different levels. Also, with such level distinction, the implications of the national level on local EC on business parks can be understood more easily. The same process was applied to actors, with additional information sought through desk research when necessary. Actors were then place into a schematic, displaying the most relevant roles and relations. In the same manner as for the within-case analyses, expectations and visions of the respondents were structured in a chronological way. Roles were as well divided in current roles and ought-to-roles. Network alignment was determined between the interviewed experts. Additionally, the expert interviews yielded generic influencing factors for business parks. These factors, including barriers, drivers, and solutions, were categorized into main and sub-categories as presented in Chapter 2.6. Ultimately, these categorized factors were utilized in Chapter 7 to develop the methodology.

## 3.8 Comparative multiple case analysis

After every case was individually analysed, the findings of the four cases were systematically compared with the help of a comparative analysis. First, the characteristics of the four different cases were compared and presented in a table (Table 6.1) to provide a quick overview of the similarities and differences in park characteristics. Park characteristics entail variables such as area, number of companies, company diversity, network alignment and so on. Subsequently, a deeper analysis was conducted on the barriers for energy cooperation. In the within-case analysis, it was already determined how often barrier main categories were mentioned during the case interviews, however to compare the cases, these frequencies were contrasted in a table, where each column houses the category frequencies of one case. Also, cumulative frequencies were added as the last column indicating the cumulatively most and least frequently mentioned factor main

categories. Also, the distribution of cumulative barriers in sub categories were displayed in a diagram. Per sub category, a small diagram was made, showing the distribution of cumulative barriers among general / specific and external / internal barriers. Also, the frequency of occurrence of the cumulative barriers in each different phase of energy cooperation was displayed in a diagram.

Besides the analysis being carried out for cumulative barriers, the analysis was also performed in a case comparison. This resulted in three additional diagrams, per sub category, showcasing the distribution of mentioned case barriers. The first diagram shows, per case, the distribution of mentioned barriers along the dimension general / specific, indicating whether a barrier can be generally applied to business parks or if the barrier specifically applies to one business park. The second diagram shows, per case, the distribution of barriers along the dimension external / internal, indicating the origin of the barrier: does the barrier originate within or outside the barriers of the business park? The last diagram of the case comparison for barriers shows four distributions of barrier occurrence in different phases. From this diagram it immediately becomes apparent which barrier phase is most frequent for each case. This type of analysis was performed in the exact same manner for the other influencing factors: drivers and solutions. This entails that ultimately, the comparative multi-case analysis shows four tables (6.2, 6.3, 6.4) and twelve figures (6.1 till 6.12) for the case comparison of barriers, drivers and solutions.

In addition to the factor comparison, the occurrences of actor roles were also analysed in a case comparison. Here, the distinction between current roles and roles that actors are ought to have according to the respondents, resulted in two tables, Table 6.5 and Table 6.6. The first table displays the frequency of mentioned current roles, per actor. For example, if four different respondents mentioned a current role from the park manager, then the frequency of roles for the park manager equals four. Such frequency shows the importance of an actor in the development of energy cooperation. If an actor is not mentioned during the interviews, it can be assumed that this actor does not play a role in the development of energy cooperation on that particular business park. Each column of the first table shows the frequency of current actor roles for one case. The last column show the cumulative frequency of current actor roles. With the last column, it is attempted to say something about the distribution of actor roles for business parks in general, showing which actor plays the most significant role. The second table shows the frequency roles that actors are ought to have. Here, a higher frequency entails that this particular actor is lacking certain capabilities in order to live up to its expected role.

## 3.9 Developing a methodology

In order to answer the last sub question, a methodology was designed to assist developers with accelerating implementation of energy cooperation on business parks. Developers can be park managers, board members of business clubs, municipal employees or external project leaders. The findings of the environmental analysis, the case analyses and the multi-case comparative analysis were used to develop a usable methodology. Although the case-interviews did not yield many explicit recommendations for a method, many implicit statements were made that could be used to construct a method. The findings from the collective data collection were structured and selected, to ensure only general applicable factors and solutions were included in the method, case-specific factors and solutions were excluded. For some mentioned barriers, no solutions were mentioned by the respondents. For these barriers, the researcher added obvious solutions. With the structured outcomes, an initial method was constructed along the different phases of energy cooperation as proposed by Rodin & Moser (2021). This method was reviewed and validated by three energy consultants of the internship company that have experience on business parks. Only the visual representation of the initial method was provided to the consultants, to ensure that the flow chart method could stand on its own. Because the consultants did not receive any background information, not all given feedback was relevant to incorporate in a new version. The given feedback can be found in Appendix A.33.

## 3.10 Validation

After the interview reports were created, the reports were e-mailed to the respondents accompanied by the question if the content was accurate. Out of 16 respondents, 10 respondents replied with complementary remarks and / or confirmation the content was accurate. In case of complementary remarks, the information in the interview reports was altered. Also, if any information already had been integrated in the thesis report, faulty information was changed to the correct information provided by the respondent.

It is important to acknowledge that the findings from the interviews are not absolute truths, particularly regarding the cases and business owners. Many factors influencing EC have been mentioned, including barriers, drivers, and solutions. However, it does not imply that all these statements by respondents are accurate, as some business owners may provide unreliable information or have limited knowledge about energy transition and energy cooperation. Some results are simply opinions, viewpoints, or subjectively perceived factors. There may not necessarily be a right or wrong aspect to these factors. For the findings that can be factually true or false, the researcher sought assistance from an expert within the

internship company. This consultant reviewed the critical findings and provided their opinion. No factual inaccuracies were identified in the process.

Furthermore, a method for EC implementation was developed (Chapter 7). To validate this method, three energy transition consultants from the internship company were asked to critically evaluate the developed methodology. The only information they received was the visual representation of the methodology in a flow chart, without any background information. This approach was chosen, so that given input from the consultants would ensure the visual representation of the method could stand on its own. After contemplating the feedback from the consultants, the relevant feedback was incorporated into the developed methodology, which can be observed in Chapter 7. The provided feedback can be observed in Appendix A.33.

# 4 Environmental analysis

This chapter delves into the findings derived from expert interviews. In addition to the interview findings, other sources may be consulted as needed to clarify aspects related to e.g. laws and regulations. Firstly, the current stage and different types of energy cooperation will be explained. Additionally, trends will be highlighted, including statements from respondents that reflect the current trends concerning business parks and the energy transition. Subsequently, the key actors will be discussed, outlining their respective roles and, where possible, expectations and visions. The institutional context will then be examined at three different levels. General barriers and drivers for the Dutch energy transition will be outlined, followed by a deeper exploration of barriers, drivers, and solutions specific to energy cooperation. Finally, findings regarding a potential business model or legal contract between cooperation partners will be presented, along with future challenges for business parks.

## 4.1 Stage of energy cooperation in the Netherlands

Energy cooperation is an upcoming concept on business parks. Currently, 80 from 3500 business parks in the Netherlands are involved in setting up a smart energy hub (PVB, 2023). This entails that 2.3 % of all business parks in the Netherlands is involved in a concrete realization of energy cooperation. However, it is likely that a higher percentage of business parks are engaged in energy cooperation, although not necessarily under the concept of Smart Energy Hub, which will become evident from the reviewed cases Twentekanaal and Groot Verlaat in Chapter 5. Currently, 48 examples of a "direct line" are known at the ACM, also a form of energy cooperation which this chapter will highlight. In terms of energy cooperatives on business parks, their appear to be 8 publicly known energy cooperatives established on business parks, specifically for business parks. The list of cooperatives can be seen in Appendix A.9.

## 4.2 Significance of business parks in energy transition

Business parks are a special case in the energy transition in the Netherlands. In the Dutch Climate Agreement, the word "business park" is mentioned zero times. This is fairly odd, because the potential for CO2 reductions on business parks could be as large as making residential areas gas free (TNO, 2022). Therefore, making business parks sustainable should receive a higher priority by governmental organisations (SolarMagazine, 2022).

## 4.3 Types of energy cooperation

In order to mitigate the effects of transmission congestion, a possibility is to utilize the existing infrastructure in a smart way, by cooperating. The local grid operator mentioned "The electricity grid can process enormous amounts of electricity, only not all at the same time. Compare it with highways, highways can handle vast amounts of cars, only not during peak hours". (GRID, 2023). This chapter will shortly discuss various forms of energy cooperation. However, first should the concepts of "before-the-meter" and "behind-the-meter" be explained.

**Before the meter**
"Before the meter" refers to the electricity measurement and solutions that take place at the point where electricity enters the transmission grid from the local grid operator, typically at the main connection of a building. This is the point where the total electricity consumption is measured and upon which the energy supplier's billing is based. The measurement "before the meter" is mostly under the control of the grid operator.

**Behind the meter**
"Behind the meter" refers to the electricity measurement and solutions that occur after the electricity has passed through the meter and entered the building or facility. This can refer to electricity measurements performed at the level of individual circuits or systems within a building. When the measurement occurs "behind the meter," it means that the self-

generated electricity is always used first. This implies that any electricity produced by decentralized installations, such as solar panels or wind turbines, is utilized within the building or facility before any additional electricity is drawn from the public grid. Only when the decentralized installation generates insufficient electricity to meet the demand, additional electricity is then sourced from the public grid.

### 4.3.1 Group contracts

With a group contract, previously separate grid connections are coupled with the goal of utilizing the available capacity on the grid more efficiently. Currently, each company has a network connection with a specific capacity for consumption and for feed-in. This capacity represents the maximum amount of energy that the company can use or feed into the grid. However, it is rare for companies to utilize their maximum capacity, and it is even more unlikely that multiple companies would do so simultaneously. Given this, companies have the opportunity to support each other. If company 1 knows that its maximum capacity is not being fully utilized, it can allocate the excess capacity to another company that currently requires more than its own capacity allows. This arrangement is facilitated by grouping the participating companies under a single grid connection, using a collective contract with the grid operator. This allows for the overall consumption/feed-in to remain the same for the grid operator, while providing companies with greater flexibility to consume/feed-in more energy when needed compared to separate contracts. This innovation can significantly reduce short-term grid expansion costs, by using the current infrastructure more efficiently. On the airport Schiphol, such group contract is already operational, however, this example is relatively straightforward because there is a single owner. Also, it is important to realize is that this group contract is for consumption only, not for feeding back energy to the grid (GRID, 2023).

### 4.3.2 Private grid

A private network or transmission grid could be a possibility, whereby this grid is owned and operated by a private party. To be able to operate such grid, exemption from the ACM is needed, as operating such network without an exemption is illegal. The standard procedure entails the grid operator is always in charge of grid management, unless specific exemptions have been obtained. The ACM is actively monitoring the existence of illegal private networks. The requirements to be able to request an exemption are the following:

- The network is located within a geographically demarcated area.
- There are no more than 500 customers connected to your network.
- There are no domestic customers connected to your network.
- The business or production process of you and your customers is integrated for technical or safety reasons, or you primarily use the network for yourself or for companies in the same holding.

### 4.3.3 Physical energy exchanges

Physical energy cooperation, whereby there exists a physical connection transmitting current, from one party to another, is also a form of energy cooperation. Popularly, this is called a "direct line". With such line, the producer and consumer are directly connected, without intervention of a substation. A condition for a direct line to be operational is that this line is not connected with the public electricity grid (Overheid.nl, 2022). The only exception here is that at most one energy producer can be connected to the grid via an energy supplier (Dorhout Advocaten, 2023). It is not allowed to single-handedly (without a grid operator) operate such grid connection without having an exemption of the ACM. This is to ensure, safety, reliability and affordability for the consumer. Also, a direct line should always be noted to the ACM (ACM, 2023a), (ACM, 2023b). Currently, according to the ACM, there have been 48 notifications of an established direct line. In Appendix A.30, the requirements from the ACM to establish a direct line are listed.

## 4.4 Institutional context

### 4.4.1 National level

**Nitrogen crisis**

In November 2022 the Council of State abolished the construction exemption (Bouwvrijstelling), which has implications for energy infrastructure projects. Now, each to-be carried out project must undergo an assessment of its nitrogen impact during the construction phase. As a result of the nitrogen crisis, also projects from grid operators, aimed at expanding the electricity grid, are experiencing significant delays. Nearly all projects of the grid operators have a temporary contribution to nitrogen deposition during the construction phase and do not yet possess an irrevocable nature permit. This poses a serious and very real threat to the desired speed of the energy transition, in addition to increasing grid congestion and the shortage of human capital at the grid operators. As a result, nearly 3000 projects may not be delivered according to schedule (Netbeheer Nederland, 2023a).

The grid operator indicates that if the grid is not sufficiently expanded in time, a domino effect of delays will occur in other sectors such as industry and housing construction, as these sectors require a connection to the electricity grid for their own sustainability goals. This situation creates a downward spiral: in order to reduce nitrogen, sectors must become more sustainable. However, to achieve this, the electricity grid needs to be expanded, but these projects are experiencing significant delays due to the nitrogen crisis.

Netbeheer Nederland urges the government to take action, so that the sustainability transition can proceed smoothly in the Netherlands. According to Netbeheer Nederland, the government can do this by creating fast, clear, and predictable processes for grid operators in handling ecological assessments and preliminary assessments. This will enable them to quickly apply for and obtain the necessary permits. For the longer term, the grid operators call for the creation of a separate category for energy infrastructure projects when allocating nitrogen space, exempting these projects from further evaluations or trade-offs. The grid operator states that because energy infrastructure projects only result in limited nitrogen emissions during the construction phase, these projects only require temporary allocation of the necessary nitrogen space (Netbeheer Nederland, 2023b), (Netbeheer Nederland, 2023a).

**Cluster Energy Strategy (CES 6)**

The Cluster Energy Strategy (CES) is a comprehensive plan dedicated to further reducing carbon emissions in the Netherlands. The strategy is divided in five different clusters, corresponding to certain regions, being Rotterdam/Rijnmond, Noordzeekanaalgebied, Chemelot, Zeeland en Noord-Nederland. A sixth cluster exists to represent the industrial companies outside of those regions. For Overijssel, this sixth cluster, CES 6, is most relevant. The strategy of the sixth cluster represents nine diverse sectors spread throughout the country, all unified in their commitment to driving sustainability and energy transition. The companies under Cluster 6 have been proactive in reducing their carbon footprints. However, they identified that current sustainability measures and conditions were falling short of their ambitions. The CES 6 strategy aims to bridge this gap, focusing on broadening the scope of sustainability, improving the visibility of Cluster 6, and tailoring the necessary conditions to achieve their climate ambitions (Programma Verduurzaming Industrie, 2022).

The CES 6 places a strong emphasis on the need for a robust, sustainable energy infrastructure that's capable of managing significant tasks, such as electrification. It states that without a well-coordinated infrastructure in place, companies, especially those outside of the big five industry clusters, face considerable roadblocks in their energy transition journey. These obstacles range from limited access to infrastructure and the associated high costs, to complexities in licensing procedures and provincial-level coordination for infrastructure development and usage (Programma Verduurzaming Industrie, 2022).

Recognizing these challenges, the CES 6 aims to collaborate with provinces and grid operators to craft solutions and streamline the energy transition process. The goal of CES 6 is to catalyze innovation in energy transition, with the target of reducing CO2 emissions by 55% by 2030. The provincial project leader raises the question what the existence of CES 6 companies entails for business parks, suggesting that business parks and surrounding businesses should seize the opportunity to collaborate with these large companies (PROV, 2023).

**CDOKE regulation**

Municipalities and provinces can apply for funding through the CDOKE scheme from the RVO (Netherlands Enterprise Agency) to support the implementation of their climate and energy policies. This funding is available for the years 2023 to 2025, with a total of 1.04 billion euros allocated for this purpose. The funding can be used to hire additional staff or external experts, allowing municipalities and provinces to strengthen their internal organization over several years. The objective of the scheme is to contribute to the reduction of CO2 emissions by 55% in the Netherlands by 2030 and achieve climate neutrality by 2050 (RVO, 2023).

The funding can be utilized in four key sectors: the built environment, electricity, mobility, and industry. Municipalities and provinces are required to report annually on how the funds have been utilized and provide accountability for the expenditure. It is important to note that the RVO has indicated that a new funding scheme will be implemented after the conclusion of the current scheme in 2025, with dedicated resources already reserved. This provides municipalities and provinces with the assurance that they will have financial support available to strengthen their organizations (RVO, 2023), (PVB, 2023).

**Label C obligation offices**

Office buildings in the Netherlands are required to have an energy label C. This requirement is outlined in the Building Decree 2012. If a building does not meet the energy label C criteria, the company is not allowed to use it as an office space. Starting from 2023, municipalities and environmental agencies will enforce this obligation and ensure compliance (RVO, 2018).

**Energy conservation obligation**

The energy-saving obligation, known as the "energiebesparingsplicht," is mandated by the Activiteitenbesluit milieubeheer (Environmental Management Activities Decree) for businesses and institutions in the Netherlands. It requires businesses to implement all energy-saving measures with a payback period of 5 years or less. The energy-saving obligation applies to locations of businesses and institutions that consume at least 50,000 kWh of electricity or 25,000 m3 of natural gas equivalent per year.Under the new Omgevingswet (Environmental Act), which is expected to come into effect on January 1, 2024, the energy-saving obligation will be incorporated into the Besluit Activiteiten Leefomgeving (BAL) and the Besluit Bouwwerken Leefomgeving. Companies subject to the energy-saving obligation are required to report once every 4 years (RVO, 2022).

**Energy audits**

There exists an obligation for certain companies to conduct an Energy Efficiency Directive (EED) audit, as mandated by the European Union. This requirement applies to companies with 250 or more full-time employees, or with an annual turnover exceeding 50 million euros and an annual balance sheet total exceeding 43 million euros. The objective of this directive is to raise awareness among businesses and institutions about their energy consumption and opportunities for energy savings and sustainability.

The EED audit provides a detailed overview of all energy flows within the company, including the energy use of buildings, facilities, industrial processes, and business transportation. It also identifies potential energy-saving measures and their expected effects. The audit must be submitted to the Netherlands Enterprise Agency (RVO).

### 4.4.2 Regional level

**Regional Energy Strategy (RES)**

The Regional Energy Strategy (RES) is a program initiated by the national government in 2019, as response on the request for regional collaboration in the energy transition of the umbrella organizations of the provinces (IPO), water boards (UvW) and municipalities (VNG). The RES implements national commitments from the Climate Agreement into lower levels. This initiative is carried out across 30 regions and aims to achieve sustainable electricity production (35 TWh), transition from fossil to sustainable energy sources in the built environment, and ensure necessary energy storage and infrastructure. The RES involves a broad collaboration among government, provinces, municipalities, grid operators, businesses, and residents, to make regionally supported decisions. These decisions are then transformed into region-specific projects and implementations. Other sustainability aspects like mobility, industry, or agriculture may also be included if desired by the region. The program is an ongoing process that continuously refines and realizes projects until 2030, with periodic evaluations and re-calibrations of the strategy to ensure effectiveness and efficiency. It serves multiple functions: defining regional energy goals and timelines, facilitating societal engagement in spatial planning, and organizing long-term collaboration among regional parties.

Importantly, the RES provides a framework for regions to define their strategies while adhering to common guidelines and agreements outlined in the Climate Agreement. The National RES Program bridges the gap between national climate agreements and regional realities, providing regions with clear directives, knowledge, tools for calculation and comparison of contributions, and a platform for knowledge sharing (Ministerie van Economische Zaken en Klimaat, 2019). In the province of Overijssel, there are two Regional Energy Strategy (RES) regions: West-Overijssel and Twente. The municipalities included in the case studies of this research are located within these regions, with three municipalities in West-Overijssel and one municipality in Twente (Regionale Energie Strategie, 2023).

**Acceleration program Smart Energy Hubs**

Oost NL, in collaboration with the provinces of Overijssel and Gelderland, has established the Smart Energy Hubs Acceleration Program, to fill a responsibility and ownership gap (4HUB, 2023). This program aims to stimulate the development of energy hubs in the region. The program consists of six key lines of action (Oost NL, 2022b). The lines of action are listed below:

1. **Development of 10 energy hubs:** The first line focuses on establishing 10 energy hubs in Overijssel and Gelderland, with 6 and 4 hubs respectively.
2. **Knowledge sharing, learning, and collaboration:** program line two aims to facilitate collaboration and knowledge sharing among energy hubs and stakeholders at regional, national, and international levels.
3. **Strengthening of energy hubs:** the third line focuses on providing necessary information, advice, and connecting

with organizations that are experts in energy technologies, as well as legal and financial structures for collaborative initiatives.
4. **Financing:** The fourth line of action focuses on developing financing instruments and matching the appropriate mix of financial tools for the different stages of hub development. This can include vouchers, subsidies, investments, and loans.
5. **Communication:** the fifth line aims to raise awareness and visibility of the 10 energy hubs, providing interested parties with regional and national information about the hub development process.
6. **Lobby:** The final line of action involves advocating for the introduction or modification of legislation, subsidies, and permits. The goal is to position smart energy hubs as integral parts of the national energy system.

### 4.4.3 Local level

**Bedrijven Investeringszone (BIZ)**

A BIZ, Business Investment Zone, is an organisational form in which all business owners on a business park contribute to the costs of improving the park. The condition is that a majority (65%) of the businesses that will contribute have agreed to the establishment of a BIZ. The municipality of the respective business park facilitates the BIZ organization by collecting the contributions and transferring them to the park management or business club of the park. With a BIZ, engagement is enforced, and resources are available to maintain the park clean, safe, and intact. Without a BIZ, it is possible that some businesses may refuse to contribute to the improvement of the park, leaving a few parties to bear the costs. A BIZ eliminates this problem. A specific law has been in place since 2015 (Bedrijven Investeringszone, 2020).

## 4.5 Key actors

In this chapter, the key actors that influence energy cooperation in some way or form are highlighted. First, the interviewed actors will be reviewed, after which other actors will be presented. For the interviewed actors, the approach of their organization and their the expectations and visions are highlighted as well. Below, the details and unique IDs of the interviewed respondents can be seen. After all interviewed actors are reviewed, the level of alignment between the interviewed actors is presented, where the alignment is measured along the dimensions of the ambition level and collaboration intention level. In Figure 4.1 the most important roles of and relations between actors are presented. A green line entails that an actor has a driving influence on energy cooperation, a red line means the actor is obstructing EC development. Details on roles and relations can be read in this sub chapter.

| Participant | Job position |
|---|---|
| PROV | Project leader at Province of Overijssel. |
| GRID | Partner at local grid operator, focusing on energy transition. |
| PVB | Project leader at a national program designed to support the sustainable transition of business parks. |
| COLL | Two initiators and directors of energy collective on business park. |

Table 4.1: Interview participants on energy transition, energy cooperation and transmission congestion

### 4.5.1 Province of Overijssel

Interview with a project leader at the Province of Overijssel. The respondent indicates to lack knowledge in policy and regulations but has a strong background in economics. The province's goal is to achieve 20% renewable energy by 2023, but it seems unlikely to be achieved. There is no new target set. For seven years, not much progress has been made, but there is now a sense that "the train is finally starting to move." (PROV, 2023).

#### 4.5.1.1 Expectations and vision

The expectation is that within the next 5 years, collaboration among businesses on business parks will become easier to mobilize and organize, because there is a significant amount of energy unleashed during sprint sessions with companies. The businesses themselves express the desire to actively participate, but it is crucial to provide them with actionable steps and tangible opportunities for engagement. By offering concrete pathways for involvement, the momentum and willingness to collaborate can be effectively harnessed (PROV, 2023).

The vision for energy transition on business parks is to move towards a fossil-free environment within the next 20 years. Also, business parks must have a clear vision of their desired future state, enabling them to approach the grid operator with specific plans. Over the next 20 years, as the execution progresses, both the grid operators and businesses will face significant demands and investments (PROV, 2023). The respondent envisions that business parks will become focal points where various elements converge. These areas will serve as hubs where the economy, energy, and mobility intersect (PROV, 2023).

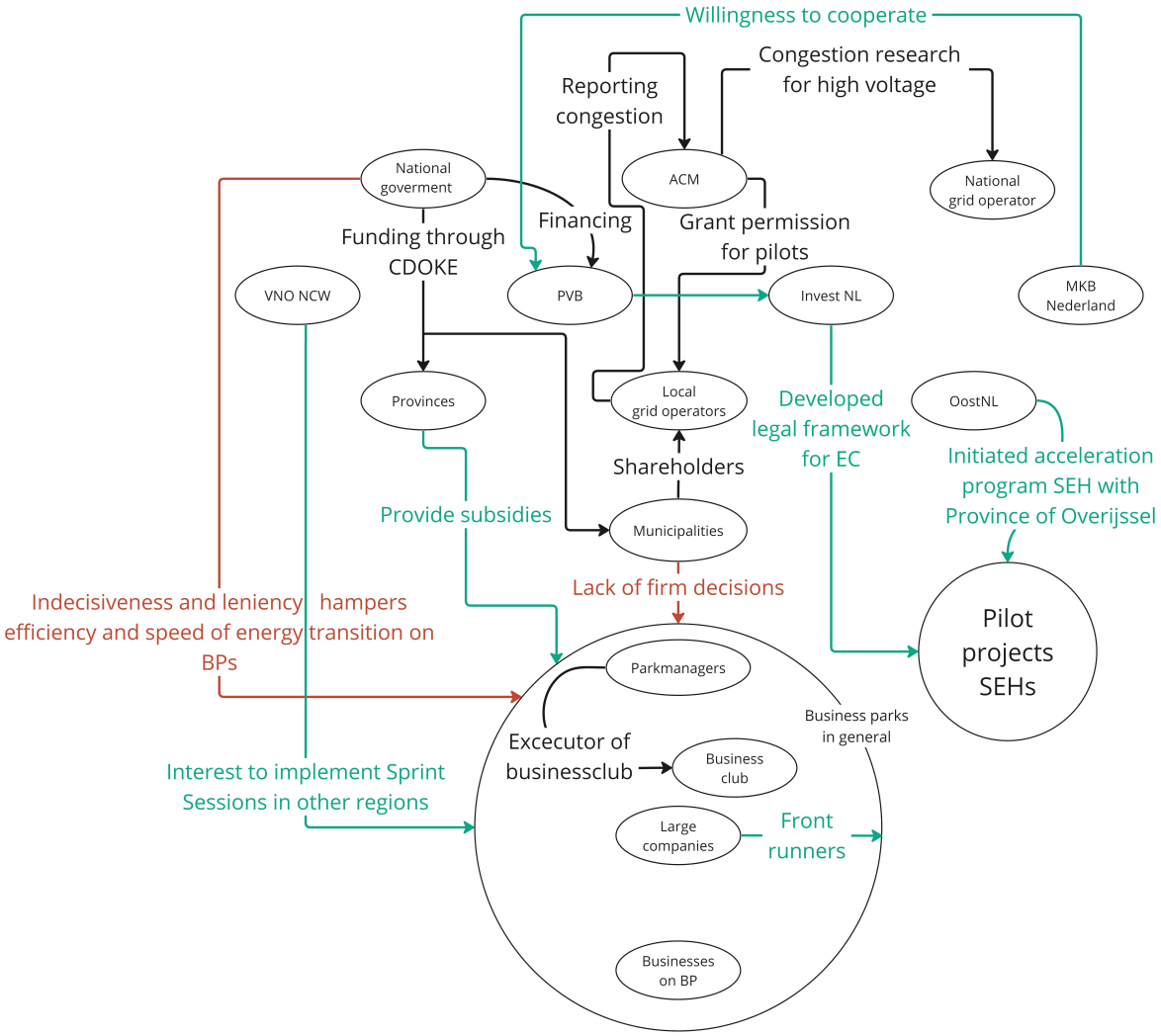



Figure 4.1: Actor chart displaying the most important roles of and relations between actors in the Netherlands

#### 4.5.1.2 Role

In 2017, the province initiated the "Nieuwe Energie Overijssel" program, which aims to connect and strengthen initiatives contributing to the energy transition with the goal of achieving an energy-neutral province by 2050. As part of this program, the province organized sprintsessions to bring together municipalities, businesses, and the grid operator to effectively address the issue of network congestion and explore solutions to minimize its impact (PROV, 2023). The province is working on the CES strategy, which also includes businesses located on business parks in the province (PROV, 2023). According to the project leader, the role of the province is not to become the owner of all 350 business parks, but rather to act as a catalyst for certain themes to ensure initiation. The province has observed that it is easier to gather entrepreneurs around the topic of energy compared to other themes such as biodiversity. This could be attributed to the fact that businesses have been directly affected in their operations by the energy crisis in the past year, making it crucial to address their concerns related to their business operations (PROV, 2023). Furthermore, it is stated that , together with the HMO, the province can ensure that business parks remain up to date (PROV, 2023). The province of Overijssel is shareholder of Enexis, the local grid operator, for 21 %. The province does not possess the authority to impose mandatory regulations (PROV, 2023). As stated earlier, the Ministry of BZK allocated EUR 1,04 billion via the CDOKE regulation, which can be utilized by provinces (and municipalities) to strengthen their internal capacity and to hire external human capital to accelerate the energy transition. This is a chance that every province should redeem (PVB, 2023). According to the cooperative initiators, the province occasionally provides subsidies,however which specific subsidies is not indicated (COLL, 2023). A concrete action performed by the province of Overijssel is the facilitation of a roof-feasibility-check for business owners on the Marslanden business park. With this, the energy transition is accelerated, because businesses know the possibilities their roof offers (COLL, 2023).

#### 4.5.1.3 Approach

Following research conducted by Kjell-Eric Bugge, out of the 8 different approaches, one approach has been selected for the energy transition of business parks. Since then, the transition department has been working together with the economic department. Also, there exist an acceleration team within the province organization, called "Toekomstbestendige Bedrijventerreinen" (Future-Proof Business Parks). However, it is not necessarily intended to address all these themes simultaneously and comprehensively on a business park. Within the province, the notion of "Trek het breed en er gebeurt geen reet" prevails. This is because if you try to connect everything, you end up waiting for each other (PROV, 2023). The province does not have the authority to enforce binding measures on businesses or business parks and can only facilitate with knowledge and funding (PROV, 2023).

### 4.5.2 Programma Verduurzaming Bedrijventerreinen (PVB)

PVB is program from the organisation TKI Urban Energy (Topconsortium Knowledge and Innovations). The program is supported financially by the Ministry of Interior and Kingdom Relations. According to PVB, their program is regional, with natioal coordination, for local realisation of sustainable business parks. The goal of the program is to learn about the best possible way to accelerate the sustainable transition on business parks. With the guidance and connection of projects, initiatives and stakeholders, PVB tries to achieve this goal. PVB identifies problems in the market and used their network to find solutions to these problems. Development of tools, resources and knowledge can help stakeholders experiencing problems. PVB organizes events where stakeholders throughout the Netherlands are connected and can learn from each other PVBNederland (2022). The respondent is project leader at PVB. Has had past job positions as project manager in various sectors. Is active at PVB since its launch, almost three years ago.

#### 4.5.2.1 Expectations and vision

The respondent expects that within the next five years, 80% of business parks in Overijssel will be organized and showcase reductions in energy consumption as part of the energy transition efforts. The existence is emphasized of several exemplary BPs that have already achieved energy neutrality and eliminated the use of natural gas. Within five years it is expected that approximately 10% of the 80% falling into this category of examplary business parks (PVB, 2023).

Furthermore, the respondent acknowledges a lack of awareness among businesses regarding the issue of water scarcity. However, it is expected that in the coming five years, companies will increasingly recognize and address this challenge (PVB, 2023).

The respondent highlights the significance of collaboration in the Dutch energy transition. He / she emphasizes that working together is essential for success, stating that individual efforts may lead to faster outcomes, but collective action is necessary to achieve substantial progress "Alone you go faster, together you go further". The respondent recognizes that the complexities and scarcities involved in energy transition cannot be solved by any single party in isolation (PVB, 2023).

Also, PVB strongly desires the participation MKB Nederland and VNO NCW, which are willing to engage because PVB generates momentum. The constituency of VNO NCW and MKB Nederland represents the group of stakeholders that PVB serves (PVB, 2023).

According to the project leader, the significance of business parks in the energy transition is immense. A considerable portion of energy consumption and emissions is attributed to businesses, particularly small and medium-sized enterprises. They account for approximately half of the natural gas consumption and one-third of the electricity usage. Therefore, the respondent deems it to be crucial to place a strong focus on business parks in the context of energy transition (PVB, 2023).

#### 4.5.2.2 Role

The respondent mentions that the PVB regularly provides recommendations to the government, engaging in interdepartmental discussions with four ministries. It is observed that these ministries are individually focused on sustainability matters but often lack awareness of each other's activities. PVB serves as an advisor to the ministries, flagging any potential issues or concerns they identify. For example, they highlight the allocation of 200 million euros for hydrogen refueling stations, which may not fall directly under the jurisdiction of the Ministry of Economic Affairs and Climate Policy (EZK) or the Ministry of the Interior and Kingdom Relations (BZK), but has significant impacts, both positive and negative, on business parks and industrial areas (PVB, 2023). It is highlighted that PVB is ready to lend support to individuals in the region who share their difficulties (PVB, 2023).

#### 4.5.2.3 Approach

PVB aims to achieve its goals without competition but through collaboration. They prefer to remain in the background, allowing other initiatives to take the lead because "it's not about us." (PVB, 2023). It is indicated by the respondent that PVB does not operate in a competitive manner with advisory or consultancy parties, providing business parks with support. Rather, PVB's goal is to facilitate an environment where the market can take the lead (PVB, 2023). A bottom-up approach is deemed most effective. PVB is ready to assist when people from the region inform them about the challenges they face (PVB, 2023). The constituency of VNO-NCW and MKB NL is the group served by PVB. These organizations operate through a sectoral approach, while PVB adopts a horizontal approach. The goal for all parties is the same (PVB, 2023).

### 4.5.3 Local grid operator

The local grid operator is Enexis in Overijssel. They ensure reliable, continuous and affordable transmission of electricity and gas in the region. The project leader from PVB emphasizes that it is important to realize which parties are the shareholders of the local grid operators: municipalities and provinces. The province of Overijssel owns around 21 % of the shares (Management-Scope, 2020). Furthermore, when reviewing the General Meeting of Members from last April, it stand out that the word "congestion" is not mentioned once. One would expect that in such energy crisis the shareholders, whom are affected by transmission congestion themselves, would at least discuss the strategy of the local grid operator, whereby collectively reducing transmission congestion is the goal.

#### 4.5.3.1 Expectations and vision

The respondent anticipates a further rise in consumption congestion in the coming years (GRID, 2023). According to the respondent, the energy transition could benefit from a strategic and comprehensive government policy, drawing parallels to the successful transition from steam to a gas infrastructure (GRID, 2023).

#### 4.5.3.2 Role

Enexis actively engages in partnerships with the province to facilitate the cooperation among business parks and enhance the sense of urgency regarding the energy transition. They participate in sprint sessions and for example organized meetings with park managers in Zwolle to communicate the challenges and stress the significance of collective action. The objective is to underscore the urgency of transmission congestion within business parks and foster collaborative efforts, together with municipalities (GRID, 2023).
When the Enexis operator anticipates for scarcity of consumption transmission capacity, they inform the ACM for further action. A thorough investigation is conducted to assess the capacity that can be made available through so called "congestion management". However, during this investigation, companies requesting a grid connection initially receive a provisional rejection. If the investigation ultimately reveals that capacity is available, Enexis reaches out to the company (Enexis, 2023). Congestion management refers to Enexis engaging in discussions with large consumers to ensure that these users can flexibly adjust their power consumption as needed. In the event of impending transport scarcity, consumers reduce their consumption in exchange for financial compensation. The consumers are notified one day in advance. Enexis actively promotes congestion management on their website, specifically targeting businesses. For Enexis, having more flexible consumers is advantageous, which is why they have launched this campaign (Enexis, 2022).

Furthermore, Enexis collaborates with the municipality to assess the electricity demand when transitioning away from gas, with coordination facilitated by the province. It is crucial for Enexis to have a clear understanding of the electrification plans, because for every cubic meter of natural gas, 10 kWhs are needed to achieve the same effect (GRID, 2023). Enexis has established the collaborative partnerships in Hessenpoort between themselves and the businesses. They have started providing advice to municipalities through the Regional Energy Strategy (RES). As additional initiatives emerged, such as the National Agenda for Charging Infrastructure (NAL), CES, and business parks, the scope of Enexis' involvement expanded. To meet the growing demand, Enexis has hired more staff members (GRID, 2023). As for why there can't be launched new pilot projects, the purpose of a pilot is to gain experience and insights, but it operates in a gray area in terms of laws and regulations. Enexis must withdraw from the pilot after its completion and ensure that another entity takes over the project. It is not practical to conduct another pilot to learn the same things. Enexis needs to seek exemption from the Authority for Consumers and Markets (ACM) for these pilots, and the ACM eventually determines when it is sufficient. Other network operators are also conducting pilots, so it is important to first assess the outcomes of those initiatives (GRID, 2023).

#### 4.5.3.3 Approach

There is a connection between local grid operators in the Netherlands. Enexis approached Liander to inquire about the legal and technical aspects of this connection (GRID, 2023). Enexis provides recommendations to governments at the municipal, provincial, and national levels. In Overijssel, they do so within four quadrants, including social costs, participation, and spatial aspects. These quadrants all have interrelated influences. For example, extending the electricity grid in rural areas incurs high costs. Bringing these quadrants together involves lengthy discussions before any realization takes place (GRID, 2023). The pilot projects have a maximum duration of two years, with Hessenpoort's pilot lasting six months. Afterward, it will be assessed whether Enexis can assist with relieving transmission congestion. If the grid operator recognizes that energy hubs can assist in resolving transmission congestion, it has the potential to be implemented nationwide. However the local grid operator states that, the market needs to take the initiative for the actual implementation (GRID, 2023).Enexis operates in a non-discriminatory manner and cannot create customized policies for each municipality. Making Enexis' operational data publicly available is not ideal as it may lead to uninformed parties interfering. For instance, if a distribution station is currently operating at 97% capacity, questions may arise as to why it cannot be at 100%. Safety aspects and significant costs are associated with reaching full capacity, and explaining these choices repeatedly can be challenging. Sharing such data also presents fluctuating risks. Additionally, sharing this type of data poses security risks, including the potential for terrorism (GRID, 2023).

Regarding the question of why an additional pilot cannot be conducted, it should be noted that the purpose of a pilot is to gain experience and operate within the gray area of Enexis' legal and regulatory framework. Enexis must withdraw after the pilot's conclusion and ensure that another entity can take it further. Conducting an additional pilot for the same purpose would be redundant. Enexis needs to request exemptions from the Authority for Consumers and Markets (ACM) for these pilots, and at a certain point, the ACM may consider the requested exemptions sufficient. Other grid operators are also conducting their own pilots, so it is important to evaluate the outcomes of those projects first (GRID, 2023). Furthermore, the the significance of an integrated approach is highlighted. While Enexis has the ability to establish measures independently, it is deemed much more effective to pursue such measure collectively. Also, the respondent emphasizes the significance of them knowing the intentions of business parks in the next 5 to 6 years. This information allows the grid operator to have a better grasp of the infrastructure needs and facilitates faster execution of the plans of the business parks (GRID, 2023). Enexis keeps their operational data secret, as publicly available data may invite interference from individuals without proper knowledge. They illustrate this with an example of a party questioning why a distribution station operates at 97% capacity rather than 100%, overlooking safety considerations and associated expenses. The respondent further emphasizes the challenges of explaining these choices over and over again and highlights the fluctuating nature of energy data, which is hard to determine a strategy on. The potential risks associated with sharing sensitive data for terrorism are mentioned as well (GRID, 2023).

### 4.5.4 Energy cooperative Marslanden

An interview was carried out with the initiators of Energy Collective Marslanden in Overijssel, as these respondents can be considered experts in establishing an energy cooperative on a business park. Both respondents live close to the business park (BP), which is why they started the initiative. They are both entrepreneurs, but do not have any further stake in the collective. Their motivation to start the initiative was to accelerate collaboration in energy and climate issues. Since no one else took the first step, they decided to initiate the collective. At the time, there was no organized effort around sustainability in the area. Both respondents indicate to have an intrinsic motivation to contribute to sustainability. Both worked within large organizations on sustainable energy projects (COLL, 2023).

#### 4.5.4.1 Expectations and vision

The respondents expect several developments for Marslanden in the next five years. These include the widespread installation of solar panels on rooftops, the implementation of a cooling system utilizing a nearby water source, the establishment of a collaborative energy network among businesses, and increased awareness among entrepreneurs about the significance of working together to achieve energy goals. It is expected that these initiatives will result in greater satisfaction among businesses with their energy costs and an overall recognition of the importance of sustainable energy practices (COLL, 2023).

Furthermore, respondents expect the implementation of CO2 taxation for businesses within the next 5-10 years, which they expect will likely become a reporting requirement and impose additional obligations on entrepreneurs (COLL, 2023).

According to the respondents, their vision for the energy transition in the Netherlands varies depending on the geographical location. Their vision is that local solutions are crucial. They promote leveraging the local environment and resources, such as using nearby bodies of water for cooling purposes, maximizing the utility of available assets. The emphasis is on extracting value from existing resources. "Pick your chance of realising a wind turbine when there is little opposition! In the next five years, the focus will primarily be on energy-related initiatives. However, the long-term vision, spanning over

20 years, is more comprehensive and integrated. Ultimately, the goal is to achieve livability and greening of the business park, prioritizing the well-being of communities and promoting sustainable practices (COLL, 2023).

#### 4.5.4.2 Organization of energy collective / cooperative

Business park Marslanden hosts approximately 800 entrepreneurs. However, the park currently lacks the infrastructure to support a green transition, as it doesn't have many solar panels and still relies on gas for energy. The target for the park is to phase out gas usage by 2050, however, there are capacity problems due to grid congestion, both in terms of consumption and feed-in of renewable energy. While the business park has a park management and a business club for basic operations, promoting sustainability isn't their main objective. This is where the energy cooperative fills a crucial gap. Its only aim is to deliver material benefits to its members through sustainable projects (COLL, 2023).

The cooperative started with five members and has now grown to ten. It is indicated that for the establishment of a cooperative, the cooperative needs initial members for the cooperative to be acknowledged. The members of the cooperative believe in the power of collective action and are dedicated to taking steps towards sustainability. They have decided that new members should either contribute to the energy supply, have a demand for it, or own property on Marslanden. Simply put, only those who believe in the collective effort and are willing to move towards sustainability are welcome. One of the major projects that the cooperative will undertake in 2023 involves installing solar panels on rooftops across Marslanden. The goal is to produce renewable energy collectively, but as indicated the project is currently facing grid congestion issues, influencing feed-in of energy (COLL, 2023).

The cooperative has an approach where members jointly create a multi-year sustainability plan, guided by a grant from the Municipality of Zwolle. This process begins with an energy scan, which identifies potential energy-saving measures. Following the scan, the members sign an agreement to commit to these sustainability measures. Also, as facilitated and funded by the province of Overijssel, the business owners can have the feasibility checked of their roof for solar panels. Throughout the three-year plan, members receive more than they contribute in terms of membership fees. The support and guidance over these years aren't necessarily provided by the cooperative's management, but can come from consultancies or other knowledgeable businesses on Marslanden, depending on the specific needs of the members (COLL, 2023).

The cooperative compares its structure to a rowing boat, where the founders are the helmsmen, and the entrepreneurs are the rowers. Without the rowers, nothing happens. The members decide, and the board works on their behalf. No external entities, like municipalities or provinces, are involved in the decision-making process (COLL, 2023).

The creation of the cooperative was triggered by a sense of frustration. Some entrepreneurs wanted to act on sustainability within the business club, but found it cumbersome to start. The cooperative's mission has thus become not only to facilitate a sustainable transition but also to encourage knowledge sharing and business amongst members.Inspiration for the cooperative came from ECUB in Utrecht, where entrepreneurs, along with the province and municipality, collectively invest and bring sustainable projects to life. ECUB shared its knowledge and approach, providing a framework for the establishment of the Marslanden cooperative. For the launch, several documents were required, including statutes and member agreements, which ECUB shared with the cooperative (COLL, 2023).

Energy cooperative Marslanden is actively exploring and showcasing their energy cooperative model to other municipalities and provinces. They emphasize the importance of government entities visiting the Marslanden site to observe and understand how the model operates. Such hands-on experience can help other regions in implementing similar initiatives (COLL, 2023).

### 4.5.5 Network alignment of interview respondents

Based on the expectations and visions, as well as the interview reports, a ranking was given to the dimensions of network alignment: ambition and cooperation intention. The exact calculation method for network alignment can be reviewed in Chapter 3.6. As can be seen, the there is a medium level of alignment between the interviewed respondents. Although these actors are not part of a local network, they are part of the national network that influences energy cooperation on business parks. Particularly the differences in dimension level highlight differences in attitude towards energy cooperation between actors. As can be seen, the local grid operator scores the lowest on the dimension ranking. This can be explained by the prudent approach of the grid operator, as their most important task is to supply energy in a reliable and continuous way. Every new innovation could be thread to that reliability and continuity. PVB and the energy cooperative score high, because the goal of those organisations is to support and stimulate energy cooperation. The province wants to support energy cooperation, however, their large organisation obstructs doing this efficiently.

| Respondent | Ambition level | Collaboration intention level |
|---|---|---|
| Province of Overijssel | Medium | Medium |
| Programma Verduurzaming Bedrijventerreinen (PVB) | High | High |
| Local grid operator Enexis | Low | Medium |
| Energy cooperative Marslanden | High | High |
| Average dimension value | 3,5 | 4 |
| | | |
| Network alignment | 3,75 | |

Table 4.2: Medium level of alignment of interviewed experts

#### 4.5.6 National government

It is indicated by the respondent that the current problem of transmission congestion could have been predicted based on the policies concerning electric vehicles and solar panels, increasing the load on the grid. According to the respondent, the government together with the grid operators, have neglected their responsibilities in preventing congestion from arising (PVB, 2023). Currently, the Ministry of BZK finances PVB, and eventually the Ministry of EZK will also contribute to provide financial support to Programma Verduurzaming Bedrijventerreinen.

The respondent states that the CDOKE regulation, administered by BZK, has made 1,04 billion euros available. This funding is designated for municipalities and provinces to enhance their internal capabilities and engage external resources to expedite the transition towards sustainability (PVB, 2023). According to the project leader from PVB, agreements are made between the Ministry of the Interior and Kingdom Relations (BZK) and the provinces regarding specific grants (Specifieke Uitkering, SPUK). The grants are then allocated to the provinces, who can further distribute them to the regions. Only a small portion is allocated to PVB, with the aim of ensuring that the work activities are demand-driven and initiated by the regions (PVB, 2023).

From the grid operator's perspective, the current absence of decisive choices by the government in the energy transition is posing challenges for business parks. The delegation of issues to lower levels hampers the efficiency and speed of the energy transition process. The participation of residents in the decision-making leads to stagnation, as diverse opinions hinder consensus-building and thus hinder progress in the energy transition. This situation creates hurdles not only for business parks but also for network operators in managing such participation. The respondent suggests that the government should make firm and non-negotiable decisions to overcome these challenges (GRID, 2023).

Also, the government should stimulate societal discussions regarding grid congestion, according to the grid operator. The different types of discussions that ought to be held are listed below:

- The discussion whether it is the responsibility of the network operator to prioritize among businesses on the waiting list for a grid connection.
- Another important discussion is regarding who should bear the losses from commercial battery operators due to changes in network management policies.
- Also a key discussion to be held is how to fairly distribute the societal costs and benefits. As an example, a farmer in a rural area may have an expensive grid connection installed to enable solar power feed-in. Such installation provokes substantial costs to society, while the farmer reaps the financial benefits of his solar panels. This is seen as unfair by the respondent.
- As last, the dilemma of either heavily investing in grid reinforcement, resulting in substantial societal expenses, or opting for more efficient utilization of the current network with higher financial contributions from businesses is an important discussion point. According to the partner from Enexis, politics should decide on this dilemma (GRID, 2023).

#### 4.5.7 ACM

The Dutch ACM (Authority for Consumers and Markets) is an independent regulatory authority responsible for promoting competition and protecting consumers in the Netherlands. One of the key tasks of the ACM is to regulate the energy market, aiming to ensure affordability, quality, continuity, and accessibility of energy. It is worth noting that since 2020, the ACM has been actively reviewing and evaluating the investment plans of grid operator (ACM, 2020). When the local grid operator detects signs of transmission congestion during a congestion investigation, it is required to report this to the ACM. The ACM registers this congestion situation and monitors the costs and benefits of congestion management. It could be that the congestion appeared to be present in the high voltage grid from the national grid operator, Tennet. When this is the case, the follow-up investigation will be carried out by Tennet (Enexis, 2022). Furthermore, the ACM grants permission to local grid operators for pilot projects. Currently, there are a significant number of ongoing pilots throughout the Netherlands, which the ACM deems to be satisfactory for learning. This explains why local grid operators

are currently not initiating additional pilots. Also, the ACM grants exemptions for the operation of a private grid (GRID, 2023).

#### 4.5.8 National grid operator

TenneT is the national grid operator of the Netherlands, also operating parts of Germany. With ownership and management of an extensive network spanning 25,000 kilometers of high-voltage cables, Tennet's primary objective is to maintain continuous electricity access for consumers. Tennet is widely regarded as one of the world's leading grid operators. As a key stakeholder in the energy sector, understanding Tennet's role and contribution is essential in comprehending the dynamics and complexities of the energy landscape (Tennet, 2023). It is indicated by the respondent from PVB that the current problem of transmission congestion could have been predicted based on the policies concerning electric vehicles and solar panels, increasing the load on the grid. According to the respondent, the grid operators, together with the government, have neglected their responsibilities in preventing congestion from arising (PVB, 2023).

#### 4.5.9 Invest NL

Invest-NL is an innovative investment fund with a size of 1.7 billion euros. As a private enterprise, Invest-NL aims to support companies engaged in innovation and the energy transition in the Netherlands. It focuses on investing in projects that may be too risky for the market but offer potential returns in the future. Specifically, Invest-NL targets scale-ups that have already demonstrated success in the development phase but require additional financial support for further improvement or expansion. Within the energy transition domain, the fund places particular emphasis on areas such as electrification, energy, circularity, agrifood, and the built environment. By providing financial assistance and driving innovation in these sectors, Invest-NL aims to contribute to the sustainable growth and transformation of the Dutch economy. The shareholder of Invest NL is the Ministry of Finance (Invest-NL, 2023). Invest NL has conducted a research project that provides clarity on the legal frameworks surrounding energy cooperation and smart energy hubs. The outcome of this research is a standardized structure for agreements, which in turn can then be assessed by the grid operator for feasibility (PVB, 2023).

#### 4.5.10 MKB Nederland

MKB Nederland represents the interests of small and medium-sized businesses in the country. It serves as a voice for these businesses, advocating for favorable economic conditions, entrepreneurship support, and a level playing field. MKB Nederland provides its members with resources, networking opportunities, and business support services to enhance their growth and success. It actively engages with policymakers, government agencies, and stakeholders to shape policies and regulations that benefit small and medium-sized enterprises. MKB Nederland plays a vital role in promoting the economic contributions and significance of the SME sector in the Netherlands (MKB-Nederland, 2015). MKB Nederland expresses their interest in implementing sprint sessions in other regions (PVB, 2023). MKB Nederland has indicated to be willing to cooperate with PVB, due to the momentum that PVB generates on business parks. The constituency of MKB Nederland is the group of stakeholders that PVB serves: businesses (PVB, 2023).

#### 4.5.11 VNO NCW

VNO-NCW is the largest employers' organization in the Netherlands, representing the interests of Dutch businesses and industries. They work towards creating favorable economic and business conditions by advocating for policies that promote entrepreneurship, innovation, and sustainable growth. It engages in dialogue with policymakers, trade unions, and other stakeholders to shape the business environment and address challenges faced by the business community. VNO-NCW provides a platform for collaboration, networking, and knowledge-sharing among its member organizations, contributing to the overall economic prosperity of the Netherlands (VNO-NCW, 2015). VNO NCW expresses their interest as well in implementing sprint sessions in other regions (PVB, 2023).

#### 4.5.12 OostNL

OostNL is a regional development agency focused on the economic growth and innovation of the eastern part of the Netherlands. It plays a key role in supporting and stimulating entrepreneurship, innovation, and investment in sectors such as high-tech, energy, and sustainability. OostNL provides financial support, advice, and access to networks for businesses and startups to foster economic development and create employment opportunities in the region. Through collaborations with government entities, educational institutions, and private enterprises, OostNL aims to improve the competitiveness and attractiveness of East-Netherlands as a business location (Oost NL, 2023). Furthermore, Oost NL initiated the acceleration program Smart Energy Hubs, together with the province of Overijssel en Gelderland (Oost NL, 2022a), (4HUB, 2023).

#### 4.5.13 Municipalities

The public space is owned by the municipality, hence the municipality is responsible for its maintenance and management (PROV, 2023). All the municipalities of the reviewed cases are shareholder of the local grid operator Enexis (Enexisgroup, 2023). As stated earlier, the Ministry of BZK allocated EUR 1,04 billion via the CDOKE regulation, which can be utilized by municipalities (and provinces) to strengthen their internal capacity and to hire external human capital to accelerate the energy transition. This is a chance that every municipality should redeem (PVB, 2023). The provincial project leader believes that the most significant shift will occur when municipalities make firm decisions, such as closing the gas supply in certain neighborhoods. Thus, in this domain, there is a role for municipalities to play (PROV, 2023). The PVB project leader calls upon municipalities not to compete when seeking expertise and knowledge, but rather to collaborate and leverage scarce knowledge and resources (PVB, 2023). The local grid operator suggests that municipalities play a crucial role in filling the knowledge gaps among businesses by providing them with easily understandable information packages, including details on pricing, legal considerations, and practical aspects. This approach aims to remove barriers and empower businesses with the necessary knowledge (GRID, 2023).

Furthermore, the grid operator highlights the role of municipalities in creating awareness among businesses about congestion issues and emphasizing that the government will not address these problems. Awareness can be created by highlighting the transmission problems for consumption in the provinces Noord- Brabant and Limburg. Furthermore, the respondent suggests that municipalities should provide business parks with clear directives and the lacking information that businesses need to develop energy cooperation initiatives, with this reducing the obstacles to start. According to the respondent, municipalities are well-suited to engage with businesses on these matters (GRID, 2023). According to the energy cooperative initiators, the municipality (of Zwolle) occasionally provides subsidies, however which specific subsidies is not indicted (COLL, 2023).

#### 4.5.14 Bussinesparks

According to the local grid operator, it is crucial that business parks develop clear plans for the coming 5 to 6 years. This knowledge will provide Enexis with a clearer understanding of future infrastructure requirements, enabling them to accelerate their planning and implementation processes (GRID, 2023).

#### 4.5.15 Large companies

Without the participation of CES 6 companies, the sprint sessions alone have not been successful in convincing larger businesses to embrace electrification, this highlights the importance of CES in the process (PROV, 2023). On the business park Marslanden, it is emphasized that multiple large companies have emerged as frontrunners in championing the energy transition on the park. For the initiators of the energy cooperative, this was a reason to involve these companies from the very beginning (COLL, 2023).

#### 4.5.16 Park managers

The primary role of the park management is focusing on maintaining the cleanliness and safety of the business park, as these are fundamental requirements for a business park to be operational (PVB, 2023). According to the respondent, not all park managers possess the necessary knowledge, experience, and ideas to progress to the next steps. It is crucial to have a park management with sufficient capacity to incorporate additional capabilities and expertise. This combination is deemed essential (PVB, 2023).

#### 4.5.17 Consultancy companies

The project leader from PVB states that consultancy companies should not only provide a report, and then leave, but should effectively support establishing a long-term relationship between the business park and its goal (PVB, 2023).

#### 4.5.18 Businesses

Businesses are a key player on business parks. Businesses ultimately decide what measures will be taken, and are critical in the formation a cooperation. Also, businesses determine the energy profiles present at the park, which in turn has a strong effect on the possibilities for energy cooperation. According to the provincial project leader, companies are eager to adopt solar panels as it demonstrates their commitment to sustainability, without directly affecting their core business processes. However, energy efficiency measures do impact business processes, which makes entrepreneurs more cautious and reluctant to embrace them. They fear that these measures might disrupt their operations (PROV, 2023). The partner emphasizes that businesses should take the energy transition into account when making decisions and should act proactively by submitting their grid connection applications to the grid operator early, to mitigate the potential impact of connection restrictions on their operations. Already, wait lists exist, whereby a first-come-first-serve policy is handled, thus the earlier business are, the earlier they will receive a new or expanded grid connection (GRID,

2023). Also, it is stated that businesses cannot expect the grid operator to tackle transmission problems single-handedly. The grid operator states that businesses should be also contribute to the solution, by actively setting up projects.

### 4.5.19 Factors influencing energy cooperation

In this sub chapter, the barriers, drivers and solutions that were mentioned by the experts are covered. In Appendix A.16, all mentioned factors by interview respondents can be read in a more elaborated way. In the appendix, context is provided for each factor, and it also indicated which respondent mentioned which factor. In Appendix A.16, a table is provided, listing all mentioned factors for each case. This Appendix table is structured along the main factor categories as proposed in Chapter 2.6 and per factor it is indicated to which sub categories the factor belongs. Now, the mentioned barriers, drivers and solutions will be presented in three tables.

| **Barriers** |
|---|
| The state of the transmission grid partly obstructs energy cooperation |
| The Energy Tax on energy exchanges hinders energy cooperation |
| Upgrading the grid to solve congestion issues would significantly increase tariffs |
| Implementing a "direct line solution" is challenging due to a high number of requirements that are needed to conform to |
| Expanding the grid requires substantial funding, time, and also space (which is hard to acquire) |
| Installation of numerous substations for business park electrification is space-demanding |
| Battery placement for energy storage requires substantial space |
| Park managers often lack the necessary knowledge and experience for effective energy cooperation development |
| Smaller enterprises may be reluctant to bear the expenses of establishing private networks |
| Lack of sustainability awareness and financial-only motivations among businesses slows down EC participation |
| Differences exist between the priorities of municipalities and individual businesses |
| Businesses struggle with understanding and complying with government regulations |
| Legal coordination of cable pooling is complicated due to multiple owners and foreign entities that could be involved |
| Supplying energy to others is currently not permitted without a difficult to acquire permit |
| Differences in grid connections for small and large businesses complicate energy cooperation |
| There is a risk of overlapping efforts among provincial initiatives |
| Government policies often cause surprises and financial challenges for businesses with SDE subsidies |
| Interactions between municipalities/provinces and businesses are limited |
| The process of obtaining subsidies from the province can be lengthy and time-consuming |
| Uncertainty and ignorance from the province project leader about revenue models for energy cooperation |
| A lack of independent knowledge hinders energy cooperation |
| Businesses lack understanding about closed energy systems and pricing |
| Many municipalities lack knowledge and understanding of energy cooperation and grid congestion issues |
| Businesses overestimate their ability to tackle congestion challenges independently |
| There is a responsibility gap at multiple levels, causing a lack of progress on business parks |
| Businesses are left to handle energy cooperation on their own due to a gap in responsibility |

Table 4.3: Generic barriers influencing EC on business parks, mentioned by experts

| Drivers |
|---|
| Businesses have shown increased interest in participating in sustainable energy initiatives due to the economic effect of geopolitical events and energy crises |
| Entrepreneurs aim to reduce costs and overcome barriers to expanding their current grid connection by participating in energy cooperation |
| Entrepreneurs appreciate Sprint Sessions initiated by the province for the opportunity to engage with stakeholders and discuss energy challenges and opportunities |
| CES 6 companies' success stories in energy transition motivate other businesses to pursue sustainability |
| The drive for the energy transition and energy cooperation is significant in Overijssel |
| There's an increased understanding and urgency among businesses about energy transition, despite the uncertainty about the proper actions to take |
| A Business Investment Zone (BIZ) encourages collective decision-making and collaboration among businesses |
| Individual legislations for businesses can stimulate collaboration and joint initiatives |
| Landlords are increasingly setting requirements for certifications for their buildings, driving business owners to take necessary actions to achieve such labels |
| A letter written by the Minister of Economic Affairs and Climat to all businesses of the Netherlands is perceived as stimulating |
| A signed commitment agreement of energy cooperative members to implement sustainable measures drives business owners to contribute to the cooperative |
| The prohibition of diesel or fossil fuel-powered delivery vans within the inner city ring by 2025 forces entrepreneurs to transition to alternative options |
| The presence of an organisational grade is crucial for the development of energy cooperation |
| The collaboration of Hessenpoort with Invest NL on developing contract structures for SEH progresses EC |
| Subsidies become available once an organized entity has been established, emphasizing the importance of formal structure |
| The pioneering role of several large companies in the energy transition leads stimulates other companies on the businesspark |
| The sharing of knowledge by energy cooperative ECUB on establishing an energy cooperative, through a publicly available handbook, accelerates the development of energy cooperatives |

Table 4.4: Generic drivers influencing EC on business parks, mentioned by experts

| Solutions |
|---|
| An automated system that facilitates the exchange and financial settlement of energy transactions |
| A private network outside the traditional grid, though complete disconnection is deemed impractical |
| A single connection (group contract) results in more efficient use of the grid and more available capacity for businesses |
| A "direct line" behind the meter with an exemption from the ACM |
| Importance of having a company that can persuade others, take the lead, and align others with its vision |
| Making significant impact on businesses' their core business is most effective in influencing them |
| Implementation of sprint sessions across the Netherlands to bring together stakeholders and address problems |
| Importance of aiding businesses with minimal effect on their operations, providing resources, knowledge, and manpower |
| Firm decisions made by municipalities, such as shutting off gas supply in specific areas, can accelerate ET and EC on BPs |
| Development of conditional consumption capacity contracts for commercial battery operators to prevent grid overload |
| Establishment of clear agreements on business park grid connections and balancing of consumption and production, whereby Enexis always can cut the capacity in emergency situations |
| Addressing issues at the appropriate level |
| Bottom-up approach is considered the best way to support the energy transition on business parks |
| Combining multiple small-scale connections as a viable solution to enable energy backfeeding |
| Importance of business parks developing clear plans for the coming 5 to 6 years to assist with Enexis' planning and implementation of infrastructural changes |

Table 4.5: Generic solutions for EC implemenation on business parks on business parks, mentioned by experts

# 5 Case studies

This chapter delves into the reviewed cases and the results from the conducted interviews with case-specific participants.The categorization from Chapter 2.6 will be used as a base to distinct the found factors (barriers, drivers and solutions) in different categories. However, the results yielded factors that cannot be subsumed in those categories. Next to the original categories, additional categories will be displayed, based on the collected qualitative data from the interviews.

Currently, all business parks in Overijssel are dealing with transmission congestion for feeding in electricity for large-scale-connections (3 x 80 Amperes), no congestion on consumption exists (Appendix A.12, Figure A.5 and Figure A.6. However, for the whole province of Overijssel, it is unavoidable that transmission congestion for consumption will arise, "It is not the question if, it is the question when. ", (GRID, 2023).

The case studies will be described as follows. First, the characteristics of the business park will described, as well as the characteristics and phase of energy cooperation on the park. Furthermore, the key actors accompanied with their expectations, visions and roles will be described. Additionally, the barriers to and drivers for energy cooperation on the business park will be evaluated, combined with possible solutions. Finally, recommendations will be given to accelerate energy cooperation implementation.

## 5.1 Case 1: Groot Verlaat Steenwijk

### 5.1.1 Characteristics of park

Business park Groot Verlaat in Steenwijk is an existing business park of 75 hectares, housing 72 companies. The businesses park exists already for 40+ years (Archieven.nl, 2023). The companies are of a diverse nature and no heavy process industry companies are existent on this park. As can be in Appendix Figure A.1, a small part of the companies has solar panels installed on their roof. This shows that there are definitely companies serious about sustainability, but that there is still potential to further make the sustainable transition. The business park has no mandatory membership (BIZ), because the members highly value voluntarism, "If we do the right things, other companies will join naturally, and that works very well.", (1PM, 2023). The active business club in the municipality is an important factor uniting the companies on the business park. The business club exists for 30+ years and has around 300 members in the municipality of Steenwijkerland.

### 5.1.2 Current state of collective initiative

Currently, no SEH is being developed. However, there is a "working group" of 3 companies together with the park management and business club that has collected the electricity consumption data of the 15 largest consumers on the business park, because "Having insight into the current situation is crucial in order to take appropriate future steps" (1PM, 2023). This working group has originated from a so-called "Sprint session" in end of 2022, whereby the province of Overijssel took the initiative gather all relevant stakeholders internal and external to the business park. The municipality, six business owners, the local grid operator and province were present to discuss the difficulties and possibilities around energy on the park. The session yielded a demand for insight in consumption data, business owners wanted this. Currently, the existing consumption and future consumption, including electrification of mobility, is being investigated. In terms of a solution for the congestion problems on the park, a collective battery was proposed, a wish from the business owners. After the session, the business owners received a "golden envelope" which appeared to include a subsidy, however it was only a form of advance financing, whereby the business owners had to repay the funds with interest. Shortly thereafter, three companies of the park, together with the park management and business club, started the working group, to further detail the plans. The park manager is disappointed in the municipality, which after the sprint session did not once get in contact about the continuation of the project, "Is the energy transition always the responsibility for the business owners and park management?" (1PM, 2023).

There is not one dominant company leading the process of developing energy cooperation, however, the 3 companies of the working group can be seen as frontrunners (1COM.B, 2023). Currently, three quotations are being developed at engineering consultant companies, which will analyze the current and future electricity consumption data and will give recommendations based on that analysis. Also, it is being investigated if electricity can be physically exchanged between companies, circumventing the electricity grid. The recommendations will yield concrete solutions and applications of technological innovations, as well as smart approaches in combining the consumption and generation of electricity. Consequently, the working group will show the results of the analysis to the local grid operator, to determine what the possibilities are on the electricity grid. The goal of the working group would be to realize electricity storage on the business park. If the local grid operator will allow the business park to realize electricity storage, the working group will approach the other companies on the business park.

### 5.1.3 Key actors

In this chapter, the key actors that are involved in developing energy cooperation on Groot Verlaat will be reviewed. For the interviewed actors, the expectations and visions will be displayed. Also, all actors the roles they currently have and the roles they are ought to have - according to interviewees - will be displayed. In Figure 5.1 the most important roles of and relations between actors are presented. A green line entails that an actor has a driving influence on energy cooperation, a red line means the actor is obstructing EC development. Details on roles and relations can be read in this sub chapter. On the next page, the interviewed participants for this case can be seen. For reference and anonymity, the participants are given a unique ID.

| Participant ID | Job position |
|---|---|
| 1COM.A | Manager of company active in concrete industry. |
| 1COM.B | Owner of company active in recycling industry. |
| 1PM | Park manager on the business park. |

Table 5.1: Interview participants for this particular case

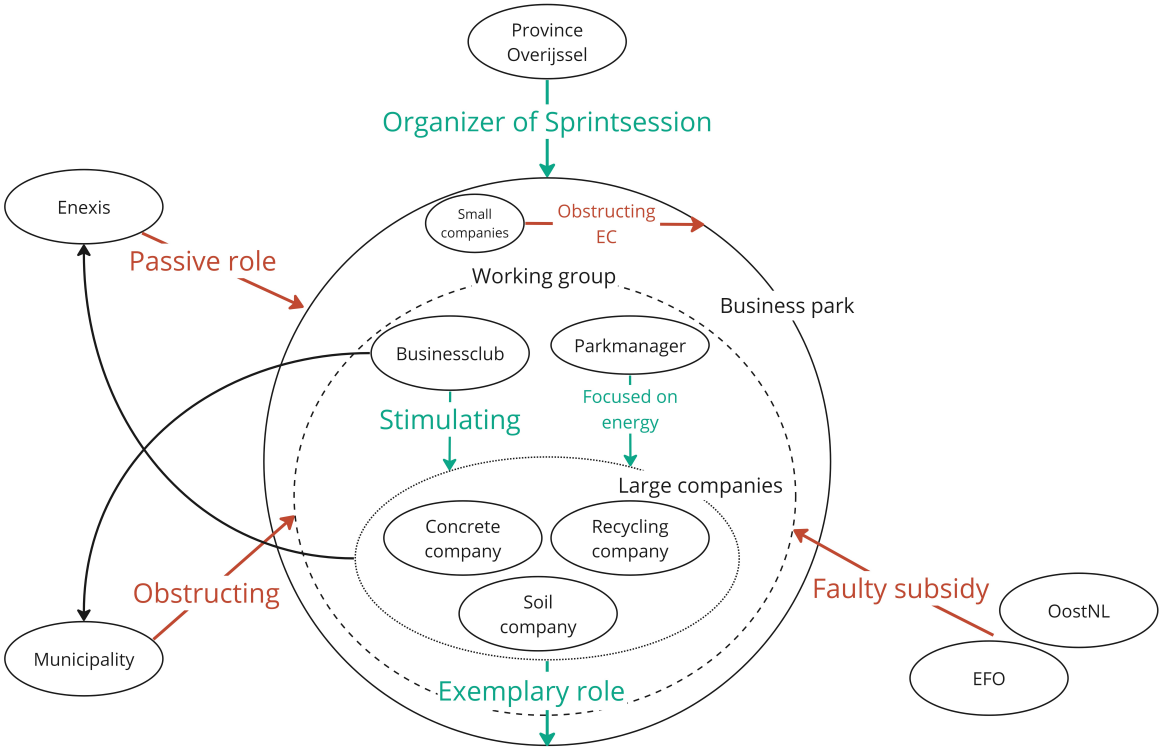



Figure 5.1: Actor chart displaying the most important roles of and relations between actors on and surrounding Groot Verlaat

#### 5.1.3.1 Park manager

The park manager has 10+ years experience as park manager and has fulfilled this role since 2015 on Groot Verlaat.

**Expectation and vision**

The park manager expects that in the coming 5 years, an energy hub or electricity storage is realized, in collaboration with the energy landscape surrounding the business park. Sees Groot Verlaat as an example for the other business parks in the municipality.

The business club, and the business park as a whole does not have a long-term vision. However, the park manager argues that municipality from Steenwijkerland should not only focus on solar energy, but should also include other energy sources such as biomass and biogas. This, because a conducted research has shown that these kinds of energy sources have a higher potential of accounting for the consumption compared to the situation where only solar energy would be used.

**Role**
The park manager is actively leading the energy working group on the business park and is fully focused on the topic of energy. Also, the park manager submits subsidies for individual sustainable projects from companies on the park. The energy projects are carried out together with the business club.

#### 5.1.3.2 Company concrete industry

This company is active in the concrete industry and is a branch location of multiple locations in the Netherlands.The branch on Groot Verlaat employs around 30-40 people. They have just installed 350 solar panels on their roof. This sustainable energy measure was financed without subsidies. In winter, the offices are being heated with the air conditioning units, which increased the electricity consumption of the company. The company would like to cover an open space with solar panels, similarly solar-carports. The company is open to collaboration and physical energy exchanges with other companies. The electricity consumption data from the company was shared with the business club and park manager.

**Expectation and vision**
The manager expects that their electricity consumption will increase through electrification of forklifts and employee cars.

The company has no clear vision for energy cooperation on the business park, however, their motivation to join an energy cooperation project would be cost reduction and the willingness to be a good neighbour for other companies.

**Role**
Currently, this company is part of the "working group", consisting of one other company in the ground displacement industry and the other interviewed company in the recycling industry. Together with these two companies, this company can be seen as one of the front runners and leaders of energy cooperation on Groot Verlaat.

#### 5.1.3.3 Company recycling industry

This company is active in the recycling industry and has only one location. In their business, circularity is highly valued and they try to close as much material cycles as possible. The company has around 40 employees.

**Expectation and vision**
The owner expects that in one year an inventory of the largest electricity consumers on the business park (20-30) has been made and that the currently pending research is finished, yielding concrete outcomes, which can be presented to the local grid operator for approval.

The respondent finds that business park Groot Verlaat, being the largest business park of the municipality, has an exemplary function to the other business parks in the municipality. The respondent envisions that the business park will be part of a larger energy landscape, whereby the business park is coupled with a solar field external of the park. The envisioned landscape is a combination of solar, wind, biomass, hydrogen and waste heat. The coupling of these different energy sources should be possible in 5-7 years according to the business owner. Cable pooling will be used and all the different energy sources will be working together optimized. The respondent expects that a profitable business case can be made with this setup, where the local community will be benefiting from. The proposed organisational form is a "PPS", a public-private-partnership with the municipality. Together with the business club, the respondent prefers to be pro-active and direct this project singlehandedly, instead of being obliged to carry out certain energy projects. Also, the owner prefers to locally own the energy assets for 100%, as a collective.

**Role**
The role of the company is similar to the other interviewed company: part of the energy working group, consisting of three companies and the park manager.

However, the role of the respondent is broader. The business owner is also part of the board of directors of the local business club and part of the board of the directors of a large energy collective, which has a consultancy branch as well, advising municipalities. This explains the detailed and broad long-term vision the respondent has. The respondent can be seen as an important link in the local network.

### 5.1.4 Network alignment

Below, the network alignment between interviewed actors is presented in a table. As can be seen, a high level of alignment exists between the interviewed actors. All actors want to collaborate with other companies on the business park. In terms of ambition level, the park manager and concrete company score medium, because they want improve their and the business park's sustainability, but do not know how. Their vision for the business park is a bit vague. The recycling company, however, has a clear vision for their own company and for the future of the business park.

| Respondent | Ambition level | Collaboration intention level |
|---|---|---|
| Park manager | Medium | High |
| Company Concrete Industry | Medium | High |
| Company Recycling Industry | High | High |
| Average dimension value | 3,67 | 5 |
| | | |
| Network alignment | 4,33 | |

Table 5.2: Fairly high level of alignment of interviewed actors on Groot Verlaat

#### 5.1.4.1 Municipality

Unfortunately, time has shown that the municipality has not been available for an interview, thus the expectations and visions around energy cooperation could not be identified. Currently, Groot Verlaat does not receive any funding for sustainability from the municipality, but the business club is working on it. According to the owner of the recycling company, it appears that the business club from the municipality will receive a subsidy from the municipality starting in 2024, to carry out various sustainability activities, including activities for the Groot Verlaat business park. In the meantime (until 2024), the municipality intends to act as the client for tasks such as conducting an analysis of network congestion (1COM.B, 2023).

**Role**

The owner of the recycling company has, together with the business club, been engaged for 12 years in the endeavor of establishing a wind turbine, "the municipality has been very restrictive in this process". However, since last month, the municipality has has expressed its intention to pursue the establishment of a wind turbine (1COM.B). Currently there is some financing from the municipality towards the business park, to cover the working hours of investigating the potential of energy cooperation on the business park. However, the decision process regarding transferring the funds to the receiving party is a cumbersome process. The municipality finds it difficult to make a choice between multiple potential parties and is not certain if the funds are used in the manner that is agreed. This slows down the process of receiving funds tremendously (1COM.B, 2023). Another restrictive factor is the short duration of employment at the municipality, resulting in repetitive knowledge gaps. Not having a fixed contact person severely slows down the process of building a sustainable relationship between business park and municipality. According to the owner of the recycling company, the municipality is certainly not a frontrunner and "finds it all very difficult", (1COM.B,2023).

According to the manager of the concrete company, the municipality should play a leading role in implementing energy cooperation, however, the manager indicates that the municipality promptly delegates this responsibility to the business club, expecting them to take on that role. Additionally, the municipality should stimulate small businesses on Groot Verlaat to join energy cooperation projects. Furthermore, the municipality should also exert more pressure on the grid operator to convey the urgency that the grid operator has an important role in enabling energy cooperation between parties. Also, a representative from the municipality should be responsible for the business park and engage non-member companies through direct outreach. This outreach should involve visiting these companies in person, presenting them with a detailed plan from the business club, and effectively communicating the benefits and objectives of energy cooperation (1COM.A, 2023).

#### 5.1.4.2 Business club

The business club is active in the whole of municipality Steenwijkerland and is not bound to one business park. The club has around 330 members. The club has a good relationship with its members and the municipality.

**Role**

Currently, the business club is actively stimulating the energy transition on the business park, together with the park management. Periodic meetings are organised where is discussed how the energy transition can be accelerated on the business park.

When asked how to accelerate energy cooperation on Groot Verlaat, the manager of the concrete company proposed that the business club should design a detailed plan (1COM.A,2023). Also, the business club could allocate funds to reimburse the expenses for the hours worked, via the account managers of the club (1COM.B).

#### 5.1.4.3 Province of Overijssel

The province of Overijssel took an important initiative in organising a sprint session on Groot Verlaat. This was the starting point for the business park to investigate the potential of energy cooperation. As stated earlier, three large businesses, the park management and the business club continued after the session by organising a working group which holds periodic meetings. The province's initiative can be seen as crucial to energy cooperation development on this business park.

#### 5.1.4.4 Local grid operator

Expectations and visions of Enexis can be read in Chapter 4.

**Role**

There currently is no active role of the local grid operator on the business park. However, according to the interviewees, the grid operator should play a much more active role in addressing the network on the business park, given their expertise, capabilities, and access to electricity consumption data (1COM.A, 2023).

#### 5.1.4.5 Other actors

**OostNL**

OostNL and EFO provided the business club with a subsidy after the sprint session, however in retrospective, the funding received was merely a form of advance financing, requiring repayment with interest. According to the owner of the recycling company, these kinds of initiatives don't help (1COM.B, 2023).

**Energie Fonds Overijssel (EFO)**

This fund is focused on sustainable energy projects and provides funds and loans to businesses and households. In 2022 M29.4 EUR was invested (E. F. Overijssel, 2023). This party also played a role in providing the businesses from the business park with a (false) subsidy, together with OostNL, as explained earlier.

**Large companies**

The larger companies on the business park that are member of the business club are the driving force on Groot Verlaat (1COM.A,2023). As mentioned earlier, more implicit, the three companies of the working group are considered large as well, confirming the role large companies have on the business park.

### 5.1.5 Factors influencing energy cooperation

In this sub chapter, the barriers, drivers and solutions that are specific to Groot Verlaat are covered, factors that apply to business parks in general are left out in order to remain focused on the specific case. In Appendix A.23, all mentioned factors by interview respondents can be read in a more elaborated way. In the appendix, context is provided for each factor, and it also indicated which respondent mentioned which factor. In Appendix A.22, a table is provided, listing all mentioned factors for each case. This table is structured along the main factor categories as proposed in Chapter 2.6 and per factor it is indicated to which sub categories the factor belongs. Now, the barriers, drivers and solutions that are specific for Groot Verlaat will be listed.

| Barriers |
|---|
| Roof structure insufficiently strong |
| Fear for fire safety of solar panels |
| Passive role of municipality |
| Non-efficient, time-consuming meetings organised by municipality |
| Short duration of employment municipality |
| Difficult to come to concrete action with local grid operator |
| No commitment and engagement from municipality after session |
| Business park has no long-term vision |
| Providing false subsidies by OostNL and EFO |
| Size-diversity of companies (difficult involving small companies) |
| Knowledge gaps in technological possibilities and costs |
| Knowledge gaps in laws and regulations |
| Responsibility gap regarding energy transition on BP |
| **Drivers** |
| Limited number stakeholders for decision-making |
| Business club avoids reinventing the wheel, seeks support where needed |
| Pro-activity and ownership from business club and working group |
| Being less dependent on energy suppliers |
| Regulations / work descriptions from industry association |
| ET on BP supports municipality sustainability goals |
| Business club, businesses and PM can act quickly due to strong relationship |
| Nearby energy generation (solar field) |
| **Solutions** |
| Additional allocation of resources by business club to reimburse worked hours |
| BP being part of large energy landscape |
| Receive help of consultant with prior experience in EC development |
| Relieve small businesses with early-stage tasks for EC development |

Table 5.3: Specific factors mentioned by respondents for Groot Verlaat

## 5.2 Case 2: Twentekanaal Hengelo

### 5.2.1 Characteristics of park

Business park Twentekanaal in Hengelo is an existing business park of 231 hectares, housing around 320 companies. The business park was started developing in the 1930's (Planviewer, 2023) The companies are of a diverse nature, both in size and profession. The park houses a few large companies where high energy consuming or producing processes are part of the business, such as Nobian and Twence. Nobian is an industrial scale chemical producing company. Twence is the local waste management company and produces energy (electricity and heat) with waste incineration. Besides, this company owns four solar parks nearby, combining in 46.7 MW output power (Twence, 2022). These two companies are part of the CES, Cluster 6 policy. In fact, Twence, the waste processor, and Nobian, a chemical company, have even signed a letter of intent with the ministry to become climate-neutral by 2030, resulting in substantial gas savings. As can be in Appendix Figure A.2, a small part of the companies has solar panels installed on their roof. This shows that there are definitely companies serious about sustainability, but that there is still potential to further make the sustainable transition. The park does have no mandatory membership (BIZ), but does have a business club with park management, specifically for the companies on Twentekanaal. In 2010, it was attempted to arrange a BIZ-organisation on the park, but the business owners voted against it (Buisman, 2010). Once every two months, the business club meets with the municipality of Hengelo. In general, the larger the company, the more progress has been made in considering sustainability. They understand that a collective approach is the only option in the energy transition (2PM, 2MUN, 2023). It is suggested that this is likely due to the fact that larger companies face stricter laws and regulations, such as the Energy Conservation Obligation and the "label-C obligation" for office buildings, as well as self-conducted energy audits (reporting on Sustainable Development Goals) for truly large corporations.

### 5.2.2 Current state of collective initiative

Currently, the business club and park management have successfully brought together a group of several large energy consumers on Twentekanaal, responsible for 30% of the total consumption, to share their energy consumption/production profiles, which will be analyzed and compared. For large companies, water usage was included as well. The business club removed a barrier, by providing all companies on the park with free energy-consumption-measuring-tool (P1-meter).

Desired outcomes of the analysis entail combinations of parties with complementary energy and / or water usage and / or production. The park management (along with a voluntary working group on the topic of energy) is in the process of developing a multi-year plan for the next three years and beyond. They have engaged an external consulting firm (Transitiemakers) to assist in this endeavor. The objective of this plan is to establish concrete solutions and projects. In the upcoming members' meeting, the intention is to request a one-time contribution from business owners, for one year, with the municipality covering the remaining costs. This, to cover the worked hours of the park manager and the external consulting firm for carrying out the consumption research and developing the multi-year plan. For the years 2024 and 2025, the municipality has also committed to providing a contribution, contingent upon co-financing from other sources. Furthermore, conversations about potential collaboration have took place between an existing energy collective (Energie van Hengelo) and the business club. The energy collective will realize a solar park in close proximity to the business park, which is expected to be finished in 2024 (EnergievanHengelo, 2023). According to the park manager, there many companies on Twentekanaal that recognize the problem of transmission congestion that are actively engaging in collaborative discussions for finding solutions. Business owners even want to realize an energy hub. However, the current phase marks a shift towards more substantive discussions and requires increased capacity from the business club to address these complex issues effectively. There is a need for additional resources and expertise within the business club to meet the demands of these in-depth challenges. (2PM, 2023), (2MUN,2023).

### 5.2.3 Key actors

In this chapter, the key actors that are involved in developing energy cooperation on Twentekanaal will be reviewed. For the interviewed actors, the expectations and visions will be displayed. Also, all actors the roles they currently have and the roles they are ought to have - according to interviewees - will be displayed as well. In Figure 5.2 the most important roles of and relations between actors are presented. A green line entails that an actor has a driving influence on energy cooperation, a red line means the actor is obstructing EC development. Details on roles and relations can be read in this sub chapter. Below, the interviewed participants for this case can be seen. For reference and anonymity, the participants are given a unique ID.

| Participant ID | Job position |
|---|---|
| 2COM.A | Director of company active in recycling industry. |
| 2MUN | Employee of Gemeente Hengelo, focusing on sustainable transition of businesses and business parks. |
| 2PM | Park manager on the business park (same as for Groot Verlaat). |

Table 5.4: Interview participants for this particular case

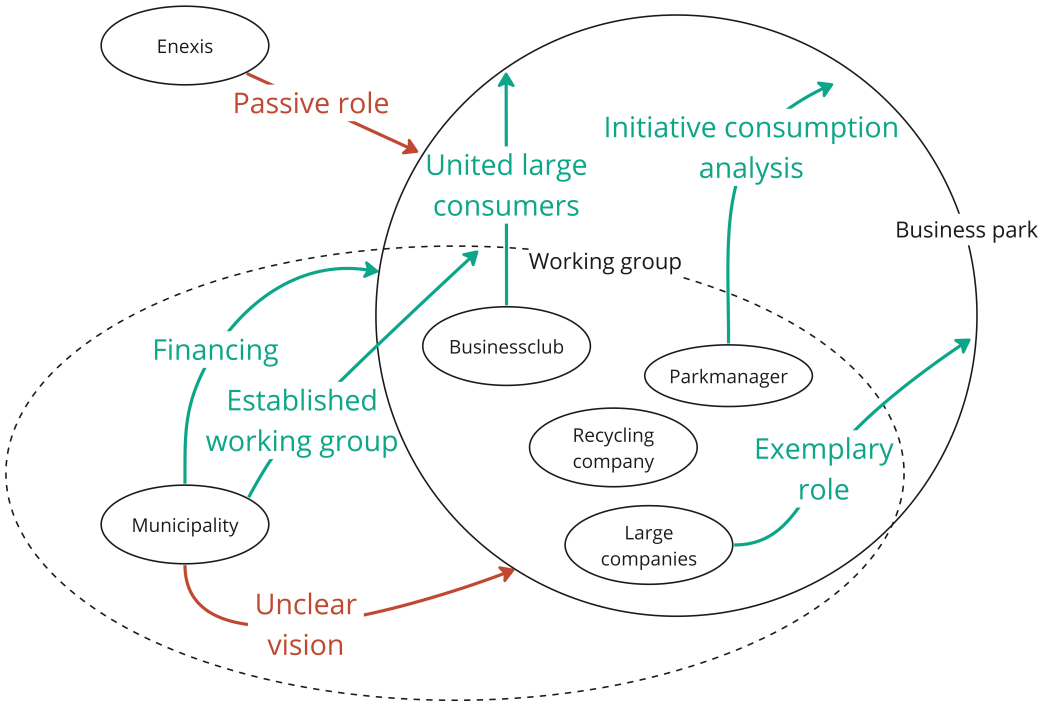



Figure 5.2: Actor chart displaying the most important roles of and relations between actors on and surrounding Twentekanaal

#### 5.2.3.1 Park manager

The park manager has 10+ years experience as park manager and has fulfilled the role on Twentekanaal since 2020.

**Expectation and vision**

The vision of the park manager for Twentekanaal in the next 20 years is to generate energy locally and consume it as much as possible within the local area. The aim is to establish intelligent energy management systems that reduce dependence on external sources.

The park manager believes that investing in the initiative from the energy working group is valuable for the municipality because the plans are driven by the businesses themselves (bottom-up), rather than being solely devised by the municipality and then in turn needing to be embraced by the business owners. According to the park manager, this approach ensures that the plans have greater acceptance and support from the business community, making them more effective and sustainable in the long run.

**Role**

The park management took the initiative to investigate the energy consumption profiles of the largest companies on the business park. The companies were approached by the park manager.

Furthermore, the park manager is part of the working group on the topic of energy on Twentekanaal. The group will develop a multi-year plan for the next three years and beyond, which are desired to yield concrete proposals for coupling companies with complementary energy profiles.

The park manager sees their role as a catalyst, having been instrumental in bringing the initiative to its current stage. The current phase requires more substantive engagement and increased capacity from the business club to address these complex issues effectively.

According to the recycling company, the park management should create a framework agreement for the exchange of energy between parties, which should be well-defined and tightly regulated.
The park manager emphasizes that the current situation does not necessarily rely on a single party taking the lead, but rather requires collective effort to align consumption profiles and explore possibilities. This collaborative approach involves consultation with the network operator to assess available capacity and determine the feasibility of implementing a pilot project for a smart energy hub.

#### 5.2.3.2 Company recycling industry

A director of a company active in the recycling industry was interviewed. The company consists has multiple locations in the Netherlands, with around 30-40 employees. On the location on business park Twentekanaal 5-10 employees are active.

Currently, the director did everything possible to reduce energy consumption, such as installing led lighting and energy-efficient electric motors for their business processes. The company did not have the possibility to install solar panels on their roof. Also, the business processes carried out on terrain yield dust, which would fall down on the panels, negatively affecting the efficiency and thus output. However, to ensure sustainable energy use, they purchase 100% green energy at Pure Energie. Ultimately, they would like to have a wind turbine, but discussions regarding this matter are still in very early stages.

**Expectation and vision**

For their own company, the director expects the electricity consumption to increase due to electrification of diesel shovels.

The recycling company's primary motivation to participate in the working group and energy cooperation in general, stems from its commitment to cost reduction and the cultivation of a green image, which strongly resonates with their corporate philosophy of minimizing CO2. Their pursuit of this goal is driven by both their intrinsic motivation to reduce CO2 emissions, which is a fundamental aspect that should be ingrained in the strategy of any company operating in the recycling sector, according to the director (2COM.A).

The director expects that a collaborative partnership between multiple companies for energy exchange within 5 years is highly ambitious. This is because it is believed that large-scale energy generation will not be feasible within that time frame and the current electricity grid is not suitable.

Looking ahead 10 to 25 years, the director expects that collaboration and energy exchange between companies will certainly be possible. This is driven by the serious commitment of several large-scale companies on the premises to generate energy and their expressed willingness to share it with fellow companies on the site.

The vision of the company director for the business park in 2030 is to achieve self-sufficiency, potentially incorporating a wind turbine on the business park, with well-aligned complementary energy profiles. The company is already contemplating its potential role in an energy exchange or energy cooperation approach with other businesses, enabling direct utilization of solar energy from neighboring companies.

**Role**

Currently, the recycling company is part of the working group that consists of the park manager, the business club, municipality and other companies. They do not have an active role in this group, but are participating in every activity the group organizes.

#### 5.2.3.3 Municipality

**Expectation and vision**

The expectation for the energy transition at Twentekanaal within the next 5 years is that active efforts will be made to establish an Energy Hub. This expectation is driven by the desire of various business owners for an energy hub, the willingness to cooperate from companies, the existence of a working group, the ongoing discussions with the energy collective (Energie van Hengelo) and the significant potential that exists for realising such hub. With a controllable energy source in the form of the waste management company Twence, a local solar field, and limited transport capacity on the grid, Twentekanaal could serve as an excellent 11th (relating to 10 current SEH pilots) pilot in the opinion of the municipality employee. The respondent believes that Twentekanaal is already more developed than other energy hub pilots due to existing organisational structures and the sharing of consumption data among major energy consumers (2MUN, 2023).

The vision for energy cooperation at Twentekanaal for approximately 10-25 years is that energy cooperation becomes a requirement. Twentekanaal should be seen as an integrated area rather than individual companies occupying a piece of land. Twentekanaal becomes a unified entity comprising various businesses. An energy hub is established, incorporating smart grid solutions and storage facilities, where companies automatically share energy data. Controllable power is then managed through automation. Companies must align with the energy profile, meaning that when a company leaves, only a new company fitting within that energy profile can join the hub (2MUN, 2023).

**Role**

The municipality has established three working groups, which they are part of themselves as well, having a facilitating role. These working groups are on the topics of: energy, nature, and mobility, with the energy group being the most active (2MUN, 2023),(2COM.A, 2023). In 2022, the municipality provided a small subsidy to support the working group in dedicating additional hours to work on the multi-year plan that is being developed (2PM, 2023).For the years 2024 and 2025, the municipality has committed to providing a contribution to the working group, contingent upon co-financing from other sources. This is a stimulating action from the municipality (2PM, 2023).

According to the municipality employee, the municipality can facilitate in terms of information by instructing account managers to inform and stimulate businesses to join an energy cooperation initiative. Additionally, the municipality can provide financial facilitation or incentives, such as co-financing, to kick-start the process. Financial facilitation serves as a catalyst to ensure the self-sustainability of energy cooperation in the long run.

According to the park manager, the municipal vision and policy for the next 5-6 years on the topic of energy is far from clear. This is perceived as hindering in developing sustainable projects, leaving businesses uncertain about making the appropriate investments. Therefore, the municipality should make clear what their strategy and plan is for the energy transition on business parks. Furthermore, it is stated that smaller businesses should not be burdened with the large challenges of the energy transition, which should be realized by the municipality as well (2PM, 2023).

### 5.2.4 Network alignment

Below, the network alignment between the interviewed actors can be observed in Table 5.5. Two out of three actors have a high ambition level. The park manager envisions a business park where sustainably generated energy is consumed locally as much as possible, with the help of an efficient energy management system. Also, companies on the park have indicated that they would like to develop an energy hub. The recycling company want to be as sustainable as possible, because they believe that is what a company in the recycling industry should stand for. The municipality has a medium ambition level, because they have ambitions sustainability goals, but their vision for the energy transition on business parks is not entirely clear. The collaboration intention level of the park manager and recycling company are high. Both are part of the working group and are willing to perform tasks to progress the energy cooperation initiative on the business park. Although the municipality has initiated the working group, their collaboration intensity is ranked medium, because their is a prevalent notion within the municipality organisation that businesses on business parks should solve their energy transition issues themselves. Such notion can have a negative effect on energy cooperation in the long run.

| Respondent | Ambition level | Collaboration intention level |
|---|---|---|
| Park manager | High | High |
| Recycling Industry Company | High | High |
| Municipality employee | Medium | Medium |
| Average dimension value | 4,33 | 4,33 |
| | | |
| Network alignment | 4,33 | |

Table 5.5: High level of network alignment of interviewed actors on Twentekanaal

#### 5.2.4.1 Business club

The business club is specifically focused on the businesses on Twentekanaal and has been present since 1992. The club consists of around 200 members, being only companies located on the be business park (BIT-Twentekanaal, 2023).

**Role**
The business club has successfully brought together a group of major energy consumers at Twentekanaal, accounting for 30 - 40% of the overall energy consumption, with the aim of sharing their energy profiles for analysis. Additionally, there is an Energy Working Group comprising the chairman of the business club, high-consumption businesses, the municipality and an externally hired project leader.

#### 5.2.4.2 National government

**Role**
Although the national government does currently not play a major role in the energy transition, the interviews highlighted multiple roles the national government is ought to have. According to the director from the recycling company, a government obligation requiring companies with a certain level of energy consumption to invest in sustainable measures would be helpful in the future. For example, companies would be required to self-generate or purchase at least 75% of their energy from green sources. This would be beneficial because the company currently refrains from investing extensively in sustainable measures due to competitive reasons. Thus, the government should implement such obligation (2COM.A, 2023). According to the municipality employee, the role of the government in the energy transition, particularly "before the meter," where gas is primarily phased out, is vital. Rather than leaving the task to individual companies, the government should assume the lead role, facilitating and providing guidance. This is especially critical given that companies primarily focus on their own energy supply, not on that of their neighbours. The government can bridge these differing interests by making use of the existing organisational structure on the park. The implementation of solutions like a smart grid or energy hub, however, hinges on the availability of energy profile data. Current General Data Protection Regulation (AVG) constraints prevent grid operators from sharing this data, needing explicit consent from all companies. The respondent suggests that the government should make compromises on privacy within the GDPR, potentially allowing access to building-specific energy consumption data without directly tying it to a specific company or individual, resulting in a large availability of energy consumption data (2MUN, 2023).

**PVB Nederland**
According to the municipality employee, PVB can play a valuable role in organizing information flows between business parks facing similar challenges. It can provide information on current and future laws and regulations, the best approach to navigate processes, and information on the necessary stakeholders that should be involved.

**OostNL**
OostNL could fulfill a role in the provision of data and the provision of financing. Furthermore, the organisation could play a connecting role between various parties (2MUN, 2023).

#### 5.2.4.3 Local grid operator

**Role** The local grid operator is perceived obstructing in the process of progressing energy cooperation. According to the park manager, multiple companies have indicated wanting to develop an energy hub. For such hub, cooperation of the grid operator is needed, where the grid operator should set up a pilot environment. The grid operator indicated that such pilot would not be possible in the coming two years.

**Large companies**
In the context of the energy transition at Twentekanaal, the director from the recycling company finds it encouraging to see several companies taking the lead and showing their willingness to participate in sustainable initiatives. Notably, Thales (chemical producing company) emerges as a driving force, spearheading in the initiative for collective sustainable projects. Twence (waste management company), with its vested interest in the matter, plays a crucial role by actively supplying a significant amount of energy through its district heating network and operating a large-scale solar park. Additionally, there are other major companies making substantial contributions to these initiatives. Recognizing the significance

of these influential players, the park manager emphasizes the importance of collaborating with entities like Nobian, a major chemical company. With its substantial energy demand, Nobian has the potential to make a significant impact on the entire business park. By leveraging the expertise and resources of these prominent companies, the vision of a sustainable and self-sufficient energy ecosystem at Twentekanaal can be effectively pursued (2COM.A, 2023), (2PM, 2023).

### 5.2.5 Factors influencing energy cooperation

In this sub chapter, the barriers, drivers and solutions that are specific to Twentekanaal are covered, factors that apply to business parks in general are left out in order to remain focused on the specific case. In Appendix A.24, all mentioned factors by interview respondents can be read in a more elaborated way. In the appendix, context is provided for each factor, and it also indicated which respondent mentioned which factor. In Appendix A.22, a table is provided, listing all mentioned factors for each case. This table is structured along the main factor categories as proposed in Chapter 2.6 and per factor it is indicated to which sub categories the factor belongs. Now, the barriers, drivers and solutions that are specific for Twentekanaal will be listed.

| **Barriers** |
|---|
| Not investing due to competitive reasons |
| Membership fee from businessclub insufficient to account for EC development |
| Ego-centricity of companies regarding energy supply |
| Limited company motivation to analyse consumption data themselves |
| Inflexibility of local grid operator |
| Short duration of employment municipality |
| Local grid operator unwilling to approve additional pilot-space |
| Municipality policy on ET mainly focused on built environment |
| Not heard of development of energy hubs |
| Knowledge gaps in laws and regulations (energy exchanges) |
| Lack of realisation that neighbours influence own energy supply in collective |
| Energy cooperation is new for parkmanager, choosing between gatherings is difficult |
| Nearby energy generation (solar park), diminishes available grid capacity |

Table 5.6: Specific factors mentioned by respondents for

| **Drivers** |
|---|
| Controllable energy source existent on BP, in form of (wastemanagement) company |
| Signed intention statement between municipality and businesspark |
| Companies are willing to cooperate |
| Large companies are independent and pro-active |
| Local-generation-local-consumption vision from PM |
| Vision-alignment PM and large companies |
| ET on BP supports municipality's sustainability goals |
| Positive attitude province and OostNL towards support of BP |
| Bottom-up support policy from municipality |
| Nearby energy generation (solar field) |
| **Solutions** |
| Networking events are most effective, more attendees than theme-specific events |
| Have extra resources and expertise within businessclub |
| Presentation of expert, sharing challenges and how to deal with them |

Table 5.7: Specific factors mentioned by respondents for

## 5.3 Case 3: Hessenpoort Zwolle

### 5.3.1 Characteristics of park

Hessenpoort is a modern and environmentally-conscious business park from around 300 hectares (Gebiedslabel, 2019), housing 56 businesses (Ondernemersvereniging-Hessenpoort, 2023a). It is not know since when the business park exists, but an approximation is 20-30 years. The business park, primarily occupied by logistics and distribution companies, has relatively few high energy consumers. Nonetheless, it is home to some critical processes - e.g. at Euroma - and well-known companies, such as Wehkamp. This unique composition of businesses has led to the mandatory membership in the park management (BIZ) since 2016, which has proven beneficial (Ondernemersvereniging-Hessenpoort, 2023b). Periodically, the members of the business club and park management gather, to discuss park-related issues. The companies

on Hessenpoort show a firm commitment to sustainability, which is reflected in the amount of solar panels installed on the roofs of the businesses, this can be seen in Appendix Figure A.3. Every new building constructed recently has had its roof entirely covered with solar panels (3COM.A, 2023). This has been made possible, in part, by the robust foundation provided by the business club and the financial commitment from the businesses. Since 2021 a "Smart Energy Hub" is being developed at Hessenpoort, which will be explained later. The park's green initiatives extend beyond energy, with an emphasis on creating a pleasing, natural environment. Current paving will be replaced with growth tiles and walking paths will be established around the park, measures where funding has been allocated for (3COM.A, 2023). There are also 13 wind turbines feeding into the local mid-to-high voltage substation, with plans to add a similar number, connected to the same substation, in the coming years. These developments and commitments have earned Hessenpoort a reputation as a hot-spot for sustainability, "not just in the province of Overijssel, but throughout the Netherlands" (3COM.B, 2023).

### 5.3.2 Current state of collective initiative

Currently, the capacity of all the installed roof-solar power is 180 MW, whereas the grid connection is only suitable for 100 MW (NetbeheerNederland, 2022). This entails that many businesses cannot feed in their excess solar energy. It is expected by national grid operator Tennet and local grid operator Enexis that the transmission congestion surrounding substation Hessenweg, near Hessenpoort, would last around 10-15 years (Enexis, 2022). The existing transmission congestion is one of the main reasons for the development of an energy hub. The energy hub was initiated by an ambitious and socially engaged business owner in need of hydrogen, (OostNL, 2021), who has invested in an electrolyzer for own usage. The investor expects that this electrolyzer can be used as well by the future energy generation in the region of Zwolle. The construction starts in 2023 (3COM.B, 2023). After the investor was supported by the business club and park management - striving for self-sufficiency - the municipality saw the potential of this initiative and provided financial resources and allocated time to support the project. The municipality of Zwolle opted for a more action-oriented approach, emphasizing doing and experimenting rather than conducting extensive research. After the municipality joined the initiative, the province of Overijssel and OostNL joined as well. In 2022, the business club and park management from Hessenpoort formed an energy collective to be able to fully focus on energy, currently consisting of 11 companies (3MUN, 2023), (RTVOost, 2022).

The electrolyzer will produce hydrogen from excess solar power and the simultaneously produced oxygen will be used in a wastewater treatment plant on the business park. Early results show that usage of pure oxygen will lead to a 50% energy reduction from the treatment plant (H2O-Waternetwerk, 2022). With this initiative, the business owner is helped with hydrogen and simultaneously helps other companies with handling their surplus solar energy. In addition to the roof solar power, the business park has been exploring other forms of sustainable energy. For instance, the "Zonneweide Hessenpoort" solar park has been operational since 2020 and supplies electricity to the companies. Also, there are plans to establish a biogas installation in the vicinity of the park at a waste management company, further diversifying the park's energy mix (Gemeente-Dalfsen, 2022). Currently, the only heat demand on the park is from office buildings and a herb drying company (Euroma), being the reason that a heat network is currently not considered. Though, Euroma has a massive heat demand, with gas pipes of 80 cm are flowing towards. However, there are plans to transition to hydrogen boilers or use residual heat (3COM.B, 2023).

In 2022, companies united in Energy Cooperatie Hessenpoort. The members shared their energy consumption / production data, with the goal of sharing and exchanging contractual capacity. In late June 2023, the first pilot will be operational, whereby three companies will exchange connection capacity with each other and have a group contract at the local grid operator. For this, a collaboration agreement has been signed between the business park and the local grid operator (4HUB, 2023). "Fortunately, we can approach these contracts pragmatically, meaning that the contracts can evolve over time." An agreement has been made with the local grid operator that the contracts will be adjusted based on evolving insights (3MUN, 2023). On the moment of writing, all hardware is being installed and prepared. By smart exchange of capacity, the pilot will accomplish the feeding-in of all solar generation from one company, where feeding-in was not even possible before. This is accomplished by combining a few small-scale connections, because with a small-scale connections one is able to feed-back energy to the grid. For the consumption connection as well, the previously three separate connections and contracts are now merged into one connection and thus one contract between the three companies and the grid operator. The local grid operator granted permission for this pilot to be operational, contingent upon the condition that the solar installation from all three companies can be directly deactivated on the prompt of the grid operator, as grid-protection mechanism. These three companies are on the same "string", which is a connection from a substation to the businesses and is a measurable entity for the local grid operator (3COM.B, 2023).

In terms of financing, the business club has been in contact with the municipality to secure funding to hire external consultants for the further development of the energy hub and to account for the worked hours by one member of the energy cooperative Hessenpoort, who works 15-20 hours per week, entirely focused on the energy hub. "It's a few hundred thousand euros per year, until the organization can stand on its own feet" (3COM.B, 2023).

### 5.3.3 Key actors

In this chapter, the key actors that are involved in developing energy cooperation on Hessenpoort will be reviewed. For the interviewed actors, the expectations and visions will be displayed. Also, all actors the roles they currently have and the roles they are ought to have - according to interviewees - will be displayed as well. In Figure 5.3 the most important roles of and relations between actors are presented. A green line entails that an actor has a driving influence on energy cooperation, a red line means the actor is obstructing EC development. Details on roles and relations can be read in this sub chapter. Below, the interviewed participants for this case can be seen. For reference and anonymity, the participants are given a unique ID.

| Participant ID | Job position |
|---|---|
| 3COM.A | Manager of branch of large company in wholesale and installation industry. |
| 3COM.B | CEO of company active in acquisition in metal- and tools industry. |
| 3MUN | Externally hired project leader for gemeente Zwolle. |

Table 5.8: Interview participants for this particular case

#### 5.3.3.1 Company wholesale industry

The CEO of a company active in the wholesale industry was interviewed. The company has one location in the Netherlands, on business park Hessenpoort, with around 50-60 employees.

Next to being CEO of the company, this respondent is as well chairman of the business club, the recently formed energy collective and the energy collective of the existing solar park. The respondent has a sustainable mindset and states wanting to be an example for other companies. The CEO is not motivated by the economic benefits energy cooperation can bring, only by being an example and sustainability. "Whether it yields 2 or 3 thousand euros per year, I don't care." (3COM.B, 2023).

In terms of sustainability at the company location on Hessenpoort, the company is forward-thinking and pioneering. The existing 20-year old building (sold last year) has been made energy-neutral with the help of 1100 solar panels and led lighting. Also, the company uses infiltration tiles to stimulate the infiltration of rain water. The majority of the generated solar energy (in the existing/current building) is consumed directly, except on weekends. There is still sufficient capacity for energy to be exported back to the grid, based on a return capacity of 300,000 kW (as of 2017). It is worth noting that the peak of 300,000 kW occurs only for 10 days per year. Energy consumption and export are monitored on a minute-by-minute basis. Furthermore, a new building is currently being constructed, which meets GPR standards with a score of 8.5, which can be considered to be one of the highest sustainability standards for buildings.

**Expectation and vision**

The respondent expects that this year, all significant companies will be connected to the energy hub within the energy collective. This will enable integral energy exchange to be organized at Hessenpoort. Ideally, all companies should be included, but companies with only offices are not of interest in terms energy profile. Involving large companies in the energy will result in the actual gain of energy feed-in capacity. The revenue model still needs to be determined. Together with the other two companies in the before-mentioned pilot, the company has agreed not to overwhelm each other with calculations of costs. They have decided to implement this solution, with each company covering costs up to a certain amount, in order to prove the local grid operator it works. Also, the solution is implemented to serve as an example for other companies, considering the bigger picture of the transmission congestion, "Whether it yields 2 or 3 thousand euros per year, it doesn't matter.' (3COM.B, 2023).

In the long-term vision, the goal from the energy collective on Hessenpoort is to achieve the energy targets by 2030. Currently, energy generation covers 20% of the energy demand at Hessenpoort. The objective is to be net positive in terms of energy generation, to compensate for the environmental impact of the business park in the Zwolle area, such as mitigating the impact of freight traffic, with the aim of "giving something back to the residents of Zwolle.". The respondent envisions the ideal scenario of having one or multiple cold storage facilities at Hessenpoort, for energy storage purposes. By 2050, the ultimate goal is to become fully "energy-neutral-plus". The "plus" symbolizes the commitment to support the energy-related needs of the municipality of Zwolle.

**Role**

This company and the CEO have a significant influence on the energy-related developments of Hessenpoort. With all the secondary postions to being CEO, the respondent actively drives the development of the energy hub, together with the park management and the other companies that are part of the energy collective.

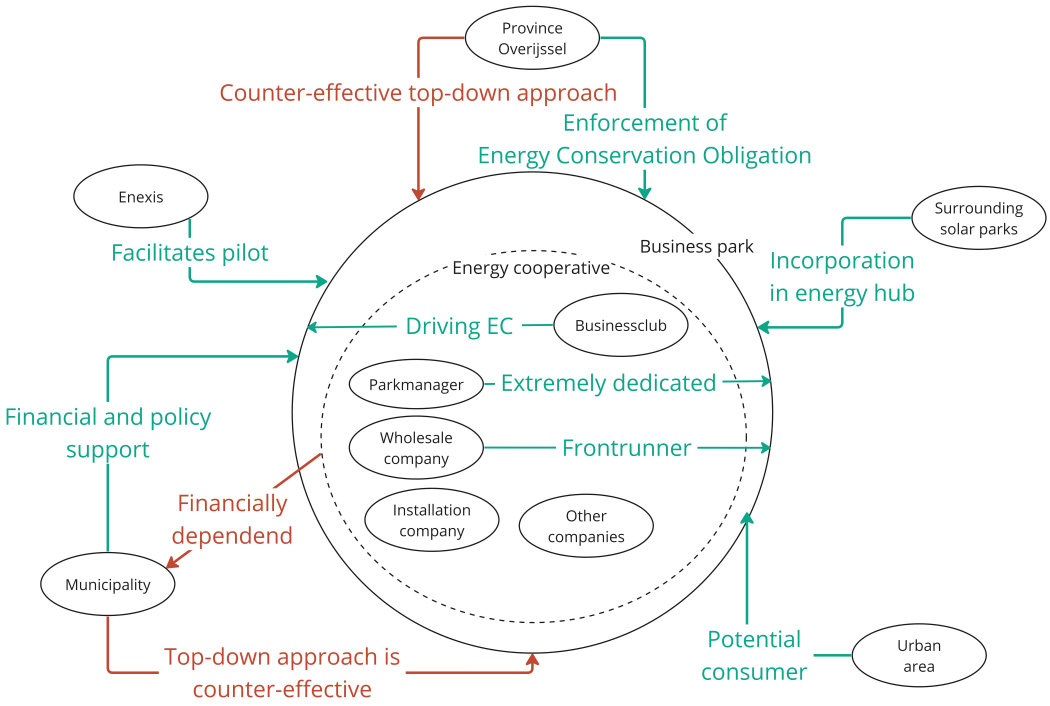



Figure 5.3: Actor chart displaying the most important roles of and relations between actors on and surrounding Hessenpoort

#### 5.3.3.2 Company installation industry

An interview was carried out with a manager from a branch location from company in the installation wholesale industry, active in the entire Netherlands. The branch on business park Hessenpoort consists of around 20-30 employees.

The manager has been working thirty-two years at the company and is currently involved in the digital transformation within the company. The brance has been located on Hessenpoort since 7 years and is housed in an existing building, owned by the mother company. The respondent indicates that the building does not meet current environmental requirements. In terms of sustainable measures taken, this branch of the company is dependent on the budget of the mother company and investments are done in phases. Also, the manager indicates to be dependent on the plans of the municipality and province and the corresponding subsidies that are available.

The building does have installed heat pumps in a few spaces. Also, all lighting has been replaced by LED lighting. The mother company has the policy of making every new building energy neutral. The branch location would have preferred to have solar panels on it's roof, but the roof structure is not sufficiently strong. Though, solar carports will be realized, in order to provide power for the charging stations, needed for the electrification of the diesel vehicles. Furthermore, the company is working on setting up hubs outside cities, where goods are transported to the hubs using combustion vehicles and then transferred to electric vehicles for transportation within the city center.

As a standpoint, the manager believes that energy suppliers hold supreme power and, despite the decrease in energy prices, they want to build up a buffer by keeping prices high. The government does not intervene because it would cost them additional money. The respondent finds the energy market to be very strange. "If Hessenpoort becomes energy self-sufficient and no longer needs electricity from energy companies, it costs the energy companies money, which means someone else has to pay more, otherwise they won't have any income. So, we are actually in a very strange world."

**Expectation and vision**

The respondent expects that the storage of electricity is the largest problem in the energy transition. There is a transformer station on the company's own premises, so the respondent expects that the modifications required for the installation of solar carports and charging stations will not incur significant costs, as the distance to the transformer station is very short. The manager expects that Hessenpoort is energy neutral within five years and that because of it, the business park and their company is more independent from the energy market. This independence is a great motivator to (potentially) join the energy cooperation on Hessenpoort. Also, the respondent expects that every company on the park will install charging stations for their vehicles.

The manager envisions a scenario whereby there is a central shared electricity storage building on Hessenpoort, but expects that the development of such solutions would take years. The manager's long-term vision on energy cooperation at

the business park depends on park management and available opportunities for infrastructure development. The manager envisions the future to be driven by hydrogen and sees it as solution for energy storage. If Hessenpoort were to have a hydrogen installation and new pipelines needed to be installed, the manager expects that the impact of such intervention would be relatively manageable. "I can envision Hessenpoort evolving and developing significantly in the coming years."

**Role**
The company has no significant role in the development of energy cooperation on the business park.

#### 5.3.3.3 Municipality

The interviewed respondent is an externally hired project leader for the municipality of Zwolle, focusing on the energy transition. The respondent has indicated that he / she can represent the municipality if needed. The project leader believes in the vision of a regional energy economy, where generation, usage, and balancing occur within the region and has been active in the energy transition consultancy since 2017. In the past 2 years, the respondent has been focused specifically on business parks, as they are not fully considered in the energy transition by the government, according to the project leader. The smart energy hub is seen as a "paper tiger". "There are many restrictions, but there are still many possibilities."(3MUN, 2023).The respondent states that "You won't solve the grid congestion problem with technical applications.", to indicate that collaboration is key in solving this problem. To reinforce this argument, the project leaders states: "A kilowatt-hour that goes through a battery costs around 15 cents, so every kilowatt you have generated already has a production cost, and on top of that, you have the cost of storage. If you want to add a margin to it, then the price becomes 40 cents."

**Expectation and vision**
According to the project leader's expectation, in 5 years, a substantial portion of the energy will come from the immediate surroundings through physical exchange. It will involve both administrative and technical solutions. If the high-voltage grid is at full capacity, the focus will shift to the medium and low-voltage grids for energy distribution.

The respondent's long-term vision for the energy ecosystem in Hessenpoort involves a broader perspective that encompasses the surrounding areas of Zwolle, Staphorst, Dalfsen, and Zwartewaterland, all connected to the high-voltage station. These regions play a vital role in energy generation, serving as energy producers for other parts of Zwolle, connected via the energy hub.

**Role**
This paragraph is about the role of the municipality of Zwolle, not about the role of the hired external project leader. According to the respondent, there are hardly any municipal officials who are engaged in the energy transition on business parks, as they "don't understand it". Though, as stated earlier, when the initiative for the energy hub emerged from the investor and the business club, the municipality supported this initiative right away by providing funding and time. The municipality had the desire to couple the large-scale energy generation surrounding Hessenpoort, to the business park, with the business park as a consumer. Thus, the energy hub initiative arrived at the right time (3MUN, 2023).

Business park Hessenpoort relies heavily on the municipality for financial support (3COM.B, 2023). According to the project leader, the role of the municipality of Zwolle is to support, drive, and facilitate the initiative. According to the project leader, the municipality does this by supporting existing vehicles that in turn support businesses, such as the business club and / or energy collective (3MUN, 2023). "The municipality provides support, but when it comes down to it, the municipality does not have direct authority in the implementation of solar power." (3MUN, 2023). The municipality is responsible for granting permits, especially for new constructions, there they can play a role. However, for existing buildings, no permit is required for solar installations, thus the only role for the municipality in such cases is to encourage and assist businesses in taking the necessary steps (3MUN, 2023).

The CEO states that the municipality should provide funding to the energy cooperative, to cover their expenses from developing the energy hub. This funding would amount to a few hundred thousand euros per year, until the concept can sustain itself (3COM.B, 2023). The municipality needs to take a leading role in establishing collaboration between businesses and engage in discussions with companies, through the business club (3COM.B, 2023).

According to the project leader, the municipality should only have a role in facilitating existing initiatives, not in organizing energy cooperation initiatives themselves. "The municipality should be willing to let go. Delegation is one thing, but letting go is even more challenging. The municipality and government advocate for more solar installations on rooftops, but they only have control over their own buildings and not private rooftops. According to the respondent, the best approach for the municipality is to facilitate existing initiatives from entrepreneurs, whereby the entrepreneurs are responsible, with the motivation that the municipality's sustainability goals are also achieved through these initiatives. To implement this approach, the project leader strives to have a more hands-on approach by actively visiting businesses on-site and proposes that such approach should be followed more by the municipality (3MUN, 2023).

#### 5.3.3.4 Business club

The business club from Hessenpoort exists since 2005 and currently has 66 members (Ondernemersvereniging-Hessenpoort, 2023b).

**Expectation and vision**
The business club strives for self-sufficiency on the business park and on the website it is stated that the club consists of a strong association (3COM.A).

**Role**
According to the manager, the business club develops plans that are in turn presented to the municipality and/or province (3COM.A, 2023). According to the CEO, the goal of the business club is to be net positive in terms of energy generation, in order to offset the inconvenience caused by e.g. freight traffic. "We want to give something back to the residents of Zwolle" (3COM.B, 2023). The business club has invested a significant amount of time and effort into this project. "Considering my own hourly rate as an entrepreneur, it is a shame that I dedicate so many hours to this project, as I should be focusing on running my own business." (3COM.B, 2023).

### 5.3.4 Network alignment

Below, the network alignment is presented in Table 5.9. As can be observed, all interviewed actors score high for ambition level, except the installation company. The wholesale company is very ambitious, with a new built building that is net positive. The municipality has ambitious sustainability goals and is willing to provide support and funding to the business park. The business club as well is ambitious and wants to be self-sufficient. The installation company is less ambitious, because their location on the business park is dependent on the head quarters, so no independent choices can be made. This is the same reason that this company scores medium for the collaboration intention level. For the rest, all interviewed actors score high on the collaboration intention level, as all are part of the energy cooperative and are willing to solve the congestion issues together.

| Respondent | Ambition level | Collaboration intention level |
|---|---|---|
| Company wholesale industry | High | High |
| Company installation industry | Medium | Medium |
| Municipality | High | High |
| Business club | High | High |
| Average dimension value | 4,5 | 4,5 |
| | | |
| Network alignment | 4,5 | |

Table 5.9: High level of alignment of interviewed actors on Hessenpoort

#### 5.3.4.1 Park manager

The park manager on Hessenpoort is the same person for already 15 years.

**Role**
According to the project leader, in general, the park management is responsible for the external aspects of the business park: the shared spaces and facilities. Not specifically for the energy transition. However, on Hessenpoort this general notion is not viable, as the park manager is very active in developing the energy transition (3MUN, 2023).

The park manager is strongly committed to achieving an energy-neutral business park and serves as a intermediary between the business park and municipality/province. The park manager put much time and effort into the business park and is familiar with every company on Hessenpoort (3COM.A, 2023) and ensures that companies realize that joining the energy cooperation initiative brings them value (3MUN, 2023).

#### 5.3.4.2 Province

**Role**
The manager indicates that to enforce the Energy Conservation Obligation, the province of Overijssel periodically (respondent believes once every 3 years) conducts an inventory of energy-saving opportunities, "they are quite strict about it". "If even one meter is not properly insulated in the boiler room, I had to have it all adjusted." (3COM.A, 2023).

According to the project leader, the province should support initiatives at the local level that involve collaboration among entrepreneurs, rather than supporting individual plans and subsidies, as they are not effective according to the respondent (3MUN, 2023).

#### 5.3.4.3 Local grid operator

Expectations and visions of Enexis can be read in Chapter 4.

**Role**

According to the project leader, the local grid operator can perform multiple pilots, but there is a limit. "The grid operator is allowed to conduct pilots, but if they become too similar, it becomes a product and they have to go through the ACM first". After the with 3 companies has been successfully completed, the local grid operator will grant permission for a group contract with 10 companies, making their power capacity shareable and exchangeable (3MUN, 2023).

According to the formal hub manager from A1 business park in Deventer - who knows much about the subject - a collaboration agreement has been signed between Hessenpoort and the local grid operator, enabling the aforementioned pilot (4HUB, 2023).

#### 5.3.4.4 Other actors

**Urban area**

The project leader indicates that the urban area is an important stakeholder outside the boundaries of the business park, because it would be a great (future) consumer of excess heat (3MUN, 2023).

**Energy collectives / solar parks**

Energy collectives developing solar parks and / or wind turbines are indicated as important for the business park / energy hub due to their energy generation (3MUN, 2023).

### 5.3.5 Factors influencing energy cooperation

In this sub chapter, the barriers, drivers and solutions that are specific to Hessenpoort are covered, factors that apply to business parks in general are left out in order to remain focused on the specific case. In Appendix A.25, all mentioned factors by interview respondents can be read in a more elaborated way. In the appendix, context is provided for each factor, and it also indicated which respondent mentioned which factor. In Appendix A.22, a table is provided, listing all mentioned factors for each case. This table is structured along the main factor categories as proposed in Chapter 2.6 and per factor it is indicated to which sub categories the factor belongs. Now, the barriers, drivers that are specific for Hessenpoort will be listed. No specific solutions for Hessenpoort were mentioned.

| **Barriers** |
|---|
| Presence of large companies obstructs decision-making due to vertical organisation structures |
| Municipality is restrictive in performing actions |
| Province's individual-business-focused policy is ineffective |
| Too much resources spent on research by municipality |
| Central decision-making by headquarters of company obstruct joining |
| Not all businesses familiar with stage of hub development |
| Knowledge gaps in laws and regulations (energy exchanges) |
| **Drivers** |
| Self-sufficiency of BP could eliminate energy bills headquarters |
| External interest and support |
| Well-defined municipality vision for coming 10 years |
| Pragmatic approach from grid operator |
| Well-organized structure is present on BP |
| Presence of frontrunners with expertise and local know-how |

Table 5.10: Specific factors mentioned by respondents for Hessenpoort

## 5.4 Case 4: A1 Bedrijvenpark Deventer

### 5.4.1 Characteristics of park

A1 Business Park in Deventer is a modern business park that originated in 2009 and is still undergoing development in terms of business park and in terms of an energy hub (Duurzaam Gebouwd, 2020). The The business park has an area

of 129 hectares and currently houses 30 companies (A1-Bedrijvenpark, 2023c) (A1-Bedrijvenpark, 2023a), but plots are still being sold on the western part. However, due to transmission congestion, these plots are being sold without a (large-scale) grid connection. As of now, the business park is primarily occupied by logistics and distribution companies, such as distribution centres of Aldi and Sligro. The eastern part is finished for the largest part, while the western part began allocating plots since late 2022. Notably, the eastern part was one of the early business parks in the Netherlands to be free from natural gas, an enormous challenge according to the project leader, because many companies were accustomed to using natural gas. Despite many companies believing it was not possible to go gas-free, the project leader gives an example of the Van der Valk hotel, that went from "We cannot operate without gas, to wanting to be the most sustainable hotel of the Netherlands".

Business park A1 being gas-free shows a commitment to sustainable practices, which is also reflected in the amount of solar panels installed on the roofs of the businesses, this can be seen in Appendix Figure A.4. For the eastern part, an obligation exists for existing businesses to prepare the roof structure for solar panels. For the western part, there even exists a requisite for establishment, requiring companies to completely cover their roof with solar panels, contingent upon that they can feed-in their surplus energy: to the grid or to the energy hub. Currently, 2 wind turbines are connected to the electricity grid of the business park and in 2023, a hydrogen fueling station will be realized for freight transportation (A1-Bedrijvenpark, 2023b).

However, despite the progress, there are still challenges to overcome, particularly regarding the lacking grid connections for new businesses in the western part, due to transmission congestion, which is posing an immediate obstacle for businesses seeking a larger grid connection for expansion of their business. This situation resulted in the selection of other companies for the plots than the municipality originally opted for. Now, companies are needed that take care of their own grid connection. The original idea was to move businesses from the city center to the business park, in order to make space available for housing development in the city center. This approach would have created a diverse composition of businesses on the park, however, currently their is a great emphasis on logistics and distribution. Furthermore, A1 Business Park has a unique status due to its location within Liander transmission grid area, while the rest of the municipality falls under the Enexis distribution area. This distinction in grid operators adds an additional layer of complexity to the energy infrastructure and management of the business park (4MUN, 2023), (4HUB, 2023).

### 5.4.2 Current state of collective initiative

In terms organisational structure of the business park, the park management enforces a mandatory park management membership, whereby plot owners automatically become member once they purchase it. Currently, energy cooperation on A1 business park involves various stakeholders and initiatives aimed at improving sustainability, with the development of an energy hub. One aspect worth noting is the connection between wind turbines near the park and a nearby solar park, which are "cable-pooled" (4MUN, 2023). While some businesses are actively engaged in these efforts, achieving the desired outcomes can be challenging if it requires significant energy, financial resources, or commitment from businesses. However, it is important to highlight that there are enough forward-thinking companies with a strong vision for sustainability (4MUN, 2023).

A well-organized park management is already in place, particularly in areas such as green maintenance and security (4MUN, 2023). Recognizing the urgency of the energy transition, companies and municipalities are gradually realizing the need for action, "The awareness started to come around March this year." (4MUN, 2023).

According to the externally hired municipality project leader, it is important to make the distinction between two different goals. The first one is the urgency of connecting new businesses to the electricity grid, which is currently not possible. Within 1.5 years, there must be a solution that ensures every new business has its desired grid connection. Apart from this most urgent short-term goal, the second goal entails the development of a smart energy hub, as a long-term goal.

Efforts are underway to conduct an inventory of what companies need, through research conducted by Firan in partnership with the municipality and the province of Overijssel. This initiative of parties already developed eight scenarios for the Smart Energy Hub (SEH), even before transmission congestion was a problem, indicating their pioneering spirit (4MUN, 2023). Additionally, the research explores various aspects of a contractual framework between participating parties, including the structure for handling the exit of companies, utilization of surplus solar power for hydrogen or truck charging, and the potential use of waste heat from cooling facilities (4MUN, 2023). However, the project leader states that in order to have a business case for hydrogen, their needs to be a structural surplus of energy on the business park. In turn, if such surplus will exist is dependent on the companies that will establish themselves on A1 business park. Additionally, the best organisational structure is currently being explored, taking into account the responsibilities involved. According to the project leader, it is important to consider the accountability aspect as well, in case the energy does not function as intended.

Furthermore, ongoing discussions and meetings involve key stakeholders such as a so-called hub manager, municipality, Liander, wind turbine operators, and truck charging operators. The hub manager is installed specifically for the development of the energy hub, whereas the park manager is in charge of the daily operations of the business park. The meetings focus on coordination and decision-making related to the energy hub, with a particular emphasis on determining incentives for stakeholders to bring assets to the energy hub (4MUN, 2023). The goal is to foster flexibility in both entry and exit for companies, but according to the externally hired municipal project leader, "It is permissible to create some obstacles for businesses to exit." (4MUN, 2023).

### 5.4.3 Key actors

In this chapter, the key actors that are involved in developing energy cooperation on Hessenpoort will be reviewed. For the interviewed actors, the expectations and visions will be displayed. Also, all actors the roles they currently have and the roles they are ought to have - according to interviewees - will be displayed as well. In Figure 5.4 the most important roles of and relations between actors are presented. A green line entails that an actor has a driving influence on energy cooperation, a red line means the actor is obstructing EC development. Details on roles and relations can be read in this sub chapter. Below, the interviewed participants for this case can be seen. For reference and anonymity, the participants are given a unique ID.

| Participant ID | Job position |
|---|---|
| 4COM | Owner of company active in distributing / wholesale industry of plastic products. |
| 4MUN | Externally hired project leader "Smart Energy Hubs"(marketing communication, acquisition) for gemeente Deventer |
| 4HUB | Formal "Hub Manager". Working at Province of Overijssel, started program SEHs together with OostNL and Province of Gelderland. |

Table 5.11: Interview participants for this particular case

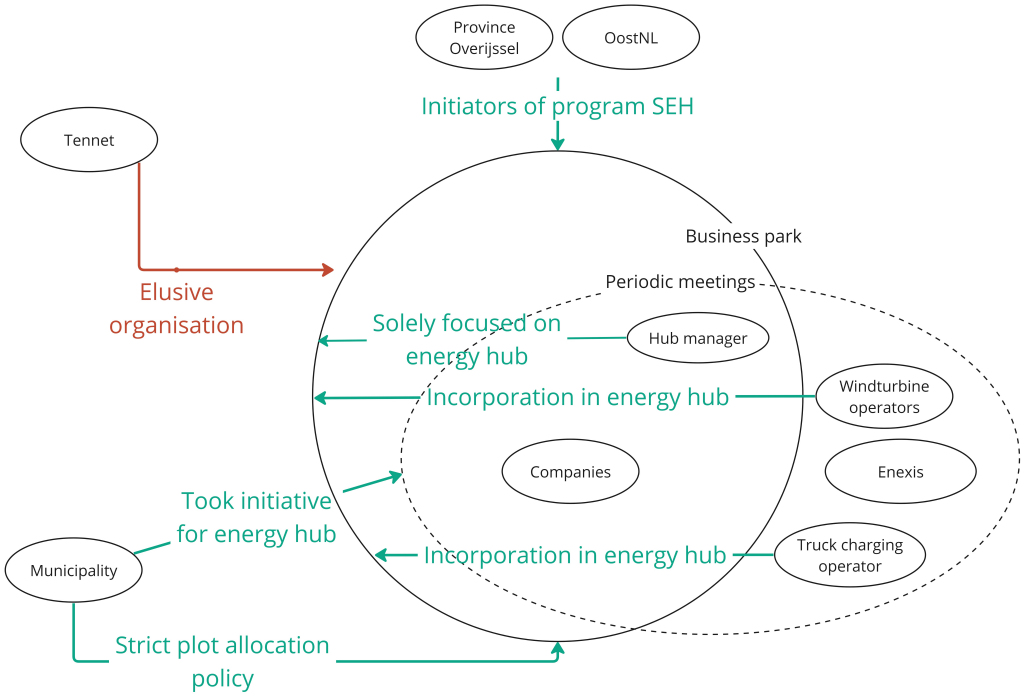



Figure 5.4: Actor chart displaying the most important roles of and relations between actors on and surrounding A1 Bedrijvenpark

#### 5.4.3.1 Externally hired municipality employee

This respondent is hired by the municipality for marketing, communication and acquisition for the A1 business park, focusing on the development of the Smart Energy Hub. The project leader indicates not to be responsible for the energy transition within the municipality, and not to be able to speak on behalf of the municipality. However, it is indicated that the respondent knows enough about it. Furthermore, the respondent states to be a positive person.

According to the project leader, we are currently in a sort of perfect storm where businesses are willing to change, but they do so for only two reasons, as do individuals: either there is a sense of urgency or there is passion. Passion drives the desire to be energy neutral, regardless of cost implications, while urgency arises from net congestion or high energy prices. Additionally, there is currently a scarcity of land, adding to the complexity of the situation.

The municipality's decision to develop an energy hub in the western part of the business park was triggered by various factors. The municipality anticipates upcoming developments such as the increased demand for electric vehicle charging and higher electricity requirements in the future. Since the establishment of the A1 business park, there has been a strong belief within the municipality that things need to change. It is essential for the energy hub to align with the municipality's overall CO2 reduction objectives and be integrated into its policy framework. The development of an energy hub was already considered during the development of the eastern part of the park, but this initiative failed. Though, this failure served as motivation to revisit the concept for the development of the western part. Additionally, the connection of two wind turbines on the opposite side of the A1 highway to the business park's grid further emphasized the need for the energy hub.

**Expectation and vision**

Companies are generally supportive of the municipality and park management's efforts in this area. However, the respondent expects that if the responsibility is left solely to the market, little progress will be made. This is due to the presence of numerous uncertainties that businesses are cautious about. The respondent acknowledges and understands these concerns, highlighting the need for a proactive approach and effective coordination between stakeholders to drive sustainable initiatives forward.

Currently, the municipality is selling plots without a large-scale connection. However, according to the respondent, this is a temporary situation. The Smart Energy Hub (SEH) is intended for the long term, not just to address congestion issues. When creating the business case, it is assumed that network congestion is a temporary problem, and by 2030, it will no longer be an issue, as they anticipate.

Looking ahead to the next five years, the project leader has a positive expectation regarding the energy transition at the A1 business park. The respondent, who holds an optimistic perspective, acknowledges that there is still considerable progress to be made. However, he / she envisions a future where the park becomes self-sufficient by harnessing locally generated wind and solar energy. The companies at the park express a favorable attitude towards the active involvement of the municipality and park management in these efforts. Nonetheless, the respondent cautions that if the responsibility is solely entrusted to the market, the pace of progress may be hindered. In terms of energy hub development, the respondent states "There are no quick wins in Deventer."

The municipal project leader emphasizes the municipality's vision on local energy generation and consumption, deeming it superior from all perspectives. The respondent envisions a collaboration with the province to establish a large charging station at the business park. The ambition is to create a business park that will be a source of pride even after 20 or 30 years, which compels the municipality to look beyond the immediate possibility of selling plots at the highest price. Their aim is to develop a high-quality business park. The municipality has made the decision to prioritize solar panels on rooftops as opposed to placing them in open fields.

**Role**

The interview respondent focuses on the allocation of the new plots of the western part of the business park, doing the marketing, acquisition and engagement with (potential) companies.

The municipality of Deventer has taken the initiative to establish the Smart Energy Hub on A1 Bedrijvenpark (4MUN, 2023).

Initially, the municipality believed that it was the responsibility of the businesses to become more sustainable. However, they now believe that in the initial phase, the municipality should take a temporary role to initiate the process, but then gradually withdraw. However, the respondent makes an important statement: "If the municipality were to take full responsibility for the SEH, it could result in businesses becoming complacent and relying solely on the government." Finding the right balance is crucial according to the project leader.

The municipality has made a clear policy for themselves, allocating the business plots under specific conditions (full roof covered with solar). Combined with the vision, ambition and facilitating capabilities of the municipality, the respondent believes that "If we cannot achieve it here, it won't happen anywhere." (4MUN, 2023).

The plot-allocation policy for the western part of the business park is constructed as follows. In total 22 plots will be allocated in phases, and since December 2022, the first 4 were allocated. The phase approach is chosen in order to ensure there always is a plot available for a local company from Deventer that wants to expand. The municipality greatly values

diversity, resulting in different plot sizes, ranging from 2.000 till 20.000 square meters. All companies are welcome as long as they fit in the zoning plan, being sustainable, circular, manufacturing, and logistics companies. Companies need to register for a plot and the five best scoring companies on the before-mentioned criteria will be invited for a presentation, where the plans will be discussed in detail. Then, the best scoring company will be chosen, after which companies have another six months to further develop their plans and proceed with the purchase (Schreiver, 2023).

Currently, the municipality does not enforce mandatory participation in the collective solution for all businesses on the park, as they believe that future land owners on the business park can also develop the understanding and willingness to participate (4MUN, 2023).

According to the externally hired project leader, the municipality should assume a coordinating and facilitating role in optimizing the utilization of available grid capacity, as it serves a societal interest. Though, this role is not seen as a permanent responsibility of governmental institutions, only during times of crisis (4MUN, 2023).

#### 5.4.3.2 Former hub manager

This respondent has been hub manager at A1 Bedrijvenpark and has been one of the initiators of the Smart Energy Hub program for the province of Overijssel en Gelderland. Currently, the interviewee works for the Ministry of Economic Affairs and Climate, to work on energy hubs within the national energy system plan. The energy hub program has been initiated to address existing gaps in responsibility and ownership, on business parks and outside of business parks. The program endeavors to fill those gaps and bridge them. The respondent proposes and challenges the province or Oost NL to take on a proactive role to facilitate the establishment of ownership and initiate collective action on business parks. Furthermore, according to the respondent, transmission congestion is the primary driving factor that significantly impacts the built environment, housing, businesses, and the overall energy system.

**Expectation and vision**

Over the next 5 years, the respondent expects that battery systems will play a significant role. The integration of Energy Management Systems and trading platforms with battery storage is anticipated to become a fundamental component of energy hubs. According to the respondent, it is crucial to ensure fairness in the development of these systems, ensuring that the recently joined entrepreneur does not end up with the worst deal. The idea of a collective entity, where entrepreneurs and their assets are part of a larger whole, is appealing. This entity could potentially include external assets that offer battery storage services. In the next 5 years, the aim is to establish hubs that are self-sufficient as much as possible. Any aspects that cannot be handled within a specific hub would then be coordinated between hubs (although 5 years might be too short of a time frame for this). This concept aligns with the idea of a "holon," where each individual entity understands how to contribute to the larger collective. Over the next 5 years, the former hub manager expects a significant surge in interest and engagement in energy hubs and the sustainable transition of business parks, as more and more stakeholders are motivated to take action in this field.

**Role**

The role of the respondent can be described as influential and broad. Having worked on the initiation of the Smart Energy Hub Program for the province of Overijssel and having served as hub manager, the respondent contributed to the regional and local acceleration of energy cooperation. Currently being employed at the ministry of Economic and Climate affairs, the influence of the respondent reaches further, on national level.

#### 5.4.3.3 Company plastics industry

The interviewee is the owner from a company in the plastics industry with 5-10 employees, located on the business park. In terms of sustainable measures taken, the company installed solar power double its consumption, with around 1/4 of the roof area. Currently, the company can feed-back its excess solar energy to the grid. The respondent states to be willing to use the remaining roof area for solar panels that can be used by other companies, contingent upon a price that is equal to or higher than the current feed-back price (€ 0,11 / kWh).

**Expectation and vision**

The business owner admits to having "no idea" about the ongoing energy-related activities or noteworthy examples of the energy transition on the business park. However, based on the fact that the park is gas-free and the presence of multiple distribution centers, the respondent assumes that those companies are likely engaged in sustainable practices.

For the coming five years, the respondent expects significant progress in the energy transition on the business park within the next five years. It is believed that companies, via the policy of the business park, are actively engaged in sustainable practices. The respondent anticipates an increased adoption of battery storage systems among businesses as a means to retain surplus energy for their own use instead of returning it to the grid. The business owner envisions a centralized storage facility within a building, where all companies can deposit their excess energy and draw from it when needed. This concept resonates with the respondent as a logical solution, especially considering his / her expectation of further

network congestion in the future. However, for the long term, the business owner expects the transmission grid to be upgraded and transmission congestion not to be a problem anymore.

The current situation where businesses cannot obtain a (new) grid connection is a valid reason for the development of energy hubs, according to the respondent. The business owner envisions complete independence from external energy related parties, stating, "We must become fully independent, from anyone." The vision entails the complete liberalization of energy trade, without government intervention or energy suppliers, allowing businesses to manage their energy needs autonomously. The manager expresses a willingness to fully utilize their rooftop space to assist other companies, provided there is appropriate compensation. They believe in supplying energy to an energy hub with proper compensation, viewing it as an ideal solution. The owner strongly advocates for direct agreements among parties on the business park, aiming to reduce costs and minimize reliance on energy suppliers. The vision includes the concept of a centralized storage facility within a building, enabling companies to contribute surplus energy and draw from it when needed, which resonates as a logical solution to the manager.

**Role**

This company has no significant role in the development of the energy hub on business park A1, which is amplified by the standpoint of the business owner, expecting the role of the company on the business park to be insignificant due to their low energy consumption (4COM, 2023). Because of this, the respondent does not read the e-mails from the park management about the development of the energy hub. Also, meetings about the energy hub are not being attended by the business owner.

### 5.4.4 Network alignment

In the table below, the network alignment between the interviewed actors is presented. The ranking is based on the expectations and visions and the interview reports. As can be observed, two out of three actors have a high score for ambition. The municipality employee envisions a self sufficient business park, where locally generated sustainable energy is consumed locally. The former hub manager is very ambitious and also envisions a self sufficient business park, where the business park is an important hub, processing regional energy streams. The plastics company has a medium ambition. Although they are almost self sufficient as a company, their ambition to improve the business park is on the lower side. The collaboration intention level of the municipality is medium, as it is believed that the energy transition on business parks is not a permanent municipal task. The hub manager has a high intention for collaboration, as it is believed that collaboration is the only solution to congestion problems on business parks. The plastics company has a low collaboration intention level, as they are almost self sufficient and do not understand the marginal gain of collaborating in a collective approach.

| Respondent | Ambition level | Collaboration intention level |
|---|---|---|
| Municipality Hired Project Leader | High | Medium |
| Former Hub Manager | High | High |
| Company Plastics Industry | Medium | Low |
| Average dimension value | 4,33 | 3 |
| | | |
| Network alignment | 3,67 | |

Table 5.12: Medium level of alignment of interviewed actors on

#### 5.4.4.1 National government

**Role**

According to the project leader, the government has a responsibility to look ahead towards the future. Also, the government should make decisions, take a more leading role, and allow for the mutual supply of energy among entities.

#### 5.4.4.2 Local grid operator

Expectations and visions of Enexis can be read in Chapter 4.

**Role**

Currently, the local grid operator is part of the periodic gatherings focusing on the development of the energy hub, together with the park manager, the wind turbines operator and future truck charging operator.

The business owner believes that the province and local grid operator, in collaboration with the park manager, should take the initiative to develop the energyhub. Although there are occasional meetings organized by park management that

include discussions about energy, the respondent has never attended these meetings, considering them to be "nonsense". In the respondent's opinion, the solution is not complicated: implementing large-scale battery storage.

#### 5.4.4.3 National grid operator

According to the project leader, the national grid operator, Tennet, is the bottleneck in the inability to change the regulations and laws regarding exchange of grid connection capacity, not the local grid operators. "It's not about Liander, it's about Tennet, and I find it elusive. As a municipality, company, or individual, there is nothing you can do about it." (4MUN, 2023).

#### 5.4.4.4 Hub manager

**Role**
According to the project leader, the role of the current hub manager on A1 business park is "doing the manual work", which entails engaging and communicating with the businesses and measuring the electricity meters. Also, the hub manager eventually will establish a legal entity, to be signed by the businesses and grid operator (4MUN, 2023).

#### 5.4.4.5 Other actors

**Province of Overijssel**
The province of Overijssel, together with OostNL and the province of Gelderland, took the initiative to launch the acceleration program Smart Energy Hubs. The project leader states that the province plays a crucial role in facilitating the development of businesses within its jurisdiction and ensuring the achievement of sustainability goals. They have the responsibility of creating an environment where companies can thrive while meeting their sustainability objectives.

According to the business owner, the province should take a leading role in guiding the efforts of developing the energy hub, together with the local grid operator and the park manager, with some involvement from the municipality.

**OostNL**
As stated earlier, the acceleration program Smart Energy Hubs was initiated by OostNL, together with the provinces of Gelderland and Overijssel.

### 5.4.5 Factors influencing energy cooperation

In this sub chapter, the barriers, drivers and solutions that are specific to A1 Bedrijvenpark are covered, factors that apply to business parks in general are left out in order to remain focused on the specific case. In Appendix A.26, all mentioned factors by interview respondents can be read in a more elaborated way. In the appendix, context is provided for each factor, and it also indicated which respondent mentioned which factor. In Appendix A.22, a table is provided, listing all mentioned factors for each case. This table is structured along the main factor categories as proposed in Chapter 2.6 and per factor it is indicated to which sub categories the factor belongs. Now, the barriers and drivers that are specific for A1 Bedrijvenpark will be listed. Specific solutions were not mentioned.

| **Barriers** |
|---|
| Developing agreements during development is time-consuming |
| Lack of signed confirmation to embark on projects to progress EC |
| Cumbersome implementation of group contracts by Enexis |
| Knowledge gaps on technology |
| Knowledge gaps on effective EC agreements |
| **Drivers** |
| Mandatory installation of solar panels enforced by park management / municipality |
| Nearby energy generation (solar field) encourages businesses to think about using that energy |

Table 5.13: Specific factors mentioned by respondents for

# 6 Comparative multi-case analysis

In this chapter, a comprehensive analysis is undertaken to examine the similarities and differences among the findings from the cases. The cases are systematically compared, starting with an exploration of the characteristics of the business parks. Subsequently, the barriers, drivers, and solutions are compared, utilizing the main and sub-categories as defined in Chapter 2.6. This analysis aims to ascertain the frequency of specific factors in each case and determine the most and least prevalent categories. Furthermore, the roles mentioned by the respondents are investigated, focusing on both the current roles and the roles that actors are expected to fulfill.

The characteristics of the parks are presented in a systematic manner in Table 6.1. Notably, Hessenpoort emerges as the largest business park in terms of surface area, while the highest number of companies are concentrated in Twentekanaal. These observations indicate variations in business density and potentially reflect differences in company size. The aerial photos in Appendix A.11 provide additional support for these findings, where can be observed that Hessenpoort houses larger companies. Moreover, the "ordinary parks" exhibit a high degree of business diversity, whereas the "energy hub parks" primarily house companies in the logistics and storage sector. A1 Bedrijvenpark stands out with the highest proportion of solar panels installed on business roofs, which could potentially attributed to its rigorous establishment policy discussed earlier. Another noteworthy aspect is the implementation of a Business Improvement District (BIZ). This policy is exclusively implemented at Hessenpoort. This policy mandates that businesses become members of the on-site business club and park management through municipal taxation. Groot Verlaat has the longest-standing business club, which also signifies its influential role within the park, as mentioned earlier. A striking finding is that each park has a different party taking the initiative to initiate some form of energy cooperation. This suggests that the success of energy cooperation does not solely rely on the party initiating it. With the exception of A1 Bedrijvenpark, additional organisational structures dedicated to energy transition and cooperation have been established in three out of the four parks, except on A1 Bedrijvenpark. Furthermore, all parks have collected energy consumption data, with Hessenpoort having already analyzed the data and Groot Verlaat expected to complete the analysis within two months.

Regarding the phases, Hessenpoort emerges as the most advanced, currently situated in phase A3. Notably, an electrolyzer will be installed this year, and a pilot project involving three companies for a group contract is currently running, with plans to expand to 10 companies upon successful implementation. These initiatives are being effectively coordinated by the recently established energy cooperative, Hessenpoort, which is fully committed to driving the development of the energy hub. Groot Verlaat and Twentekanaal are progressing almost in parallel, currently in phase A2. During this phase, energy data has been collected and is presently undergoing analysis. In both parks, a collaborative working group comprising prominent companies is actively exploring possibilities, inviting smaller companies to participate in the process after concrete possibilities have been established. A1 Bedrijvenpark, despite its ambitious goals, is still in the early stages of tangible results. However, significant developments are taking place behind the scenes, as reported by the municipal respondent. The slower progress can be attributed to the park's novelty and the fact that many companies are still in the process of establishing their presence, resulting in incomplete knowledge of energy profiles. The absence of companies significantly impacts the outcomes of phase S2, as it is currently not known which companies could and would cooperate. The lack of energy profiles hinders the execution of phase A2, as no analysis can be made yet.

| | **Groot Verlaat** | **Twentekanaal** | **Hessenpoort** | **A1 Bedrijvenpark** |
|---|---|---|---|---|
| **Area (hectares)** | 75 | 231 | 300 | 129 |
| **Number of companies** | 72 | 320 | 56 | 30 |
| **Company diversity** | High | High | Low | Low |
| **Park management** | Yes | Yes | Yes | Yes |
| **Network alignment** | 4,33 | 4,33 | 4,5 | 3,67 |
| **Percentage of solar panels** | Low | Low | Medium | High |
| **BIZ** | No | No | Yes | Unknown |
| **Active years business club** | 30 | 29 | 18 | Unknown |
| **Initiator energy cooperation** | Province of Overijssel | Park management | Business owner | Municipality |
| **Additional organisational structure** | Working group | Working group | Energy cooperative | No |
| **Energy consumption data collected** | Yes | Yes | Yes | No |
| **Consumption data analysis done** | August 2023 | No | Yes | No |
| **Stage (Rodin & Moser, 2021)** | Action 2 | Action 2 | Action 3 | Action 1 |

Table 6.1: Characteristics and state of energy cooperation, compared for all cases

## 6.1 Barriers

This sub chapter will compare the collected barriers among different cases. Using the framework outlined in Chapter 2.6, the barriers will be compared across various categories and subcategories to ultimately draw conclusions about the differences between the business parks and the nature of the barriers.

A cumulative representation and cross-case representation have been chosen. According to the author, this approach allows for quicker generalizations about business parks overall, and the results are valuable for the average business park to understand the average outcomes of this research.

First, the frequencies of barriers in the different main categories will be compared for all cases. The table below provides a schematic representation of this comparison. It is evident that Groot Verlaat has the highest number of social/managerial barriers. Twentekanaal also has a significant share of social/managerial barriers, along with legal/regulatory and information barriers. Information barriers are most prevalent at Hessenpoort, as well as A1 Bedrijvenpark. Cumulative, social/managerial, information, and policy barriers are among the top three categories. This corresponds with findings from Rodin & Moser (2021) and Henriques et al. (2021), where social barriers were the most frequent type found. Furthermore, Rodin & Moser (2021) found that information barriers had a great impact on energy cooperation. This corresponds with the cumulative findings of the case analyses.

| Category/business park | Groot Verlaat | Twentekanaal | Hessenpoort | A1 Bedrijvenpark | Cumulative |
|---|---|---|---|---|---|
| Economic / financial | 1 | 2 | 0 | 3 | 6 |
| Technical / engineering | 3 | 1 | 2 | 1 | 7 |
| Social / managerial | 6 | 5 | 3 | 3 | **17** |
| Legal / regulation | 0 | 5 | 1 | 3 | 9 |
| Policy | 3 | 3 | 2 | 3 | 11 |
| Organisational | 2 | 0 | 3 | 1 | 6 |
| Information | 2 | 4 | 5 | 4 | 15 |
| Responsibility | 1 | 0 | 0 | 1 | 2 |
| Surroundings | 0 | 1 | 0 | 0 | 1 |
| Human capital | 0 | 0 | 1 | 2 | 3 |
| Indepence | 0 | 0 | 0 | 0 | 0 |
| Safety | 0 | 0 | 0 | 0 | 0 |
| | | | | | |
| **Total** | **18** | **21** | **17** | **21** | **77** |

Table 6.2: Frequency of different types of barriers, compared for the four cases

This section will provide an analysis of the subcategories of barriers in a cumulative context. As illustrated in Figure 6.1, the number of general and specific barriers is equivalent. This indicates that there are an equal number of barriers that apply universally to business parks and barriers that are specific to individual parks. The count of external barriers exceeds that of internal barriers. Consequently, the cumulative impact on the four business parks is primarily influenced by external forces. Although there are instances where forces transcend the boundaries of external and internal factors, this proportion is minimal.

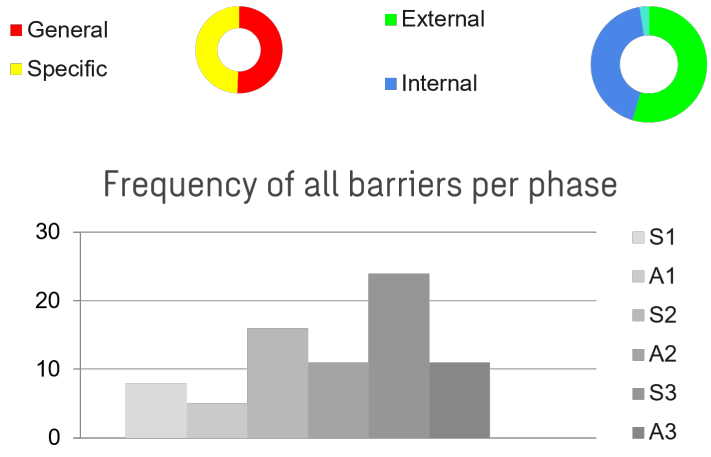



Figure 6.1: Statistics of cumulative barriers (sum of all cases)

When considering the phase at which barriers exert their influence, the majority of barriers only become relevant from phase S3 onwards. This signifies that these barriers come into play once the inventory of energy consumption and production has been conducted, and the opportunities for energy cooperation are identified. Another substantial portion of barriers influences energy cooperation during phase S2. These barriers affect stakeholders' willingness to collaborate and invest. The fewest barriers come into effect during phase A1, in which interest is generated from (potential) participants of energy cooperation.

Figure 6.2 illustrates the distribution of general and specific barriers across the different cases. It becomes evident that A1 Bedrijvenpark experiences a significant proportion of general barriers, which are barriers that could potentially occur on any business park. On the other hand, Groot Verlaat faces a substantial share of specific barriers, which are barriers specific to this particular business park and its surroundings. Overall, it can be stated that three out of the four business parks have a higher proportion of general barriers.


Figure 6.2: General / specific barriers, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

The following diagram, Figure 6.3, presents the distribution of the origin of barriers: whether they originate within the boundaries of the business park or outside of it. It is also possible for the origin of a barrier to not be strictly internal or external to the business park, as exemplified by the barrier "Developing agreements during development is time-consuming.", where agreements can be developed with actors within and outside the park. Twentekanaal exhibits the highest number of barriers with an external origin, while Hessenpoort has the fewest external barriers. This implies that most barriers at Hessenpoort originate within the boundaries of the business park. Groot Verlaat encounters the most barriers whose origin is not directly known, including the aforementioned barrier and the barrier related to a responsibility gap, which refers to the lack of clarity regarding who is responsible for the energy transition at the business park. The responsible party may exist within or outside the park's boundaries, or be a combination of both.


Figure 6.3: External / internal barriers, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

The following figure illustrates the phases in which the mentioned barriers have an impact. It is important to note that these depicted phases are not necessarily aligned with the current phase of the business park. During the interviews, barriers were mentioned that had previous impacts or were anticipated to have an impact in later phases.Figure 6.4 demonstrates that, for three out of the four business parks, the majority of barriers were mentioned to occur in phase S3, which is the phase where potential gains and collaboration opportunities are identified. Groot Verlaat is an exception to this pattern, with most mentioned barriers already having an impact from phase S2, the phase in which the willingness to collaborate and invest exists. It is worth noting that no barriers were mentioned in phase S4. This could be explained by the limited experience in this phase, resulting in a lack of knowledge regarding potential barriers that may arise.

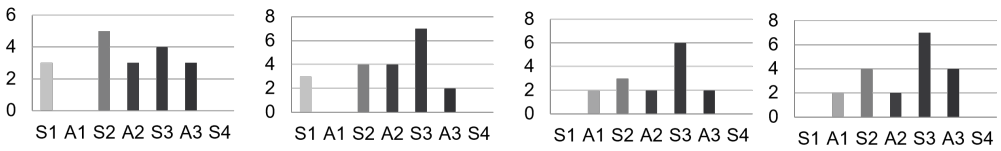



Figure 6.4: Phase where barriers become influential, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

## 6.2 Drivers

Similar to Chapter 6.1, the frequencies of the mentioned drivers will be categorized according to the main categories, which can be observed in Table 6.3. It becomes evident that, for three out of the four business parks, the majority of drivers are mentioned in the social/managerial category. However, at Hessenpoort, there are notably fewer social/managerial drivers mentioned, with the policy category taking the lead. Cumulatively, after social/managerial drivers, policy drivers are the most frequently mentioned. Economic/financial drivers rank third in terms of cumulative frequency. Another notable observation is that only Hessenpoort has a driver mentioned in the information category, and only A1 Bedrijvenpark has a safety driver mentioned.

| Category/business park | Groot Verlaat | Twentekanaal | Hessenpoort | A1 Bedrijvenpark | Cumulative |
|---|---|---|---|---|---|
| Economic / financial | 1 | 2 | 2 | 3 | 8 |
| Technical / engineering | 0 | 1 | 0 | 1 | 2 |
| Social / managerial | 4 | 6 | 2 | 4 | **16** |
| Legal / regulation | 2 | 1 | 2 | 0 | 5 |
| Policy | 2 | 3 | 3 | 1 | 9 |
| Organisational | 2 | 0 | 1 | 0 | 3 |
| Information | 0 | 0 | 1 | 0 | 1 |
| Responsibility | 0 | 0 | 0 | 0 | 0 |
| Surroundings | 1 | 1 | 1 | 2 | 5 |
| Human capital | 0 | 0 | 0 | 0 | 0 |
| Indepence | 0 | 1 | 1 | 0 | 2 |
| Safety | 0 | 0 | 0 | 1 | 1 |
| | | | | | |
| **Total** | **12** | **15** | **13** | **12** | **52** |

Table 6.3: Frequency of different types of drivers, compared for the four cases

In Figure 6.5, one can observe the statistics of the cumulative drivers. Cumulatively, across all cases, the number of mentioned general and specific drivers is balanced. In the interviews, an equal number of drivers with an external origin as well as an internal origin were mentioned. A small portion of drivers does not have a clear origin within or outside the park. These drivers include:

- Limited number of stakeholders for decision-making is perceived to accelerate energy cooperation
- Signed intention statement between municipality and business park
- Consensus that the energy system will become decentralized
- Increased national safety due to decentralized infrastructure

Regarding the phase from which the mentioned drivers have an impact, it is notable that the majority of drivers exert influence from phase A1 onwards when there is an interest or awakening for energy cooperation. The second-place drivers emerge in phase S2 when the willingness for cooperation and investment already exists. The third-place drivers have an impact from phase S3 when there is a clear understanding of potential improvements on the park and the possibilities for energy cooperation. There is a clear trend indicating that most drivers have an impact from the moment there is an interest in energy cooperation.

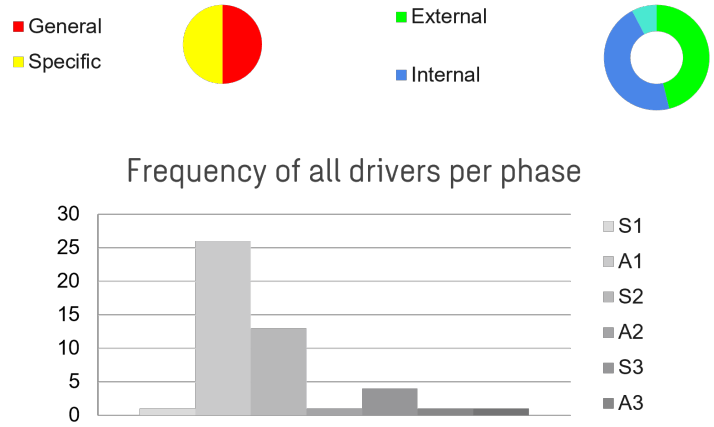



Figure 6.5: Statistics of cumulative drivers (sum of all cases)

Figure 6.6 illustrates the distribution of mentioned drivers under general and specific barriers for the four different cases. It becomes evident that Groot Verlaat has the highest number of specific drivers mentioned, while A1 Bedrijvenpark has a significant portion of general drivers mentioned. This highlights a clear distinction between the types of parks. The "ordinary" business parks have a higher proportion of specific drivers mentioned, while the "energy hub parks" have a higher proportion of mentioned general drivers.


Figure 6.6: General / specific drivers, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

The diagram below illustrates the distribution of mentioned drivers with an external origin and those with an internal origin for the four different cases. On Hessenpoort, the majority of mentioned drivers originate from outside the park. On Groot Verlaat, the highest number of drivers originates within the boundaries of the park. A1 Bedrijvenpark has the largest proportion of drivers with an origin that cannot be specifically attributed to either inside or outside the park.


Figure 6.7: External / internal drivers, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

The figure below shows the frequency of mentioned drivers along the different phases of energy cooperation. It becomes clear that for three out of four cases, the most drivers become influential from phase S2 onward, where the will for investment and cooperation exists. At Groot Verlaat, most mentioned drivers are affecting phase A1, where interest is being generated for energy cooperation. What is also noticeable is that Groot Verlaat has the highest number of drivers mentioned that have an impact in every phase. These drivers include:

- Limited number stakeholders for decision-making
- Pro-activity and ownership from business club and working group
- ET on BP supports municipality sustainability goals
- Business club, businesses and PM can act quickly due to strong relationship

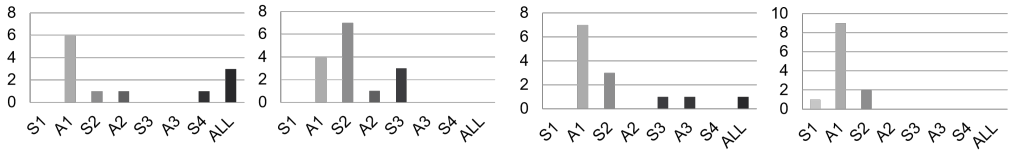



Figure 6.8: Phase where drivers become influential, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

## 6.3 Solutions

Similarly to the other learning categories, the mentioned solutions for problems related to energy cooperation will be analyzed based on the main categories. The resulting analysis is presented in Table 6.4. The analysis reveals that, for 2 out of the 4 parks, the majority of solutions are mentioned in the social/managerial category. This is not the case for Twentekanaal and A1 Bedrijvenpark, as no specific category stands out for these parks. Cumulatively, the majority of solutions fall under the social/managerial category, followed by policy solutions in second place. Technical solutions and legal/regulatory solutions share the third place.

| Category/business park | Groot Verlaat | Twentekanaal | Hessenpoort | A1 Bedrijvenpark | Cumulative |
|---|---|---|---|---|---|
| Economic / financial | 1 | 0 | 0 | 0 | 1 |
| Technical / engineering | 2 | 1 | 1 | 1 | 5 |
| Social / managerial | 3 | 2 | 3 | 1 | **9** |
| Legal / regulation | 1 | 2 | 0 | 2 | 5 |
| Policy | 0 | 1 | 3 | 2 | 6 |
| Organisational | 0 | 2 | 0 | 2 | 4 |
| Information | 0 | 1 | 0 | 0 | 1 |
| Responsibility | 0 | 0 | 0 | 0 | 0 |
| Surroundings | 0 | 0 | 0 | 0 | 0 |
| Human capital | 0 | 0 | 0 | 0 | 0 |
| Indepence | 0 | 0 | 0 | 0 | 0 |
| Safety | 0 | 0 | 0 | 0 | 0 |
| | | | | | |
| **Total** | **7** | **9** | **7** | **8** | **31** |

Table 6.4: Frequency of different types of solutions, compared for the four cases

In Figure 6.9, the cumulative distribution of solutions is presented. Cumulatively, 3 out of 4 mentioned solutions are generally applicable, which is valuable because these types of solutions can be applied to any type of business park. 1 out of 4 solutions is specific to a particular business park, addressing specific problems on that park. However, it is not excluded that these solutions may not be applicable to any other business park in the Netherlands. The majority of solutions fall within the boundaries of the business park. This means that most solutions can be directly implemented within the park, and actors within the park can take up these solutions. There is also a portion of solutions mentioned that do not necessarily fall strictly within or outside the boundaries of the business park. These include:

- Cable pooling
- Business park being part of a larger energy landscape
- Capable individuals able to realize and implement plans
- Ensuring stakeholders are aware of all obvious solutions
- Collective approach in solving complex problems on business parks

In terms of the phases where solutions can have an impact, the mentioned solutions are most prevalent in phase S3, the phase where inefficiencies to improve and the possibilities for doing so are identified. There is also a clear trend observed up to phase A3, where as energy cooperation progresses to later stages, more solutions come forward. Thus, as the phase of energy cooperation advances, more solutions become available for implementation. It is notable that there are few solutions mentioned in phase A3, which involves conducting an investment analysis and actually implementing the necessary measures.

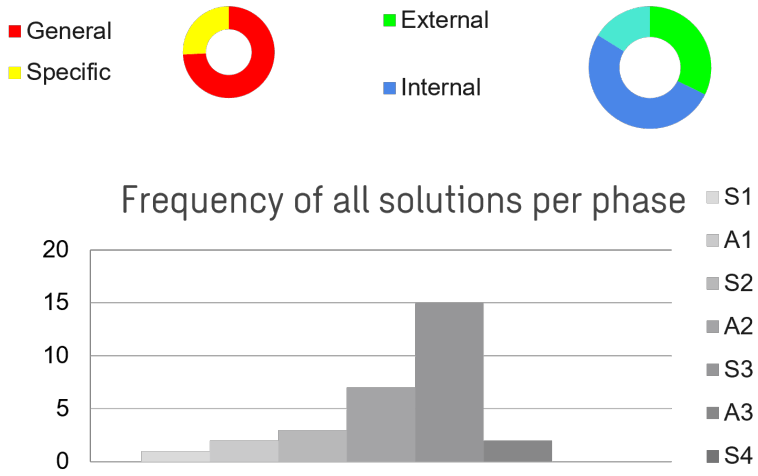



Figure 6.9: Statistics for cumulative solutions (sum of all cases)

In terms of general or specific solutions mentioned, it becomes evident that respondents from Groot Verlaat named the most solutions that are specific to that particular business park. In contrast, the other business parks mentioned solutions that can be generally applied to all business parks in the Netherlands. It is also worth noting that the "energy hub parks" only mentioned solutions that can be generally utilized, while the distribution between specific and general solutions is roughly equal among the "ordinary parks".


Figure 6.10: General / specific solutions, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

For Groot Verlaat and A1 Bedrijvenpark, the majority of the mentioned solutions can be implemented within the boundaries of the respective parks. Hessenpoort has the highest proportion of external solutions and also a significant portion of solutions that do not strictly fall within or outside the business park.


Figure 6.11: External / internal solutions, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

The distribution of phases in which solutions can be applied varies significantly across the parks, as depicted in Figure 6.12 below. It is notable that only Hessenpoort mentioned solutions that occur in phase A3, which involves conducting the investment analysis and implementing interventions.

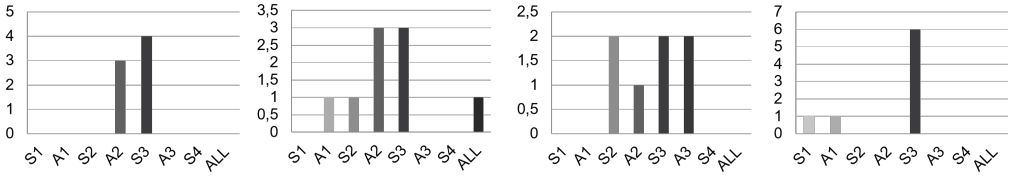



Figure 6.12: Phase where solutions become influential, for Groot Verlaat, Twentekanaal, Hessenpoort and A1 Bedrijvenpark

## 6.4 Roles

This chapter focuses on the roles of various actors within and beyond the boundaries of a business park, as mentioned by respondents in the interviews. The roles are categorized into roles that actors currently have or have had in the past, as well as roles that respondents believe actors should have (either currently or in the future). The first table, Table 6.5, presents the current roles. It is noteworthy that for Groot Verlaat, most mentioned roles belong to companies within the business park. For Twentekanaal and Hessenpoort, the park manager occupies the majority of current roles. In the case of A1 Bedrijvenpark, the municipality has the most mentioned roles. Cumulatively, the park manager has the most roles at present. The municipality ranks second, followed by companies in third place. The business club is also a party that assumes a significant number of roles.

| Current roles | Groot Verlaat | Twentekanaal | Hessenpoort | A1 Bedrijvenpark | Cumulative |
|---|---|---|---|---|---|
| Companies general | 5 | 1 | 2 | 0 | 8 |
| Large companies | 1 | 1 | 1 | 0 | 3 |
| Park manager | 3 | 3 | 4 | 0 | 10 |
| Hub manager | 0 | 0 | 0 | 2 | 2 |
| business club | 2 | 2 | 3 | 0 | 7 |
| Energy collectives / solar parks | 0 | 0 | 1 | 0 | 1 |
| Municipality | 2 | 2 | 2 | 3 | 9 |
| Energiefonds Overijssel | 0 | 0 | 0 | 0 | 0 |
| Province | 1 | 0 | 1 | 2 | 4 |
| OostNL | 0 | 0 | 0 | 1 | 1 |
| PVB Nederland | 0 | 0 | 0 | 0 | 0 |
| Local grid operator | 0 | 0 | 1 | 1 | 2 |
| National grid operator | 0 | 0 | 0 | 0 | 0 |
| ACM | 0 | 0 | 0 | 0 | 0 |
| Government | 0 | 0 | 0 | 0 | 0 |

Table 6.5: Frequency of current roles from actors, mentioned by case respondents

The following table presents the roles that actors are expected to have according to the respondents. It immediately becomes apparent that the municipality is expected to have the most roles by far, implying that cumulatively, the municipality is currently not doing enough in terms of energy cooperation on business parks. This is the case for Groot Verlaat and Hessenpoort, but not for Twentekanaal and A1 Bedrijvenpark. For Twentekanaal, most mentioned roles are attributed to the national government. A1 Bedrijvenpark does not have a specific actor that stands out in terms of expected roles.

| Proposed roles | Groot Verlaat | Twentekanaal | Hessenpoort | A1 Bedrijvenpark | Cumulative |
|---|---|---|---|---|---|
| Companies general | 0 | 0 | 0 | 0 | 0 |
| Large companies | 0 | 0 | 0 | 0 | 0 |
| Park manager | 0 | 1 | 0 | 0 | 1 |
| Hub manager | 0 | 0 | 0 | 0 | 0 |
| business club | 2 | 0 | 0 | 0 | 2 |
| Energy collectives / solar parks | 0 | 0 | 0 | 0 | 0 |
| Municipality | 4 | 1 | 3 | 1 | 9 |
| Energiefonds Overijssel | 1 | 0 | 0 | 0 | 1 |
| Province | 0 | 0 | 1 | 1 | 2 |
| OostNL | 1 | 0 | 0 | 0 | 1 |
| PVB Nederland | 0 | 1 | 0 | 0 | 1 |
| Local grid operator | 1 | 0 | 0 | 1 | 2 |
| National grid operator | 0 | 0 | 0 | 1 | 1 |
| ACM | 0 | 0 | 0 | 0 | 0 |
| Government | 0 | 2 | 0 | 1 | 3 |

Table 6.6: Frequency of proposed roles for actors, mentioned by case-respondents

# 7 Method development

This chapter focuses on merging the findings into a usable method for developers of energy cooperation projects on business parks. Developers in this case are park managers, business clubs, external projects leaders or possibly municipalities. To enhance the usability, the methodology developed is being structured in the phases as proposed by Rodin & Moser (2021).

For the construction of the method, the barriers mentioned by experts and case-respondents are coupled - per phase - with the mentioned drivers and solutions. Also, mentioned barriers without a corresponding solution being mentioned in the interviews, where supplemented by the researcher with obvious solutions. This coupling was carried out in order to gain comprehensive insights per phase of EC. With these insights, the researcher could construct a method that accounts for encountered barriers and uses proposed drivers and solutions. The coupling of factors and solutions per phase, including the supplemented solutions can be observed in Appendix A.31. Only the barriers for which a short-term solution is believed to exist, have been included in the method. Barriers that identify issues for which no immediate action can be taken by any actor have not been considered. An example is the "passive role of municipality." Although it is evident that municipalities should have a more active role, it is unlikely that such a role will be implemented immediately in the coming years. Also, the existence of a personnel shortage is a barrier that cannot be solved in the short term. As the congestion situation and businesses cannot wait for these kinds of solutions, the development of the method focused only on barriers for which a solution is deemed available in the reasonably short term. For example, "Businesses overlook the impact of congestion," highlights the need to educate businesses about the fact that transmission congestion will only worsen and cannot be solved individually. This is a valid short-term solution for.

After selecting on the relative short term, the factors and solutions were sorted on their specificity. For the usability of this method, only the factors and solutions that apply for business parks in general were included in the methodology, factors and solutions only applicable to specific business parks were excluded. Furthermore, concrete actions to accelerate EC implementation were proposed by respondents. The actions that could be applied to business parks in general were also included in the method as solutions. Relevant findings about a potential business model / legal contract between parties were included as well. The final selection of relevant factors and solutions for the development of the method can be observed in Appendix A.31. The appendix also shows which factors and solutions are mentioned multiple times, by displaying the number in parentheses. The final selection of factors was merged in an initial version of the method, which was reviewed by three energy consultants of the internship company. The relevant feedback was incorporated into the final version of the method.

The method is structured along the phases of energy cooperation as proposed by Rodin & Moser (2021). Per phase, elaboration on the main steps and sub steps is provided. With the elaboration, the users of the method are expected to understand the motivations and argumentation for the construction of the method. The actual steps that should be conducted by developers of energy cooperation are displayed in Figure 7.2, in landscape orientation, in the visual format of a flow chart. The steps are sorted on chronological order. The method consists of main steps, decision moments (based on the Stage-Gate model, as proposed by an energy consultant) dedicated meetings. It is important to realize that this method and the proposed solutions are not exhaustive, and that external advice should always be sought if the developer wants to learn more about a specific topic. The legend is displayed below.

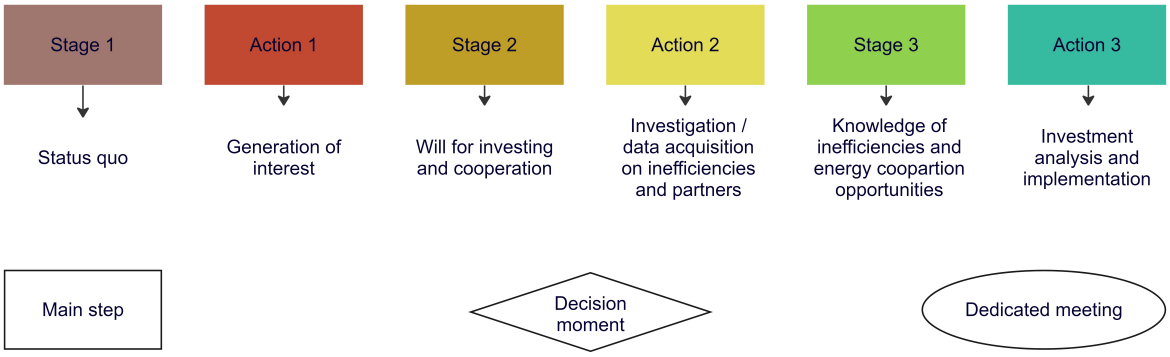



Figure 7.1: Legend of methodology for EC development

## Conditions for usability of method

### Park

This method is designed for business parks with certain characteristics. The most important requirement for this method to be effective, is that the business park possesses an organisational grade. This can be in the form of a park management, BIZ, cooperative, or business club / entrepreneurs' association. If such organisation is not present, this should first be addressed. The process of setting up an organisational structure is expected to take a few years (2PM, 2023), (3COM.B, 2023). The second condition is that the essential facilities are adequately provided for within the park, ensuring that the park is clean, well-maintained, and secure. This implies that the park is collectively maintained in a clean condition, that measures have been taken to address vacancies, and that a communal security system has been implemented.

### Developer

As stated before, a developer can virtually be any person, however, a certain level of familiarity and expertise is required. The developer should be familiar with the park and should roughly know the current challenges businesses face. A park manager, business board member or a prominent company is naturally familiar with these topics. Preferably, the developer is known on the park and easily and physically approachable, which are important traits to involve businesses (4MUN, 2023). Another requirement for the developer is expertise in the topic of energy. As the specific task of the developer is to implement energy cooperation, the individual should have experience in energy related topics and connecting different parties. The developer should be aware that the assignment of implementing EC is a multi-year project and that continuity is required to make the project successful.

## Stage 1: Status quo

In this phase, the business park is at its current state. This is the starting point for improvements and upgrades to the park.

### Conduct stakeholder analysis

As a project leader, board member of the business club or park manager it is important to know exactly which actors and stakeholders are relevant to an energy cooperation initiative, inside and external of the park. A stakeholder analysis is a suitable tool to map potential businesses and external parties that can contribute to the collective initiative. The (potential) roles should be identified, as well as how actors should be influenced to achieve the desired goal.

### Create awareness on future congestion

As the environmental analysis and case analyses showed, entrepreneurs are often not aware of the current and future congestion problems that will be expected. Business owners have their sustainable measures arranged themselves and believe they can solve congestion problems individually, or business owners do not have sustainable measures yet and do not see the consequences of congestion. Both situations lead to low incentives to join a collective. By creating the awareness that current and future congestion has immense consequences on the business park and businesses, such incentive can be created. Preferably, this awareness should be shortly addressed on a networking event, because these kinds of events attract more businesses compared to theme-specific events (2PM, 2023). Furthermore, during this event, the upcoming Sprintsession should be announced and businesses should be invited.

### Mandatory solar for new parks

As the case of A1 Bedrijvenpark showed, mandatory installation of solar panels on roofs can be a great driver for energy cooperation. Therefore, if plot allocation is yet to be carried out, park management, together with the municipality, can create a strict plot allocation policy. In this policy, every company that establishes itself on the park, is required to cover their entire roof with solar panels. The annotation, however, is that companies should be able to feed-in their surplus energy (4MUN, 2023).

## Action 1: Generation of interest

In this phase, interest is being generated for the participation in energy cooperation.

### Organize a Sprintsession with influential businesses

As the findings showed, Sprintsessions can be an effective solution for initiating energy cooperation (1PM, 2023), (PROV, 2023), (PVB, 2023). With a Sprintsession, interested companies gather with other relevant stakeholders, such as the park management, business club, municipality, grid operator and sometimes province. The goal of the Sprintsession is to unite

actors, discuss the main role of each actor and what actors need from each other to ensure a successful energy transition on the business park. Because this meeting is the first moment of diving into the topic of energy cooperation, this meeting has a few distinct goals:

- **Create awareness on current and future congestion implications.** The local grid operator should elaborate on this topic, and show that congestion has and will have significant impact on businesses on business parks. Also, many companies see energy as a utility service (2MUN, 2023), but the grid operator should clarify that this is not the case.
- **Create awareness on the topic of energy cooperation.** By inviting an experience individual from a front runner business park such as Hessenpoort, Pannenweg (Samen Om (2023)), Marslanden (interviewed collective initiators), or ECUB (ECUB (2021)), awareness can be created on the possibilities and benefits of a collective approach. It should be highlighted that a collective approach can achieve more and is more cost effective, as such realisation is often lacking, as Hessenpoort and A1 Bedrijvenpark showed. Also, it should be emphasized that funding will become available, when a collective entity exists (COLL, 2023). Furthermore, an important motivator to embark on a collective approach is that local energy flows keep economic flows local (3HUB, 2023). Besides, with collective energy system independence from energy suppliers and energy prices can be realized (3COM.B, 2023), (3HUB, 2023). A concrete case should be presented, making it attractive to join a collective approach, however, it should be realistic.
- **Sustainability goals of municipality can be achieved quicker.** The municipality is present during the Sprintsession, thus it should be highlighted that their sustainability and energy goals could be achieved quicker by supporting the business park embarking on their energy transition. Multiple municipalities indicated that their motivation to support a business park comes from the desire to achieve their sustainability goals (2MUN, 2023), (3MUN, 2023), (4MUN, 2023).
- **Future regulations** It should be highlighted that future regulations can pose a significant thread to current business operations. Energy audits, for example, are already reality for large companies, implying that certain energy standards should be met which can have an impact on business operations (2PM, 2023). It is expected that such audits will become an obligation for every company in the coming years (COLL, 2023), which entails that companies early in their energy transition should realize significant measures to account for the then applying standards. A collective approach could help with this.
- **Discuss visions and challenges on energy** After the informative part of the meeting, energy visions and challenges of businesses should be shared and discussed, to give all actors an initial idea where others are. This also give the developer an overview of the phase of the business park and the corresponding challenges.
- **Assignment**. As an assignment for the follow-up meeting, ask businesses to clarify their visions and think about the role their company could have in a collective energy approach. This ensures that businesses are prepared for the next meeting.

#### Provide information to businesses

Business could be triggered by the Sprintsession, thus if any questions arise in response to the meeting, businesses should have the opportunity to clarify them. Ensure that external advice is being obtained if the developer cannot answer certain questions.

#### Follow-up meeting

The goal of this meeting is to develop a rough energy vision for the business park for the coming five years. This should be done by discussing visions of individual companies, the park manager / business club, possible neighbouring energy cooperatives and the municipality. If a clear and strong energy vision exists from the municipality, the business park should attempt to align their vision with the one from the municipality. If any nearby energy cooperatives exist, they should be invited to this meeting and it should be discussed how these cooperatives could fit in a comprehensive vision, coupling the business park with these cooperatives and the municipality. Such all-encompassing energy vision was mentioned as being a long-term solution for solving transmission congestion (1COM.B, 2023), (3HUB, 2023), (3COM.B, 2023). If a clear business park vision exists, it is easier for the grid operator to align their infrastructure expansion strategy (GRID, 2023). If needed, consult experienced external parties to help with aligning these visions. Also, multiple iterations may be needed to achieve a shared vision.

### Stage 2: Will for investing and cooperation

In this phase, the involved actors are willing to invest and cooperate, based on the recently developed energy vision.

#### Sign letter of intent

To confirm the commitment of the involved actors, a letter of intent should be signed by all the involved actors, confirming they are now part of a working group. The letter should entail that the involved parties will investigate the possibilities for energy cooperation, at least for 1 year, to ensure continuity. The municipality should also be part of this working group, in

the form of a dedicated employee that signs to be involved for the long-term, as the quick rotation of municipal employees is perceived obstructing (1COM.B, 2023), (1PM, 2023), (2PM, 2023). The moment of signing the letter of intent may lead to certain parties leaving the collective, however, this is not a bad thing, at it is proposed that only businesses that are willing to participate actively should be involved (3COM.B, 2023). Signing a letter of intent has shown to be an effective way confirming the commitment of involved actors (2PM, 2023). As way of operation, meetings should be kept formal and to the point, with no non-relevant parties involved. For many businesses, such meeting format is preferred (1COM.B, 2023). The developer should prepare all working group gatherings thoroughly and prepare decisions, so that the involved businesses can minimize their involved time (PROV, 2023).

#### Discuss BIZ

It could be that the business park already has a BIZ (Business Investment Zone) in place, however, if this is not the case an opportunity exists. A BIZ was mentioned as "the first step any business park should take" (3COM.B, 2023). A BIZ can ensure that 100% of all businesses participate in collective actions. In terms of a collective energy approach, such mandatory policy could strengthen the general organisational structure of the business park and increase the involvement of "free-riding" companies. Although, it was advised to involve smaller companies at a later state on the topic of energy (PROV, 2023), (1COM.A, 2023), a BIZ can be set up independently of the energy working group. However, strengthening the general involvement of businesses on the park (on the topic of clean, whole and safe) could have a positive influence on the collective energy approach later on, resulting in greater involvement and greater allocation of funding through mandatory membership. If the working group agrees on setting up a BIZ, the park management should develop such BIZ parallel to the energy working group. Information on how to set up a BIZ can be found online Bedrijven Investeringszone (2020).

#### Streamline process of connecting parties

As mentioned earlier, smaller companies should not be involved until Stage 3. Smaller companies often have challenges enough to operate their business, so until a clear plan exists where expected costs and benefits are known, small business should not be involved.

#### Attract external consultants

The next phase will investigate the inefficiencies and opportunities based on the current and future energy consumption of businesses. To guide this process, external consultants with prior experience in this field should be attracted on time, to ensure continuity of the process.

### Action 2: Investigation

This phase will yield a clear overview of energy profiles of the involved actors, combined with rough business cases for cost reductions and CO2 reductions.

#### Data collection

The most important step of this phase is to collect the energy consumption and feeding-back data. For this, businesses should provide consent for the data to be shared with the working group and external consultant guiding the process. If businesses do not possess a smart meter, the developer should facilitate the measurement by providing smart meters (P1 meters), as happened on Twentekanaal (2MUN, 2023), (2PM, 2023). Next to the current energy profiles, the future energy profiles should be approximated in order to know the future collective energy system requirements (4MUN, 2023). This can be done by using the energy visions of the businesses and focusing on the electrification desires of the companies. Together with the energy consultant, realistic approximations can be made of all current and future energy profiles.

#### Roughly work out business cases

After collection of the current and future energy profiles, the consultant should roughly work out business cases based on the complementarity of the energy profiles. Complementarity of energy profiles can be utilized virtually or physically. Virtually, with group contracts, physically, by physical connections between businesses. Although the physical solution is much more expensive, the consultant should roughly workout the corresponding business cases, giving businesses an idea of the potential cost reductions. Cost reductions are one of the most mentioned motivators for businesses to participate in energy collectives, thus proving that their situation can lead to cost reductions is extremely important.

#### Roughly work out CO2 reduction model

Businesses have become more sustainably conscious (PROV, 2023), thus it is important for them to know the CO2 reductions that could be achieved by implementing collective energy solutions. Also, the CO2 reduction potential can later serve as way of persuading investors and / or subsidy providers, such as municipality, province and national government.

#### Energy cooperative inventory

The next step will be the establishment of an energy cooperative, hence a final inventory should be made of businesses that want to become member of the cooperative. This inventory should be done in the working group, but also other businesses on the park could be invited. The time since the last networking event and Sprintsession is significant, thus it could be that businesses changed their mind in the mean time. The recently developed business cases and C02 reduction figures could be way to persuade these other businesses.

### Stage 3: Knowledge of opportunities

#### Establish an energy cooperative

To further concretize the collective energy approach, an energy cooperative will be established. Such legal entity offers many advantages, such as easier application for subsidies and increased involvement of companies, and a strengthened organisational structure where other companies easily can become member of (COLL, 2023). To guide this process, the handbook designed by ECUB (2021) can be consulted, but physical guidance from an experienced individual is also recommended. The first step is to democratically choose a board. Then, the goal of the cooperative should be determined, which can imply for-profit or non-profit. The goal should be identified in a bottom-up manner, as such approach is deemed most effective (3COM.B, 2023), (4MUN, 2023). It is recommended to aim for a minimal membership of three years, as such period ensure continuity and commitment of companies (COLL, 2023). Furthermore, the yearly membership fees should be determined. Although it is difficult to reimburse all development costs by membership fees (1PM, 2023), it the fee should reimburse the largest part of the made development costs and worked hours.

#### Work out detailed projects

Now a legal entity has been established and certainty exists on the involved parties, detailed projects for the coming year can be worked out. Although any collective solution is an option, it is recommended to start with virtual solutions, such as the group contract. Such solution does not entail any major infrastructural and costly measures. This means, virtual solutions can be implemented relatively quickly, offering businesses a relieve from congestion problems. A strategy could be to start with a small pilot, as is done on Hessenpoort, whereby three businesses are coupled into one grid connection (3COM.B, 2023). For such strategy, however, it is required that the grid operator can disconnect the connection in any situation when there is overload (3COM.B, 2023). If the grid operator is obstructing the operation of a pilot, it can be attempted to realize a group contract independently of the grid operator, such as done on Pannenweg in Weert Samen Om (2023). In terms of financial energy trading agreements, businesses should aim to improve market tariffs when exchanging (virtual energy). This entails that prices for consumption will be lower than the market tariffs and that feeding-in tariffs are higher. Such strategy ensures that investments will be recovered more quickly (PROV, 2023), (4COM, 2023).

#### Attract external advice

In parallel to working out the detailed projects, external advice from experienced individuals should be consulted. Next to virtual solutions, also physical collective solutions exist. Based on the desire of the cooperative and advice from external parties, the board from the cooperative should make a final decision for project(s) to carry out the coming year. This can be an iterative process.

#### Apply for subsidies

As applying for subsidies can be cumbersome and time-consuming (COLL, 2023), this should be the first step after choosing concrete projects. Subsidies at municipality, province and national government can be utilized. If no expertise on subsidy application is present within the cooperative, it is advised to seek external help to ensure continuity of the process. The business cases and CO2 reduction models developed earlier can be utilized to emphasize the impact of the measures.

#### Invite smaller companies

Now concrete projects for the coming year are known, smaller companies can be approached and be asked to join the projects. With such concrete projects, only have to agree or not agree. The energy profiles of smaller companies are most probably smaller compared to the larger involved companies in the cooperative. This entails that involvement of these smaller energy profiles in the energy system is not a major challenge.

#### Propose plans to local grid operator

Once the final participants of the concrete solutions are known, the plans must be presented to the local grid operator. The local grid operator should grant permission to carry out the projects. Iterations may be needed to arrive at a solution

that will be accepted by the grid operator. If only a virtual solution will be carried out, independent from the grid operator (such as Pannenweg, (Samen Om, 2023)), this step can be skipped.

## Action 3: Investment analysis and implementation

#### Work out final financing

At this step, it is expected that more is known about the trajectory of the subsidies and the amounts that will be received. This entails that the remaining financing needed is known. Business should be the largest investors, to ensure involvement and ownership (3HUB, 2023), however, municipalities can also invest a significant amount, considering the fact that the projects can achieve their sustainability goals. In Twentekanaal, the municipality proposed co-financing of a few projects (2PM, 2023), which could be a usable financing strategy.

#### Attract capable executors

In order to realize the projects, capable executors should be attracted. It is advised to consult earlier approached experts that can propose suitable companies for the actual implementation of the measures. Although the energy cooperation topic is still new, enough companies exist that have experience with realizing collective energy measures.

#### Exit/entry policy

Although members of the cooperative have signed to be involved at least three years, a future policy should be created that facilitates exit and entry of the cooperative. It will be inevitable that business leave the cooperation, due to financial default or change of location. It should not be easy to leave as a business, to protect the cooperative energy system. Therefore, explicit agreements should be made on this topic, whereby only new business can establish themselves that fit into a certain energy profile (3MUN, 2023).

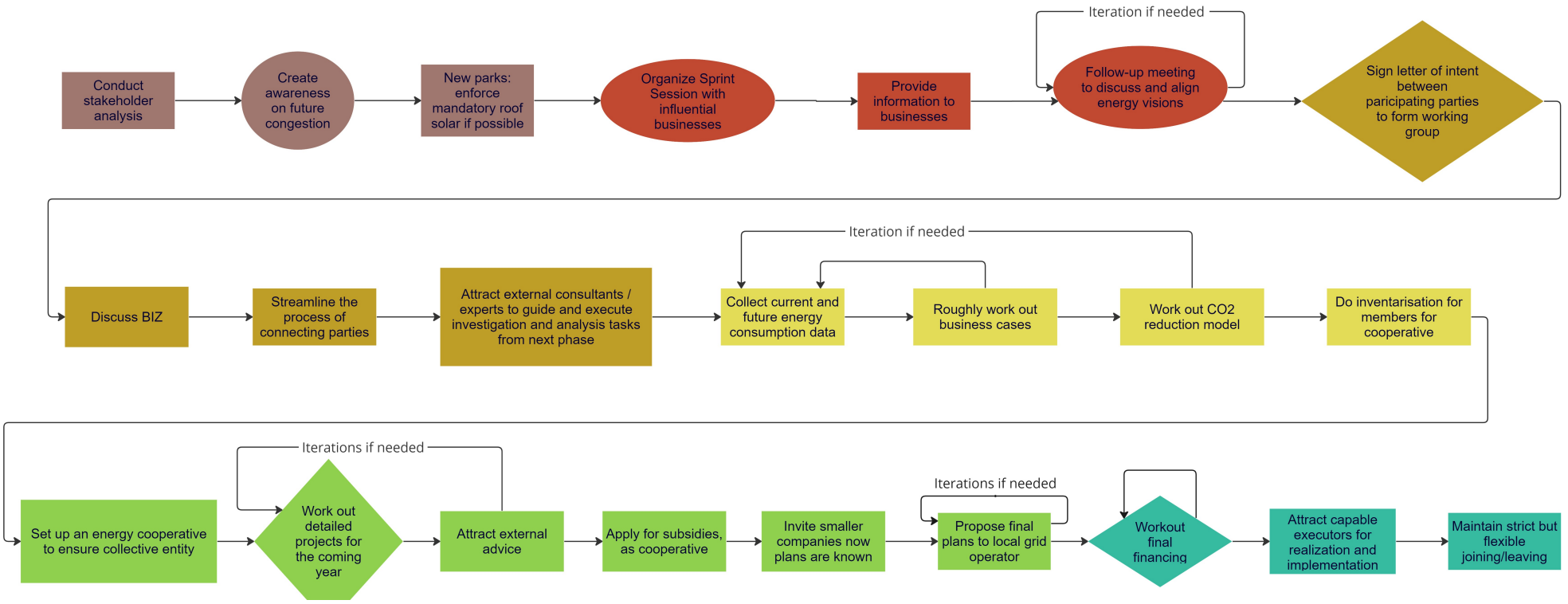



Figure 7.2: Visual representation of the method for EC development

# 8 Discussion

This chapter sheds a light on the meaning of the results. Also, the framework developed in Chapter 2.6 is being reviewed, did it prove to be suitable for this research? Subsequently, the limitations of this study are being addressed, as well as the scientific contribution of this thesis. Furthermore, the practical and managerial relevance is being discussed. Next, fields for further research will be addressed, to leverage the potential impact of this thesis study. As last, the link to the MOT study program is explained.

## 8.1 Framework reflections

During the data collection, many factors, solutions, actors, laws, and regulations have been uncovered that are all in some way influential to the implementation of energy cooperation on business parks in the Netherlands. The framework developed in Chapter 2.6 has proven to be robust and helpful in structuring the extensive findings. First, all the stakeholders have been identified that play a role in the implementation of EC. From the interviewed actors, expectations and visions have been collected during the interviews, which in turn were used to determine the alignment between the actors in the network. Although the conceptual framework of this study proposed to map visions on national, regional and local level, this study has only been able to map the local vision due to limited interviews. For national and regional visions, more actors should have been interviewed, however, this does not imply that these components should be removed from the framework. Future research could attempt to map national and regional visions.

Furthermore, the roles of all actors were identified. Important to note is that the roles were not incorporated in the framework proposed by Susur et al. (2019), but were incorporated in the conceptual framework of this study. During the data collection, it became apparent that many respondents highlighted roles that actors were lacking - roles that actors are ought to have. Therefore, in the analysis, the distinction was made between two types of roles: current roles, and "ought-to" roles. Mainly the latter roles are valuable for answering the research questions and constructing recommendations. Actor roles were deemed to be extremely important for this thesis project.

After the social network had been identified on multiple levels, the learning activities were investigated. The data collection yielded a vast collection of barriers, drivers and solutions for energy cooperation implementation on business parks. The framework from Chapter 2.6 proposed 7 main categories of factors and 3 sub categories. The findings, however, yielded 13 main categories. It has proven not to be possible to fit certain learning activities into the original main categories, thus the researcher proposed 6 additional categories. Below, in Table 8.1, it can be observed which main categories have been newly added.

| | |
|---|---|
| Economic/financial | Learning about whether and how EC implementation is being influenced by economic / financial factors |
| Technical/engineering | Learning about technical and engineering related drivers, barriers (and solutions) influencing EC implementation |
| Social/managerial | Learning about social and managerial factors that influence EC implementation |
| Legal/regulatory | Learning about whether and how EC implementation is being influenced by laws and regulations of different levels |
| Policy | Learning about whether and how policy, on different levels, influences EC implementation |
| Businessmodel | Learning about businessmodels that ensure fair collaboration and are succesful for EC projects |
| Information | Learning about how (the absence of) information influences EC implementation |
| Organisational | Learning about the organisation and organisational types of specific EC projects |
| Responsibility | Learning about responsibilities of actors should be distributed and how responsibility influence EC |
| Surroundings | Learning about surrounding features of the business park can influence EC development |
| Human capital | Learning about the effect of human capital on the development of energy cooperation |
| (In)dependence | Learning about dependence or indepence of actors or features influences EC |
| Safety | Learning about how safety issues positively and negatively influence EC |

Table 8.1: In grey, the original learning activity main categories, in green the newly added categories based on the collected data

Next to the main categories, the sub categories used in the framework, also proposed by Rodin & Moser (2021), have proven to be of great significance to the analysis. With these sub categories, all factors and solutions could be easily distinguished and it made data analysis insightful. Therefore, it was clear which factors and solutions to include in the method, and which not. This categorization also made the comparative case analysis very clear, concise and insightful, highlighting differences and similarities.

The different business owners as categorized by TNO (2016) proved to not be of any help to this thesis project. This could be partly explained by the lesser amount of business interviewed than initially expected. Another explanation for the uselessness of the business owner categorization is the type of businesses that responded to the invitation e-mail. All of the businesses interviewed can be considered pioneers on the topic of energy on their business park. Thus, a categorization with the aim of differentiating businesses owner types is not needed in this case.

### 8.1.1 Proposed changes to framework

In order to improve the usability of the research framework, the following changes are proposed:

- Incorporate the measurement of network alignment along the dimensions of ambition and collaboration intention
- Incorporate the roles of actors, distinguishing between current roles and roles that actors are ought to have
- Add the new categories
- Remove the business motivations from TNO
- Add institutional context as being a fixed boundary condition to the process of EC development

Below, the proposed changes can be observed in an altered framework schematic:

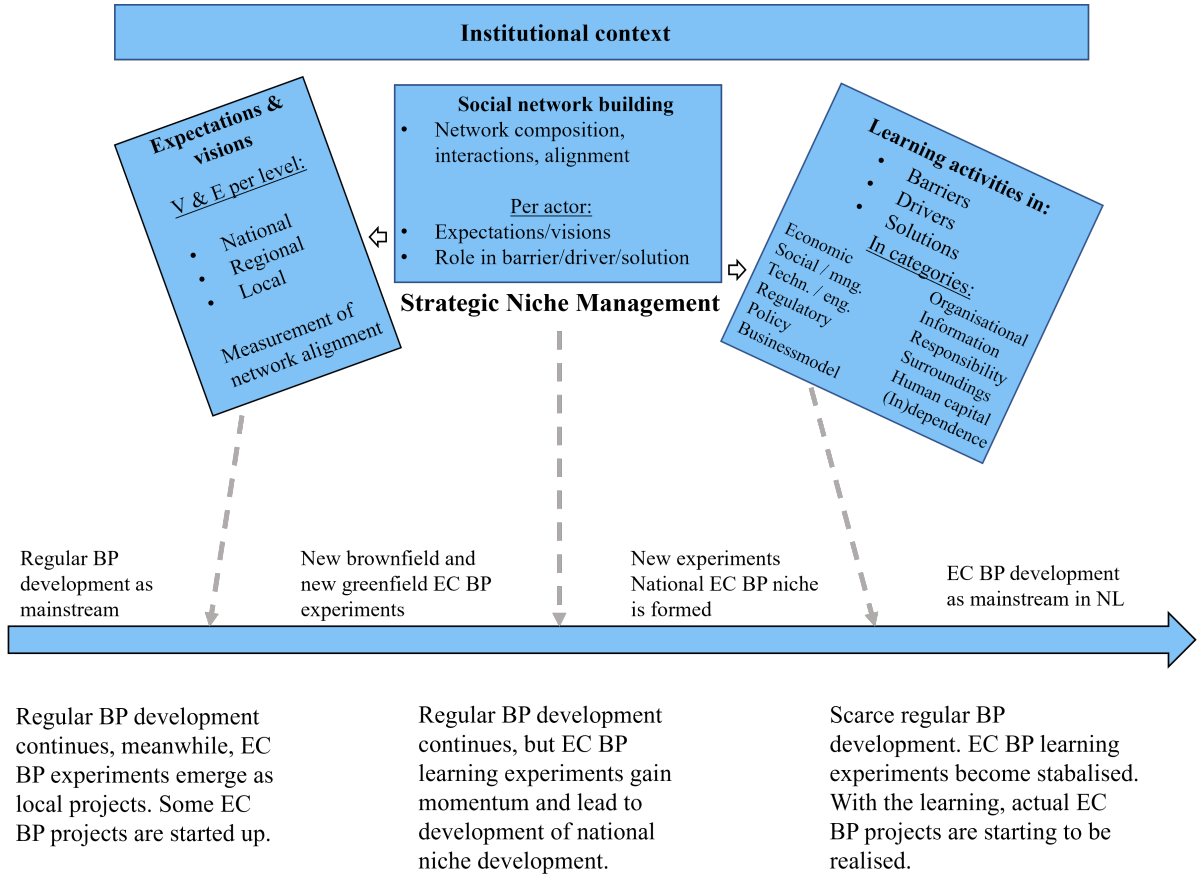



Figure 8.1: Schematic of the proposed changes to the developed framework as proposed in Chapter 2.6, based on Susur et al. (2019)

## 8.2 Limitations

This research project is not perfect. However, when aware of the limitations of this study, the outcomes can be used consciously, increasing the usability of the findings. Below, the limitations of this thesis are listed in bullet points.

- In this study, certain dimensions have been used for case selection: company diversity and whether an energy hub is being developed. These dimensions yielded a particular case selection, however, other dimensions could have been chosen. For example, the dimension "number of companies" could have been chosen to distinguish different parks and make a selection. Another dimension to distinguish business parks could be whether a business club exists on the park. As the case analyses showed, a business club can be of great significance in the development of energy cooperation.
- It is important to be aware of how the respondents were selected, especially for the businesses involved. All businesses on the four business parks were e-mailed simultaneously with an invitation mail. Obviously, only the businesses that have affinity with the subject responded. These types of businesses are not the average type of business on a business park in the Netherlands, but businesses that are sustainably conscious and have at least some level of ambition in terms of the energy transition. This influences the results in a positive way. When a more realistic sample of companies could have been interviewed, the alignment between actors most probably had been lower.
- Due to circumstances, it has been proven that the initial selection of respondents could not completely be interviewed. Due the absence of communication of potential respondents or the explicit refusal, the ultimate number of interviews is 16, instead of the 19 proposed. This also means that not the same set of actors have been interviewed for each cases, potentially leading to different results.
- Due to time constraints, the researcher chose to create interview reports instead of transcripts. These interview reports display what respondents answered, but not exactly what the researcher asked. Because of this, context misses for external readers. Although exact words were not deemed relevant for this research, this decision had an effect on the deepness of analysis. Transcripts allow for more thorough analysis and the effect of the researcher on the interviewer becomes apparent. The latter did not happen in this analysis.
- It is important the consider the fact that the author of this thesis categorized the collected factors and solutions. Although done objectively to his best ability, dividing factors between categorizations stays subjective. However, in the Appendixes, all the factors and solutions are listed, so the reader is invited to have a critical look at the categorizations.
- For the method development, the researcher determined which factors and solutions to cooperate into the method. Again, such decisions are subjective, which is important to consider. Also, during the method development, the researcher identified valuable sources that could increase the value of the method, however, time constraints prevented these additions to be added. This entails only findings from the qualitative data collection were included in the method.
- As last, it is important to realize that the proposed solutions in the method are not exhaustive; therefore, there may exist multiple solutions not mentioned in this study, that could contribute to EC development.

## 8.3 Scientific contribution and implications

The aim of this research was to investigate how implementation of energy cooperation on business parks can be accelerated. This research aim originated from a scarcity of research done in energy cooperation in the Netherlands, as well as the existence of little case studies done on the topic of energy cooperation. Also, Rodin & Moser (2021) highlighted the demand for research on energy cooperation implementation on business parks. This thesis fills those research gaps. Besides, literature covering the topic of transmission congestion in the Netherlands is thinly represented. The effect of transmission congestion on business parks could not be found in the present literature. Hence, this thesis contributes by showing that transmission congestion is a barrier for the energy transition of individual businesses, but is a significant driver for energy cooperation between businesses.

Moreover, this research project contributes to the industrial symbiosis field by proposing a novel framework based on Strategic Niche Management. A framework developed by Susur et al. (2019) was used as basis. This framework was originally used in industrial symbiosis, reviewing eco-industrial park cases. In this thesis, the framework is used in the context of energy cooperation on business parks. Although Susur et al. (2019) re-interpreted an extensive amount of cases from the literature, their framework stays on the surface. Especially by re-interpreting cases, one would have expected indicators for the three processes of SNM, such as proposed by Kamp & Vanheule (2015). This research combines four approaches from the literature into one framework, to ensure thorough structuring and analysis of the collected data. A custom framework was designed because a thorough literature review could not provide a suitable research framework. Susur et al. (2019) was used as basis, niche process indicators from Kamp & Vanheule (2015) concertize the niche processes and the main and sub categories as proposed by Rodin & Moser (2021) were used to structure the learning activities. Furthermore, a business owner categorization proposed by TNO (2016) was used to map types of business owners. The researcher also added his own ideas to the framework, such as actor roles and the operationalization of network alignment. The latter is of great novelty and this research is the first that made network alignment measurable. Moreover, drivers and solutions were added, as a learning activities. With the addition of roles, this research contributes to the SNM frameworks of Susur

et al. (2019) and Kamp & Vanheule (2015), by making recommendations and strategies more concrete. Another layer is added by distinguishing between current roles and expected roles. The operationalization of network alignment allows for better case comparison and contributes to the work ofKamp & Vanheule (2015). The added drivers and solutions contribute to the field by offering a different perspective than only focusing on barriers, which seemed to be the prevalent perspective in the literature. Novel factor categories contribute to the work of Rodin & Moser (2021), by showing that different factor categories can arise in different environments. As last, the institutional context was explicitly added to the framework. Although learning could occur in the legal / regulatory and policy categories, the institutional context was added as a semi-fixed boundary condition for the niche experiments and development of energy cooperation. The institutional context is quite rigid. Laws, regulations and policies can and will change, however with regard to an urgent problem such as transmission congestion, one cannot wait for the institutional context to change. This results in the fact that the institutional context appears rigid.

Furthermore, this research contributes to the energy cooperation field by showing actor charts. Such charts could not be identified in the literature, and make complex relations and roles easily visible. Kamp & Vanheule (2015) do present an actor chart, however, no visual representation of roles and effects on niche experiments were included. This research does include visual representations of actor relations and roles. In the same manner, this research demonstrates a rich visual representation of actor and factor case comparisons, which is novel to the industrial symbiosis field. No literature conducts a frequency analysis of the occurrence of actors and factors. By conducting such analysis, cases can be easily compared in a visual manner, easily showing similarities and differences between business parks. The occurrence analysis of actor roles quickly shows which actors play a significant role and which actors are expected to have a more prominent role, a distinction that is also new to the literature.

Additionally, this thesis conducts an extensive environmental analysis that maps national, regional and local stakeholders and the institutional context on three levels: national, regional and local. With such analysis, it becomes apparent how the national institutional context translates to the local environment that business parks finds themselves in. Such explicit approach showing laws and regulations enables better understanding of current issues. To the best of the researcher's knowledge, such explicit approach is currently lacking in the in the literature round industrial symbiosis and energy cooperation.

As opposed to the thinly represented literature on EC, this research proposes concrete examples of energy cooperation. For example, research by Rodin & Moser (2021) and Rodin & Moser (2022) indicated that various forms of energy cooperation exist and some forms of EC were mentioned. However, it was not described how such forms of EC operate. This thesis does describe how various energy cooperation forms operate, by presenting state of the art system innovations that have the potential to solve a large part of congestion problems. The group contract innovation, whereby multiple businesses share one grid connection, exchanging grid capacity, could not be encountered in present literature. Although different institutional environments exist in different countries, these concrete examples of energy cooperation could be applied in similar forms.

Besides, no literature could be identified that researched energy cooperation after the start of the Russia-Ukraine war. This thesis shows the immense driving effect of the energy crisis on business owners, desperately demanding ways to reduce energy costs. As this study showed, multiple forms of energy cooperation exist that have the potential to significantly reduce energy costs.

As last, this study contributes to the energy cooperation field by providing an extensive method that can be used for the acceleration of EC on business parks. Pyakurel & Wright (2021) present a method for energy cooperation development, but stay on the surface and do not provide concrete steps that guide EC developers to their envisioned goal. Pyakurel & Wright (2021) only provide generic steps that seem self-evident. Also, this method was developed before the energy crisis of 2022 originated, a situation where energy urgency among businesses was significantly lower, leading to lower willingness of businesses, that in turn leads to different dynamics between them. In comparison to the method developed in this study, the task of gathering and uniting businesses could have been more difficult, leading to a different method. The latter is also the case for the method developed by TNO (2016), which is more extensive than Pyakurel & Wright (2021), but originates from a time where transmission congestion was not a problem for businesses. This leads to a method that is more focused on individual sustainability measures, whereas the method developed in this thesis project solely focuses on collaborative measures. This method contributes also by providing factors and solutions per method-phase. With these factors and solutions, developers are not fixed to the method, but can construct their own, based on the factors of their respective business park. Such context lacks in the method developed by TNO (2016).

## 8.4 Practical and managerial contribution

With the results of this thesis, managers of companies, park managers but also managers of higher level institutions can make more informed decisions about the development and enhancement of energy cooperation on business parks. In-

sights are given on role for specific actors, which can be helpful for policy makers with no experience in this field. Also, this research showed that top-down approaches in energy cooperation do work counter-effective and that bottom-up approaches should be chosen to accelerate energy cooperation on business parks.

Developers of EC projects on business parks are provided with an extensive collection of factors that influence EC. The categorizations of these factors provide valuable insights ensure particular types of factors can be easily identified. These categorized factors ensure that EC developers quickly can determine which factors apply to their particular business park. For example, developers can identify to which phase their business park belongs, and they can identify the barriers, drivers and solutions that can be encountered in that phase. With the four different business parks evaluated, developers of business parks can pick the results from the park that matches theirs the most, in order to increase the predictability of the actions they will perform. Developers of EC can use the extensive methodology as general guidance of the process of EC development. Something worth noting is that the internship company, Sweco, will be using the proposed method in their next project that focuses on business parks. This amplifies the practical relevance of this research.

Recommendations are proposed for specific policy makers, such as the national government, provinces and municipalities. These actors are often new to the topic of energy cooperation on business parks and have little connection with the practical world of local EC projects. By providing hands-on advice to those actors, these actors can prevent common pitfalls and perform actions that help accelerate the implementation of EC on business parks.

## 8.5 Future research

An obvious direction for future research is to test the developed methodology for other business parks in the Netherlands. Although it could be used right away, more input would be of great value for the method. This testing could be performed in the Netherlands, but also elsewhere in Europe, whereby the effect of different institutional contexts should be highlighted. The result would be a more robust method. Moreover, research with different business parks would be interesting, with other dimensions used for the case selection. Different dimensions could entail varying the cases along the number of companies on a business park and whether a business club exists.

Also, future research should use a more realistic sample of business, whereby companies are included that have moderate to low sustainability ambitions. In terms of data analysis, future research should analyse interview transcripts instead of interview reports. Such analysis would yield a richer set of data. The effect such deep analysis on the outcome of a similar study is interesting. Furthermore, to increase objectivity, future research should adopt a four eye principle for categorizing the collected factors. As last, to increase the value and usability of the developed method, other sources should be included, such as ECUB (2021), Zwart (2023) and Samen Om (2023). These sources contain concrete information and examples that could be easily implemented in the method, leading to a higher usability.

## 8.6 Link and reflection on MOT program

This thesis was written as part of the master Management of Technology. During the MOT program, the main goal was to understand how firms and organisations can use technology improve out- comes such as productivity, profitability, competitive advantage, customer satisfaction and sustainability. This research project is closely related to the latter, because knowledge was developed about how firms can use energy and information technologies to achieve economic, social and environmental benefits.

Because of the complex nature of energy cooperation with the light on the institutional context, transmission congestion and multi-stakeholder decisions, this study needed a multidisciplinary approach to achieve the research objective. A multidisciplinary approach is that what makes the MOT master, a feature that makes this master very valuable and interesting in my opinion.

An analytical part also is present in this study, having extensively analysed the collected data and with that providing valuable insights. This analysis feature is also part of the MOT program, whereby the problem should be completely clear first, before a solution can be proposed.

# 9 Conclusion

This study examines energy cooperation on business parks in the Netherlands, with a specific focus on accelerating the implementation. The demand for this research stems partly from the existing literature, which called for further investigation into the implementation of energy cooperation. There is limited literature available specifically on energy cooperation, particularly in the context of mixed-use Dutch industrial parks, and few case studies have been conducted. Additionally, practical observations highlight the need to study the implementation of energy cooperation on business parks due to the constrains caused by grid congestion on the energy transition. The congestion prevents businesses from expanding or even establishing themselves on certain business parks. These issues have hindering consequences on the Dutch energy transition.

In order to address the before-mentioned scientific gaps and practical problems, this study was structured along four sub questions. The sub questions were answered with the help of semi-structured interviews, an environmental analysis, within-case analyses and a multi-case comparative analysis. The conclusion is structured according to the four sub-questions. In this Chapter, each sub-question will be addressed to ultimately answer the main research question.

*1. What are the key stakeholders and institutional context influencing energy cooperation on business parks, what types of cooperation do exist and what is its significance to the Dutch energy transition in congested areas?*

Sub question 1 was answered with findings from expert interviews, supplemented with desk research in an environmental analysis. First, the current stage of energy cooperation on business parks in the Netherlands was investigated, showing that only 2.3 % of the 3500 business parks in the Netherlands is involved in the realization of energy cooperation projects. Then, types of energy cooperation were determined, where focus lies on electricity as energy carrier. So called group contracts are a way of EC, whereby grid capacity is exchanged on paper, resulting in more efficient utilization of the current space on the transmission grid. This type of EC ensures the combined contracted capacity remains the same, while businesses can increase their consumption. Furthermore, a private grid and the physical exchange of electricity were discussed as energy cooperation types. Both are forms of EC that are technically and legally possible, however, many requirements need to be met, which decreases the applicability of these types of energy cooperation.

A stakeholder analysis highlighted that a vast amount of stakeholders play a role in the development of EC on business parks, on national, regional and local level. On national level, the government provides funding to provinces and municipalities through the CDOKE regulation. This funding ensures that provinces and municipalities can strengthen their internal capacity or hire the needed human capital to support energy cooperation initiatives on business parks. The national government finances the existence of PVB, whose goal is to accelerate the sustainable transition of business parks also with the help of EC. In turn, PVB has requested InvestNL to construct a legal framework that can be used for energy cooperation among businesses. The ACM is an important player on the topic of transmission congestion. Structural congestion should be reported to the ACM, and this party also grants permission to the local grid operators to perform pilot projects. On regional level, the province of Overijssel and OostNL play an influential role by launching the Smart Energy Hub program. Furthermore, the province of Overijssel provides subsidies to business parks to support the sustainable transition. The local grid operators such as Enexis are the executing party on the grid, and point of contact for business parks. On local level, municipalities issue permits and play a significant role in providing a clear future vision. Park managers are important executors of the plans of the business club and are the connection between the business park and actors outside the boundaries of the business park. Large companies can have an exemplary role and stimulate energy cooperation while being sustainable front runners.

As for the institutional context, laws, regulations and policies exist on multiple levels. On the national level, the nitrogen crisis plays an obstructing role in the ability of the grid operator to expand the transmission grid, implicitly stimulating energy cooperation. The CES 6 strategy stimulates larger companies to be proactive in the energy transition. Large companies stimulate EC development, so this strategy implicitly stimulates EC as well. The CDOKE regulation is a good way for municipalities and provinces to complement missing resources that are needed to accelerate the energy transition and thus energy cooperation. Furthermore, a few obligations exists targeted at individual companies to stimulate the energy transition and thus implicitly energy cooperation: label C office building obligation, energy conservation obligation and energy audits for larger companies. On a regional level, the Regional Energy Strategy exists, creating coherence between national policies and local policies related to the energy transition. Also, the acceleration program Smart Energy Hubs exists, that actively stimulates the development of energy hubs on business parks in the East of the Netherlands. On a local level, a business investment zone (BIZ) exists, which is a way to stimulate collaboration on business parks. This instrument is valuable to the development of energy cooperation due to the collective payment for development and measures.

*2. How do actors and factors constrain/enable energy cooperation implementation on business parks in congested areas?*

This sub question was answered with the help of expert interviews and case interviews. On a national level, the government hampers the energy transition on business parks, by being indecisive and being too lenient for provinces and municipalities. On the other hand, the government is positively influencing energy cooperation on business parks by funding provinces and municipalities, who in turn can support energy cooperation projects on business parks. On regional level, the province of Overijssel positively influences EC by providing subsidies, organizing Sprint Sessions on business parks and by launching the acceleration program Smart Energy Hubs together with OostNL. Nonetheless, the province also hampers EC by attempting to enforce a top-down approach, which works counter effective on businesses. The local grid operator can have a positive or negative influence on EC, depending on the reviewed cases. On Hessenpoort, Enexis facilitates a pilot for a group contract, while on the other parks such pilots are not being allowed. On the local level, municipalities generally obstruct EC by lack of firm decisions, clear future visions and are ought to have a more active role in EC. Also, counter effective top-down policies are utilized. However, in some cases municipalities also drive EC by financially supporting BPs, by taking initiative for EC and by applying effective business park establishment policies. Park managers are the actors that currently conduct most tasks for EC on business parks, by connecting stakeholders internal and external of the park.

In terms of factors influencing EC, the distinction was made between barriers and drivers. Many barriers and drivers were mentioned in the conducted interviews, however, not all of them had significant impact. The barriers and drivers with most impact - according to the researcher - are shown next along to the main categories from the conceptual framework.

## Barriers

**Economic / financial**
Financing can be a problem for EC, because no memberships fees of business clubs provide insufficient funding to account for the development of energy cooperation. Also, the fact that no subsidies exist for system innovations as EC, complicate the financing of EC development. Furthermore, the current energy taxes prevent profitable energy exchanges, because taxes are effectively paid twice.

**Technical / engineering**
Currently, there is a scarcity of energy management systems that integrate an energy trading platform that is needed to perform virtual or physical energy exchanges, which negatively influences the implementation of energy cooperation. Furthermore, batteries must be integrated to account for intermittency of renewable sources, however, space for the placement of large batteries is scarce on business parks.

**Social / managerial**
Most barriers occur on the local level, whereby municipalities can be constraining due to short employment duration, lack of a clear vision, or the holding of inefficient and counterproductive meetings. Park managers can also be a bottleneck, by not possessing the necessary knowledge and expertise for EC development. Furthermore, companies can be a constraining factor by being ego-centric. The grid operators can be obstructing EC as well, by being inflexible and unapproachable.

**Legal / regulation**
First of all, businesses struggle with understanding and complying to present laws and regulations regarding energy. The GDPR is further obstructing EC, by making it difficult to gather the much needed energy profiles of businesses. Local grid operators obstruct EC by the inability to grant access for new pilot projects for group contracts or energy hubs. Moreover, currently the Energy Law prevents parties from exchanging / supplying energy to others.

**Policy**
Policies can work counter-effective, such as municipalities and provinces having a top-down approach for EC development, and provinces supporting individual businesses instead of collectives. Besides, municipalities often focus on the built-environment, whereas more CO2 reduction potential lies in business parks. Also, obtaining subsidies from provinces can be lengthy and time-consuming, decreasing the momentum of EC projects.

**Organisational**
For non-organized business parks, the number one barrier is the difficulty of the process of gaining an organisational grade. This process take time, effort and commitment of businesses.

**Information**
Many municipalities lack knowledge and understanding about transmission congestion in general, and even more so about the potential of business parks in addressing this congestion. Furthermore, many knowledge gaps exists among

businesses on laws/regulations and technological possibilities and costs. A key realisation that is often lacking is that a collective approach is cheaper can achieves more.

**Responsibility**
A responsibility gap on multiple levels leads to the fact that no party really feels responsible for the energy transition on business parks. This implies that businesses and park managers are in most cases the actors that need to take initiative.

**Human capital**
Lack of human capital is a problem that affects energy cooperation in multiple ways. For example, personnel shortage at the grid operators results in longer application processes for pilots. Even though business parks present plans to the grid operators, they do not have the capacity to review and execute them. Moreover, there is a lack of skilled and experienced people that can guide EC development to successful operation.

## Drivers

**Economic / financial**
Due to the indirect economic consequences of the Russia-Ukraine war, businesses have shown increased interest in participating in sustainable energy initiatives to reduce energy costs. Next to the energy crisis, businesses experience negative economic effects due to transmission congestion, if they cannot obtain a new connection or cannot feed-back their energy. Reducing costs is the primal motivator for businesses to participate in energy cooperation projects.

**Technical / engineering**
A controllable energy source on a business park is an important driving factor that can serve as stabilizer in an energy system, to account for the intermittency of renewable energy sources. An example of such controllable source is a waste management company.

**Social / managerial**
This research has shown that companies are undoubtedly willing to cooperate, which has a positive influence on EC development. This can partly be attributed to the realisation that a collective approach can achieve more and that companies need each other to solve transmission congestion on their park. Furthermore, a signed intention agreement between involved actors drives EC by confirming the commitment of those actors.

**Legal / regulation**
Individual laws and regulations aimed at businesses are an effective way to persuade businesses to think about joining an EC initiative. Examples of such regulations are the Label C Obligation and Energy Conservation Obligation. Furthermore, the fact that most businesses cannot feed-in their surplus solar energy anymore, drives them to think about participating in collective solutions.

**Policy**
In terms of policy, a clear municipality vision for the coming 10 years greatly helps business parks to align their visions with the one from the municipality. Furthermore, on to-be developed business parks, municipalities could implement a policy requiring businesses to install solar panels, in order to stimulate EC. Moreover, the municipality can assist in establishing a BIZ within the business park, thereby promoting collective financing among businesses.

**Organisational**
A prerequisite for any form of energy cooperation to flourish is a form of organisation on the business park. This can be in the form of a park management or a business club, ensuring the park is clean, whole and safe. In order to receive subsidies, a business park should be an organized entity, emphasising the importance of such organisation. Large companies positively influence the organisation of EC, as they often inspire other businesses to embark on energy related projects.

**Information**
Frontrunners, in the form of large companies that possess expertise and local know-how are important actors to have. This, because the expertise can accelerate project development and local know-how can ensure connections that are needed for establishing an EC project.

**Surroundings**
The presence of a nearby solar field frequently emerges as a catalyst that prompts municipalities, park managers, and businesses to explore the potential of establishing connections between the field and the park.

**(In)dependence**
Multiple actors emphasized the desire to be independent from energy suppliers, the energy prices and countries such as Russia. Often, a vision for self-sufficiency is expressed, whereby actors have control over their own energy supply. Such vision is critical in developing EC on a business park.

*3. How can barriers be circumvented and drivers be utilized in order to accelerate implementation of energy cooperation on business parks: which solutions exist?*

This research question was answered with the case-interviews and expert interviews. The solutions that can be implemented by EC developers or policy makers are presented in the main categories of the conceptual framework.

**Technical / engineering**
In terms of technical solutions, a few exist. Cable pooling entails coupling the relatively small connection of solar energy to an existing large wind turbine connection. The complementary nature of solar and wind energy allows the same connection to be used, and ensures the grid operator can reduce new connections. Such solution could be used on a business park with a group contract coupling the feeding-in of solar energy. Furthermore, an often mentioned solution for business parks is a battery system with energy management system ans trading platform, allowing businesses to virtually or physically exchange energy. The physical exchange of energy is, however, not easily implementable.

**Social / managerial**
A company with a champion role is important to have on a business park, in order to persuade and align other companies with its vision. The champion role can also be taken by the park management or business club. Sprint Sessions prove to be effective, thus in order to accelerate EC, these sessions should be implemented nation-wide. Businesses value a dedicated point of contact from the municipality, otherwise they cannot construct and execute long-term plans.Furthermore, small businesses should not be involved in early stages of EC development, and minimal effect on businesses in general is deemed most effective.

**Legal / regulation**
Obligations for businesses prove to be effective solutions for gaining momentum. A governmental obligation for investment in renewable energy would stimulate businesses to think about joining EC initiatives. The same goes for municipal obligations that require businesses to install solar panels. A governmental emergency law might be a solution for accelerating the implementation of group contracts among businesses.

**Policy**
It was often mentioned that firm decisions by municipality or national government would be effective in creating urgency and momentum for energy cooperation. In terms of supporting EC initiatives, policy makers can best adopt a bottom-up approach, as such approach is deemed most effective.

**Organisational**
In case of an Energy Management System, a simple and easy to understand decision-making model should be installed. Furthermore, a favorable pricing can be included in such system, to improve profitability of renewable energy investments from the participants. In order to ensure cooperation of the grid operator, innovative solutions should incorporate the possibility of for the grid operator to shut down the connection in case of an emergency. This give the grid operator the certainty that their operations will not be disrupted. Combining multiple small-scale connections to feed-in surplus energy is one of those solutions. Merging multiple consumption connections into one grid connection is also a novel and viable solution that gives businesses more space on the grid.

**Information**
On business parks in early stages of EC, it would help tremendously if an expert would present their experience with energy cooperation, addressing common bottlenecks and inspiring other businesses.

*4. How can the outcomes be merged into a usable method for developers of energy cooperation on business parks?*

To construct a usable method for developers of energy cooperation on business parks, the researcher divided the method along six phases. This, to enhance the usability of the method, implicating that a business park in every phase of EC development can use the methodology. In order to extract value from the vast amount of factors and solutions collected, only the factors and solutions that could apply to business parks in general were included in the method. These factors and solutions were structured in phases, in order to identify the best strategy to overcome barriers per phase. An initial method was constructed which was reviewed and validated by three energy consultants. This feedback was incorporated into the final method. Furthermore, requirements were constructed to enhance the usability of the method. These requirements entail that the developer should have connecting and approachable traits and that he or she should possess expertise on the topic of energy and business parks, which means that virtually any individual or organisation can be a developer of energy cooperation. Furthermore, the method can only be used on organized parks. Organisation can be in the form of a park management, business club or BIZ.

Answering the last sub question yielded an extensive methodology, whereby per phase it became evident which conditions should be met, which barriers to encounter and which solutions exist for those barriers. The method consists of 22 steps. Some steps are decision moments and dedicated meetings. The first step of the method is to conduct a stakeholder analysis, the last step is to agree on flexible entry and exit of companies. Multiple iteration moments exist, where the involved stakeholders are allowed to iterate until a desirable outcome is achieved.

***"How can implementation of energy cooperation be accelerated on four selected business parks in Overijssel dealing with transmission congestion, in order to support the Dutch energy transition?"***

Answering the main research question, it became apparent that many strategies exist that can be used to accelerate energy cooperation on business parks. Which strategy to be used is mainly dependent on the factors (barriers and drivers) encountered on the respective business parks. Many factors and solutions exist, and many are specific to particular business parks, however also many general applicable factors and solution exist. Developers of energy cooperation projects on business parks should be aware of the park characteristics and barriers for EC that exist on the respective business park, in order to utilize general drivers and solutions. Besides the individual analysis that developers can perform, the developed EC implementation method of this study can be used to guide the process of accelerating energy cooperation.

# 10 Recommendations

In Appendix A.32, the recommendations for the specific cases can found. First, recommendations per actor will be given.

## 10.1 National government

In order to accelerate the Dutch energy transition, the government should take a leading role and make firm and non-negotiable decisions. Now, the delegation of energy transition related issues to lower levels hampers the efficiency and speed of the energy transition process. This, because participation of many stakeholders (especially residents) leads to stagnation due to the fact that consensus is hardly achieved. Furthermore, societal discussions regarding grid congestion should be initiated, so that politics can decide. Grid operators indicated that such discussions should be conducted, because they cannot decide on several topics themselves. Important issues are: who is responsible for prioritizing on connection waiting lists, who should bear the losses experienced by commercial battery operators due to stricter rules. Furthermore, discussion should be held about how to fairly distribute societal costs and benefits of grid interventions. As last, the government should make compromises on privacy for businesses within the GDPR, where energy is building specific and can be shared by the grid operators, in order to accelerate feasibility studies for energy cooperation.

## 10.2 OostNL

OostNL wants to support energy cooperation initiatives, however they should do this in a transparent way and provide genuine subsidies to energy cooperation initiatives.

## 10.3 Provinces

Provinces should redeem the chance to allocate funding via the CDOKE regulation in order to strengthen their internal capacity and hire external human capital if needed, to accelerate the energy transition on business parks. They can accelerate this transition by financially supporting existing collective initiatives on BPs, instead of supporting individual businesses. Next to financial support, support could entail providing guidance or connecting business parks to the appropriate parties.

## 10.4 Local grid operators

Local grid operators should be open and transparent about their choices. For example, if a certain amount of pilots is active and new pilots cannot be started, the grid operator should clearly provide the reasons behind this choice. Such approach could alleviate the perception that the local grid operator is unwilling and rigid, and provide understanding among stakeholders. Furthermore, to increase process efficiency, the local grid operators should develop a framework with minimal requirements and conditions for energy cooperation solutions for business parks. In such way, business parks immediately know what type of plan they should provide, eliminating several iterations and meetings. This is important, because local grid operators lack the human capital to handle all submissions they receive. Furthermore, local grid operators should launch conditional consumption and feeding-in contracts for commercial battery operators (traders), whereby sparing the transmission grid is the number one goal. Now, commercial energy traders strain the grid too much with profit-enhancing energy trading strategies.

## 10.5 Municipalities

Many different types of municipalities exist, some made notable progressions in the energy transitions, others not. However, what is universal in relation to business parks, is that municipalities should have a clear vision for the energy transition on business parks, such that their policy for at least the coming five years is known. If this is not the case, businesses and park managers have no direction and are uncertain about making investments. Municipalities should be motivated by the fact that the energy transition of business parks can significantly help achieve their sustainability goals. If no organisational grade exists on a business park, the municipality should facilitate such organisation by engaging in discussions with entrepreneurs regarding the establishment of park management. For business with park management and businesses club: if not all companies are part of the business club, the municipality should approach these companies by physically visiting these businesses to persuade them by effectively communicating the benefits. If energy cooperation initiatives exist, municipalities should support these by being receptive and easy to approach by business parks. Funding should also be provided to reimburse development costs.

## 10.6 Park managers

Park managers should evaluate their role in relation to the energy transition. This, because some park managers do not have the expertise and skills to lead the energy transition on a business park. If this is the case, this should be acknowledged and an external "energy project leader" should be assigned.

## 10.7 Business clubs

Business clubs must ensure enough funding is available to cover the hours of developing energy cooperation on the business park. Hours can be made by the park manager or an externally hired project leader and sufficient funding could be secured by increasing membership fees. If the latter is not possible, the municipality should be consulted, where a co-financing solution could be viable.

# Bibliography


A1-Bedrijvenpark. (2023a). *Archief Vestigers.* Retrieved 2023-06-18, from https://a1bedrijvenparkdeventer.nl/vestigers/

A1-Bedrijvenpark. (2023b). *Duurzaamheid.* Retrieved 2023-06-21, from https://a1bedrijvenparkdeventer.nl/duurzaamheid/

A1-Bedrijvenpark. (2023c). *Home.* Retrieved 2023-06-18, from https://a1bedrijvenparkdeventer.nl/

ACM. (2020). *De rol van de ACM bij transportschaarste op het elektriciteitsnet | ACM.nl.* Retrieved 2023-07-02, from https://www.acm.nl/nl/onderwerpen/energie/transportschaarste

ACM. (2023a). *Mag ik mijn net zelf beheren of moet de netbeheerder dat doen?* Retrieved 2023-07-02, from https://www.acm.nl/nl/onderwerpen/energie/netbeheerders/ontheffing-aanwijzing-netbeheer

ACM. (2023b). *Melding directe lijn.* Retrieved 2023-07-02, from https://www.acm.nl/nl/onderwerpen/energie/netbeheerders/melding-directe-lijn

Adams, W. C. (2015). *Conducting semi-structured interviews.* John Wiley & Sons, Inc. Retrieved from https://doi.org/10.1002/9781119171386.ch19 doi: 10.1002/9781119171386.ch19

Anastasovski, A. (2023, 2). What is needed for transformation of industrial parks into potential positive energy industrial parks? A review. *Energy Policy*, *173*, 113400. doi: 10.1016/j.enpol.2022.113400

Archieven.nl. (2023). *Archieven.nl - 99 - 1099 Industrieterrein "Groot Verlaat" te Steenwijk in 1985 (Gemeentearchief Steenwijkerland).* Retrieved 2023-08-04, from https://www.archieven.nl/nl/zoeken?mivast=0&mizig=187&miadt=1648&miaet=14&micode=99&minr=961079&miview=ldt

Bedrijven Investeringszone. (2020). *Waarom een BIZ?* Retrieved 2023-07-05, from https://bedrijveninvesteringszone.biz/waarom-een-biz/

Bhattacherjee, A. (2012). *Social science research.* North Charleston, SC: Createspace Independent Publishing Platform.

BIT-Twentekanaal. (2021). *Concrete plannen om Bedrijvenpark Twentekanaal te verduurzamen.* Retrieved 2023-06-15, from https://www.twentekanaal.com/nieuws/concrete-plannen-om-bedrijvenpark-twentekanaal-te-verduurzamen/

BIT-Twentekanaal. (2023). *Over BIT.* Retrieved 2023-06-18, from https://www.twentekanaal.com/over-bit/

Buisman, P. (2010, October). *Twentekanaal Hengelo.* Retrieved 2023-06-18, from https://bedrijveninvesteringszone.biz/twentekanaal-hengelo/

Butturi, M. A., & Gamberini, R. (2020, 11). Urban–industrial symbiosis to support sustainable energy transition. *International Journal of Energy Production and Management*, *5*(4), 355–366. doi: 10.2495/EQ-V5-N4-355-366

Ceglia, D., Abreu, M. C. S. d., & Da Silva Filho, J. C. L. (2017, 2). Critical elements for eco-retrofitting a conventional industrial park: Social barriers to be overcome. *Journal of Environmental Management*, *187*, 375–383. doi: 10.1016/j.jenvman.2016.10.064

Chertow, M., & Ehrenfeld, J. (2012, 2). Organizing Self-Organizing Systems. *Journal of Industrial Ecology*, *16*(1), 13–27. doi: 10.1111/j.1530-9290.2011.00450.x

Chertow, M. R. (2000, 11). INDUSTRIAL SYMBIOSIS: Literature and Taxonomy. *Annual Review of Energy and the Environment*, *25*(1), 313–337. doi: 10.1146/annurev.energy.25.1.313

D'Agnolo. (2022). *Local energy hubs zijn een mogelijke oplossing voor de congestie op het elektriciteitsnetwerk - next2company.* Retrieved from https://next2company.com/local-energy-hubs-zijn-een-mogelijke-oplossing-voor-de-congestie-op-het-elektriciteitsnetwerk/

Domenech, T., Bleischwitz, R., Doranova, A., Panayotopoulos, D., & Roman, L. (2019, 2). Mapping Industrial Symbiosis Development in Europe_ typologies of networks, characteristics, performance and contribution to the Circular Economy. *Resources, Conservation and Recycling*, *141*, 76–98. doi: 10.1016/j.resconrec.2018.09.016

Dorhout Advocaten. (2023, January). *Het gesloten distributiesysteem en de directe lijn.* Retrieved 2023-07-02, from https://www.dorhout.nl/2023/01/30/het-gesloten-distributiesysteem-en-de-directe-lijn/

Duurzaam Gebouwd. (2020, November). *A1 bedrijvenpark Deventer West gaat circulair.* Retrieved 2023-08-04, from https://www.duurzaamgebouwd.nl/artikel/20201126-a1-bedrijvenpark-deventer-west-gaat-circulair

Duurzaam Gebouwd. (2023, February). *Verduurzaming bedrijventerreinen vraagt innovatie en organisatie.* Retrieved 2023-08-01, from https://www.duurzaamgebouwd.nl/artikel/20230223-verduurzaming-bedrijventerreinen-vraagt-innovatie-en-organisatie

ECUB. (2021). *Handboek Aanpak collectieve verduurzaming bedrijventerreinen* (Tech. Rep.). Retrieved from https://www.klimaatakkoord.nl/binaries/klimaatakkoord/documenten/publicaties/2021/01/30/handboek-duurzame-bedrijfsterreinen-ecub/Handboek-januari-2021-webversie.pdf

Eilering, J. A., & Vermeulen, W. J. (2004). Eco-industrial parks: toward industrial symbiosis and utility sharing in practice. *Progress in Industrial Ecology, An International Journal, 1*, 245. doi: 10.1504/PIE.2004.004681

EnergievanHengelo. (2023). *Zonneveld Boeldershoek.* Retrieved 2023-06-14, from https://www.energievanhengelo.nl/projecten/ZonneveldBoeldershoek

Energievergelijker.nl. (2023). *Energievergelijker.* Retrieved 2023-07-03, from https://www.energievergelijker.nl/energie-informatie/verklarende-woordenlijst/e/energiebelasting

Enexis. (2022). *Congestiemanagement in de praktijk | Enexis Netbeheer.* Retrieved 2023-07-02, from https://www.enexis.nl/zakelijk/transportschaarste-elektriciteit/congestiemanagement/in-de-praktijk

Enexis. (2022, November). *Congestieonderzoek Zwolle Hessenweg | Enexis Netbeheer.* Retrieved 2023-06-11, from https://www.enexis.nl/zakelijk/aansluitingen/congestie-onderzoeken/overijssel/zwolle-hessenweg-et

Enexis. (2023, June). *Beperkte transportcapaciteit voor afname op het elektriciteitsnet | Enexis Netbeheer.* Retrieved 2023-07-02, from https://www.enexis.nl/zakelijk/aansluitingen/beperkte-capaciteit-afname

Enexisgroup. (2023). *Lijst van aandeelhouders.* Enexis. Retrieved 2023-07-01, from https://www.enexisgroep.nl/media/3486/vergaderbundel-ava-enexis-holding-nv-13-april-2023.pdf

Enkhardt, S. (2022, 8). *Österreich befreit Photovoltaik-Anlagen bis 25 Kilowatt von Einkommensteuer – pv magazine Deutschland.* Retrieved from https://www.pv-magazine.de/2022/08/08/oesterreich-befreit-photovoltaik-anlagen-bis-25-kilowatt-von-einkommensteuer/

Fereday, J., & Muir-Cochrane, E. (2006, March). *Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development* (Vol. 5) (No. 1). SAGE Publications. Retrieved from https://doi.org/10.1177/160940690600500107 doi: 10.1177/160940690600500107

Gebiedslabel. (2019). *Hessenpoort, Wehkamp.* Retrieved 2023-06-18, from https://www.nlgebiedslabel.nl/nproject/hessenpoort-natuurlijk-zwolle/

Gemeente-Dalfsen, G. (2022, December). *Regionale ontwikkelingen grootschalige energieopwek* [Pagina]. Retrieved 2023-06-19, from https://www.dalfsen.nl/regionale-ontwikkelingen-grootschalige-energieopwek

Golev, A., Corder, G. D., & Giurco, D. P. (2015, 2). Barriers to Industrial Symbiosis: Insights from the Use of a Maturity Grid. *Journal of Industrial Ecology*, *19*(1), 141–153. doi: 10.1111/jiec.12159

Gregson, N., Crang, M., Fuller, S., & Holmes, H. (2015, 4). Interrogating the circular economy: the moral economy of resource recovery in the EU. *Economy and Society*, *44*(2), 218–243. doi: 10.1080/03085147.2015.1013353

Grünewald, P. H., Cockerill, T. T., Contestabile, M., & Pearson, P. J. (2012, 11). The socio-technical transition of distributed electricity storage into future networks—System value and stakeholder views. *Energy Policy*, *50*, 449–457. doi: 10.1016/j.enpol.2012.07.041

H2O-Waternetwerk. (2022, February). *Klimaatminister Rob Jetten start proef zuurstofinfuus rwzi Hessenpoort.* Retrieved 2023-06-19, from https://www.h2owaternetwerk.nl/h2o-actueel/klimaatminister-rob-jetten-start-proef-zuurstofinfuus-rwzi-hessenpoort

Henriques, J., Ferrão, P., Castro, R., & Azevedo, J. (2021, 2). Industrial Symbiosis: A Sectoral Analysis on Enablers and Barriers. *Sustainability*, *13*(4), 1723. doi: 10.3390/su13041723

Hoogma, R., Kemp, R., Schot, J., & Truffer, B. (2005). *Experimenting for sustainable transport.* Routledge. Retrieved from https://doi.org/10.4324/9780203994061 doi: 10.4324/9780203994061

Invest-NL. (2023). *Over ons.* Retrieved 2023-07-05, from https://www.invest-nl.nl/page/1087/over-ons

Kamp, L. M., & Vanheule, L. F. (2015, September). Review of the small wind turbine sector in kenya: Status and bottlenecks for growth. *Renewable and Sustainable Energy Reviews*, *49*, 470–480. Retrieved from https://doi.org/10.1016/j.rser.2015.04.082 doi: 10.1016/j.rser.2015.04.082

Lambert, A., & Boons, F. (2002, August). Eco-industrial parks: stimulating sustainable development in mixed industrial parks. *Technovation*, *22*(8), 471–484. Retrieved from https://doi.org/10.1016/s0166-4972(01)00040-2 doi: 10.1016/s0166-4972(01)00040-2

Liander. (2022). *Beschikbaarheid capaciteit per gebied | Liander.* Retrieved from https://www.liander.nl/grootzakelijk/transportschaarste/beschikbaarheid-capaciteit

Mainar-Toledo, M., Castan, M., Millán, G., Rodin, V., Kollmann, A., Peccianti, F., ... Kuittinen, H. (2022, 1). Accelerating sustainable and economic development via industrial energy cooperation and shared services – A case study for three European countries. *Renewable and Sustainable Energy Reviews*, *153*, 111737. doi: 10.1016/j.rser.2021.111737

Management-Scope. (2020). *Enexis - Raad van bestuur en raad van commissarissen.* Retrieved 2023-07-01, from https://managementscope.nl/bedrijf/enexis

Mendez-Alva, F., Cervo, H., Krese, G., & Van Eetvelde, G. (2021, 9). Industrial symbiosis profiles in energy-intensive industries: Sectoral insights from open databases. *Journal of Cleaner Production*, *314*, 128031. doi: 10.1016/j.jclepro.2021.128031

Ministerie van Economische Zaken en Klimaat. (2019, June). *Klimaatakkoord hoofdstuk RES - Publicatie - Klimaatakkoord* [publicatie]. Retrieved 2023-07-05, from https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/klimaatakkoord-hoofdstuk-res

MKB-Nederland. (2015, October). *Wat doet MKB-Nederland?* Retrieved 2023-07-05, from https://www.mkb.nl/over-mkb-nederland/wat-doet-mkb-nederland

Mortensen, L., & Kørnøv, L. (2019, 3). Critical factors for industrial symbiosis emergence process. *Journal of Cleaner Production*, *212*, 56-69. doi: 10.1016/J.JCLEPRO.2018.11.222

NCW, V., & Nederlnad, M. M. (2021). *Integrale aanpak duurzame bedrijventerreinen.* Retrieved from https://www.vno-ncwmidden.nl/wp-content/uploads/2021/05/IADB.Rapport.pdf

Netbeheer Nederland. (2023a, June). *Geef elektriciteitsnet stikstofvrijstelling, anders valt transitie stil - Netbeheer Nederland.* Retrieved 2023-07-05, from https://www.netbeheernederland.nlnieuws/geef-elektriciteitsnet-stikstofvrijstelling-anders-valt-transitie-stil-1645

Netbeheer Nederland. (2023b, February). *Stikstofimpasse zet rem op energietransitie - Netbeheer Nederland.* Retrieved 2023-07-05, from https://www.netbeheernederland.nlnieuws/stikstofimpasse-zet-rem-op-energietransitie-1609

NetbeheerNederland. (2022, March). *Uit Net NL#36: Bedrijvenpark wordt energie-knooppunt - Netbeheer Nederland.* Retrieved 2023-06-19, from https://www.netbeheernederland.nlnieuws/uit-net-nl-36-bedrijvenpark-wordt-energie-knooppunt-1518

Neves, A., Godina, R., Azevedo, S. G., & Matias, J. C. (2020, 2). A comprehensive review of industrial symbiosis. *Journal of Cleaner Production*, *247*, 119113. doi: 10.1016/j.jclepro.2019.119113

Neves, A., Godina, R., G. Azevedo, S., Pimentel, C., & C.O. Matias, J. (2019, 12). The Potential of Industrial Symbiosis: Case Analysis and Main Drivers and Barriers to Its Implementation. *Sustainability*, *11*(24), 7095. doi: 10.3390/su11247095

NieuweEnergieOverijssel. (2022). *Praktisch overzicht van duurzame maatregelen bedrijven(terreinen) | nieuwe energie overijssel.* Retrieved from https://www.nieuweenergieoverijssel.nl/praktisch-overzicht-van-duurzame-maatregelen-bedrijventerreinen/

NOS. (2019). *Geen plek voor nieuwe zonneparken op stroomnetwerk.* Retrieved from https://nos.nl/artikel/2266953-geen-plek-voor-nieuwe-zonneparken-op-stroomnetwerk

NOS. (2023a, 3). *Knipperende lampen of zelfs uitval: alliander waarschuwt voor vol stroomnet.* Retrieved from https://nos.nl/artikel/2466776-knipperende-lampen-of-zelfs-uitval-alliander-waarschuwt-voor-vol-stroomnet

NOS. (2023b, 2). *Netbeheerders: stop met zonneparken daar waar nauwelijks vraag naar stroom is.* Retrieved from https://nos.nl/nieuwsuur/artikel/2465631-netbeheerders-stop-met-zonneparken-daar-waar-nauwelijks-vraag-naar-stroom-is

Ondernemersvereniging-Hessenpoort. (2023a). *Leden – Ondernemersvereniging Hessenpoort.* Retrieved 2023-06-18, from https://www.ondernemersverenigingheSSenpoort.nl/leden/

Ondernemersvereniging-Hessenpoort. (2023b). *Over – Ondernemersvereniging Hessenpoort.* Retrieved 2023-06-18, from https://www.ondernemersverenigingheSSenpoort.nl/over/

Oost NL. (2022a, October). *Smart Energy Hubs als basis voor het energiesysteem van de toekomst.* Retrieved 2023-07-05, from https://oostnl.nl/nl/nieuws/smart-energy-hubs-als-basis-voor-het-energiesysteem-van-de-toekomst

Oost NL. (2022b). *Versnellingprogramma Smart Energy Hubs.* Retrieved 2023-07-05, from https://oostnl.nl/nl/smartenergyhubs/programma-smart-energy-hubs-oost-nederland

Oost NL. (2023). *Wie zijn we.* Retrieved 2023-07-05, from https://oostnl.nl/nl/wie-zijn-we

OostNL. (2021, July). *'Zwolle is de eerste met een smart energy hub van formaat'.* Retrieved 2023-06-19, from https://oostnl.nl/nl/nieuws/zwolle-de-eerste-met-een-smart-energy-hub-van-formaat-0

Overheid.nl. (2021). *Juridische kaders rondom het delen van energiedata | data overheid.* Retrieved from https://data.overheid.nl/juridische-kaders-rondom-het-delen-van-energiedata#_Verdiepende_achtergrondinformatie

Overheid.nl. (2022, October). *Elektriciteitswet 1998.* Retrieved 2023-07-02, from https://wetten.overheid.nl/BWBR0009755/2022-10-01

Overijssel, E. F. (2023, June). *Over Energiefonds Overijssel - Over ons.* Retrieved 2023-06-14, from https://www.energiefondsoverijssel.nl/over-ons/over-energiefonds-overijssel/

Overijssel, N. E. (2023). *Netcongestie.*

PBL. (2022, 11). *Hogere klimaatambitie vergt snellere uitvoering en meer beleid | pbl planbureau voor de leefomgeving.* Retrieved from https://www.pbl.nl/nieuws/2022/hogere-klimaatambitie-vergt-snellere-uitvoering-en-meer-beleid

Planviewer. (2023). *Bedrijventerrein Twentekanaal: 2.1 Geschiedenis van het gebied.* Retrieved 2013-08-04, from https://www.planviewer.nl/imro/files/NL.IMRO.0164.BP0009-0301/t_NL.IMRO.0164.BP0009-0301_2.1.html

Programma Verduurzaming Industrie. (2022, March). *Cluster Energie Strategie van 'Cluster 6' aangeboden aan minister Rob Jetten.* Retrieved 2023-07-05, from https://www.verduurzamingindustrie.nl/actueel/nieuws/2185806.aspx?t=Cluster-Energie-Strategie-van-%E2%80%98Cluster-6%E2%80%99-aangeboden-aan-minister-Rob-Jetten

PVB. (2023). *Toekomstbestendige Bedrijventerreinen Live 3.0.* Retrieved 2023-07-02, from https://pvbnederland.nl/event/tbbt-live-3-0/

PVBNederland. (2022). *Over pvb nederland | programma verduurzaming bedrijventerreinen.* Retrieved from https://pvbnederland.nl/over-pvb/

Pyakurel, P., & Wright, L. (2021, 6). Energy and resources cooperation for greenhouse gases emissions reduction of industrial sector. *Energy Environment*, *32*, 635-647. doi: 10.1177/0958305X20949957

Regionale Energie Strategie. (2023). *RES Regio's op de kaart.* Retrieved 2023-07-05, from https://www.regionale-energiestrategie.nl/resregios/default.aspx

Rodin, V., & Moser, S. (2021, 4). The perfect match? 100 reasons why energy cooperation is not realized in industrial parks. *Energy Research & Social Science*, *74*, 101964. doi: 10.1016/j.erss.2021.101964

Rodin, V., & Moser, S. (2022, 12). From theory to practice: Supporting industrial decarbonization and energy cooperation in Austria. *Energy Research & Social Science*, *94*, 102863. doi: 10.1016/j.erss.2022.102863

Rooijers, E. (2023, 2). *Nog jarenlang wachtlijsten voor aansluiting op het stroomnet.* Retrieved from https://fd.nl/bedrijfsleven/1468954/nog-jarenlang-wachtlijsten-voor-aansluiting-op-het-stroomnet

RTVOost. (2022, July). *Bedrijven op industrieterrein Hessenpoort Zwolle starten innovatief energieproject.* Retrieved 2023-06-19, from https://www.rtvoost.nl/nieuws/2124815/bedrijven-op-industrieterrein-hessenpoort-zwolle-starten-innovatief-energieproject

RVO. (2018). *Energielabel C kantoren.* Retrieved 2023-07-05, from https://www.rvo.nl/onderwerpen/wetten-en-regels-gebouwen/energielabel-c-kantoren

RVO. (2022, September). *Wat is de energiebesparingsplicht? (vanaf 2023).* Retrieved 2023-06-15, from https://www.rvo.nl/onderwerpen/energiebesparingsplicht-2023/energiebesparingsplicht

RVO. (2023, July). *Tijdelijke regeling capaciteit decentrale overheden voor klimaat- en energiebeleid (CDOKE).* Retrieved 2023-07-05, from https://www.rvo.nl/subsidies-financiering/cdoke

Samen Om. (2023, May). *Eerste bedrijvenpark in Nederland lost eigen netwerkcongestie op met Energy hub.* Retrieved 2023-08-13, from https://samenom.nl/eerste-bedrijvenpark-in-nederland-lost-eigen-netwerkcongestie-op-met-energy-hub/

Schreiver, W. (2023, April). *A1 Bedrijvenpark Deventer: 'Bedrijven moeten echt iets toevoegen aan de stad'.* Retrieved 2023-06-25, from https://www.driestedenbusiness.nl/lees-meer/nieuws/41252/A1-Bedrijvenpark-Deventer:--Bedrijven-moeten-echt-iets-toevoegen-aan-de-stad-'

Sekaran, U. S., & Bougie, R. (2009). *Research methods for business.* Chichester, England: John Wiley & Sons.

SolarMagazine. (2022, 9). *Solar magazine - programma verduurzaming bedrijventerreinen nederland: 'zonnepanelen pas echt interessant in integraal hernieuwbare-energiesysteem'.* Retrieved from https://solarmagazine.nl/nieuws-zonne-energie/i27931/programma-verduurzaming-bedrijventerreinen-nederland-zonnepanelen-pas-echt-interessant-in-integraal-hernieuwbare-energiesysteem

Susur, E., Hidalgo, A., & Chiaroni, D. (2019, January). A strategic niche management perspective on transitions to eco-industrial park development: A systematic review of case studies. *Resources, Conservation and Recycling*, *140*, 338–359. Retrieved from https://doi.org/10.1016/j.resconrec.2018.06.002 doi: 10.1016/j.resconrec.2018.06.002

Taqi, H. M. M., Meem, E. J., Bhattacharjee, P., Salman, S., Ali, S. M., & Sankaranarayanan, B. (2022, 10). What are the challenges that make the journey towards industrial symbiosis complicated? *Journal of Cleaner Production*, *370*, 133384. doi: 10.1016/j.jclepro.2022.133384

Tellier, M. L., Berrah, L., Stutz, B., Audy, J.-F., & Barnabé, S. (2019, April). Towards sustainable business parks: A literature review and a systemic model. *Journal of Cleaner Production*, *216*, 129–138. Retrieved from https://doi.org/10.1016/j.jclepro.2019.01.145 doi: 10.1016/j.jclepro.2019.01.145

Tennet. (2023). *Over TenneT | TenneT.* Retrieved 2023-07-05, from https://www.tennet.eu/nl/over-tennet

TNO. (2016). *Snelstartgids: Duurzame energiemaatregelen op bedrijventerreinen.*

TNO. (2021, 8). *Bedrijventerreinen verduurzamen | tno.* Retrieved from https://www.tno.nl/nl/duurzaam/systeemtransitie/energietransitie-wijken/bedrijventerreinen-verduurzamen/

TNO. (2022). *Bedrijventerreinen verduurzamen | tno.* Retrieved from https://www.tno.nl/nl/duurzaam/systeemtransitie/energietransitie-wijken/bedrijventerreinen-verduurzamen/

Twence. (2022). *Zonne-energie opwekken.* Retrieved 2023-06-14, from https://www.twence.nl/innovaties/duurzame-energie/zonne-energie-opwekken

Valladolid, C. (2021). *Creating synergies in eco-industrial parks in the netherlands: A refined framework through a cross-case analysis [msc thesis]* .

VNO-NCW. (2015, September). *Wat is VNO-NCW?* Retrieved 2023-07-05, from https://www.vno-ncw.nl/over-vno-ncw

Yin, R. K. (1994, October). *Discovering the future of the case study. method in evaluation research* (Vol. 15) (No. 3). SAGE Publications. Retrieved from https://doi.org/10.1177/109821409401500309 doi: 10.1177/109821409401500309

Zwart, M. (2023, August). *De plek van bedrijventerreinen in de energietransitie van de Leidse regio* (Tech. Rep.). Retrieved from https://www.economie071.nl/economie-071/expert-sessie/

# A Appendices

## A.1 Search terms

| Search term | # Results | # Relevant results |
|---|---|---|
| TITLE-ABS-KEY ( energy cooperation" AND ( netherlands OR dutch ) ) " | 2 | 0 |
| TITLE-ABS-KEY ( industrial symbiosis" AND energy AND ( netherlands OR dutch ) ) " | 5 | 1 [1] |
| TITLE-ABS-KEY ( energy exchange" AND ( netherlands OR dutch ) AND "business park*" ) " | 0 | 0 |
| TITLE-ABS-KEY ( "grid congestion" AND "energy cooperation" ) | 0 | 0 |
| TITLE-ABS-KEY ( "grid congestion" AND "industrial symbiosis" ) | 0 | 0 |
| TITLE-ABS-KEY ( "grid congestion" AND ( "business park*" OR "eco-industrial park*" OR "industrial park*" ) ) | 0 | 0 |
| TITLE-ABS-KEY ( ( "grid congestion" OR "transmission congestion" ) AND ( "business park*" OR "eco-industrial park*" OR "industrial park*" ) ) | 0 | 0 |
| TITLE-ABS-KEY ( congestion AND ( "industrial symbiosis" OR "energy cooperation" OR "energy exchange" ) AND ( "business park*" OR "eco-industrial park*" OR "eco industrial park*" ) ) | 0 | 0 |
| TITLE-ABS-KEY ( mixed AND "energy cooperation" ) | 18 | 0 [2] |
| TITLE-ABS-KEY ( "energy cooperation" OR "industrial symbiosis" AND implementation OR realisation AND "business park*" ) | 2 | 1 [3] |
| TITLE-ABS-KEY ( ( "energy cooperation" OR "industrial symbiosis" ) AND implementation OR realisation AND ( "business park*" OR "eco-industrial park*" OR "industrial park*" ) AND energy ) AND ( LIMIT-TO ( SUBJAREA , "BUSI" ) OR LIMIT-TO ( SUBJAREA , "SOCI" ) ) | 13 | 1 [4] |
| TITLE-ABS-KEY(transition* AND "business park*") | 3 | 0 |
| TITLE-ABS-KEY(("heat exhange*"OR "heat exchanging" OR "heat network*") AND "business park*" OR "eco-industrial park*" OR "eco industrial park*") AND (LIMIT-TO (SUBJAREA, "BUSI" OR LIMIT-TO (SUBJAREA, "ECON") OR LIMIT-TO (SUBJAREA, "SOCI")) | 3 | 0 |
| TITLE-ABS-KEY ( heat AND ( "industrial symbiosis" OR "eco-industrial park*" OR "eco industrial park" OR "business park*" ) AND barrier* ) AND ( LIMIT-TO ( SUBJAREA , "BUSI" ) OR LIMIT-TO ( SUBJAREA , "ECON" ) OR LIMIT-TO ( SUBJAREA , "SOCI" ) ) | 7 | 0 |
| TITLE-ABS-KEY ( "energy cooperation" AND "industrial symbiosis" ) | 6 | 4 [5] |
| TITLE-ABS-KEY ( "mixed-use industrial park*" OR "mixed use industrial park*" OR "mixed-use eco-industrial park*" OR "mixed use eco-industrial park*" OR "mixed-use business park*" OR "mixed use business park*" OR "service-based eco-industrial park*" OR "service-based industrial park*" OR "service-based industrial park*" ) | 3 | 0 |
| TITLE-ABS-KEY ( "strategic niche management" AND "industrial symbiosis" OR "energy cooperation" ) | 2 | 0 |
| TITLE-ABS-KEY ( "industrial symbiosis" AND ( energy OR electricity ) OR "energy cooperation" AND ( "evaluat*" OR assess* ) AND ( "business park*" OR "eco-industrial park*" OR "industrial park*" ) AND ( framework OR theor* ) ) AND ( LIMIT-TO ( SUBJAREA , "BUSI" ) ) | 7 | 1? [6] |

| | | |
|---|---|---|
| TITLE-ABS-KEY ( ( "renewable energy*" OR "solar energy" OR "solar pv" OR "pv" OR "solar panel*" ) AND ( "business park*" ) ) AND ( LIMIT-TO ( SUBJAREA , "ENVI" ) OR LIMIT-TO ( SUBJAREA , "BUSI" ) ) | 5 | 0 |
| TITLE-ABS-KEY ( "industrial symbiosis" AND ( energy OR electricity ) AND implementation AND "business park*" OR "industrial park*" OR "mixed-use eco-industrial park*" ) | 24 | |
| TITLE-ABS-KEY ( "energy transition" AND ( "business park*" OR "industrial park*" OR "eco-industrial park*" ) AND netherlands ) | 0 | 0 |
| TITLE-ABS-KEY ( "energy transition" AND ( "business park*" OR "industrial park*" OR "eco-industrial park*" ) ) | 10 | 2 [7] |
| TITLE-ABS-KEY ( "community energy systems" AND ( "industrial park*" OR "business park*" OR "eco-industrial park*" ) ) | 2 | 1 [8] |

Table A.2: Second part of search terms used in Scopus database

**[1]** Article by Eilering & Vermeulen (2004).
**[2]** Nothing could be found about mixed-use industrial parks or mixed-use eco-industrial parks.
**[3]** Article by Pyakurel & Wright (2021) is really relevant due to usability and feasibility of proposed framework.
**[4]** Article by Rodin & Moser (2021), mostly on heavy industrial parks and decarbonization, not on mixed-use industrial business parks.

## A.2 Interview with expert on sustainable business parks, consulting company

**Main points of orienting interview**

- **Sentiment** is very important on business parks. Some companies are located already 30 years and their could have been incidents between those companies, making collaboration (almost) impossible.
- The existence of a central, park-wide **organisation** such as a park manager or a business park association has a significant influence on the success of energy cooperation initiatives. With the existence of such organisation, all companies on the park are connected to one central party that has the overview. That party can easily arrange meetings between companies and connect them and know which companies have highest potential to participate in collective energy projects. Also, a central park-organisation knows the sentiment on the park and between companies. If such organisation is not existent, you could imagine that getting together companies is much more difficult. Also, if there is tension between companies, an external facilitator would always hear one side of the story, hindering the understanding of possible collaborations.
- The type of company, in terms of **decision-maker-location** is very important. Is company on a business park a local company, with a local management, or is it a multinational company with management elsewhere? This has a significant influence on how easily collective projects can be arranged (or not).
- Also, the ownership of the building where energy measures are being applied to is important. If the company rents the building from a landlord, then this could be a barrier, if the landlord has a different vision.
- Politicians in The Hague think **too easily** about collective energy projects on business parks. They think along the lines "Just make a flexible contract between grid operator and company, and you are done." In reality, it is not as simple as that.
- From having a lot of experience with business parks, I know that companies want to collaborate. The question is: in which form? How should it be organized? On what terms? Creating a (legal) **entity** is super important. 1) To determine the collective goal, 2) the scope and 3) collaborative terms.
- Given the fact that an entity is important, it is difficult the determine the outcome and the contract terms at the start of a project.
- We (consulting company) have our own method of selecting the most suitable business parks. This can be included in your (this) research.

## A.3 Respondent invitation e-mail: businesses

Beste heer/mevrouw,

Ik stuur deze mail om u te laten weten dat u bent geselecteerd voor een interview over een (potentieel) energiecollectief op het bedrijventerrein [X].

Mijn naam is Sam Wiesman en ik ben masterstudent van de opleiding Management of Technology aan de TU Delft. Momenteel ben ik bezig met mijn afstudeeronderwerp en ik zou u graag uitnodigen hieraan deel te nemen.

Mijn onderzoek gaat over het samenwerken van bedrijven op bedrijventerreinen op energie gebied. Op dit moment willen veel bedrijven verduurzamen, bijvoorbeeld met zonnepanelen. Een van de moeilijkheden bij deze verduurzaming is het recente probleem van netcongestie, waardoor terugleveren van elektriciteit op het net niet mogelijk is en men vaak nog maar even wacht met de zonnepanelen. Netcongestie staat kortgezegd de energietransitie in de weg. Een oplossing voor dit probleem is om samen te werken met collega-bedrijven op het bedrijventerrein, hierbij moet u denken aan: collectieve inkoop van zonnepanelen, collectieve inkoop van batterijen, het fysiek uitwisselen van energie of zelfs het opzetten van een “Smart Energy Hub” (een eigen netwerk waarbij vraag en aanbod gekoppeld wordt).

Zo’n collectieve duurzame aanpak is relatief nieuw en wordt nog niet veel geïmplementeerd. Met mijn thesisproject wil ik onderzoeken hoe de implementatie van zo’n collectieve aanpak op bedrijventerreinen in Overijssel versneld kan worden. Ik zou daarom graag te weten komen hoe u als ondernemer op een bedrijventerrein tegen zo’n collectieve aanpak aankijkt. Het interview zal maximaal 45 minuten duren en zal worden opgenomen via Microsoft Teams. Persoonlijke gegevens zullen uiteraard vertrouwelijk behandeld worden en alle resultaten zullen worden geanonimiseerd.

Ik hoor graag of u mee wilt deelnemen aan het interview. Het zou mij en mijn onderzoek erg helpen!

Met vriendelijke groeten,

Sam Wiesman

(Masterstudent aan de faculteit Techniek, Bestuur en Management)

## A.4 Interview question list (Dutch)

**Deel 1: introductie deelnemer**

1. Kunt zichzelf kort voorstellen?
2. Hoe zou u uw functie omschrijven?
3. Kunt u kort beschrijven wat u en uw organisatie doet aan de energietransitie op [dit terrein / bedrijventerreinen in Overijssel] en welke rol wordt vervuld?

**Deel 2: energietransitie**

1. Wat is uw visie op de Nederlandse energietransitie?
2. Wat is het belang van bedrijventerreinen in de nationale energietransitie?
   (a) Welke rol kan een collectieve energieaanpak op bedrijventerreinen spelen in de energietransitie?
3. Welke ontwikkelingen en stappen rond de energietransitie op bedrijventerreinen vinden plaats in de provincie Overijssel (en op nationaal niveau)? Wat zijn de doelen en ambitie?
4. Wat zijn goede voorbeelden van de energietransitie op [dit terrein / bedrijventerreinen in Overijssel] en waarom?
5. Welke factoren en ontwikkelingen stimuleren of belemmeren de energietransitie op [dit terrein / bedrijventerreinen in Overijssel], op nationaal, regionaal en lokaal niveau?
   (a) Wat is het effect van netcongestie op de energietransitie op [dit terrein / bedrijventerreinen in Overijssel]?

**Deel 3: visie en verwachting**

1. Wat is uw verwachting van de energietransitie op [dit terrein / bedrijventerreinen in Overijssel] (binnen 5 jaar)?
2. Wat is uw visie op de energietransitie op voor uw bedrijf op dit terrein voor 2030? En voor 2050?
3. Wat is uw verwachting van energiecoöperatie op [dit terrein / bedrijventerreinen in Overijssel] (binnen 5 jaar)?
4. Wat is uw visie op energiecoöperatie op [dit terrein / bedrijventerreinen in Overijssel] (10 tot 25 jaar)?
   (a) Welke factoren hebben deze verwachtingen en visies beïnvloed?
5. In hoeverre komen uw verwachtingen en visies overeen met andere actoren op dit terrein?

**Deel 4: sociaal netwerk**

1. Welke actoren binnen de grenzen van [dit terrein / bedrijventerreinen in Overijssel] zijn belangrijk in het versnellen van de implementatie van energiecoöperatie op [dit terrein / bedrijventerreinen in Overijssel]?
2. Welke actoren buiten de grenzen van [dit terrein / bedrijventerreinen in Overijssel] zijn belangrijk in het versnellen van de implementatie van energiecoöperatie op [dit terrein / bedrijventerreinen in Overijssel]?
   (a) Bv: Gemeente, Provincie, het Rijk, Europa, netbeheerder, brancheorganisatie
   (b) En wat is hun rol/bijdrage daarin?
3. Wat is de relatie tussen die actoren en hoe werken ze samen?
   (a) Hoe zouden ze samen moeten werken?
4. Hoe ziet u uw eigen rol in het versnellen van de implementatie van energiecoöperatie op [dit terrein / bedrijventerreinen in Overijssel]?

**Deel 5: leeractiviteiten (barrières, bevorderende factoren, oplossingen)**

1. Welk beleid en regelgeving beïnvloedt energiecoöperatie op [dit terrein / bedrijventerreinen in Overijssel] op drie verschillende niveaus: nationaal, regionaal, lokaal?
   (a) Welke wetten zijn van toepassing en welke veranderingen zijn nodig?
   (b) Welke beleidsinstrumenten worden op deze niveaus ingezet, en wat kan beter?
   (c) Wat is de relatie tussen deze drie niveaus?
2. Welke belemmeringen ziet u op [dit terrein] ten aanzien van energiecoöperatie, op korte en lange termijn?
   (a) Economisch/financieel, sociaal/management, technisch, wet/regelgeving, beleid, verdienmodel
   (b) Komt deze barrière vanuit het bedrijventerrein of daarbuiten?
   (c) Welke actoren spelen een rol in deze barrières? Wat is hun rol?
   (d) Is deze barrière specifiek voor dit terrein of komt dit in heel Nederland voor?
   (e) In welke fase van energiecoöperatie komt deze barrière voor?
3. Wat voor oplossingen ziet u voor deze barrières op korte termijn (< 5 jaar) en op lange termijn (10 tot 25 jaar)?
   (a) Welke actoren spelen hier een belangrijke rol in? Wat is hun rol?
4. Welke bevorderende/stimulerende factoren ziet u ten aanzien van energiecoöperatie op [dit terrein], op korte en lange termijn?
   (a) Economisch/financieel, sociaal/management, technisch, wet/regelgeving, beleid, verdienmodel
   (b) Welke actoren spelen een rol in deze bevorderende factor? Wat is hun rol?

   (c) Komt deze bevorderende factor vanuit het bedrijventerrein of daarbuiten?
   (d) Is deze barrière specifiek voor dit terrein of komt dit in heel Nederland voor?
   (e) In welke fase van een energiecoöperatie komt deze bevorderende factor voor?
5. Hoe zou een verdienmodel van een energiecoöperatie er idealiter uitzien op [dit terrein / op bedrijventerreinen in Overijssel]?

**Deel 6: versnelling implementatie/methode**

1. Welke acties zijn nodig om energiecoöperatie versneld te implementeren [dit terrein / bedrijventerreinen in Overijssel] in de komende 5 jaar en komende 20 jaar?
2. Hoe zou een methode/roadmap eruitzien die dit proces van begin tot realisatie begeleidt?
3. Heeft u nog iets toe te voegen aan dit interview?
4. Zijn er nog andere partijen die u aanbeveelt voor een interview?

## A.5 Interview question list (English)

**Part 1: introduction**

1. Can you briefly introduce yourself?
2. How would you describe your role?
3. Can you briefly describe what you and your organization are doing regarding the energy transition in [this area / business parks in Overijssel] and what role is being fulfilled?

**Part 2: Energy Transition**

1. What is your vision on the Dutch energy transition?
2. What is the importance of business parks in the national energy transition?
   (a) What role can a collective energy approach on business parks play in the energy transition?
3. What developments and steps are taking place in the province of Overijssel (and at the national level) regarding the energy transition on business parks? What are the goals and ambitions?
4. What are good examples of the energy transition in [this area / business parks in Overijssel] and why?
5. Which factors and developments stimulate or hinder the energy transition in [this area / business parks in Overijssel] at the national, regional, and local levels?
   (a) What is the effect of grid congestion on the energy transition in [this area / business parks in Overijssel]?

**Part 3: Vision and Expectations**

1. What are your expectations for the energy transition in [this area / business parks in Overijssel] (within 5 years)?
2. What is your vision for the energy transition for your company in this area by 2030? And by 2050?
3. What are your expectations regarding energy cooperatives in [this area / business parks in Overijssel] (within 5 years)?
4. What is your vision on energy cooperatives in [this area / business parks in Overijssel] (10 to 25 years)?
   (a) Which factors have influenced these expectations and visions?
5. To what extent do your expectations and visions align with other actors in this area?

**Part 4: Social Network**

1. Which actors within the boundaries of [this area / business parks in Overijssel] are important in accelerating the implementation of energy cooperatives in [this area / business parks in Overijssel]?
2. Which actors outside the boundaries of [this area / business parks in Overijssel] are important in accelerating the implementation of energy cooperatives in [this area / business parks in Overijssel]?
   (a) E.g., Municipality, Province, the State, Europe, grid operator, industry association.
   (b) And what is their role/contribution in this?
3. What is the relationship between these actors and how do they collaborate?
   (a) How should they collaborate?
4. How do you see your own role in accelerating the implementation of energy cooperatives in [this area / business parks in Overijssel]?

**Part 5: Learning Activities (Barriers, Enabling Factors, Solutions)**

1. Which policies and regulations influence energy cooperatives in [this area / business parks in Overijssel] at three different levels: national, regional, and local?
   (a) Which laws are applicable and what changes are needed?
   (b) Which policy instruments are implemented at these levels, and what can be improved?
   (c) What is the relationship between these three levels?
2. What barriers do you see in [this area] regarding energy cooperatives, in the short and long term?
   (a) Economic/financial, social/management, technical, legal/regulatory, policy, business model.
   (b) Does this barrier originate from the business park or from external sources?
   (c) Which actors play a role in these barriers? What is their role?
   (d) Is this barrier specific to this area or is it common throughout the Netherlands?
   (e) At which stage of energy cooperatives does this barrier occur?
3. What solutions do you see for these barriers in the short term (< 5 years) and in the long term (10 to 25 years)?
   (a) Which actors play an important role in these solutions? What is their role?
4. What enabling factors do you see regarding energy cooperatives in [this area], in the short and long term?
   (a) Economic/financial, social/management, technical, legal/regulatory, policy, business model.
   (b) Which actors play a role in these enabling factors? What is their role?

   (c) Does this enabling factor originate from the business park or from external sources?
   (d) Is this enabling factor specific to this area or is it common throughout the Netherlands?
   (e) At which stage of an energy cooperative does this enabling factor occur?
5. How would an ideal revenue model of an energy cooperative look like in [this area / in business parks in Overijssel]?

**Part 6: Acceleration of Implementation / Method**

1. What actions are needed to accelerate the implementation of energy cooperatives in [this area / business parks in Overijssel] in the next 5 years and the next 20 years?
2. How would a method/roadmap look like that guides this process from start to realization?
3. Do you have anything else to add to this interview?
4. Are there any other parties you recommend for an interview?

## A.6 List of pre-defined codes for thematic analysis in AtlasTi

| | | | |
|---|---|---|---|
| **Expectations and vision** | | | |
| | Expectations on ET specific BP <5 jaar | | |
| | Expectations on ET BPs in general <5 jaar | | |
| | Vision on ET for business on this BP for 2030 | | |
| | Vision on ET for business on this BP for 2050 | | |
| | | | |
| | Expectation of EC specific BP <5 jaar | | |
| | Expectation of EC BPs in general <5 jaar | | |
| | Vision on EC specific BP 10-25 jaar | | |
| | | Influencing factor | |
| | Vision on EC BPs in general 10-25 jaar | | |
| | | Influencing factor | |
| | Similarity expectations on specific BP | | |
| | | | |
| **Social network** | | | |
| | Actor inside specific BP | | |
| | | Role | |
| | Actor outside specific BP | | |
| | | Role | |
| | Actor inside general BP | | |
| | | Role | |
| | Actor outside general BP | | |
| | Own role in accelerating EC implementation EC on specific BP | | |
| | Own role in accelerating EC implementation EC on BPs general | | |
| | | | |
| | | | |
| **Learning activities** | | | |
| | Lesson about ET on specific BP | | |
| | Lesson about EC on specific BP | | |
| | Lesson about ET on BPs general | | |
| | Lesson about EC on BPs general | | |
| | Influence of policy / regulation on specific BP Local | | |
| | Influence of policy / regulation on specific BP Regional | | |
| | Influence of policy / regulation on specific BP National | | |
| | Influence of policy / regulation on BPs general Local | | |
| | Influence of policy / regulation on BPs general Regional | | |
| | Influence of policy / regulation on BPs general National | | |
| | Needed changes in policy | | |
| | Needed changes in regulation | | |
| | Relation between 3 levels | | |
| | | | |
| | | **Category** | **Subcategory** |
| | Barriers | | |
| | | Economic | Internal ofcompany/park or external |
| | | Social/Managerial | General or specific? |
| | | Technical/engineering | Phase |
| | | Regulatory | |
| | | Policy | |
| | Drivers | | |
| | | Economic | Internal ofcompany/park or external |
| | | Social/Managerial | General or specific? |
| | | Technical/engineering | Phase |
| | | Regulatory | |
| | | Policy | |

Table A.3: Set of pre-defined codes based on framework, first part

| | | | |
|---|---|---|---|
| | Solutions | | |
| | | Economic | Internal ofcompany/park or external |
| | | Social/Managerial | General or specific? |
| | | Technical/engineering | Phase |
| | | Regulatory | |
| | | Policy | |
| | Businessmodel of energy cooperation | | |
| | | | |
| | Methodology / roadmap | | |
| | | Actions to accelerate EC implementation on specific BP | |
| | | Actions to accelerate EC implementation on BPs general | |
| | | Appearance of methodology/roadmap | |

Table A.4: Set of pre-defined codes based on framework, second part

## A.7 Final list of code for thematic analysis in AtlasTi

| Final code list used to analyse data in AtlasTi pt. 1 |
|---|
| Sustainable energy measures: taken |
| Aanwezig: initiatief voor collectieve energieoplossing |
| Fase collectieve energie oplossing |
| Role: parkmanager |
| Barrier EC, general: technical |
| Barrier EC, general: regulatory |
| Expectation EC: short term, specific BP |
| Expectation EC: long term, specific BP |
| Driver EC, specific, internal: social / managerial |
| Similarity of expectations on specific BP |
| Sustainable energy measures: plan |
| Role: large companies |
| Role: municipality |
| Driver EC, specific, external: policy |
| Vision ET: long term, specific BP |
| Motivatie, economic: business |
| Motivatie, social/manegerial: business |
| Driver EC, specific, internal: economic / financial |
| Driver ET, specific, external: social / managerial |
| Role: province Overijssel |
| Driver ET, general, external: policy |
| Driver ET, general, external: regulation |
| Barrier ET, specific: information |
| Solution ET, general, external: regulatory |
| Role: national government |
| Barrier ET, specific, external: economic / financial |
| Driver ET, general, external: economic |
| Barrier EC, specific: information |
| Solution EC, specific: technical |
| Barrier ET, specific: technical |
| Barrier ET, specific: regulatory |
| Role: grid operator |
| Solution EC, specific: regulatory |
| Barrier EC, specific, external: economic/financial |
| Solution EC, general, external: regulatory |
| Action method / roadmap |
| Solution EC, specific: social / managerial |
| Solution EC, specific: information |
| Role: businesses |
| Solution EC, general, external: policy |
| Collective contract |
| Role: businessclub |
| Expectation ET individual business |
| Barrier EC, specific: social / managerial |
| Verdienmodel / business model |
| Driver EC, external: surroundings |
| Vision EC: long term, specific BP |
| Characteristics of collective inititative |
| Characteristics business / BP |
| Barrier ET, specific, external: policy |
| Trends / Energy Transition characteristics |
| Driver ET, general, internal: social / managerial |
| Driver EC, general, external: regulation |
| Barrier EC, general: policy |
| Barriere EC, specific, external: regulatory |
| Driver EC, specific: technical |
| Role: external party / consultant / expert |
| Role: PVB |

Table A.5: Final code list

| Final code list used to analyse data in AtlasTi pt. 2 |
|---|
| Role: OostNL |
| Driver EC, general, external: economic |
| Interviewee details |
| Motivatie: business |
| Driver EC, external: social / managerial |
| Barrier EC, specific, internal: economic |
| Barrier ET, general, external: social / managerial |
| Driver EC, general, internal: social / managerial |
| Barrier EC, specific, external: policy |
| Barrier EC, specific, external: social / managerial |
| Barrier EC, specific, internal: social / managerial |
| Barrier EC, specific: safety |
| Role: province Gelderland |
| Driver ET, general, external: social / managerial |
| Driver ET, general, external: information |
| Doel programma / initiatief |
| Barrier EC, general, external: social / managerial |
| Vision ET: long term, general |
| Fase programma |
| Context |
| Barriere EC, general: economic |
| Barriere EC, general: social / managerial |
| Role: hub director |
| Driver EC, specific, external: economic |
| Current infrastructural possibilities |
| Driver EC, general: energy security |
| Driver EC, general: independence |
| Barrier EC, general: responsibility |
| Barrier EC, general: safety |
| Barrier EC, general: human capital |
| Driver EC, general: business motivation |
| Motivatie: municipality |
| Driver ET, specific, internal: regulation |
| Mening congestie / energiemarkt |
| Conditions |
| Barrier EC, specific: future plans / proactivity |
| Policy: municipality |
| Driver EC, general: urgency |
| Role: wind turbine operator |
| Role: truck charging operator |
| Barrier EC, general: insecurities |
| Organisational form |
| Barrier EC, general, internal: economic |
| Solution EC, general: economic |
| Driver ET, specific, internal: economic |
| Driver ET, external: surroundings |
| Barrier ET, general, external: supply problems |
| Barrier ET, specific: mother company |
| Driver EC, internal: surroundings |
| Influencing factor: energy market |
| Dependent relationship |
| Barrier EC |
| Driver EC |
| Barrier EC, general: energy security |
| Energy symbiosis |
| Motivatie: interviewee |
| Role: energiecooperatie / nabijgelegen energievoorziening |
| Role: ACM |

Table A.6: Final code list

| Final code list used to analyse data in AtlasTi pt. 3 |
|---|
| Role: urban area |
| Barriere EC, specific, external: social / managerial |
| Driver EC, general, internal: economic |
| Mening EC |
| Driver EC, general: information |
| Expectation ET: short term, specific BP |
| Assumption interviewee |
| Driver EC, specific: publicity / examplary / voorbeeld function |
| Driver ET: general, global politics |
| Driver ET, general: global politics |
| Nog te lezen |
| Bestaande wetten / regelingen |
| Driver EC, general: policy |
| Role: Ministerie van Binnenlandse Zaken |
| Role: provinces (in general) |
| Barrier EC, general: information |
| Solution EC, general: social / managerial |
| Belang van BPs in ET |
| Driver ET, general: social / managerial |
| Driver EC, general: social / managerial |
| Role: MKB Nederland |
| Role: VNO NCW |
| Barrier EC, general: resources |
| Expectation ET, general: short term |
| Future challenges for BPs |
| Barrier EC, general: assumption |
| Solution EC, general: policy |
| Aanpak |
| Role: Ministerie van Economische Zaken en Klimaat |
| Role: NAL |
| Role: Invest NL |
| Solution EC, general: technical |
| Solution EC, general: regulatory |
| Barrier ET, general: policy |
| Barrier ET, general: awareness |
| Barrier ET, general: cohesie |
| Barrier EC, general: social / managerial |
| Barrier ET, general: social / managerial |
| Mobility |
| Driver ET, general: invloed op business |
| Barrier ET, general: invloed op business |
| Vision EC: long term, general |
| Driver EC, general: willingness |
| Driver ET, general: congestie |
| Expectation EC: short term, general |
| Actoren binnen BP |
| Solution ET, general: mobility |
| Role: HMO |
| Uitzoeken |
| Maatschappelijke discussie (nog te voeren) |
| Barrier EC, general: spatial |
| Barrier EC, general: citizen participation |
| Role: battery exploitant |
| Barrier EC, general: conflicting interests |
| Solution EC, general: spatial |
| Role: market |
| Origin collectief |
| Role: ECUB |

Table A.7: Final code list

| Final code list used to analyse data in AtlasTi pt. 4 |
|---|
| Role: RVO |
| Driver EC, specific: information |
| Role: directors of collective initiative |
| Driver EC, general: economic |
| Vision EC: short term, specific BP |
| Barrier EC, general: business motivation |
| Driver EC, general: regulatory |

Table A.8: Final code list

## A.8 Interview participants: generic

| Participant | Job position | Attitude towards sustainability |
|---|---|---|
| PROV | Project leader at Province of Overijssel. | Positive. |
| GRID | Partner at local grid operator, focusing on energy transition. | Positive. |
| PVB | Project leader at a national program designed to support the sustainable transition of business parks. | Positive. |
| COLL | Two initiators and directors of energy collective on business park. | Positive. |

Table A.9: Interview participants on energy transition, energy cooperation and transmission congestion

## A.9 Energy cooperatives on BPs in the Netherlands

| Energy cooperative | Location |
|---|---|
| NDSM Energie | Amsterdam |
| Cooperatie Ecofactorij | Apeldoorn |
| Bedrijventerrein Majoppeveld | Roosendaal |
| CDBZ | Zaltbommel |
| GreenBiz Ijmond | Beverwijk |
| ECUB | Utrecht |
| EKCM | Zwolle |
| Energie cooperatie Hessenpoort | Zwolle |

Table A.10: Known energy cooperatives in the Netherlands

## A.10 Interview participants: cases

| Participant | Job position | Attitude towards sustainability | Relevant other activities |
|---|---|---|---|
| 1COM.A | Manager of company active in concrete industry. | Positive. Company has installed 350 solar panels on roof, without subsidy. | |
| 1COM.A | Owner of company active in recycling industry. | Positive, company aims to close material cycli 100% circular. Active in large "energiecooperatie". | Chair of business club. One of directors of "energiecooperatie". "MKB ambassador" in the region of Zwolle. |
| 1PM | Parkmanager on the business park. | Positive, is actively leading sustainable transition on 3 business parks. | Parkmanager on 2 more business parks. |
| 2COM.A | Director of company active in recycling industry. | Positive. Possible energy saving measure are taken, solar panels and a wind turbine are on wishlist. | |
| 2MUN | Employee of Gemeente Hengelo, focusing on sustainable transition of businesses and business parks. | Positive. | Completed a thesis research last year that is relevant to this research. |
| 2PM | Parkmanager on the business park (same as for Groot Verlaat). | Positive, is actively leading sustainable transition on 3 business parks. | Parkmanager on 2 more business parks. |
| 3COM.A | Manager of auxilarry branch of company in wholesale and installation industry. | Positive, has installed heatpumps and has roof solar and solar-carports on whishlist. | |
| 3COM.B | CEO of company active in acquisition in metal- and tools industry. | Positive, energy-neutral building, tries to be climate-adaptive, new building being built according to GPR standard of 8.5. | Chair of business club. Chair of "eneriecooperatie" of the businesspark, chair of existing solarfield on the BP. |
| 3MUN | Externally hired project leader for gemeente Zwolle. | Positive | Board member of VNONCW in Drenthe, has been director of wind turbine park, experience at different "energiecooperaties". |
| 3COM.C | Co-owner of wholesaler in the floor industry. | Positive, multiple auxillary locations of company have solar panel, led lights installed in current location | |
| 4COM.A | Owner of company active in distributing / wholesale industry of plastic products. | Positive, has solar panels with the capacity of double the consumption. | |
| 4MUN | Externally hired project leader "Smart Energy Hubs" (marketing communication, acquisition) for gemeente Deventer | Positive. | |
| 4HUB | Formal "Hub Manager". Working at Province of Overijssel, started program SEHs together with OostNL and Province of Gelderland. | Positive. | Works as well for Ministry of EZK, working on energy hubs. |

Table A.11: Interview participants from the cases

## A.11 Solar panel coverage on business parks

### A.11.1 Groot Verlaat

Figure A.1: Amount of realised solar energy on business park: yellow is realised, blue is not realised (Zonnedakje.nl)

### A.11.2 Twentekanaal

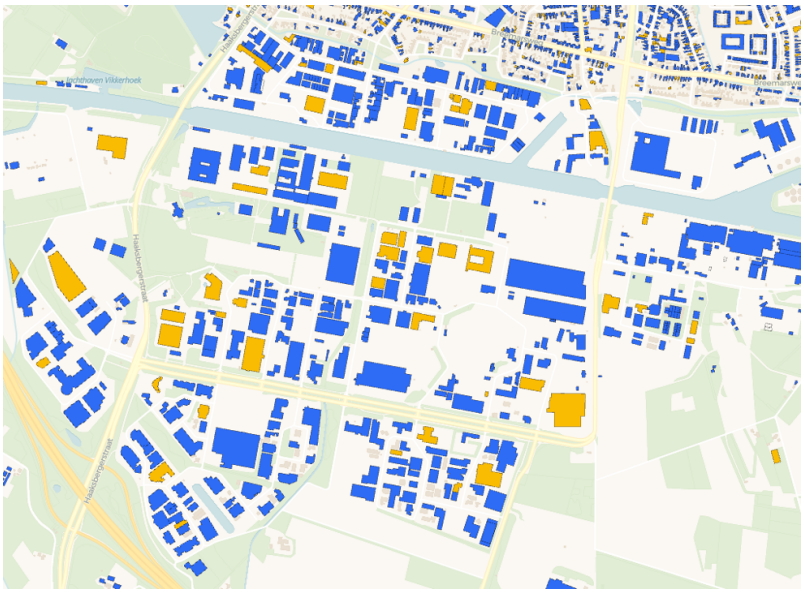


Figure A.2: Amount of realised solar energy on business park: yellow is realised, blue is not realised (Zonnedakje.nl)

### A.11.3 Hessenpoort

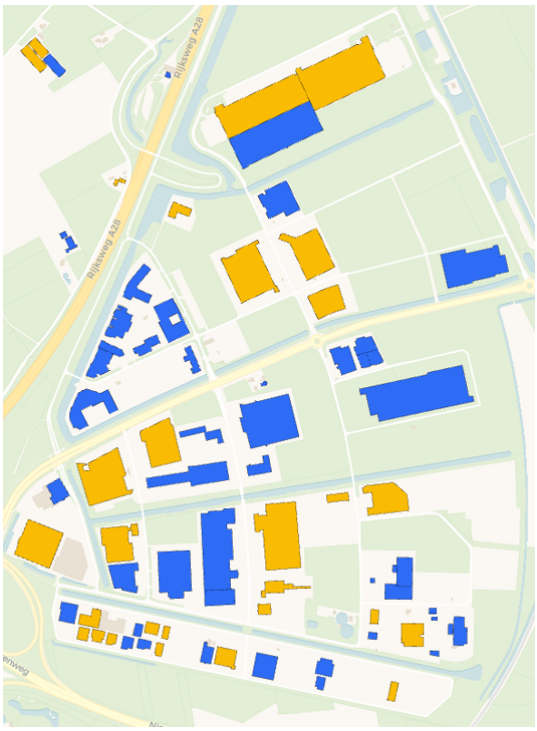


Figure A.3: Amount of realised solar energy on business park: yellow is realised, blue is not realised (Zonnedakje.nl)

### A.11.4 A1 Bedrijvenpark

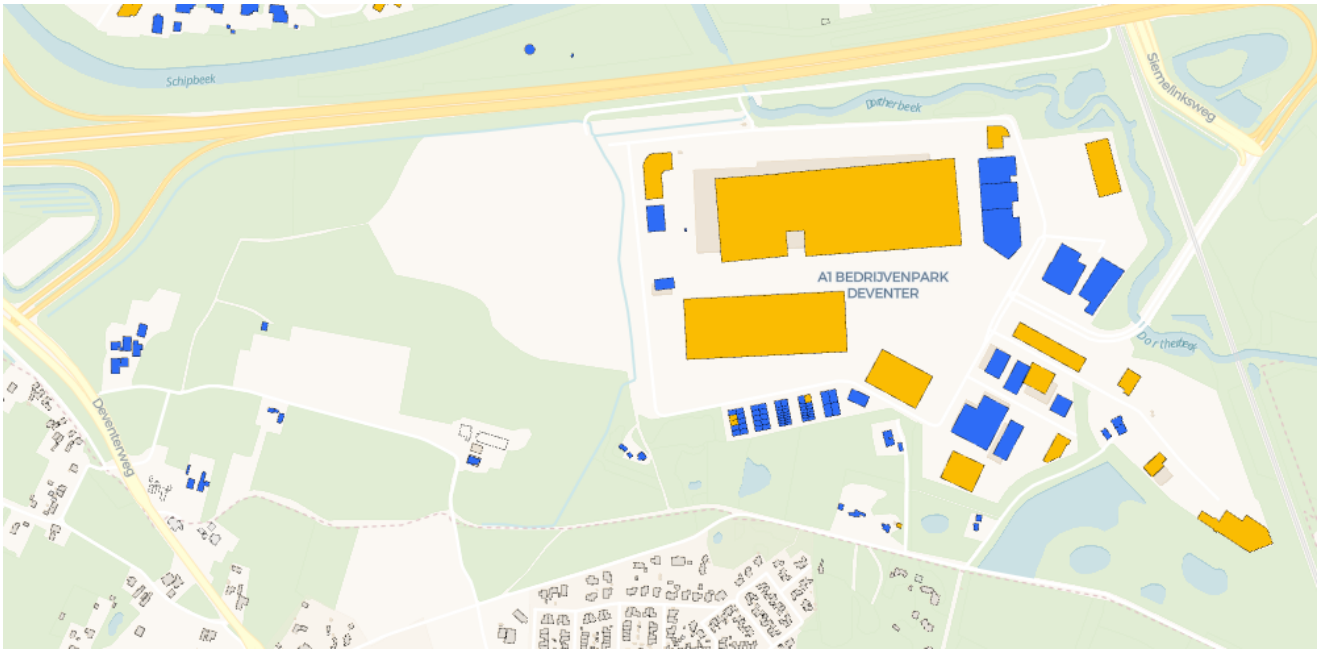



Figure A.4: Amount of realised solar energy on business park: yellow is realised, blue is not realised (Zonnedakje.nl)

## A.12 Level of transmission congestion, June 2023

### A.12.1 Consumption congestion map

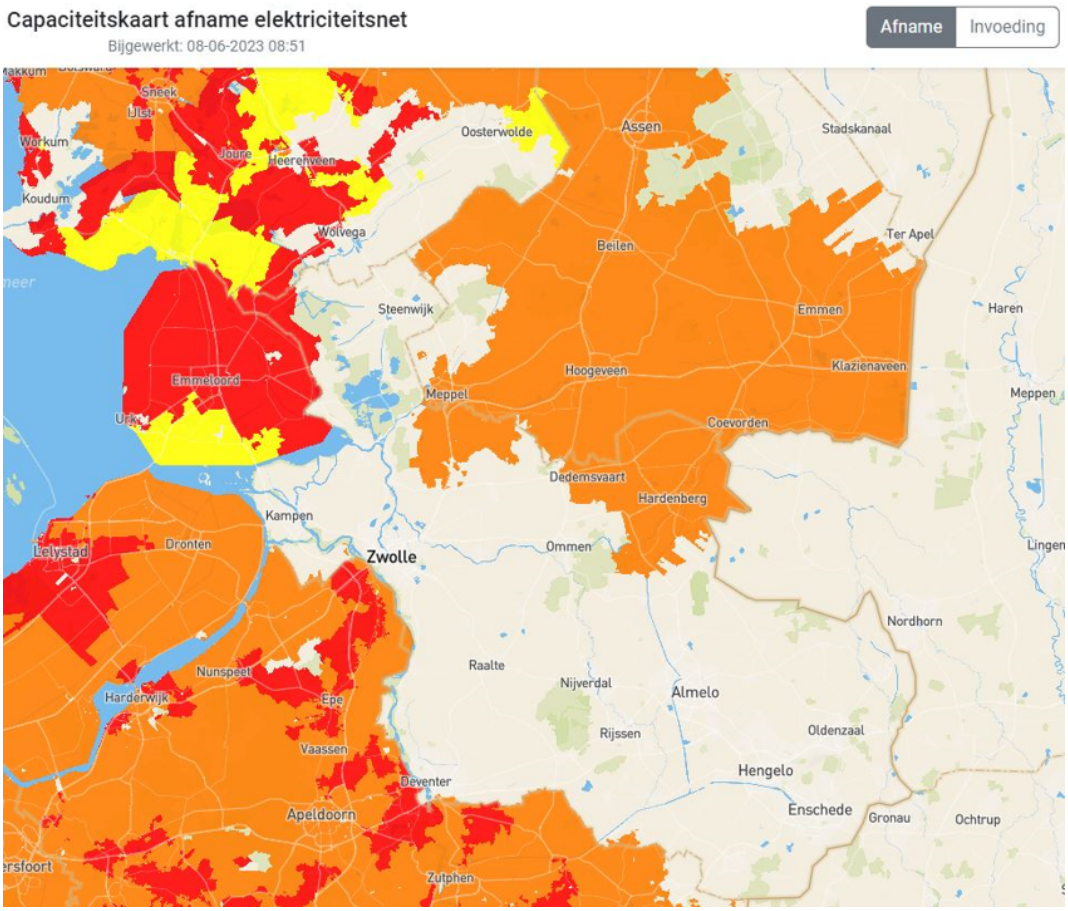



Figure A.5: Level of transmission congestion in the Province of Overijssel for consumption

### A.12.2 Feeding in congestion map

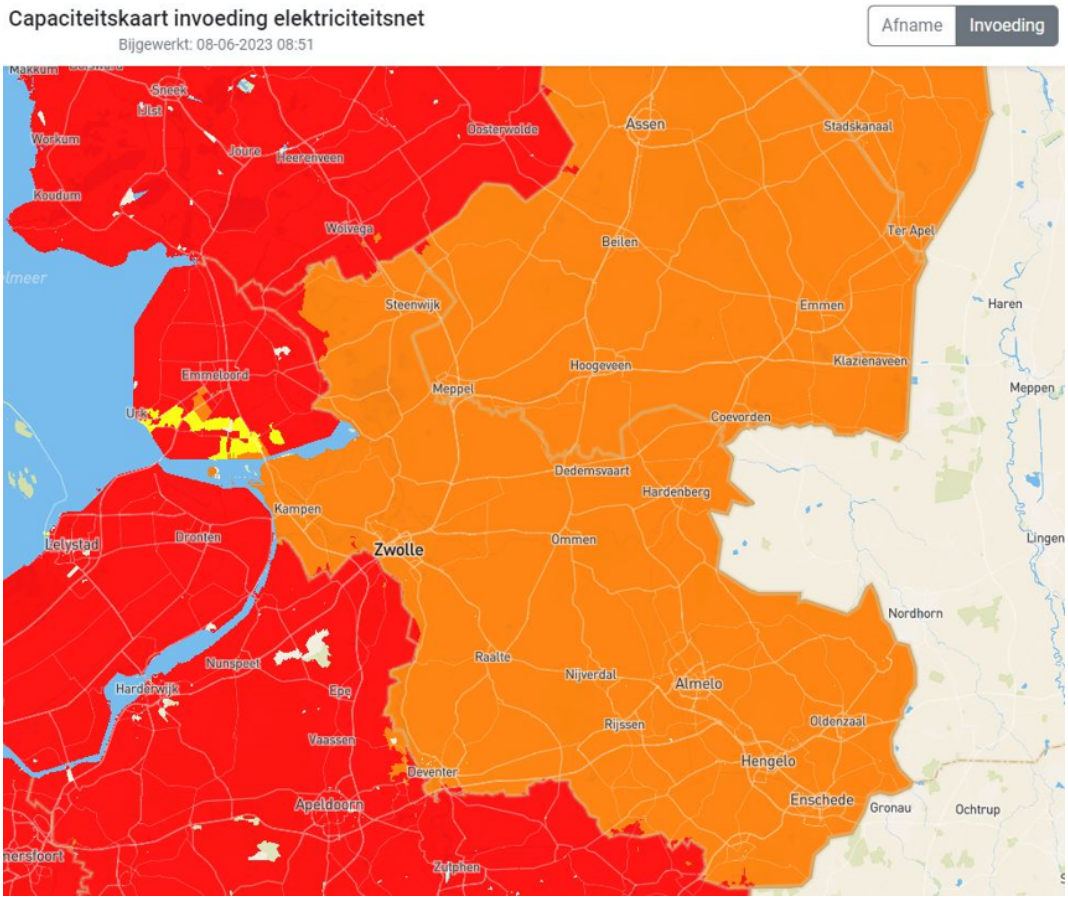



Figure A.6: Level of transmission congestion in the Province of Overijssel for feeding in)

- Transparant: Transmission capacity available
- Yellow: Limited transmission capacity available
- Orange: Temporarily no transmission capacity available, congestion management research pending
- Red: No transmission capacity available: no possibility of applying congestion management

Figure A.7: Legend for Figure A.5 and Figure A.6

.

## A.13 Factors influencing energy transition on BPs

### A.13.1 Expert interviews

## A.14 Influencing factors for the energy transition in general

### A.14.1 Barriers

According to the project leader, there is a need for a more bottom-up approach in policy-making instead of decisions being predominantly made in The Hague. The respondent emphasizes the importance of actively involving people in the planning process and stresses that the government should listen to their voices. The respondent cites the example of the Groningen gas incidents and the Toeslagenaffaire to highlight the consequences of decisions made without sufficient input from those affected (PVB, 2023).

Also the the respondent points out the tendency of the government to pursue "holy grail" solutions and remain focused on specific goals without taking into account the desires and needs of the people involved. This approach may overlook

valuable insights and perspectives. The respondent emphasizes the importance of actively listening to what people want and need in order to develop effective and inclusive solutions (PVB, 2023).

Furthermore, the project leader highlights that four different ministries are involved in addressing sustainability concerns; however, there is limited collaboration and awareness among them (PVB, 2023).
The grid operator points out that resident participation often results in stagnation, as conflicting perspectives and the challenge of mobilizing stakeholders obstruct the progress of the energy transition (GRID, 2023).
The respondent emphasizes the need for more tailored policies that account for such variations, suggesting that greater differentiation should be encouraged. "The center of the old city center presents distinct challenges compared to the relatively new neighborhood." Such tailored approach would help minimize unnecessary discussions that could have been avoided, according to the partner (GRID, 2023).

The Energy Conservation Obligation is named as a driving factor for business owners, as well as the label-C obligation for office buildings (COLL, 2023).

The grid operator highlights the divergent interests of commercial battery operators and Enexis. While Enexis seeks to alleviate network congestion, operators focus on maximizing profits through active energy trading. Trading involves supplying electricity during high-demand periods when prices are at their peak. However, this increased activity can strain the network's capacity. According to the partner, allowing the market to dictate operations introduces conflicting objectives. The question of who should bear the cost of compensating battery operators to supply electricity during off-peak periods remains unaddressed (GRID, 2023).

Furthermore, the partner points out that the municipality relies too heavily on the assumption that the grid operator will solve the congestion issues for them. However, it is crucial to acknowledge that this is not the case. Municipalities expect consumption scarcity to be prevented, but this form of transmission congestion is inevitable (GRID, 2023).

Also, the government's lack of clear decision-making leads to issues being delegated to lower levels, resulting in a more cumbersome and time-consuming process. For instance, for the "Proeftuin aardgasvrije wijken" conversations were initiated in 2018, but no tangible progress has been made so far (GRID, 2023).

It is indicated by PVB that there is no consistent subsidy policy from the government, as people with SDE subsidies are surprised to find out that they have to repay an advance payment, due to the risen energy prices resulting from the energy crisis, in turn leading to a negative feed-in tariff (PVB, 2023).

The cooperative initiators highlight the issue of the abundance of reports and plans from municipalities and provinces, without corresponding actions, leading to a stagnation in progress (COLL, 2023).

### A.14.2 Drivers

The provincial project leader highlights that the Building Decree (Bouwbesluit) serves as a stimulus for promoting sustainable construction practices. The regulations outlined in the Building Decree require the construction of more sustainable buildings. By enforcing these requirements, it encourages the development of environmentally friendly and energy-efficient structures (PROV, 2023).

Additionally, it was mentioned that 1 billion euros has become available through the CDOKE regulation, administered by the Ministry of BZK. This funding is available for municipalities and provinces to strengthen their internal capacity and attract external expertise to accelerate the sustainable transition (PVB, 2023).

### A.14.3 Groot Verlaat

No barriers or drivers were mentioned specifically for the energy transition on the business park.

### A.14.4 Twentekanaal

**Barriers**

- Not every roof of company roofs are suitable to place solar panels on. Party due to the structure not being sufficiently strong, partly due to the underlying roofing material. The latter refers to the fact that the combination of roofing material and solar panels can present issues related to fire insurance (2COM.A, 2023).
- Not every company possesses sufficient roof surface area to account for their energy consumption (2COM.A, 2023).
- A hindering factor for the energy transition on business parks is the lack of clarity in policies and regulations from the national government, local authorities, and grid operators for the coming years, which creates uncertainty for

businesses and hinders their ability to make informed investment decisions. Specifically, the municipality's policy for the next 5 to 6 years is simply not clear (2PM, 2023).
- The ambiguity of the municipality's plans does not align with the need for specificity expressed by the business owners on Twentekanaal. There is a disconnect in the communication between the municipality and the business owners (2PM, 2023).
- Some companies are overwhelmed by the complexity of challenges that the energy transition brings for them and "can't see the wood for the trees" (2PM, 2023).

**Drivers**
- The current high energy prices, combined with the urgency for change accelerated by the energy crisis, are perceived as driving to start thinking about realisation of sustainable energy measures (2COM.A, 2023).
- Currently, the recycling company is subject to an Energy Reduction Obligation (EML), which serves as a driving factor for the company to take sustainable energy measures or participate in sustainable energy solutions.
- Energy audits for the large companies, such as Thales, stimulate the energy transition for the company, but also for the business park (2PM, 2023).
- For the recycling company, having a green image is important as it aligns with their corporate philosophy and they are keen to promote it externally.

#### A.14.5 Hessenpoort

**Barriers**
- Too much money is being spent on research and. "You can gather a lot of information through research, but it's about the "how" question. How are we going to realize it?" (3MUN, 2023).
- The municipality is complex. The respondent looks at it from an external perspective, having a role that is half within and half outside the municipality. The most important stakeholders when working permanently within the municipality are the board and council, but actually getting things done is very challenging, according to the respondent. "You are basically bound hand and foot, the focus is mainly on the energy transition of residential areas." (3MUN, 2023).
- Furthermore, the manager wonders what the status of the energy market is, considering prices for feeding-in excess surplus solar energy. "Will feeding-in cost money or will it generate income?" (3COM.A,2023).

**Drivers**
- The energy crisis and the high energy prices as a result of the Russia-Ukraine war is perceived as stimulating stimulating for the energy transition on the business park (3COM.B, 2023).
- The office label-C obligation and the Energy Conservation Obligation are perceived as stimulating regulations for the energy transition and energy cooperation (3COM.A, 2023).
- Some client locations require all-electric vehicles, stimulating the company to have electric vehicles, and thus charging facilities at their location, in turn increasing their energy consumption (3COM.A, 2023).
- The vision for the municipality of Zwolle is well-defined, with a clear focus on accelerating goals within a 10-year timeframe. In this vision, active involvement of the business community is emphasized, as the municipality recognizes the potential for greater environmental benefits compared to residential areas. The municipality strives to effectively communicate this message to businesses, highlighting the importance of their active participation and engagement (3MUN, 2023).

#### A.14.6 A1 Bedrijvenpark

**Barriers**
- According to the project leader, the mandatory implementation of electric vehicles in conjunction with grid congestion is not a viable solution. Such policies only exacerbate the problem. The respondent expresses support for electric vehicles (even operating a company that manages charging stations), but disagrees with the narrow focus of the government on electric vehicle adoption. They have anticipated the issue of transmission congestion for years and now seem surprised (4MUN, 2023).
- It is mentioned that the current energy and electricity prices are "just a snapshot" and that future prices are hard to predict. This source of unpredictability makes decision-making complicated for businesses (4MUN, 2023).
- The business owner does not understand the height of the energy taxes when generating and consuming one's own energy and current amount tax paid is perceived as an obstructing factor for the energy transition in general (4COM, 2023).

**Drivers**
- The former hub manager states that transmission congestion is the primary driving factor that significantly impacts the built environment, housing, businesses, and the overall energy system (4HUB, 2023).
- According to the project leader, "we are currently in a sort of perfect storm where businesses are willing to change, but they do so for only two reasons, as do individuals: either there is a sense of urgency or there is passion". Passion drives the desire to be energy neutral, regardless of cost implications, while urgency arises from net congestion

or high energy prices. Additionally, there is currently a scarcity of land, adding to the complexity of the situation (4MUN, 2023).
- Also, the comparison is made with the Covid crisis. The project leader states that "In a situation of crisis, a lot can suddenly be achieved", implying that the current energy crisis is an important driver to create action on business parks.
- The desire for autonomy and control over one's own energy supply is emphasized, with the aim of reducing dependence on countries like Russia (4HUB, 2023), (4COM, 2023).
- According to the former hub manager, businesses perceive the possibility to transition towards a more sustainable business as a stimulating factor for joining energy cooperation initiatives (4HUB, 2023).

## A.15 Trends for business parks in the light of the energy transition

According to project leader from the Province of Overijssel, the current energy distribution is approximately 40% for households, 40% for industry, and 20% for mobility. However, in the coming years, there will be a shift at the regional level, resulting in 50-60% of energy consumption being attributed to business park, especially with the inclusion of electric freight transport that needs to charge at these locations. As a result, business parks are becoming focal points for our energy areas (PROV, 2023).

Furthermore, it is highlighted that while entrepreneurs are more receptive to discussions and collaborations concerning energy, their involvement in biodiversity initiatives tends to be relatively lower (PROV, 2023).

Also, there has been a significant shift in the way companies are responding to sustainability initiatives compared to seven years ago. Back then, many companies were reluctant to participate, but now they are actively reaching out and expressing their interest in getting involved. This change in attitude can be attributed, among other factors, to the recent energy crisis and concerns over energy security following events involving Russia. The respondent suggests that these experiences have made everyone more aware of the implications and consequences of energy-related issues (PROV, 2023).

The grid operator highlights the difference between utilizing a battery system in front of or behind the meter. Deploying a battery system behind the meter allows a business park, for instance, to meet their own energy needs. This is distinct from traders, who operate in front of the meter and actively engage in trading with the grid (GRID, 2023).

According to the grid partner, it is crucial to recognize the inherent link between the built environment, its inhabitants, and the energy transition. He / she advocates for a more cooperative approach that actively involves the community, aiming to proactively address challenges and avoid potential issues with citizens that became more vocal and engaged over the years (GRID, 2023).

Also, it is expected that demand congestion will continue to increase, due to the rising requests for battery connections. In Brabant and Limburg this problem appeared due to the number of connection requests from commercial battery exploiters. "And then we have to say no a hospital, that is contradictory." (GRID, 2023).

## A.16 Factors influencing EC mentioned in expert interviews

| Categories | Barriers | G/S | I/E | Ph |
|---|---|---|---|---|
| **Economic / Financial** | The state of the transmission grid partly obstructs energy cooperation (PVB, 2023). | G | E | S1 |
| | The Energy Tax on energy exchanges hinders energy cooperation (PVB, 2023). | G | E | S3 |
| | Upgrading the grid to solve congestion issues would significantly increase tariffs (GRID, 2023). | G | E | S1 |
| **Technical / Engineering** | Implementing a "direct line solution" is challenging due to issues of grid connection and integration (GRID, 2023). | G | I/E | S3 |
| | Expanding the grid requires substantial funding, time, and space which is hard to acquire (GRID, 2023). | G | E | S1 |
| | Installation of numerous substations for business park electrification is space-demanding (GRID, 2023). | G | I/E | S3 |
| | Battery placement for energy storage requires substantial space (GRID, 2023). | G | I/E | S3 |
| **Social / Managerial** | Park Managers often lack the necessary knowledge and experience for effective energy cooperation development (PVB, 2023). | G | I/E | A1 |
| | Smaller enterprises may be reluctant to bear the expenses of establishing private networks (GRID, 2023). | G | I | S3 |
| | Lack of sustainability awareness and finaincial-only motivations among business owners affects participation in energy cooperation (COLL, 2023). | G | I | S2 |
| | Differences exist between the priorities of municipalities and individual businesses (COLL, 2023). | G | I/E | A1 |
| **Legal / Regulation** | Businesses struggle with understanding and complying with government regulations (PVB, 2023). | G | I | A1 |
| | Legal coordination of cable pooling is complicated due to multiple owners and foreign entities (GRID, 2023). | G | I/E | A3 |
| | Supplying energy to others is currently not permitted (PVB, 2023). | G | E | S3 |
| | Differences in grid connections for small and large businesses complicate energy cooperation (PVB, 2023). | G | E | S |
| **Policy** | There is a risk of overlapping efforts among provincial initiatives (PROV, 2023). | G | E | S1 |
| | Government policies often cause surprises and financial challenges for businesses with SDE subsidies (PVB, 2023). | G | I/E | |
| | Interactions between municipalities/provinces and businesses are limited (COLL, 2023). | G | E | A1 |
| | The process of obtaining subsidies from the province can be lengthy and time-consuming (COLL, 2023). | G | E | A2 |
| **Information** | Uncertainty and ignorance from the province project leader about revenue models for energy cooperation (PROV, 2023). | G | E | S3 |
| | A lack of independent knowledge hinders energy cooperation (PVB, 2023). | G | E | A2 |
| | Businesses lack understanding about closed energy systems and pricing (GRID, 2023). | G | I | S3 |
| | Many municipalities lack knowledge and understanding of energy cooperation and grid congestion issues (PVB, 2023). | G | E | A1 |
| | Businesses overestimate their ability to tackle congestion challenges independently (COLL, 2023). | G | I | S1 |
| **Responsibility** | There is a responsibility gap at multiple levels, causing a lack of progress (PVB, 2023). | G | I/E | S1 |
| | Businesses are left to handle energy cooperation on their own due to a gap in responsibility (COLL, 2023). | G | I | S1 |

Figure A.8: All barriers mentioned during the general interviews, distributed along the main categories, with corresponding sub categories indicated as well

| Categories | Drivers | G/S | I/E | Ph |
|---|---|---|---|---|
| **Economic/financial** | Businesses have shown increased interest in participating in sustainable energy initiatives due to the economic effect of geopolitical events and energy crises (PROV, 2023). | G | I | S2 |
| | Entrepreneurs aim to reduce costs and overcome barriers to expanding their current grid connection by participating in energy cooperation (COLL, 2023). | G | I | A1 |
| **Social / managerial** | Entrepreneurs appreciate Sprint Sessions initiated by the province for the opportunity to engage with stakeholders and discuss energy challenges and opportunities (PROV, 2023). | G | E | A1 |
| | CES 6 companies' success stories in energy transition motivate other businesses to pursue sustainability (PROV, 2023). | G | E | A1 |
| | The drive for the energy transition and energy cooperation is significant in Overijssel (PVB, 2023). | G | I | A1 |
| | There's an increased understanding and urgency among businesses about energy transition, despite the uncertainty about the proper actions to take (PVB, 2023). | G | I | A1 |
| **Legal / regulation** | A Business Investment Zone (BIZ) encourages collective decision-making and collaboration among businesses (PROV, 2023). | G | I | S2 |
| | Individual legislations for businesses can stimulate collaboration and joint initiatives (PROV, 2023). | G | E | A1 |
| | Laws and regulations drive businesses to take action, such as participating in an energy cooperative (COLL, 2023). | G | E | A1 |
| | Landlords are increasingly setting requirements for certifications for their buildings, driving business owners to take necessary actions to achieve such labels (COLL, 2023). | G | E | A1 |
| **Policy** | A letter written by the Minister of Economic Affairs and Climat to all businesses of the Netherlands is perceived stimulating (PROV, 2023). | G | E | A1 |
| | The commitment agreement of energy cooperative Marslanden members to implement sustainable measures drives business owners to contribute to the cooperative (COLL, 2023). | G | I | S2 |
| | The prohibition of diesel or fossil fuel-powered delivery vans within the inner city ring by 2025 forces entrepreneurs to transition to alternative options (COLL, 2023). | G | E | A1 |
| **Organisational** | The presence of an organisational grade is crucial for the development of energy cooperation (PROV, 2023). | G | I | S1 |
| | The collaboration from Hessenpoort with Invest NL on developing contract structures for Smart Energy Hubs (PVB, 2023). | S | I/E | S3 |
| | Subsidies become available once an organized entity has been established, emphasizing the importance of formal structure (COLL, 2023). | G | E | A1 |
| | The pioneering role of several large companies in the energy transition leads stimulates other companies on the businesspark (COLL, 2023). | S | I | A1 |
| **Information** | The sharing of knowledge by energy cooperative ECUB on establishing an energy cooperative, through a publicly available handbook, accelerates the cooperative development process (COLL, 2023). | G | E | A1 |

Figure A.9: All drivers mentioned during the general interviews, distributed along the main categories, with corresponding sub categories indicated as well

| Categories | Solutions | G/S | I/E | Ph |
|---|---|---|---|---|
| **Technical / engineering** | An automated system that facilitates the exchange and financial settlement of energy transactions (PROV, 2023). | G | I | S3 |
| | A private network outside the traditional grid, though complete disconnection is deemed impractical (GRID, 2023). | G | I | S3 |
| | A single connection (group contract), such as operational at Schiphol Tradepark and Hessenpoort (pilot) (GRID, 2023). | G | I | S3 |
| | A "direct line" behind the meter with an exemption from the ACM (GRID, 2023). | G | I | S3 |
| **Social / managerial** | Importance of having a company that can persuade others, take the lead, and align others with its vision (PROV, 2023). | G | I | A1 |
| | Make significant impact on businesses in their core business for quick achievements (PROV, 2023). | G | I | A1 |
| | Implementation of sprint sessions across the Netherlands to bring together stakeholders and address problems (PVB, 2023). | G | I/E | A1 |
| | Importance of aiding businesses with minimal effect on their operations, providing resources, knowledge, and manpower (PVB, 2023). | G | I | A2 |
| **Legal / regulation** | Firm decisions made by municipalities, such as shutting off gas supply in specific areas (PROV, 2023). | G | E | A1 |
| | Increasing cost of energy prompts businesses to reconsider their consumption patterns and seek efficient alternatives (PROV, 2023). | G | E | A1 |
| | Development of conditional consumption capacity contracts for commercial battery operators by Enexis (GRID, 2023). | G | E | S3 |
| | The possibility of regulations enabling municipalities to require installation of solar panels on existing buildings is highlighted (PROV, 2023). | G | E | A1 |
| **Organisational** | Establishment of clear agreements on business park grid connections and balancing of consumption and production, whereby Enexis always can cut the capacity in emergency situations (PVB, 2023). | G | I/E | S3 |
| | Addressing issues at the appropriate level (PVB, 2023). | G | I/E | ALL |
| | Bottom-up approach is considered the best way to support the energy transition on business parks (PVB, 2023). | G | I/E | ALL |
| | Combining multiple small-scale connections as a viable solution to enable energy backfeeding (GRID, 2023). | G | I | S3 |
| | Smart utilization of the transmission grid to reduce societal costs (GRID, 2023). | G | I/E | ALL |
| | Importance of business parks developing clear plans for the coming 5 to 6 years to assist with Enexis' planning and implementation of infrastructural changes (GRID, 2023). | G | I | S2 |
| **Information** | Requirement for robust tooling to provide information on subsidy opportunities and connect businesses with relevant parties for conducting analyses and implementation (PVB, 2023). | G | E | A2 |

Figure A.10: All solutions mentioned during the general interviews, distributed along the main categories, with corresponding sub categories indicated as well

## A.17 Elaboration on factors mentioned by experts

In this Appendix, one can read the elaborations and context around the mentioned barriers from the general expert interviews, structured along the main categories of the conceptual framework. It is also indicated which respondent mentioned which factor.

## A.18 Barriers for energy cooperation

**Economic / financial**
The current state of the transmission grid is mentioned party obstructing and enabling energy cooperation (PVB, 2023).

The Energy Tax is mentioned as obstructing for energy cooperation and specifically for energy exchanges. Namely, when one party supplies energy to another party, tax should be paid over that energy. For example, with a direct line configuration between two businesses, where the consuming party receives surplus energy from the producing party, the consuming party should pay tax over the used energy. In turn, the producer is responsible for transferring it to the tax authorities (Energievergelijker.nl, 2023) (PVB, 2023).

In response to the notion that "companies expect the grid operator to solve the congestion issues," the partner points out that while that may be possible, it would require a significant increase in tariffs, potentially by 100 per month. However, it is unlikely that many companies would be willing to bear such costs (GRID, 2023).

**Technical / engineering**
According to the respondent, one of the challenges with implementing a physical "direct line solution" is determining the point of connection. If you connect it to the existing network of the company, you will inevitably interact with Enexis' network, which would require the establishment of a separate network. The respondent highlights the difficulties in managing such a setup and ensuring a smooth integration with the grid, particularly during periods when there is no sunlight (GRID, 2023).

Expanding the grid requires substantial funding, takes a considerable amount of time, and requires ample space. Acquiring the necessary space, such as within a neighborhood or on a street level, poses significant challenges. Gaining approval without facing resistance is exceptionally difficult. Community members often voice objections, leading to lengthy legal processes, including appeals to the Council of State (GRID, 2023).

The partner from Enexis emphasizes that the electrification of business parks in Zwolle necessitates the installation of 60 compact distribution substations and 2 large distribution substations with a large surface area. These substations are vital for enabling the energy transition to take place, however, it is crucial to take into account the spatial aspect and carefully plan the placement of these substations (GRID, 2023).

The same barrier applies to the placement of batteries, which would be placed next to substations. The respondent states that for forty households, a battery of 3x3x2 meters is needed, to indicate the space needed for business park-size batteries (GRID, 2023).

**Social / managerial**
According to the respondent, not every Park Manager (PM) possesses the necessary knowledge, experience, and ideas to take the next steps in the process. It is crucial to have a PM who is capable of bringing in additional expertise and knowledge from external sources. This combination of skills and capabilities is deemed essential for effective decision-making and successful implementation of energy cooperation initiatives (PVB, 2023).

The partner emphasizes the need for businesses to collaborate in tackling congestion issues. A private network may be an option, however smaller enterprises may be reluctant to bear the expenses of establishing their individual network connections. Establishing a private network can be a complex process, involving questions of ownership, network management, and navigating responsibilities with property landlords (GRID, 2023).

The cooperative initiators highlight that the motivation of individuals and businesses significantly affect for the success of energy cooperation. It is indicated that business owners often only have a financial perspective. According to the respondents the intrinsic driver for sustainability is often missing (COLL, 2023).

Furthermore, the respondents point out that there is often a misalignment between the perspectives of municipalities, which prioritize the broader societal interest, and individual businesses, which tend to prioritize their own operational needs (COLL, 2023).

**Legal / regulation**

According to the PVB project leader, the government imposes even more regulations and assumes that businesses are already familiar with these rules. This creates a tension that needs to be addressed. (PVB, 2023).

According to the local grid operator, the legal coordination of cable pooling can be challenging due to the involvement of numerous owners. For instance, each participating wind turbine may have a different owner. Additionally, the complexity increases when some of the owners are foreign entities. These factors can further complicate the process of cable pooling and require careful legal considerations (GRID, 2023).

Furthermore it is stated that it is currently not allowed to supply energy to others (PVB, 2023).

The respondent states that there the differences between small and large connections business grid connections do not make sense and that these differences make the process of energy cooperation development extra difficult (PVB, 2023).

**Policy**
The respondent mentions that the province is involved in various initiatives, including the presence of charging consultants, logistics brokers, biodiversity projects, and climate adaptation efforts. However, they note that there is a risk of overlapping efforts among these initiatives. Currently, an inventory is being conducted to assess the range of initiatives taking place on business parks (PROV, 2023).

It is indicated by the respondent that there is no consistent policy from the government, as people with SDE subsidies are surprised to find out that they have to repay an advance payment, due to the risen energy prices resulting from the energy crisis, in turn leading to a negative feed-in tariff (PVB, 2023).

They also highlight the limited engagement and interaction between municipalities / provinces and business owners as a key obstacle (COLL, 2023).

It is mentioned that the bureaucratic process for obtaining the subsidies at the province can be lengthy and time-consuming, hindering the process of projects (COLL, 2023).

**Organisational**
The respondent highlights that through an organisational grade, such as a mandatory park management membership through a BIZ or an entrepreneurial fund, funding can be made available for implementation and professionalization efforts. This financial support enables the hiring of experts and the enhancement of operational capabilities, as mentioned by the respondent (PVB, 2023).

**Information**
The respondent is not familiar with the specific details of the revenue model but is aware that discussions regarding it are taking place. They mention that if there is no possibility to feed energy back into the grid, any profit generated from energy generation or savings would be considered valuable. However, they do not have further information on the specific revenue model being discussed (PROV, 2023).

The projectleader from PVB names the scarcity of knowledge, and specifically independent knowledge, as a barrier for energy cooperation (PVB, 2023).
The respondent highlights that there is a substantial gap in knowledge among businesses, particularly regarding closed energy systems. The lack of awareness about how these systems operate, including essential details like pricing, poses a significant challenge. This knowledge gap acts as a barrier for many entrepreneurs (GRID, 2023).

According to the respondent, he / she gave a presentation to 25 municipalities about energy cooperation and the transmission congestion issues affecting business parks. However, the respondent observed that all the municipalities seemed perplexed, as if they were witnessing something completely unfamiliar. This highlights the limited knowledge and understanding that many municipalities have regarding these topics (PVB, 2023).

According to the cooperative initiators, there is a prevalent misconception among entrepreneurs that they can address the congestion challenges on their own, being unaware of how the situation regarding the transmission grid will be within the next 5 years: more problems than now (COLL, 2023).

**Responsibility**
The project leader from PVB indicates there is a responsibility gap at multiple levels. No one feels responsible, which has resulted in a lack of progress so far. (PVB, 2023).

According to the initiators, there is a gap in responsibility where businesses are left to handle the situation on their own (COLL, 2023).

**Human capital**
According to the respondent, there is currently a lack of operational capacity on business parks to guide and develop energy cooperation (PVB, 2023).

The personnel capacity of the local grid operator Enexis limits the possibility of setting up additional pilots (PVB, 2023).

A notable concern raised is the personnel scarcity at Enexis, which contributes to longer processing times and the current waiting lists of businesses for a new or larger grid connection. To manage the situation, Enexis follows a "first come, first served" policy (GRID, 2023).

## A.19 Drivers for energy cooperation

**Economic / financial**
The response and attitude of businesses have significantly changed compared to seven years ago when they were hesitant to engage in sustainable energy-related initiatives. "Now I am even being called by businesses, asking if they can participate!" (PROV, 2023). This shift in behavior can be attributed to various factors, but mostly the energy crisis and geopolitical events such as the situation with Russia. The influence of these events has made a significant economic impact on businesses, driving them to think about options to balance such events (PROV, 2023).

According to the initiators, entrepreneurs on a business park have the primary goal of cost reduction and frequently face barriers that hinder their ability to expand their businesses, due to the inability to expand their current grid connection (COLL, 2023).

**Technical / engineering**
**Social / managerial**
The entrepreneurs are enthusiastic about Sprint Sessions because they have the opportunity to sit at the table with all stakeholders involved, such as the Zon op Dak acceleration team. This allows for discussions about the identified challenges and potential opportunities (PROV, 2023).

The respondent hopes that CES 6 companies can play a catalytic role in inspiring other businesses during sprint sessions. By showcasing their experiences and success stories in the energy transition, CES 6 companies can serve as a motivating force for other businesses to embark on their own sustainable initiatives (PROV, 2023).

Without the participation of CES 6 companies, the sprint sessions alone have not been successful in convincing larger businesses to embrace electrification, this highlights the importance of CES in the process (PROV, 2023).

The project leader from PVB indicates that the drive for the energy transition and energy cooperation is significant in Overijssel (PVB, 2023).

The respondent highlights that there has been a significant increase in understanding and a growing sense of urgency among businesses in the past 1.5 years. The acknowledgement of the problem is not being dismissed; however, there remains uncertainty about the appropriate actions to take (PVB, 2023).

**Legal / regulation**
The respondent highlights the significant role of a Business Investment Zone (BIZ) in terms of regulations, as it helps to enforce mandatory membership for businesses within an organizational structure. Being part of such a structure enables businesses to engage in collective decision-making and collaborate more effectively. It is emphasized that having an organizational structure in place through a BIZ can facilitate business interactions and transactions (PROV, 2023).

The respondent suggests that individual legislation for businesses can serve as an incentive for them to engage in collaborative efforts. By implementing regulations tailored to specific businesses, there is a greater motivation for them to come together and work collectively towards shared goals or initiatives. The idea is that individual legislation can foster a sense of collaboration and cooperation among businesses, encouraging them to join forces and pursue joint endeavors (PROV, 2023).

According to the initiators, laws and regulations are an important driver for businesses to take action, e.g. participate in an energy cooperative (COLL, 2023).

Furthermore, it is indicated that landlords are increasingly setting requirements for certifications they want for their buildings, which makes obtaining specific labels necessary, whereby the business owner should perform the needed actions to

achieve such label (COLL, 2023).

**Policy**
The respondent mentions that there is significant content in a letter from Jetten. According to the letter, the poorest-performing buildings must make a leap in energy efficiency by 2027. It is important to note that these are announcements and not yet legally binding regulations. This suggests that there is a plan to enforce stricter energy efficiency standards for buildings in the future, but the specific details and requirements are still being developed (PROV, 2023).

The members of the energy cooperative Marslanden sign a membership agreement in which they agree to the commitment to implement sustainable measures. This drives business owners to contribute to the energy cooperative (COLL, 2023).

According to the respondents, the municipalities, including Zwolle, have made a joint decision to prohibit diesel or fossil fuel-powered delivery vans within the inner city ring by 2025. Entrepreneurs are required to transition to alternative options, but the question arises: how will they handle charging? This drives business owners to take action (COLL, 2023).

**Organisational**
The respondent mentions the presence of an organisational grade to be crucial for the development of energy cooperation (PROV, 2023).

The PVB project leader highlights that through an organisational grade, such as a mandatory park management membership through a BIZ or an entrepreneurial fund, funding can be made available for implementation and professionalization ef- forts. This financial support enables the hiring of experts and the enhancement of operational capabilities, as mentioned by the respondent (PVB, 2023).

According to the respondent, they are currently working with Invest NL, the government's investment company, to develop contract structures for Smart Energy Hubs. Invest NL is scheduled to unveil the completed contracts on June 22nd, featuring a standardized format. Subsequently, they plan to consult Netbeheer Nederland and inquire about the feasibility of implementing the proposed framework (PVB, 2023).

The initiators emphasize that subsidies become available once you have established an organized entity. This highlights the significance of having a formal structure in place to qualify for and access subsidies (COLL, 2023).

Furthermore it is indicated that several large companies have taken on a pioneering role in the energy transition and have therefore become members of a cooperative (COLL, 2023).

**Information**
According to the initiators of energy cooperative Marslanden, the sharing of knowledge by energy cooperative ECUB on the process of establishing an energy cooperative has had a remarkable impact on their business park in Zwolle, enabling them to accelerate their own cooperative. The valuable insights and expertise are made available through the "Handboek aanpak collectieve verduurzaming" (Handbook for Collective Sustainability Approach), which holds great potential to assist other business parks in their collective sustainability endeavors (COLL, 2023).

## A.20 Solutions for energy cooperation

**Economic / financial**
**Technical / engineering**
According to the province project leader, ultimately, there is a need for an automated system that facilitates the exchange and financial settlement of energy transactions—a system that is widely accepted and adopted by all stakeholders (PROV, 2023).

The partner mentions that discussions are also taking place regarding solutions that operate truly outside the traditional grid. However, complete disconnection from the grid is deemed impractical, because in such situation, one is fully responsible for their own energy production, and it is never possible to extract power from the public grid, which might come in handy in cases such as maintenance or malfunction.
The concept of having a single connection is currently being implemented and operational at Schiphol Tradepark and Hessenpoort (pilot) and is considered to be a effective solution for smart utilization of the current infrastructure (GRID, 2023).

According to the respondent, it is possible to establish a "direct line", but it should be done behind the meter, allowing businesses to handle the connection and financial arrangements among themselves. If the connection needs to cross

public land, an exemption from the ACM must be obtained, and a separate network company needs to be established to create a private network on public grounds. For such network company, it is necessary to have a 24-hour emergency service and other requirements to ensure safety, reliability and affordability. Enexis is not allowed to interfere with private networks. For a direct line, in principle, it is possible to have an above-ground direct connection to prevent needing an exemption from the ACM. According to the partner, the challenge lies in determining the connection point, to ensure independency of the public grid. If the connection is made to the existing network of the company, the direct line will inevitably come into contact with Enexis' public network (GRID, 2023).

**Social / managerial**
The respondent emphasized the importance of having a company on the business park that can persuade its neighbors, take the lead, and have a vision that others can align with, so it is important to identify such companies early in the process (PROV, 2023).

Furthermore, it was stated that it is of great significance to impact businesses directly in their core business, if one wants achieve something quick (PROV, 2023).

The respondent highly values the sprint sessions facilitated by the province of Overijssel and expresses the desire to replicate them across the rest of the Netherlands. It is believed that it is important to bring together various stakeholders, through sprintsessions, to identify and address the problem business parks face. MKB Nederland and VNO NCW also express their interest in implementing sprint sessions in other regions (PVB, 2023).

The respondent (PVB, 2023) emphasizes the importance of aiding businesses in a way that minimally affects their operational activities, which is considered to be essential for business owners. It is suggested that by providing resources, knowledge, and manpower to the process, a positive business case can be established. Once entrepreneurs are willing to invest, the support can be gradually withdrawn, according to the respondent (PVB, 2023).

**Legal / regulation**
The province project leader expects that the most significant shift will occur when municipalities make firm decisions, such as "we will shut off the gas supply in that neighborhood." However, it is anticipated that only a few municipalities will have the courage to take such steps. The establishment of a Wijk Uitvoeringsplan (WUP) is necessary before such decisions can be made, but municipalities do have the authority to implement them (PROV, 2023).

The respondent suggests the possibility of regulations that would enable municipalities to mandate the installation of solar panels on existing buildings (PROV, 2023).

When the cost of energy increases, it prompts businesses to reconsider their energy consumption patterns and seek more efficient and sustainable alternatives. A regulated energy price increase could be a solution to accelerate energy cooperation (PROV, 2023).

Furthermore, according to the respondent there is a need for the implementation of strong and mandatory measures from municipalities that leave business with no choice but to comply. The respondent specifically mentioned the example of closing the gas supply, whereby businesses are given a certain period to make the needed changes, before access to gas is restricted (PROV, 2023).

The local grid operator highlights that Enexis is in the process of developing conditional consumption capacity contracts for commercial battery operators, to counteract the before-mentioned barrier. However, if these contracts result in reduced profitability for the operators, it raises the important question of who will bear the financial burden. The discussion surrounding this matter needs to be initiated, particularly with regards to existing operational trading batteries (GRID, 2023).

**Organisational**
The respondent emphasizes the importance of establishing clear agreements on how business parks are connected to the grid and how consumption and production are balance on business parks. It is also proposed to thoroughly think about the operating agent of the balancing, being an external party or a park-internal party. It is indicated that the easiest solution is to set up agreements with the local grid operator on the medium voltage grid. Essential in such agreements is the authorization of the grid operator to be able to fully disconnect the grid connection if the energy consumption / production exceeds a certain limit. The respondent emphasizes the need for reliable and competent entities to facilitate this process (PVB, 2023).

The respondent highlights the importance of addressing issues at the appropriate level. When a business park encounters a problem, such as facing difficulties in obtaining grid connections, it becomes necessary to explore collaborative solutions. One potential approach is to redistribute contracted capacity among businesses, enabling the network to op-

erate within its bandwidth limits. While it may not always be possible for every business to have optimal conditions at any given moment, clear agreements need to be established among companies to address such situations. By fostering collaboration and establishing agreements, these challenges can be effectively managed (PVB, 2023).

The respondent asserts that a bottom-up approach is the best way of supporting the energy transition on business parks (PVB, 2023).

Combining multiple small-scale connections is a viable solution to enable energy backfeeding in cases where it is not feasible with a single large-scale connection (GRID, 2023).

Furthermore, the smart utilization of the transmission grid, such as done at airport Schiphol, is considered to be a solutions fot the congestion problems, simultaneously reducing societal costs, by preventing additional grid to be built (GRID, 2023).

According to the local grid operator, it is crucial that business parks develop clear plans for the coming 5 to 6 years. This knowledge will provide Enexis with a clearer understanding of future infrastructure requirements, enabling them to accelerate their planning and implementation processes (GRID, 2023).

**Information**
As stated by the respondent, there is a requirement for robust tooling that can effectively steer businesses in the right direction. It is crucial to provide information on subsidy opportunities and connect them with relevant parties who can offer suitable solutions to address their specific challenges (PVB, 2023).

## A.21 Future challenges for business parks

During the interviews, that focused on the energy transition and transmission congestion, more challenges were named that are currently not that urgent, but will be in the future. These challenges will be listed below.

- Climate adaptation (PVB, 2023).
- Circularity (PROV, 2023), (PVB, 2023).
- Water scarcity (PVB, 2023).

## A.22 Factors influencing EC mentioned in case interviews

| | Groot Verlaat | G/S | I/E | Ph | Twentekanaal | G/S | I/E | Ph | Hessenpoort | G/S | I/E | Ph | A1 Deventer | G/S | I/E | Ph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Barriers** | | | | **Barriers** | | | | **Barriers** | | | | **Barriers** | | | |
| **Economic / financial** | High cost of electricity storage batteries | G | E | A3 | Not investing due to competitive reasons | S | E | S2 | | | | | No subsidies available for system innovations | G | E | A3 |
| | | | | | Membership fee from businessclub insufficient to account for EC development | S | I | A2 | | | | | Participating in SEH perceived to cost money | G | I | S2 |
| | | | | | | | | | | | | | Expectation that grid connection is worth money | G | I | S2 |
| **Technical / engineering** | Roof structure insufficiently strong | S | I | A2 | Incapability of transmission grid to handle energy exhanges | G | E | S3 | Vulnerability of business processes to technical malfunctions | G | I | S3 | Scarce availability of valid energy trading platforms | G | E | S3 |
| | Technical changes to electricity grid are difficult | G | E | A3 | | | | | Scarce availabilty of space for battery placement | G | I | S3 | | | | |
| | Fear for fire safety of solar panels | S | I | S3 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| **Social / managerial** | Passive role of municipality | S | E | S2 | Ego-centricity of companies regarding energy supply | S | I | S2 | Internal focus of companies | G | I | S2 | Developing agreements during development is time-consuming | S | I/E | AL |
| | Non-efficient, timeconsuming meetings organised by municipality | S | E | S2 | Limited company motivation to analyse consumption data themselves | S | I | A2 | Presence of large companies w.r.t. vertical organization | S | I | S2 | Excessive demands from businesses hinder desired outcomes | G | I | S2 |
| | Short duration of employment municipality | S | E | S2 | Smaller businesses avoid responsibility for ET, see energy as utility service | G | I | A1 | Municipality is restrictive in performing actions | S | E | S3 | Lack of signed confirmation to embark on project | S | I | A3 |
| | Difficult to come to concrete action with local grid operator | S | E | S3 | Inflexibility of local grid operator | S | E | S3 | | | | | | | | |
| | No commitment and engagement from municipality after session | S | E | A3 | Short duration of employment municipality | S | E | S2 | | | | | | | | |
| | Businesspark has no long-term vision | S | I | S2 | | | | | | | | | | | | |
| **Legal / regulation** | | | | | Direct sales of energy between parties (municipality cannot be energy supplier) | G | E | S3 | Energy Law, does not allow technical possibilities | G | E | S3 | Not allowed to operate without energy energy supplier | G | E | S3 |
| | | | | | GDPR obstructs accesability of needed energy consumption data | G | E | A2 | | | | | Cumbersome implementation of group contracts by Enexis | S | E | A3 |
| | | | | | Didam-arrest: gov not being able to directly award contracts to single party | G | E | A3 | | | | | Elusiveness of Tennet | G | E | S3 |
| | | | | | Socialization of grid costs makes revenue models complex | G | E | S3 | | | | | | | | |
| | | | | | Local grid operator unwilling to approve additional pilot-space | S | E | S3 | | | | | | | | |
| **Policy** | Providing false subsidies by OostNL and EFO | S | E | A2 | Municipality policy on ET mainly focused on built environment | S | E | S1 | Province's individual business focused policy is ineffective | S | E | A1 | Unchanged governmental grid operation policy | G | E | S1 |
| | Counterproductive national energy policy | G | E | S1 | Different governmental levels responsible for businesses | G | E | S1 | Too much resources spent on research by municipality | S | E | A2 | Conveying long-term cost-effectiveness of EC is difficult | G | E | A1 |
| | Static and fixed policy from national government | G | E | S1 | Obtaining subsidies for non-technical innovations is challenging | G | E | A3 | | | | | Developing effective and efficient financing policy | G | E | S3 |
| **Organisational** | Size-diversity of companies (difficult involving small companies) | S | I | A2 | | | | | Insufficient rate of organisation present (general) | G | I | S1 | Organisation of accountability in energy hub | G | E | S3 |
| | Gaining organisational rate on non-organised park is difficult | G | I | S1 | | | | | Centrally organized battery storage is vulnerable | G | I | S3 | | | | |
| | | | | | | | | | Central decision-making by headquarters of company | S | E | S2 | | | | |
| **Information** | Knowledge gaps in technological possibilities and costs | S | I | S3 | Not heard of development of energy hubs | S | I | S1 | Not all businesses familiar with stage of hub development | S | I | A2 | Knowledge gaps on technology | S | I | S3 |
| | Knowledge gaps in laws and regulations | S | I | S3 | Knowledge gaps in laws and regulations (energy exchanges) | S | I | S3 | Knowledge gaps in laws and regulations (energy exchanges) | S | I | S3 | Knowledge gaps on effective EC agreements | S | I | S3 |
| | | | | | Lack of realisation that neighbours influence own energy supply in collective | S | I | S2 | Uncertainty regarding energy market and effect on feed-in tarrif | G | E | A3 | Businesses overlook the impact of congestion | G | I | A1 |
| | | | | | Energy cooperation is new for parkmanager, choosing between gatherings is difficult | S | I | S3 | Lack of realisation that collective approach can achieve more | G | I | A1 | Lack of realisation collective approach is cheaper | G | I | S2 |
| | | | | | | | | | Unclear where knowledge for project realisation should come from | G | E | A3 | | | | |
| **Responsibility** | Responsibility gap regarding energy transition on BP | S | I/E | S2 | | | | | | | | | Existence of responsibility and ownership gap | G | I | A2 |
| **Surroundings** | | | | | Nearby energy generation (solar park), diminishes available grid capacity | S | E | A2 | | | | | | | | |
| **Human capital** | | | | | | | | | Lack of holistic, entrepreneurial thinking persistent people | G | E | AL L | Lack of guides for development of energy hub | G | E | A2 |
| | | | | | | | | | | | | | Personell shortage of energy suppliers | G | E | A3 |

Figure A.11: All barriers mentioned during the case-interviews, distributed along the main categories, with corresponding sub categories indicated as well

| | Groot Verlaat | G/S | I/E | Ph | Twentekanaal | G/S | I/E | Ph | Hessenpoort | G/S | I/E | Ph | A1 Deventer | G/S | I/E | Ph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Drivers** | | | | **Drivers** | | | | **Drivers** | | | | **Drivers** | | | |
| **Economic / financial** | Economic advantages due collective approach | G | I | A1 | Economic advantages due collective approach | G | I | A1 | Self-sufficiency of BP could eliminate energy bills headquarters | S | E | S2 | Local energy flows keeps economic flows local | G | I | A1 |
| | | | | | Negative economic consequences of transmission congestion | G | E | A1 | Current height of energy prices | G | E | A1 | No grid connection avaiilable, influence on business | G | I | A1 |
| | | | | | | | | | | | | | Compensation for grid connection sharing | G | I | A1 |
| **Technical / engineering** | | | | | Controllable energy source in form of (wastemanagement) company | S | I | S3 | | | | | Influence of transmission congestion on business | G | E | A1 |
| **Social / managerial** | Limited number stakeholders for decision-making | S | I/E | All | Signed intention statement between municipality and businesspark | S | I/E | S2 | Collective approach achieves more then individual approach | G | I | A1 | Perfect storm exists for EC to be developed | G | E | S1 |
| | Businessclub avoids reinventing the wheel, seeks support where needed | S | I | A2, S4 | Companies are willing to cooperate | S | I | S2 | External interest and support | S | E | ALL | Desire for autonomy and control over own energy supply | G | E | S2 |
| | Proactivity and ownership from businessclub and working group | S | I | ALL | Collective effort boosts likelihood of success in solving congestion | G | E | S2 | | | | | Possibility to shift towards sustainable way of business | G | E | A1 |
| | Being less dependend on energy suppliers | S | I | A1 | Large companies are independent and pro-active | S | I | A2 | | | | | Concensus that energy system will become decentralized | G | I/E | A1 |
| | | | | | Local-generation-local-consumption vision from PM | S | I | S2 | | | | | | | | |
| | | | | | Vision-allighment PM and large companies | S | I | S2 | | | | | | | | |
| **Legal / regulation** | Regulations / work descriptions from industry association | S | E | A1 | Feeding-back energy not possible for large-scale connections | G | E | S3 | Energy Conservation Obligation | G | E | A1 | | | | |
| | Energy Conversvation Obligation | G | E | A1 | | | | | Label-C obligation | G | E | A1 | | | | |
| **Policy** | ET on BP supports municipality sustainability goals | S | E | ALL | ET on BP supports municipality sustainability goals | S | E | S2 | Mandatory organizational structure (BIZ) | G | I | S2 | Mandatory installation of solar panels | S | I | S2 |
| | Letter written by Ministry of EZK | G | E | A1 | Positive attitude province and OostNL towards support of BP | S | E | S2 | Well-defined municipality vision for coming 10 years | S | I | A1 | | | | |
| | | | | | Bottom-up support policy from municipality | S | E | S3 | Pragmatic approach from grid operator | S | E | A3 | | | | |
| **Organisational** | Existence of organizational structure on BP | G | I | S2 | | | | | Well-organized structure is present on BP | S | I | S2 | | | | |
| | Businessclub, businesses and PM can act quickly due to strong relationship | S | I | ALL | | | | | | | | | | | | |
| **Information** | | | | | | | | | Presence of frontrunners with expertise and local know-how | S | I | S3 | | | | |
| **Surroundings** | Nearby energy generation (solar field) | S | E | A1 | Nearby energy generation (solar field) | S | E | A1 | Available energy existent from neighbours | G | I | A1 | Available energy existent from neighbours | G | I | A1 |
| | | | | | | | | | | | | | Nearby energy generation (solar field) | S | E | A1 |
| **Indepence** | | | | | Reliability and and availability of energy | G | I | A1 | Independence from energy suppliers and energy prices | G | E | A1 | | | | |
| **Safety** | | | | | | | | | | | | | Increased safety due to decentralized infrastructure | G | I/E | A1 |

Figure A.12: All drivers mentioned during the case-interviews, distributed along the main categories, with corresponding sub categories indicated as well

| | Groot Verlaat | G/S | I/E | Ph | Twentekanaal | G/S | I/E | Ph | Hessenpoort | G/S | I/E | Ph | A1 Deventer | G/S | I/E | Ph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Solutions** | | | | **Solutions** | | | | **Solutions** | | | | **Solutions** | | | |
| **Economic / financial** | Additional allocation of resources by businessclub to reimburse worked hours | S | I | A2 | | | | | | | | | | | | |
| **Technical / engineering** | Cable pooling | G | I/E | S3 | Electricity storage solution for intermittency of ren. energy | G | I | S3 | Large diesel generators to cope with malfunctions | G | I | S3 | Battery system coupled with EMS and trading platform | G | I | S3 |
| | BP being part of larg energy landscape | S | I/E | S3 | | | | | | | | | | | | |
| **Social / managerial** | Educate companies on smart and efficient consumption | G | I | S3 | Networking events are most effective, more attendees | S | I | S2 | Decicated municipality contact for businesses, to build trust | G | E | A2 | Ensure stakeholders are aware of all obvious solutions | G | I/E | S3 |
| | Receive help of consultant with prior experience in EC development | S | E | A2 | Have extra resources and expertise within businessclub | S | I | A2 | Capable people able to realise and implement made plans | G | I/E | A3 | | | | |
| | Relieve small businesses with early-stage tasks for EC development | S | I | A2 | | | | | Simple decision-making model for EMS and capacity exhange | G | I | A3 | | | | |
| **Legal / regulation** | Battery with own legal entity | G | I | S3 | Government obligation to invest in renewable generation | G | E | A1 | | | | | Emergency law to enable group contracts | G | E | S3 |
| | | | | | Compromise on privacy, energy data known per building | G | E | ALL | | | | | Governmental redistribution of grid connection capacity | G | E | S3 |
| **Policy** | | | | | Tax reductions for producer and user of energy exchange | G | E | S3 | Efficient infrastructure utilization by influencing behaviour | G | I | S3 | Sustainable municipal plot allocation policy | G | I | S1 |
| | | | | | | | | | Bottum-up municipal facilitation of existing initiatives | G | E | S2 | Leading role of national government | G | I | A1 |
| | | | | | | | | | Local collective initiative support by province | G | E | S2 | | | | |
| **Organisational** | | | | | Not burdening small companies with long-term challenges | G | I | A2 | | | | | Set-up of development and exploitation agencies | G | I | S3 |
| | | | | | Collective approach in solving complex problems on BPs | S | I/E | S3 | | | | | Agree on favorable pricing to increase ROI | G | I | S3 |
| | | | | | | | | | | | | | | | | |
| **Information** | | | | | Presentation of expert, sharing challenges and how to deal with them | S | E | A2 | | | | | | | | |

Figure A.13: All solutions mentioned during the case-interviews, distributed along the main categories, with corresponding sub categories indicated as well

## A.23 Elaboration on factors influencing EC, Groot Verlaat

In this Appendix, one can read the elaborations and context around the mentioned barriers from the case interviews, structured along the main categories of the conceptual framework. It is also indicated which respondent mentioned which factor.

### A.23.1 Barriers to energy cooperation

**Economic / financial**
The high cost of electricity storage batteries have been highlighted as restrictive for energy cooperation. Apart from the fact that prices for batteries are perceived high, the exact prices are also not know, hence payback periods cannot be determined (1COM.B, 2023).

**Technical / engineering**
Some roof structures of companies on the business park are currently not suitable for placement of solar panels (1COM.B, 2023).

Also, realising energy cooperation and energy exchanges requires altering the current electricity grid. According to the local grid operator, such operation is technically difficult (1COM.A, 2023).

Additionally, some companies on the business park fear the fire safety of solar panels, withholding them from investing in this source of sustainable energy.

**Social / managerial**
Furthermore, the municipality has a passive role in stimulating energy cooperation, as they quickly defer to the business club, expecting them to take up the responsibility (1COM.A,2023).

Also, the meetings around sustainability organised by the municipality are perceived as restrictive and time-consuming, with too many actors involved, not coming to concrete actions, "Would be nice if not too much money disappears in all kinds of talking groups from the municipality and province" (1COM.B,2023).

In addition, the short duration of employment at the municipality severely restricts the momentum of developing energy cooperation and creating a sustainable relationship between business park and municipality (1COM.B,2023).

Generating actions with the local grid operator is perceived difficult (1COM.B,2023). Also, the grid operator restricts developing energy cooperation, due to the complex nature of the needed modifications to be made to the electricity grid (1COM.A,2023).

The municipality did not contact the park manager or business owners after the sprint session, to discuss continuation of the discussed plans. This characterizes the municipality according to the park manager (1PM, 2023).

As mentioned earlier, the business park has no long-term vision (1PM, 2023). This could be seen as a barrier, because there is no clear goal for all the stakeholders on the park to collectively work towards.

**Policy**
The policy of OostNL to provide companies with a "subsidy" that later turned out to be a form of advance financing where the receivers had to pay back the amount with interest, is perceived as counter-effective (1COM.B,2023).

The current policy of the national government is perceived obstructive, whereby solar panels are stimulated with subsidies, but the energy of those panels cannot be fed-in into the grid. Given the fact that the problem of transmission congestion was predicted a significant time ago, it is not understood why the policy is not altered (1PM, 2023).

The park manager questions how the policy of the national government is not changed after so many years, whereby solar panels are stimulated, but feeding back energy to the grid is not possible.

**Organisation**
Diversity of companies is, especially in terms of size, is perceived as restricting to energy cooperation, because the smaller companies are difficult to involve in the process of setting up energy cooperation projects (1COM.A, 2023).

Furthermore it is mentioned that establishing a level of organisation on a non-organised business park is extremely difficult (1PM, 2023).

**Information**
A general notion that appears from the conducted interviews, is the existing knowledge gaps and lack of information from several stakeholders about technology, regulation and costs of technology. Sometimes, companies do not have knowledge on which laws and regulations influence their business on an individual scale (1COM.A, 2023).

Business owners do not know what is allowed by the ACM and grid operator within the boundaries of the current electricity grid infrastructure, for sharing capacity or physically exchanging energy (1PM, 2023).

Also, there is no knowledge about what the size of a potential battery should be and what the costs of that battery then are (1COM.B,2023).

**Responsibility**
It is not clear who is responsible for the energy transition on the business park (1PM, 2023).

### A.23.2 Drivers for energy cooperation

**Economic / financial**
It was mentioned that companies would make unnecessary costs if they would individually want to solve their sustainability and transmission congestion issues. Cooperating in a collective manner on the field of energy brings cost reductions (1COM.B,2023).

**Regulatory**
For the concrete company, the industry association also plays a stimulating role. For example, the association creates job descriptions specifying that deliveries should be transported using electric vehicles. Also the Energy Conservation Obligation is perceived as motivating (1COM.A, 2023).

**Social / managerial**
"Sometimes you go quicker if you don't have to collaborate with too much parties" (1COM.B,2023), relating to the meetings of municipality and province where a high number of actors is present.

The business club seeks collaboration where necessary and strives to avoid reinventing the wheel with energy related topics (1COM.B, 2023).

It is believed that if the business club and working group do not take the initiative themselves in realising sustainable energy measures, it may be imposed upon them. They prioritize maintaining control of the development of such projects themselves, ensuring 100% local ownership (1COM.B, 2023).

Furthermore, participating in energy cooperation projects is believed to bring the participants less hassle than the current situation, with the dependency on energy suppliers (1COM.B, 2023).

**Policy**
The municipality has a vested interest in the sustainable transition of Groot Verlaat, which could potentially unlock funding opportunities, because this supports their own sustainability goals (1COM.B, 2023).

According to the company in the concrete industry, the letter written by the Ministry of EZK is perceived as motivating.

**Organisational**
The park manager emphasizes the importance of having an organizational structure within an industrial park, for developing energy cooperation projects. On Groot Verlaat, this organizational structure is the business club, and it was highlighted that gathering electricity consumption data went seamlessly. Normally, without the existence of organisation, such process would be cumbersome (1PM, 2023).

It is mentioned that the businesses on the park, together with the business club and park management, can act quickly if needed, due to the strong relationship between business club and businesses. The business owners want to collectively solve the energy-related problems they individually face, and mutual goodwill exists, also because they can learn from each other.

This can be partly explained by the clear policy of the business club wherein is stated that businesses should bring something to the club / park, resulting in a pro-active and willing attitude of the businesses (1PM, 2023).

**Surroundings**

Coupling a nearby solar field with the demand of the business park is mentioned a few times. Stakeholders are driven by the existence of this energy source and evaluate the potential possibilities this could bring for the business park (1COM.B, 2023).

### A.23.3 Solutions

**Economic / financial**
As a solution to the problem of having not enough resources that reimburse the worked hours for developing energy cooperation, it was mentioned that additional resources could be allocated by the business club by increasing the subscription fee.

**Technical / engineering**
As highlighted earlier, there exists a broad vision for an "energy landscape" in which the business park plays an important role. Cable pooling here mentioned as a means to efficiently couple the different energy sources to one grid connection.

**Social / managerial**
According to a business owner, companies can and need to be educated on consumption and optimize their energy usage by coordinating with each other in a smart manner (1COM.B,2023).

Also, a consultant with prior experience in developing and realising energy cooperation could help (1COM.B,2023).

Smaller businesses should be relieved with early-stage tasks related to energy cooperation, as small businesses will not delve into sustainable challenges themselves. They either join in or not. A compelling picture needs to be presented, demonstrating that these types of businesses can benefit from energy cooperation as well (1COM.A, 2023).

**Legal / regulatory**
It was mentioned that when realising a battery for shared storage, it possibly should have its own legal entity (1COM.B, 2023).

## A.24 Elaboration on factors influencing EC, Twentekanaal

In this Appendix, one can read the elaborations and context around the mentioned barriers from the case interviews, structured along the main categories of the conceptual framework. It is also indicated which respondent mentioned which factor.

### A.24.1 Barriers to energy cooperation

**Economic / financial**
An important notion is made by the recycling company, which takes into account a competitive consideration in decisions on sustainable energy measures and energy cooperation. Their argument is: we are willing to invest, but if our cost price will go up because of these investments, this could influence our market position, compared to our competitors. Thus, if the investments in energy (cooperation) measures would increase their cost price too much, they would not invest / participate (2COM.A, 2023).

The current membership fee from the business club is not sufficient to account for the costs being made by analysing the energy consumption data and developing a multi-year plan (2PM, 2023).

**Technical / engineering**
The incapability of the transmission grid to physically exchange energy between parties is highlighted as a barrier to energy cooperation (2COM.A, 2023).

**Social / managerial**
Companies prioritize their own energy supply but do not prioritize that of their neighbors (2MUN, 2023).

Furthermore, companies appeared to have limited motivation to take initiative to analyze the collected energy consumption data themselves (2MUN, 2023).

Smaller businesses tend to shift the responsibility of their and the business park's energy transition onto the municipality, grid operator, and government, expecting them to take care of the energy supply as it is considered a utility service. These

smaller businesses focus on immediate concerns and are primarily preoccupied with energy tariffs of today (2PM, 2023).

The inflexibility of the (local) grid operator is highlighted as a hindering factor for the energy transition and for energy cooperation on business parks (2PM, 2023).

**Legal / regulatory**

Currently, it is not allowed to as a municipality to directly sell energy to a company as an energy supplier (2MUN, 2023).

The current process of gathering the needed energy consumption data is perceived cumbersome, as data provision is crucial for implementing energy cooperation solutions such as a smart grid or energy hub. According to the General Data Protection Regulation (AVG), the grid operator is not permitted to disclose information about energy profiles. Therefore, you need the explicit consent of all companies to access their data, which is obtained through smart meters (which often times is not even installed). This makes the process time-consuming and difficult. Even if the grid operator would want to disclose the data, it is prohibited by law (2MUN, 2023).

The "Didam-arrest" often poses challenges to the energy transition. Government entities are not allowed to directly award contracts to a single party; an open tender process must be followed. Hence, the municipality is prohibited from directly supplying solar energy to an adjacent party (2MUN,2023).

Incorporating the reduction in grid reinforcement investments into the revenue model- due to realisation of smart solutions - is difficult according the municipality employee. This is because the costs of the electricity grid are socialized. It is challenging to include this aspect fairly in the revenue model without disadvantaging realized projects. Although it could be feasible, it would require applying such an approach throughout the entire service area of the local grid operator (2MUN, 2023).

Enexis is a limiting factor in setting up an energy, as they are unwilling to approve a pilot in 2023 (2MUN, 2023).

**Policy**

The sustainable transition policy from the municipality is mainly focused on the built environment, while the greatest potential lies in businesses/business parks. The argument for the built environment is that they have the largest sphere of influence within this environment, combined with prevailing notion within the municipality (board) that businesses should solve the energy transition themselves. According to the municipality employee, this notion is gradually changing (2MUN, 2023).

In terms of national policies in the Netherlands, different levels of government are responsible for businesses. The energy conservation obligation (EML) is governed by the RVO (Netherlands Enterprise Agency), which is beyond the jurisdiction of the local government. This makes it difficult for the municipality to influence the businesses on a local level (2MUN, 2023).

Another policy related barrier for energy cooperation is: obtaining subsidies for setting up an organizational structure is challenging because it doesn't have a direct and measurable output, whereas particularly now subsidies are needed for reimbursing hours worked for setting up organizational structure and feasibility studies (2MUN, 2023).

**Information**

The company does not know which laws and regulations apply to physical energy exhanges between parties on a business park.

Also, the business owner has not yet heard about the developments of energy hubs in Deventer en Zwolle.

The realisation that the choices made by your neighbor have an impact on collective (pre-meter) solutions, is often non-existent (2MUN, 2023).

In some cases, the park manager finds it difficult to choose between initiatives, meetings or programs on energy cooperation on business parks. Mainly, because the topic of energy cooperation is new for the park manager as well (2PM, 2023).

**Surroundings**

The presence of an adjacent solar park is both perceived hindering and driving for energy cooperation. It is hindering energy cooperation, because it significantly diminishes the available grid capacity for the businesses operating in the

business park, posing a substantial constraint on their electricity consumption- and feed-in options (2PM, 2023).

### A.24.2 Drivers for energy cooperation

**Economic / financial**

For the interviewed company, reducing costs is a driver factor to participate in energy cooperation on the business park (2COM.A, 2023), (2PM, 2023).

Companies think about the economic effect that transmission congestion could have on their business. A consequence of transmission congestion could be (and will be, Chapter **??**) that businesses cannot obtain a new or larger electricity connection. This situation would hamper the possibility to increase energy usage and thus expand their business. Therefore, such scenario triggers companies to participate, or at least think about participating in energy cooperation projects (2MUN, 2023).

**Technical / engineering**

A technically stimulating factor for energy cooperation is the controllable energy source from the waste management company Twence. Having a regulable energy sources on a business park where energy cooperation is being operationalized is usable, to account for the variability of the own produced sustainable energy (2MUN, 2023).

**Social / managerial**

In 2021, an intention statement was signed between the municipality and the business park, to stimulate the sustainable transition on the park (BIT-Twentekanaal, 2021).

Companies want to collaborate in energy cooperation projects and there exist no conflicts between companies that could hinder such cooperation in any way (2COM.A, 2023), (2MUN, 2023).

According to the park manager, the likelihood of success for a project aiming to solve transmission congestion problems on a business park is much higher with a collective approach, compared to an individual approach.

Large companies understand that they cannot expect much (priority) from the grid operator, municipality, and government around their own energy transition and the one from the business park. Therefore, they take matters into their own hands (2PM, 2023).

The vision of the park manager for Twentekanaal in the next 20 years is to generate energy locally and consume it as much as possible within the local area. The aim is to have smart energy management in place to reduce dependency. This vision aligns with the vision of the large companies on the site, as they are keen on establishing an energy hub (2PM, 2023).

**Legal / regulatory**

The fact that it is not possible for companies with a large grid connection to feed-in their excess solar energy, is driving business owners to think about other options, such as participating in an energy cooperation initiative (2MUN, 2023).

**Policy**

The municipality's sustainability goals play a role in supporting energy cooperation on business parks, as previous plans by the municipality (such as the installation of wind turbines) have faced resistance, prompting them to explore alternative options to achieve their goals (1COM.A, 2023).

It was mentioned that the province of Overijssel and OostNL have a postive atttitude towards supporting energy cooperation on Twentekanaal (2MUN, 2023).

The park manager believes that investing in the initiative from the energy working group is valuable for the municipality because the plans are driven by the businesses themselves (bottom-up), rather than being solely devised by the municipality and then in turn needing to be embraced by the business owners. According to the park manager, this approach ensures that the plans have greater acceptance and support from the business community, making them more effective and sustainable in the long run.

**Surroundings**

The development of a 25 hectares solar park in close proximity to Twentekanaal (Boeldershoek) is mentioned multiple times as a driving factor for energy cooperation. The solar park is being developed by energy collective Energie van Hengelo. Companies are considering joining this collective, to ensure being able to use the sustainably produced electricity (2COM.A, 2023).

**Organisation**

**Energy security / availability / independency**

Next to affordability of energy, supply reliability, and availability of energy are also important drivers for companies to join forces in an energy cooperation project (2PM, 2023).

### A.24.3 Solutions

**Technical / engineering**

Electricity storage capacity is considered to be a solution for transmission congestion and the intermittency of renewable energy (2COM.A, 2023).

**Social / managerial**

Networking events where information is shared about companies and issues faced by entrepreneurs are found to be more effective than specific theme-based meetings. Also, more business owners should attend these meetings (2PM, 2023).

There is a need for additional resources and expertise within the business club to meet the demands of these in-depth challenges (2PM, 2023).

**Legal / regulatory**

According to the director of the recycling company, a government obligation that requires companies with a certain level of energy consumption to invest in sustainable measures would be helpful to accelerate the energy transition and energy cooperation. For example, companies would be mandated to self-generate at least 75% of their energy consumption or purchase green energy. This would address the current barrier where companies are hesitant to invest in sustainable measures due to competitive reasons, as explained earlier.

The municipality employee believes that we would need - as a country - to compromise on privacy to some extent, considering the General Data Protection Regulation (AVG), as the AVG poses challenges to the energy transition, as explained earlier. The government should make adjustments so that per building, we can have information about energy consumption without directly associating it with a specific company or individual. This would massively increase the availability of energy consumption data, accelerating the rate feasibility studies that could be carried out across business parks in the Netherlands.

**Policy**

One possible way to encourage energy cooperation, according to the director of the recycling company, would be through a form of energy tax reduction. This would ensure sufficient returns for energy generation. For example, the energy producer would receive tax refunds, while the consumer would benefit from procurement advantages.

**Organisation**

It is important not to burden the smaller companies with long-term challenges that lie ahead (2PM, 2023).

The park manager emphasizes that the current situation does not necessarily rely on a single party taking the lead, but rather requires collective effort to align consumption profiles and explore possibilities. This collaborative approach involves consultation with the network operator to assess available capacity and determine the feasibility of implementing a pilot project for a smart energy hub.

**Information**

As highlighted in earlier, for companies there often exist knowledge gaps on what is possible, technically and legal / regulatory. According to the director of the recycling company, it would be beneficial for their business and other businesses

on the site if an experienced individual could give a presentation (for example a business owner from Hessenpoort, where an energy hub is being developed), sharing the challenges they have encountered. This would prevent reinventing the wheel and provide valuable insights for others.

## A.25 Elaboration on factors influencing EC, Hessenpoort

In this Appendix, one can read the elaborations and context around the mentioned barriers from the case interviews, structured along the main categories of the conceptual framework. It is also indicated which respondent mentioned which factor.

### A.25.1 Barriers to energy cooperation

**Technical / engineering**
The vulnerability to technical malfunctions is named as a barrier to energy cooperation, with the example of herb drying company Euroma having critical business processes that can never be interrupted in terms of power input. "If the power goes out, then you really have nothing left." (3COM.A, 2023).

Also, it is questioned where a potential battery can be placed, referring to the scarce available space on the business park (3COM.A, 2023).

**Social / managerial**
Businesses that have an internal focus, focusing on surviving financially, are perceived hindering for energy cooperation. "If you are only internally focused, financial support from the government also will not get you there." (3COM.B, 2023).

The presence of larger companies is partly perceived to be a disadvantage. On Hessenpoort such companies are DHL, Ikea, Postnl, AH, Picnic and Scania. These companies need to be willing to collaborate with and support each other. Also their headquarters must also understand the need for action on transmission congestion. Without their cooperation, park management or business club cannot effectively mobilize these companies. "If an IKEA manager has to ask their headquarters in Sweden for permission to participate in such a project, progress will be limited." (3COM.B, 2023).

The municipality is complex. The respondent looks at it from an external perspective, having a role that is half within and half outside the municipality. The most important stakeholders when working permanently within the municipality are the board and council, but actually getting things done is very challenging, according to the respondent. "You are basically bound hand and foot, the focus is mainly on the energy transition of residential areas." (3MUN, 2023).

**Legal / regulatory**
The Energy Law is perceived the largest bottleneck for energy cooperation on Hessenpoort. "Technically, much more is possible than what the law allows." (3MUN, 2023).

**Policy**
The external municipality employee considers the current role of the province a waste of money, whereby the province actively approaches businesses to support them in the energy transition. "The province calls you to let you know they can do something for you, well, the average SME entrepreneur thinks, go away." The majority consists of SMEs and they are not interested in governmental interference.

Too much money is being spent on research and. "You can gather a lot of information through research, but it's about the "how" question. How are we going to realize it?" (3MUN, 2023).

**Organisation**
For business parks in general, the notion is made that insufficient rate of organisation is present (3COM.B, 2023).

One business manager wonders whether storage should be organized centrally or per company. Points out that a centralized facility carries risks in terms of vulnerability, stating, "If it goes up in flames, nobody will have energy anymore." (3COM.A, 2023).

The central decision-making by the headquarters is perceived as delaying in the participation of the branch in energy cooperation initiatives (3COM.A, 2023).

**Information**
One manager does not know if energy consumption data from companies has already been collected (3COM.A, 2023). As

stated earlier, energy consumption data was collected and shortly a pilot will start, based on this data. This indicates a knowledge gap between what is happening on Hessenpoort and what is known at business level.

Furthermore, the manager wonders what the status of the energy market is, considering prices for feeding-in excess surplus solar energy. "Will feeding-in cost money or will it generate income?" (3COM.A,2023).
The manager also has no knowledge on what laws and regulations influence energy cooperation between companies. "Is it allowed to supply excess energy to your neighbour?" (3COM.A, 2023).

The realization that collaboration can achieve things that cannot be achieved individually needs to be present. Currently, this awareness is not always existent (3MUN, 2023).

In general, according to the municipality respondent, it is not known where the knowledge should come from that is needed to realise projects.

**Human capital**
According to the hired municipality project leader, there is a shortage of people with the qualities: being able to think holistically and also being capable of understanding what drives an entrepreneur and having the courage to follow through with a plan. Not someone who leaves after just one conversation.

### A.25.2 Drivers for energy cooperation

**Economic / financial**
The manager of the branch location mentions that their energy contract is centrally negotiated and paid for by the headquarters, but that a self-sustaining business park could potentially lower or even eliminate this expense. This statement is meant as motivating for the headquarters, because the central decision-making is perceived as delaying in the participation of the branch in energy cooperation initiatives.

The current high energy prices are mentioned as stimulating for energy cooperation (3MUN, 2023).

**Social / managerial**
"By collaborating, you can achieve things that would be impossible to accomplish individually." (3MUN, 2023).

Furthermore, the attention that Hessenpoort receives is identified as a driving factor for the development of energy cooperation. The current project receives extra support as a result of the attention it receives. "The support we receive from being in the spotlight helps accelerate the entire Netherlands." The CEO draws a comparison with the attention and publicity received by the first solar fields in the Netherlands, "which is now commonplace. We need to make that transition." (3COM.B, 2023).

**Legal / regulatory**
The office label-C obligation and the Energy Conservation Obligation are perceived as stimulating regulations for energy cooperation (3COM.A, 2023).

Some client locations require all-electric vehicles, stimulating the company to have electric vehicles, and thus charging facilities at their location, in turn increasing their energy consumption (3COM.A, 2023).

**Policy**
A mandatory organizational structure is proposed as driver for energy cooperation on a business park (BIZ) by the CEO and hired municipality employee. According to the CEO, such park policy ensures universal participation and active involvement of all stakeholders, effectively eliminating the aforementioned barrier of the involvement of large companies such as IKEA. "I actually recommend it to every business park and municipality: establish a robust organizational framework. As a business owner, you need not worry about dedicating time to it; simply appoint a competent park manager who works on your behalf." (3COM.B, 2023).

The vision for the municipality of Zwolle is well-defined, with a clear focus on accelerating goals within a 10-year timeframe. In this vision, active involvement of the business community is emphasized, as the municipality recognizes the potential for greater environmental benefits compared to residential areas. The municipality strives to effectively communicate this message to businesses, highlighting the importance of their active participation and engagement (3MUN, 2023).

The pragmatic approach from the local grid operator in the evolvement of contracts is perceived as driving to energy cooperation, because such approach achieves the desired outcome faster (3MUN, 2023).

**Organisational**
According to the CEO and chairman of the business club, at Hessenpoort there is a well-organized structure, with competent board and individuals who are intrinsically motivated by sustainability and collaboration (3COM.B, 2023). As well, this organized structure is mentioned as stimulating for energy cooperation by the hired municipality employee.

**Information**
The presence of several frontrunners with expertise and local know-how, such as entrepreneurs within the business park that are known in the area, play a crucial role in stimulating energy cooperation (3MUN, 2023).

**Independence**
According to the branch manager, having an energy-neutral business park would ensure independence from energy suppliers and energy prices. This independency is a large motivator for the manager to join an energy cooperation initiative.

**Surroundings**
The branch manager wonders if excess solar power from their neighbours could be used and if waste heat from the herb drying company could be used. This shows that the existence of energy sources in close proximity is perceived as stimulating to think about energy cooperation.

### A.25.3 Solutions

**Technical / engineering**
As back-up for malfunctions on the electricity grid, it is proposed that companies with critical processes need large diesel generators (1COM.A, 2023).

**Social / managerial**
As stated earlier, the awareness that collaboration can achieve things that cannot be achieved individually is often non-existent among businesses. The project leader states that this awareness is created by ensuring that entrepreneurs have a point of contact, that trust can be build, and by creating municipality presence . The respondent believes it is important to build such relationship by utilizing municipality employees who are committed for the long term (3MUN, 2023).

The right people are needed that are capable of realising and implementing the proposed plans made by the businesses on the business park (3MUN, 2023).

In terms of energy management systems for energy and capacity exchange among businesses, the decision-making models should be simple but effective (3MUN, 2023).

**Policy**
According to the branch manager, efficient utilization of infrastructure is determined by people's behavior, and that behavior can be influenced.

According to the hired municipality project leader, the best approach is for the municipality to facilitate existing initiatives from entrepreneurs, whereby the entrepreneurs are responsible, with the motivation that achieving sustainability goals within their own municipality is also accomplished through these initiatives.

The province should support local-level initiatives that involve entrepreneurs working together on such projects, rather than focusing on individual plans and subsidies, as they are deemed less effective, according to municipality project leader.

## A.26 Elaboration on factors influencing EC, A1 Bedrijvenpark

In this Appendix, one can read the elaborations and context around the mentioned barriers from the case interviews, structured along the main categories of the conceptual framework. It is also indicated which respondent mentioned which factor.

### A.26.1 Barriers to energy cooperation

**Economic / financial**
The former hub manager states that no subsidies exist for system innovations such as an energy hub, to indicate that financing is a problem when businesses need to finance the energy hub themselves. Also, the respondent indicates that

the societal benefits created by an energy hub are not directly returned to the companies that invested, which makes the financing even more complicated.(4HUB, 2023).

For many businesses, participating in the development of the energy hub is perceived to cost additional money (4MUN, 2023).

In the near future, grid connections will be grouped and contracted capacity will be exchanged among companies. Companies always paid for their maximum capacity, but when exchanging capacity, some companies expect to earn income on exchanging capacity. Such expectation can act as obstructing for the roll-out of group contracts (4MUN, 2023).

**Technical / engineering**
There are only a few parties that offer a trading platform with a proven track record. All of them are relatively new in the Netherlands. There is a steep learning curve in this area, and it can be challenging as the level of expertise varies across different entities. The absence of such parties is perceived obstructing for quick development of energy hubs (4HUB, 2023).

**Social / managerial**
According to the former hub manager, contracts and letters of intent all have to be devised while in progress, stating that this takes a lot of time.

Currently, businesses are involved to some extent, but if it requires too much energy, money, or commitment from them, it becomes challenging to achieve the desired outcomes. However, it is important to note that this does not apply to every company, as the respondent states that there are indeed businesses that have a vision and are forward-thinking in terms of sustainability (4MUN, 2023).

According to the project leader, companies and energy profiles have been inventoried, "but at some point, it comes down to who puts their signature and says, we're going to do it." As of yet, such confirming act has not happened yet (4MUN, 2023).

**Legal / regulatory**
According to the business owner, in the Netherlands it is currently not allowed to operate as a company without an energy supplier, which the respondent finds strange (4COM, 2023).

The former hub manager states that group contracts are currently tolerated by grid operators, but are not easy to implement. Energy exchange among companies is even more challenging (4HUB, 2023).

According to the project leader, the national grid operator, Tennet, is the bottleneck in the inability to change the regulations and laws regarding exchange of grid connection capacity, not the local grid operators. "It's not about Liander, it's about Tennet, and I find it elusive. As a municipality, company, or individual, there is nothing you can do about it." (4MUN, 2023).

**Policy**
According to the project leader, the policy from government and grid operators has remained unchanged too long, resulting in laws and regulation that is not suitable for the current situation. "There is a problem because we adhere to the fact that 40 years ago we stated that you cannot exchange contract capacity with each other." (4MUN, 2023).

According to the municipal project leader, conveying the message that joining an energy cooperation project is more cost-effective in the long term, costs a lot of effort and energy (4MUN, 2023).

According to the former hub manager, it is a challenge to provide financing and subsidies in such way, to ensure that there does not accumulate a backlog of initiatives that cannot be realized.

**Organisational**
Additionally, the accountability of actors involved in the energy hub is seen as a challenge. "As the responsibility for energy generation and distribution shifts to a more decentralized model, it becomes crucial to determine who will assume accountability for ensuring the safety and reliability of the system." (4HUB, 2023).

**Information**
The former hub manager states that a lot of uncertainty and knowledge gaps exist about technology, how different technologies can work together, and how agreements can be made regarding them (4HUB, 2023).

Furthermore, because of the novelty of energy trading in the Netherlands, the knowledge level among companies that

provide energy trading platforms is not uniform accross the country (4HUB, 2023).

According to the project leader, many companies believe they do not have a problem with regard to transmission congestion (4MUN, 2023).

Additionally is stated that companies perceive investing in an energy hub often as additional cost. However, according to the project leader, long-term calculations show it is actually more cost-effective. This realisation is often non-existent (4MUN, 2023).

For many companies the economic incentive to participate is not clear (4MUN, 2023).

**Responsibility**
The former hub manager mentions the existence of a responsibility gap and an ownership gap. Meaning that in the process of the energy transition on business parks, the process is from everyone and nobody at the same time. It is not clear who is responsible (4HUB, 2023).

**Human capital**
According to the formal hub manager, a shortage of human capital exists who can guide the process of developing an energy hub (4HUB, 2023).

The personnel capacity from energy suppliers is also perceived as a concern. When business parks would become self-sufficient and all current energy contracts need to be terminated, there is insufficient capacity to handle such situation. "Moreover, if you put 100 billion on the table now, the problem is still not easily resolved." (4MUN, 2023).

### A.26.2 Drivers for energy cooperation

**Economic / financial**
As indicated by the interviewee, decentralized energy consumption and generation allows for keeping energy flows local, which in turn keeps financial flows local as well. This is an important driver for the development of an energy hub, because according to the formal hub manager, currently a significant amount of money is directed towards countries that produce fossil fuels, resulting in a loss of those financial resources in the region (4HUB, 2023).

According to the former hub manager, the western part of the business park is facing an acute problem as they cannot obtain large consumer connections. This factor has negative economic consequences on the current way of doing business and on expansion plans, so companies have an economic incentive to join the energy cooperation project (4HUB, 2023), (4COM, 2023).

The project leader states that in the near future, grid connections will be grouped and contracted capacity will be exchanged among companies. Companies always paid for their maximum capacity, but when exchanging capacity, some companies expect to earn income on exchanging capacity. For those companies this outlook on income is a motivator to participate in an energy cooperation initiative such as describe (4MUN, 2023).

According to the businessowner, being able to generate income from exchanging excess solar energy is perceived as motivating for participating in the energy hub (4COM, 2023).

**Technical / engineering**
The former hub manager states that transmission congestion is the primary driving factor that significantly impacts the built environment, housing, businesses, and the overall energy system (4HUB, 2023).

**Social / managerial**
According to the project leader, "we are currently in a sort of perfect storm where businesses are willing to change, but they do so for only two reasons, as do individuals: either there is a sense of urgency or there is passion". Passion drives the desire to be energy neutral, regardless of cost implications, while urgency arises from net congestion or high energy prices. Additionally, there is currently a scarcity of land, adding to the complexity of the situation (4MUN, 2023).

The desire for autonomy and control over one's own energy supply is emphasized, with the aim of reducing dependence on countries like Russia (4HUB, 2023), (4COM, 2023).

According to the former hub manager, businesses perceive the possibility to transition towards a more sustainable business as a stimulating factor for joining energy cooperation initiatives (4HUB, 2023).

Furthermore it is stated that there is a growing consensus that the energy system will become increasingly decentralized. Many individuals and experts believe that the future of energy will involve a shift towards a more localized and distributed model (4HUB, 2023).

**Policy**
Due to the mandatory installation of solar panels on the business park, companies are required to invest regardless, making it more attractive to participate in a collective solution or energy hub (4MUN, 2023).

**Surroundings**
Utilizing the waste heat generated by a cold storage facility is also being considered in the current exploratory energy consumption investigation, according to the project leader. The existence of this facility drives the involved stakeholders to think about the possibilities that arise by including the facility into the energy hub (4MUN, 2023).

The existence of two wind turbines in close proximity of the business park is perceived to offer possibilities for the energy hub (4MUN, 2023).

**Safety**
According to the former hub manager, Tom Middendorp (well known military general) emphasizes the importance of energy security and safety being of national interest, stating that "cutting three cables at sea is easier than cutting 10,000 cables on land." (4HUB, 2023).

### A.26.3 Solutions

**Technical / engineering**
Battery systems, coupled with an Energy Management System (EMS) and a trading platform, are seen as a viable solution by the former hub manager. By integrating these systems, it is expected that they can effectively address the challenges posed by grid congestion and fluctuating energy supply and demand (4HUB, 2023).

**Social / managerial**
The respondent also states that solutions that appear obvious, but are currently not possible / allowed, should be listed and be uniformly known around involved stakeholders (4MUN, 2023).

**Legal / regulatory**
According to the project leader, signing an emergency law could be a solution to quickly arrange the formation of group contracts, whereby exchanging contracted capacity becomes possible (4MUN, 2023).

Currently, businesses have a grid connection of a certain capacity, however, this capacity has been concluded for the maximum capacity the business would ever need. In normal operation, used capacity is often much lower, meaning there is unused grid capacity left. According to the project leader, the government or grid operator should redistribute these grid connections, bases on the energy consumption from the past number of years "You are allowed to exceed your newly contracted capacity by a maximum of 40%, but the not-used capacity must be returned to the grid operator." According to the project leader, such decision will solve many problems in one go (4MUN, 2023).

**Policy**
The municipality allocated the plots from the business park contingent upon self-determined conditions. Such policy is presented as a solution to achieve the desired sustainability level on the business park (4MUN, 2023).

Furthermore, to accelerate energy cooperation on business parks, the government should take decisive actions and assume a more leading role, allowing for the exchange of energy between parties (4MUN, 2023).

**Organisation**
According to the project leader, the return on investment could be increased by establishing favorable pricing agreements among the participants, surpassing the rates offered by energy suppliers for energy feed-in to the grid. Also, through these mutually beneficial arrangements, a higher degree of predictability is integrated into the business operations. This predictability empowers the stakeholders to make informed decisions based on reliable expectations and optimize their outcomes (4MUN, 2023).

The municipality is considering the establishment of a development agency to ensure the implementation of the Energy Hub. Subsequently, an exploitation agency would be set up to handle the exploitation on behalf of the businesses. Companies would contribute assets to the energy hub, which would entail a corresponding compensation. For instance, a truck charging station would be a customer of the exploitation agency. This could be a viable organizational structure

according to the project leader (4MUN, 2023).

## A.27 Factors sorted by phase

| **Barriers** | | | |
|---|---|---|---|
| Not heard of development of energy hubs | S | I | S1 |
| Gaining organisational rate on non-organised park is difficult | G | I | S1 |
| Insufficient rate of organisation present (general) | G | I | S1 |
| Businesses overestimate their ability to tackle congestion challenges independently (COLL, 2023). | G | I | S1 |
| Businesses are left to handle energy cooperation on their own due to a gap in responsibility (COLL, 2023). | G | I | S1 |
| There is a responsibility gap at multiple levels, causing a lack of progress (PVB, 2023). | G | I/E | S1 |
| Municipality policy on ET mainly focused on built environment | S | E | S1 |
| Counterproductive national energy policy | G | E | S1 |
| Static and fixed policy from national government | G | E | S1 |
| Different governmental levels responsible for businesses | G | E | S1 |
| Unchanged governmental grid operation policy | G | E | S1 |
| The state of the transmission grid partly obstructs energy cooperation (PVB, 2023). | G | E | S1 |
| Upgrading the grid to solve congestion issues would significantly increase tariffs (GRID, 2023). | G | E | S1 |
| Expanding the grid requires substantial funding, time, and space which is hard to acquire (GRID, 2023). | G | E | S1 |
| There is a risk of overlapping efforts among provincial initiatives (PROV, 2023). | G | E | S1 |
| **Drivers** | | | |
| The presence of an organisational grade is crucial for the development of energy cooperation (PROV, 2023). | G | I | S1 |
| Perfect storm exists for EC to be developed | G | E | S1 |
| **Solutions** | | | |
| Sustainable municipal plot allocation policy | G | I | S1 |

Figure A.14: All factors mentioned during the interviews for phase S1, distributed along the main categories, with corresponding sub categories indicated as well. Bold means mentioned 2 times or more.

| | | | |
|---|---|---|---|
| **Barriers** | | | |
| Smaller businesses avoid responsibility for ET, see energy as utility service | G | I | A1 |
| Lack of realisation that collective approach can achieve more | G | I | A1 |
| Businesses overlook the impact of congestion | G | I | A1 |
| Businesses struggle with understanding and complying with government regulations (PVB, 2023). | G | I | A1 |
| Park Managers often lack the necessary knowledge and experience for effective energy cooperation development (PVB, 2023). | G | I/E | A1 |
| Differences exist between the priorities of municipalities and individual businesses (COLL, 2023). | G | I/E | A1 |
| Conveying long-term cost-effectiveness of EC is difficult | G | I/E | A1 |
| Province's individual business focused policy is ineffective | S | E | A1 |
| Interactions between municipalities/provinces and businesses are limited (COLL, 2023). | G | E | A1 |
| Many municipalities lack knowledge and understanding of energy cooperation and grid congestion issues (PVB, 2023). | G | E | A1 |
| **Drivers** | | | |
| Being less dependend on energy suppliers | S | I | A1 |
| Well-defined municipality vision for coming 10 years | S | I | A1 |
| The pioneering role of several large companies in the energy transition leads stimulates other companies on the businesspark (COLL, 2023). | S | I | A1 |
| **Economic advantages due collective approach** | G | I | A1 |
| Local energy flows keeps economic flows local | G | I | A1 |
| No grid connection avaiilable, influence on business | G | I | A1 |
| Compensation for grid connection sharing | G | I | A1 |
| Collective approach achieves more then individual approach | G | I | A1 |
| **Available energy existent from neighbours** | G | I | A1 |
| Reliability and and availability of energy | G | I | A1 |
| Entrepreneurs aim to reduce costs and overcome barriers to expanding their current grid connection by participating in energy cooperation (COLL, 2023). | G | I | A1 |
| The drive for the energy transition and energy cooperation is significant in Overijssel (PVB, 2023). | G | I | A1 |
| There's an increased understanding and urgency among businesses about energy transition, despite the uncertainty about the proper actions to take (PVB, 2023). | G | I | A1 |
| Concensus that energy system will become decentralized | G | I/E | A1 |
| Increased safety due to decentralized infrastructure | G | I/E | A1 |
| Regulations / work descriptions from industry association | S | E | A1 |
| **Nearby energy generation (solar field)** | S | E | A1 |
| Negative economic consequences of transmission congestion | G | E | A1 |
| Current height of energy prices | G | E | A1 |
| Influence of transmission congestion on business | G | E | A1 |
| Possibility to shift towards sustainable way of business | G | E | A1 |
| **Energy Conversvation Obligation** | G | E | A1 |
| **Label-C obligation** | G | E | A1 |
| **Letter written by Ministry of EZK** | G | E | A1 |
| Independence from energy suppliers and energy prices | G | E | A1 |
| Entrepreneurs appreciate Sprint Sessions initiated by the province for the opportunity to engage with stakeholders and discuss energy challenges and opportunities (PROV, 2023). | G | E | A1 |
| CES 6 companies' success stories in energy transition motivate other businesses to pursue sustainability (PROV, 2023). | G | E | A1 |
| Individual legislations for businesses can stimulate collaboration and joint initiatives (PROV, 2023). | G | E | A1 |
| Laws and regulations drive businesses to take action, such as participating in an energy cooperative (COLL, 2023). | G | E | A1 |
| Landlords are increasingly setting requirements for certifications for their buildings, driving business owners to take necessary actions to achieve such labels (COLL, 2023). | G | E | A1 |
| A letter written by the Minister of Economic Affairs and Climat to all businesses of the Netherlands is perceived stimulating (PROV, 2023). | G | E | A1 |
| The prohibition of diesel or fossil fuel-powered delivery vans within the inner city ring by 2025 forces entrepreneurs to transition to alternative options (COLL, 2023). | G | E | A1 |
| Subsidies become available once an organized entity has been established, emphasizing the importance of formal structure (COLL, 2023). | G | E | A1 |
| The sharing of knowledge by energy cooperative ECUB on establishing an energy cooperative, through a publicly available handbook, accelerates the cooperative development process (COLL, 2023). | G | E | A1 |
| **Solutions** | | | |
| Importance of having a company that can persuade others, take the lead, and align others with its vision (PROV, 2023). | G | I | A1 |
| Make significant impact on businesses in their core business for quick achievements (PROV, 2023). | G | I | A1 |
| Implementation of sprint sessions across the Netherlands to bring together stakeholders and address problems (PVB, 2023). | G | I/E | A1 |
| Government obligation to invest in renewable generation | G | E | A1 |
| Firm decisions made by municipalities, such as shutting off gas supply in specific areas (PROV, 2023). | G | E | A1 |
| Increasing cost of energy prompts businesses to reconsider their consumption patterns and seek efficient alternatives (PROV, 2023). | G | E | A1 |
| The possibility of regulations enabling municipalities to require installation of solar panels on existing buildings is highlighted (PROV, 2023). | G | E | A1 |
| Leading role of national government | G | E | A1 |

Figure A.15: All factors mentioned during the interviews for phase A1, distributed along the main categories, with corresponding sub categories indicated as well. Bold means mentioned 2 times or more.

| **Barriers** | | | |
|---|---|---|---|
| Businesspark has no long-term vision | S | I | S2 |
| Ego-centricity of companies regarding energy supply | S | I | S2 |
| Presence of large companies w.r.t. vertical organization | S | I | S2 |
| Lack of realisation that neighbours influence own energy supply in collective | S | I | S2 |
| Participating in SEH perceived to cost money | G | I | S2 |
| Expectation that grid connection is worth money | G | I | S2 |
| Internal focus of companies | G | I | S2 |
| Excessive demands from businesses hinders desired outcomes | G | I | S2 |
| Lack of realisation collective approach is cheaper | G | I | S2 |
| Lack of sustainability awareness and finaincial-only motivations among business owners affects participation in energy cooperation (COLL, 2023). | G | I | S2 |
| Responsibility gap regarding energy transition on BP | S | I/E | S2 |
| Not investing due to competitive reasons | S | E | S2 |
| Passive role of municipality | S | E | S2 |
| Non-efficient, timeconsuming meetings organised by municipality | S | E | S2 |
| **Short duration of employment municipality** | S | E | S2 |
| **Central decision-making by headquarters of company** | S | E | S2 |
| **Drivers** | | | |
| Companies are willing to cooperate | S | I | S2 |
| Local-generation-local-consumption vision from PM | S | I | S2 |
| Vision-allighment PM and large companies | S | I | S2 |
| Mandatory installation of solar panels | S | I | S2 |
| Well-organized structure is present on BP | S | I | S2 |
| Mandatory organizational structure (BIZ) | G | I | S2 |
| Existence of organizational structure on BP | G | I | S2 |
| Businesses have shown increased interest in participating in sustainable energy initiatives due to the economic effect of geopolitical events and energy crises (PROV, 2023). | G | I | S2 |
| A Business Investment Zone (BIZ) encourages collective decision-making and collaboration among businesses (PROV, 2023). | G | I | S2 |
| The commitment agreement of energy cooperative Marslanden members to implement sustainable measures drives business owners to contribute to the cooperative (COLL, 2023). | G | I | S2 |
| Signed intention statement between municipality and businesspark | S | I/E | S2 |
| Self-sufficiency of BP could eliminate energy bills headquarters | S | E | S2 |
| ET on BP supports municipality sustainability goals | S | E | S2 |
| Positive attitude province and OostNL towards support of BP | S | E | S2 |
| Collective effort boosts likelihood of success in solving congestion | G | E | S2 |
| Desire for autonomy and control over own energy supply | G | E | S2 |
| **Solutions** | | | |
| Networking events are most effective, more attendees | S | I | S2 |
| Importance of business parks developing clear plans for the coming 5 to 6 years to assist with Enexis' planning and implementation of infrastructural changes (GRID, 2023). | G | I | S2 |
| Bottum-up municipal facilitation of existing initiatives | G | E | S2 |
| Local collective initiative support by province | G | E | S2 |

Figure A.16: All factors mentioned during the interviews for phase S2, distributed along the main categories, with corresponding sub categories indicated as well. Bold means mentioned 2 times or more.

| **Barriers** | | | |
|---|---|---|---|
| Membership fee from businessclub insufficient to account for EC development | S | I | A2 |
| Roof structure insufficiently strong | S | I | A2 |
| Limited company motivation to analyse consumption data themselves | S | I | A2 |
| Size-diversity of companies (difficult involving small companies) | S | I | A2 |
| Not all businesses familiar with stage of hub development | S | I | A2 |
| Existence of responsibility and ownership gap | G | I | A2 |
| Providing false subsidies by OostNL and EFO | S | E | A2 |
| Too much resources spent on research by municipality | S | E | A2 |
| Nearby energy generation (solar park), diminishes available grid capacity | S | E | A2 |
| GDPR obstructs accesability of needed energy consumption data | G | E | A2 |
| Lack of guides for development of energy hub | G | E | A2 |
| The process of obtaining subsidies from the province can be lengthy and time-consuming (COLL, 2023). | G | E | A2 |
| A lack of independent knowledge hinders energy cooperation (PVB, 2023). | G | E | A2 |
| **Drivers** | | | |
| Large companies are independent and pro-active | S | I | A2 |
| Businessclub avoids reinventing the wheel, seeks support where needed | S | I | A2 |
| **Solutions** | | | |
| Additional allocation of resources by businessclub to reimburse worked hours | S | I | A2 |
| Relieve small businesses with early-stage tasks for EC development | S | I | A2 |
| Have extra resources and expertise within businessclub | S | I | A2 |
| Not burdening small companies with long-term challenges | G | I | A2 |
| Importance of aiding businesses with minimal effect on their operations, providing resources, knowledge, and manpower (PVB, 2023). | G | I | A2 |
| Receive help of consultant with prior experience in EC development | S | E | A2 |
| Presentation of expert, sharing challenges and how to deal with them | S | E | A2 |
| Decicated municipality contact for businesses, to build trust | G | E | A2 |
| Requirement for robust tooling to provide information on subsidy opportunities and connect businesses with relevant parties for conducting analyses and implementation (PVB, 2023). | G | E | A2 |

Figure A.17: All factors mentioned during the interviews for phase A2, distributed along the main categories, with corresponding sub categories indicated as well. Bold means mentioned 2 times or more.

| Barriers | | | |
|---|---|---|---|
| Fear for fire safety of solar panels | S | I | S3 |
| **Knowledge gaps in technological possibilities and costs** | S | I | S3 |
| **Knowledge gaps in laws and regulations around EC** | S | I | S3 |
| | | | |
| Energy cooperation is new for parkmanager, choosing between gatherings is difficult | S | I | S3 |
| | | | |
| | | | |
| Knowledge gaps on effective EC agreements | S | I | S3 |
| Vulnerability of business processes to technical malfunctions | G | I | S3 |
| Scarce availabilty of space for battery placement | G | I | S3 |
| Centrally organized battery storage is vulnerable | G | I | S3 |
| Smaller enterprises may be reluctant to bear the expenses of establishing private networks (GRID, 2023). | G | I | S3 |
| Businesses lack understanding about closed energy systems and pricing (GRID, 2023). | G | I | S3 |
| Implementing a "direct line solution" is challenging due to issues of grid connection and integration (GRID, 2023). | G | I/E | S3 |
| Installation of numerous substations for business park electrification is space-demanding (GRID, 2023). | G | I/E | S3 |
| Battery placement for energy storage requires substantial space (GRID, 2023). | G | I/E | S3 |
| Difficult to come to concrete action with local grid operator | S | E | S3 |
| Inflexibility of local grid operator | S | E | S3 |
| Municipality is restrictive in performing actions | S | E | S3 |
| Local grid operator unwilling to approve additional pilot-space | S | E | S3 |
| Incapability of transmission grid to handle energy exhanges | G | E | S3 |
| Scarce availability of valid energy trading platforms | G | E | S3 |
| **Direct sales of energy between parties not allowed without permit** | G | E | S3 |
| Socialization of grid costs makes revenue models complex | G | E | S3 |
| Energy Law, does not allow technical possibilities | G | E | S3 |
| Not allowed to operate without energy energy supplier | G | E | S3 |
| Elusiveness of Tennet | G | E | S3 |
| Developing effective and efficient financing policy is difficult | G | E | S3 |
| Organisation of accountability in energy hub is difficult, who is accountable? | G | E | S3 |
| The Energy Tax on energy exchanges hinders energy cooperation (PVB, 2023). | G | E | S3 |
| Differences in grid connections for small and large businesses complicate energy cooperation (PVB, 2023). | G | E | S3 |
| Uncertainty and ignorance from the province project leader about revenue models for energy cooperation (PROV, 2023). | G | E | S3 |
| **Drivers** | | | |
| Controllable energy source in form of (wastemanagement) company existent on park | S | I | S3 |
| Presence of frontrunners with expertise and local know-how | S | I | S3 |
| The collaboration from Hessenpoort with Invest NL on developing contract structures for Smart Energy Hubs (PVB, 2023). | S | I/E | S3 |
| Bottom-up support policy from municipality | S | E | S3 |
| Feeding-back energy not possible for large-scale connections | G | E | S3 |
| **Solutions** | | | |
| Electricity storage solution for intermittency of ren. energy | G | I | S3 |
| Large diesel generators to cope with malfunctions | G | I | S3 |
| Battery system coupled with EMS and trading platform | G | I | S3 |
| Educate companies on smart and efficient consumption | G | I | S3 |
| Battery with own legal entity | G | I | S3 |
| Efficient infrastructure utilization by influencing behaviour | G | I | S3 |
| Set-up of development and exploitation agencies | G | I | S3 |
| Agree on favorable pricing to increase ROI | G | I | S3 |
| An automated system that facilitates the exchange and financial settlement of energy transactions (PROV, 2023). | G | I | S3 |
| A private network outside the traditional grid, though complete disconnection is deemed impractical (GRID, 2023). | G | I | S3 |
| A single connection (group contract), such as operational at Schiphol Tradepark and Hessenpoort (pilot) (GRID, 2023). | G | I | S3 |
| A "direct line" behind the meter with an exemption from the ACM (GRID, 2023). | G | I | S3 |
| Combining multiple small-scale connections as a viable solution to enable energy backfeeding (GRID, 2023). | G | I | S3 |
| BP being part of larg energy landscape | S | I/E | S3 |
| Collective approach in solving complex problems on BPs | S | I/E | S3 |
| Cable pooling | G | I/E | S3 |
| Ensure stakeholders are aware of all obvious solutions | G | I/E | S3 |
| Establishment of clear agreements on business park grid connections and balancing of consumption and production, whereby Enexis always can cut the capacity in emergency situations (PVB, 2023). | G | I/E | S3 |
| Emergency law to enable group contracts | G | E | S3 |
| Governmental redistribution of grid connection capacity | G | E | S3 |
| Tax reductions for producer and user of energy exchange | G | E | S3 |
| Development of conditional consumption capacity contracts for commercial battery operators by Enexis (GRID, 2023). | G | E | S3 |

Figure A.18: All factors mentioned during the interviews for phase S3, distributed along the main categories, with corresponding sub categories indicated as well. Bold means mentioned 2 times or more.

| **Barriers** | | | |
|---|---|---|---|
| Lack of signed confirmation to embark on project | S | I | A3 |
| Legal coordination of cable pooling is complicated due to multiple owners and foreign entities (GRID, 2023). | G | I/E | A3 |
| Government policies often cause surprises and financial challenges for businesses with SDE subsidies (PVB, 2023). | G | I/E | A3 |
| No commitment and engagement from municipality after session | S | E | A3 |
| Cumbersome implementation of group contracts by Enexis | S | E | A3 |
| High cost of electricity storage batteries | G | E | A3 |
| No subsidies available for system innovations | G | E | A3 |
| Technical changes to electricity grid are difficult | G | E | A3 |
| Didam-arrest: gov not being able to directly award contracts to single party | G | E | A3 |
| Obtaining subsidies for non-technical innovations is challenging | G | E | A3 |
| Uncertainty regarding energy market and effect on feed-in tarrif | G | E | A3 |
| Unclear where knowledge for project realisation should come from | G | E | A3 |
| Personell shortage of energy suppliers | G | E | A3 |
| **Drivers** | | | |
| Pragmatic approach from grid operator | S | E | A3 |
| **Solutions** | | | |
| Simple decision-making model for EMS and capacity exhange | G | I | A3 |
| Capable people able to realise and implement made plans | G | I/E | A3 |

Figure A.19: All factors mentioned during the interviews for phase A3, distributed along the main categories, with corresponding sub categories indicated as well. Bold means mentioned 2 times or more.

| **Barriers** | | | |
|---|---|---|---|
| Developing agreements during development is time-consuming | S | I/E | ALL |
| Lack of holistic, entrepreneurial thinking persistent people | G | E | ALL |
| **Drivers** | | | |
| Proactivity and ownership from businessclub and working group | S | I | ALL |
| Businessclub, businesses and PM can act quickly due to strong relationship | S | I | ALL |
| Limited number stakeholders for decision-making | S | I/E | All |
| External interest and support | S | E | ALL |
| ET on BP supports municipality sustainability goals | S | E | ALL |
| **Solutions** | | | |
| Addressing issues at the appropriate level (PVB, 2023). | G | I/E | ALL |
| Bottom-up approach is considered the best way to support the energy transition on business parks (PVB, 2023). | G | I/E | ALL |
| Smart utilization of the transmission grid to reduce societal costs (GRID, 2023). | G | I/E | ALL |
| Compromise on privacy, energy data known per building | G | E | ALL |

Figure A.20: All factors mentioned during the interviews that apply to all phases, distributed along the main categories, with corresponding sub categories indicated as well. Bold means mentioned 2 times or more.

## A.28 Statements on business models / legal energy cooperation contracts

This appendix houses statements made by respondents about a possible business model or legal contract. For the expert interviews and per case, these statements are presented.

### A.28.1 Expert interviews

It is indicated by the project leader that in the case of multiple companies sharing a connection through a group contract with the grid operator, the grid operator should have the authority to completely disconnect the connection if the capacity is exceeded, in order to safeguard the electricity grid (PVB, 2023).

According to the respondent, if the feed-in tariff for exporting energy to the grid is 2 cents, it should be set at 3 cents when supplying it to your neighbor within a business park. Charging stations should also be included in this context. It is crucial to ensure that everyone can understand the process clearly (PROV, 2023).

### A.28.2 Groot Verlaat

The interviewed participants were asked if they had ever thought about a possible business model for energy cooperation, and if yes, how this model would be composed.

One company has considered a revenue model among different businesses, where the producer would receive compensation for supplying energy to a neighbor during times when they do not need it, creating a win-win situation. Another possibility is supplying the generated energy to public locations such as a large charging station or a battery. The flexible utilization of consumption is also mentioned, where certain business processes are delayed or advanced to meet the variable energy supply. Though, the electricity price received for the produced energy should align with market rates to ensure the viability of the business case for investing in sustainable measures. For the company, the payback period targeted for sustainable investments is 5 to 6 years (1COM.A,2023).

### A.28.3 Twentekanaal

The recycling company has already thought about potential revenue models that involve energy exchange between different businesses, wherein the producer would receive compensation for supplying energy to a neighboring company during times when they do not require it, creating a mutually beneficial arrangement. Another possibility considered is supplying the produced energy to public locations such as a charging station or a future battery storage facility. Additionally, there is mention of flexible consumption management, whereby certain business processes can be delayed or advanced to align with the variable energy supply. A colleague adds that the electricity price should align with market rates for the business case of investing in sustainable measures to be financially viable. The anticipated payback period for sustainable investments is set at around 5 to 6 years.

According to the municipality, specific businessmodels for energy trading or exhanging between multiple entities do not yet exist. The park manager adds that there is currently no consideration of revenue models, as it is still too early in the process of energy cooperation.

Incorporating the reduction in grid reinforcement investments into the revenue model- due to realisation of smart energy cooperation solutions - is difficult according the municipality employee. This is because the costs of the electricity grid are socialized. It is challenging to include this aspect fairly in the revenue model from one business park without disadvantaging realized projects in the region/nation. Although it could be feasible, it would require applying such an approach throughout the entire service area of the local grid operator (2MUN, 2023).

The director from the recycling business is not in favor of establishing a specific contract between two entrepreneurs, as it is believed to be legally challenging. Instead, it is suggested to have a general legal framework.

The municipality employee suggests that in the future, when energy cooperation is operational on the business park, companies must be aligned with a certain energy profile, meaning that when a company leaves, only a new company that fits within that energy profile is allowed to locate on the business park.

### A.28.4 Hessenpoort

The CEO emphasizes the importance of creating a collective space on the grid, rather than viewing it as a profit-driven endeavor. The respondent believes that an individualistic approach is insufficient and that facilitating the progress of others is key. The focus should be on providing room for others to make significant advancements. Furthermore, the

respondent suggests that charging fees for exchanging energy or capacity is not appropriate (3COM.B, 2023).

The CEO states that even though companies may desire financial compensation for energy exchanges, the amounts involved would not significantly impact their operations. For companies, the main focus should be on the ability to individually supply and meet their own energy needs through energy generation. Generating income by selling excess energy should be a secondary concern (3COM.B, 2023).

#### A.28.5 A1 Bedrijvenpark

According to the project leader, it is important to consider the accountability aspect of a business model / contract is very important, in case the energy hub does not function as intended. It should be clear who is accountable for certain types of losses. Furthermore, a valuable feature to embed into the model would be to agree collectively on better prices for energy feed-in (when exhanging energy) than those currently offered by the grid. With such agreement, companies can increase their investment returns and it allows for greater predictability in business operations, compared to being dependent on the tariffs of energy suppliers. This empowers the stakeholders to make informed decisions based on reliable expectations and optimize their outcomes. Additionally, the project leader and hub manager highlight the feature to have flexible entry and exit policies in place, considering the situation that businesses leave the park or new businesses join. "You must ensure that the next business joining the hub should not receive the least favorable deal." (4HUB, 2023). However, the project leader indicates that one can ensure that businesses face consequences if they choose not to participate actively anymore, to protect the operational hub (4MUN, 2023).

##### A.28.5.1 Conditional features / assumptions

The respondents highlighted conditional features for joining an energy cooperation initiative. Also, important assumptions were mentioned that significantly influence the outcome of certain events. These conditional features and assumptions are listed below in order to provide input for additional solutions and context, respectively.

**Conditional features**

- The business owner would be willing to cover their remaining roof space to assist other businesses, contingent upon there is compensation involved (4COM, 2023).
- Furthermore, the business owner finds that when feeding-back energy to the energy hub, the compensation tariff should exceed the current tariff they receive from the energy supplying company (11 cents) (4COM, 2023).
- In terms of sharing data, the business owner would be willing to share their energy consumption data only if the tariff rates are not included (4COM, 2023).
- The project leader states that in order to have a business case to produce hydrogen, the business park should have a large structural surplus of energy. The existence of such surplus is dependent on the companies that will establish themselves on the business park (4MUN, 2023).
- The word "pilot" should be used carefully, according to the project leader. "You cannot ask companies to invest and then call it a pilot" (4COM, 2023).
- According to the grid operator, it is easier to make agreements regarding energy exchange with businesses connected to the same "string", rather than between different strings. It is possible, but it becomes more complex. "Your neighbour could not simply be your neighbour on the grid, it may not be logically connected." (4HUB, 2023).

**Assumptions**

- The business owner in the plastics industry expects that battery storage can provide weeks of electricity.
- The municipal project leader and colleagues at the municipality assume that transmission congestion is temporary problem and this problem is solved around 2030. When constructing business cases, this assumption is used.

### A.29 Concrete actions for EC implementation acceleration

This appendix shows concrete actions that respondents proposed for the acceleration of energy cooperation implementation on business parks. Respondents were asked to propose concrete actions during the interviews.

#### A.29.1 Expert interviews

All the respondents from the generic part were asked to provide concrete actions for the coming years, that should be performed to accelerate the implementation of energy cooperation on business parks. The bullet points below list all the actions, sorted from early EC phases to later EC phases.

- Establish an organisational grade or improve it when already existent. When there is no organisational grade yet "Just start!" (COLL, 2023).

- It is crucial to have a clear picture of the problem before taking action (PVB, 2023).
- It is important to identify the challenges and concerns faced by entrepreneurs (PVB, 2023).
- Before solving energy related problems on business parks, the foundational aspects of the business park should be adressed (PVB, 2023).
- According to the project leader from PVB, providing assistance to businesses and focusing on their operational needs is crucial. By offering resources, knowledge, and support, a favorable business case can be developed, motivating entrepreneurs to make investments, ultimately enabling a phased withdrawal PVB, 2023).
- The utilization of suitable tools that can steer businesses in the right direction is deemed necesary. These tools should provide information on subsidy opportunities and help establish connections with relevant parties who can offer solutions for specific problems (PVB, 2023).
- Creating a sense of urgency among entrepreneurs is crucial, as emphasized by the respondent (PROV, 2023).
- Data sharing is essential for obtaining insights into energy consumption and assessing the available space on the transmission grid. Guidance from experts with relevant knowledge in this area is required (PROV, 2023).
- A dedicated project leader should be responsible for guiding businesses and preparing actionable decisions, as many businesses may not have the time to do so themselves (PROV, 2023).
- It is needed to assess the possibilities of implementing solutions "behind the meter" while avoiding the complexities of becoming an energy supplier (PROV, 2023).
- After having investigated various possibilities, it is essential to seek input from Enexis to determine the feasibility of the proposed initiatives (PROV, 2023), (COLL, 2023).

#### A.29.2 Groot Verlaat

The respondents were asked what concrete actions should be undertaken in the coming years to acccelerate the implementation of energy cooperation on the business park. The park manager had a more short-term focus for the action points, due to the believe that the results from the energy consumption analysis should be first be known, before any further actions can be planned. The different actions points given by the respondents have been arranged in chronological order based on the phase of energy cooperation.

- Provide support and assistance to small businesses, as they may not have the resources or knowledge to engage in energy cooperation initiatives. Show them a compelling case that demonstrates the potential benefits they can gain from participating, as expecting them to delve into the topic themselves is said to be non-feasible (1COM.A, 2023).
- Obtain insights from consumption data and aim to provide recommendations or suggestions for outsourcing before the august 2023 (1PM, 2023).
- Make a decision regarding the recommendations or suggestions from the energy consumption analysis (1PM, 2023).
- Provide feedback and communicate the outcomes of the analysis to the companies involved (1PM, 2023).
- Collaboratively decide on what projects to start and proceed accordingly (1PM, 2023).
- The business club should develop a comprehensive plan, outlining the necessary steps and actions for energy cooperation on the business park (1COM.A, 2023).
- Search for an advisory firm with prior experience in the field, who can provide guiding with carrying out the plan (1COM.B, 2023).
- Designate a representative from the municipality to take responsibility for the business park and actively promote the detailed plan of the business club to non-member companies. This can be done through personal visits, presenting a compelling and clear narrative that highlights the benefits and opportunities of the plan (1COM.A, 2023).
- The park manager aims to have clarity on the chosen approach by the end of this year (1PM, 2023).
- Engage with the local grid operator to ensure their involvement and cooperation (1COM.A, 2023).

#### A.29.3 Twentekanaal

The respondents were asked what concrete actions should be undertaken in the coming years to acccelerate the implementation of energy cooperation on the business park. According to the park manager, currently there exists no concrete action plan for the coming years. The outcomes of the energy consumption analysis should be known first, before any concrete plans can be made. However, the respondents have proposed actions that they believed would accelerate energy cooperation implementation, which are listed below.

- Working group needs to attract more companies (2MUN,2023), (2PM, 2023).
- Working groups need to be streamlined: the capabilities available from different participants should be utilized more efficiently and effectively (2MUN, 2023).
- More companies should become members of the business club (2MUN, 2023).
- Companies that are not members or do not want to become members of the business club should be included as well in the energy cooperation initiative (2MUN,2023).
- Maximize the localization of the energy system: produce and consume locally (2MUN, 2023).
- Develop concrete plans and then engage with the municipality and grid operator to determine the feasibility and implementation approach of those plans (2PM, 2023).

- Align with a major player like Nobian, as their significant energy consumption can have an impact on the entire business park (2PM, 2023).
- Technical aspects: grid reinforcement, battery storage, and increased energy production from solar and/or wind (2MUN, 2023)

#### A.29.4 Hessenpoort

The respondents were asked what concrete actions should be undertaken in the coming years to acccelerate the implementation of energy cooperation on the business park. The CEO and the project leader kept the actions more general, for less organized business parks. The actions points are listed in a chronological way, starting from the very beginning, transitioning to later phases of energy cooperation.

- The first step is to establish a strong and unified business community on the business park, preferably through a business club, to facilitate communication and collaboration among businesses. This would streamline interactions with entities like Enexis and avoid excessive individual engagement (3COM.B, 2023).
- Gain a clear understanding of the sustainability ambitions and energy-related challenges of individual businesses on the park, and identify ways to assist them. Have a comprehensive overview of their ambitions for the coming years (3MUN, 2023).
- Conduct an assessment of the current and future energy consumption within the area to determine the current energy flows. **Understand the energy needs and generation potential, including practical consumption profiles that may differ from theoretical ones**. Strive to bridge the gap between meso and micro levels, especially within the identified electricity network hub (3MUN, 2023).
- The municipality should take a proactive role in initiating and facilitating cooperation between businesses. This can be done through regular consultations with businesses, preferably in collaboration with the business club (3COM.B, 2023).
- Ensure the presence of a well-functioning and active business club with the necessary willingness, time, and expertise to drive energy cooperation initiatives. If the club lacks these aspects, consider using public funds to hire an external project leader who can involve all stakeholders within the collaboration (3COM.B, 2023).
- Prioritize the inclusion of businesses in energy initiatives based on network congestion rather than financial considerations. Emphasize the urgency of the problem, highlighting that any company may face difficulties in obtaining new connections. Clearly explain the shared problem and its implications (3COM.B, 2023).
- Focus on engaging and collaborating with large energy consumers on the business park (3MUN, 2023).
- Focus on investing time and attention in businesses that are willing to participate actively. It is important to prioritize those who are interested and committed while avoiding unnecessary energy expenditure on businesses that are not interested or engaged (3COM.B, 2023).
- Map out the future energy usage and expected growth, considering not only electricity but also exploring other possibilities for energy exchange. Use this information to guide government policies and interventions (3MUN, 2023).

#### A.29.5 A1 Bedrijvenpark

The respondents were asked what concrete actions should be undertaken in the coming years to accelerate the implementation of energy cooperation on the business park. The CEO and the project leader kept the actions more general, for less organized business parks. The actions points are listed in a chronological way, from earlier to later stages of energy cooperation.

- According to the project leader, the only was to accelerate energy cooperation on business parks is to "collaborate" (4MUN, 2023).
- Conduct a legal analysis to determine the legal framework and requirements for the energy hub (4MUN, 2023).
- Engage in public discussions and consider the societal impact of energy hub, solving societal problems and creating societal benefits (4MUN, 2023).
- Conduct a financial analysis to determine the financial aspects and funding options for energy hubs (4MUN, 2023).
- Undertake technical research to evaluate the technical aspects and requirements of energy hubs (4MUN, 2023).
- Make joining the energy hub attractive for businesses, by constructing a "good marketing plan, because everyone is very busy". This plan must show there exist economic benefits of joining, by showing advantages from an energy consuming perspective and energy producing perspective (4COM, 2023).

### A.30 Requirements for direct line establishment (ACM, 2023b)

## 1. Ownership and Management:

- Prove ownership of the connections/pipelines. You can:
  - Provide an extract from the Kadaster (land registry in the Netherlands) showing you're registered as the owner.

  - If not registered as the owner, justify that you're the 'authorized installer'.
  - If you can't prove ownership, justify that you're the operator or manager of the grid.
- You must not be a formal grid operator as per the Electricity or Gas Act.
- You must not be part of a group of legal entities that includes a grid operator.

### 2. Location Requirements:

- The grid must be within a geographically defined industrial, commercial location, or a location with shared services.
- Provide a description of this geographic demarcation.

### 3. Customer Base Details:

- Provide an overview of all parties that are connected to the grid.
- Identify the connected parties as 'consumers', determined based on copies of municipal decisions on property tax (OZB decision).

### 4. Legislative Compliance:

- Your grid must not be part of the national gas transport network or the national high-voltage network.
- Meet one of the following conditions:
  - The business or production process of the users of your grid is integrated for specific technical or safety reasons.
  - You transport electricity or gas primarily for yourself as the owner or for companies related to you.

### 5. Safety and Quality Assurance:

- Describe how you can guarantee safety and quality on the grid. Provide the following documents:
  - Safety policy
  - Emergency plan
  - Maintenance plan
  - Outage plan
  - Policy on replacement and expansion investments in the grid (or a description thereof)

### 6. Direct Line-Specific Requirements:

- Prove that you are the owner of a direct line.
- You must be a producer of electricity or gas.
- Demonstrate that as a legal entity, you are involved in the generation of electricity or gas, evident from your statutes or the registration in the Chamber of Commerce.
- Your direct line must be connected to a network or another connection or pipeline for the transport of electricity or gas via the installation of one connected party at most.
- Your production installation must be directly connected to the consumer, not via a transformer.
- As a producer, you must supply the consumers of electricity or gas. Prove this by submitting a supply agreement and invoices from the last four months sent to consumers.
- Prove that primarily non-domestic consumers use your direct line.

## A.31 Used input for development of energy cooperation method

First, the mentioned drivers will be listed, acting as a sort of conditions and motivators for successful energy cooperation. If the business park meets these drivers / conditions, the likelihood of succesful EC implementation is higher. If a business park does not comply to these conditions, it should strive to accomplish those conditions. Some drivers can be used by developers as motivators for businesses to participate in energy cooperation.

Secondly, below the drivers, barriers are presented with corresponding solutions proposed by the researcher. Although the researcher of this thesis does not have multiple years of experience in energy cooperation on business parks, the solution is often implicitly stated inside of the barrier.

Below the combination of solutions and barriers, other solutions / good practices for EC development are listed. These are not particularly relieving a mentioned barrier, but are useful for the implementation of energy cooperation practices on business parks.

If certain factors or solutions are mentioned by multiple interview respondents, this is indicated with a number in parentheses.

### A.31.1 Stage 1

| **Drivers / conditions for succesful EC development** | |
|---|---|
| Perfect storm exists for EC to be developed | |
| The presence of an organisational grade is crucial for the development of energy cooperation | |
| | |
| **Barrier** | **Proposed solution (researcher)** |
| Not heard of development of energy hubs | Tell businesses about energy hub and advantages |
| Too little organisational grade is present and establishing such grade is difficult (2) | Establish organisational grade together with large companies and help of municipaliy / province |
| Businesses overestimate their ability to tackle congestion challenges independently | Bring awareness to businesses that this is not the case |
| Municipality policy on ET mainly focused on built environment | Municipalities should re-evaulate their policy and construct a new one, that even achieves their sustainability goals quicker |
| | |
| **Solutions / good practices for succesful EC development** | |
| Before solving energy related problems on businessparks, the foundational aspects of the businesspark should be adressed | |
| The first step is to establish a strong and unified business community on the business park, preferably through a businessclub, to facilitate communication and collaboration among businesses. Ensure the businessclub has the necessary willingness, time, and expertise to drive energy cooperation initiatives. If the club lacks these aspects, consider using public funds to hire an external project leader who can involve all stakeholders within the collaboration. | |

Figure A.21: Factors and solutions from data collection, including proposed solutions by researcher for Stage 1

### A.31.2 Action 1

| Drivers / conditions for succesful EC development | |
|---|---|
| Cost reductions achieved by collective approach (4) | |
| Feeding-back energy not possible for large-scale connections (4) | |
| Nearby energy generation (solar field) (3) | |
| Current height of energy prices (3) | |
| Negative influence of grid congestion on the economics of businesses (3) | |
| Available energy existent from neighbours (2) | |
| Energy Conversvation Obligation (2) | |
| Label-C obligation (2) | |
| Letter written by Ministry of EZK (2) | |
| Independence of energy suppliers and energy prices (2) | |
| Laws and regulations on individual companies stimulate thinking about EC (2) | |
| Large companies motivate and stimulate other businesses to embark on sustainability practices and to cooperate (2) | |
| Subsidies become available once an organized entity has been established (2) | |
| Well-defined municipality vision for coming 10 years | |
| Local energy flows keeps economic flows local | |
| Collective approach achieves more then individual approach | |
| Reliability and and availability of energy | |
| Entrepreneurs aim to reduce costs and overcome barriers to expanding their current grid connection by participating in energy cooperation | |
| The drive for the energy transition and energy cooperation is significant in Overijssel | |
| There's an increased understanding and urgency among businesses about energy transition, despite the uncertainty about the proper actions to take | |
| Increased safety due to decentralized infrastructure | |
| Entrepreneurs appreciate Sprint Sessions initiated by the province for the opportunity to engage with stakeholders and discuss energy challenges and opportunities | |
| Landlords are increasingly setting requirements for certifications for their buildings, driving business owners to take necessary actions to achieve such labels | |
| The prohibition of diesel or fossil fuel-powered delivery vans within the inner city ring by 2025 forces entrepreneurs to transition to alternative options | |
| The sharing of knowledge by energy cooperative ECUB on establishing an energy cooperative, through a publicly available handbook, accelerates the cooperative development process | |
| | |
| **Barrier** | **Proposed solution (researcher)** |
| Smaller businesses avoid responsibility for ET, see energy as utility service | Create awareness that energy is not a utility service, now and in the future |
| Lack of realisation that collective approach can achieve more | Create awareness that a collective approach is more cost efficient and achieves more than individual |
| Businesses overlook the impact of congestion | Create awareness and create future scenarios for businesses |
| Businesses struggle with understanding and complying with government regulations | Provide advice on regulations, propose possible strategies to cope with these regulations |
| Park Managers often lack the necessary knowledge and experience for effective energy cooperation development | Establish an energy cooperative or hire an individual with expertise specifically focusing on energy cooperation |
| Province's individual business focused policy is ineffective | Province should ceas the individual focused support policy for businesses |
| Interactions between municipalities/provinces and businesses are limited | Municipalities should build firm and long-term relationships with businessparks |
| | |
| **Solutions / good practices for succesful EC development** | |
| Make joining an EC initiative attractive with a compelling case and good marketing plan (2) | |
| Emphasize the urgency of the problem, highlighting that any company may face difficulties in obtaining new connections. Clearly explain the shared problem and its implications (2) | |
| Make significant impact on businesses in their core business for quick achievements | |
| Implementation of sprint sessions across the Netherlands to bring together stakeholders and address problems | |
| Firm decisions made by municipalities, such as shutting off gas supply in specific areas | |
| The possibility of regulations enabling municipalities to require installation of solar panels on existing buildings is highlighted | |
| Designate a representative from the municipality to take responsibility for the business park and actively promote the detailed plan of the businessclub to non-member companies. This can be done through personal visits, pre- senting a compelling and clear narrative that highlights the benefits and opportunities of the plan | |
| The word "pilot" should be used carefully, "You cannot ask companies to invest and then call it a pilot" | |

Figure A.22: Factors and solutions from data collection, including proposed solutions by researcher for Action 1

### A.31.3 Stage 2

| Drivers / conditions for succesful EC development | |
|---|---|
| Signed agreement between parties to collaborate and embark on energy transition (3) | |
| Mandatory membership of parkmanagement with BIZ (2) | |
| Energy transition on BP supports sustainability goals of municipality (2) | |
| Vision-alignment PM and large companies | |
| Mandatory installation of solar panels | |
| Self-sufficiency of BP could eliminate energy bills headquarters | |
| Positive attitude province and OostNL towards support of BP | |
| Collective effort boosts likelihood of success in solving congestion | |
| Desire for autonomy and control over own energy supply | |
| | |
| **Barrier** | **Proposed solution (researcher)** |
| Internal focus of companies, only focused on financial performance of own business (3) | Create awareness that a collective approach achieves more than individual measures |
| Lack of realisation collective approach is cheaper (2) | Create awareness that a collective approach is more cost efficient |
| Businesspark has no long-term vision | Businesspark should create long-term vision |
| Lack of realisation that neighbours influence own energy supply in collective | Create awareness that with energy cooperation, every action of each member influences the other members |
| | |
| Expectation that grid connection is worth money | Create awareness that granting each other space on the grid can be a solution in crisis times, also for businesses that currently don't experience problems |
| Excessive demands from businesses hinders desired outcomes | Ensure that as a parkmanager, municipality or province, not too much operational or time-consuming tasks are demanded. Unburden businesses as much as possible. |
| Non-efficient, timeconsuming meetings organised by municipality | Keep meetings to the point, with only one person of each relevant party present. Non-relevant parties are not welcome, to streamline the process. |
| | |
| **Solutions / good practices for succesful EC development** | |
| Support and facilitation of bottom-up initiatieves are most effective (3) | |
| Collaborate with large company on businesspark to accelerate ET of other businesses (2) | |
| Focus on investing time and attention in businesses that are willing to participate actively. It is important to prior- itize those who are interested and committed while avoiding unnecessary energy expenditure on businesses that are not interested or engaged | |
| Networking events are most effective for gathering many businesses than theme specific gatherings | |
| Importance of business parks developing clear plans for the coming 5 to 6 years to assist with Enexis' planning and implementation of infrastructural changes | |
| The municipality should take a proactive role in initiating and facilitating cooperation between businesses. This can be done through regular consultations with businesses, preferably in collaboration with the business club | |

Figure A.23: Factors and solutions from data collection, including proposed solutions by researcher for Stage 2

### A.31.4 Action 2

| Drivers / conditions for succesful EC development | |
|---|---|
| Large companies are independent and pro-active | |
| Avoid reinventing the wheel , seek support where needed | |
| | |
| **Barrier** | **Proposed solution (researcher)** |
| Membership fee from businessclub insufficient to account for EC development | Additional allocation of resources by businessclub to reimburse worked hours |
| Roof structure insufficiently strong | Reinforce roof |
| Not all businesses familiar with stage of hub development | Ensure every business on the businesspark has access to the current state of energy cooperation |
| Providing false subsidies by OostNL and EFO | Subsidies provided should be clear, without hidden conditions |
| Too much resources spent on research by municipality | Municipality should gain knowledge by experimenting, not by acquiring expensive investigations and reports |
| | |
| **Solutions / good practices for succesful EC development** | |
| Use an external consultant or expert with prior experience in EC to guide process (3) | |
| Ensure the businessclub has enough financial resources to reimburse the development of EC. Could be achieved by increasing membership fee (2) | |
| Do not burden small companies with energy transition challenges, especially in early stages of development. Involve small businesses once clear opportunities are known (2) | |
| Conduct an assessment of the current and future energy consumption within the area to determine the current energy flows. Understand the energy needs and generation potential, including practical consumption profiles that may differ from theoretical ones (2) | |
| Importance of aiding businesses with minimal effect on their operations, providing resources, knowledge, and manpower | |
| Decicated municipality contact for businesses, to build trust | |
| Requirement for robust tooling to provide information on subsidy opportunities and connect businesses with relevant parties for conducting analyses and implementation | |
| Data sharing is essential for obtaining insights into energy consumption and assessing the available space on the transmission grid. Guidance from experts with relevant knowledge in this area is required | |
| A dedicated project leader should be responsible for guiding businesses and preparing actionable decisions, as many businesses may not have the time to do so themselves | |
| Gain a clear understanding of the sustainability ambitions and energy-related challenges of individual businesses on the park, and identify ways to assist them. Have a comprehensive overview of their ambitions for the coming years | |
| In terms of sharing data ensure business owners only have to submit their consumption data, without tarriffs | |

Figure A.24: Factors and solutions from data collection, including proposed solutions by researcher for Action 2

### A.31.5 Stage 3

| Drivers / conditions for succesful EC development | |
|---|---|
| Feeding-back energy not possible for large-scale connections (4) | |
| Controllable energy source in form of (wastemanagement) company | |
| Presence of frontrunners with expertise and local know-how | |
| Invest NL developing contract structures for Smart Energy Hubs | |
| Bottom-up support policy from municipality | |
| | |
| **Barrier** | **Proposed solution (researcher)** |
| Knowledge gaps in laws and regulations around EC (3) | Provide information on the current and anticipated legal environment |
| Knowledge gaps in technological possibilities and costs (2) | Provide information on technical possibilities and corresponding costs |
| Fear for fire safety of solar panels | Place equipment in low-risk configuration, use fire-resistant materials |
| Knowledge gaps on effective EC agreements | Provide information on latest agreement forms, with their (dis)advantages |
| Vulnerability of business processes to technical malfunctions | Install emergency power generators or other safety mechanisms ensuring continuity of business processes |
| Centrally organized battery storage is vulnerable | Have high-level security mechanisms or have decentralized storage |
| Businesses lack understanding about closed energy systems and pricing | Provide information on closed energy systems, its (dis)advantages and costs |
| Implementing a "direct line solution" is challenging due to issues of grid connection and integration | Request exemption at the ACM, create private grid at the receiver, the only allowed connection to the public grid is a consumption connection from the supplying party. |
| The Energy Tax on energy exchanges hinders energy cooperation | Possible solution could be to change the landlord of the building. Since no energy tax is being paid over the exhanged energy from landlord to tenant, this could alleviate costs of exhanging energy. |
| | |
| **Solutions / good practices for succesful EC development** | |
| Feedback tarrif in energy cooperation should exceed market tarrif to increase profitability of investments (4) | |
| A single connection (group contract) for energy consumption (3) | |
| BP being part of larger energy landscape(3) | |
| Combining multiple small-scale connections as a viable solution to enable energy backfeeding (2) | |
| Cable pooling: integration of complementary energy production source on same connection (2) | |
| Develop plans / possibilities and then connect with local grid operator to determine the feasibility of those plans (2) | |

Figure A.25: Factors and solutions from data collection, including proposed solutions by researcher for Stage 3

### A.31.6 Action 3

| Drivers / conditions for succesful EC development | |
|---|---|
| Pragmatic approach from grid operator | |
| | |
| **Barrier** | **Proposed solution (researcher)** |
| Legal coordination of cable pooling is complicated due to multiple owners and foreign entities | Develop standardised legal framework for cable pooling |
| No commitment and engagement from municipality after session | Municipalities must ensure good communication during the process of EC development |
| | |
| **Solutions / good practices for succesful EC development** | |
| Simple decision-making model for energy management system (EMS) that controls capacity exhanges and physical energy exchanges | |
| Capable people able to realise and implement made plans | |
| With a group contract, the grid operator should have the authority to completely disconnect the connection if the capacity is exceeded, in order to safeguard the electricity grid | |
| When energy cooperation is operational on the businesspark, companies must be aligned with a certain energy profile, meaning that when a company leaves, only a new company that fits within that energy profile is allowed to locate on the businesspark | |

Figure A.26: Factors and solutions from data collection, including proposed solutions by researcher for Action 3

### A.31.7 All phases

| Drivers / conditions for succesful EC development | |
|---|---|
| Limited number stakeholders for decision-making to accelerate process | |
| ET on BP supports municipality sustainability goals | |
| | |
| **Barrier** | **Proposed solution (researcher)** |
| Developing agreements during development is time-consuming | Create agreements before development, based on experience from current projects elsewhere. |
| | |
| **Solutions / good practices for succesful EC development** | |
| Address issues at the appropriate level | |
| Bottom-up approach is considered the best way to support the energy transition on business parks | |
| Compromise on privacy, energy data known per building | |

Figure A.27: Caption

## A.32 Recommendations per case

### A.32.1 Groot Verlaat

- Provide support and assistance to small businesses, as they may not have the resources or knowledge to engage in energy cooperation initiatives. Show them a compelling case that demonstrates the potential benefits they can gain from participating, as expecting them to delve into the topic themselves is said to be non-feasible.
- Obtain insights from consumption data and aim to provide recommendations or suggestions for outsourcing before August 2023.
- Make a decision regarding the recommendations or suggestions from the energy consumption analysis.
- Provide feedback and communicate the outcomes of the analysis to the companies involved.
- Collaboratively decide on what projects to start and proceed accordingly.
- The business club should develop a comprehensive plan, outlining the necessary steps and actions for energy cooperation on the business park.
- Search for an advisory firm with prior experience in the field, who can provide guidance with carrying out the plan.
- Designate a representative from the municipality to take responsibility for the business park and actively promote the detailed plan of the business club to non-member companies. This can be done through personal visits, presenting a compelling and clear narrative that highlights the benefits and opportunities of the plan.
- Engage with the local grid operator to ensure their involvement and cooperation.

### A.32.2 Twentekanaal

- Working group needs to attract more companies.
- Working groups need to be streamlined: the capabilities available from different participants should be utilized more efficiently and effectively.
- More companies should become members of the business club.
- Companies that are not members or do not want to become members of the business club should be included as well in the energy cooperation initiative.
- Maximize the localization of the energy system: produce and consume locally.
- Develop concrete plans and then engage with the municipality and grid operator to determine the feasibility and implementation approach of those plans.
- Align with a major player like Nobian, as their significant energy consumption can have an impact on the entire business park.

### A.32.3 Hessenpoort

- The municipality should take a proactive role in initiating and facilitating cooperation between businesses. This can be done through regular consultations with businesses, preferably in collaboration with the business club.
- Prioritize the inclusion of businesses in energy initiatives based on network congestion rather than financial considerations. Emphasize the urgency of the problem, highlighting that any company may face difficulties in obtaining new connections. Clearly explain the shared problem and its implications.
- Focus on engaging and collaborating with large energy consumers on the business park.
- Focus on investing time and attention in businesses that are willing to participate actively. It is important to prioritize those who are interested and committed while avoiding unnecessary energy expenditure on businesses that are not interested or engaged.
- Map out the future energy usage and expected growth, considering not only electricity but also exploring other possibilities for energy exchange. Use this information to guide government policies and interventions.

### A.32.4 A1 Bedrijvenpark

- Conduct a legal analysis to determine the legal framework and requirements for the energy hub.
- Engage in public discussions and consider the societal impact of the energy hub, solving societal problems and creating societal benefits.
- Conduct a financial analysis to determine the financial aspects and funding options for energy hubs.
- Undertake technical research to evaluate the technical aspects and requirements of energy hubs.
- Make joining the energy hub attractive for businesses, by constructing a "good marketing plan, because everyone is very busy". This plan must show there exist economic benefits of joining, by showing advantages from an energy consuming perspective and energy producing perspective.

## A.33 Feedback on develop methodology by energy transition consultants

### A.33.1 Consultant 1

**Algemeen**

- Wie voorzie je als opdrachtgever voor proces?
- Als ik je verschillende sub steps lees denk ik dat je een compleet beeld hebt van de voorliggende uitdaging. Het proces is wel zeer uitgebreid en soms hoog over en dan weer zeer specifiek.
- Het schema is op dit moment niet losstaand leesbaar. Er zijn veel afkortingen die multi-interpretabel zijn: als voorbeeld BP. In de context waarschijnlijk Business Park maar kan bijvoorbeeld ook Business Proposition zijn. Verder ET, EC, TG, ACM (maar dat is weer een partij) en EMS.
- Je beschrijf nu een lineair proces. Als één van de stappen niet is voltooid of kan worden voltooid, stopt het proces dan?
- Kritische noot: 'enforcement' voor zonnepanelen zie ik niet als haalbare kaart?

**Aanbevelingen**

- Ik zou je willen adviseren het processchema 'in te dikken' en veel van de sub steps bullet gewijs onder te brengen in de tekstuele omschrijving in je scriptie. Nu leidt de inhoud erg af van het proces.
- Ik ben een voorstander van het gefaseerd model (stages) wat je hebt weergegeven maar zou wel vooraf gedefinieerde gates (stage-gate) willen zien. Ieder einde van een uitgevoerde stage levert een go- no go moment voor het (dus eventuele) vervolg. Dit maakt het voor de opdrachtgever ook duidelijk waar hij instapt en waar nog eventueel kan uitstappen.
- Als Sweco een eigen bedrijventerreinen aanpak wil ontwikkelen zou ik adviseren er een onderscheidt te maken in het proces voor een fysiek concept (vragen als wat moet er opgelost worden? Welke oplossingen voorzien wij voor het bedrijventerrein? Welke (minimale) voorwaarden gelden voor welke oplossingen?) en een 'engagement' concept (hier horen vragen bij als wie zijn de stakeholders, wat houdt hen bezig en hoe kunnen ze worden verleid tot het deelnemen aan een collectieve oplossing)
- Voorzie in het vroegtijdig opstellen van een Stakeholder model en liever nog stakeholder analyse (bijvoorbeeld Mendelow matrix). Wie zijn er bij het bedrijventerrein betrokken? Netbeheerder, parkmanagement (facultatief), gemeentelijk niveau (subsidieclubs, facultatief), provinciaal niveau (subsidieclubs, facultatief), collectieve energieleverancier (facultatief, vnl. warmtenet). Wat is de rol van de verschillende stakeholders en wat moet er met de stakeholders gebeuren om het project succesvol te maken?
- In de 'sub steps' raak je veel van de problemen en mogelijke oplossingen. Het is echter niet uitputtend en daardoor gevaarlijk. Probeer te segmenteren in bijvoorbeeld barrières: technisch (bijvoorbeeld congestie, ongelijktijdigheid opwek afname, onvoldoende eigenvraag voor opwek potentieel en vice versa, etc.), organisatorisch (energiecollectief, smart grid, etc.), wet- en regelgeving (energiewet, belastingwetgeving, etc.) en financieel (kosten, opbrengsten, subsidies)
- Een haalbare oplossing is gestoeld op een solide business case en verduurzamingsmodel (voornamelijk CO2-reductie). Ik zou dan ook adviseren deze vroegtijdig in het proces te introduceren (grofmazig) en deze naar mate het proces vordert te actualiseren en te verfijnen. Demarcatie is hierbij strikt commodity en netwerk. De waarde van het wel of niet krijgen van verruiming van een aansluiting om een productieproces verder te brengen ligt bij de opdrachtgever.
- Als onderlegger zou je een aantal elementen van bijvoorbeeld Idea Funnel kunnen gebruiken. De gehele funnel zou doorlopen kunnen worden voor de propositie. Als proces/methode zou er per bedrijventerrein gestart worden vanuit de Ideation/exploration. De MVP zou hierin bijvoorbeeld verbouwd kunnen worden naar Minimum Viable Project.
- Elementen uit "Ideation Funnel" zijn goed te gebruiken voor het technisch deel van het proces. Het meekrijgen van de verschillende stakeholders vraagt mee een 'engagement' proces zoals bijvoorbeeld weergegeven in onderstaande afbeelding.

### A.33.2 Consultant 2

- Blok 1 benoemt de organisatiegraad. Ik zou dit eerder als een voorwaarde stellen. Op een BP dat nog niet goed is georganiseerd zou ik eerst een paar jaar uittrekken voor organisatie algemeen optuigen voordat er over een EC gedacht kan worden.
- Je maakt snel de slag naar een EC en doet dat via de grotere bedrijven. Je eindigt stage 1 met de actie om een EC op te richten. Daarover: Ik denk dat het in praktijk lastig is om dit voor elkaar te krijgen zonder duidelijk beeld van de energiebehoefte individueel, collectieve mogelijkheden maar zeker ook de externe ontwikkelingen/factoren die richtinggevend gaan worden. Dit komt nu in Stage 2 gedeeltelijk terug, maar dat lijkt me laat. Ik denk dat inzichten uit 2 nodig zijn om tot de acties van 1 te komen.

- De inzet op grotere bedrijven lijkt logisch. Ook hier de vraag of dit in praktijk werkt. Op een BP met maar een paar grote spelers is het de vraag of er vooraf voldoende winst wordt gezien om in te zetten op het collectieve spoor. Ik verwacht dat bedrijven lastig in beweging komen als kosten/baten niet duidelijk in beeld zijn.
- Oprichten EC is nu 1 blokje. Maar een enorm complexe. Dat kan op veel manieren. Afhankelijk van de bedrijven, de energiesituatie, etc. Een EC moet denk ik ook gewoon een uitvoeringsorganisatie zijn namens de bedrijven, dus hoe verhouden deze zich daartoe?
- Een andere vraag die ik niet terugzie is het doel van de EC. Ik neem aan een energetisch toekomstbestendig BP, maar je ziet steeds vaker dat het handelen in energie als een nieuw businessplan wordt opgepakt. Vaak niet constructief vanuit blik op totaal energiesysteem en congestievraagstuk. Ook het doel is van invloed op de organisatie/governance van de EC.
- Ik mis een blokje met energievisie. Welk energieconcept wordt gevolgd, zowel individueel, collectief en in relatie met omliggend energiesysteem, lijkt me bepalend voor vervolgstappen. En kunnen de bedrijven zich daartoe allemaal ook goed verhouden? In die visie zou ook overheid en netbeheerder een rol moeten spelen: past het in de totale energievisie (die hopelijk steeds vaker worden gemaakt...).
- Het vastleggen van een ontwikkelrichting met de grote spelers maakt dat kleinere spelers eigenlijk geen keuze meer hebben. Of maakt het voor netbeheerders erg lastig omdat er binnen een energiesysteem toch verschillende relaties zijn.
- Hoe zie je de rol van overheden en netbeheerders in de latere fases? Relevant om steeds blik op relatie met overkoepelend systeem te houden.
- Tariefafspraken en in- en uittreden zijn dingen die ik in eerdere fase zou verwachten. Het is bepalend onderdeel om te kunnen besluiten over oprichting EC.
- Mbt verplichte PV: Dit lijkt me 1 van de mogelijke oplossingen. Wel een logische, maar zo zou je er nog wel een paar kunnen noemen. Wellicht wat algemener maken in trant van no regret maatregelen zoals....
- Je noemt ergens de inhuur van een expert bij oprichten EC. Bij afspraken tarieven etc wellicht ook zoiets noemen. Dat is een complexe vraag volgens mij.

In de opmerkingen zie je dat het vaak gaat over bepaalde blokken in bepaalde fases. Het lastige is dat je enerzijds heel veel duidelijk wilt hebben op moment 0, zodat bedrijven weloverwogen actieve rol kunnen pakken, maar dat niemand zich op moment 0 verantwoordelijk voelt om aan de slag te gaan om tot die duidelijkheid te komen. Wellicht interessant om na te denken welke stappen echt opeenvolgend moeten, en waar wellicht lussen en loops nodig kunnen zijn.