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Conditions for Collectivity

An exploration of drivers and barriers for collective energy on Dutch SME business parks

Emma Schrauwen

MSc Management in the Built Environment
Delft University of Technology

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E.L. Schrauwen

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Thesis committee:

Delegate:	Dr. Ir. G. Slingerland
Supervisors:	Dr. Ir. M.U.J. (Michaël) Peeters
	Dr. K.B.J. (Karel) Van den Berghe

Faculty:	Architecture and the Built Environment
Department:	Management in the Built Environment
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Student number:	5034582

Graduation organisation:	Fakton
External supervisor:	Ir. N. Westerhuis

Preface

During my studies at the Faculty of Architecture, sustainability has always been a central theme. However, the question remains: who is willing and able to invest? Within the built environment, sustainability ambitions are widely shared, yet their realisation often depends on financial decision-making under conditions of uncertainty. It was this tension between long-term societal value and short-term financial logic that formed the starting point of this research.

Over the course of this graduation process, this interest gradually converged on the context of Dutch SME business parks. Through academic and professional guidance, it became clear that the current geopolitical, regulatory and infrastructural landscape has made energy a critical and tangible issue for entrepreneurs. Access to affordable and reliable energy directly affects the continuity of daily operations, shifting 'sustainability' from an ambition to a matter of security of supply. This research, therefore, focuses on collective energy systems not as an abstract sustainability ideal, but as a practical response to structural constraints faced by SMEs in today's energy system. The study is based primarily on interviews with a wide range of stakeholders involved in collective energy initiatives on Dutch SME business parks. The most rewarding aspect of this process was engaging with these diverse perspectives and experiencing the strong recognition among interviewees of the relevance of the topic.

This thesis marks the final step of the Master of Science in Architecture, Urbanism and Building Sciences, track Management in the Built Environment, at the Faculty of Architecture and the Built Environment of Delft University of Technology.

I would like to thank my university supervisors, Michaël Peeters and Karel Van den Berghe, for their guidance throughout my graduation journey. Their feedback and support helped shape both the content and the process of the research, creating a balance between providing direction and encouraging me to take ownership of the research. I am also grateful to Nathan Westerhuis at Fakton Consultancy for his mentorship and for helping me maintain an overview of the research when I became lost in the details. In addition, I would like to thank Benny Roelse from Fakton Energy for sharing his practical insights. Finally, I thank all interviewees for their willingness to share their time and expertise, as well as my colleagues at Fakton for their support and engagement during my graduation process.

Emma Schrauwen
Delft, January 2026

Abstract

This thesis examines the conditions under which collective energy can be implemented on Dutch SME business parks. In the current Dutch context of rapid electrification, persistent grid congestion and heightened geopolitical and energy market instability, many SMEs face growing concerns about the security and reliability of their energy supply. Collective energy arrangements are increasingly explored as a way to improve access, flexibility and future-proofing, yet their feasibility depends on the interplay of multiple factors. This study aims to link collective energy governance with SME behaviour in the setting of Dutch business parks.

An exploratory qualitative methodology is employed, analysing eight business park cases and expert interviews through a multi-dimensional framework applied across governance scales. The findings show that collective energy for Dutch SME business parks is predominantly an electricity challenge. The most relevant collective arrangements are those that reorganise electricity supply and grid access, although individual solutions must also be considered. Their feasibility is shaped by the interaction of firm-level motivations, park-level organisation and cohesion and enabling or constraining institutional frameworks.

Commercial and operational drivers, including cost advantages, price stability, business continuity and congestion-related growth limitations, most strongly motivate participation. Necessary conditions for implementation arise in both the political and the social–organisational domains: an enabling regulatory framework and applicable contract forms, together with trust, willingness to cooperate and the presence of a coordinating actor, are critical. Barriers persist where commercial risks, regulatory uncertainty, limited organisational capacity or weak collaboration culture undermine collective action.

The thesis demonstrates that collective energy on Dutch SME business parks is not a single technical solution but a multi-dimensional, multi-scale process shaped by the alignment of SME-level incentives, organisational business park dynamics and political-institutional conditions. Ensuring this alignment is essential for translating collective ambitions into feasible and durable energy arrangements.

Keywords: Collective energy, Energy security, SME business parks, Drivers and barriers

Executive summary

Context

Energy security has become a strategic concern for firms operating in an increasingly unstable geopolitical and economic environment. Rising price volatility, supply uncertainties and growing dependence on internationally traded fossil fuels have exposed the vulnerability of existing energy systems. In response, firms increasingly seek greater autonomy through electrification, which allows for local renewable generation, greater control over energy use and reduced exposure to global fuel markets, while also aligning with national climate policy objectives. However, this rapid shift towards electricity places unprecedented pressure on the Dutch electricity grid. Structural capacity constraints and regional imbalances have resulted in widespread grid congestion, limiting firms' ability to electrify and revealing a vulnerability to both geopolitical energy dependencies and constrained electricity infrastructures.

This situation has intensified interest in collective energy solutions, particularly on SME-dominated business parks where spatial concentration and shared infrastructure offer opportunities for coordinated energy production and management. At the same time, these collective approaches confront the characteristics of the SME actor. Collective energy requires collaboration, shared decision-making and long-term commitment, while SMEs typically operate as independent, profit-driven firms with limited organisational capacity and a strong focus on risk management. The convergence of these dynamics defines the central problem of this study: how collective energy systems can emerge and function in a context shaped by individual incentives, coordination challenges and rapidly evolving institutional conditions. This thesis, therefore, aims to examine under which conditions collective energy systems can be implemented on Dutch SME business parks. The central research question asks: *what drivers and barriers exist for the implementation of collective energy on Dutch SME business parks?*

Methodology

This research adopts an exploratory qualitative approach based on semi-structured interviews with a diverse range of stakeholders involved in collective energy initiatives. The empirical analysis combines eight business park use cases with expert interviews, allowing both practical experiences and system-level dynamics to be examined. Interview data were thematically analysed using a structured analytical framework, derived from the TECOP dimensions and applied across multiple governance scales, ranging from the company level to the global level. This approach enables a systematic assessment of drivers, barriers and necessary conditions shaping collective energy implementation.

Key findings

The findings show that collective energy on Dutch SME business parks is predominantly an electricity-related challenge driven by geopolitical pressures on energy security, decarbonisation policies and structural grid constraints. These pressures create a sense of urgency among firms, particularly where electrification is required for business continuity or growth. Rather than being motivated primarily by environmental ambitions, collective initiatives emerge as pragmatic responses to operational constraints and risks associated with limited grid capacity. As a result, the most relevant collective arrangements are those that reorganise electricity supply and grid access at the business park level, such as energy hubs, closed distribution systems and cable pooling. Individual optimisation remains an important prerequisite, with collective solutions becoming relevant only when they offer clear advantages over individual measures.

At the company level, participation is mainly driven by commercial and operational considerations. The most influential drivers relate to business continuity and improvement: cost and risk reduction, protection against price volatility and safeguarding capacity and future growth under conditions of grid congestion are strong motivators. SMEs are willing to participate when these translate into a clear and credible business case.

At the business park level, social and organisational conditions are decisive. Trust between firms, willingness to cooperate, a shared sense of urgency and the presence of a coordinating actor or park management structure are critical for collective initiatives to emerge. Where such conditions are absent, technically viable solutions struggle to progress.

At higher governance scales, political and institutional factors form the most significant barriers. Regulatory uncertainty, fragmented contracting options and inconsistent procedures at national and grid-operator levels translate into perceived investment risk at the firm level. Overall, the findings reveal a structural mismatch between bottom-up initiative capacity and top-down institutional constraints.

Conclusion

This thesis concludes that the implementation of collective energy on Dutch SME business parks is not determined by technical feasibility alone, but by the alignment of incentives, organisational capacity and institutional conditions across governance scales. Collective energy emerges as a context-dependent response to energy security pressures, whose feasibility depends on whether commercial-operational motivations at the company level, social-organisational capacity at the business park level and a coherent national regulatory framework reinforce rather than contradict one another.

Policy recommendations

The research indicates that collective energy on Dutch SME business parks depends on the interaction between local initiative capacity and national institutional frameworks. Effective policy intervention is required to align this bottom-up capacity with the regulatory and organisational conditions necessary for implementation.

At the national level, the primary recommendation is to reform the regulatory framework to recognise collective energy as a standard and scalable component of the Dutch energy system. Stable legal definitions, clear and uniform collective contract forms and consistent grid-operator procedures are required to reduce uncertainty and perceived investment risk for SMEs. Moving away from temporary pilot-based arrangements towards long-term regulatory clarity would significantly improve feasibility.

At the business park level, policy should actively support the development of formalised governance and coordination structures. Park management entities, cooperatives or similar collective organisations are critical for organising decision-making, allocating responsibilities and lowering transaction costs for individual firms. Public support and intermediary facilitation can help compensate for SMEs' limited time, expertise and organisational capacity.

Finally, policy design should be aligned with firm-level motivations. Collective energy initiatives are most likely to succeed when they are framed in terms of business continuity, access to electricity capacity, cost stability and risk reduction. Translating system-level objectives into clear, firm-level value propositions is essential for securing participation and enabling durable implementation.

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1. Introduction

Energy security has become a strategic concern for firms operating in an increasingly unstable geopolitical and economic environment. Recent geopolitical conflicts and trade restrictions have exposed the vulnerability of energy systems that depend on internationally traded fossil fuels, leading to extreme price volatility and supply uncertainties (Wang et al., 2024). For businesses, these developments have highlighted that affordable and reliable energy form fundamental prerequisites for economic continuity (Niers, 2024). In response to this growing insecurity, firms increasingly seek greater autonomy from global energy markets, geopolitical dependencies and fluctuating regulatory conditions. Electrification plays a central role in this shift. Compared to natural gas, electricity allows for local generation through renewable sources such as solar and wind, greater controllability of consumption and production and increased insulation from global fuel price volatility (Wang & Tian, 2025). At the same time, electrification aligns with national climate policy objectives. International climate agreements, translated into Dutch policy through the Climate Agreement (Klimaatakkoord) and the Climate Act (Klimaatwet), set legally binding targets to reduce greenhouse gas emissions by at least 55% by 2030 and to achieve climate neutrality by 2050. These policies accelerate the phase-out of natural gas and reinforce the strategic shift toward electricity-based energy systems, together driving the ongoing energy transition (PVB Nederland, 2025a). However, the rapid electrification of energy demand coincides with structural limitations of the electricity infrastructure. As firms replace gas-based processes with electric alternatives and as renewable electricity generation expands, the Dutch electricity grid faces unprecedented pressure. Despite significant investments by grid operators, capacity constraints and regional imbalances persist, resulting in widespread grid congestion: the inability of the grid to accommodate simultaneous inflows and outflows of electricity (RVO, 2025b). For firms, this congestion limits their potential to electrify. Together, these developments expose the combined vulnerability of businesses to geopolitical energy dependencies and constrained electricity infrastructures.

While electrification offers a pathway towards greater energy autonomy, it cannot be realised through isolated, firm-level solutions. Electrification places systemic demands on electricity networks that cannot be addressed effectively through fragmented investments. Instead, collective approaches are required to manage growing electricity demand, integrate decentralised renewable generation and mitigate local grid congestion. By organising energy production and consumption collectively, users can balance supply and demand at the local level, reduce simultaneous peak loads and limit the need for grid reinforcement. Moreover, collective energy systems allow for the deployment of larger and more efficiently sized renewable assets and shared infrastructure, generating economies of scale that improve the economic feasibility of electrification (Ahmed et al., 2024). In this context, collective approaches to energy generation and management have gained attention as potential solutions to both climate and energy security challenges. Locally organised systems, where energy users jointly produce and manage their own energy, offer a way to reduce dependency on centralised grids and external suppliers (Fouladvand et al., 2024). For businesses, this collective approach not only enhances energy security but also enables more efficient and cost-effective implementation of sustainability measures. Shared infrastructure and coordinated management allow firms to overcome individual limitations in knowledge, capacity and investment power. Particularly on business parks, where spatial and operational links already exist, such collaboration provides a practical framework for advancing the energy transition (Rli, 2023; Suchek & Franco, 2023). These areas account for a significant share of the Netherlands' total energy consumption, meaning that modest efficiency gains can yield substantial national impact. Their concentrated layout and shared infrastructure enable collective approaches such as energy hubs and shared grid connections. Because business parks host a major part of the Dutch economy, progress at this scale not only reduces emissions, but also strengthens regional competitiveness and economic resilience (Nordkamp et al., 2021; Kamphuis et al., 2023; 2024). On Dutch business parks, SMEs make up the majority of companies, contributing to the large energy consumption, but also to the economic value of business parks (Kamphuis et al., 2024; Nederlands Comité voor Ondernemerschap, 2024). Their smaller size and flexible organisational structures make them adaptable to technological change and shifting market conditions (Gherghina et al., 2020). Yet, SMEs face barriers such as a desire for independence and perceived risk (Lewis et al., 2015). Next to this, SMEs remain underrepresented in energy policy, despite their importance in the energy transition (Nordkamp et al., 2021; Kamphuis et al., 2024).

The convergence of these two dynamics, the need for collective energy solutions and the characteristics of the SME actor, defines the central problem of this study. Collective energy systems depend on collaboration, shared decision-making and trust between firms, while SMEs typically act as independent, profit-driven entities. This tension between the collective good and individual interest reflects a fundamental coordination problem, echoing the logic of collective action described by Olson (1965) and Ostrom (2000). While collective action in energy systems and SME behaviour in the energy transition have each received growing academic attention, their intersection remains only partially explored. Research on collective energy primarily addresses community or cooperative settings, whereas studies on SMEs mainly examine individual firms operating within competitive market contexts. Moreover, the context in which these dynamics occur is changing rapidly: grid congestion, volatile energy prices and new contractual and regulatory instruments are reshaping the practical and institutional conditions for collaboration. This evolving context defines an emerging field in which this study aims to link collective energy governance with SME behaviour in the specific setting of Dutch business parks.

To address this gap, the main research question of this study is as follows:

What drivers and barriers exist for the implementation of collective energy on Dutch SME business parks?

This research question will be answered through the following sub-questions:

1. What forms of collective energy are relevant for Dutch SME business parks?
2. How do necessary conditions, drivers and barriers for collective energy manifest across scales and dimensions?

By addressing this question, the research aims to contribute to accelerating the energy transition and reducing carbon emissions. It seeks to support the upscaling of sustainable energy solutions at the level of business parks, thereby enhancing energy security and ensuring the continuity of SME operations. Ultimately, the research aims to translate these insights into actionable policy recommendations that facilitate the implementation of collective energy systems and strengthen the resilience of Dutch business parks.

The research question is answered as follows. The next chapter explores the main concepts underlying this study: the SME actor, collective action and energy systems, which intersect within the broader context of Dutch business parks (Figure 1). Subsequently, the methodology of the research will be explained in chapter 3. The results, following from the empirical research, will be set out in chapter 4 and further discussed in chapter 5. The conclusions and policy recommendations are laid out in the final chapter of this thesis.

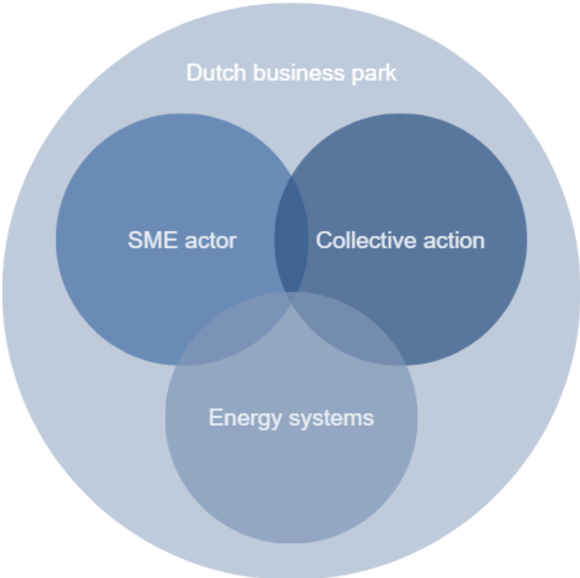

Figure 1: Conceptual positioning of the research (own work)

2. Literature

2.1. Collective action

The concept of collective action describes situations where individuals or groups must cooperate to achieve shared benefits that cannot be realised through individual effort alone. The foundations of this theory were laid by Mancur Olson (1965), who argued that rational, self-interested individuals will not voluntarily act to achieve common interests if they can benefit without contributing. This dynamic, known as the 'free-rider' problem, arises because a collective good means no participant can be excluded from the same benefits as others in the group (Olson, 1965, pp. 14-16).

Olson's central argument, often termed the 'zero-contribution thesis', states that unless the number of actors is small or unless there is coercion or a special mechanism to enforce cooperation, individuals will not contribute to the provision of collective goods (p. 2). Group size is identified as a crucial determinant of collective outcomes. In small groups, where each member's contribution significantly influences results, individuals may find it worthwhile to act collectively. In contrast, in large groups, the marginal benefit of each contribution diminishes, making voluntary cooperation unlikely (pp. 21-36). Olson also argues that exclusive groups can often act more efficiently because the incentive to contribute is stronger and the group can use selective incentives or social pressure to sustain participation. To explain why some groups succeed in acting collectively while others fail, Olson developed a taxonomy of groups, privileged, intermediate and latent, showing that the likelihood of successful collective action decreases as group size and inclusivity increase (pp. 36-52). As a result, collective action does not emerge naturally from common interests but requires mechanisms that alter the cost-benefit balance for individuals. Olson suggested three main conditions: selective incentives (rewards or benefits available only to contributors), coercion (compulsory participation or taxation) or special organisational mechanisms that enable coordination.

While Olson's theory highlights why collective action often fails, Elinor Ostrom's later work demonstrated that cooperation can also emerge voluntarily. Ostrom (2000) challenged Olson's pessimistic assumptions by presenting empirical and experimental evidence that individuals frequently self-organise to manage shared resources effectively. Laboratory studies and fieldwork revealed that, next to the 'rational egoists', many people behave as 'conditional cooperators' and 'willing punishers'. Conditional co-operators contribute to collective efforts when they expect others to do the same and willing punishers enforce norms by sanctioning non-cooperative behaviour (p. 142). Ostrom revealed that trust, face-to-face communication and social norms play a decisive role in sustaining cooperation.

From extensive studies of self-organised resource regimes, Ostrom identified eight design principles that characterise long-lasting, cooperative systems (pp. 149–153). These include:

1. Clearly defined boundaries specifying who is included and who has rights to the resource.
2. Locally adapted rules that regulate use, align costs and benefits and fit local conditions.
3. Collective decision-making arrangements that allow participants to design and modify their own rules.
4. Locally accountable monitoring of both resource conditions and user behaviour.
5. Graduated sanctions proportional to the severity of rule violations.
6. Accessible conflict-resolution mechanisms.
7. Recognition by higher-level authorities of the group's right to self-organise.
8. Nested layers of governance for larger or more complex systems.

These principles explain how communities maintain cooperation through reciprocity, trust and fairness, without relying solely on external enforcement. Ostrom further cautioned that externally imposed rules can undermine ('crowd out') intrinsic motivation for cooperation, suggesting that flexible and participatory governance is often more effective (p. 147).

Together, Olson (1965) and Ostrom (2000) provide a comprehensive understanding of collective action. Olson clarifies why individual actors are often unwilling to contribute to shared goals, showing that collective action is constrained by rational self-interest, group size and the absence of mechanisms to align individual and collective benefits. Ostrom demonstrates how cooperation can succeed through institutional design, social trust and participatory governance. Together, their work reveals that collective action depends on aligning individual incentives with collective outcomes through social norms and institutional arrangements that sustain cooperation over time.

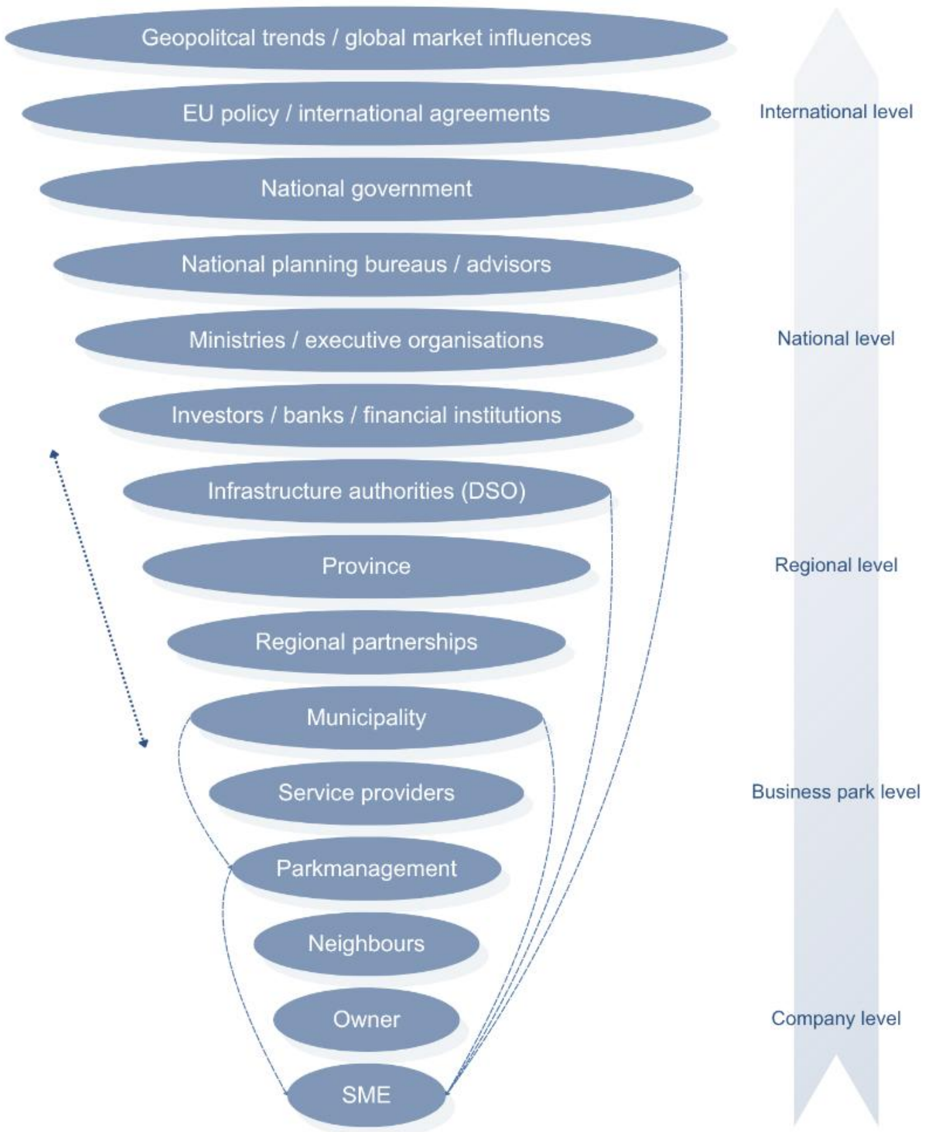

Figure 2: Multi-scale stakeholder structure influencing SME collective energy initiatives (own work)

Collective action theory has been applied across a wide range of empirical settings where interdependent actors must coordinate to manage shared resources or pursue joint benefits. Classic applications concern natural resource management where communities negotiate rules, monitoring and enforcement to avoid overuse or conflict. The theory is also used in agricultural development, for example to analyse the functioning of farmer cooperatives. Further applications appear in commons governance, such as community conservation areas and multi-use coastal resources (Faysse & Mustapha, 2017). These applications show how collective action theory helps explain cooperation across diverse contexts, particularly where shared resources, heterogeneous actors and multi-level governance structures shape collective outcomes. Collective energy initiatives represent one such recent application.

Collective action theory provides a useful lens for understanding collective energy initiatives on Dutch SME business parks, the context of this research. It provides behavioural and institutional logic that connects the two analytical concepts: the collective (shared energy system requiring coordination) and the SME actor (individual firms acting based on their own interests). In this context, collective action requires coordination across multiple actors and scales. Figure 2 illustrates the stakeholder landscape surrounding collective energy initiatives on SME business parks, starting from the SME actor. The figure shows how stakeholders vary in both proximity to the SME (horizontal layering) and the scale of operation (vertical axis from company to international level). The dashed lines in the figure indicate that, despite their position at higher governance levels, certain stakeholders (such as advisors, DSOs or municipalities) can have direct interactions with SMEs. By visualising both scale and proximity, the figure highlights the multi-level and multi-actor dynamics that shape collective energy initiatives on business parks.

The stakeholder landscape shows how collective energy initiatives operate within a wider system of multi-level collective action. York et al. (2021) demonstrate that climate and energy challenges are fundamentally multi-level collective action problems, shaped by interdependent decisions made at individual, organisational, local, national and global scales. Their work shows that action at one level is often constrained or enabled by conditions at another and that shortcomings in collective action frequently result from misalignment across these levels (York et al., 2021). Similar dynamics are evident in the governance of energy communities. The development and empowerment of energy communities depend heavily on the configuration of governance structures across scales. EU directives set the legal foundations, national governments shape regulatory and financial conditions, regional authorities interpret and support these frameworks and local governments play a decisive role in enabling participation and implementation. This demonstrates that energy communities, much like collective initiatives on business parks, are influenced simultaneously by actors operating at different governance levels (Trovalusci, 2022). Radtke (2025) further reinforces this perspective by conceptualising energy transitions as multi-level socio-technical transformations in which governance processes unfold across interacting layers of authority and influence. His analysis also emphasises that such transitions are inherently multi-dimensional, shaped not only by technical and infrastructural factors, but also by economic incentives, social norms, political dynamics, operational capacity and environmental considerations (Radtke, 2025). Taken together, these insights show that energy-related cooperation and decision-making are shaped simultaneously by the governance scale at which actors operate and by the multiple dimensions that structure their possibilities for action. In the next section, collective energy is examined in greater depth by outlining its background, context and specific functions.

2.2. Collective energy

Energy security is increasingly challenged by both infrastructural and geopolitical factors. The International Energy Agency (2025) highlights that grid congestion creates serious challenges for connecting new users and producers. This restricts system flexibility, delays renewable deployment and heightens vulnerability to supply disruptions, as seen in the Netherlands where thousands of projects await grid connection (IEA, 2025; RVO, 2025b). Beyond technical constraints, geopolitical instability also undermines energy security. As Wang et al. (2024) show, political unrest, trade sanctions and international conflicts such as the Russia-Ukraine war disrupt global energy flows and fuel price volatility, revealing the dependence of national economies on the stability of exporting regions and diplomatic relations (Wang et al., 2024). Together, these infrastructural and geopolitical pressures expose the fragility of current energy systems. For businesses, energy security is crucial because it forms a fundamental prerequisite for business continuity. Energy is the backbone of all business operations, without a stable and affordable energy supply, economic activity comes to a standstill. The recent infrastructural and geopolitical developments have underscored the vulnerability of businesses to rising prices and disrupted supply. As a result, entrepreneurs increasingly recognise the need for a less vulnerable and more locally controlled energy system, reducing dependence on international markets and systemic risks such as regional grid failures (Niers, 2024). Renewable energy offers a structural solution to these risks. Wang and Tian (2025) demonstrate that increasing renewable energy consumption reduces overall energy security risk by lessening reliance on imported fossil fuels and insulating economies from external shocks. Because renewables are locally generated and decentralised, they strengthen energy autonomy and long-term resilience, making them a key way to mitigate both geopolitical and infrastructural vulnerabilities in the energy transition (Wang & Tian, 2025).

At the local level, energy communities can further strengthen energy security by enabling decentralised, collective control over energy generation and consumption (Fouladvand et al., 2024). An energy community represents a locally managed segment of the energy grid in which connected members collectively govern the system to deliver environmental, economic or social benefits to the community (Reijnders et al., 2020). This local control reduces dependence on centralised grids and external suppliers, thereby increasing security of supply. When energy is produced and managed within the community, the system becomes less vulnerable to national or geopolitical disruptions. Such community-based systems enhance energy security through diversified infrastructure, effective governance and strong social cohesion. Well-governed and technologically diverse communities are better equipped to manage disruptions, while cooperation and trust among participants support the long-term stability and resilience of local energy systems (Fouladvand et al., 2024).

In the Netherlands, the cooperative movement within the sustainable energy sector has expanded considerably over the past decade. Whereas the initial growth was primarily reflected in the increasing number of cooperatives, recent years have shown a trend towards more professionalised organisations and a steady increase in the number of members. Due to this development, energy cooperatives are engaging in larger and more diverse projects within an increasingly complex field (De Graaff et al., 2023).

To optimise the use of the electricity grid and advance the broader energy transition and sustainability goals, several coordinated measures are made available to collectives of businesses in the Netherlands (PVB Nederland, 2025a; Gelders Energieakkoord & Transitiemakers, 2024). These include:

- **Shared charging infrastructure**: Jointly developed charging systems that reduce grid pressure by optimising electricity distribution across users.
- **Collective heating networks**: Business parks can invest in local district heating systems to decouple thermal energy needs from the electricity grid.
- **Multiple suppliers on a single connection**: Allows multiple energy suppliers to operate through one grid connection, enhancing flexibility and local balancing.
- **Direct lines**: Private electricity connections between producers and consumers, bypassing the public grid and thus reducing congestion.
- **Cable pooling**: Shared use of existing grid connections by multiple producers, such as solar and wind installations, to optimise grid capacity.
- **Closed Distribution Systems (CDS or energy hubs)**: Local, semi-autonomous grids that manage energy flows internally, enabling more efficient balancing and integration of renewable sources.

In addition to the measures currently available for business collectives, several emerging solutions are expected to play an important role in the near future. Governments, commercial actors and grid operators are actively developing new approaches to address energy challenges and enhance the resilience and efficiency of local energy systems (Gelders Energieakkoord & Transitiemakers, 2024).

- **Time-bound contracts (tijdgebonden contracten):** Agreements allowing companies to use or supply electricity only at specified times when the grid is less congested.
- **Congestion management (congestiemanagement):** A system in which grid operators allocate more capacity than the network can technically handle by temporarily asking large users to reduce or shift their consumption or generation during peak moments.
- **Energy hubs (energiehubs):** Local networks in which companies collectively balance electricity generation, consumption and storage. Energy hubs are currently under development, with several successful pilots demonstrating their potential, though large-scale implementation in practice has yet to occur.
- **Group contracts (groepscontracten):** Agreements where multiple businesses share a single contracted grid capacity, allowing them to align consumption profiles and free up unused capacity for collective or individual growth.
- **Alternative energy carriers (alternatieve energiedragers):** The development and future application of energy carriers such as hydrogen and biogas to complement the electricity system.

To facilitate these new measures, the legal and regulatory framework in the Netherlands is undergoing significant transformation. The current laws regulating energy systems in the Netherlands are the Electricity Act 1998 (Elektriciteitswet 1998) and the Gas Act 2000 (Gaswet van 2000). The Electricity Act 1998 governs the production, transmission and supply of electricity in the Netherlands. This act liberalised the market by implementing European directives promoting an open and competitive energy market. It stipulates that the national high-voltage grid remains state-owned and sets out the responsibilities of distribution system operators (DSOs) (Eerste Kamer, 1998; *Elektriciteitswet 1998*, 1998). The Gas Act regulates the market for natural gas transport and supply, implements European regulations and assigns the Authority for Consumers and Markets (ACM) with supervision of compliance (Eerste Kamer, 2000; *Gaswet, 2000*).

Between 2015 and 2018, an exception to the Electricity Act 1998 was introduced through the Experiments Electricity Act 2015-2018 (*Experimenten Elektriciteitswet 2015-2018*, 2015). This exemption allowed cooperatives and owners' associations to deviate from the Electricity Act 1998. The Ministry of Economic Affairs and Climate Policy introduced this scheme to encourage the development of sustainable energy systems in the Netherlands. It granted several local initiatives the right to share electricity among their members and in some cases, to establish and operate private electricity networks. At present, there are 15 active exemption holders (RVO, 2025a). Based on the advice of the Council of State, the Minister decided not to reopen the scheme after 2018, partly in anticipation of the new Energy Act (Energiewet). In December 2020, the draft Energy Act was released for public consultation. This act will replace both the Electricity Act and the Gas Act. In light of the ongoing energy transition, the new legislation introduces several additional topics (RVO, 2021). The energy transition has increased electricity demand, while generation is increasingly decentralised and based on renewable sources. Furthermore, due to grid congestion, existing regulations no longer align with current realities and newly adopted European legislation requires national implementation (De Haan, 2025).

In 2019, the European Union introduced an updated legal framework for the energy sector known as the *Clean Energy for all Europeans Package* (CEP) (EU Commission, 2019). This reform recognises the importance of consumer empowerment and for the first time, explicitly addresses citizens as key actors in accelerating the transition towards a low-carbon energy system. A central innovation introduced by the CEP is the concept of the 'energy community'. While the Directives grant member states significant flexibility to define the legal form and activities of such communities, they clearly prescribe the purpose they have to fulfil: energy communities must "provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits." This principle distinguishes energy communities from conventional market players, such as energy suppliers and DSOs, whose primary aim lies in maximising profit or efficiency within a liberalised energy market (Swens & Diestelmeier, 2022). These energy communities are also recognised in Dutch law under the new Energy Act. The rules concerning energy communities aim to facilitate local cooperation in generating, sharing and using renewable energy, thereby accelerating the energy transition (Van Dijke, 2024).

At the end of 2024, the new Energy Act was approved by the Senate (Eerste Kamer). The law will enter into force on 1 January 2026 (De Haan, 2025). The new legislation enhances consumer protection, introduces greater flexibility in the use of the congested electricity grid and improves the secure exchange of data between grid operators, energy suppliers and customers. Furthermore, the new framework aligns more closely with the future energy system, characterised by increased local renewable energy production, storage and flexibility (NPLW, n.d.). Many of the coordinated energy measures mentioned above require new contractual arrangements. In addition to the new Energy Act, flexible contract forms are increasingly emerging between consumers (both individual and collective) and DSOs (Kennisplatform Energiehubs, 2025; Netbeheer Nederland, 2025). Traditionally, energy consumers in the Netherlands have a connection and transport agreement (Aansluit- en Transportovereenkomst, ATO) with the grid operator, granting continuous access to a fixed amount of transport capacity. As grid congestion increases, DSOs are introducing new categories of contracts that allow more flexible and efficient use of the electricity network. Three main categories of contracts can be distinguished:

Alternative transport rights: Flexible agreements that grant access to the grid under specific time or capacity conditions. These include:

- Time-block-based transport right (Blokstroom)
- Duration-based transport right (Tijdsduurgebonden transportrecht)
- Fully variable transport right (Volledig Variabel Transportrecht)

Congestion management contracts: Arrangements that allow users to provide flexibility to the DSO, either individually or collectively, by temporarily reducing consumption or generation. Examples include:

- Redispatch agreements
- Capacity Limitation Contracts (Capaciteitsbeperkingscontracten, CBC): Agreements allowing the DSO to temporarily limit electricity use or generation for compensation. In collective form (group CBC), companies jointly offer flexibility, distributing curtailments among members to optimise shared grid capacity.

Collective contract models: New forms of cooperation that enable businesses to share and manage grid capacity collectively. These are particularly relevant for energy collectives on business parks:

- Group Transport Agreement (Groepstransportovereenkomst, GTO): A collective agreement where several companies share a fixed total amount of transport capacity, redistributing it according to real-time needs. This model allows temporary peaks for individual members without increasing total contracted capacity. Figure 3 shows a visualisation of this group contract.
- Cable Pooling: A shared connection between multiple producers (such as solar and wind installations) who jointly use the available grid capacity based on complementary generation profiles.
- Closed Distribution Systems (Gesloten Distributiesystemen, GDS): Privately operated local grids where connected companies manage internal energy flows behind a single public connection, optimising flexibility and reducing dependence on the national grid (Kennisplatform Energiehubs, 2025; Netbeheer Nederland, 2025).

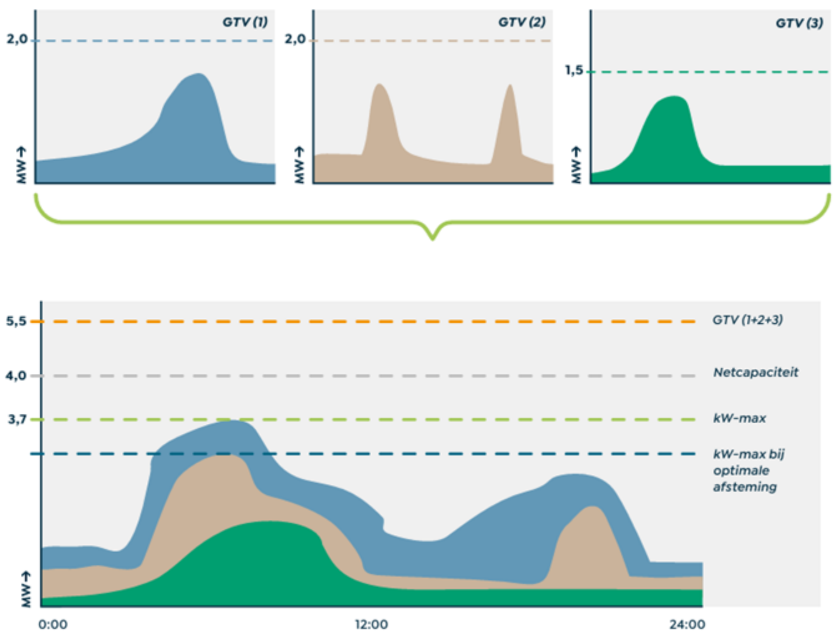

Figure 3: Visualisation of group contract (Netbeheer Nederland, 2024)

These developments mark a shift from static, individual grid access towards dynamic, cooperative frameworks that support more efficient grid use and facilitate collective energy initiatives. To enter into a collective contract with a grid operator, an energy collective must be organised as a legal entity (Netbeheer Nederland, 2024). Even when a formal entity is not strictly required for contracting, a cooperative structure remains crucial for advancing the sustainability of a business park (and its energy system). Implementing sustainability measures on business parks requires close collaboration among key stakeholders, including business associations, property owners and tenants, energy suppliers, consultants and public authorities. Without a collective approach, sustainability efforts are likely to remain limited to isolated, company-level interventions. Only through structured cooperation can the full potential for sustainability, within the individual businesses and the broader business park, be effectively realised. Collective strategies are essential to optimise the use of the increasingly congested electricity grid (PVB Nederland, 2025a).

However, when examining Dutch business parks, it becomes clear that many are not formally organised. In 2023, only 20% of business parks in the Netherlands had a (joint) management organisation and many of these were larger business parks. However, recent years have seen a rise in collaborative initiatives and efforts to accelerate the sustainability of business parks. The energy transition, in particular, has emerged as a key driver and unifying theme in this development (De Kort et al., 2023). Effective implementation of sustainability measures is only possible through collaboration between firms and/or with other stakeholders in and around the park. Even when measures can be carried out individually, joint implementation is often more cost-effective and efficient. In some cases, collaboration with regional (governmental) institutions is essential for success. The sustainability transition of business parks, therefore, typically requires a collective effort across multiple levels. Organised collaboration in a cooperative structure is a critical condition for this. When businesses are able to delegate shared responsibilities to a capable park manager, they are no longer required to individually resolve complex issues. Instead, central coordination can streamline processes and enhance the effectiveness of sustainability initiatives (Rli, 2023).

This organised collaboration can take various forms. On Dutch business parks that actively pursue sustainability, multiple governance structures often coexist to facilitate joint initiatives (PVB Nederland, 2025b). This section outlines the most common organisational forms that support collective action. One prominent model is the *Bedrijveninvesteringszone* (BIZ), a legally grounded investment zone where entrepreneurs jointly fund collective services. Once approved through a formal voting process, participation is mandatory for all businesses within the zone. Another widespread mechanism is the *Ondernemersfonds*, which channels additional property tax revenues into geographically defined areas. Local businesses then decide collectively, often via a foundation or association, how the funds are spent. More informal governance takes place through *ondernemersverenigingen* (entrepreneurs' associations), which rely on voluntary participation but can play a key role in fostering cooperation. Alternatively, more formal legal entities such as *coöperaties* (cooperatives), *stichtingen* (foundations) or *besloten vennootschappen* (private limited companies) are used to manage shared services or investments. These legal forms offer varying degrees of control, risk distribution and profit allocation, depending on the nature and goals of the collaboration. *Parkmanagement* can function alongside or within these structures, often as an operational role responsible for coordination, maintenance and stakeholder engagement. The choice of governance model depends on factors such as scale, objectives, financing needs and the willingness of stakeholders to commit formally to joint action (PVB Nederland, 2025b).

2.3. Drivers and barriers for SMEs

According to Senel et al. (2023), Dutch business parks can be categorised in eleven different types (Figure 4). About 40% of business parks fall under the category of medium-scale mixed small- and medium sized enterprise (SME) zones. This is followed by small-scale mixed SME zones with almost 20% of all business parks. The remaining 30% of business parks consist of a distribution of the other nine business types mentioned below. This study focuses on the fifth typology of business parks, medium-scale mixed-use SME areas, as identified by Senel et al. (2023), which is the most prevalent category.

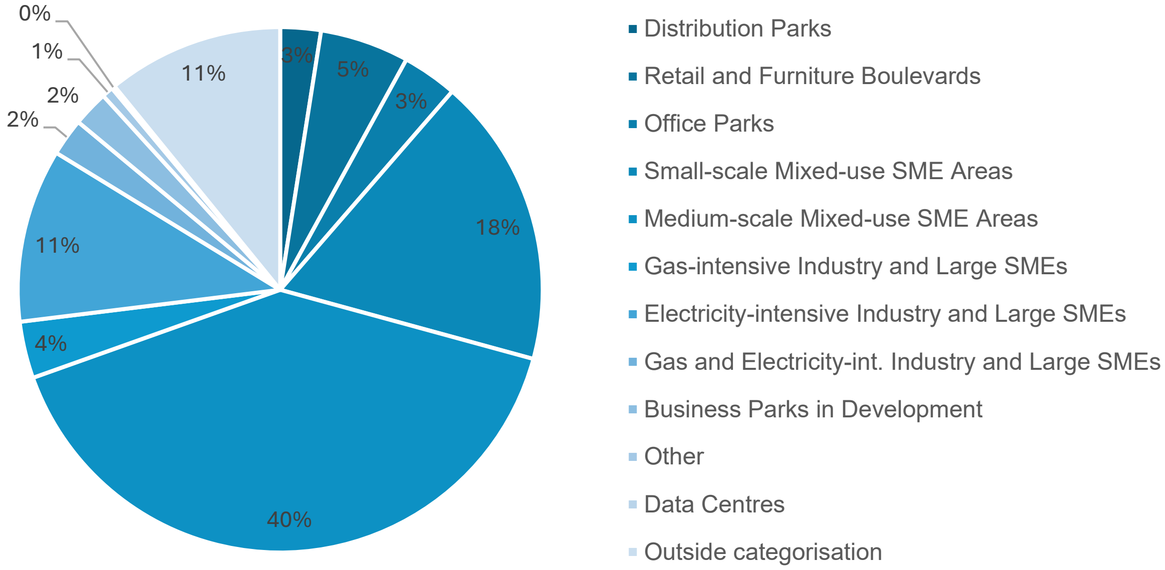

Figure 4: Typologies of Dutch business parks (own work, adapted from Senel et al., 2023)

Business parks represent strategic focal points in the Dutch energy transition due to their high concentration of energy use, collective potential and economic importance (Nordkamp et al., 2021). In 2020, these parks accounted for nearly half of the Netherlands' total gas consumption and about one-third of its total electricity use (Kamphuis et al., 2023). Because of this concentration, even small efficiency gains on business parks can have a significant national impact. Their spatial clustering enables collective measures such as local energy hubs, shared heat networks and pooled grid capacity, while extensive roof areas and relatively high local acceptance make on-site renewable energy generation (especially rooftop PV and in some cases solar/wind nearby) highly scalable. Business parks also accommodate a significant share of the Dutch economy, hosting both industrial enterprises and a large proportion of SMEs. Advancing sustainability within these areas contributes not only to reducing emissions but also to enhancing regional economic resilience and competitiveness. Accelerating sustainability efforts on business parks is, therefore, essential for achieving national climate targets, particularly in the sectors of energy efficiency, renewable energy production and electrification. It is also essential for ensuring the long-term viability of industrial activity in the Netherlands (Nordkamp et al., 2021; Kamphuis et al., 2024). Furthermore, the electrification of energy use on business parks increases electricity demand by approximately 50% of current levels, underscoring the need for grid capacity expansion and local balancing (Kamphuis et al., 2024).

SMEs, which make up the majority of companies located on business parks, play a crucial role in the Dutch energy transition. They account for a substantial share of national energy consumption and are, therefore, key to reducing emissions and improving energy efficiency

(Kamphuis et al., 2024). SMEs also play a vital role in the broader Dutch economy and society. They contribute significantly to employment, innovation and regional value creation, while their entrepreneurial activities also fulfil important social functions (Nederlands Comité voor Ondernemerschap, 2024). Due to their smaller size and flexible organisational structures, SMEs are often more adaptable to technological change and shifting market conditions, allowing for quicker decision-making and potentially faster adoption of sustainable practices (Gherghina et al., 2020). Yet, SMEs remain underrepresented in energy policy despite their collective importance. They often face barriers such as limited financial capacity, lack of technical expertise and insufficient coordination at the local level. Targeted support for SMEs can therefore accelerate the sustainability transition, as many measures (such as building insulation, the electrification of heating and collective solar energy projects) are cost-effective and easily replicable across business parks (Nordkamp et al., 2021). Similarly, Kamphuis et al. (2024) highlights that SMEs and light industry outside the major industrial clusters hold a significant share of untapped energy-saving potential, capable of contributing several megatonnes of CO_2 reduction (Kamphuis et al., 2024).

2.3.1. Collaboration as necessary condition

Many SME owner-managers express positive attitudes toward environmental responsibility and collaboration, but this rarely translates into action (Lewis et al., 2015). In their study, Lewis et al. (2015) show that while 74% of SME owner-managers believe collaboration could improve competitiveness, only 24% engage in formal collaborations and 43% in informal collaborations based on a verbal agreement, experience or trust. Despite recognising potential benefits such as access to knowledge, new markets and a broader supply of products/services, SMEs often face barriers including a desire for independence, reluctance to share sensitive information and perceived risk. The study also found minimal differences in how collaborating and non-collaborating firms responded to environmental issues. This suggests that while the willingness to collaborate exists in principle, SMEs often require external support to turn intention into action. Lewis et al. (2015) argue that collaborative environmental initiatives are unlikely to be initiated and sustained by SMEs alone. Instead, they may need to be facilitated by intermediaries such as trade associations, industry networks or local authorities. These actors can help address information gaps, build trust and create the organisational infrastructure needed for sustained cooperation (Lewis et al., 2015).

A systematic literature review by Suchek and Franco (2023) highlights the growing importance of inter-organisational cooperation as a strategy for SMEs to engage in sustainability. Based on 55 empirical studies, the review shows that cooperation enables SMEs to overcome limitations such as lack of knowledge, capital and technical capacity by providing access to shared resources, innovation networks and organisational learning. Government programmes, NGOs and local authorities often act as facilitators, particularly in early collaborations, though many initiatives initially emphasised economic efficiency over broader sustainability goals. Key factors that support successful cooperation include sustainability-oriented leadership, informal trust-based agreements, resource complementarity and support from intermediaries, such as universities or chambers of commerce. Conversely, barriers include weak institutional support, lack of alignment between partners and limited internal capacity. Overall, the study concludes that inter-organisational cooperation is essential for SMEs to contribute meaningfully to sustainability transitions, but it must be embedded in supportive institutional and socio-economic frameworks (Suchek & Franco, 2023).

Verkade and Höffken (2019) offer a broader conceptual perspective by situating such collective practices within wider institutional and systemic contexts. They use the concept of collective energy practices to describe the coordinated activities of civic energy communities (CECs). These collective energy practices (individual energy practices, developing collective energy generation and development) emerge when individuals or organisations come together to do what they could not achieve alone. The authors show that collective energy practices are embedded within a broader system of energy practices, meaning that their development is shaped by interactions with other actors such as grid operators, policymakers and commercial suppliers. This systemic framing highlights that collective action in energy transitions does not happen in isolation but is co-shaped by institutional, technical and social structures. Although their focus is on citizen-led initiatives, the concept is equally relevant for understanding collective action among SMEs on business parks, where similar dynamics of shared purpose, resource pooling, institutional barriers and external dependencies are at play (Verkade & Höffken, 2019).

2.3.2. Governance as necessary condition

Following from Lewis et al. (2015), Suchek & Franco (2023) and Verkade & Höffken (2019), the role of governance and institutional design is also central to the formation and success of collective energy initiatives, next to inter-organisational collaboration. A global review by Leonhardt et al. (2022) highlights how government instruments significantly influence the viability and attractiveness of community energy projects, particularly in local, decentralised settings. Their analysis identifies four categories of policy instruments that shape collective energy action: payment-based tools, grid access regulations, environmental protection policies and planning and capacity-building instruments. While the study primarily focuses on citizen-led initiatives, its findings are also applicable to business-led collectives such as SME collaborations on Dutch business parks. The authors emphasise that the effectiveness of these instruments depends not only on their design, but also on contextual alignment with local needs, capacities and governance structures. Crucially, they argue that successful collective energy efforts require coordinated and complementary action across governance levels, from national subsidies to local planning and permitting. This echoes the importance of multi-level, networked governance in enabling collective action (Leonhardt et al., 2022).

Across the literature, the role of government and institutional support is seen as crucial. SMEunited (2024) concludes that facilitating easy access to clear, centralised information is essential. Equally important is providing accessible technical assistance to help entrepreneurs interpret and apply that information. Financial support schemes must be tailored to SMEs, with simple, fast application procedures that avoid unnecessary administrative burdens. The report also stresses the value of showcasing best practices and clearly communicating financial benefits to facilitate action from the SMEs' side. Because most SMEs lack in-house expertise, step-by-step, sector-specific guidance and individualised technical support are critical to enable action. These insights point to the importance of targeted, practical support structures in shaping SME investment behaviour in the energy transition (Kiraly & SMEunited, 2024). This aligns with Chenari's (2023) conclusion that gradual interventions are not enough; SMEs need comprehensive support that tackles financial, informational and organisational gaps simultaneously (Chenari, 2023). Aparisi-Cerdá et al. (2024) likewise highlight that political will, technological maturity and fiscal incentives and economic incentives collectively underscore the importance of mature, supported technologies for accelerating the adoption of decentralised renewable energy technologies (Aparisi-Cerdá et al., 2024). Bernat et al. (2024) argue that broader value-based communication and supportive EU energy transition policies are especially important for reaching low-energy-intensity firms and overcoming trust issues in under-supported markets (Bernat et al., 2024). Purwandani and Michaud (2021) emphasise that governmental entities can support SMEs by providing financial assistance, including tax reductions, incentives and subsidies. In addition, state agencies have an important role to play in offering accessible information and raising awareness. Educational strategies are effective in reducing misconceptions that green practices are inherently complex or financially burdensome. By providing clear guidance, improving access to sustainable technologies and showcasing best practices, public institutions can help lower both practical and psychological thresholds for SMEs to engage in more ambitious sustainability measures (Purwandani & Michaud, 2021). These perspectives suggest that SMEs will only act on their internal motivations when the external conditions are enabling.

Wiser (2006) adds an important behavioural perspective. His study examines how people's willingness to pay for renewable energy is influenced by different payment and governance arrangements. The study compares voluntary and collective payment mechanisms, as well as government versus private provision. Based on a large-scale survey of U.S. households, the study finds that collective (mandatory) payment schemes lead to higher willingness to pay than voluntary ones, likely due to reduced free-riding behaviour. Similarly, private provision of renewable energy services is associated with higher willingness to pay than government provision, possibly reflecting greater trust in private actors. Importantly, the study demonstrates that social expectations matter: respondents were more willing to contribute when they believed that others would do the same. These findings offer critical insights into the behavioural and institutional dimensions of collective investment in sustainability initiatives (Wiser, 2006). In the context of Dutch SME business parks, they highlight the importance of designing collective energy solutions that build on trust, reciprocity and credible governance structures to mobilise joint action and overcome barriers to cooperation.

In sum, enabling collective energy action on SME business parks requires both supportive institutional arrangements and targeted efforts to foster collaboration among firms. While external governance tools and intermediary support are essential, internal motivations, trust and the social design of collective schemes also play a crucial role. These interrelated factors must be addressed simultaneously to shift from individual responsibility to collective sustainability efforts.

2.3.3. Drivers and barriers

To understand how collective energy initiatives can be advanced within the context of SMEs on Dutch business parks, the following section examines the drivers and barriers that shape SMEs willingness and ability to invest in sustainable energy initiatives. These decisions are often influenced by structural and contextual conditions. Investments in green infrastructure are often made by different parties than those who benefit from them. This misalignment can reduce the motivation to invest for businesses. Another potential issue is that the benefits of such investments often only become apparent in the long term. Even then, the benefits may be incurred by parties other than the original investor. This can occur, for example, when an extreme weather event takes place and a green measure helps reduce the damage or when energy costs are lowered due to measures such as solar panels. It may also be the case that a measure (such as a green roof) has a longer lifespan. In such instances, the costs are borne by the investing party, such as the developer, while the benefits go to another party, such as the property manager or the renting business (Arcadis et al., 2021). This misalignment is particularly relevant in the context of business parks in the Netherlands, where many SMEs view sustainability as a lower priority. Entrepreneurs commonly argue that basic conditions such as cleanliness, safety and maintenance must be addressed first. This stance is understandable given the substandard condition of business parks. In the Netherlands, nearly 20% of conventional business parks are considered outdated. Of these, approximately one third are technically outdated, largely as a result of deferred maintenance. That is why restoring basic functionality is seen as a prerequisite to more ambitious sustainability efforts (Rli, 2023).

Numerous studies confirm that SMEs face a variety of interrelated barriers in adopting sustainability practices. Chenari (2023) provides a nuanced understanding of the barriers that SMEs face in adopting sustainable resource practices. Based on semi-structured interviews with 34 SME leaders, the study identifies three overarching categories of barriers: financial constraints, organisational challenges and external influences. Financial barriers include high upfront investment costs, limited access to funding and a lack of economies of scale. Organisational challenges stem from insufficient leadership commitment, low employee engagement and a lack of internal sustainability expertise. External influences such as inconsistent regulatory support, unsustainable supply chain practices and market pressure further complicate the adoption of sustainable strategies. The findings underscore the interconnectedness of these barriers, suggesting that addressing one dimension without considering internal capabilities or external support systems may not be effective (Chenari, 2023). The SMEunited (2024) report reinforces this, identifying access to funding and information as the two most critical barriers to SMEs engaging with the energy transition. Although many entrepreneurs recognise the importance of sustainability, they often lack the tools to act. Financial assistance is frequently difficult to access and information is often fragmented or overly complex (Kiraly & SMEunited, 2024). Similarly, Purwandani and Michaud (2021) observe that most SMEs favour low-cost sustainability practices like recycling and waste reduction, whereas more impactful but capital-intensive measures, such as energy efficiency upgrades or green certification, remain rare. The primary reason is a lack of capital. Their study also notes that internal motivation and public image are important drivers, but cannot substitute for missing financial support (Purwandani & Michaud, 2021). Bernat et al. (2024), studying micro and small enterprises in Poland, highlight similar constraints. These include limited knowledge and awareness, technical and financial barriers, energy illiteracy, entrenched consumption behaviours and a lack of trust and transparency in energy markets. Despite these barriers, the authors observe that energy cost savings and long-term efficiency goals can still motivate firms, especially when supported by EU energy policies or financial incentives (Bernat et al., 2024). Aparisi-Cerdá et al. (2024), analysing decentralised renewable energy adoption in Spain, identify techno-economic uncertainty, inadequate tariff structures, lack of standardisation, limited technical knowledge and institutional passivity as the most influential barriers, together accounting for 65% of all adoption obstacles. This confirms the broader finding that barriers are multidimensional and mutually reinforcing (Aparisi-Cerdá et al., 2024). According to Niers (2024), the barriers to participation in energy hubs mirror broader investment barriers but are amplified by the collective context. Entrepreneurs often face limited financial capacity and perceive high upfront costs for energy infrastructure as prohibitive, especially when returns are uncertain or long-term. Complexity and information asymmetry also pose challenges: many entrepreneurs lack a clear understanding of what an energy hub entails, how it operates and what benefits participation offers. Moreover, lack of trust and coordination mechanisms between firms on business parks hampers cooperation, as many businesses act independently and prioritise short-term operational concerns. The absence of a clear initiator or coordinating entity (such as park management or a public facilitator) further limits participation. Finally, entrepreneurs experience regulatory and contractual uncertainty, particularly regarding data sharing, governance responsibilities and the division of costs and benefits within the hub (Niers, 2024).

While barriers are significant, there are also internal and external drivers for investment in sustainability. De Boer (2022), in a mixed-method study of SMEs in the Dutch province of Fryslân, finds that a significant majority of SMEs actively seek ways to improve energy efficiency. The main drivers include environmental concern, anticipated long-term benefits and regulatory foresight, while customer demand and market pressure appear less influential. The study also reveals that energy efficiency investments often lead to increased organisational awareness, which can influence broader business operations. These findings suggest that SMEs do not merely respond to external mandates but may pursue energy efficiency as part of a strategic orientation towards sustainability, aligning with broader goals of the energy transition (De Boer, 2022). In their study, Bernat et al. (2024) observe a positive correlation between the implementation of specific energy efficiency measures (renewable energy generation, energy consumption monitoring and energy storage) and improved financial and market performance. This supports the view that energy transition initiatives can yield competitive benefits even for smaller firms (Bernat et al., 2024). Uhlaner et al. (2011) also highlight the importance of internal firm characteristics. Their study of Dutch SMEs moves beyond the conventional emphasis on firm size and identifies additional predictors such as sector tangibility, innovation orientation, perceived financial benefits and family ownership structures. The authors argue that SMEs' sustainable investment behaviours are shaped not only by resource availability but also by attitudes and perceived control. The perceived financial advantages of energy-saving measures emerged as the strongest direct motivator for environmental engagement, suggesting that economic self-interest remains a key driver of SME sustainability initiatives (Uhlaner et al., 2011). Purwandani and Michaud (2021) note that internal motivations and the desire to improve public image can drive low-cost green actions even when financial constraints persist. Thomas, Castellano, et al. (2024) offer further nuance by examining SMEs in Italy. Their framework distinguishes four categories of influencing factors: country-specific conditions, firm-specific factors, social and psychological traits and stakeholder pressures. Using structural equation modelling, they find that only the first and third categories significantly affect investment behaviour. In other words, external factors such as regulations, incentives and access to technology, as well as internal motivations such as environmental awareness and managerial values, play a decisive role. Conversely, firm-level economic considerations and stakeholder pressures were not statistically significant. This reinforces the notion that cultural and contextual drivers are more important than market dynamics alone (Thomas, Castellano, et al., 2024). Complementing this, Thomas, Scandurra, et al. (2024) argue that corporate culture is the single most important driver for SME investment in sustainability. Their research identifies awareness and commitment from owners and employees as the primary drivers behind an enterprise's decision to invest in the energy transition. While financial incentives and regulatory obligations are helpful, they are often insufficient to overcome internal passivity unless cultural buy-in is present. However, the authors caution that even a strong internal culture cannot compensate for structural limitations such as financial constraints or unclear regulations (Thomas, Scandurra, et al., 2024). Niers (2024) identifies several drivers that motivate entrepreneurs to participate in energy hubs, many of which align with broader drivers of sustainable investment. Key motivators include the desire for energy security, particularly in light of rising prices and grid congestion and the opportunity to reduce dependence on external energy suppliers. Entrepreneurs also value cost savings, especially through shared infrastructure and collective purchasing power and see participation as a way to future-proof their operations against upcoming sustainability regulations. Beyond economic drivers, social and reputational factors play a role: participation can enhance a company's sustainable image and foster collaboration within the business park community. Finally, trust and visible leadership, for example, from park management or frontrunner firms, act as enablers that lower the perceived risks of joining collective energy initiatives (Niers, 2024).

Overall, the literature indicates that SME investment in the energy transition is shaped by a web of interdependent barriers and drivers. While many firms are motivated by environmental values and strategic foresight, their ability to act is constrained by financial, organisational and regulatory factors. Moreover, misalignments in benefit distribution and the poor condition of physical infrastructure further complicate sustainable investment. To accelerate SME engagement in the energy transition, multi-level strategies are required. These should combine accessible funding, regulatory clarity and targeted knowledge support with efforts to raise internal commitment and sustainability culture. Only when internal motivations align with supportive external conditions can the potential of SMEs in the energy transition be fully unlocked.

To further understand how SMEs engage with collective forms of energy generation and management, recent studies have explored the behavioural, institutional and economic conditions that shape their participation or investment decisions in collaborative energy initiatives. A closely related study by Eslamizadeh et al. (2022a) investigates the willingness of industrial companies in Iran to invest in Industrial Community Energy Systems (InCES), a form of collective renewable energy generation within industrial clusters. The study states that in many developing economies, the industrial sector faces an increasing disparity between the rapid expansion of the sector and the limited capacity of the energy supply. A similar mismatch is increasingly evident in The Netherlands. Here, the accelerated growth of the electricity demand is driven by the energy transition. This growth is outpacing the development of grid infrastructure, contributing to widespread grid congestion (RVO, 2025b). The findings of Eslamizadeh et al. (2022a) underline the importance of social, environmental and institutional factors in shaping investment behaviour. These factors include the crucial role of awareness of renewable energy benefits, strong community identity, trust between firms and confidence in institutional arrangements. These determinants align closely with the themes explored in this thesis. However, their study is situated in the context of a developing economy with an unstable energy market, limited financing options and a strong government presence in energy pricing (Eslamizadeh et al., 2022a). In contrast, this thesis focuses on Dutch SME business parks, where firms operate in a liberalised energy market, often face capacity constraints (e.g. grid congestion) and are influenced by strong sustainability policies at both the European and national levels (Rli, 2023). By examining similar behavioural drivers in a different institutional and economic setting, this study contributes to understanding how context shapes SME investment behaviour in collective energy solutions. It also responds to the call for more comparative insights into how social and structural conditions affect the feasibility and uptake of collaborative energy initiatives. In another study, Eslamizadeh et al. (2022b) explore the conditions under which industrial firms choose to participate in InCESs. Using an agent-based model, the study simulates how financial incentives and social decision rules affect firm participation across six countries, including the Netherlands. The results demonstrate that tax incentives are the most effective mechanism for encouraging firms to establish and sustain InCESs, outperforming both feed-in tariffs and tradable green certificates in terms of renewable energy generation and firm participation. Notably, the model shows that economic viability is a stronger predictor of participation than social or cultural dynamics, although strong peer networks and trust do play a role in initiating new energy collectives. These insights highlight the importance of designing financial and institutional frameworks that align with firms' rational, profit-oriented decision processes, particularly in settings like Dutch SME business parks where collaboration is voluntary and cost-sensitive (Eslamizadeh et al., 2022b). Building on this work, a more recent study by Eslamizadeh et al. (2023) investigates the internal institutional arrangements and social dynamics that influence the successful establishment of Industrial Community Energy Systems. Using agent-based modelling grounded in empirical data from the Arak industrial cluster, the study explores how design choices shape participation and system stability. These design choices include flexible membership rules, energy capacity buffers and payment enforcement mechanisms. The results demonstrate that inclusive and adaptable institutional designs significantly improve participation rates and system resilience, especially when trust among firms is moderate and consumption behaviour is diverse. Importantly, the study reinforces the insight that economic viability remains the dominant factor, but also shows that institutional clarity and fairness can mitigate social frictions and reduce dropout risks. Together with the 2022b study, these findings highlight that while financial incentives are essential to initiate collective energy solutions, the design of governance structures within collectives plays a critical role in sustaining them over time (Eslamizadeh et al., 2023). Taken together, these studies suggest that SME investment in collective energy solutions is shaped by a similar interplay of financial, institutional and social factors as observed in individual sustainability efforts. While economic viability remains the dominant driver, successful uptake and long-term participation in initiatives like Industrial Community Energy Systems depend heavily on well-designed governance structures, institutional clarity and social trust. This reinforces the broader insight that SMEs are motivated not only by profit but also by cultural and contextual factors and that internal motivation must be matched with enabling external conditions.

A Dutch report from the RVO commissioned by the Ministry of Economic Affairs and Climate offers a complementary perspective on these dynamics by exploring the issues mentioned before in the setting of Dutch business parks (De Gier & Koenen, 2018). The study shows that while sustainability of the energy system is widely recognised as relevant, implementation often lags due to financial constraints, lack of time, limited knowledge and insufficient coordination among companies. Clear agreements on financing, active municipal and provincial support and better insight into funding opportunities are seen as essential conditions for progress. The report also notes cautious optimism regarding collective approaches: many organisations expect substantial participation if government co-financing is available, with investment funds and energy cooperatives viewed as promising financing models. Overall, the findings highlight that effective collective energy initiatives on business parks require shared financial frameworks, institutional support and accessible knowledge to translate ambition into action (De Gier & Koenen, 2018).

A more recent regional study provides broader insights into how the energy transition on business parks can be accelerated through regional coordination and governance. The Key Region Leiden report (2023) emphasises that progress on sustainability requires more than technological innovation or financial investment; it depends on coherent governance, collaboration and long-term institutional support (Zwart, 2023). The study highlights that the success of energy transition efforts on business parks relies on strong regional cooperation and governance structures that align the ambitions of municipalities, grid operators and business associations. Clear coordination between these actors is essential to balance sustainability goals, grid capacity and investment planning. While the report addresses a range of sustainability measures, from energy efficiency and renewable generation to heat networks and grid optimisation, it also identifies collective energy approaches as particularly promising, scalable solutions within this framework. However, the report notes that knowledge about collective approaches remains limited and poorly accessible, making it unclear who is responsible for facilitating and disseminating such expertise. To accelerate progress, the study stresses the need for dedicated intermediaries that can guide the process of developing collective projects and systematically capture and share lessons from existing pilots. Moreover, current legislation is strongly oriented towards individual entrepreneurs and grid connections, rather than larger, shared facilities. This legal framework creates significant barriers for collective initiatives such as shared solar roofs, parking facilities with charging infrastructure or multi-user energy hubs. The report warns that this individualised legal structure risks becoming untenable as the energy transition advances. To address these challenges, the report recommends strengthening intermediary structures, such as regional project offices or park management alliances, that can support business parks with expertise in financing, technical design and stakeholder engagement. It also calls for regulatory reform that explicitly enables shared facilities and collective energy systems, allowing entrepreneurs to collaborate without being legally bound as a single installation. By connecting local initiatives to regional coordination platforms and embedding sustainability within regional development agendas such as innovation, circularity and workforce policy, the study shows how business parks can move from fragmented pilot projects to long-term, scalable strategies that reinforce both competitiveness and regional cohesion (Zwart, 2023).

Across the reviewed literature, the formation of collective energy is primarily motivated by behavioural and social drivers, energy security concerns, expected cost savings, environmental values, trust and local leadership, manifesting at the lower (firm and park) scales. Progressing to formalisation, projects increasingly depend on governance design, financing instruments, contracting models and institutional clarity at higher (park, regional and national) levels. Conditions such as inter-organisational collaboration, intermediary support, clear governance arrangements and accessible financial frameworks are essential. In their absence, collective ambitions fail to materialise. Based on this, Figure 5 shows the projected determinants of the implementation across scales, dimensions and project stages.

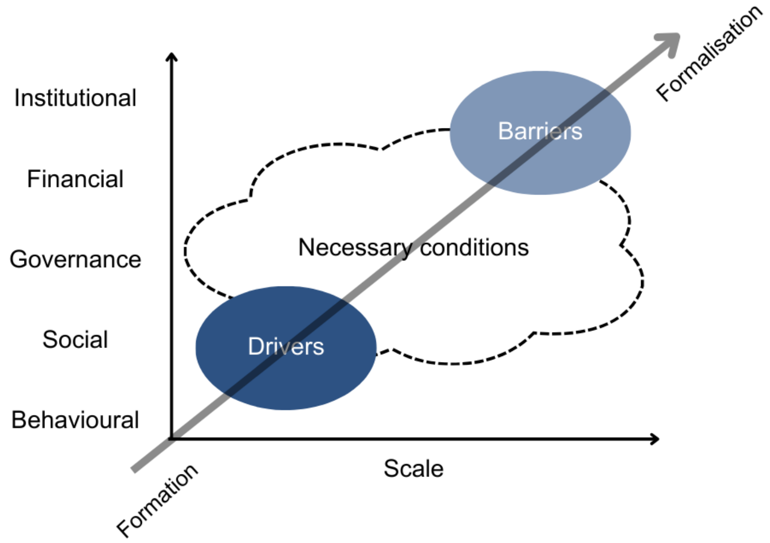

Figure 5: Determinants of implementing collective energy, from the literature (own work)

3. Research methodology

This study employs a comparative and exploratory qualitative research design (Figure 6). Multiple use cases will be compared and explored through conducting semi-structured interviews with different stakeholders. First, a literature review will be conducted to define key concepts, develop a theoretical framework and identify expected drivers and barriers related to collective energy. The review will include both academic and grey literature, including market reports and relevant policy or research documents from government and industry bodies. A use case approach provides contextual structure for this study. The use cases (different business parks) serve to identify and compare drivers and barriers for the implementation of collective energy across different contexts, guiding both the design and interpretation of the interviews. Subsequently, semi-structured interviews, informed by literature, will be conducted with different stakeholders across multiple business park contexts in the Netherlands. The interviews will offer qualitative depth, explore personal motivations, experiences and contextual influences on the implementation of collective energy initiatives. Finally, findings will be triangulated and validated through an expert meeting.

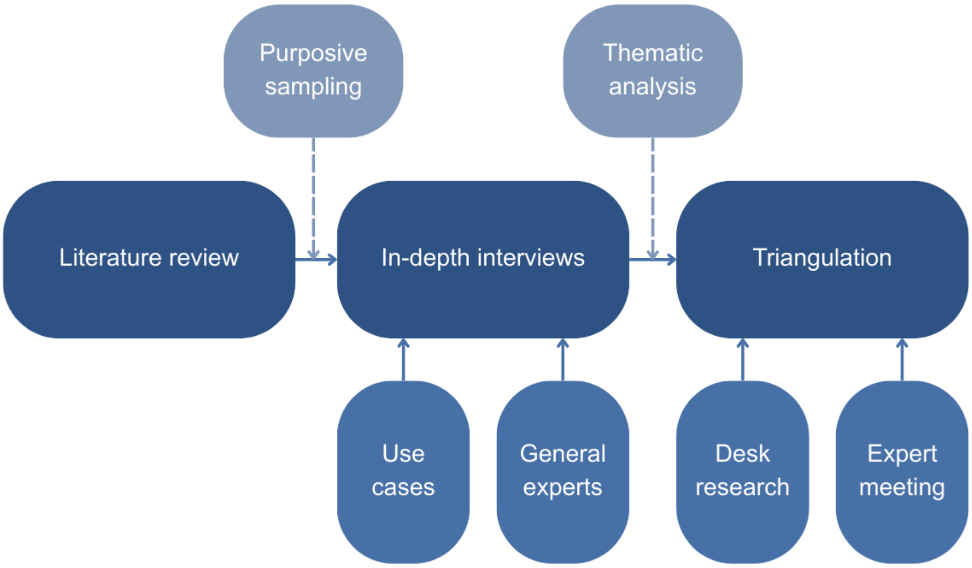

Figure 6: Qualitative research design (own work)

The use cases are selected to capture a broad understanding of the drivers and barriers influencing collective energy initiatives on Dutch SME business parks. A purposive sampling strategy will be applied to include business parks that differ in key contextual characteristics, such as the presence or absence of energy pilots, type of energy infrastructure, organisational maturity and governance model. Variation will also be sought in park size and geographic location. This diversity allows the study to compare different spatial, institutional and organisational settings, identifying both shared and context-specific factors. Table 1 provides an overview of the selected use cases, their collective energy measures, operational status and key contextual characteristics. The use cases can be divided in three categories: Business parks with a pilot status and an operational collective energy system (operational pilots), business parks with a pilot status but without an operational collective energy system (non-operational pilots) and business parks without a pilot status and, therefore, without an operational collective energy system (non-pilot parks).

Table 1: Overview of use cases (own work)

	Collective energy measure	**Operational?**	**Contextual characteristics**
Use case 1	Pilot: energy hub	Yes	Noord-Brabant, 70 ha, *coöperatie*, 5 businesses in energy hub (18 in *samenwerkingsovereenkomst*), pilot-GTO, business park recently completed (new)
Use case 2	B-ontheffing: CDS	Yes	Gelderland, 75 ha, *coöperatie* (*coöperatief parkmanagement*), private electricity grid, CDS developed on empty plots (new)
Use case 3	Pilot: energy hub	From 2026	Noord-Holland, 70 ha, business park still under development (new), active developer, *parkmanagement, energie coöperatie*
Use case 4	Pilot: energy hub	Yes	Utrecht, 310 ha (existing: established begin 20th century), *industrievereniging*, *park-management*, *ondernemersfonds, coöperatie*, pilot-GTO with 5 businesses
Use case 5	Pilot: multi commodity energy hub (MCEH)	From 2028	Gelderland, 220 ha, business park is being expanded and renewed, MCEH for new park (50 ha), *ondernemersfonds*, but *energie-maatschappij* & *parkmanagement* are also being established
Use case 6	No collective energy	N/a	Zuid-Holland, 10 ha (existing: established begin 20th century), *ondernemersvereniging*, *BIZ*, *energie coöperatie*, ambition for an energy-positive park
Use case 7	No collective energy	N/a	Zuid-Holland, 15 ha (existing: established end 20th century), *ondernemersvereniging*, *parkmanagement*, ambition to be energy and climate neutral
Use case 8	Exploration phase	N/a	Limburg, 140 ha (existing: established mid 20th century), *vitaalvereniging, parkmanagement,* ambition to be climate neutral, exploring collective energy option: currently analysing user profiles

To capture a broad range of perspectives on the implementation of collective energy initiatives, a purposive sampling strategy was applied to select stakeholders relevant to the research topic. Interviewees were chosen for their experience with (collective) energy-related initiatives, leadership roles within business parks or positions within specific sectors. The sample includes seven stakeholder groups: SME entrepreneurs, park managers, energy hub coordinators, government representatives, distribution system operators (DSOs), developers and specialists or advisors. This diversity ensures that both operational and institutional perspectives are represented, allowing for comparison across different roles and business park contexts. Table

2 provides an overview of the interviewees, their stakeholder group and their role. It also shows the scale in which they operate, indicating whether their influence and decision-making take place at the company, business park, regional, national or global level.

Table 2: Overview of interviewees (own work)

Stakeholder group	Scale	Stakeholder role
SME entrepreneurs	Company	Entrepreneur 1
	Company	Entrepreneur 2
Parkmanagers	Business park	Parkmanager 1
	Business park	Parkmanager 2
	Business park	Parkmanager 3
Energy hub coordinator	Business park	Coordinator
Developers	Business park	EH project manager 1
	Business park	EH project manager 2
	Regional / business park	Developer
Specialists/advisors	Business park	Specialist 1
	Business park	Specialist 2
	National / business park	Specialist 3
	National / business park	Specialist 4
DSOs	Regional	DSO actor 1
	Regional	DSO actor 2
	Regional	DSO actor 3
Governments	Business park	Municipality actor 1
	Regional / business park	Municipality actor 2
	Regional / business park	Municipality actor 3
	Regional	Province actor
	National	Ministry EZ actor

To clarify the composition of the sample, interviewees were categorised according to the stakeholder role they fulfil in the context of collective energy initiatives. This categorisation is a descriptive outcome of the sampling process. It shows the functional positions represented in the dataset and the types of responsibilities these actors typically hold within business park energy developments. Based on the interviews, a brief profile of each stakeholder group was constructed, summarising the tasks they perform in practice. Table 3 presents an overview of the stakeholder groups in the study and outlines the tasks associated with each role, as described by interviewees themselves. It should also be noted that collective energy on Dutch business parks is still in full development. As a result, roles are not yet clearly defined: the same task may be carried out by different stakeholders depending on the park's context and organisational maturity. This fluidity means that the stakeholder roles should be understood as a reflection of how responsibilities were described in the studied cases, rather than a fixed role division. Their inclusion here serves to clarify the diversity represented in the sample.

Table 3: Stakeholder roles and their tasks (own work)

Role	Task (based on interview quotes)
Advisor	Provide technical and contractual expertise; support selection of EMS and collective solutions; act as sparring partner; translate complex information for entrepreneurs; conduct analyses; sometimes lead outreach; provide independent, trusted advice.

Developer (gebiedsontwikkelaar)	Ensure energy availability; hand over long-term operations to park management once development is done; stimulate intensification & sustainability on business parks.
DSO (netbeheerder)	Provide contract forms (GTO, non-firm, flex products); clarify possibilities and constraints; ensure grid safety and equal possibilities; offer transparency (data, asset limits); enable pilots; co-design workable contract forms; give long-term clarity; support with process guidance where possible; keep infrastructure reliable; communicate realistic, honest timelines.
Entrepreneur	Ensure continuity of business operations; signal problems and raise their hands as early adopters; maintain ownership of decisions; invest time and money when urgency exists; participate in co-operative governance; share data; help build trust with other firms; share success stories with peers.
Entrepreneurs' association	Provide an organised platform for collaboration; connect firms; initiate collective issues; support board in decision-making; communicate consistently with members; maintain community cohesion; bring forward motivated entrepreneurs; act as trusted intermediary; sometimes act as implementing organisation for collective assets; keep attention on shared problems.
Government (municipality, province, ministry)	Facilitate, finance and coordinate early phases; assign process managers; pressure DSOs for flexibility and faster contract development; set long-term, consistent policy; support with subsidies, guarantees and risk capital; ensure regulatory conditions; provide neutral information; keep focus on entrepreneurs' actual needs; create uniform national frameworks; enable data-sharing rules.
Parkmanagement	Act as initiator, coordinator and/or long-term operator; bring companies together; maintain neutral position; communicate continuously; identify firms' needs; connect to municipality/DSO; sometimes execute collective projects; guide entrepreneurs toward opportunities; maintain long-term continuity of business park; be the "face on the terrain" who knows everyone; push innovation and sustainable actions.
Project manager / coordinator	Be the "spider in the web"; orchestrate the entire process; connect stakeholders; identify problems and urgency; coordinate technical and organisational steps; organise meetings; drive community building; chase firms individually where needed; ensure project momentum; translate between engineering, governance and firms; prepare and monitor implementation.

3.1. Data collection

The literature search follows a structured strategy to ensure both academic rigour and contextual relevance. Databases consulted include Scopus, the TU Delft Repository and Google Scholar. To complement these, exploratory tools such as Research Rabbit and Elicit are used to identify connections between sources. Literature recommended by supervisors and sources found through snowballing techniques are also included. Search queries combine keywords such as *"SME"*, *"entrepreneur"*, *"collective energy"*, *"business park"*, *"investment behaviour"*, *"sustainability"* and *"governance"*, using Boolean operators (e.g. AND, OR) to refine results. Studies are excluded if they are non-empirical or lack clear relevance to the research focus.

Inclusion criteria are:

- Empirical or theoretical contributions
- Preference for publications from 2015 onwards
- Relevance to SMEs, investment behaviour, the energy transition/sustainability or industrial/business park contexts
- Focus on collective action or governance structures
- Peer-reviewed academic literature or grey literature (e.g. policy and market reports)
- English-language sources or Dutch sources when necessary for local context

The selected literature is thematically structured into three main domains: (1) collective action, (2) collective energy context and solutions and (3) SME and business park context, including drivers and barriers. The literature review informs the following empirical research. The study applies a use case approach to contextualise the implementation of collective energy initiatives on Dutch business parks. A use case describes how actors interact with a system within a specific context to achieve certain outcomes. While originally developed in systems engineering, the concept has since been applied in broader innovation and organisational settings. Use case scenarios can be used to analyse how actors, technologies and contextual conditions interact within innovation projects like energy initiatives (Henke, 2024). In this study, each business park represents a use case, a contextual example, used to identify the main drivers and barriers influencing collective energy initiatives under different spatial, institutional and infrastructural conditions. By briefly outlining these contexts, the use case approach helps to explain how differences in organisation, governance and infrastructure influence decision-making, while keeping the analysis focused on the actors themselves.

Within this framework, the use case approach serves as the structural basis for the empirical research. Each business park provides a contextual setting for the interviews, ensuring that stakeholder perspectives are interpreted in relation to their specific circumstances. This connection allows the interview data to be compared across cases, highlighting how similar drivers and barriers manifest differently depending on the local context. The interviews form the primary source of insight within each use case. Semi-structured interviews will be conducted with different types of stakeholders (SME entrepreneurs, park managers, government entities, advisors, grid operators) who are involved in different collective energy initiatives and different business park contexts. The interview protocol is based on key themes identified in the literature review and will be supplemented with themes discovered during the empirical research. Interviews will explore relevant types of collective energy supply, organisational structures for collaboration, entrepreneurial investment motivations and perceived barriers, conditions for collective energy initiatives and possible interventions. The full interview protocols per stakeholder group can be found in Appendix A.

3.2. Data analysis

The collected qualitative data will be analysed using thematic analysis. Interview transcripts are coded through a combination of deductive and inductive approaches, following Burnard et al. (2008). Deductive coding applies categories derived from the theoretical framework and existing literature, providing structure and comparability across interviews. In contrast, inductive coding allows themes to emerge directly from the data through iterative reading and refinement of categories. This combination ensures both theoretical grounding and openness to new insights. Coding will be conducted in ATLAS.ti, enabling systematic organisation and comparison of coded material while maintaining researcher-led interpretation. After initial coding, overlapping or related codes are combined into broader categories. These categories are then refined and grouped into main themes that reflect the overall content of the interviews (Burnard et al., 2008). In this research, the themes are separated into context- and content-related categories. The context-related categories are (1) ideas and opinions (on collective energy), (2) context (of the business park), (3) process (of the initiative) and (4) stakeholder roles. The content-related categories are (1) scales, (2) barriers (incl. dimensions), (3) drivers (incl. dimensions) and (4) necessary conditions (incl. dimensions). To guide the coding and ensure consistent interpretation across interviews, barriers, drivers and necessary conditions are understood as analytically distinct categories. Barriers refer to factors that hinder or slow down the development or implementation of collective energy initiatives. Drivers describe factors that stimulate or accelerate engagement. Necessary conditions (from now on: conditions) are defined as factors that must be in place for collective energy initiatives to be feasible or effective, serving as enabling conditions rather than direct motivations.

To systematically analyse how barriers, drivers and conditions manifest across different contexts, the coded interview data will be organised along two analytical axes: scale and dimension. The vertical axis represents six analytical dimensions that structure the nature of the factors identified in the data: Technical (T), Environmental (E), Commercial (C), Operational (O), Political (P) and Social (S). These dimensions are an adapted version of the TECOP framework, originally developed as a risk assessment tool in project management (Hillson, 2003). In this research, the framework was reinterpreted as a categorisation model to group the identified drivers, barriers and enabling conditions influencing collective energy initiatives on Dutch business parks. The rationale for using TECOP lies in its coverage of the key domains affecting such initiatives. To capture social dynamics such as trust, collaboration and motivation, which are critical for collective action, a sixth 'Social' category was added. The adapted framework thus enables a systematic yet flexible interpretation of the qualitative data. The six analytical dimensions are defined as follows:

The **Technical** dimension refers to the technical feasibility, complexity and performance of collective energy systems. It includes the availability and maturity of solutions, the compatibility of load profiles and the extent to which firms possess the required technical expertise.

The **Environmental** dimension concerns sustainability ambitions, ecological considerations and the extent to which environmental goals are integrated into company or park strategies.

The **Commercial** dimension covers economic and financial considerations such as cost savings, competitiveness, price stability, property value and the strategic importance of securing future energy supply for business continuity.

The **Operational** dimension relates to the day-to-day functioning of businesses and business parks, including congestion pressures, operational urgency and continuity, managerial capacity and the practical effort required for collaboration.

The **Political** dimension captures regulatory frameworks, policy signals, subsidy conditions, governance arrangements and the pace and capacity of public authorities and DSOs.

The **Social** dimension captures relational and behavioural factors. It refers to interpersonal and organisational dynamics such as trust, reciprocity, peer influence, communication, collaboration culture and collective identity.

The horizontal axis represents the scale at which these factors occur or exert influence, ranging from the company level, through business park, regional and national levels to the global level. Each coded segment from the interviews in ATLAS.ti was assigned both a dimension (indicating the type of factor) and a scale (indicating the spatial or institutional level at which it manifests). This double classification enables a cross-scalar interpretation of the empirical findings. To visualise the relative prominence of different types of factors, a bubble chart will be created. Figure 7 presents an illustrative example of the visualisation format, included here solely to demonstrate the analytical approach. Each bubble represents the frequency and qualitative significance of a factor type occurring within a particular dimension–scale combination. The size of the bubble corresponds to the number of coded references and the colour tone distinguishes between barriers, drivers and conditions. This visual mapping allows for an integrative comparison of how certain types of barriers, drivers or conditions are concentrated at specific levels of action (scales) and within particular thematic domains (dimensions). In doing so, it provides an overview of the distribution and interaction of factors influencing the development of collective energy initiatives across multiple levels.

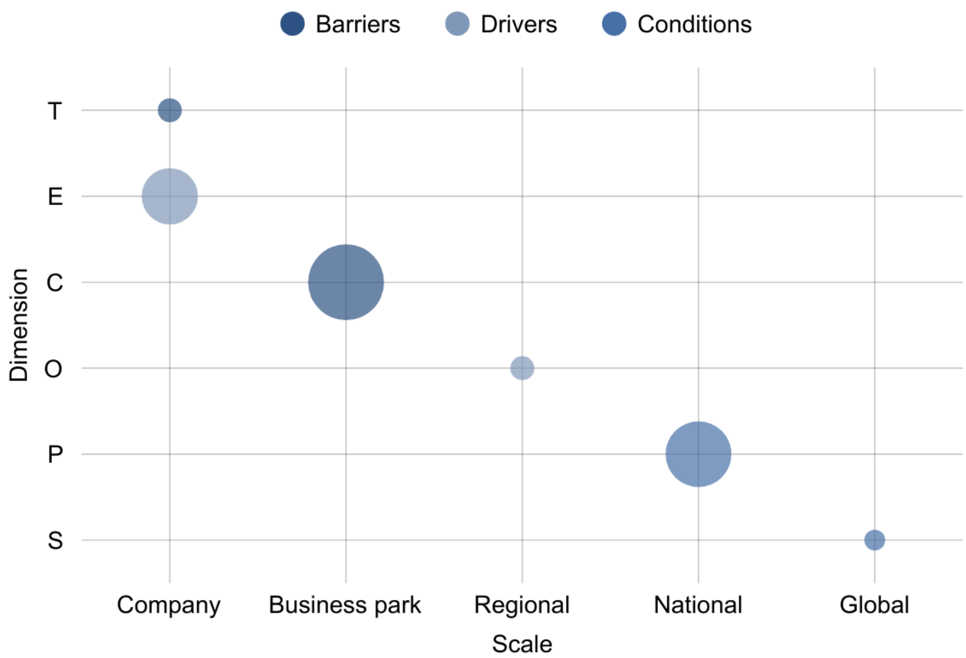

Figure 7: Illustrative example chart (own work)

To ensure the validity and reliability of the findings, several strategies will be applied. Credibility will be strengthened through triangulation of data sources and use cases. Interview data will be cross-checked with desk research, including policy documents, project reports and materials provided by interview participants or other involved parties. Findings will also be compared across the different business park use cases to validate recurring drivers and barriers and to identify context-specific variations. In addition, a validation process will be carried out in which external experts in the field of collective energy will be consulted to assess the plausibility and relevance of the conclusions, thereby reinforcing the practical validity of the research outcomes.

4. Results

This chapter presents the empirical findings of the study, based on the thematic analysis of interviews conducted across the selected use cases and the general expert interviews. The results provide insight into how drivers, barriers and conditions for collective energy manifest within different SME business park contexts and how these factors relate to the dimensions and scales used in the analytical framework. The results are presented in four steps, starting with an overview of how drivers and barriers are distributed across the use case categories. The second part of the results shows the co-occurrence tables exported from ATLAS.ti that show the outcomes of the thematically coded interviews within the use case categories. The third part presents the co-occurrence tables of all interview data, including all use case and general interviews. Lastly, the fourth part translates these co-occurrence patterns into bubble charts. These visualisations provide an integrated overview of the relative weight and distribution of drivers, barriers and conditions across dimensions and scales.

Table 4 presents the distribution of drivers and barriers across the different use case categories selected for this research. It shows how the balance between motivating and constraining factors varies depending on the status of its collective energy form, by dividing the use cases into the three analytical categories used in this study: operational pilots, non-operational pilots and non-pilot parks. Of the eight business park cases analysed, five are designated as pilots (three operational and two non-operational), while three concern non-pilot parks. The table shows how often drivers and barriers are mentioned in the interviews within each category. Non-pilot parks show a higher share of barriers, while operational pilots show almost as many drivers as barriers. Non-operational pilots, on the other hand, show a larger share of drivers. A recurring theme across the interviews is the difference between developing a collective energy system on a new (yet-to-be-developed) business park versus an existing one, describing the latter as more difficult. This distinction also appears in the use cases: four out of the five pilots concern new business parks.

“Op een bestaand bedrijventerrein zit historie. Partijen weten welk gecontracteerd vermogen ze hebben. Op een nieuw bedrijventerrein ligt geen historie.” – Coordinator

“Het is ook een stukje lastiger om het op een bestaand bedrijventerrein voor elkaar te krijgen dan op een heel nieuw bedrijventerrein. Dan kun je het als een van de voorwaarden stellen.” – Municipality actor 2

Table 4: Amount of drivers and barriers for each use case category (ATLAS.ti export, own work)

	0. Non-pilot park 5 309	1. Non-operational pilot 2 139	2. Operational pilot 5 301	Totals
Barriers 6 279	83 58,45%	14 36,84%	63 50,81%	160 52,63%
Drivers 6 226	59 41,55%	24 63,16%	61 49,19%	144 47,37%
Totals	142 100,00%	38 100,00%	124 100,00%	304 100,00%

To deepen this comparison, the following subsections present co-occurrence tables for each use case category. These tables show how drivers, barriers and conditions are distributed across analytical dimensions and scales within the non-pilot parks, non-operational pilots and operational pilots. Each cell represents the co-occurrence of a specific dimension with a specific scale, indicating how often this combination was coded in the interview data. In other words, the tables illustrate how frequently drivers, barriers or conditions appear at the intersection of particular dimensions and scales within the three use case types. This provides a more detailed view of the thematic patterns before turning to the combined co-occurrence tables and the subsequent visualisations.

Table 5: Co-occurrence of dimensions and scales for identified barriers in non-pilot parks (ATLAS.ti export, own work)

		0. Company level 89	1. Business park l... 57	2. Regional level 25	3. National level 25	4. Global level 2
Commercial barrier	10	9			1	
Environmental barrier	2	1	1			
Operational barrier	11	9	1			
Political barrier	31	5	9	9	10	
Social barrier	19	8	6	4		
Technical barrier	11	8	2	1		

Table 6: Co-occurrence of dimensions and scales for identified drivers in non-pilot parks (ATLAS.ti export, own work)

		0. Company level 89	1. Business park l... 57	2. Regional level 25	3. National level 25	4. Global level 2
Commercial driver	15	12	1		1	
Environmental driver	8	7	1			
Operational driver	12	9	6			
Political driver	11	3	1	2	2	2
Social driver	16	8	7	1		
Technical driver	2	1	1			

Table 7: Co-occurrence of dimensions and scales for identified conditions in non-pilot parks (ATLAS.ti export, own work)

		0. Company level 89	1. Business park l... 57	2. Regional level 25	3. National level 25	4. Global level 2
Commercial condition	5	4		1		
Environmental condition	0					
Operational condition	13	6	6	2	1	
Political condition	20	1	2	6	12	
Social condition	14	3	11			
Technical condition	15	4	8	2		

The results presented in the tables above (Table 5, 6,7) follow from the use case category non-pilot parks. This category includes business parks without a pilot designation and without an operational collective energy system. These parks represent cases in which no formal experimentation or structured development process has been initiated. The tables below show how drivers, barriers and conditions are distributed across dimensions and scales for this category. The non-pilot parks in this study are use cases 6, 7 and 8.

Table 8: Co-occurrence of dimensions and scales for identified barriers in non-operational pilots (ATLAS.ti export, own work)

	0. Company level 39	1. Business park l... 19	2. Regional level 4	3. National level 4	4. Global level 0
Commercial barrier 1	1				
Environmental barrier 0					
Operational barrier 5	3	2			
Political barrier 2			1	1	
Social barrier 3	2		1		
Technical barrier 3	2	1		1	

Table 9: Co-occurrence of dimensions and scales for identified drivers in non-operational pilots (ATLAS.ti export, own work)

	0. Company level 39	1. Business park l... 19	2. Regional level 4	3. National level 4	4. Global level 0
Commercial driver 4	5				
Environmental driver 3	3				
Operational driver 8	9				
Political driver 2	1	1		1	
Social driver 7	5	1			
Technical driver 5	4				

Table 10: Co-occurrence of dimensions and scales for identified conditions in non-operational pilots (ATLAS.ti export, own work)

	0. Company level 39	1. Business park l... 19	2. Regional level 4	3. National level 4	4. Global level 0
Commercial condition 5	4	1			
Environmental condition 0					
Operational condition 5	1	3	2		
Political condition 10	3	5		3	
Social condition 9	2	7			
Technical condition 6	2	4	1		

The results shown above (Table 8, 9, 10) relate to the use case category non-operational pilots. These business parks have been designated as pilots but do not yet have an operational collective energy system. They are in a phase where planning, coordination and early development activities have taken place, but implementation has not progressed to a functioning system. The tables below present the distribution of drivers, barriers and conditions for this category. The non-operational pilot parks included in this study are use cases 3 and 5.

Table 11: Co-occurrence of dimensions and scales for identified barriers in operational pilots (ATLAS.ti export, own work)

		0. Company level 82	1. Business park l... 58	2. Regional level 5	3. National level 13	4. Global level 0
Commercial barrier	13	12	1			
Environmental barrier	0					
Operational barrier	24	14	8		1	
Political barrier	16	4	3	2	8	
Social barrier	14	9	4			
Technical barrier	2	1	1			

Table 12: Co-occurrence of dimensions and scales for identified drivers in operational pilots (ATLAS.ti export, own work)

		0. Company level 82	1. Business park l... 58	2. Regional level 5	3. National level 13	4. Global level 0
Commercial driver	11	10	1			
Environmental driver	5	4	1			
Operational driver	16	13	2	1		
Political driver	6	1	2		1	
Social driver	13	3	10			
Technical driver	14	8	6			

Table 13: Co-occurrence of dimensions and scales for identified conditions in operational pilots (ATLAS.ti export, own work)

		0. Company level 82	1. Business park l... 58	2. Regional level 5	3. National level 13	4. Global level 0
Commercial condition	13	5	5			
Environmental condition	0					
Operational condition	10	3	6	1		
Political condition	13		5	1	5	
Social condition	9	1	8			
Technical condition	3		3			

The results in the tables above (Table 11, 12, 13) are based on the use case category operational pilots. These business parks have a pilot status and possess a functioning collective energy system. They represent the most mature category in the sample, allowing insights into the factors at play when collective systems are already in operation. The tables below show how drivers, barriers and conditions are distributed across dimensions and scales for these cases. The operational pilot parks in this study are use cases 1, 2 and 4.

Having examined the co-occurrence patterns within each use case category, the analysis now turns to the combined interview dataset, including both the use case interviews and the general expert interviews. The following tables present the overall co-occurrences of dimensions and scales across all material, offering an integrated view of how drivers, barriers and conditions are distributed across these different dimensions and scales. The combined analysis reveals several overarching patterns that indicate where the main enablers and obstacles for collective energy initiatives are situated. Barriers are mentioned most frequently (293 instances), followed by drivers (248) and conditions (228), indicating that stakeholders primarily experience the implementation of collective energy through constraints and challenges, while recognising the presence of important drivers and enabling factors.

Tables 14, 15 and 16 present the co-occurrence matrices exported from ATLAS.ti that show the outcomes of the thematic coding of the combined interview data set. Each table shows how often a specific type of coded element (condition, driver or barrier) appears in combination with a particular dimension and scale. The values in the cells indicate the frequency with which these combinations occurred across all interview quotations. Higher numbers therefore reflect stronger thematic presence within that specific dimension–scale pairing.

Table 14 shows the co-occurrences for conditions. It illustrates at which scales and within which dimensions certain requirements were most frequently mentioned. The concentrations in the social dimension at business park scale and political dimension at the national scale indicate where conditions cluster most strongly. Table 15 displays the co-occurrence patterns for drivers. This table highlights which motivating factors occur most often and at what scales. The commercial and operational drivers at the company level stand out. Table 16 presents the co-occurrences for barriers. These data reveal where obstacles were most frequently identified. In particular, political barriers recur at the national scale.

Table 14: Co-occurrence of dimensions and scales for all identified conditions (ATLAS.ti export, own work)

	0. Company level 298	1. Business park l... 206	2. Regional level 63	3. National level 108	4. Global level 7
Commercial condition 31	20	7	1	1	
Environmental condition 0					
Operational condition 34	11	19	6	1	
Political condition 68	8	15	10	36	1
Social condition 55	10	42	3	4	
Technical condition 32	13	16	3	1	

Table 15: Co-occurrence of dimensions and scales for all identified drivers (ATLAS.ti export, own work)

	0. Company level 298	1. Business park l... 206	2. Regional level 63	3. National level 108	4. Global level 7
Commercial driver 63	48	15		2	
Environmental driver 18	16	2			
Operational driver 49	37	12	3	1	
Political driver 35	7	7	3	12	4
Social driver 51	21	27	4		
Technical driver 28	15	8	1	1	2

Table 16: Co-occurrence of dimensions and scales for all identified barriers (ATLAS.ti export, own work)

	0. Company level 298	1. Business park l... 206	2. Regional level 63	3. National level 108	4. Global level 7
Commercial barrier 37	32	4		1	
Environmental barrier 2	1	1			
Operational barrier 63	33	16	4	9	
Political barrier 98	20	16	20	44	1
Social barrier 55	23	20	9	3	
Technical barrier 35	21	6	4	5	

For the conditions, the strongest concentrations appear in the social domain at the business park level (42) and in the political domain at the national level (36). These patterns underline that collective organisation, trust-building and coordination structures, together with supportive national regulatory frameworks, are perceived as the most essential foundations for developing collective energy initiatives. Similarly, political conditions operate as boundary-setting factors that define the institutional space in which local initiatives can develop. Additional conditions emerge in the commercial domain at the company level (20) and in the operational domain at the business park scale (19), indicating that firms still require a viable business case and that operational needs must be in place before cooperation becomes feasible. Together, the necessary conditions shape the feasibility of collective energy, whereas the drivers shape the desirability. The distribution of drivers emphasises the dominance of firm-level motivations. Commercial drivers at the company level (48) are by far the most prominent, followed by operational drivers at the same scale (37). This confirms that company-specific motivations related to individual business rationales, such as cost savings, business continuity and efficiency, constitute the core reasons for participating in collective energy. Social drivers appear next, primarily at the business park level (27) and the company level (21), suggesting that relational factors and emerging collective identity increasingly motivate participation as coordination structures develop. The barriers also reveal a distinct pattern. Political barriers at the national scale (44) represent the most frequent constraint, demonstrating the persistent influence of legal restrictions, regulatory uncertainty and centralised decision-making on local implementation processes. Operational (33) and commercial (32) barriers at the company level then follow closely, showing that individual risk considerations, such as operational challenges and firm-level financial concerns remain important obstacles. Social barriers at both the company (23) and business park (20) scales, together with political barriers at the company and regional levels (20 each), confirm that issues of trust, alignment and governance are also substantial sources of friction across scales.

In addition to the most prominent dimension–scale combinations, the overall frequency of themes across all scales provides further insight into which dimensions dominate stakeholder perspectives. Political barriers are the most frequently mentioned theme overall (101 references), followed by political conditions (70) and commercial drivers (65). This means that across the entire dataset, the political domain emerges most strongly in relation to both constraints and enabling conditions, whereas commercial considerations dominate the motivational side. When aggregating all mentions over all scales per dimension, the political dimension stands out as the most frequently referenced overall (204 occurrences). By contrast, the environmental dimension is mentioned least often (20 occurrences), indicating that environmental considerations currently play only a marginal role in how stakeholders perceive the implementation of collective energy. This suggests that sustainability, from an environmental perspective, functions primarily as a supportive consideration, rather than as a decisive driver for action. Together, these patterns show that regulatory and governance factors exert the greatest influence on collective energy initiatives, while commercial motivations drive participation and environmental concerns are minor in practice.

When analysed by dimension, commercial and environmental themes are predominantly framed as drivers. Political and technical themes, by contrast, are most frequently identified as barriers or as conditional factors that must be addressed for implementation to proceed. Social and operational themes display a more balanced pattern, functioning both as drivers and as barriers or enabling conditions depending on context. Across governance scales, conditions are most frequently observed at the business park level (99 instances), while both drivers (144) and barriers (130) are most strongly concentrated at the company level. Overall, the most drivers, barriers and conditions occur on these two scales, underscoring their central role in shaping the feasibility of collective energy systems.

In addition to the co-occurrence matrices, Tables 17, 18 and 19 provide an overview of the content underlying these patterns. Whereas the co-occurrence tables indicate how often specific dimension–scale combinations appear, these summary tables show what conditions, drivers and barriers were actually mentioned in the interviews. The tables group the coded material by analytical dimension and list the main themes that emerged within each category. Together, they offer a qualitative interpretation of the factors identified.

The interview findings show that collective energy initiatives on SME business parks depend on a set of mutually reinforcing conditions across commercial, operational, political, social and technical dimensions (Table 17). Commercially, entrepreneurs only participate when there is no financial downside and when the business case is clear, concrete and low-risk. Interviewees indicate that most SMEs act independently and prioritise firm-level continuity. Early public or external funding is often needed to move beyond initial hesitation, reflecting the broader pattern that SMEs act collectively only when individual benefits are tangible.

"Er moet een concreet aanwijsbaar voordeel zijn voor deelname in een collectief ten opzichte van de individuele oplossing." – Specialist 3

"Er moet financiering zijn voor het eerste traject, want bedrijven gaan pas bijdragen […] als ze nut en noodzaak zien." – Specialist 4

Technical conditions emphasise the need for expertise, early data collection and simple, turn-key solutions. Most SMEs lack the time and knowledge to interpret energy profiles or optimise systems, making (external) technical guidance and process simplification critical.

"Wat ik iedereen zou aanraden, is om te beginnen meten en gewoon inzicht krijgen in je energieverbruik." – DSO actor 3

"Het exploiteren van bijvoorbeeld een energiehub of een zonnepark, daar is expertise voor nodig. En dat moet gewoon uit handen genomen worden door een betrouwbare partij. Wat mij betreft een onafhankelijke partij die gewoon de exploitatie op zich neemt van dat soort zaken. Die inzichtelijk maakt van wat iets oplevert en wat iets opbrengt en hoe je daar als collectief wat aan kan hebben." – Entrepreneur 1

Within the operational dimension, interviewees identify urgency as a decisive condition for engagement. Firms tend to act when grid congestion or growth limitations create immediate pressure on their operations. However, respondents emphasise that urgency alone is insufficient. The interview data show that collective initiatives require governance at the business park level, combined with entrepreneurial ownership of the system. Interviewees indicate that most SMEs lack the time and capacity to organise collective arrangements independently. As a result, a clear organisational structure and external process guidance are described as necessary to manage complexity and support entrepreneurs in navigating an unfamiliar trajectory. Without the combined presence of urgency, coordination and facilitation, respondents report that collective energy initiatives struggle to progress.

"Er moet een bepaalde urgentie zijn. Dat is met congestie al vrij snel het geval, maar op sommige bedrijventerreinen is er weliswaar congestie, maar zijn er bijvoorbeeld geen toekomstplannen. […] Dan krijg je het ook niet voor elkaar." – Specialist 4

"Zorg in ieder geval voor een lokale samenwerking dus met een parkmanager en parkmanagement die de bedrijven bij elkaar roepen." – Municipality actor 1

"Een serieus stuk begeleiding door procesregisseurs en vanuit gemeentes, provincies, netbeheerders om te ontzorgen en om een beetje de klappen van de dynamiek op te vangen […]. Ik heb de indruk dat op plekken waar de energiehubs groeien dat het helpt en

gewaardeerd wordt. Dus dat de ondernemers wel iets hebben van, wij zijn zelf in de lead en het is onze Energy Hub maar vanwege het feit dat er nog veel in beweging is, is het wel fijn als er een stukje procesregie en expertise beschikbaar is." – Specialist 1

Political conditions form a second layer of uncertainty. Stakeholders consistently point to unstable rules, unclear contract forms and inconsistent approaches among DSOs as barriers to commitment. In response, interviewees emphasise the importance of stable long-term policy, transparent and flexible contract arrangements and a more active role for public authorities in coordinating and steering DSO practices to reduce perceived risk.

"[Beleidsmakers zouden prioriteit moeten geven aan] duidelijkheid. Houvast creëren voor de ondernemers. Dat is denk ik het belangrijkste. Een soort van consequent lange termijn beleid. Met name vanuit denk ik vanuit de netbeheerders en daar zouden andere overheden of andere beleidsmakers bij kunnen helpen." – Specialist 1

"Het moet makkelijker worden. Er zijn heel veel varianten van contracten die telkens genoemd worden vanuit de netbeheerder. Maar dat zijn allemaal pilots en het mag alleen onder voorwaarden en er is een wachtlijst. Daar moet een stuk meer flexibiliteit in komen. Dan kunnen er ook meer ondernemers geholpen worden." – Municipality actor 2

"[Een voorwaarde om ondernemers mee te krijgen is] de pilot status van de netbeheerder waardoor zij mee kunnen doen zonder dat ze het risico lopen dat ze, als ze weer uit de coöperatie stappen, hun individuele vermogen kwijt zijn." – EH project manager 1

Social conditions emerge as a foundational factor. Respondents consistently refer to trust, familiarity between firms and a willingness to collaborate as factors that influence whether collective action is considered at all. Cooperation is described as something that needs to be actively developed through interaction, shared expectations and basic agreements. Interviewees also point to the importance of an existing sense of community, supported by shared communication channels and a minimal organisational structure at the business park level, as a context in which collective energy initiatives can take shape before technical or financial steps are pursued.

"Er zit een heleboel omheen. Vertrouwen, elkaar kennen, samen optrekken. Het woord gezamenlijkheid alleen al. Dat is key in de totstandkoming van zoiets." – Parkmanager 2

"Begin die samenwerking met een paar basale afspraken van joh. We gaan mekaar helpen. […] Eerlijke prijs voor gemaakte kosten, dat soort afspraken maak je." – Specialist 4

"Het helpt sowieso dat bedrijven nauw met elkaar verbonden zijn […] en elkaar weten te vinden, waardoor er animo is voor zoiets. Want je hebt ook bedrijventerreinen waar er geen samenhang is en dan is het heel lastig om partijen zover te krijgen om samen in zo een coöperatie te zitten." – EH project manager 1

"Er moet een soort organisatievorm zijn op dat bedrijventerrein dus een park management in ieder geval actief. Dat bedrijven al in een soort community zitten, Dat is één." – Specialist 4

Together, the data show that collective energy initiatives only emerge when multiple conditions across different dimensions align with one another.

Table 17: Conditions mentioned per dimension (own work)

Dimension	Main conditions
Political	Stable rules; flexible contracts; governmental support;

	legal permissions; reducing regulatory barriers; safeguarding fairness
Technical	Expertise; monitoring/data; professionalisation; grid eligibility; turn-key solutions & relieving concerns
Operational	Urgency; organisational capacity/governance structure; process facilitation; iterative development; alignment with DSO; entrepreneurial ownership; first optimise individually
Social	Trust; cooperation willingness; existing community; start small; transparency/data sharing; intrinsic motivation
Commercial	Risk-free participation; clear business case; advantages over individual solutions; early financial support; risk removal
Environmental	No conditions mentioned

After conditions have been established, stakeholders mention drivers for the implementation of collective energy that are shaped by a combination of all dimensions (Table 18). Commercial considerations are the most consistent drivers across all interviews. Entrepreneurs participate when collective energy offers clear economic benefits, which can be lower costs, stable prices, a higher property value, improved competitiveness or avoidance of high individual investments. Many firms also anticipate future constraints or market pressures, such as supply chain or customer requirements for sustainable production or the need to secure energy supply for expansion. For these companies, collective systems are not only mentioned as financially attractive but also strategically relevant for maintaining continuity and value creation.

“De continuïteit van je bedrijf, dat is een belangrijke drijfveer.” – Parkmanager 1

“De voornaamste reden is natuurlijk als je het rendabel krijgt, dus dat je het in 5/ 6 jaar bijvoorbeeld terugverdient. Nou, dan zou ik zeggen doen en er zijn heel veel ondernemers die het dan gelijk doen.” – Entrepreneur 2

“Vorig jaar hebben we 3 weken geen zon gehad. […] Voor bedrijven sprong de elektriciteitsprijs 3 keer zo hoog dan hij normaal is. […] Dus de bedrijven die op dat soort fenomenen toegerust zijn, die hebben uiteindelijk een concurrentievoordeel.” – DSO actor 1

Operational drivers are equally important. Grid congestion repeatedly emerges as the strongest trigger for action, this is often mentioned in the interviews as “urgency”. Firms facing growth limitations, electrification barriers or operational risks are more willing to cooperate and to consider solutions beyond their own property boundaries. Collective arrangements offer a way to unlock unused contracted capacity, stabilise supply and accommodate future expansions. The SME context reinforces this: since they are often owner-occupiers, entrepreneurs function as direct decision-makers and can respond pragmatically when a shared operational problem becomes urgent.

“Er zijn een aantal bedrijven die nadrukkelijk mee in wilden stappen omdat ze belemmerd zijn door congestie in groei.” – Municipality actor 1

“Dan is die urgentie toch wel echt de nummer één drijfveer van die bedrijven” – Specialist 1

Environmental motivations play a supportive but meaningful role. Some firms are driven by sustainability ambitions, a desire to improve local liveability or a personal commitment to reducing emissions. For these actors, participation contributes to broader organisational or individual values, often linked to family-business identity or ESG performance. While environmental ideals rarely serve as the primary driver, they strengthen willingness to participate once commercial and operational conditions are favourable.

"Er zijn ook wel echt heel veel ondernemers, bijvoorbeeld familiebedrijven zijn wel echt van die belangrijke. Die hebben ook wel intrinsieke motivatie. Die willen echt iets duurzamers op deze wereld. Die willen hun product duurzamer op de wereld." – Ministry

"[Een beweegreden om mee te doen is] soms omdat ze gewoon een groen hart hebben." – Parkmanager 3

Political drivers stem from external pressures and opportunities. Geopolitical developments are frequently mentioned as an important context shaping interest in collective energy systems. Respondents refer to recent energy crises and international tensions as events that increased awareness of vulnerability to external disruptions. Several interviewees emphasise the importance of certainty of supply and operational continuity, particularly in relation to dependence on international energy markets and geopolitical instability. References to the Russia–Ukraine conflict illustrate how geopolitical developments have contributed to an acceleration in attention towards energy autonomy across different stakeholder groups. In addition to geopolitical developments, interviewees refer to other political drivers, including regulatory changes, evolving policy frameworks and expectations regarding future government interventions. Dependency on national regulations, grid operators and policy decisions is perceived as a risk alongside market volatility. At the same time, subsidies and governmental programmes lower thresholds for experimentation. Policy signals suggesting an increasing role for collective systems are also mentioned as encouraging early engagement in anticipation of future regulatory requirements.

"Ik denk dat die leveringsgarantie, in combinatie met niet afhankelijk meer zijn van […] de hele discussie wereldwijd met Rusland en goederen. Ik denk dat, en dat is ook onderdeel van die leveringsgarantie, maar dat niet afhankelijk kunnen zijn van zo'n stroomstoring, dat dat belangrijk is [voor continuïteit]." – Developer

"Mede door de energiecrisis door de inval van Rusland in Oekraïne heeft wel een soort tempoversnelling opgeleverd." – Ministry

"Volledig autonoom kunnen draaien, niet afhankelijk zijn van wet- en regelgeving, van situaties in de wereld waar we ook niet allemaal controle over hebben." – Entrepreneur 1

Social drivers are closely intertwined with the others. Reciprocity between neighbours, trust, peer influence and the presence of frontrunners make collaboration more attractive. Entrepreneurs often emphasise solidarity: helping a neighbour who has a shortage or supporting the business park as a whole. Collective identity, active park management and existing networks further strengthen these motivations, showing that social cohesion can accelerate or amplify commercial and operational drivers.

"Alles staat of valt met vertrouwen." – Energy hub coordinator

"Ook de bedrijven die geen problemen hebben die willen best een buurman helpen. Dat komt echt naar voren. Ze willen hun buurman helpen, Dat is belangrijk." – Municipality actor 1

"Ik geloof altijd meer dat samenwerking beter werkt dan subsidies en wet- en regelgeving. In ieder geval om dingen van de grond te trekken." – Developer

Finally, technical drivers relate to perceived feasibility and innovation. Seeing that collective systems can technically work, that profiles complement each other or that local generation can be shared creates confidence. For some companies, participation is driven by a pioneering mindset or a desire to learn from innovative projects. Access to additional capacity and transparency of technical data also plays a role in recognising practical opportunities.

"Dat innovatieve en voorop willen lopen, dat zit er ook zeker in." – Specialist 2

"Je hebt ook bedrijven die zeggen van dit zijn zulke innovatieve trajecten. Ik wil daar wel in meedoen om van te leren." – Specialist 4

Together, the data show that collective energy initiatives are driven by a mix of motivations. Economic and operational incentives create the primary momentum, while social, political and technical factors shape the willingness and confidence to act collectively.

Table 18: Drivers mentioned per dimension (own work)

Dimension	Main drivers
Political	Regulatory pressure; new legislation; subsidies; independence from suppliers, government and geopolitical tensions; clearer long-term policy direction; obligations
Technical	Feasibility; pioneering mindset; shared capacity; local generation/storage; data transparency; reduced risks
Operational	Urgency from congestion; business continuity; solving operational issues; enabling expansion; small scale/SME agility; profile complementarity
Social	Helping neighbours; peer influence; community identity; ESG/image; trust; intrinsic motivation
Commercial	Profitability; competitive advantage and continuity; avoiding high individual costs; property value; supply-chain demands; price stability
Environmental	Sustainability ambitions; improving local environment; intrinsic green motivation; future-proofing

Next to the drivers, the interview data reveal that the implementation of collective energy is constrained by barriers that also cut across all dimensions (Table 19). Commercially, many firms perceive collective arrangements as financially risky or less attractive than individual solutions. Concerns about losing contracted capacity, facing complex cost-sharing arrangements or committing to long-term contracts discourage participation. For a substantial group of entrepreneurs, energy is not a major cost driver, which reduces the perceived urgency and makes the additional coordination burdens of collective action difficult to justify.

"Als je op winst en continuïteit bent gericht dan ja, dan moet het collectief interessanter zijn, beter uitvallen, economisch gezien en voor de levenszekerheid van jouw onderneming, en dan pas doe je het." – Specialist 3

Operational barriers are similarly influential. A large share of firms does not yet experience acute congestion or electrification pressure, reducing their willingness to invest time in collective processes. Limited managerial capacity, the length and complexity of organisational trajectories and the fragmented nature of many business parks further complicate collaboration. These practical constraints mean that when the technical potential for collective optimisation exists, the organisational effort required is often viewed as disproportionate.

"Dat zien we in de praktijk. Dat [energie op elkaar afstemmen] werkt, maar dat werkt alleen maar omdat we samen met die partijen in de pilot vorm dat contract hebben gemaakt. Dus wij als sector hebben een versie 0.1 gemaakt en samen maak je dan een versie 0.5 en nu zijn we dan bij versie 0.9. Dat doe je samen en dat duurt lang omdat het dus zo complex is" – DSO actor 2

Environmental barriers are not mentioned explicitly. Instead, it is the low prioritisation of sustainability that inhibits action. When environmental drivers are weak or absent, sustainability fails to generate momentum and thus becomes a barrier in practice.

"Je hebt het over verduurzaming en vergroenen, maar heel eerlijk, dat staat echt laag op het prioriteitenlijstje." – Parkmanager 1

Political and regulatory issues form the most structural set of barriers. The interviews consistently point to restrictive or outdated legislation, slow development of collective contract forms and a lack of clarity around rights, obligations and exit options. Another barrier is the mismatch between the pace of government and that of businesses: companies must respond quickly to operational pressures, while public authorities and DSOs move slowly through procedural cycles. This temporal misalignment contributes to frustration and delays. Uncertain or shifting policy signals, such as changing subsidy rules or withdrawn obligations, further undermine trust and make long-term investment decisions risky. Moreover, limited capacity within public authorities and DSOs results in slow procedures and a reliance on pilot exceptions, which hinders wider scaling.

"Als je praat over belemmeringen is dat vaak wet- en regelgeving. [..] Het zijn allemaal pilot vormen en dan mag ineens best wel veel meer, maar als je kijkt van wat mag er wettelijk. Dan worden er nu contracten ontwikkeld, die eigenlijk alleen maar slecht zijn." – Specialist 4

Social barriers further shape the feasibility of collective energy. Entrepreneurs are reluctant to depend on neighbours for critical operational needs, particularly when competitive relations or past tensions exist. Mistrust in municipalities or DSOs, low familiarity between firms and limited understanding of collective energy concepts reduce willingness to commit. Top-down processes initiated by government actors can exacerbate this dynamic. Communication problems and conceptual confusion also emerge frequently, reinforcing hesitancy.

"Als je dat sociale aspect niet op orde hebt, dan hoef je niet over subsidie te praten. Dan kun je wat geld ertegenaan gooien. Dan komt dat er toch niet van." – Municipality actor 3

Finally, technical barriers relate less to the availability of technology than to its complexity and the surrounding uncertainty. Many entrepreneurs lack the expertise to assess risks or understand technical proposals, which generates caution. Physical grid constraints and immature contract or energy management system solutions further limit feasibility on certain sites. These technical uncertainties interact with commercial and political concerns, reinforcing reluctance to adopt collective solutions that are perceived as experimental.

"[Redenen voor ondernemers om niet mee te doen zijn] gebrek aan kennis en daardoor angst, risico's niet goed kunnen inschatten en dan dus niet meedoen." – Entrepreneur 1

"Het net is gewoon heel ranzig opgebouwd eigenlijk. Dus vaak liggen er kabels en als er een woonwijk bij wordt gebouwd wordt er gewoon een stukje kabel bijgetrokken en dat maakt het

heel moeilijk om nu op een slimme manier met die kabels om te gaan, Omdat het gewoon fysiek niet kan op heel veel plekken." – DSO actor 3

Together, the data show that barriers to collective energy arise from the interaction of challenges in different dimensions.

Table 19: Barriers mentioned per dimension (own work)

Dimension	Main barriers
Political	Restrictive legislation; slow and uncertain contract forms; policy instability; complex subsidies; pace mismatch; limited government/DSO capacity; no pilot status; data/liability issues; governance complexity
Technical	Lack of knowledge and ability to assess risks; complexity of solutions; physical grid constraints; limited technical capacity at DSOs; non-standardised products; technology limits; unclear responsibilities
Operational	Lack of urgency; time and capacity constraints; perceived inconvenience; weak park organisation; dynamic park composition; limited implementation capacity
Social	Dependence on neighbours; mistrust of public actors/DSOs; competition and conflicting interests; low awareness; weak collaboration culture; top-down approaches; communication problems; reluctance to share data
Commercial	Stronger business case for individual solutions; fear of financial risk and loss of autonomy; high costs/weak business cases; low financial urgency; strategic uncertainty
Environmental	Sustainability low on agenda; environmental issues not prioritised in park or company strategies

Beyond conditions, drivers and barriers, stakeholders who have initiated collective energy projects highlight several lessons that shape the practical feasibility of such initiatives. Across cases, urgency, accessible financing and cooperation emerge as indispensable foundations; without these three elements, collective processes fail to gain traction. Stakeholders consistently emphasise that collective energy is, above all, a social innovation: trust, relationships and organisational maturity matter more in early phases than technology, finances or contract design. This means that the "soft side" must precede the "hard side"; formal structures, legal arrangements and technical optimisation only become effective once a basic level of trust and collaboration exists. At the same time, premature formalisation, such as establishing cooperatives before a trust base exists, can make initiatives fragile. A recurring lesson is that collective systems are not universally applicable. Their suitability depends on location-specific conditions, particularly the technical characteristics of the grid. The implementation process itself benefits from simplicity. Clear communication, straightforward governance and clear role division help prevent stagnation and reduce the cognitive load for entrepreneurs. Stakeholders also observe that small, phased projects tend to succeed more often than ambitious, large-scale plans without a solid support base. Combining long-term vision with realism, particularly honest communication about timelines, regulatory uncertainty and grid expansion, helps manage expectations and maintain momentum. Trust deepens as results become visible, suggesting that early, concrete wins are essential for broader mobilisation. Finally, several stakeholders note that a freer energy market and more flexible regulation would remove substantial barriers and that well-aligned governance, legal frameworks and financial arrangements can enable collective energy systems to strengthen local economies rather than remain isolated pilots.

Next to these lessons, the interview data show that collective solutions are not consistently presented as the preferred or most effective option. Several respondents emphasise that optimisation at the individual firm level is a necessary first step to reveal genuine opportunities, with collective arrangements considered only after internal measures ("behind the meter") have been explored. Interviewees also stress that the suitability of collective solutions depends on the specific objectives and context of individual firms and that in some cases faster or more effective outcomes may be achieved through individual rather than collective interventions. On the other hand, respondents refer to a broader range of collective energy systems, including smaller-scale arrangements such as direct lines, cable pooling and shared charging facilities. Interviewees indicate that these smaller-scale systems are often considered feasible within the current regulatory framework and can typically be realised within a shorter timeframe. More integrated systems, such as energy hubs or group transport arrangements, are also discussed, but are described as involving higher levels of technical, organisational and legal complexity. Nevertheless, stakeholders frame these more integrated systems as indispensable for the longer-term evolution of the Dutch energy system.

"In hoeverre is de collectieve weg een oplossing voor netcongestie? In zekere zin, maar het is niet dé oplossing. […] Zorg dat je in vier stappen handelingsperspectief creëert. Stap één is inzicht creëren […] en stap twee is zoeken naar bouwstenen in je eigen aansluiting […], de allereerste stappen richting optimalisatie.

Het derde is kijken wat er samen met de netbeheerder kan, bijvoorbeeld flexibiliseren […].

En als laatste: kijk naar het collectief. Dan is een energy hub een optie, maar ook kleinere collectieven zoals cable pooling.

En wat belangrijk is, is dat je niet uit al die drie pijlers iets hoeft te halen, maar aan de hand van de doelstellingen van het bedrijf moet kijken: welke bouwsteen past het best? […] Dan kan het zijn dat een collectieve oplossing heel mooi werkt voor netcongestie, maar het kan ook zijn dat je veel sneller […] de oplossing vindt in het individuele vlak.

Dat is het antwoord op de vraag in hoeverre het collectief een oplossing biedt voor netcongestie; dat is echt iets anders dan energy hubs als vitaal onderdeel van het ecosysteem van de toekomst." – DSO actor 1

"Achter de meter valt er ontzettend veel te optimaliseren en ondernemers moeten eerst daar kijken naar hoe kan ik het oplossen voordat je in dat collectief stapt." – Coordinator

"Kijk eerst naar individuele maatregelen. Heb die eerst op orde voordat je in een collectief stapt. Hoe graag je ze ook in een collectief wil hebben, zeg ik wel, kijk eerst intern." – Municipality actor 2

Building on the combined co-occurrence patterns, the three bubble charts presented next (Figures 7, 8 and 9) summarise the results of the total thematic analysis of all interview data. Their purpose is to visually communicate how drivers, barriers and conditions for the implementation of collective energy are distributed across different analytical dimensions and governance scales. Each bubble in the charts represents the occurrence of a driver, barrier or condition within a specific combination of dimension and scale. The size of the bubble indicates how frequently this specific combination appeared in the interviews. Larger bubbles, therefore, represent themes that were mentioned more often in the interviews in relation to that particular dimension–scale pairing. The vertical axis shows the six dimensions used in this research: political, technical, operational, social, commercial and environmental. The horizontal axis displays the scale at which the theme arises, ranging from the level of the individual company to the global scale. The colour of the bubbles shows the category to which the theme belongs. In the first two charts, drivers and barriers are shown together, while the third chart presents the conditions. Together, these charts provide an overview of how frequently certain types of drivers, barriers and conditions occur at different scales and within different dimensions, allowing patterns and concentrations to be visually identified.

The first two charts (Figure 8 and 9) show where the drivers and barriers are concentrated and how they relate to each other. The bubbles indicate what kind of drivers or barriers (within dimensions) occur at a given scale. By displaying both categories together, the chart provides an immediate impression of where drivers and barriers overlap, reinforce or oppose each other. The underlying information in both charts is the same and the colour emphasis shows the difference in category.

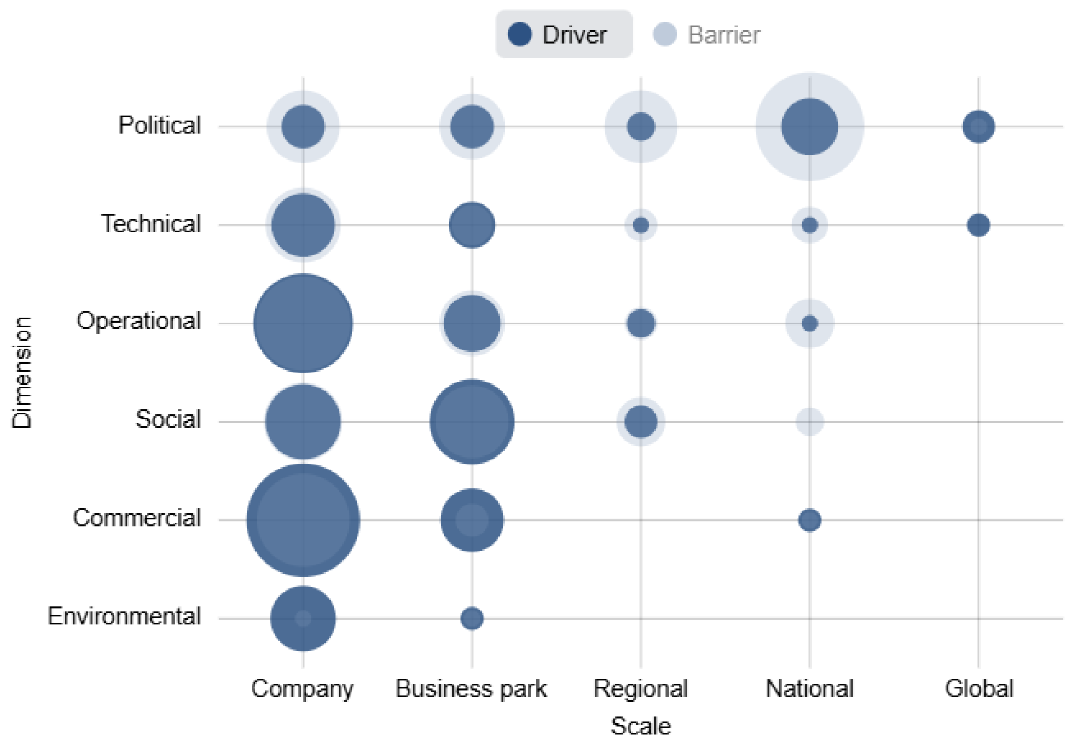

Figure 8: Distribution of drivers for collective energy across scales and dimensions in relation to barriers (own work)

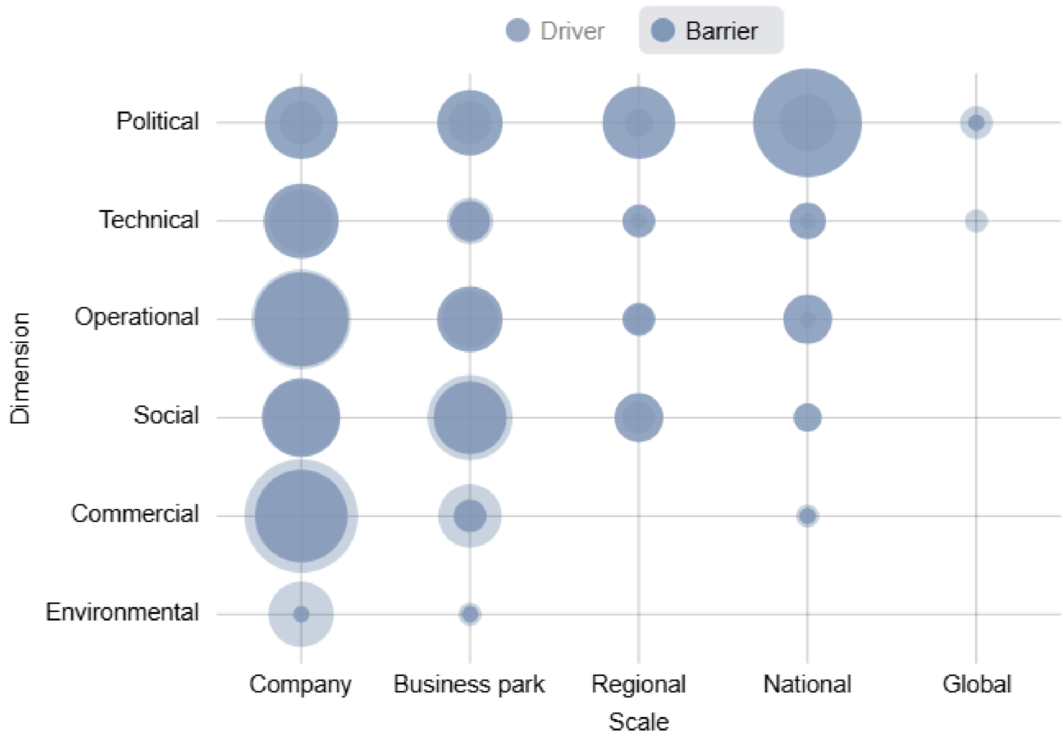

Figure 9: Distribution of barriers for collective energy across scales and dimensions in relation to drivers (own work)

The third chart (Figure 10) focuses exclusively on conditions that interviewees identified as necessary for the implementation of collective energy initiatives. The bubbles indicate what kind of conditions (within dimensions) are required at a given scale.

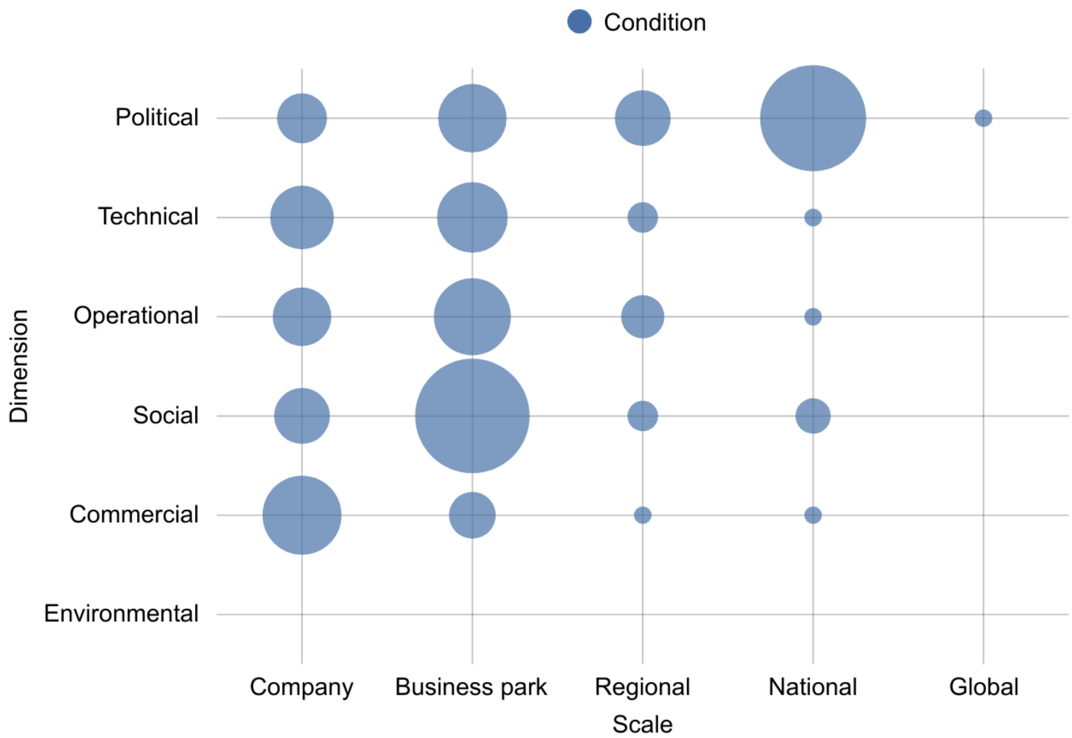

Figure 10: Distribution of conditions for collective energy across scales and dimensions (own work)

5. Discussion

This chapter interprets the empirical results and discusses the findings in relation to the theoretical framework and previous research.

5.1. Cross-case analysis

The cross-case analysis reveals clear differences in how drivers, barriers and conditions manifest across the three use case categories. Non-pilot parks show a higher share of barriers, while non-operational pilots show a higher share of drivers. Operational pilots show as many drivers as barriers. This distribution of drivers and barriers reflects the different stages of development in the three use case categories. Non-pilot parks show the highest share of barriers and show relatively more barriers and conditions at higher scales than the other use case categories. This is because these parks do not possess a pilot status. Due to this, they remain fully dependent on national and regional policies, regulatory constraints and external institutional conditions. As these enabling frameworks have not been adjusted or relaxed for them, challenges at higher governance scales play a much stronger role. In non-operational pilots, barriers are less prominent and drivers dominate, as these parks are in the early phase of collective energy development. Here, companies are motivated to participate, stakeholders see clear opportunities and the pilot status removes many regulatory obstacles that would otherwise hinder progress. In operational pilots, drivers and barriers re-emerge in a more balanced way. Although the collective structure continues to generate strong drivers, new barriers arise during implementation that were not yet visible at the start of the process.

Beyond the overall balance of drivers and barriers, the cross-case comparison also shows how the types of drivers, barriers and conditions shift between the three categories. A comparison of the barriers across the three use case categories shows how the nature of constraints shifts as collective initiatives progress. Commercial barriers are most frequent in both non-pilot parks and operational pilots, predominantly at the company level, indicating that financial uncertainty and firm-level investment considerations remain persistent constraints regardless of maturity. Political barriers, however, clearly appear most frequently in the non-pilot parks and occur mainly at the national and regional scales. This again shows that parks without a pilot status face the full weight of regulatory restrictions and policy uncertainty, whereas pilot arrangements largely mitigate these challenges. Operational barriers are particularly prominent in the operational pilots, reflecting the practical and organisational difficulties that arise once a collective system moves from planning to actual functioning. Social barriers occur in all three categories and are consistently linked to the company level, suggesting that issues related to trust, collaboration or varying priorities among firms are inherent to all stages of development. Technical barriers decrease noticeably from non-pilot to operational pilots, signalling that technological uncertainties become less dominant as initiatives gain experience, build capacity and establish technical feasibility. Finally, environmental barriers are only present in the non-pilot parks, which may indicate that environmental constraints are most visible in contexts where no structured process toward collective energy has yet begun.

A comparison of the drivers across the three use case categories shows how motivating factors evolve. Commercial drivers are consistently strong in all categories and are predominantly linked to the company level. This indicates that firm-level considerations, such as cost reduction and operational continuity, form a stable foundational motivation throughout all stages. Operational drivers also occur across all three categories but show a narrowing focus: while they are more broadly distributed across company and business park levels in non-pilot parks, they concentrate primarily at the company level in non-operational and operational pilots. This suggests that before a collective exists, shared operational challenges motivate park-level cooperation, but once these issues are resolved through the pilot process, operational motivations shift back to firm-specific needs. Social drivers likewise appear in all categories but shift in emphasis: whereas they are largely company-level motivations in non-pilots and non-operational pilots, they move toward the business park level in operational pilots, reflecting the strengthening of collective identity, shared objectives and park-wide collaboration once a system is in place. Technical drivers rise clearly from non-pilot parks to operational pilots and are present at both business park and company levels, indicating growing confidence in technical feasibility as initiatives mature. Political drivers appear across scales in all case categories, suggesting that favourable policy developments or perceived political support consistently play a supportive role. Environmental drivers remain limited overall and are mostly tied to the company level, implying that sustainability motivations exist but are not the primary drivers for collective action in any of the three categories.

A comparison of the conditions across the three use case categories highlights how the requirements for collective energy initiatives shift. Operational conditions appear across all cases and are particularly prominent at the business park level, indicating that shared organisational capacity, coordination structures and an active collective entity are essential throughout the process. Political conditions are most visible in the non-pilot parks, especially at the national scale. This reinforces the earlier finding that parks without a pilot status rely heavily on external regulatory clarity, supportive policy frameworks and institutional facilitation before collective action becomes feasible. These political requirements diminish in the pilot categories, reflecting how pilot arrangements help to lower political-related thresholds. Social conditions occur in all three categories and are most common at the business park level, showing that trust and collaboration are fundamental prerequisites across all stages. Technical conditions also appear in every category but decline from non-pilot parks towards operational pilots, suggesting that as initiatives progress, uncertainties about technical feasibility are gradually resolved. Commercial conditions appear consistently across all cases at the company level, indicating that firms always require a viable business case or clear financial rationale before committing to collective arrangements. Finally, environmental conditions are absent in all categories, suggesting that environmental criteria are not perceived as essential prerequisites for starting or operating collective energy initiatives.

A recurring theme across the interviews concerns the distinction between developing collective energy systems in new (yet-to-be-developed) business parks and implementing them in existing ones. Interviews show that collective action is considerably easier to organise in new developments, as no historical claims, individual contracted capacities or long-standing rights exist. New parks allow stakeholders to define collective rules, technical configurations and participation requirements from the outset. Companies that settle there are automatically incorporated into a shared capacity structure, making collective energy a built-in condition rather than a negotiated change. On existing business parks, by contrast, collective solutions face structural barriers. Firms already have contracted capacities and established energy arrangements, which creates resistance when changes imply redistribution or perceived loss of entitlements. Physical constraints further complicate implementation. Overall, the interviews show that implementing collective energy systems is more complex in existing parks than in new developments.

5.2. Full data analysis

The distribution of drivers and barriers within specific dimension–scale combinations reveals a structural asymmetry between local initiative capacity and institutional control. While SMEs experience urgency and opportunity primarily at the firm and business park levels, the results show that political barriers are most strongly concentrated at the national scale. This pattern suggests that key decision-making power remains centralised, creating a dependency on external actors and policy arrangements that lie beyond the direct influence of individual entrepreneurs or park-level collectives. As a result, uncertainty at higher governance levels can be understood as being translated into perceived investment risk at the firm level through unclear regulatory frameworks, contracting arrangements and grid access procedures, even when local motivation and organisational capacity are present.

Across the six analytical dimensions, additional patterns become visible when comparing conditions, drivers and barriers. Commercial and environmental themes are predominantly driver-oriented, indicating that financial incentives and sustainability motives mainly act as positive impulses rather than as sources of constraint. By contrast, political and technical themes are more strongly associated with barriers and conditions, reflecting the continued importance of regulatory clarity and technical feasibility as structural conditions that must be resolved before collective energy can function effectively. Social and operational themes appear more evenly spread across barriers, drivers and conditions, suggesting that collaboration, trust and day-to-day operational issues play a contradictory role: they can enable progress but also easily become points of friction.

A notable insight emerging from the analysis is that several factors emerge simultaneously as drivers and barriers, depending on whether the underlying conditions are present or absent. Rather than constituting fixed categories, drivers and barriers emerge as two sides of the same conditional mechanisms. This overlap is particularly visible in the social, operational, technical and commercial dimensions at company and business-park level, as well as in operational factors at the regional scale. For example, operational urgency functions as a strong driver when firms face congestion or electrification constraints, yet becomes a barrier when these pressures are not felt. Similarly, commercial feasibility stimulates participation when the business case is clear, but perceived financial risk or uncertainty turns these same considerations into obstacles. Social cohesion, trust and reciprocity can accelerate collective processes, while their absence reinforces hesitation and resistance. Technical feasibility acts as a driver once proven in pilots but forms a barrier when complexity, uncertainty or local grid constraints dominate. These mirrored patterns show that drivers and barriers often stem from the same underlying conditions, capable of enabling or constraining implementation depending on the specific context, scale and timing.

Another notable finding concerns the limited prominence of the environmental dimension across the dataset. Despite the strong emphasis on sustainability in national policy discourse, environmental considerations are mentioned least frequently by stakeholders and rarely function as decisive conditions or barriers for collective energy initiatives. Instead, environmental themes mainly appear as supporting drivers, suggesting that sustainability operates primarily as a co-benefit rather than as a central motivation for participation. For SMEs on business parks, investment decisions are driven first by commercial and operational concerns, such as cost control, energy security and continuity of operations. While these concerns are rarely framed by interviewees as ‘sustainability’, they nevertheless reflect a form of long-term continuity-oriented thinking that aligns with a broader understanding of sustainability beyond its environmental dimension.

Comparing across governance scales further reinforces the importance of company- and park-level dynamics. At these scales, the majority of drivers, barriers and necessary conditions for collective energy systems take shape. This concentration of activity at the lower scales suggests that collective energy initiatives are shaped primarily from the bottom up: it is at the level of firms and the business park organisation that motivations emerge, coordination takes place and practical obstacles are encountered. Higher governance scales mainly define the regulatory context, but the daily implementation of collective energy ultimately depends on firm-level motivations and park-level coordination.

Moving from the numerical patterns to the visual ones, the bubble charts provide an integrated visual overview of how drivers, barriers and conditions are distributed across dimensions and scales, revealing patterns that are less apparent in the tables alone. The charts show a clear diagonal gradient running from environmental themes at the company level toward political themes at the national and global scales. This visual slope confirms that the environmental, commercial, social and operational dimensions are primarily experienced as locally embedded issues, whereas technical and political themes increasingly dominate at higher governance scales. A second insight that emerges from the charts is the spatial clustering of drivers and barriers. Drivers are strongly concentrated at the lower scales, particularly in the environmental, commercial and social dimensions at the company and business park levels. Barriers, by contrast, increase in prominence as the scale rises. The national and regional levels are dominated by larger barrier bubbles, especially in the political and technical dimensions, illustrating that external governance and system-level constraints are more substantial than local ones. The charts, therefore, visually reinforce the interpretation that collective energy initiatives on business parks tend to be driven from the bottom up, yet constrained from the top down.

Finally, the visual comparison across scales provides additional nuance. At the company level, drivers generally outweigh barriers in most dimensions, especially commercial, environmental and operational themes, indicating that firms primarily perceive opportunities rather than constraints in their immediate environment. At the regional and national levels, this pattern reverses, with barriers dominating almost all dimensions. The global level shows only a handful of themes, but here political and technical drivers exceed barriers, suggesting that global developments, such as geopolitical tensions or energy crises, are perceived more as drivers than as direct hindrances for collective energy. Taken together, the charts reveal a layered implementation landscape in which local motivations and collaboration drive progress, while higher-level governance structures shape the conditions under which such progress can occur.

5.3. Relation to literature

The initial analytical angle of this research was grounded in the Dutch and EU decarbonisation agenda. The introduction emphasises national climate targets, the ambition to reduce greenhouse gas emissions and the necessity of phasing out natural gas in favour of renewable electricity, positioning collective energy primarily as a tool to accelerate the low-carbon transition (PVB Nederland, 2025a; Klimaatakkoord; Klimaatwet). However, the interviews reveal that entrepreneurs on SME business parks approach collective energy from a different perspective. Rather than being driven by environmental objectives, most firms frame collective systems as a strategy to secure certainty of supply. This contrasts with the literature's initial emphasis on climate mitigation and aligns more closely with the energy-security logic outlined in section 2.2. of the literature, which describes how infrastructural constraints and geopolitical instability, including rising energy prices and disruptions caused by international conflicts, expose the vulnerability of businesses to external energy dependencies (IEA, 2025; Wang et al., 2024; Niers, 2024). The interview data demonstrate that for many entrepreneurs, concerns about energy autonomy, operational continuity and vulnerability to geopolitical shocks outweigh environmental motivations. Several respondents emphasised the importance of certainty of supply, independence from international markets and resilience against external disruptions. Whereas policymakers and advisors often highlight grid congestion as the primary driver for collective systems, entrepreneurs interpret the problem more broadly as a need to avoid dependency on national regulations, DSOs and volatile global energy markets. Their accounts, such as wanting to be “fully autonomous,” “not dependent on government or global situations” and accelerated action in response to the Russia–Ukraine energy crisis, demonstrate that certainty of supply has become the dominant motive. This shift suggests that collective energy initiatives on business parks are not primarily understood as environmental interventions but as strategic risk-mitigation measures. Decarbonisation, while recognised as beneficial, becomes a secondary or co-benefit rather than the primary motivation.

Alongside this contextual angle, collective action theory (Olson, 1965; Ostrom, 2000) offers a theoretical lens through which collective energy initiatives can be examined. The theory focuses on coordination problems, free-riding behaviour, trust and incentive alignment in the provision of shared goods, all of which are characteristic challenges in collective energy systems. Several empirical findings indeed resonate with these assumptions. Interviewees emphasise difficulties related to coordination, unequal distribution of costs and benefits, limited trust between firms and the absence of clear governance structures. In this sense, collective action theory offers a useful framework for interpreting why collective energy initiatives often struggle to progress without facilitation, leadership or external support. However, the empirical results suggest that the central assumptions of collective action theory only partially capture the dynamics observed in this study. Rather than being driven primarily by internal group dynamics, participation is strongly shaped by external pressures such as geopolitical energy insecurity, volatile fossil fuel markets, electrification requirements and grid congestion. These macro-level forces create a sense of urgency that fundamentally reshapes decision-making behaviour. Under such conditions, firms do not primarily deliberate on free-riding risks or collective efficiency, but on safeguarding operational continuity and future viability. The results, therefore, indicate that the relevance of collective action theory in this context is limited, because collective dynamics are subordinated to stronger geopolitical, infrastructural and regulatory drivers. While it remains relevant for understanding the internal dynamics of collective initiatives, it is less suited to explaining decision-making under conditions of systemic pressure and high uncertainty. In the case of collective energy, macro-level pressures shape the conditions under which collective action mechanisms become operative, positioning collective action theory as a secondary, rather than dominant, explanatory lens.

Not only the motivation behind collective energy proved different, but the assumption that collective solutions would take precedence also required reconsideration. At the start of this research, the literature suggested that collective energy systems were the most promising way to strengthen the resilience of Dutch business parks. Several studies emphasise that locally organised and jointly governed energy systems reduce dependency on centralised grids and external suppliers, thereby improving energy security (Fouladvand et al., 2024; Reijnders et al., 2020). Other authors highlight that decentralised renewable generation enhances local autonomy and shields businesses from geopolitical shocks and market volatility (Niers, 2024; Wang & Tian, 2025). This is accompanied by the argument that collective governance structures allow firms to overcome individual limitations in knowledge, investment power and organisational capacity (Rli, 2023; Suchek & Franco, 2023). Within the Dutch context, the growing professionalisation of energy cooperatives further reinforced the impression that collective arrangements form a mature and scalable solution for the energy transition (De Graaff et al., 2023). Taken together, this body of literature suggested that collective arrangements would generally be more valuable than individual solutions. However, interview findings reveal a far more nuanced and pragmatic reality. Stakeholders consistently emphasise that collective systems are not necessarily the better option for now, nor are they always the fastest or most feasible solution in practice. Many government entities, advisors and DSOs stressed that individual measures often form the necessary first steps, both because they are quicker to implement and because such measures are required to optimise the individual energy profile, even when a collective solution is ultimately pursued. Several interviewees also noted that entrepreneurs frequently prefer individual solutions to avoid dependency on neighbours or complex collective governance, particularly when investment capacity or timelines differ. In some cases, processes that initially aimed for collectivity eventually shifted back to private, individual arrangements because these offered more control, speed or clarity for the entrepreneur.

However, both the literature and the interviews present a broad range of collective energy forms that are considered relevant for SME business parks. In the empirical cases, collective solutions materialise in the form of energy hubs and closed distribution systems, which the literature similarly highlights as emerging models for reorganising electricity flows at local scale (Reijnders et al., 2020; Fouladvand et al., 2024). These systems cluster companies behind a shared connection and enable joint management of local energy flows. They typically combine on-site generation, shared grid connections, internal distribution infrastructure and in some cases, storage and smart control. Alongside these concepts, both the interviews and the literature identify smaller-scale collective arrangements. These include various forms of shared or coordinated infrastructure that allow firms to jointly organise generation, capacity or connections, such as direct lines between producers and neighbouring users, cable pooling and shared charging infrastructure (Gelders Energieakkoord & Transitiemakers, 2024; PVB Nederland, 2025a). Interviewees describe cable pooling and shared charging as options that are already feasible under the current regulatory framework and can often be realised more quickly. More integrated hubs and group transport agreements are seen as promising but tend to involve greater technical, organisational and legal complexity.

Across interviews, a recurring pattern emerges: step 1 is gaining insight into one's own energy use; step 2 is optimising and implementing individual measures; and only then, as step 3, does it make sense to evaluate whether collective solutions add value. DSOs explicitly underline this sequence, explaining that collective systems may be vital for the long term, but individual optimisation is often the most effective short-term response to congestion and economic continuity pressures. This shows that the assumption of collective superiority, derived from literature focused on long-term system resilience, does not automatically hold at the level of day-to-day decision-making on Dutch SME business parks. Instead, the interviews highlight an “and-and” logic: collective systems may be essential for the future, but they do not replace the need for individual solutions. Rather than a binary choice, the emerging practice shows phased decision-making. Collective arrangements only become meaningful when individual optimisation is insufficient, collectives are technically possible and businesses have the trust, capacity and shared incentives to move beyond firm-level solutions.

These findings show that both the underlying motivation for collective energy and the expected dominance of collective solutions differ from the initial angle of this research. Rather than primarily environmental projects that are self-evidently superior to individual measures, collective initiatives emerge as context-dependent strategies that must compete with and build on firm-level solutions. Given these insights, it becomes essential to look more closely at the conditions under which collective energy can develop in practice. The following sections, therefore, examine how the literature on conditions, drivers and barriers relates to the empirical findings across the different dimensions.

The Rli report (2023) mentions that effective implementation of sustainability measures is only possible through collaboration between firms. Across all interviews, collaboration on business parks (the social dimension) also emerges as one of the most important conditions for developing collective energy initiatives. This reflects the theoretical foundations of collective action, where Olson (1965) shows that individual rationality often prevents actors from contributing to shared goals unless mechanisms for coordination, selective incentives or strong social norms are in place. This logic is clearly visible in the empirical findings: most SMEs act independently, prioritise firm-level continuity and will not invest in collective arrangements unless trust, reciprocity and benefits are made explicit. The interviews illustrate this through recurring references to the need for “trust,” “collaboration agreements” and “having neighbours you already cooperate with,” which resonates with Ostrom’s (2000) argument that cooperation becomes possible when social norms, mutual expectations and local rule-making structures enable conditional cooperation and reduce perceived risk. The literature on SMEs reinforces this point. Section 2.3.1 shows that collective energy practices arise when individuals come together to do what they could not achieve on their own (Verkade & Höffken, 2019). Although many SMEs express positive attitudes towards collaboration, this rarely translates into action without local leadership, trust-based agreements or support from intermediaries (Lewis et al., 2015; Suchek & Franco, 2023). The interview data fully confirm this: cooperation is not an automatic starting point but a condition that must be actively constructed. Stakeholders emphasise that collective energy is a social innovation, requiring the creation of a minimal organisational structure, shared communication channels and relationships before technical or financial steps become possible. This mirrors the literature’s conclusion that collaboration is essential for overcoming SME limitations in knowledge, capacity and resources, but only emerges when trust and social cohesion are actively stimulated.

An organisational structure is not only needed for collaboration, but also as a form of governance. The interview data show that governance at the business park level is perceived as an essential condition for developing collective energy systems. Interviewees frequently emphasise the need for a clear organisational form, referring to structures such as a cooperative, a foundation, a park management entity or a legally defined collective with decision-making authority. Stakeholders repeatedly stated that without a coordinating body, the process becomes too fragmented for SMEs to engage in. Several respondents noted that entrepreneurs lack the time and knowledge to organise collective arrangements themselves, making park-level coordination indispensable for managing data collection, communication and the distribution of responsibilities. This closely mirrors the literature. Section 2.2 shows that even when collective contracts do not legally require a specific entity, a cooperative or formalised organisational structure remains crucial for advancing sustainability efforts on business parks (PVB Nederland, 2025a). The literature describes the shift from individual grid access toward cooperative frameworks, which rely on shared governance arrangements to manage energy flows efficiently (Netbeheer Nederland, 2024). The Rli (2023) further argues that sustainability on business parks requires a collective effort across multiple levels and that central coordination through park management helps streamline processes and reduce the burden on individual firms. This finding is directly echoed in the interviews. The literature, therefore, supports the empirical insight that governance at the park level is a practical necessity, providing the organisational capacity and social infrastructure that enable local cooperation.

Whereas interviewees view lower-scale governance as an organisational condition, higher-scale governance, particularly at the national level, appears in the results as the most frequently mentioned political condition. Across interviews, entrepreneurs, advisors and public actors consistently emphasise the need for clear and stable rules, predictable contract forms and coordinated action by DSOs and governments. Many interviewees stress the need for (legal) certainty and long-term policy consistency, noting that entrepreneurs can only commit when responsibilities, exit options, data arrangements and contract conditions are transparently defined. Governance at higher scales is perceived less as facilitation and more as a condition-setting mechanism whose clarity and stability determine whether collective energy projects are viable. These findings strongly align with the literature. Leonhardt et al. (2022) emphasise that government instruments fundamentally shape the viability of local energy initiatives and that effective governance requires coordination across levels, from national subsidies to local permitting. This matches the interviewees' call for coherent governance that removes uncertainty and supports park-level initiatives. The reports by SMEunited (2024) and Chenari (2023) further stress that SMEs require clear information, accessible procedures and tailored support, echoing the expressed need for understandable contract frameworks, legal clarity and guidance for entrepreneurs. Likewise, Purwandani and Michaud (2021) underline that governments must provide financial assistance and accessible information: conditions mirrored in interviewees' emphasis on early public (financial) support, simplified rules and consistent long-term policy.

This higher-scale governance is also one of the strongest barriers when absent. The same need for clarity, stability and coordinated action that emerges as a political condition becomes a source of friction when rules remain uncertain, contract forms incomplete or DSO procedures inconsistent. Across both the literature and the empirical findings, the political dimension clearly emerges as the most influential in shaping drivers and barriers for collective energy initiatives. In the interviews, political factors dominate as barriers (uncertain legislation, slow contract development, inconsistent rules across DSOs, unclear responsibilities), but are also mentioned as drivers (regulatory pressure, subsidies, obligations, independence from geopolitical risks). Similarly, the literature identifies political and regulatory conditions as crucial determinants for SME sustainability action. Financial incentives, tax reductions and subsidies are highlighted as key enablers (Purwandani & Michaud, 2021), while inconsistent or unclear policies limit adoption (Chenari, 2023). Political will and regulatory stability are shown to reduce uncertainty and increase investment willingness (Aparisi-Cerdá et al., 2024). Another important theme in the interview data is the need for credible intermediary support. Stakeholders emphasise that entrepreneurs trust explanations and guidance more when they come from independent technical experts or fellow entrepreneurs, rather than from governmental actors or government-commissioned advisors. This insight resonates strongly with Wiser's (2006) finding that private provision of renewable energy services increases willingness to pay compared to government provision, partly because of greater trust in private actors.

Governments can provide this technical assistance to help entrepreneurs interpret and apply technical information (Kiraly & SMEunited, 2024). In the literature, the technical dimension is discussed as a need for support, but also as a matter of knowledge gaps. Technical barriers arise when SMEs lack the expertise to interpret technologies or evaluate energy solutions (Chenari, 2023; Aparisi-Cerdá et al., 2024). Technical drivers involve external technical assistance that simplifies adoption and reduces perceived risk (Purwandani & Michaud, 2021). However, the literature provides relatively few insights into system-level technical limitations or infrastructural constraints. In contrast, the interview data reveal a broader technical dimension. At the SME level, the same knowledge gaps appear: entrepreneurs lack time and expertise to understand complex systems, rely heavily on intermediaries and require simple, turn-key solutions. But at the regional and DSO level, technical barriers become structural and spatial. Interviewees describe inadequate local infrastructure, unsuitable cable layouts and physical constraints that make collective energy impossible or risky in certain locations. These technical barriers are specific to the Dutch grid context and do not appear in the literature because they are operational and location-specific realities rather than general theoretical drivers or barriers.

The literature identifies several operational barriers for SMEs, including lack of internal capacity, limited time, fragmented responsibilities and challenges in coordinating sustainability actions (Chenari, 2023; SMEunited, 2024). Operational drivers in the literature include the opportunity to increase efficiency and optimise resource use (De Boer, 2022), though operational issues receive comparatively little emphasis. In the interview data, the operational dimension plays a significantly stronger and more immediate role. Operational drivers are especially prominent: grid congestion, capacity shortages, inability to expand and risks to continuity make collective energy attractive and urgent. Entrepreneurs are motivated when operational problems directly threaten business growth or when shared infrastructure can unlock capacity. Operational barriers, however, also stand out: absence of urgency, lack of time, insufficient organisational capacity, weak park management and the complexity of multi-stakeholder processes all impede progress. Although the operational barriers align with the barriers mentioned in the literature, these operational dynamics are grounded in the day-to-day realities of business parks, making operational considerations far more influential in practice than they appear in the literature.

In the literature, social drivers stem from trust, reciprocity, peer influence and shared identity: SMEs are more likely to engage in sustainability efforts when they perceive others doing the same, when cooperation feels fair and when norms reinforce collective behaviour (Ostrom, 2000; Lewis et al., 2015; Suchek & Franco, 2023). Social cohesion, informal networks and local leadership similarly support collaboration, while social barriers arise when mistrust, reluctance to collaborate or misalignment between actors limit willingness to act (Chenari, 2023; Bernat et al., 2024). The literature also notes that reputational benefits and intrinsic motivations can encourage sustainability participation (Purwandani & Michaud, 2021). These themes strongly reappear in the interviews. Social drivers include reciprocity (“helping neighbours”), emerging collective identity, trust between entrepreneurs and the presence of frontrunners. Social barriers include mistrust in municipalities or DSOs, reluctance to depend on neighbouring firms and unclear communication. The empirical data strengthen the literature’s conclusion that social cohesion is fundamental. The interviews add that the social dimension is particularly fundamental at early stages, before technical or financial viability becomes convincing.

The commercial dimension is one of the most frequently mentioned themes in both the literature and the empirical results. The literature highlights financial incentives, perceived economic benefits, cost savings, improved efficiency and competitive advantage as key drivers for SMEs to engage in sustainability efforts (Uhlaner et al., 2011; De Boer, 2022; Bernat et al., 2024). SMEs tend to favour measures that lower costs, stabilise long-term expenses or support business continuity. Conversely, high upfront investments, long payback times, limited access to financing and uncertain returns consistently appear as commercial barriers (Chenari, 2023; Kiraly & SMEunited, 2024). The literature further notes that perceived financial benefits are often the strongest direct motivator for action (Uhlaner et al., 2011). The interview data align closely with these insights. Commercial drivers are the most consistent motivations across all interviews: entrepreneurs participate when collective energy provides clear economic value through lower or more stable prices, avoidance of high individual investments, improved competitiveness or higher property value. Barriers also include high costs and long payback times. At the same time, the interviews reveal additional barriers not fully captured in the literature. Many SMEs perceive a stronger business case for individual solutions, express fear of losing autonomy or are discouraged by complex cost-sharing arrangements. For firms where energy costs form a small share of total expenses, commercial urgency is low, making the time and organisational effort required for collective action difficult to justify. Overall, commercial dynamics show agreement between literature and empirical findings; firm-level financial logic remains decisive in both.

The literature presents environmental motives as meaningful but secondary: environmental concern and sustainability values can drive SMEs, but usually in combination with financial or operational incentives (De Boer, 2022; Uhlaner et al., 2011). Environmental barriers include limited awareness, low prioritisation and competing operational pressures (Bernat et al., 2024). The interview data largely confirm this pattern. Environmental drivers are mentioned, but mainly for a subgroup of entrepreneurs motivated by personal values, ESG ambitions or a desire to contribute to a more sustainable business park. For these actors, environmental considerations strengthen willingness to participate once commercial or operational arguments are already convincing. Environmental barriers barely appear in the interviews. Rather than encountering explicit environmental objections, most entrepreneurs simply treat sustainability as a lower priority compared to other concerns. Overall, both literature and empirical findings show that environmental considerations function as supportive, image-enhancing or value-driven motivators, but are not decisive drivers or barriers for implementing collective energy systems on SME business parks.

Taken together, the empirical findings broadly confirm the mechanisms identified in the literature, but they also show how these play out with greater nuance and urgency in practice. Inter-organisational collaboration (social conditions at business park level) and multi-level governance (political conditions) emerge as indispensable conditions in both the literature and interviews. Across all dimensions, the drivers and barriers identified in theory reappear in the interviews, yet the empirical data reveal more context-specific dynamics, especially around grid limitations, operational pressures and the strategic considerations of SMEs. Overall, the comparison shows that while the literature and interview data largely point to the same underlying mechanisms, the interviews highlight how these factors unfold within the specific organisational, regulatory and infrastructural realities of SME business parks. Successful collective energy initiatives depend on the alignment of social trust, institutional clarity and the commercial and operational conditions present in practice.

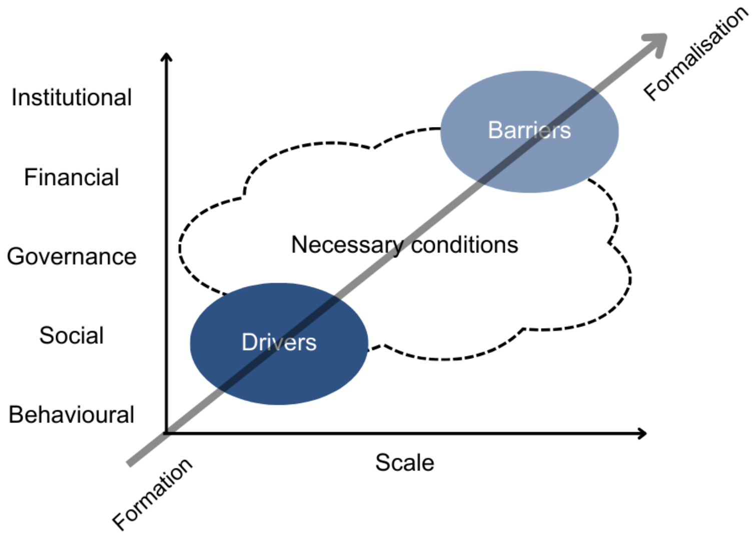

Figure 11: Visualisation of hypothesis based on the literature (own work)

Based on the literature, the figure above was formed to visualise the projected determinants for collective energy. It serves as a hypothesis for the empirical part of the research. This hypothesis suggested that the implementation of collective energy systems follows a phased and scalar progression. Early stages were expected to be driven primarily by behavioural and social motivations, such as trust, local leadership and environmental or cost-related considerations, manifesting at lower scales. As initiatives move towards formalisation, the literature anticipated a growing dependence on governance design, financing instruments, contracting models and institutional clarity at higher levels. Conditions such as inter-organisational collaboration, intermediary support, clear governance arrangements and accessible financial frameworks were assumed to form a multi-scalar, multidimensional layer situated between early drivers and later-stage barriers. The empirical findings (Figure 12) largely confirm this conceptual expectation, while also introducing important refinements that sharpen the theoretical understanding of collective energy development.

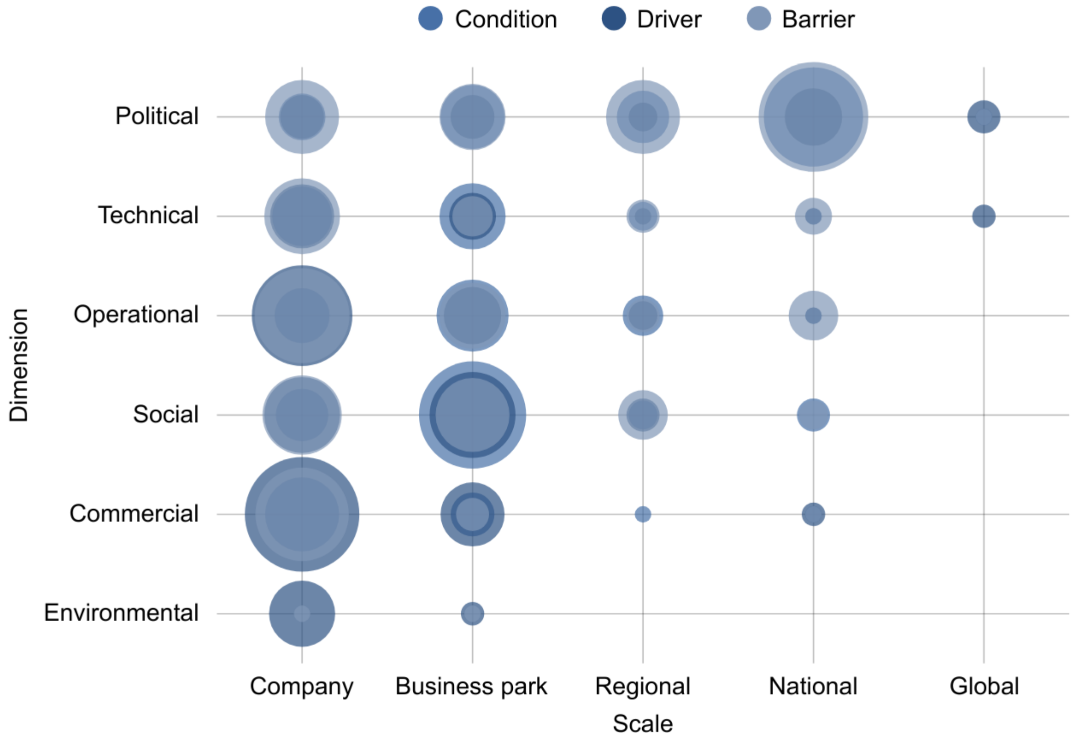

Figure 12: Visualisation of results across scales and dimensions based on empirical research (own work)

First, the results for the drivers align closely with the hypothesis. Most motivations arise at firm level and within the commercial, operational, social and environmental dimensions, which is also where the literature located behavioural and social drivers. Energy security concerns, which the literature frames as part of broader decarbonisation and resilience agendas, emerge in the interviews as a more direct motivation for entrepreneurs. A notable divergence from the literature is the strength of operational urgency: congestion, growth restrictions and dependency on limited grid capacity represent a more powerful driver than previously assumed. The empirical data on barriers supports the hypothesis that obstacles manifest at higher scales and intensify during formalisation. However, the barriers in anticipation of the formation are also dominant. Political barriers form by far the most prevailing category, particularly at the national level. This aligns with the hypothesis that financial and institutional barriers occur at higher scales. The results also reveal that technical barriers (grid capacity, physical constraints) are place-specific and stronger than suggested in the literature.

The findings for the conditions also correspond broadly with the hypothesis. The empirical analysis shows a clear clustering of conditions on two levels: social conditions at the business park scale and political conditions at the national scale. This confirms the expectation of conditions as a multidimensional, multi-scalar category, bridging the space between initial motivations and later barriers. However, the conditions that emerge from the interviews are more specific and stringent than anticipated. In particular, national political conditions constitute a more dominant requirement than suggested in the literature. The results further underscore that social conditions must materialise before any technical or financial steps can be taken. A minimal governance structure and trust between entrepreneurs are repeatedly described as essential. Additionally, intermediary support and technical facilitation appear as indispensable conditions, especially given the limited time, capacity and expertise available within SMEs. The interviews also highlight that these conditions arise more readily on newly developed business parks, whereas existing parks face structural challenges due to historical claims, established rights and physical constraints.

When viewed along the projected diagonal, from lower-scale drivers, through multi-scale conditions, to higher scale barriers, the empirical results present a similar pattern to the hypothesised model. Although both drivers and barriers appear across all scales, the drivers indeed cluster at the lower levels, while the biggest barriers appear at higher scales. Collective energy initiatives prove to be driven from the bottom up, but constrained from the top down. The hypothesised progression from formation to formalisation is also reflected in the empirical findings. In non-pilot parks, barriers dominate, reflecting an early stage where institutional constraints are most restrictive. In developing pilots, drivers outweigh barriers due to the regulatory flexibility associated with pilot status. In operational pilots, new institutional and technical barriers resurface during implementation. Overall, the empirical findings largely confirm the hypothesised progression, but they also refine it. The results show that political conditions play a more decisive role than anticipated. They also highlight that operational urgency is a stronger driver in practice and that physical grid constraints shape feasibility more directly than the literature suggests. These insights sharpen the theoretical model by grounding it more firmly in the practical realities of Dutch SME business parks.

5.4. Policy recommendations

Ensuring the feasibility of collective energy on Dutch SME business parks has broader societal relevance, as it intersects with ongoing pressures on the Dutch energy system and the economic resilience of SMEs. SME business parks host a substantial share of the country's economic activity and employment; when energy constraints limit their operations, the consequences extend beyond individual firms to the continuity of the wider business environment. Collective energy systems offer a way to strengthen local energy resilience, safeguard business continuity and support the long-term competitiveness and future-proofing of the Dutch business climate. In light of this, the following policy recommendations translate the empirical findings of this thesis into governance interventions aimed at enabling collective energy initiatives under real-world conditions.

Recommendation: Reform the national regulatory framework to enable scalable, bottom-up collective energy systems on SME business parks

Primary scale: National
Secondary scale: Regional & DSO level (implementation)

The empirical findings show that the current national regulatory framework, shaped by the Electricity Act, Gas Act and temporary pilot exemptions, creates major constraints for the development of collective energy systems. Legal uncertainty, fragmented contracting possibilities, inconsistent DSO procedures, slow administrative processes and the absence of clear long-term policy direction together hinder implementation. At the same time, the interviews reveal that successful collective energy initiatives emerge primarily through bottom-up governance, driven by local cooperation, trust and context-specific operational needs. Collective energy is not initiated by regulation, but by entrepreneurs responding to congestion, growth limitations and business continuity risks.

To resolve this misalignment, national policy should evolve from treating collective energy as an experimental exception to recognising it as a standardised, scalable and locally governed component of the Dutch energy system. **A future-oriented regulatory framework should:**

- Provide stable legal definitions and rights for business-park collectives, allowing them to operate without relying on temporary pilot regimes.
- Enable a bottom-up approach, allowing business parks to tailor collective arrangements to local technical and organisational conditions.
- Introduce uniform and transparent collective contract forms across all DSOs and streamline approval procedures, while allowing local flexibility in how capacity allocation, responsibilities and cost-sharing are organised.
- Support park-level governance entities by simplifying the establishment of cooperatives or collective management structures, including clearer rules for data sharing, liability, financial schemes and exit options.
- Ensure long-term policy continuity, giving entrepreneurs confidence that investments in collective systems will remain valid under future regulatory frameworks.

By embedding bottom-up steering into national regulation, collective energy systems can develop organically from local initiatives while still fitting within a coherent national framework. This shift would allow collective energy to move from isolated pilots toward a replicable, system-integrated model that enhances grid efficiency, strengthens local resilience and supports the energy transition on SME business parks in a manner that aligns with the realities observed in practice.

Recommendation: Strengthen social-organisational capacity at the business park level to enable bottom-up collective energy development

Primary scale: Business park
Secondary scale: Local & regional (public process lead)

Collective energy depends fundamentally on the social and organisational capacity of the business park community. The interviews show that collaboration among SMEs is not spontaneous but must be actively constructed. Entrepreneurs only engage in collective arrangements when shared interests are identified, trust is developed and a sense of mutual benefit emerges. Establishing this foundation requires deliberate effort and facilitation.

First, social capacity must be built. This includes cultivating trust, familiarity and reciprocal relationships between firms and developing a shared purpose that aligns expectations and motivations. Stakeholders repeatedly emphasised that cooperation begins only when businesses recognise a joint operational or strategic interest. Strengthening social cohesion is, therefore, a prerequisite for any collective energy initiative and must be approached through a bottom-up process that allows firms to articulate their own needs and priorities.

Second, organisational capacity must be established. This requires a minimal governance structure at the business park level that allows SMEs to act collectively, make joint decisions and represent themselves as one actor toward external parties. Alongside this, a process lead is needed: an initiating, coordinating actor at a higher governance scale who brings firms together, identifies shared interests, facilitates communication and gathers the information needed to advance the technical and legal steps. The implementation process itself should follow a phased trajectory: starting with a small group of frontrunners who formalise initial collaborative arrangements, test early agreements and demonstrate practical value, after which the collective can expand gradually as trust, experience and confidence grow.

Currently, there is no actor that assumes a coordinating or initiating role in developing collective energy on business parks. Because DSOs are legally restricted, private market actors do not step in and SMEs lack the time and capacity to organise collective systems themselves, this process lead inevitably falls to the public sector. By supporting the development of social cohesion, enabling a minimal organisational structure and providing process leadership, the public sector can create the conditions under which collective energy initiatives emerge organically from the bottom up.

Recommendation: Align incentives with firm-level motivations to increase participation in collective energy initiatives

Primary scale: Company
Secondary scale: National & regional (design & tailoring of incentives)

Collective energy will only materialise when individual firms perceive clear commercial and operational benefits. The empirical findings show that continuity of business operations and a positive business case are the dominant commercial drivers for SMEs, while operational urgency is the primary trigger for collaboration. When these conditions are absent or ambiguous, entrepreneurs do not commit. Participation depends on whether firms can recognise a concrete, quantifiable advantage that directly affects their operations.

To stimulate participation, **policy should be designed from the perspective of the entrepreneur.** SMEs require incentives that are visible, measurable and directly linked to their continuity, growth space or operational flexibility. This means moving beyond abstract sustainability objectives and instead embedding incentives that articulate what individual companies stand to gain, whether through reduced risk exposure, more reliable access to capacity, lower long-term energy costs or improved competitiveness. These incentives must be communicated clearly and framed in language that aligns with SME decision-making.

Because private parties do not currently assume this role and SMEs lack the time and expertise to translate system-level benefits into firm-level value, a public process lead is needed to develop and convey these incentives. This actor should analyse what specific operational pressures firms face, identify which elements of collective energy can address them and ensure that incentives are tailored to different business profiles within a park. At the same time, the public sector should work with private market actors to align their products, services and contractual arrangements with the practical needs and motivations of SMEs. By **translating collective benefits into firm-level value propositions** and **ensuring that market offerings match these incentives**, the public sector can help bridge the gap between system goals and individual decision-making.

Together, these recommendations show that advancing collective energy on SME business parks requires bottom-up energy systems supported by clear national rules, strong park-level social and organisational capacity and incentives aligned with firm-level motivations. Only when these conditions reinforce one another can collective energy scale effectively.

5.5. Limitations and future research

This research provides insight into the conditions under which collective energy can be implemented on Dutch SME business parks; however, several methodological, contextual and analytical limitations must be acknowledged. First, the qualitative, case-based design necessarily limits the generalisability of the findings. Although the eight use cases offer valuable variation, the sample is not representative of all Dutch SME business parks and use-case diversity, particularly the small number of non-operational pilots, restricted the ability to draw firm conclusions about differences across development stages. Interviewee selection was shaped by practical constraints: entrepreneurs were difficult to reach due to limited availability, resulting in fewer SME interviews than intended. A survey was initially considered to broaden the empirical base, but response expectations were insufficient, leading the study to rely primarily on semi-structured interviews. Moreover, the sample contained more general expert interviews than detailed case-specific ones, which reduced the detail of insights into park-level processes. Second, analytical limitations arise from the use of interview-based data and the application of the TECOP framework. While TECOP provided a useful structure, the categorisation of conditions required interpretative judgement. Several factors operated across multiple dimensions and governance scales and distinctions between conditions, drivers and barriers often blurred in practice. The analytical boundaries between categories should, therefore, be understood as indicative. Lastly, the rapidly evolving regulatory and infrastructural context forms an important boundary. The research was conducted during a period of intensifying grid congestion, new pilots and forthcoming regulatory reforms, including the Energy Act, meaning that several relevant developments emerged after data collection. Relatedly, the empirical focus converged on electricity, since congestion dominated the challenges faced by the cases, leaving less opportunity to explore other energy vectors.

These limitations do not undermine the value of the findings but highlight several areas for future research. First, there is a clear need for more systematic empirical work on the development phases of collective energy initiatives. Comparative case studies that cover a wider range of development stages or longitudinal designs that follow initiatives over time would deepen understanding of how cooperation, governance, risk allocation and investment decisions unfold across phases. Second, since entrepreneurs were underrepresented in this study, future research should prioritise their perspectives through targeted sampling strategies or sector-based recruitment. Future research could also benefit from mixed-methods approaches that complement qualitative insights with broader quantitative validation. Surveys among SMEs, focus groups involving multiple stakeholder groups or experimental workshops around collective decision-making could reveal interaction effects, behavioural dynamics and willingness-to-cooperate patterns that remain difficult to capture through interviews alone. Third, conceptual development is needed to strengthen analytical clarity in the field. The blurred boundaries between conditions, drivers and barriers and the cross-scalar nature of many conditions suggest that existing frameworks such as TECOP could be refined or extended to better account for interdependencies in multi-actor energy governance. Research focusing on a single form of collective energy could also provide greater conceptual precision and allow investigation of different actor constellations, governance models and risk profiles. Finally, as this study centred primarily on electricity due to its empirical significance, future work should explore other energy vectors, hybrid systems and sector-specific contexts. Comparative research on collective energy in different settings would support a broader understanding of how institutional, spatial and organisational contexts shape feasibility. In addition, further inquiry into the role of the public sector, including which governmental actor is best positioned to assume a coordinating or initiating role, would provide valuable insights for policy design and implementation.

6. Conclusion

This thesis set out to understand the conditions under which collective energy can be implemented on Dutch SME business parks. It did so by analysing eight business park cases and expert interviews through a TECOP-based framework across five governance scales. The research is situated in a broader macro-context characterised by increasing geopolitical instability, rising energy price volatility and growing concerns over security of supply. Within this context, energy has become a strategic issue for firms whose daily operations depend on reliable and affordable energy.

In light of this, collective energy is examined as a potentially effective response to external pressures affecting SMEs. The relevance of collective energy in this research is, therefore, explicitly limited to the SME business park context, where firms are simultaneously exposed to grid congestion, electrification requirements and limited individual bargaining power in energy markets. Collective arrangements can, under certain conditions, offer advantages in terms of capacity management, risk reduction and operational continuity. At the same time, this thesis does not assume collective energy to be universally applicable or beneficial.

The empirical analysis demonstrates that whether such advantages can actually be realised depends strongly on context. The findings show that collective energy consists of a series of context-dependent arrangements whose feasibility is determined by the interaction between firm-level motivations, park-level organisation and national institutional frameworks.

The first sub-question asked: *What forms of collective energy are relevant for Dutch SME business parks?*

In the current Dutch context of electrification and grid congestion, shaped by both geopolitical pressures on energy security and decarbonisation policies, collective energy on SME business parks is first and foremost an electricity question. In response to rising electricity demand, structural grid capacity constraints and increasing exposure to energy supply risks, the most relevant collective arrangements are those that reorganise electricity supply and grid access at park level. In the empirical cases, this materialises in the form of energy hubs and closed distribution systems (CDS). Alongside these concepts, interviews with DSOs, government entities and intermediaries identify a broader range of smaller-scale collective solutions that are considered relevant for SME business parks. These include direct lines between producers and neighbouring users, cable pooling and shared charging infrastructure. Stakeholders describe cable pooling and shared charging as concrete options that can already be implemented under current regulation, while group transport agreements and more integrated hubs are seen as promising but more complex or longer-term solutions.

At the same time, the interviews make clear that collective energy forms do not replace individual action, but build on it. DSOs, government officials and experts emphasise that businesses should first obtain insight into their own energy profile, reduce and shift their own demand and explore individual contractual and technical options before turning to collective arrangements. Individual solutions are described as faster, more straightforward and less dependent on coordination and trust, which makes them the default starting point for many entrepreneurs. Collective systems such as energy hubs are recognised as important building blocks of the future energy system, but they are not treated as a universal or immediate answer to energy security. Instead, stakeholders stress that collective solutions only become relevant when they offer a distinct advantage over individual measures in terms of cost, capacity or risk and when companies are willing and able to engage in the additional organisational effort. Therefore, in many situations, individual optimisation or smaller forms of collectivity remain more realistic or faster to realise.

Together, these findings show that the relevant forms of collective energy are inherently multi-dimensional and multi-scalar. When arrangements move beyond purely individual installations, they require the alignment of technical and operational infrastructures, commercial and environmental incentives, social relations and political rules across company, business park, regional, national and global scales. In line with broader literature on multi-level energy governance, the empirical analysis confirms that the implementation of collective energy is shaped by restrictions at different governance scales and within different dimensions.

The second sub-question asked: *How do conditions, drivers and barriers for collective energy manifest across scales and dimensions?*

In this multi-dimensional and multi-scalar context, the empirical findings reveal that the implementation of collective energy is driven by an interplay of mutually reinforcing and constraining factors. First, a set of structural conditions must be in place before collective energy can move beyond conceptual interest. Drivers incentivise firms and parks to act once these enabling conditions exist. Barriers restrict progress where essential conditions are absent or weak. The most decisive conditions arise in the social and political dimensions. At the business park level, collective energy initiatives depend on a minimal degree of social cohesion, trust and willingness to cooperate among firms, supported by a basic organisational structure that can coordinate, represent the collective and maintain continuity. Without such park-level governance, more advanced technical or financial arrangements cannot take shape. This social-organisational foundation must be complemented by external guidance to reduce complexity and relieve SMEs of the procedural and technical burden. At the national scale, political-institutional conditions are equally critical: a stable and predictable regulatory framework, workable and standardised collective contract models and alignment between DSOs and governmental bodies. These institutional conditions determine whether collective energy is perceived as a feasible option rather than an experimental exception.

Drivers emerge most strongly at the company level, particularly within the commercial and operational dimensions. Firms are motivated by concrete commercial advantages, such as cost savings or risk reduction and by operational pressures related to business continuity: grid congestion, expansion constraints and certainty of supply. At the business park scale, social drivers, such as trust, reciprocity and shared identity can accelerate collective uptake. Environmental motivations function primarily as supportive drivers for value-oriented or sustainability-minded firms, but they rarely initiate action on their own. Barriers, by contrast, cluster at higher governance scales and within organisational constraints. Political barriers at national and regional (DSO) levels are the most restrictive, reflecting regulatory uncertainty, slow and inconsistent procedures and unclear contract forms. Commercial barriers at company level arise when collective systems are perceived as financially unattractive or riskier than individual alternatives. Operational barriers appear where firms or park organisations lack time, capacity or a sense of urgency, while social barriers hinge on insufficient trust, weak collaboration culture or limited familiarity among neighbouring businesses.

Taken together, the findings demonstrate that collective energy emerges only when enabling social-organisational structures at the business park level intersect with a supportive national regulatory environment and when firm-level drivers outweigh remaining commercial, operational and social barriers.

The main research question asked: *What drivers and barriers exist for the implementation of collective energy on Dutch SME business parks?*

The implementation of collective energy on Dutch SME business parks is ultimately determined by three interconnected conditions: the national institutional framework, the organisational capacity of business parks and the motivations of individual firms. Across these layers, the same underlying factors repeatedly function as either drivers or barriers depending on how they manifest in specific contexts.

At the company level, commercial and operational conditions form the core determinants. When firms perceive clear financial benefits, reduced risk and operational urgency, caused by congestion, expansion constraints or security-of-supply concerns, these conditions act as strong drivers. When these advantages are absent, unclear or overshadowed by simpler individual solutions, the same conditions become barriers, producing hesitation and delaying collective action. At the business park level, social and organisational conditions similarly operate in an equally dynamic manner. Trust, reciprocity, shared identity and a capable park management enable firms to collaborate and thereby function as social drivers. Where such cohesion, familiarity or organisational capacity is weak, these conditions become barriers that hinder coordination and prevent collective arrangements from taking shape. However, the most structurally decisive obstacles arise at higher governance scales. Political and regulatory barriers at national and regional (DSO) levels, including institutional uncertainty, inconsistent procedures and immature collective contract models, form the dominant constraints and frequently prevent initiatives from progressing beyond pilots or exploratory phases.

Taken together, the research concludes that the feasibility of collective energy on Dutch SME business parks depends on the alignment of three core conditions: (1) commercial-operational motivations at the company level, (2) social-organisational capacity at the business park level and (3) a coherent national regulatory framework. These conditions operate across different governance scales and address distinct, yet interdependent, drivers and barriers. Only when they reinforce one another can collective energy move beyond exploratory interest and pilot initiatives towards sustained implementation in practice. Together, they point to the need for governance approaches that move beyond purely technical or market-based solutions and instead address institutional design, collective organisation and firm-level incentives in an integrated manner.

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Appendix A – Interview protocols

Interview protocol – Entrepreneur

0. Introductie

Dank dat u wilt deelnemen aan dit interview. Dit gesprek maakt onderdeel uit van mijn masterthesis aan de TU Delft over hoe ondernemers op bedrijventerreinen in Nederland omgaan met collectieve energievoorzieningen.

Het doel van dit gesprek is om te begrijpen hoe u als ondernemer kijkt naar energievoorziening op het terrein, uw ervaringen met samenwerking of verduurzaming, en wat u zou motiveren of juist tegenhoudt om te investeren in een collectieve energieoplossing (zoals een energiehub, gedeelde laadinfrastructuur of warmtenet).

Uw antwoorden worden anoniem verwerkt en uitsluitend gebruikt voor academische doeleinden. Het gesprek duurt ongeveer 30–45 minuten. Met uw toestemming neem ik dit gesprek op voor analyse.

Heeft u nog vragen voordat we beginnen?

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1. IJsbreker

- “Als ik ‘collectieve energievoorziening op bedrijventerreinen’ zeg, waar denkt u dan als eerste aan?”

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2. Algemene achtergrond

- Kunt u kort iets vertellen over uw bedrijf en wat u doet?
- Hoe groot is uw bedrijf (ongeveer hoeveel medewerkers)?
- Hoe lang bent u al gevestigd op dit bedrijventerrein?
- Bent u eigenaar of huurder van uw bedrijfspand?

Probes:

- Waarom heeft u destijds voor dit terrein gekozen?
- Wat vindt u goed of juist minder goed geregeld op dit terrein?

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3. Huidige energiesituatie

- Hoe regelt uw bedrijf op dit moment de energievoorziening (elektriciteit, gas, laadinfra)?
- Heeft u al duurzaamheidsmaatregelen genomen (zoals zonnepanelen, warmtepomp, isolatie)?
- Ervaart u energie gerelateerde uitdagingen, zoals netcongestie of hoge energiekosten?

Probes:

- Hoe beïnvloedt dit uw bedrijfsvoering?
- Denkt u dat dit in de toekomst een groter probleem wordt?

---

4. Bekendheid en ervaring met collectieve energievoorzieningen

- Bent u bekend met collectieve energie-initiatieven (bijv. energiehubs, gedeelde laadinfrastructuur, collectieve warmtenetten)?
- Heeft u ooit deelgenomen of is uw bedrijf ooit benaderd om deel te nemen aan zo'n initiatief?
- Zo ja, wat was uw ervaring of eerste reactie?

---

5. Bereidheid tot investeren

- Hoe kijkt u aan tegen investeren in een collectieve energievoorziening?
- Wat zou u meer of minder bereid maken om hier financieel aan deel te nemen?
- Ziet u voordelen of meerwaarde voor uw bedrijf?

---

6. Ervaren drijfveren

- Wat zou u motiveren om mee te doen aan een collectief energie-initiatief?
- Zijn er bepaalde randvoorwaarden die u nodig heeft voordat u zich zou committeren?

---

7. Ervaren belemmeringen

- Wat zijn voor u de grootste zorgen of drempels om mee te doen?
- Weet u zorgen of drempels voor andere ondernemers op dit terrein?
- Hoe belangrijk is de rol van parkmanagement of externe coördinatie?

Snelle samenvatting-vragen:

- In drie woorden: wat zijn volgens u de grootste obstakels?
- In één zin: waar loopt het meestal op vast?

---

8. Voorwaarden voor actie

- Wat zou u over de streep trekken om mee te doen?
- Welke vormen van ondersteuning, organisatie (samenwerking) of stimulansen zouden u motiveren?
- Wie zou volgens u de leiding moeten nemen: de overheid (gemeente), netbeheerders, een parkmanager of de ondernemers zelf?

9. Afsluiting

- Wat zou u andere ondernemers adviseren die voor zo'n keuze staan?
- Is er nog iets dat we niet hebben besproken, maar dat volgens u belangrijk is om te delen?
- Als ik nog aanvullende vragen heb, mag ik die dan eventueel later per mail aan u voorleggen?

Interview protocol – Expert (use case)

0. Introductie

Dank dat u wilt deelnemen aan dit interview. Dit gesprek maakt onderdeel uit van mijn masterthesis aan de TU Delft naar hoe ondernemers op bedrijventerreinen in Nederland omgaan met collectieve energievoorzieningen.

In dit interview wil ik inzicht krijgen in de context van het bedrijventerrein en uw ervaringen met het ontwikkelen of begeleiden van collectieve energievoorzieningen. Ik ben vooral benieuwd naar de factoren die bedrijven motiveren of juist belemmeren om deel te nemen.

Uw antwoorden worden anoniem verwerkt en alleen gebruikt voor academische doeleinden. Het gesprek duurt ongeveer 45–60 minuten. Met uw toestemming neem ik dit gesprek op voor analyse.

Heeft u nog vragen voordat we beginnen?

---

1. IJsbreker

- "Als ik 'collectieve energievoorziening op bedrijventerreinen' zeg, waar denkt u dan als eerste aan?"

---

2. Achtergrond en rol

- Wat is uw rol binnen dit bedrijventerrein en hoe lang bent u hierbij betrokken?
- Kunt u het bedrijventerrein kort schetsen: wat voor soort bedrijven zitten er (sector, omvang, diversiteit)?
- Hoe belangrijk is duurzaamheid en energievoorziening in de strategie van dit terrein?

---

3. Collectieve energievoorziening

- Wat voor collectieve energievoorziening is er gerealiseerd (of wordt er ontwikkeld)? Waarom specifiek deze?
- Wanneer is dit traject gestart en (indien afgerond) opgeleverd?
- Wordt alle energie via de voorziening geregeld of gaat het om een deeloplossing?
- Wie nam het initiatief? Wie ontwikkelt de collectieve energievoorziening?

---

4. Organisatie en samenwerking

- Hoe is dit organisatorisch geregeld (bijv. coöperatie, parkmanagement, BIZ)?
- Hoeveel bedrijven zijn aangesloten? Zijn er bedrijven die bewust niet meedoen?
- Welke andere partijen spelen een rol (gemeente, provincie, netbeheerder, subsidiegevers)?

Probes:

- Hoe verliep de besluitvorming? Wat waren drempels? Succesfactoren?
- Welke rol speelde parkmanagement of externe coördinatie?

---

5. Drijfveren en commitment van bedrijven

- Hoe was de bereidheid van bedrijven om te investeren?
- Wanneer in het traject kwam hun commitment?
- Wat zag u als de grootste stimulansen voor de bedrijven om aan te haken?

Probes:

- Wie waren de eerste partijen die instapten? Wie de laatste?
- Welke rol spelen kostenbesparing, leveringszekerheid, regelgeving of imago?

---

6. Barrières voor bedrijven

- Wat zijn volgens u de grootste drempels of zorgen die ondernemers ervaren?
- Kunt u in drie woorden de belangrijkste obstakels samenvatten?
- Ziet u verschil tussen huurders, eigenaar-gebruikers en vastgoedeigenaren?
- Ziet u verschillen tussen mkb of grote bedrijven in hun bereidheid?

Probes:

- Hoe belangrijk zijn factoren zoals onzekerheid over rendement, gebrek aan vertrouwen of onduidelijke regelgeving?

---

7. Voorwaarden en interventies

- Welke voorwaarden zijn volgens u cruciaal om ondernemers te laten deelnemen?
- Welke rol kunnen gemeenten, provincies of de rijksoverheid spelen om dit te stimuleren?
- Wat zouden beleidsmakers volgens u prioriteit moeten geven om collectieve energievoorzieningen op bedrijventerreinen verder te brengen?
- Hoe belangrijk zijn subsidies en regelgeving versus sociale of organisatorische factoren (zoals vertrouwen of samenwerking)?

---

8. Lessen en aanbevelingen

- Wat zou u anderen adviseren die een vergelijkbaar traject starten?
- Zijn er specifieke aandachtspunten of ervaringen die ik zeker in mijn onderzoek moet meenemen?

9. Afsluiting

- Is er nog iets dat we niet hebben besproken, maar dat volgens u relevant is voor mijn onderzoek?
- Kunt u mij eventueel in contact brengen met ondernemers?
- Als ik nog aanvullende vragen heb, mag ik die dan eventueel later per mail aan u voorleggen?

Interview protocol – Expert (general)

0. Introductie
Dank dat u wilt deelnemen aan dit interview. Dit gesprek maakt onderdeel uit van mijn masterthesis aan de TU Delft naar hoe ondernemers op mkb-bedrijventerreinen in Nederland omgaan met collectieve energievoorzieningen.

In dit interview wil ik inzicht krijgen in uw visie en expertise rondom collectieve energievoorzieningen op bedrijventerreinen in Nederland. Ik ben vooral benieuwd naar uw ervaringen met succesfactoren en belemmeringen, en naar de voorwaarden die de bereidheid van ondernemers om te investeren kunnen vergroten.

Uw antwoorden worden anoniem verwerkt en alleen gebruikt voor academische doeleinden. Het gesprek duurt ongeveer 45–60 minuten. Met uw toestemming neem ik dit gesprek op voor analyse.

Heeft u nog vragen voordat we beginnen?

---

1. IJsbreker

- "Als ik 'collectieve energievoorziening op bedrijventerreinen' zeg, waar denkt u dan als eerste aan?"

---

2. Achtergrond en rol

- Kunt u kort uw achtergrond en ervaring met dit thema schetsen?
- Vanuit welke rol of organisatie houdt u zich bezig met collectieve energievoorzieningen?

---

3. Relevante collectieve energie oplossingen

- Netcongestie: in hoeverre ziet u initiatieven voor een collectieve energievoorziening als een oplossing hiervoor? Ten opzichte van individuele oplossingen?
- Welke collectieve energie oplossingen ziet u momenteel als het meest relevant op Nederlandse bedrijventerreinen? En met wat voor collectieve energievoorzieningen houdt u zich bezig?
- Hoe verschillen deze oplossingen tussen grote terreinen en mkb-terreinen?

---

4. Organisatie en samenwerking

- Wie neemt het initiatief voor deze collectieve oplossingen? Wie ontwikkelt ze?
- Hoe wordt dit doorgaans organisatorisch geregeld (BIZ, coöperatie, stichting, etc.)?
- Hoe verloopt de besluitvorming doorgaans? Hoe worden bedrijven betrokken?

5. Drijfveren en commitment van bedrijven

- Vanuit uw ervaring: welke factoren overtuigen ondernemers om te investeren in collectieve oplossingen?
- Ziet u verschillen tussen huurders, eigenaar-gebruikers en vastgoedeigenaren?
- Zijn er verschillen tussen mkb en grote bedrijven in hun bereidheid?
- Welke succesfactoren zag u in eerdere trajecten?
- Hoe is de bereidheid van bedrijven om geld te investeren?
- Welke rol spelen kostenbesparing, leveringszekerheid, regelgeving of imago?

Probes:

- Welke rol spelen kostenbesparing, leveringszekerheid, regelgeving of imago?

---

6. Barrières voor bedrijven

- Wat zijn volgens u de grootste drempels of zorgen die ondernemers ervaren?
- Kunt u in één zin aangeven waar dit soort trajecten meestal op vastlopen?
- Hoe belangrijk zijn factoren zoals onzekerheid over rendement, gebrek aan vertrouwen, of ingewikkelde regels?

Probes:

- Hoe belangrijk zijn factoren zoals onzekerheid over rendement, gebrek aan vertrouwen of onduidelijke regelgeving?

---

7. Voorwaarden en interventies

- Welke voorwaarden zijn volgens u cruciaal om ondernemers te laten deelnemen?
- Welke rol kunnen gemeenten, provincies of de rijksoverheid spelen om dit te stimuleren?
- Wat gaat de nieuwe energiewet hierin volgens u veranderen?
- Wat zouden beleidsmakers volgens u prioriteit moeten geven om collectieve energievoorzieningen op bedrijventerreinen verder te brengen?
- Hoe belangrijk zijn subsidies en regelgeving versus sociale of organisatorische factoren (zoals vertrouwen of samenwerking)?

---

8. Lessen en aanbevelingen

- Welke lessen uit eerdere trajecten zijn het meest waardevol voor de toekomst?
- Wat zou u mkb-ondernemers adviseren die overwegen om aan te sluiten bij een collectief systeem?

9. Afsluiting

- Is er nog iets dat we niet hebben besproken, maar dat volgens u relevant is voor mijn onderzoek?
- Als ik nog aanvullende vragen heb, mag ik die dan eventueel later per mail aan u voorleggen?

Interview protocol – DSO

0. Introductie
Dank dat u wilt deelnemen aan dit interview. Dit gesprek maakt onderdeel uit van mijn masterthesis aan de TU Delft naar hoe ondernemers op mkb-bedrijventerreinen in Nederland omgaan met collectieve energievoorzieningen.

In dit interview wil ik inzicht krijgen in uw visie en expertise rondom collectieve energievoorzieningen op bedrijventerreinen in Nederland. Ik ben vooral benieuwd naar uw ervaringen met succesfactoren en belemmeringen, en naar de voorwaarden die de bereidheid van ondernemers om te investeren kunnen vergroten.

Uw antwoorden worden anoniem verwerkt en alleen gebruikt voor academische doeleinden. Het gesprek duurt ongeveer 45–60 minuten. Met uw toestemming neem ik dit gesprek op voor analyse.

Heeft u nog vragen voordat we beginnen?

---

1. IJsbreker

- “Als ik ‘collectieve energievoorziening op bedrijventerreinen’ zeg, waar denkt u dan als eerste aan?”

---

2. Achtergrond en rol

- Kunt u kort uw achtergrond en ervaring met dit thema schetsen?
- Kunt u kort uw rol bij [naam netbeheerder] toelichten?
- Wat is de rol van een netbeheerder bij initiatieven voor collectieve energie?

---

3. De huidige situatie en uitdagingen

- In Nederland speelt netcongestie nu een steeds belangrijkere rol, ook op bedrijventerreinen. Hoe groot acht u dit probleem en in hoeverre ziet u initiatieven voor een collectieve energievoorziening als een oplossing hiervoor?
- Hoe kijkt u naar collectieve oplossingen ten opzichte van individuele?
- In hoeverre stimuleren of belemmeren huidige aansluitregels en capaciteitstarieven deze collectieve initiatieven?
- Wat zijn typische technische of organisatorische knelpunten die u tegenkomt?
- Wat zijn volgens u de grootste misvattingen die bedrijven hebben over de rol van de netbeheerder?

---

4. Relevante collectieve energie oplossingen

- Welke typen collectieve energievoorzieningen ziet u in de praktijk ontstaan? (bijv. energiehubs, cable pooling, gesloten distributiesystemen, multi-user aansluitingen)

- Veel van deze initiatieven (energy hubs) zijn pilots, zo heeft [naam netbeheerder] er ook een aantal. Hoe ziet u deze oplossingen in werking treden in de praktijk? Hoe zijn jullie daar nu mee bezig?
- Welke van deze typen zijn volgens u het meest kansrijk op mkb-terreinen?

Probes:

- Welke randvoorwaarden zijn belangrijk voor succes?
- Hoe verloopt de samenwerking tussen netbeheerder, bedrijven en gemeenten in deze projecten?

---

5. Drijfveren van bedrijven

- Vanuit uw ervaring: wat motiveert bedrijven om een collectieve energieoplossing op te zetten?
- In hoeverre helpt de netbeheerder actief om bedrijven te motiveren of informeren?

Probes:

- Welke rol spelen netcongestie, leveringszekerheid, kostenbesparing of regelgeving?
- Welke succesfactoren zag u in eerdere trajecten?
- Hoe is de bereidheid van bedrijven om geld te investeren?

---

6. Barrières voor bedrijven

- Wat zijn volgens u de grootste drempels of zorgen die ondernemers ervaren bij het opzetten van zo'n collectieve energievoorziening?
- Dit soort trajecten lopen ook weleens vast, wat zijn daar de oorzaken van?
- Kunt u in één zin samenvatten wat u als de kern van het probleem ziet?

Probes:

- Spelen vooral technische, financiële of organisatorische factoren een rol?
- Hoe beïnvloeden bestaande regelgeving of aansluitprocedures de snelheid van dit soort trajecten?

---

7. Voorwaarden en interventies

- Welke voorwaarden zijn volgens u cruciaal om collectieve energievoorzieningen op bedrijventerreinen te laten slagen?
- Wat kunnen netbeheerders doen om ondernemers beter te ondersteunen?
- Wat is volgens u de rol van gemeenten, provincies en de rijksoverheid hierin?
- Wat verwacht u dat de nieuwe Energiewet zal veranderen voor dit soort initiatieven?
- Zouden flexibele aansluitvormen of experimenteerregelingen helpen?

Probes:

- Wat zouden beleidsmakers volgens u prioriteit moeten geven om collectieve energievoorzieningen op bedrijventerreinen verder te brengen?
- Hoe belangrijk zijn subsidies en regelgeving versus sociale of organisatorische factoren (zoals vertrouwen of samenwerking)?

---

8. Lessen en aanbevelingen

- Zijn er belangrijke lessen uit eerdere projecten of samenwerkingen op bedrijventerreinen?
- Wat ziet u als de belangrijkste succesfactoren in toekomstige energiehubs of collectieve systemen?

---

9. Afsluiting

- Is er nog iets dat we niet hebben besproken, maar dat volgens u relevant is voor mijn onderzoek?
- Als ik nog aanvullende vragen heb, mag ik die dan eventueel later per mail aan u voorleggen?

Interview protocol – Government entity

0. Introductie
Dank dat u wilt deelnemen aan dit interview. Dit gesprek maakt onderdeel uit van mijn masterthesis aan de TU Delft over hoe ondernemers op mkb-bedrijventerreinen in Nederland omgaan met collectieve energievoorzieningen.

Het doel van dit interview is om inzicht te krijgen in het nationale beleid en de rol van de overheid in het stimuleren van collectieve energievoorzieningen op bedrijventerreinen. Ik ben vooral benieuwd naar uw visie op de huidige beleidscontext, de belangrijkste knelpunten, en de mogelijkheden om ondernemers te stimuleren tot deelname en investering.

Uw antwoorden worden anoniem verwerkt en uitsluitend gebruikt voor academische doeleinden. Het gesprek duurt ongeveer 45–60 minuten. Met uw toestemming neem ik dit gesprek op voor analyse.

Heeft u nog vragen voordat we beginnen?

---

1. IJsbreker

- "Als ik 'collectieve energievoorziening op bedrijventerreinen' zeg, waar denkt u dan als eerste aan?"

---

2. Achtergrond en rol

- Kunt u kort uw functie en ervaring met dit thema schetsen?
- Op welke manier houdt uw team zich bezig met collectieve energie of met bedrijventerreinen?
- Hoe verhoudt uw werk zich tot andere afdelingen of ministeries die aan dit thema werken?

---

3. Beleidscontext en visie

- Hoe kijkt het ministerie naar de rol van bedrijventerreinen in de energietransitie?
- Hoe belangrijk is de collectieve aanpak op bedrijventerreinen volgens u binnen de nationale energietransitie?
- Welke beleidsdoelen of instrumenten spelen hier direct op in (bijv. SDE++, MOOI, Programma Verduurzaming Bedrijventerreinen, Regionale Energiestrategieën)?
- Hoe ziet u de balans tussen nationale sturing en regionale of lokale verantwoordelijkheid?

Probes:

- Waar ligt volgens u de grootste beleidsmatige uitdaging: bij techniek, financiën, organisatie of samenwerking?
- Hoe wordt binnen het ministerie nagedacht over het betrekken van ondernemers in dit proces?

4. Drijfveren en belemmeringen voor ondernemers

- Vanuit uw perspectief: wat motiveert ondernemers om te investeren in collectieve energie oplossingen?
- En wat houdt hen volgens u het meest tegen?
- In hoeverre spelen financiële instrumenten (zoals subsidies of fiscale regelingen) hierin een doorslaggevende rol?
- Ziet u ook niet-financiële belemmeringen, zoals regelgeving, samenwerking of gebrek aan kennis?
- Hoe belangrijk zijn subsidies en regelgeving versus sociale of organisatorische factoren (zoals vertrouwen of samenwerking)?

Probes:

- Zijn er typen bedrijven die makkelijker instappen dan anderen (bijv. grote bedrijven versus mkb)?
- Hoe ziet u de rol van de rijksoverheid, gemeenten en provincies in het overbruggen van deze belemmeringen?

---

5. Huidige wet- en regelgeving

- Hoe ziet u de rol van regelgeving in het stimuleren van collectieve initiatieven?
- Zijn er beleidsdossiers of wetswijzigingen (zoals de nieuwe Energiewet) die hierin een grote rol gaan spelen?
- Welke obstakels ziet u momenteel in bestaande wet- of regelgeving voor collectieve energievoorzieningen?

Probes:

- Hoe proberen overheden op dit moment obstakels te verkleinen of weg te nemen?
- Ziet u ruimte voor experimenten of meer maatwerk op bedrijventerreinen?

---

6. Samenwerking en governance

- Hoe verloopt de samenwerking tussen overheden, netbeheerders, parkorganisaties en ondernemers?
- Wat voor organisatievormen voor samenwerking op bedrijventerreinen ziet u als relevant (bijv. coöperatie, parkmanagement, BIZ)?
- Welke rol ziet u voor overheden in het stimuleren van die samenwerking?

7. Toekomst en beleidsaanbevelingen

- Welke beleidsmaatregelen of interventies zouden volgens u de grootste impact hebben om collectieve energievoorzieningen op bedrijventerreinen te versnellen?
- Welke randvoorwaarden moeten worden verbeterd (bijv. regelgeving, financiering, kennisdeling, samenwerking)?
- Hoe kan beleid beter aansluiten op de realiteit van mkb-bedrijven?

8. Afsluiting

- Is er nog iets dat we niet hebben besproken, maar dat volgens u relevant is voor mijn onderzoek?
- Als ik nog aanvullende vragen heb, mag ik die dan eventueel later per mail aan u voorleggen?

Appendix B – Codebook

Code group	Code
Context	Business park features Current situation Governance structure Collective energy form Practical implementation collective energy Other forms of energy Energy challenges Individual vs. collective New vs. existing business park
Process	Decision-making process Collective energy procedure Contract forms Initial phase Final phase Hard side Soft side Mismatch stakeholders Long-term Short-term
Ideas and opinions	Idea about collective energy Collective energy definition Commitment to sustainability Positive association Negative association
Stakeholder roles	Role entrepreneur Role entrepreneurs' association Owner/tenant/owner-occupier Role parkmanagement Role developer Role DSO Role government Role project manager Role advisor Role external technical party Initiator Facilitator Operator Financier Leader
Scales	Company level Business park level Regional level National level Global level

Necessary conditions	Technical condition Environmental condition Commercial condition Operational condition Political condition Social condition
Drivers	Technical driver Environmental driver Commercial driver Operational driver Political driver Social driver
Barriers	Technical barrier Environmental barrier Commercial barrier Operational barrier Political barrier Social barrier

Appendix C – Ethical considerations

This research involves human participants and, therefore, requires careful attention to ethical principles. To ensure compliance with ethical and data protection standards, a Data Management Plan (DMP) has been created and reviewed by the data steward of the faculty. After this, an ethical plan, including the DMP, informed consent materials and a risk assessment and mitigation plan, is submitted to the Human Research Ethics Committee (HREC) of the TU Delft. Before the interviews will be carried out, approval of the committee is necessary. This approval serves as confirmation that the study meets ethical guidelines and respects the rights and privacy of participants. Key ethical considerations include minimising potential harm to participants, ensuring the validity and integrity of the research process and reflecting on the role and position of the researcher. The following sections outline how these ethical considerations are addressed.

The research poses minimal risk to participants. Participants include SME entrepreneurs operating on Dutch business parks, as well as park managers, government entities, advisors, grid operators or other stakeholders involved in collective energy initiatives. Data collected includes semi-structured interview transcripts, which will cover topics such as relevant types of collective energy supply, necessary conditions, organisational structures, entrepreneurial investment motivations and perceived barriers. No sensitive financial, legal or personal data will be collected. Although the study does not involve special categories of personal data, there is a minor risk of discomfort when discussing sustainability challenges or professional motivations. There is also a small risk of reputational or commercial sensitivity if comments were linked to specific companies or parks. To minimise harm, all participation is voluntary and informed consent will be obtained via consent forms signed prior to data collection. Participants may withdraw at any time without consequence. Personally identifiable information (e.g. names, email addresses) will be stored separately from research data and encrypted. All data will be securely stored on TU Delft OneDrive. Interview transcripts will be fully anonymised and findings will be reported in a way that avoids the possibility of re-identification.

Multiple measures are taken to enhance the validity of the research. Findings which follow from the in-depth interviews are triangulated with desk research and across different business park contexts. The interview protocols are developed in such a way that they directly address the research questions and ensure consistency while allowing for flexibility to explore relevant themes in depth. Interviews are audio-recorded and played back to ensure validity of the data. However, interviews are conducted with individuals who are involved in the particular projects they are asked about and, therefore, will be biased. To mitigate these biases, multiple projects and multiple stakeholders within these projects are interviewed to gather information from multiple sources.

This research is conducted as part of a graduation internship at an external organisation, which provides useful access to relevant cases and participants. However, the researcher remains fully responsible for the academic quality and independence of the study. The organisation has no influence on the research design, interpretation of results or publication. The researcher is aware that their position and access to stakeholders may introduce bias, especially during interviews and when interpreting qualitative data. To address this, a reflective approach will be used. Interviews will be recorded and transcribed to ensure accurate analysis. The researcher will regularly discuss findings and interpretations with the academic supervisors to check for possible bias or assumptions. By being transparent about their role and actively reflecting on how it may influence the research process, the researcher aims to protect the objectivity and reliability of the study.

Appendix D – Data Management Plan

Plan Overview

A Data Management Plan created using DMPonline

Title: MBE MSc Graduation - Entrepreneurial Investment in Collective Energy Solutions

Creator: Emma Schrauwen

Contributor: Michaël Peeters, Karel van den Berghe

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2025)

Project abstract:

This research explores the willingness of entrepreneurs on Dutch SME business parks to invest in collective energy supply solutions. Using a comparative case study design, data will be collected through an online survey and separate semi-structured interviews with entrepreneurs at two to three selected business parks. The study focuses on identifying perceived drivers, barriers, and conditions that could enhance investment behaviour.

Survey data will be analysed using descriptive statistics and visualisations; interview data will be coded and thematically analysed using qualitative software (Atlas.ti). Findings will be triangulated across cases to gain insight into behavioural patterns and contextual influences.

Participants include SME entrepreneurs, with optional interviews involving park managers, government entities or other stakeholders. All data will be anonymised, stored securely, and used solely for academic purposes, in compliance with TU Delft ethical guidelines.

While an initial survey was planned, the final research design focused on qualitative interviews due to response limitations.

ID: 179255

Start date: 10-02-2025

End date: 30-01-2026

Last modified: 21-10-2025

MBE MSc Graduation - Entrepreneurial Investment in Collective Energy Solutions

0. Adminstrative questions

1. Provide the name of the data management support staff consulted during the preparation of this plan and the date of consultation. Please also mention if you consulted any other support staff.

The DMP has been shared with my thesis supervisors Michaël Peeters and Karel van de Berghe via DMPonline. The responsible researcher for my ethical application is my first mentor: Michaël Peeters.

The data steward of the Faculty of Architecture and the Built Environment is Janine Strandberg. She has reviewed this DMP on 20-06-2025.

2. Is TU Delft the lead institution for this project?

- Yes, leading the collaboration – please provide details of the type of collaboration and the involved parties below

TU Delft is the lead institution for this project. I will also be doing an internship at Fakton B.V. during this graduation project. Fakton is not a research partner but provides general guidance in the professional context of the project. Their role includes offering access to relevant stakeholders, providing feedback from a practical perspective, and allowing the researcher to work on site. Fakton will not determine the research questions or influence the analysis or outcomes.

Fakton will not have access to any raw data that I retrieve from my research. No proprietary or internal company data will be used or processed as part of the research.

I. Data/code description and collection or re-use

3. Provide a general description of the types of data/code you will be working with, including any re-used data/code.

Type of data/code	File format(s)	How will data/code be collected/generated? *For re-used data/code: what are the sources and terms of use?*	Purpose of processing	Storage location	Who will have access to the data/code?

Personally identifiable information: participants' name, company name and business park name	.xlsx / .pdf	Collected via survey sign-up and interview scheduling. Participants will sign informed consent forms digitally. Contact details are only used for arranging interviews and sharing transcripts.	For administrative communication and to obtain informed consent	TU Delft OneDrive	Emma Schrauwen, Michaël Peeters and Karel van den Berghe
Audio-recordings of interviews with SME entrepreneurs, parkmanagers, government entities or other stakeholders	.mp3	Recorded on-site or via video call (with consent) using external device or software (MS Teams). Recordings are transferred to OneDrive and deleted after transcription.	Capturing detailed perspectives of participants for analysis	External device (temporary storage), then OneDrive (primary storage)	Same as above
Anonymous interview transcripts	.txt	Anonymous transcriptions created manually based on audio-recordings. Participants are asked to review the transcriptions of their interview before the transcript is finalised.	Privacy-preserving thematic analysis of SME motivations and conditions for investment	TU Delft OneDrive	Same as above
Coded anonymised interview data (Atlas.ti project files) + company type and business park context	.atlproj / .xlsx	Transcripts coded using Atlas.ti. Codes exported and grouped into themes. TU Delft Atlas.ti campus license is used.	Structuring and analysing key themes on investment behaviour across cases	Atlas.ti (temporary storage) + TU Delft OneDrive (primary storage)	Same as above
Anonymous survey responses + company type and business park name	.csv	Collected via online survey tool (e.g. Qualtrics or MS Forms). IP tracking disabled, anonymous link distributed via mailing lists at case study parks.	Identifying patterns in awareness, willingness to invest, and barriers among entrepreneurs	Qualtrics server (temporary storage) + TU Delft OneDrive (primary storage)	Same as above
Secondary data: policy reports and academic literature	.pdf	Collected from public/open-access sources (e.g. RVO, Rli, academic journals). Cited under fair use or open licences.	Supporting theoretical framework, case selection and instrument design (survey + interviews)	TU Delft OneDrive	Same as above
Final report / thesis	.pdf	Compiled from all processed and anonymised data. Will be shared with TU Delft repository after thesis defence.	Documentation and dissemination of research results	TU Delft OneDrive + TU Delft Repository	Same as above

II. Storage and backup during the research process

4. How much data/code storage will you require during the project lifetime?

- 250 GB – 5 TB

5. Where will the data/code be stored and backed-up during the project lifetime? (Select all that apply.)

- Another storage system – please explain below, including provided security measures
- TU Delft OneDrive

OneDrive: Primary research data storage. Only TU Delft team members (Emma Schrauwen, Michaël Peeters and Karel van den Berghe) have access. Survey and interview data will be stored in separate folders, and within the interview folder, there are separate folders for audio-recordings and anonymous transcriptions. Informed consent forms and contact information are encrypted separately from research data to minimise risk of re-identification.

External recording device: Used as a temporary storage location for recorded on-site interviews. Interviews will be deleted from device as soon as they are moved to OneDrive.

Qualtrics or Microsoft Forms server: Server of online survey platform. Temporary storage for anonymous survey responses.

Atlas.ti: Used for qualitative data analysis. Interview transcripts will be coded using the Atlas.ti desktop application (licensed by TU Delft). The project file (.atlproj) and exported coding outputs will be stored locally and backed up on TU Delft OneDrive. Only the researcher (Emma Schrauwen) has access to the Atlas.ti environment.

III. Data/code documentation

6. What documentation will accompany data/code? (Select all that apply.)

- Data – Methodology of data collection

IV. Legal and ethical requirements, code of conducts

7. Does your research involve human subjects or third-party datasets collected from human participants?

29. ***If you are working with a human subject(s), you will need to obtain the HREC approval for your research project.***

- Yes – please provide details in the additional information box below

I have applied for ethical approval from the Human Research Ethics Committee on 24-09-2025 with HREC application number 6077.

8. Will you work with personal data? (This is information about an identified or identifiable natural person, either for research or project administration purposes.)

- Yes

The research data collected in the project will be anonymised, but processing of personal data is required for conducting the research project.

9. Will you work with any other types of confidential or classified data or code as listed below? (Select all that apply and provide additional details below.)

30. ***If you are not sure which option to select, ask your Faculty Data Steward for advice.***

- No, I will not work with any other types of confidential or classified data/code

10. How will ownership of the data and intellectual property rights to the data be managed?

The research project is conducted as part of a graduation internship at Fakton B.V. The intellectual property rights are framed by a graduation agreement between Delft University of Technology, myself and Fakton B.V. As stated in this agreement, the author's rights on the achieved results lie with the student (Emma Schrauwen).

The interview and survey data produced by the student belongs to the student and will not be shared in a data repository. Fakton will not have access to any raw data that I retrieve from my research.

11. Which personal data or data from human participants do you work with? (Select all that apply.)

- Other types of personal data or other data from human participants – please provide details below
- Free text fields (for instance, in questionnaires) in which participants could unintentionally share personal data

- Proof of consent (such as signed consent materials which contain name and signature)
- Audio recordings
- Telephone number, email addresses and/or other addresses as contact details for administrative purposes
- Names and/or geolocation information as part of research data
- Names as contact details for administrative purposes

Personally Identifiable Information (PII): interviewee name, work address, company name, email address, and mobile phone number are processed for administrative reasons (to obtain informed consent and communicate with participants).

Personally Identifiable Research Data (PIRD): Personal research data processed for interview participants and via the online Qualtrics or MS forms survey includes:

- audio-recordings (deleted after transcription)
- information on willingness to invest in collective energy solutions
- occupation / company type
- business park name / geographical location

Audio recordings are made during semi-structured interviews, only with informed consent. These are deleted after transcription.

Survey responses are collected anonymously using Qualtrics or Microsoft Forms (using anonymous links and without collecting IP-addresses). The form uses multiple-choice and scaled questions to minimise the risk of unintentionally shared personal data, but free text fields are included and will be checked for personal identifiers before analysis.

Consent forms are digitally signed and stored securely on TU Delft OneDrive.

12. Please list the categories of data subjects and their geographical location.

Interview participants are entrepreneurs (tenants) and other stakeholders (e.g. municipalities and park managers) operating on SME business parks in the Netherlands.

Survey participants are SME entrepreneurs located on selected SME business parks in the Netherlands. The specific business parks are not yet determined; selection will be based on variation in geography, size, sustainability ambition, and organisational structure.

13. Will you be receiving personal data from or transferring personal data to third parties (groups of individuals or organisations)?

- No

16. What are the legal grounds for personal data processing?

- Informed consent

The HREC informed consent guide and templates will be used to create the Participant Information Sheet (template 1) and the Explicit Informed Consent Form (template 2) for the interviews.

For the anonymous online surveys, an Opening Statement (template 1 in the HREC guide) will be used in place of the explicit Informed Consent form.

17. Please describe the informed consent procedure you will follow below.

Interviews: The researcher will inform the potential participants about the goals and procedures of the research project. The researcher will also inform them about the personal data that are being processed and for what purpose. A digital copy of the information will be emailed to participants before the interview, and all participants will be asked for their consent for taking part in the study and for data processing by signing a digital informed consent form before the start of the interview.

Survey: For the anonymous surveys, an Opening Statement will be used at the start of the survey to inform participants about the goals and procedures of the research project, as well as the type of information that is requested in the survey. Participants' agreement with the terms and conditions of the research are signified by clicking through to the survey.

18. Where will you store the physical/digital signed consent forms or other types of proof of consent (such as recording of verbal consent)?

Digital informed consent forms and contact information are stored in the TU Delft OneDrive and encrypted separately from research data to minimise risk of re-identification.

19. Does the processing of the personal data result in a high risk to the data subjects? (Select all that apply.)

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data in your research project.

If any category applies, please provide additional information in the box below. Likewise, if you collect other type of potentially sensitive data, or if you have any additional comments, include these in the box below.

If one or more options listed below apply, your project might need a DPIA. Please get in touch with the Privacy team (privacy-tud@tudelft.nl) to get advice as to whether DPIA is necessary.

- None of the above apply

23. What will happen with the personal data used in the research after the end of the research project?

- Anonymised or aggregated data will be shared with others

The anonymised research data consists of anonymised interview transcripts, anonymised coded datasets, anonymous survey data. These data will be used in the body of the thesis to form the results, but will not be shared in a data repository.

24. For how long will personal research data (including pseudonymised data) be stored?

- Personal data will be deleted at the end of the research project

Audio-recordings of interviews are destroyed after completion of anonymised interview transcriptions. All other personal research data will be destroyed at the latest 1 month after the end of the project.

25. How will your study participants be asked for their consent for data sharing?

- In the informed consent form: participants are informed that their personal data will be anonymised and that the anonymised dataset is shared publicly

All participants will be asked for their consent for data to be shared anonymously in the body of the MSc thesis, which is made publicly accessible in the TU Delft Repository. Participants who do not consent to their data being included publicly in the thesis will not be included in the research project.

V. Data sharing and long term preservation

27. Apart from personal data mentioned in question 23, will any other data be publicly shared?

31. ***Please provide a list of data/code you are going to share under 'Additional Information'.***

- I do not work with any data other than personal data

32. How will you share research data/code, including those mentioned in question 23?

33. ***Select all that apply and provide additional details below.***

- I am a Bachelor's/Master's student at TU Delft and I will share the data/code in the body and/or appendices of my thesis/report in the TU Delft Repository

Anonymised data collected during the project will be included in the body and appendix of the MSc thesis, made available in the TU Delft Repository. The dataset is not shared in a data repository

34. How much of your data/code will be shared in a research data repository?

- Not applicable - No data/code will be shared in a repository

35. When will the data/code be shared?

- As soon as corresponding results (papers, theses, reports) are published

Anonymised data collected during the project will be included in the body and appendix of the MSc thesis, made available in the TU Delft Repository. The dataset is not shared in a data repository.

36. Under what licence(s) will the data/code be released?

- Other – please explain below

The thesis is made publicly available in the TU Delft Repository under copyright. The data are not shared in a data repository with a data licence.

VI. Data management responsibilities and resources

37. If you leave TU Delft (or are unavailable), who is going to be responsible for the data/code resulting from this project?

Thesis supervisor, Michaël Peeters of department Real Estate Management of the track Management in de Built Environment at the Faculty of Architecture and the Built Environment: m.u.j.peeters@tudelft.nl.

38. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

Research data are only shared within the MSc thesis: no additional resources are required.

39. Which faculty do you belong to?

- Faculty of Architecture and the Built Environment (ABE)

Appendix E – HREC

Research Overview

This research explores the willingness of entrepreneurs on Dutch SME business parks to invest in collective energy supply solutions, such as energy hubs or shared charging infrastructure. The goal is to understand what motivates or discourages investment and under what conditions collective action can be stimulated. The study involves two main data collection methods: an anonymous online survey and semi-structured interviews. The survey will be distributed to entrepreneurs operating on 2 or 3 selected SME business parks in the Netherlands (estimated 25-50 responses). A subset of approximately 10-15 entrepreneurs and park stakeholders (e.g. park managers, municipalities) will be invited for interviews to gain deeper qualitative insight into their perceptions and decision-making processes. Participants will be recruited via business park organisations or direct outreach. Survey participants will respond to multiple-choice and Likert-scale questions, with some open-ended items. Interview participants will be asked about their energy-related experiences, motivations and perceived barriers to collective investment. Participation is entirely voluntary. All personal data (e.g. names, contact details) will be stored securely and separately from research data. Interview recordings will be transcribed and anonymised. The research will adhere to TU Delft's ethical and data protection guidelines.

While an initial survey was planned, the final research design focused on qualitative interviews due to response limitations.

Risk Assessment and Mitigation Plan

ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise?	MITIGATION PLAN – what mitigating steps will you take?	DMP	ICF
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider	**Yes**		Yes, the research will be carried out in collaboration with an organisational partner, as part of a graduation internship. Potential risks: Conflicting interests between academic independence and company priorities. Risk of implicit pressure on participants if recruited via the company. Risk of disclosing commercially sensitive or strategic information, intentionally or unintentionally. Risk of restricted access to findings if the company seeks to influence publication or data use.	Mitigation of the risks: The research will remain academically independent; the internship provider has no control over final content or publication. All participation in surveys and interviews is voluntary, and recruitment will clearly state this to avoid perceived pressure. Interview and survey questions will avoid probing for company-sensitive strategies; findings will be anonymised to protect confidentiality. A clear agreement will be established with the internship provider, ensuring compliance with TU Delft's academic and ethical standards.		
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier?		**No**				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)?		**No**				

ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise?	MITIGATION PLAN – what mitigating steps will you take?	DMP	ICF
B: Location						
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?		**No**				
5. Will the research take place in a country or countries outside the EU?		**No**				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		**No**				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		**No**				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?		**No**				
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)?		**No**				
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?		**No**				
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups		**No**				

ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise?	MITIGATION PLAN – what mitigating steps will you take?	DMP	ICF
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)		**No**				
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		**No**				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?		**No**				
E: Subject Matter						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		**No**				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants?		**No**				
17. Will blood or tissue samples be obtained from participants?		**No**				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		**No**				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups)		**No**				
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)	**Yes**		Yes, the study will involve discussion of general professional decision-making processes. However, participants will not be asked to disclose confidential business strategies, proprietary information, or sensitive financial data. The	Mitigation of the risks: Accidental disclosure of personal or business information:		

ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise?	MITIGATION PLAN – what mitigating steps will you take?	DMP	ICF
			questions focus on general motivations, barriers, and conditions for collective investment. All data will be anonymised, and participants can skip any questions they do not feel comfortable answering. The study is designed to minimise any risk of reputational or competitive harm, and no commercially sensitive information will be published or shared. Potential risks: Accidental disclosure of personally identifiable or sensitive business information. Unintended collection of commercially sensitive data during interviews. Participants feeling uncomfortable when discussing investment decisions or barriers. Misinterpretation of questions leading to unclear or misleading responses. Low survey or interview response rates, risking limited representation.	All data will be anonymised during transcription; identifying details will be removed. Pseudonymised data and consent forms will be stored separately and encrypted. Unintended collection of commercially sensitive data: Interview questions are designed to avoid sensitive business specifics. Participants are informed they can skip questions or stop the interview at any time. Participant discomfort during interviews: Clear information will be provided beforehand. Interviews are voluntary and participants can withdraw at any time without consequence. Misinterpretation of questions: The survey will be piloted to test clarity. Interviews allow for follow-up and clarification in real-time. Low response rate: Multiple recruitment channels will be used. Survey kept brief to encourage participation. Re-identification risk in small samples:		

ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise?	MITIGATION PLAN – what mitigating steps will you take?	DMP	ICF
			Potential re-identification risk in small business park contexts, even after anonymisation.	Case descriptions and quotes will be generalised to prevent tracing responses back to specific companies or parks.		
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)?		**No**				
22. Does your research investigate causes or areas of conflict?		**No**				
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences		**No**				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		**No**				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		**No**				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		**No**				
27. Will the experiment involve the use of devices that are not 'CE' certified?		**No**				
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?	**Yes**		**n/a**			
29. Will your research involve **either:** a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants **and/or**		**No**				

ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise?	MITIGATION PLAN – what mitigating steps will you take?	DMP	ICF
b) artificial intelligence or algorithm training where, for example biased datasets could lead to biased outcomes?						
G: Data Processing and Privacy						
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)	**Yes**		Accidental disclosure of contact details or consent forms. Storage of PII alongside research data, increasing re-identification risk. Unauthorised access to PII files.	PII will be stored separately from research data on TU Delft OneDrive in an encrypted folder. Files containing names and contact details will be labelled and managed separately, and only accessible by the researcher and supervisor. Informed consent forms will be stored securely and linked to participants via a pseudonymous ID code. PII will be deleted after the research project is completed and the thesis is submitted.		
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?		**No**				
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		**No**				
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	**Yes**		Indirect identification of participants or companies through case details, quotes, or context.	All data will be fully anonymised before inclusion in the thesis or any publication.		

ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise?	MITIGATION PLAN – what mitigating steps will you take?	DMP	ICF
			Misinterpretation or misuse of findings in the public or policy domain.	Quotes will be paraphrased or generalised where necessary to prevent re-identification. Case descriptions will avoid specific names or characteristics that could reveal identities. The final thesis will be reviewed to ensure that no confidential or sensitive information is published.		
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?		**No**				

Appendix F – Personal study targets

This graduation research project aimed not only to deliver relevant academic and practical insights, but also to support my personal and professional development. The following personal study targets have been defined to guide this learning process:

Develop academic expertise

- Gain in-depth knowledge of SME investment behaviour within the energy transition and the Dutch energy landscape (including challenges like grid congestion).
- Develop a deep understanding of what drives entrepreneurs' decision-making and willingness to invest in collective measures for a secure energy supply.
- Translate academic findings into actionable insights and policy recommendations.

Strengthen research skills

- Design and execute an empirical study using an exploratory and comparative use case approach.
- Apply a qualitative research strategy.
- Design an interview protocol, including an informed consent procedure and conduct qualitative interviews.
- Use software tools such as ATLAS.ti and Excel to process and interpret the data.
- Triangulate findings from literature, use cases and interviews to draw validated conclusions.
- Report research findings in a scientific and clearly structured manner.

Deliver professional research outputs

- Write a coherent and well-structured master's thesis that answers the research questions and integrates theory with empirical insights.
- Present clear policy and practice recommendations to support sustainability transitions on SME business parks and contribute to the broader agenda for collective energy infrastructure.
- Prepare and deliver professional presentations of the research outcomes during the P4 and P5 moments.

Develop personal and project management skills

- Manage a long-term project by setting and monitoring self-defined goals.
- Communicate regularly and effectively with academic and internship supervisors and external stakeholders.
- Remain flexible and solution-oriented in the face of planning uncertainties or data access challenges.

Graduation internship

- Gain practical insight into the day-to-day work of a consultancy office.
- Gain insight into professional perspectives and further develop relevant professional skills in the process.

Appendix G – Reflection

I started this graduation trajectory with a broad curiosity about the intersection of finance and sustainability. While this provided a strong motivation, it also made the early phase of my research challenging. The field is wide, fast-moving and characterised by emerging agendas, new regulations and shifting priorities, which made it difficult to define a clear and workable focus. I learned early on that academic progress requires deliberate narrowing: choosing a research angle not because other topics are uninteresting, but because no thesis can address the entire landscape. This realisation was an important step in learning how to work within a complex and evolving research environment.

The process of refining my research question was strongly iterative. I moved through several potential perspectives before reaching a formulation that felt both meaningful and manageable. During this phase, I often hoped external guidance would provide a definitive direction. Instead, I gradually came to understand that taking ownership of my research was essential. This shift from an exploratory, somewhat hesitant attitude to a more assertive and self-directed approach marked a key moment in my academic development. It helped me to make well-reasoned choices and to accept that uncertainty is an inherent part of research in an emerging domain.

A similar learning process occurred in the development of my methodological approach. I initially envisioned conducting in-depth case studies, including surveys with entrepreneurs and interviews with park-level stakeholders. When response rates remained low, I adapted my methodology towards a broader, cross-park perspective grounded in use cases and expert interviews. This shift proved valuable: it allowed me to capture patterns across different business parks and to better understand how sustainability and energy issues manifest across governance levels. Adding analytical structures such as scales and dimensions provided further clarity and supported a more systematic analysis of my empirical findings. Learning to adjust my methodology pragmatically, rather than holding on to the original plan, was an important insight into the flexibility required in qualitative research.

In contrast to the conceptual and methodological struggles of the early phase, the empirical research progressed more naturally. Once I had a clearer direction, the work became more intuitive and coherent. Speaking with stakeholders from different governance levels broadened my understanding of the system around collective energy and sharpened my ability to engage with diverse perspectives. Through these conversations, I also gained content-related insights into the Dutch energy landscape, the challenges business parks face and the decision-making logic of SMEs.

Looking back, this graduation process has shaped both my academic and personal development. Academically, I learned how to bring structure to a broad topic, make informed choices within an emerging field and adapt methods to fit real-world constraints. Personally, I learned to take responsibility for my research direction, to navigate iterative processes without a fixed end-point and to trust in my ability to create clarity where none initially existed. Ultimately, this thesis taught me what it means to lead a research project: not by eliminating uncertainty, but by engaging with it thoughtfully, confidently and with purpose.