

Governing Grid Congestion in Amsterdam

Designing Context-Sensitive Governance for Electricity Grid Expansion

Master Thesis

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Governing Grid Congestion in Amsterdam

Designing Context-Sensitive Governance for
Electricity Grid Expansion

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Preface

The writing of this thesis marks the end of an inspiring journey as a student of Technology, Policy and Management at Delft University of Technology. During this time, I have discovered many interesting subjects, methods and people, all of which have shaped both my academic development and my perspective on the world around me.

While writing this thesis, I combined academic work with field work, which was not always easy to balance. However, this made my thesis feel even more connected to real-life problems, which is what attracted me to TPM in the first place. Therefore, I can proudly say that this was the perfect ending to six years of studying in Delft.

I would like to express my gratitude to my academic supervisors, Tamara Metze and Laurens de Vries, for their guidance, time and valuable feedback throughout this process. They helped me build the bridge between the practical and academic world. Their insights were fundamental in shaping this research.

I would also like to thank my external supervisors from Andersson Elffers Felix, Jim Romijn, for the amount of time he put into guiding me through the work environment in Amsterdam, providing valuable feedback, and helping me develop practical professional skills in various ways. I would also like to thank Maarten van Poelgeest for helping me navigate the Amsterdam context, which felt a bit overwhelming at first, and for taking the time to explain the context and provide feedback on various parts of the research.

A special thank you goes to all the people from TenneT, Liander, the Municipality of Amsterdam, the Province of North-Holland, the Municipality of Rotterdam, Haskoning and Holland-Rijnland for taking the time to participate in interviews, fill out the survey and participate in various focus groups and the co-creation session. I have learned a lot from all your inspiring insights, expertise and involvement in the subject, which I greatly appreciate.

Mette van den Heuvel
Delft, June 2026

AI Statement

Artificial intelligence (AI) tools were used throughout this research as supportive instruments to enhance efficiency, structure, and clarity. Their use was carefully controlled and critically assessed to ensure the academic integrity, validity, and transparency of the research process.

AI tools were applied across several phases of the study. During the literature review, Perplexity AI was used to identify additional relevant academic sources and explore existing research on collaborative governance, energy systems, and infrastructure planning. All suggested sources were manually verified. In the data collection and preparation phase, NotebookLM was used to support the processing of qualitative data, including summarizing documents and assisting in the translation of interview transcripts from Dutch to English. These translations and summaries were carefully reviewed and, where necessary, adjusted to ensure accuracy and to preserve the original meaning of the respondents. Respondents could review these documents and adjust if they saw the need.

During the analysis and ideation phase, generative AI tools such as ChatGPT, Claude Opus and Gemini were used to support the structuring of insights and the development of governance design options. This included assistance in organizing qualitative findings, refining design dimensions for the morphological chart, and improving the clarity and consistency of scenario descriptions. AI was used to explore alternative formulations and structures, but not to generate empirical findings or make analytical decisions. The interpretation of data, identification of patterns, and development of governance scenarios were conducted by the researcher and grounded in the empirical material.

In the writing phase, AI tools were used to improve readability and translate concepts into academically appropriate English. AI-assisted outputs were always critically reviewed and edited to ensure that the final text reflects the researcher's own reasoning, tone, and conclusions.

Lastly, Lovable AI was used to turn the governance design into a practical and visual website which could show how the design could be implemented in real life. The website was build on fictional exact data, but real life mechanisms. This made sure that no personal or confidential data was incorporated in the websie, but the visuals and potential was clear.

Throughout the research process, attention was paid to the limitations and risks associated with AI use, including potential bias, hallucination, and lack of source transparency. These risks were mitigated by cross-checking AI-generated outputs with primary data, academic literature, and domain knowledge. AI outputs were never used as standalone evidence or as a substitute for critical analysis. All interpretations, conclusions, and design choices presented in this thesis are the original work of the author. AI tools were used solely as supportive instruments and did not replace methodological decisions, analytical reasoning, or stakeholder engagement.

To enhance transparency, examples of prompts used during the research process are provided and clustered into different subjects. These are examples of some shorter prompts.

Writing and structure

- Can you rewrite this paragraph in a clearer and more concise academic style without making it overly complex?
- Can you shorten this section while keeping the key message intact?
- What are the main themes emerging from this interview?
- Can you critically challenge this reasoning and identify potential weaknesses or blind spots?
- Does the structure of my ideate and test chapter logically follow from the problem definition?
- Can you critically review this chapter and point out what needs attention?

Problem definition and analysis

- Based on these interview summaries, can you help cluster the main governance bottlenecks into 4–6 key themes?
- Can you map these findings to the Ansell & Gash collaborative governance framework and indicate which elements are most problematic?
- How do these governance challenges relate to multi-level governance tensions between municipalities, province, and grid operators?

Ideate and test phase

- Based on these identified governance bottlenecks, can you define suitable design functions for a morphological chart?
- Can you refine these options to make them more specific and actionable (avoid abstract wording)?
- Using this morphological chart, can you combine options into 4 mutually exclusive governance scenarios that are internally consistent?
- Based on these governance challenges and system constraints, what would be appropriate evaluation criteria for comparing scenarios?
- How can I structure a co-creation workshop to explore governance design options instead of selecting one solution?

Executive Summary

Increasing electrification of housing, mobility, heating and industry places growing pressure on the electricity grid. Because demand exceeds infrastructure capacity, grid congestion has become one of the main bottlenecks in the Dutch energy transition. In Amsterdam, this challenge is especially complex. The city faces high electricity demand, severe spatial scarcity, competing land-use claims and a complex institutional environment. Expanding the grid requires new substations, transformer houses and cable routes, but these expansion interventions depend on spatial planning, permitting, public space, political-administrative choices and coordination between many actors.

This means that grid congestion in Amsterdam is not only a technical problem. It is also a socio-technical and governance challenge. Grid operators are responsible for the physical electricity infrastructure, but depend on public authorities for spatial integration, permits and policy alignment. The municipality controls important spatial and administrative conditions, but depends on grid operators for technical knowledge, planning and investment. As a result, no single actor can solve grid congestion independently.

The Taskforce Congestion Amsterdam (TFCA) was created to improve coordination around grid congestion in Amsterdam. In this thesis, the TFCA is understood as a collaborative governance arrangement, not as a single actor. It consists of participating organizations, consultation layers such as workstreams, the Kernteam (KT), the Administrative Consultation (AC) and independent facilitation. The TFCA supports coordination, but does not have formal decision-making authority. Formal responsibilities remain within the participating organizations.

This research examines how the TFCA governance arrangement can be adjusted to better fit the current Amsterdam context and support collaboration, coordination and implementation of long-term grid expansion. The research follows a qualitative and design-oriented approach. It combines literature review, system analysis, stakeholder analysis, survey results, semi-structured interviews, focus groups, a co-creation session, a morphological chart, Multi-Criteria Analysis (MCA) and validation interviews. Collaborative governance, Multi-Level Governance (MLG) and governance design are used as analytical lenses to understand the current arrangement and develop a context-sensitive governance design.

The findings show that the TFCA governance arrangement has improved collaboration, communication and shared understanding between participating organizations. However, collaboration does not automatically translate into issue preparation, escalation, follow-up or implementation. Persistent bottlenecks include unclear roles and responsibilities, weak issue ownership, fragmented internal municipal alignment, limited implementation capacity, spatial constraints and different expectations of the role of the TFCA. The main governance challenge is therefore not the absence of collaboration, but the limited connection between coordination, decision routes and implementation capacity within the Amsterdam context.

The design phase translated the problem definition into governance tensions, design principles, governance actions and four governance archetypes. The MCA selected the strengthened TFCA governance arrangement as the most suitable governance direction based on criteria derived from the definition of the problem. This direction was selected because it keeps the existing collaborative capacity of the TFCA, while strengthening issue preparation, escalation, role clarity, shared information and the connection to implementation.

The final governance design builds on this selected direction. It does not replace the current TFCA governance arrangement, but makes it more explicit, phase-sensitive and implementation-oriented. The design clarifies the function, frequency, and escalation role of consultation layers and workstreams. It introduces a joint issue, decision and planning log, strengthens Elektriciteit voor Amsterdam (EVA) as municipal integrator, involves implementation actors earlier and selectively, uses activation-based expert resources and bottleneck support, and introduces a pilot workstream on better grid use as an exploratory element.

The proposed design does not claim to solve grid congestion by itself. Spatial scarcity, permitting

procedures, workforce shortages, material constraints and political-administrative choices remain important constraints. However, the design can improve the governance conditions under which long-term grid expansion becomes more feasible. The thesis therefore contributes to collaborative governance and governance design by showing that collaboration is necessary but not sufficient: governance arrangements must also organize issue ownership, escalation, decision routes, shared information and implementation readiness.

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List of Abbreviations

- AC** Administrative Consultation. iv, 26, 56, 63, 82, 97, 148
- ACM** Autoriteit Consument & Markt. 20, 24, 79, 80, 82, 85, 87
- AEF** Andersson Elffers Felix. 14, 60
- APM** Asset Product Management. 26, 43–45, 52, 55, 57, 61, 63, 122, 133, 147
- CLD** Causal Loop Diagram. vi, viii, xi, 13, 14, 21, 23, 27, 28, 72, 74–78
- DSO** Distribution System Operator. 115
- EVA** Elektriciteit voor Amsterdam. iv, vii, 16, 23–25, 30–32, 42, 44, 48, 53, 55–58, 61, 63, 65, 86, 97, 98, 122, 124
- K&O** Client & Design. 26
- KT** Kernteam. iv, 26, 39, 44, 50, 51, 55, 56, 63, 82, 97, 107, 142, 148
- LAN** Landelijk Actieprogramma Netcongestie. 20
- MCA** Multi-Criteria Analysis. iv, vii, 3, 13, 17, 18, 41, 46–48, 58–60, 64, 122
- MIEK** Meerjarenprogramma Infrastructuur Energie en Klimaat. 20, 80, 81
- MLG** Multi-Level Governance. iv, ix, 2, 5, 8, 10–13, 15, 25, 30, 33–36, 39, 112, 116, 121
- MSR** Medium-Voltage Spaces. viii, 44, 52, 97, 98, 103
- OCC** Overarching Coordination Consultation. 26, 51, 61
- PMIEK** Provinciaal Meerjarenprogramma Infrastructuur Energie en Klimaat. 20, 23, 81
- RACI** Responsible, Accountable, Consulted, Informed. 51, 55, 62, 128
- RES** Regional Energy Strategy. 10, 23, 81, 86
- SME** Small and Medium-sized Enterprises. 21, 85, 88
- TFCA** Taskforce Congestion Amsterdam. iv, vi–xiii, 2–5, 8–18, 23–27, 31–53, 55–59, 61–65, 75, 76, 78, 81–83, 85, 87–90, 92, 94–98, 100–111, 115, 120, 122, 124, 126–128, 130–134, 138, 141, 147, 148, 152
- TSA** Themastudie Elektriciteitsnetwerk Amsterdam. 23, 81

1 | Introduction

The Netherlands' path toward climate neutrality is being shaped increasingly by electrification of energy, mobility and industry. Achieving national and European climate targets requires a fundamental shift from fossil fuels towards electricity-based solutions, which include heat pumps, electric vehicles and renewable generation (Ministerie van Economische zaken en Klimaat, 2023). This means that electricity is becoming the backbone of the new energy system, just as gas was in the past (Ministerie van Financien, 2023). This shift towards increased electricity use places substantial pressure on the electricity infrastructure in place (Lakerink & Tempelman, 2024).

The increased demand for electricity exceeds the available transport capacity of the current grid infrastructure leading to grid congestion (Ministerie van Financien, 2023). This issue was once an incidental and local issue, but has now developed into a structural and systemic constraint affecting both transmission and distribution networks (Lakerink & Tempelman, 2024). As a result, grid congestion has emerged as a critical bottleneck in the Dutch energy system (Autoriteit Consument & Markt, 2022).

The consequences of grid congestion extend far beyond technical inefficiencies. Housing developments are delayed, businesses face limitations in electrification and expansion, and renewable energy projects are postponed or canceled (Verhoeven, 2026). As a result, grid congestion increasingly constrains broader societal objectives such as sustainable urban development, economic growth, and the achievement of climate targets (de Winkel et al., 2025).

To prevent the limited grid capacity from becoming an increasingly significant economic and social bottleneck, the electricity infrastructure must be significantly expanded with stations, transformer houses and cables (Ministerie van Financien, 2023). The scale of this task is immense. For a future-proof system, an unprecedented renovation of the electricity grid is required that will result in a widespread societal disruption with an estimated one in three streets requiring excavation (Ministerie van Economische zaken en Klimaat, 2023). This involves adding over 100,000 kilometers of cables and results in a cumulative investment task estimated at 195 billion euros for the period of 2024-2040 (Ministerie van Financien, 2023).

Although grid congestion is often framed as a solely technical capacity problem, it is inherently a complex socio-technical and governance challenge. Resource scarcity results in difficult trade-offs in terms of the prioritization of connections, the location of spatial integration, and the allocation of costs (Ministerie van Financien, 2023). The electricity system is embedded in a fragmented institutional landscape involving system operators, municipalities, provinces, national government, market actors, and citizens, each with their own interests (van Poelgeest, n.d.). Realizing this transition in a timely and effective way requires coordination and decision-making capacity (Ministerie van Economische zaken en Klimaat, 2023).

Coordination between the different actors is difficult due to differences in organizational structures, planning horizons, regulatory frameworks and access to information (van Poelgeest, n.d.). However, they are interdependent. For example, municipalities control spatial planning decisions, while grid operators possess technical system knowledge and are responsible for infrastructure investments. Furthermore, regional characteristics such as urban density and spatial constraints complicate the problem. In highly urbanized areas, competing land use interests make it difficult to allocate space for energy infrastructure (Lakerink & Tempelman, 2024). As a result, grid congestion has emerged as a wicked governance problem: it is characterized by high uncertainty, conflicting values, interdependent actors and the absence of one clear-cut solution (Rittel & Webber, 1973). The growing scarcity of grid capacity is increasingly becoming a constraint on the economic, spatial and societal development of the Netherlands (Ministerie van Financien, 2023). This thesis therefore approaches grid congestion not only as an infrastructure shortage, but as a governance design challenge, and explores how interdependent actors can organize collaboration, decision-making and implementation capacity in a context of spatial scarcity and institutional fragmentation.

In Amsterdam, these coordination challenges are addressed through the Taskforce Congestion Amsterdam (TFCA), a collaborative governance arrangement in which the municipality, grid operators and other involved actors coordinate long-term grid expansion. The TFCA is not a single actor with formal decision-making authority, but a platform consisting of participating organizations, consultation layers, workstreams and independent facilitation. This makes Amsterdam a relevant case for studying how an existing collaborative arrangement works in practice.

1.1. Research Objective, Relevance and Knowledge Gap

The objective of this research is to analyze the governance challenges that hinder long-term grid expansion in Amsterdam and to develop a context-sensitive governance design for strengthening the TFCA governance arrangement. First, the study develops a system-level understanding of how grid congestion persists as a socio-technical and institutional constraint. Second, it examines how stakeholders perceive the current governance arrangement and where they experience bottlenecks in collaboration, issue preparation and implementation. Third, it translates these findings into governance design options that clarify roles and responsibilities, strengthen escalation routes and connect collaboration more explicitly to implementation.

1.1.1. Scientific Relevance

This study is scientifically relevant, as it combines insights from collaborative governance, Multi-Level Governance (MLG), and system analysis to analyse the governance arrangement in Amsterdam. It addresses the inherent tension in the Dutch electricity system, where the national government is responsible for the system, but execution is fragmented between grid operators, independent regulators, and municipalities (Ministerie van Financiën, 2023). By linking these perspectives, the research offers a more integrated understanding of how system-level tensions and divergent organizational logic constrain the institutional capacity required for rapid grid reinforcement.

1.1.2. Societal Relevance

From a societal perspective, this research addresses an urgent issue within the energy transition. Grid congestion in the Netherlands is estimated to cause 10 to 40 billion euros in annual societal costs (Ministerie van Financiën, 2023). Improving coordination in grid expansion is essential to facilitate the 195 billion euros investment agenda required by 2040 and to enable critical urban priorities such as housing development and the transition to a sustainable economy (Ministerie van Financiën, 2023). For Amsterdam, this is particularly relevant because grid expansion competes with housing, mobility, public space and urban greening in an already dense city. Resolving grid congestion is therefore not only a matter of accelerating infrastructure, but also of making spatial trade-offs more explicit and manageable.

1.1.3. Knowledge Gap

Existing research on grid congestion has mainly focused on technical and market-based solutions, while the governance bottlenecks that delay physical grid expansion have received less attention. At the same time, collaborative governance theory and MLG theory provide useful lenses for studying coordination in complex systems, but they have rarely been applied to the current scale, urgency and implementation pressure of grid expansion in Amsterdam specifically.

What remains underexplored is how existing collaborative governance arrangements between grid operators and municipalities can be adapted when collaboration is already present, but does not sufficiently translate into decision routes, escalation and implementation capacity. This gap is particularly relevant in Amsterdam, where the TFCA provides a collaborative platform, but where spatial scarcity, fragmented responsibilities and changing project phases create new demands for how collaboration should be organized.

1.2. Research Questions

Building on the problem statement and knowledge gap introduced in this chapter, the following central research question is formulated: *How can the Taskforce Congestion Amsterdam (TFCA) governance arrangement be adjusted to better fit the current Amsterdam context and support collaboration, coordination*

and implementation of long-term grid expansion?

Besides the main research question, there are three sub-questions designed to systematically answer the main research question:

1. *How do the technical, social, and institutional variables of the Amsterdam electricity system interact and influence the pace of grid expansion?*
2. *How do stakeholders perceive and evaluate the current TFCA governance arrangement and collaboration processes in addressing grid expansion in Amsterdam?*
3. *Which governance design principles and governance actions can be combined to strengthen the TFCA governance arrangement?*

Together, these sub-questions structure the research from problem understanding to governance design. The first sub-question analyzes how technical, social and institutional variables interact in the Amsterdam electricity system. This provides the necessary foundation for understanding how grid expansion is currently organized and where systemic bottlenecks influence the pace required for the energy transition. The second sub-question examines how stakeholders perceive the current governance arrangement and where they experience bottlenecks in collaboration, issue preparation and implementation to formulate an overarching problem definition. The third sub-question translates this problem definition into design principles and, through an ideation phase, a combination of governance actions that form the basis for the final governance design.

1.3. Scope of the Research

This research focuses on long-term grid infrastructure expansion in Amsterdam as the main research context because grid congestion, spatial scarcity and institutional complexity come together strongly in this city. Amsterdam faces rapidly increasing electricity demand due to urban growth, electrification of mobility, data centers and the heat transition, while the available urban space for substations, transformer houses and cable routes is limited. This creates a direct tension between the technical requirements of the electricity system and the spatial priorities of the city.

Amsterdam is also relevant because it already has a dedicated collaborative governance arrangement: the TFCA. As introduced above, the TFCA is not treated as a single actor, but as a governance arrangement consisting of participating organizations, consultation layers, workstreams and independent facilitation. This makes Amsterdam an information-rich case for studying how an existing collaborative governance arrangement can be strengthened when the coordination and collaboration platform is already present.

The research focuses on governance processes related to long-term grid infrastructure expansion in Amsterdam, including stations, transformer houses and cable routes. Technical optimization strategies, such as load flow calculations, engineering design and market-based congestion management, are treated as contextual inputs rather than objects of analysis. The main focus is on how actors coordinate, prepare decisions and organize implementation around grid expansion under conditions of spatial scarcity and institutional fragmentation.

1.4. Research Approach

The research follows a sequential and iterative multi-method design. The first phase develops the problem definition through literature review, system analysis, stakeholder analysis, survey data and interviews. The second phase translates the problem definition into governance actions through system and futuring interviews, focus groups, and a co-creation session. These governance actions are combined using a morphological chart. The resulting governance archetypes are evaluated through an Multi-Criteria Analysis (MCA) and validation interviews, after which a final governance design with several design components and recommendations are formulated.

1.5. Thesis Outline

This thesis is structured as follows. Chapter 2 presents the theoretical framework, including collaborative governance, multi-level governance and system analysis, which are used as analytical lenses. Chapter

3 explains the research methodology. Chapter 4 provides the system and stakeholder analysis of grid congestion in Amsterdam. Chapter 5 develops the problem definition by presenting the survey results, interview analysis and synthesis of the main governance bottlenecks. Chapter 6 describes the ideation and testing phase, including focus groups, co-creation, design principles, the morphological chart, governance archetypes and validation activities. Chapter 7 presents the proposed governance design, implementation roadmap, and implementation risks and conditions. Chapter 8 reflects on limitations and proposes directions for further research. Chapter 9 concludes the thesis by answering the research questions.

This chapter has introduced grid congestion as a socio-technical and governance design challenge and has positioned Amsterdam and the TFCA governance arrangement as the central research context. The following chapter develops the conceptual framework used to analyze this challenge. It introduces the theoretical lenses of collaborative governance, multi-level governance and governance design, which together guide the empirical analysis and design-oriented phases of the thesis.

2 | Literature Review and Conceptual Framework

This chapter develops the conceptual framework used in this research. It explains why grid congestion should be understood as a socio-technical and governance challenge, and introduces the theoretical lenses used to analyze the TFCA governance arrangement. The chapter focuses on energy infrastructure planning, collaborative governance, Multi-Level Governance (MLG) and governance design, because these concepts together explain why collaboration is central to long-term grid expansion in Amsterdam. This chapter is based on a targeted literature review, as further explained in Chapter 3.

2.1. Conceptual Framework

The concepts discussed in this chapter form the analytical lens used to interpret the governance of grid congestion. They are used to understand why grid expansion is difficult to organize, how collaboration is structured, where multi-level dependencies arise, and how governance arrangements can be redesigned.

2.1.1. Energy Infrastructure Planning and Spatial Integration

This section explains the energy infrastructure planning and spatial integration related to and underlying grid congestion, to provide a better understanding of the technical perspective adopted in this study.

The Institutionalized Clash of Energy and Spatial Planning

The integration of energy policy and spatial planning in the Netherlands represents an institutionalized clash between energy planning and spatial planning. In this context, an institutionalized clash means that energy planning and spatial planning follow different routines, priorities and decision-making logic, even though they increasingly depend on each other. Kooij et al. (2025) identify "blind spots" where spatial planners treat energy as a secondary precondition, leading to system irritations. This has led to calls for a form of energy planning, in which the expansion of energy infrastructure is considered a guiding spatial condition, comparable to water or road infrastructure (Kooij et al., 2025). Marshall (2014) situates this fragmentation within a broader neoliberal shift. The 1990s trend toward privatization has favored vital infrastructures for economic competitiveness, making it increasingly difficult to steer grid expansion toward public values, which is mostly due to underlying political values. Implementations often depend on complex public-private partnerships and market logic. To overcome this slow execution bottleneck, a shift toward proactive energy planning must be made. According to Kooij et al. (2025), there are four main reasons for the institutionalized clash of energy and spatial planning.

- **Different system theories:** Spatial planning and the energy system operate as separate 'social systems' with their own language and priorities. Spatial planners focus on landscape quality and public support, while network operators focus on network efficiency and cost optimization.
- **Blind spots:** Spatial planners often treat energy infrastructure as an afterthought, the idea that one first selects a location and that it is then merely a matter of 'laying a cable in the ground'. Additionally, grid operators often have no formal say in the spatial planning process until the plans are already at an advanced stage.
- **System irritations:** Communication between these two systems often leads to irritations. Initially, grid operators' concerns about capacity were incomprehensible to planners, or they arose at an inopportune moment in the process, causing them to be overlooked.
- **Grid congestion as a 'wall':** The current crisis acts as a hard physical boundary that disrupts the traditional way of working. It is now forcing spatial planners to view energy infrastructure not as a precondition, but as a guiding element (energy planning).

Electricity networks are capital-intensive infrastructures with long life cycles, high sunk costs and strong path dependencies. Their expansion typically follows lengthy planning and investment trajectories that include regulatory approval, spatial planning procedures, environmental assessments, financing decisions, and coordination between different stakeholders. This makes it particularly difficult to realize the change on a large scale in the time span that is needed. Over time, the interaction between energy and spatial planning appears to shift from mutual incomprehension towards interpretive friction: actors increasingly recognize each other's constraints, but still struggle to translate this recognition into aligned planning practices. The Planning Act from 2008 changed the traditional way of dealing with these major issues (Marshall, 2014). Spatial planning initially followed its own priorities focused on landscape and spatial quality, which led to misunderstandings and later poorly timed communication when energy system actors tried to integrate renewable energy needs. As grid congestion began to disrupt regular planning processes, spatial planners started to reinterpret energy-sector signals and gradually incorporate energy considerations into their decision-making plans (Kooij et al., 2025). According to Marshall (2014), the fact that considerable control remains in public or semi public hands in the main transport sectors in the Netherlands and in much of the water and energy systems, means that the levers are also there to turn long term policy directions into effect. However, this evidently depends on financing, as well as the political and ideological priorities of governments (Marshall, 2014).

Intervention Strategies

In response to congestion, different intervention strategies can be distinguished between capacity optimization and capacity expansion measures. While optimization focuses on increasing system efficiency, for example by selecting a more favorable ratio between wind and solar energy to make better use of the existing grid, expansion focuses on physically increasing grid capacity. This research paper emphasizes capacity expansion through new or reinforced stations, transformer houses and cable routes, as the physical limits of the current electricity grid have been reached in many places in the Netherlands (Netbeheer Nederland, 2025). This focus on expansion is necessary, for example because the planned growth of renewable energy sources cannot be fully accommodated by simply using the existing grid more efficiently. Earlier work on renewable electricity in the Netherlands already pointed to the need for reinforcement of high-voltage infrastructure and storage capacity to accommodate variable renewable generation (Junginger et al., 2004). In this thesis, this historical insight is used as background, while the current grid congestion challenge is understood through more recent policy, planning and governance documents.

Grid congestion cannot be understood solely as a technical capacity problem. It represents a governance challenge situated at the intersection of infrastructure planning, institutional coordination and multi-actor decision-making processes. Expanding grid infrastructure requires alignment between grid operators, public authorities, regulators, spatial planners and market actors operating across multiple governance levels (Fuchs & Fettke, 2023). Therefore, the effectiveness of expansion efforts depends not only on technical feasibility and financial resources, but also on institutional coordination mechanisms and the ability to manage competing spatial and societal interests (Markard, 2018).

2.1.2. Opening Up and Closing Down in Infrastructure Planning

Energy infrastructure planning requires both inclusion and closure. On the one hand, planning processes need to be opened up to include local knowledge, stakeholder concerns, spatial constraints and competing public values. This is especially important in dense urban environments, where the siting of substations, cable routes and transformer houses directly affects public space, housing, mobility, green space and local communities. On the other hand, infrastructure planning also requires moments of closure, in which uncertainty is reduced, decisions are made, and projects can move towards implementation. Ruiten et al. (2023) describe this as a tension between opening up and closing down in the siting of high-voltage infrastructure. Opening up allows multiple perspectives and local concerns to enter the decision-making process, while closing down is necessary to reach binding decisions and prevent processes from remaining open indefinitely. This tension is highly relevant for grid expansion, because legitimacy and local acceptance are important, but prolonged deliberation can also delay urgently needed infrastructure. For this research, the opening up/closing down tension helps explain why collaboration alone is insufficient. Collaborative governance arrangements may improve mutual understanding and stakeholder involvement, but they also need mechanisms that clarify when issues are still open for discussion, when they should be escalated, and when a decision is final. This insight later informs

design principles related to decision finality, escalation, role clarity and avoiding unnecessary coordination layers.

2.1.3. Complexity and Wicked Problems

Complexity

The complexity of Dutch infrastructure planning as described above can be partially explained by the fact that the electricity system is a large-scale socio-technical system. This means that the system consists of intertwined social and techno-physical components. Therefore, technical infrastructure cannot be viewed in isolation from decision-making processes, culture, institutions and the environment. According to Kwakkel and Yucel (2012), this system is complex and unpredictable for four reasons:

- **Fragmented decision-making authority:** Since the neoliberal shift as described above, the system has shifted from a centrally controlled model focused on cost minimization and integrated planning to a system of independent actors (such as different energy companies, regions and households) acting on the basis of individual profit maximization.
- **Deep uncertainty:** The future of the system is determined by factors on which there is no consensus, such as technological costs, fluctuations in fuel prices and political uncertainty regarding policy. Traditional forecasting techniques fall short, because the underlying structure of the system itself is subject to change.
- **Long lead times:** Large socio-technical systems are characterized by long lead times, meaning that the impact of institutional changes or new investment only becomes apparent after many years.
- **System dynamics and resistance:** The internal dynamics of the system can produce outcomes that contradict policy intentions. Research shows that sustainable support programs are often ineffective. In many simulated scenarios, the system continues to rely on fossil fuels such as coal and gas despite incentives. The main reasons behind this are the focus on individual benefit maximization, and the fact that fossil fuels are cheaper in practice.

Wicked Problem

Whereas complexity focuses on the interdependencies within the system, the non-linearity and uncertainty, the concept of a “wicked problem” centers on socio-political tension, lack of problem definition and the presence of conflicting values (Radtke & Wurster, 2023). A system may be complex due to technical interdependencies, but it becomes wicked when there are fundamental disagreements about how the problem should be defined and which solutions are appropriate (Rittel & Webber, 1973). In such contexts, every intervention generates new problems, and there is no objective standard for determining what constitutes a right or wrong solution.

According to Radtke and Wurster (2023), the energy transition can be regarded as a prototypical wicked problem for several reasons. First, there is a structural conflict between values and interests, where climate objectives interact with economic concerns such as energy prices, inflation and competitiveness. As a result, stakeholders frame the same problem in different ways. Second, there is a democratic dilemma between system effectiveness and inclusive participation. While stakeholder involvement is essential for legitimacy, it increases coordination costs and can slow down decision-making required for infrastructure development (Radtke & Wurster, 2023), and decentralized investment responsibilities are also adding up to the decision-making time (Kwakkel & Yucel, 2012). Third, issues of justice are central, as benefits and burdens of infrastructure expansion cannot be distributed in a fully equitable way. This requires continuous negotiation across distributive justice (spatial allocation of infrastructure), procedural justice (who is involved), and recognition justice (whether local needs are acknowledged). Finally, wicked problems are context-dependent, meaning that solutions are rarely transferable across regions due to differences in spatial, technological and social conditions, which limits the effectiveness of centralized approaches (Uyterlinde et al., n.d.).

Public organizations are increasingly confronted with wicked problems, especially in the energy infrastructure networks. These networks are characterized by substantive, strategic and institutional complexity, making hierarchical governance insufficient. Effective coordination therefore requires deliberate management focused on connecting actors, exploring shared solutions, and establishing rules for cooperation (Klijn

et al. 2016). Wicked problems cannot be solved through linear planning or single-actor control, but require iterative, collaborative and adaptive governance approaches (Head & Alford, 2015); (Huiteima et al. 2016).

2.1.4. Governance of Complex Socio-Technical Systems

As stated above, systems like the Dutch electricity grid infrastructure are complex socio-technical systems and can be characterized as a wicked problem (Markard, 2018). Consequently, grid congestion can be conceptualized as a coordination problem embedded in a multi-actor governance setting, rather than as a purely technical bottleneck (Fuchs & Fettke, 2023), since no single actor controls the technical, spatial and institutional conditions required for grid expansion.

In order to analyze such coordination challenges, it is important to distinguish between governance frameworks and analytical or interpretative approaches. Governance frameworks refer to institutionalized forms of coordination and decision-making processes, specifying how authority is distributed, how actors interact and how collective outcomes are produced (Hoppe et al., 2025). In contrast, analytical approaches provide conceptual lenses to understand system dynamics, actor constellations, or complexity, without prescribing specific institutional arrangements. This distinction is essential, as conflating the two can obscure whether a framework explains system behavior or actively structures decision-making processes.

Within the category of governance frameworks, several approaches have been developed to capture coordination in complex, multi-actor settings. In the case of the Dutch electricity system, the forms of collaborative governance and Multi-Level Governance (MLG) are mainly in place (Hoppe et al., 2025). The main characteristics, strengths and limitations of these governance frameworks are summarized in Table 2.1. While collaborative governance focuses on the processes through which interdependent actors jointly coordinate, deliberate and prepare collective action, MLG captures how authority and responsibilities are distributed across local, regional and national levels. Other governance approaches, such as network governance and poly-centric governance also offer relevant insights, particularly regarding inter-organizational coordination and distributed authority. However, they are not used as the primary frameworks in this thesis because the research focuses specifically on collaborative processes within the TFCA governance arrangement and on vertical dependencies across governance levels. Network governance involves coordination among non-hierarchical actors (Provan & Kenis, 2008). Polycentric governance focuses on formally independent but interacting decision-making, which is also not primarily the case in the dutch electricity system, since multiple actors are formally dependent from each other (Ostrom, 2010). Therefore, only collaborative governance and MLG are explained in Table 2.1.

Table 2.1: Central Analytical Lenses used in this Research: Collaborative Governance and Multi-level Governance ((Ansell & Gash, 2008) and (Hooghe & Marks, 2003))

Governance framework	Core characteristics	Strengths in complex systems	Limitations
Collaborative governance	Structured, consensus-oriented processes in which public and private actors deliberate, coordinate and seek joint agreement.	Facilitates coordination, mutual understanding and joint problem-solving; supports alignment across actors; builds trust and shared ownership.	Time-intensive; dependent on actor willingness and facilitation quality.
Multi-level governance	Authority distributed across local, regional, national, and supranational levels.	Captures cross-scale interactions; highlights vertical interdependencies.	Primarily descriptive; limited insight into concrete coordination mechanisms.

Collaborative Governance

Collaborative governance emphasizes facilitation, collaboration, good starting conditions, solid institutional design and intermediate outcomes as conditions for addressing interdependencies that cannot be

resolved through hierarchical steering alone (Ansell & Gash, 2008). This is complemented by the integrative collaborative governance framework of (Emerson et al., 2012), which emphasizes that collaboration depends not only on bringing actors together, but also on shared motivation and capacity for joint action. To understand how collaboration within such settings succeeds or fails, the framework of Ansell and Gash (2008) is used (Figure 2.1), which identifies four critical variables:

- **Starting conditions:** Success depends on the balance of power and the history between actors. In the context of infrastructure planning, information asymmetries are common, as different actors control different types of resources, such as technical knowledge or spatial planning authority. Interdependence between actors creates incentives to participate in collaboration.
- **Facilitative leadership:** Leadership is crucial for guiding actors through conflicts and periods of stagnation. Effective leadership often takes the form of an 'honest broker' who is able to mediate between different perspectives and interests.
- **Institutional design:** This refers to the rules and procedures that structure the collaboration. Inclusive processes are essential, as the exclusion of relevant stakeholders can undermine the legitimacy and effectiveness of outcomes.
- **The collaborative process:** This is a cyclical process involving face-to-face dialogue, trust-building, and the development of shared understanding. Achieving intermediate outcomes or 'small wins' can be an important strategy to build momentum and sustain collaboration over time.

In this research, these four elements are used to examine whether the TFCA provides the conditions for effective collaboration: whether actors have incentives and capacity to participate, whether facilitation supports trust and issue preparation, whether the institutional design clarifies roles and escalation routes, and whether the collaborative process produces actionable outcomes.

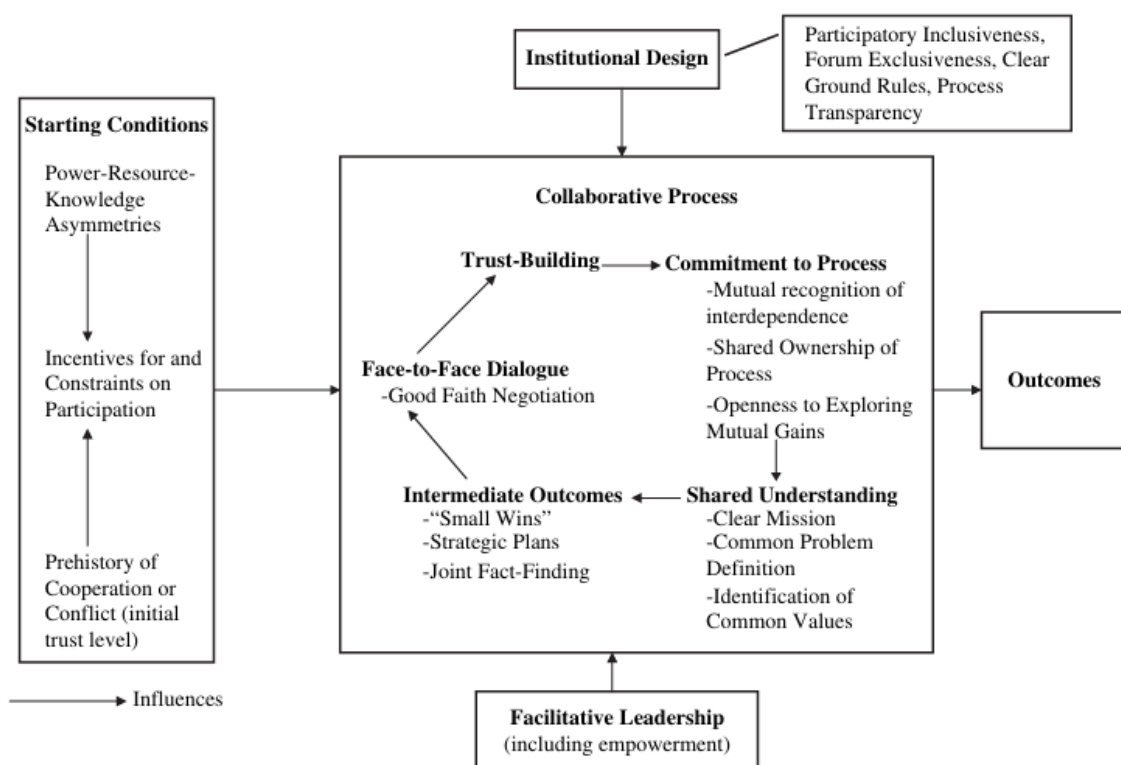


Figure 2.1: Collaborative Governance Framework (Ansell & Gash, 2008)

Figure 2.1 should be read as a process model. Starting conditions, institutional design and facilitative leadership shape the collaborative process, which in turn influences intermediate outcomes and longer-term collaborative results. In this thesis, the framework is not used to measure collaboration quantitatively,

but to structure the analysis of how the TFCA enables or constrains coordination, trust-building, escalation and implementation-oriented action.

Multi-Level Governance (MLG)

MLG complements the framework for collaborative governance by situating these interactions within a vertically differentiated institutional context, where decisions taken at one level constrain and shape possibilities at others. Tamtik and Colorado (2022) distinguish two types of governance that characterize contemporary states, which are also shown in Figure 2.2:

1. **Type I Governance:** Reflects the traditional, hierarchical federalist structure with stable, nested jurisdictions and clear functional boundaries. While providing stability, Type I structures can lead to jurisdiction gaps where rigid boundaries hinder rapid innovation and coordination.
2. **Type II Governance:** consists of task-specific, flexible jurisdictions with intersecting memberships of state and non-state actors.

This multi-level dimension is particularly evident in electricity systems, where Regional Energy Strategy (RES) can be, for example, understood as Type II governance arrangements embedded within more traditional Type I structures (van Dijk et al., 2022). For this thesis, MLG is mainly used to analyze how responsibilities, mandates and dependencies are distributed across municipal, regional, provincial and national levels, and how these vertical relationships affect collaboration within and around the TFCA governance arrangement.

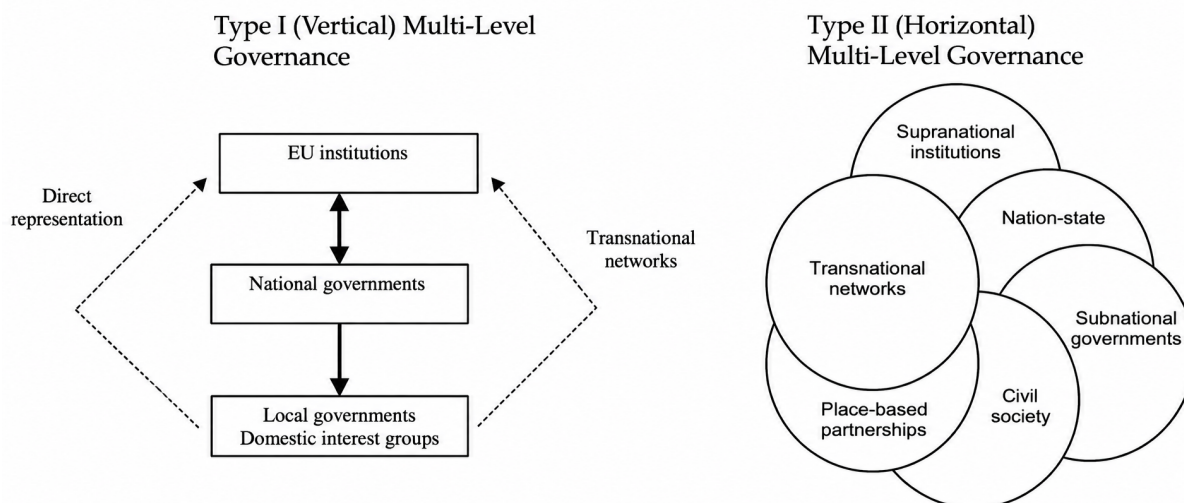


Figure 2.2: Multi-level Governance Framework (Duygu Butun, 2016)

Figure 2.2 illustrates the distinction between stable, nested jurisdictions and more flexible, task-specific governance arrangements. This distinction is useful for understanding how the TFCA operates within a broader institutional context in which municipal, regional, provincial and national responsibilities intersect.

2.1.5. Governance Design as Institutional Design

In this thesis, governance design is understood as more than the design of an organizational chart or meeting structure. Governance arrangements consist of rules, roles, responsibilities, routines, authority relations, interaction arenas and accountability mechanisms. Designing governance therefore means shaping the conditions under which actors interact, exchange information, make agreements, escalate conflicts and translate coordination into implementation-oriented action (Romme et al., 2017). This understanding connects to institutional design literature, in which institutions are understood as the formal and informal rules that structure interaction between actors (Ostrom, 2010). In collaborative governance, institutional design is also one of the central conditions shaping the functioning of collaboration, as it defines who participates, how interaction is structured, which procedures guide collaboration, and

how transparency and legitimacy are organized (Ansell & Gash, 2008). Governance design therefore concerns both formal arrangements, such as mandates and escalation routes, and informal practices, such as trust, shared routines and communication norms. For the TFCA context, this means that redesigning governance is not simply a matter of adding another meeting or actor. Rather, it requires examining how roles, mandates, decision routes, escalation mechanisms, information flows and implementation responsibilities are organized across the participating organizations. This perspective provides the basis for the later development of governance archetypes and design components.

2.2. Knowledge Gap

Existing research shows that grid congestion cannot be understood as a purely technical capacity problem, and that it is shaped by an institutionalized clash between energy planning and spatial planning (Kooij et al., 2025). At the same time, many intervention strategies for grid congestion focus primarily on technical solutions and market-based mechanisms, and not specifically on infrastructure expansion.

Literature on collaborative governance and MLG provide useful lenses for understanding collaboration between actors in the complex infrastructure expansion setting. However, these perspectives have been limitedly applied to the specific Amsterdam and energy planning context. The changing role of grid operators towards engaging actors (Steekelenburg, 2024) and the spatially constrained reality of local infrastructure planning are therefore not yet well understood (de Vries et al., 2026).

A further challenge concerns the tension between inclusive collaboration and implementation-oriented decision-making. Research on energy infrastructure planning shows the importance of participation, stakeholder engagement and the inclusion of local knowledge in siting processes (Ruiten et al., 2023). However, opening up decision-making to multiple perspectives also creates the need to close down the process at certain moments in order to make binding decisions and move towards implementation. Literature is not yet specific on how to handle this kind of trade-off, and how that should be organized in a specific region.

What remains underexplored is how existing collaborative governance arrangements between grid operators and municipalities can be adapted to better fit the practical needs and contextual conditions of large-scale electricity infrastructure expansion. In other words, there is limited understanding of how a collaborative structure can be designed in a way that balances inclusion, coordination, spatial complexity, organizational responsibilities and implementation needs without assuming that one universal governance model will work across regions. This gap is particularly relevant in Amsterdam, where the TFCA already provides a collaborative platform, but where the specific urban context, fragmented responsibilities, spatial scarcity and changing project phases create new demands for how collaboration should be organized.

2.3. Conclusion

This research does not study collaborative governance, MLG and governance design as a general solution to grid congestion. Instead, it uses them as analytical and design lenses to examine how the TFCA governance arrangement can be adjusted to better match the Amsterdam context and the practical requirements of long-term grid expansion. The literature points to three conceptual tensions that guide the empirical analysis in later chapters: the tension between energy system requirements and spatial planning, the tension between opening up participation and closing down decisions, and the tension between collaborative coordination and implementation-oriented action.

This chapter has developed the conceptual framework for analyzing grid congestion as a socio-technical and governance design challenge. Collaborative governance is used to analyze interaction, facilitation, trust-building and institutional design within the TFCA, while MLG is used to examine vertical and horizontal dependencies between governmental levels and organizations. Governance design provides the bridge from analysis to intervention by focusing on roles, responsibilities, routines, escalation routes, information flows and implementation interfaces. Chapter 3 explains how these theoretical lenses are operationalized in the research design and methods.

3 | Methodology

In the previous chapters, grid congestion was introduced as a socio-technical governance challenge and conceptualized through the lenses of collaborative governance, Multi-Level Governance (MLG) and governance design. These steps helped define the knowledge gap and led to the central research question: how the TFCA governance arrangement can be adjusted to better support coordinated grid expansion in Amsterdam. This chapter explains the methodological approach used to answer this question.

3.1. Research Design

The research follows a design-oriented and iterative methodology. The design-oriented approach is based on the double-diamond model created by Liu (2016) (Figure 3.1). The double-diamond model is a framework for design thinking that structures the creative process combining several other double diamond approaches ((Design Council, n.d.); (Stanford University, 2025); (Elmansy, 2016)). The upgraded double diamond model by Liu (2016) emphasizes the importance of identifying the core problem within the context of the research before designing solutions. It highlights the balance between divergent and convergent thinking, along with continuous iteration to refine ideas and adapt based on stakeholder insights. The model is grounded in human-centered design, ensuring that solutions address real human needs across products, services, and in this case, systems.

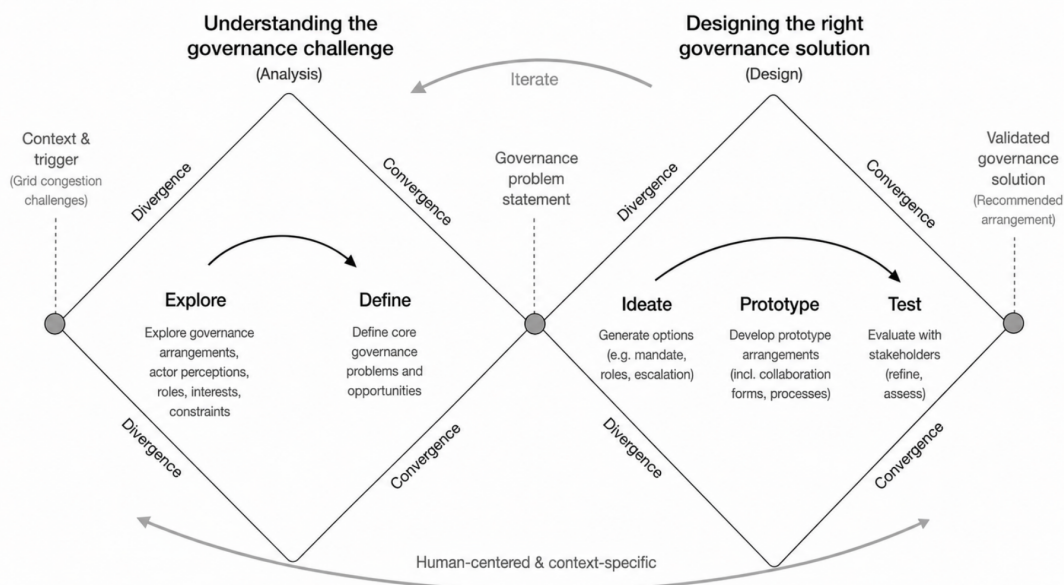


Figure 3.1: Application of the Double Diamond Model to the Research Process: from Problem Exploration to Governance Design and Validation, adapted from (Liu, 2016)

The figure shows that the research first broadens the understanding of the problem before converging towards a problem definition, and then broadens again towards possible design options before converging towards a final governance design. The design process was informed by design-oriented methods that support the movement from problem exploration to the generation, structuring and evaluation of possible solutions (van Boeijen et al., 2020).

The overall research design used in this research is presented in Figure 3.2. The first diamond of the double diamond is defined as problem exploration, where a literature review, system analysis, survey,

and exploratory interviews are a part of. The second diamond of the double diamond is defined as design and validation, which consists of focus groups, system and futuring interviews, a co-creation session, a morphological chart and Multi-Criteria Analysis (MCA), evaluation and validation interviews and a final governance design and implementation roadmap. Collaborative governance and Multi-Level Governance (MLG) frameworks (conceptualized in Chapter 2) are used as theoretical lenses to interpret the empirical findings and to guide the development of governance design options throughout the whole research. The design artifact of this research is the proposed governance arrangement for the TFCA context.

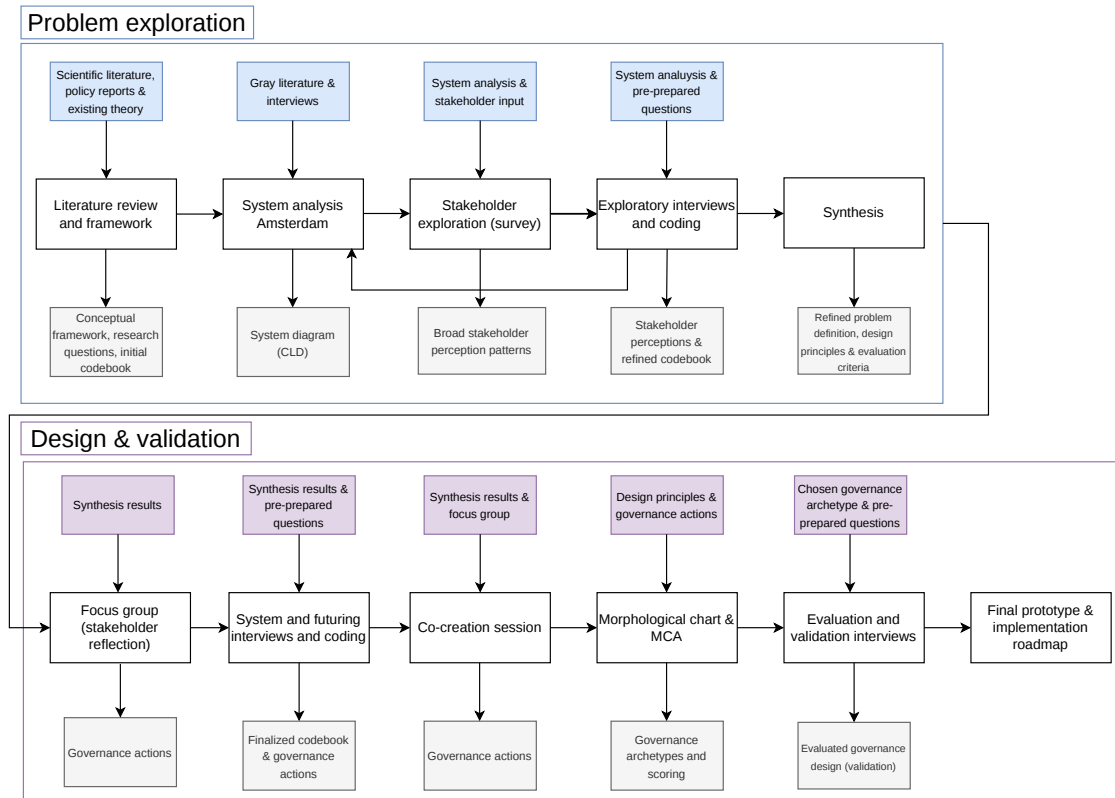


Figure 3.2: Overview of the Research Process, Methods and Outputs (Own Illustration)

3.1.1. System Analysis Amsterdam

Following the literature review and conceptual framework, a combination of a gray literature review, stakeholder analysis and system analysis is conducted for the Amsterdam context. The system analysis was used to understand grid congestion as a set of interacting components, dependencies and feedback mechanisms rather than as a linear technical problem. This follows a systems thinking perspective, in which system behavior is shaped by relationships, feedback loops and delays between system elements (Meadows, 2008).

The gray literature review maps the historical development of the electricity system, the emergence of grid congestion, the stakeholders involved, and the governance arrangement in place. Policy documents, reports, and academic literature are used to map the stakeholders and system. To map the stakeholders involved in the context, a formal chart and a power-interest grid are used. The formal chart shows the formal relations between stakeholder groups, while the power-interest matrix shows which are the key stakeholders in the system. A CLD is finally used to capture systemic interdependencies between actors and technical variables (Moallemi et al., 2022). System thinking using a CLD is chosen because Amsterdam's electricity system is characterized by interdependent technical, institutional, and actor-related dynamics that cannot be captured through linear analysis (Lawrence, 2024; Cassidy et al., 2022). Additionally, the CLD can reveal structural interdependencies that require coordination

and collaboration. This can be used to add to the governance frameworks defined in Chapter 2. By structuring the CLD around subsystems it becomes possible to analyze how similar mechanisms lead to different outcomes depending on the context.

3.1.2. Semi-structured Interviews

Semi-structured interviews were used at different stages of the research to explore the complex governance processes in more depth. Semi-structured interviews follow a predefined topic guide while allowing flexibility to ask follow-up questions and explore unexpected themes. The pre-prepared questions and interviews can be found in Appendix G.

The interviewees were mainly contacted using the network of Andersson Elffers Felix (AEF). Also, people involved in the TFCA who found the research interesting could express their interest in an interview. In order to better understand the context of governing grid congestion in the Netherlands, in total six people from other regions were interviewed, each holding different positions (Appendix E). The purpose of this exploratory reflection was not to compare cases, but to understand the grid congestion context in the Netherlands better. As stated in Chapter 2.1, grid congestion is a wicked problem and thus context-dependent. Solutions are rarely exactly transferable across regions which makes a comparison less interesting (Uyterlinde et al., n.d.).

Interviews were conducted both online and in-person. Prior to each interview, participants received an information sheet and informed consent form outlining the purpose of the study, the voluntary nature of participation, and data handling procedures (for interviews that were also conducted in the context of the AEF assignment, consent was obtained verbally and the purpose of both uses was explained to participants.). With explicit consent, interviews were recorded and subsequently transcribed. Transcripts were anonymized if interviewees requested that. The transcripts form the primary qualitative dataset for subsequent coding and analysis.

Phase	Organization	Label	Number of Interviews
Exploratory	Grid operator	E1	1
Exploratory	Municipality of Amsterdam	E2 and E3	2
Exploratory	Independent	E4 and E5	2
Exploratory (regional)	Province	R1 and R6	2
Exploratory (regional)	Independent	R2 - R4	4
System & futuring	Grid operator	S3 and S4	2
System & futuring	Municipality of Amsterdam	S1 and S2	3
Evaluation & validation	Independent	V1	1
Evaluation & validation	Independent program director	V2	1
Total			19

Table 3.1: Overview of interview respondents and their role in the analysis

The exploratory Amsterdam interviews were used to further delineate the problem scope, gain a more detailed understanding of the role and functioning of the TFCA, and explore initial stakeholder perceptions regarding the added value and limitations of the arrangement. The interviews about the other regions were used as exploratory reflection to better understand the grid congestion context in the Netherlands. Together, these exploratory interviews helped refine the research focus and informed the survey, system analysis and later design-oriented phases.

Second, system and futuring interviews were conducted with stakeholders in Amsterdam. These interviews focused on stakeholder perspectives on the electricity system, the current and future role of the TFCA, and possible developments in the governance of grid expansion. The same general interview approach was used as in the exploratory interviews, but with different pre-prepared questions. The interviews mainly served as input for the focus groups, co-creation session, design principles and

the development of governance design options.

Third, evaluation and validation interviews were conducted later in the research with independent facilitators involved in the TFCA. These interviews were used to assess the relevance, feasibility and potential risks of the developed governance archetypes and design components. The independent facilitators were selected because of their overarching role in the governance arrangement and their relative distance from the formal organizational interests of the participating organizations. The results were used to refine the final governance design and implementation roadmap.

In addition to the formal interviews, informal expert input was received from a Liander representative during the final design phase. This input was not treated as part of the coded interview dataset, since no full interview was conducted. Instead, it was used as supplementary validation input to reflect on the practical feasibility of specific design components.

Qualitative Analysis in Atlas.ti

The exploratory interviews and system and futuring interviews were analyzed using ATLAS.ti to create a broad understanding of stakeholder perceptions, recurring patterns and governance bottlenecks. This coding process contributed to the final synthesis of the system analysis and problem definition. The evaluation and validation interviews were used more specifically to test and refine the proposed design direction. The analysis followed an iterative movement between empirical findings and the theoretical lenses introduced in Chapter 2. This means that the coding remained open to themes emerging from the data, while also being informed by concepts from collaborative governance and MLG (Van Hulst & Visser, 2022).

The coding process was inspired by the logic of the Gioia approach (Gioia et al., 2013). This approach helped structure the movement from first-order codes close to respondent statements, to broader second-order themes, and finally to aggregate dimensions such as coordination problems, unclear responsibilities, escalation challenges and implementation constraints. The Gioia approach was therefore not applied as a rigid template, but used to make the analytical movement from empirical material to conceptual findings more transparent.

The qualitative analysis was further guided by the collaborative governance framework of Ansell and Gash (2008). Its components; starting conditions, institutional design, facilitative leadership, collaborative processes and outcomes, helped interpret how collaboration within the TFCA is structured and where bottlenecks emerge. In addition, a MLG perspective was used to examine coordination challenges between national, regional and local actors.

The coding did not only summarize what respondents said, but focused on reconstructing the underlying rationales behind their statements. This improved the transparency and traceability of the analysis and supported the synthesis of governance dynamics around grid expansion in Amsterdam. More information on the coding methodology and code structure can be found in Appendix H.

3.1.3. Survey

Based on the system analysis and exploratory interviews, a mixed-question survey was designed to capture a broader range of stakeholder perceptions and to identify patterns in an exploratory manner (Artino et al., 2014). To achieve a mixed-question survey design that allows for the structured exploration of abstract concepts within a complex socio-technical system in which stakeholder perceptions and perspectives play a central role, three types of questions were included:

1. **Descriptive questions:** These questions are used to capture background information about respondents, such as their organizational affiliation, role, and level of involvement in the TFCA. This allows for meaningful comparison between different stakeholder groups.
2. **5 point Likert-scale questions:** These questions are used to assess stakeholder perceptions in a structured way, for example regarding collaboration, governance effectiveness, and perceived challenges. The Likert scale enables the identification of patterns and differences across respondents.
3. **Open questions:** These questions provide respondents with the opportunity to elaborate on their perspectives, highlight nuances, and introduce new insights that may not be captured through predefined answer categories.

To ensure content validity, the draft survey was reviewed by four TFCA experts, who evaluated whether the questions were relevant. In addition, attention was paid to response-process validity by assessing how respondents would interpret and understand the questions. The final survey was administered in Dutch to stakeholders involved in the Amsterdam electricity system. The full survey question set and analysis can be found in Appendix F. A total of 59 respondents completed the survey (Table 3.2). The sample was purposively selected to include the key organizations involved in the governance and execution of electricity grid expansion in Amsterdam. These actors represent different stakeholders within the TFCA context, ensuring that the survey captures perspectives across the full governance system. The results of the survey serve as input for the problem definition. In this way, the survey functions not as a standalone instrument, but as a structured foundation for the subsequent phases of the research. Given the exploratory and design-oriented nature of this study, and the relatively small, purposively selected sample, the survey results are not used for statistical inference or significance testing, but rather to identify patterns in stakeholder perceptions that are subsequently triangulated with qualitative data sources.

Organization	Number of Respondents
Municipality of Amsterdam	8
Elektriciteit voor Amsterdam (EVA)	18
TenneT	9
Liander	12
Independent agency	4
Qirion & Reddyn	8
Total	59

Table 3.2: Survey Respondents by Organization

3.1.4. Synthesis

The synthesis is not a separate data collection method, but an analytical integration step. The synthesis phase integrates the insights derived from the literature review, system analysis, survey, and semi-structured interviews. The aim is to move beyond individual findings and identify overarching patterns, tensions and relationships between system dynamics, stakeholder perceptions and governance processes. By combining these different sources of data, key bottlenecks and leverage points in the governance of grid congestion are identified. The synthesis results in a refined problem definition and a set of design requirements that guide the design phase.

3.1.5. Focus Groups

Based on the input from the interviews, two focus groups were organized. One with Workstream 1A (high-voltage) and one with Workstream 1B (distribution grid). The purpose of these focus groups is to collectively reflect on the identified governance tensions, and to translate these findings into possible governance actions. In both workstreams, people from communication were also present. In that way, people from as many workstreams as possible were heard. Through facilitated discussion and structured design exercises (such as future visioning), participants jointly explore what could better support long-term grid expansion and reduce coordination bottlenecks. The focus groups consist of two steps:

1. **Future visioning (Simonse, 2018):** This method is used to explore desirable future states of the governance of the electricity system by encouraging participants to think beyond current constraints and articulate shared long-term ambitions. It helps to create a common direction and align stakeholders around a future-oriented perspective.
2. **Brainstorming to fill in the effort-impact matrix (Mustafa, 2026):** In this step, participants generate and structure potential interventions by evaluating them based on their expected impact and required effort. This approach supports prioritization by distinguishing between “quick wins” and more complex, long-term strategies.

Nine people participated in the WS1a focus group and ten people participated in the WS1b focus group (Table 3.3). By bringing together actors from different organizations and institutional levels, the session

creates a collaborative setting in which diverse perspectives, interests, and expertise can be aligned.

Organization	Participants WS1a	Participants WS1b
Municipality of Amsterdam / EVA	3	6
TenneT	3	-
Liander	2	4
Qirion	1	-
Total	9	10

Table 3.3: Participants in the Two Focus Groups by Organization and Workstream

3.1.6. Co-creation Session

The co-creation session was organized after the focus groups. Its purpose was to identify practical possible governance actions for different future TFCA tasks, including the current scope, the shift towards execution, and broader energy system questions. Participants worked in groups (based on their Workstream) and reflected on four design dimensions (based on the problem definition): roles and responsibilities, collaboration culture, governance arrangement and capacity. The output of the session was used to inform the governance actions in the morphological chart.

3.1.7. Structuring Ideation

Building on the problem definition, the structuring ideation step translated the identified governance tensions into design principles. The focus groups and co-creation session were then used to generate governance actions for these principles, which were structured in a morphological chart. This morphological chart resulted in four mutually exclusive governance archetypes. The governance archetypes were compared using a Multi-Criteria Analysis (MCA). The MCA was used as a structured judgment tool to compare the alternatives across criteria derived from the governance tensions. The purpose of the MCA was not to calculate an objectively best solution, but to make explicit which governance direction was most promising in terms of important criteria. After this direction was selected, the design process moved from comparing archetypes to specifying design components within one specific archetype.

3.1.8. Final Governance Design and Implementation Roadmap

The final step of the research translates the selected and refined governance direction into a final governance design, implementation roadmap and implementation risks and conditions. The proposed design reflects both theoretical principles from the conceptual framework and practical insights from the problem definition based on stakeholder perceptions. In doing so, the research provides a context-sensitive and practically applicable contribution to the governance of grid congestion in Amsterdam.

3.2. Methods per Sub-question

Different research methods are used to address each of the sub-questions. The data requirements differ per sub-question and include both primary and secondary data sources (Table 3.4). Together, the sub-questions structure the research from problem understanding, to ideation and testing, to the final governance design.

Sub-question 1 examines how technical, social and institutional variables interact in the Amsterdam electricity system and influence the pace of grid expansion. This question is addressed through a literature review, document analysis, exploratory interviews and system analysis. These sources provide insight into the development of grid congestion, the actors involved, existing institutional arrangements and the interdependencies that shape grid expansion. The output of this step is a system analysis, including a system diagram and process-oriented description of how technical, spatial and governance dynamics interact.

Sub-question 2 explores how stakeholders perceive and evaluate current governance arrangements and collaboration processes in addressing grid expansion in Amsterdam. This question is addressed through the survey and interviews with key stakeholders, including policymakers, grid operators, consultants and other involved actors. The survey and interviews capture stakeholder experiences, governance challenges and expectations regarding the future development of the TFCA. The interview data are

analyzed using ATLAS.ti, which supports systematic coding of interview material and the identification of recurring themes across stakeholder perspectives.

Sub-question 3 examines which governance design principles and combination of governance actions can strengthen the TFCA governance arrangement. This question is addressed through the development and comparison of mutually exclusive governance archetypes, a MCA, design element analysis, evaluation and validation interviews, and the formulation of the final governance design and recommendations.

Sub-question	Chapter	Data Source
1	Chapter 4	(gray) literature, system analysis & exploratory interviews
2	Chapter 5	Survey, exploratory interviews & system and futuring interviews
3	Chapter 6	Focus groups, co-creation session, morphological chart, MCA & evaluation and validation interviews

Table 3.4: Data requirements and sources per sub-question

3.3. Conclusion

Together, these methods provide a stepwise research design for moving from system understanding to problem definition, ideation, evaluation and final design. The chapter has shown how document analysis, system analysis, survey data and interviews support the problem definition, while focus groups, co-creation, MCA and validation interviews support the development and refinement of the governance design. This combination enables triangulation and fits the design-oriented character of the research.

The next chapter applies the first part of this methodology by analyzing the Amsterdam electricity system, its institutional context, and the stakeholders involved. It shows how technical, spatial, social and governance dynamics interact, and why grid congestion in Amsterdam should be understood as a systemic governance challenge rather than only as a technical capacity problem.

4 | System Analysis

This chapter provides the system analysis of the Amsterdam electricity system and addresses the first sub-question of this research. It first introduces the national and Amsterdam-specific context of grid congestion, after which the technical, spatial, social, economic and institutional components are discussed. The chapter then brings these components together in a system diagram to show how grid congestion in Amsterdam is shaped by interacting system dynamics rather than by one isolated technical bottleneck. This system-level understanding forms the basis for the empirical problem definition in the next chapter.

4.1. National Context

When analyzing grid congestion at a national level, forecasts show an increasing pressure on the grid infrastructure in the Netherlands. As explained in Chapter 1, electricity demand and supply is driven by the expansion of renewable energy, increasing electrification of industry and households, and the growing electricity demand for digital infrastructure such as data centers. At the same time, the Dutch electricity grid was historically designed for a more centralized energy system with relatively predictable demand and no small supply from households. That is not the case anymore. This pressure is visualized in capacity maps (Figures 4.1 and 4.2), which show that capacity scarcity is not limited to Amsterdam, but part of a broader national grid congestion pattern (Netbeheer Nederland, 2025). Because grid operators want to prevent blackouts due to grid overload, they introduced waiting lists. The red and orange areas indicate regions where transport capacity is constrained or where waiting lists are present. In Appendix B more information on the national context can be found.

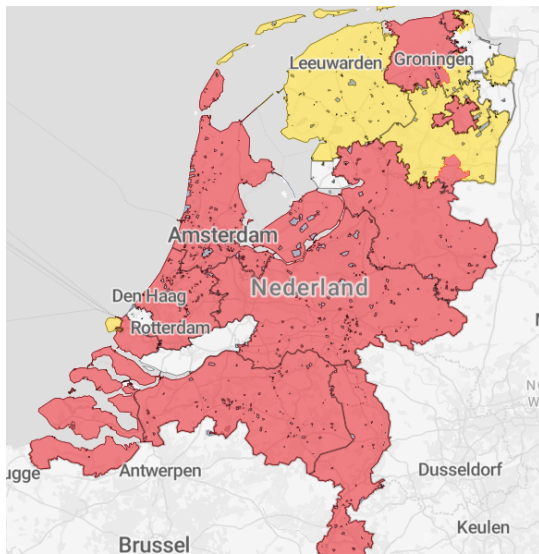


Figure 4.1: Capacity Map for Electricity Demand on the National High-Voltage Grid in the Netherlands (Netbeheer Nederland, 2025)

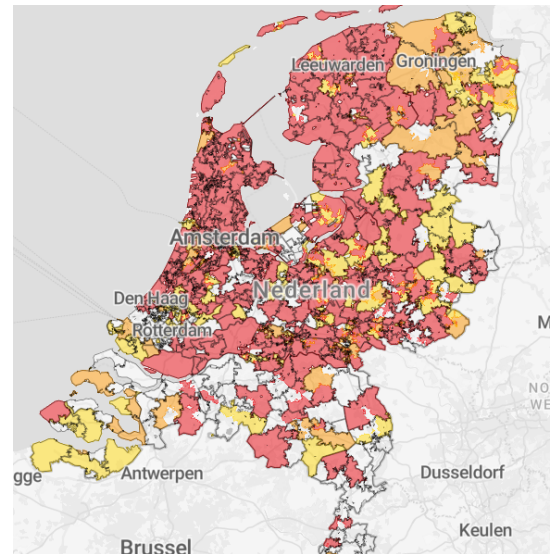


Figure 4.2: Capacity Map for Electricity Demand on the Regional Distribution Grid in the Netherlands (Netbeheer Nederland, 2025)



Figure 4.3: Legend Capacity Maps (Netbeheer Nederland, 2025)

The Dutch grid infrastructure consists of the high-voltage grid and the distribution grid. The national high-voltage grid is managed by TenneT, which is the company responsible for the high-voltage transmission network. The regional distribution grid refers to regional distribution networks managed by operators such as Liander, Stedin and Enexis (Taskforce Congestie Amsterdam, 2025). To understand what the grid infrastructure looks like and how it could be expanded or renovated, Figure 4.4 illustrates the basic structure of the electricity system, from high-voltage transmission to local distribution and final connection to households and other users.

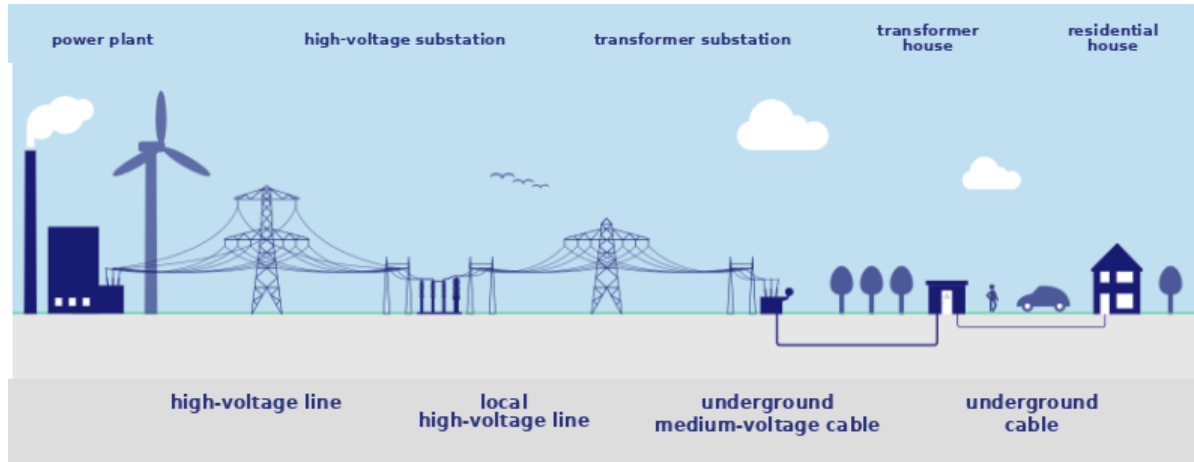


Figure 4.4: Main Components of the Dutch Electricity Infrastructure (Kennisplatform EMV, n.d.)

Both the high-voltage and distribution grid operators are regulated monopolies and operate within a national regulatory framework supervised by the Autoriteit Consument & Markt (ACM). These rules, regulations and policy define how grid operators can manage the electricity infrastructure. The most important components of the national legal framework are further illustrated in Table 4.1. For example, grid operators are obligated to deliver electricity to their clients when they demand it. More information on the national legal framework can be found in Appendix C.

Table 4.1: Key national legal and policy frameworks relevant to grid expansion

Law / mechanism	Main focus	Relevance for Amsterdam
Electriciteitswet 1998, Energiewet and Netcode Elektriciteit	Statutory duties, connection rights and grid access rules	Define the legal tasks of grid operators, including grid management, connection duties, transport capacity rules and congestion management. This is relevant because congestion creates a gap between connection rights and the timely availability of transport capacity. Transport capacity refers to the amount of electricity that can be transported through the grid at a given moment without overloading the infrastructure (Simonetti et al., 2019).
ACM allocation and prioritization rules	Allocation of scarce transport capacity	Historically, transport capacity was largely allocated first-come-first-served. The prioritization framework allows certain socially important or congestion-relieving projects to receive priority, creating a direct link between grid access and societal prioritization (Autoriteit Consument & Markt, 2022).
Omgevingswet	Spatial planning and environmental permitting	Structures spatial planning, environmental assessment and permitting. For Amsterdam, this affects the siting of substations, cable routes and transformer houses in scarce urban space (Barnhoorn, 2016).
LAN and MIEK/PMIEK	National and regional acceleration of grid expansion	Coordinate actions to accelerate grid expansion, improve grid use and prioritize major energy infrastructure projects. This provides the broader policy context for local and regional governance efforts.
Investment plans of grid operators	Long-term grid investment planning	Define planned grid reinforcements and investment timelines. These plans shape the timing and feasibility of infrastructure expansion in Amsterdam and need to be aligned with municipal spatial planning.

4.2. The Amsterdam Electricity System

This section will highlight how Amsterdam fits into the national context and legal framework. Also, the Amsterdam electricity system is described using different components, which will later shape the Causal Loop Diagram (CLD). The CLD is used here as a qualitative system diagram that shows relationships between variables, rather than as a quantitative model. The full set of variables used to construct the CLD is provided in Appendix B.3.

In Amsterdam, grid congestion was first raised in 2021, when Liander announced that there was no capacity available for new applications from large consumers in the port area and north of the IJ. Various locations and stations followed and reached their maximum capacity. On October 18, 2023, TenneT announced congestion on the high-voltage grid in North Holland. From that date onwards, all applications were placed on a waiting list (van der Woude et al., 2024).

According to Gemeente Amsterdam and Liander (2024), the load on Amsterdam's electricity grid is expected to be 3 to 4.5 times higher in 2050 than in 2020. The predicted increase in electricity demand in Amsterdam will grow from 870 MW in 2020 to 2854-4250 MW in 2050. In Amsterdam, there are currently around 560 requests for electricity which have been placed on the waiting list. The minimum waiting time is calculated to be 1,5 years (NXT Mobility, 2025). These predictions are highly uncertain, as it remains unclear whether these represent all applications, or whether there are still many companies that are not applying because there is already a waiting list. This high pressure on the electricity grid in Amsterdam originates mainly in the growing demand-side, which can be seen in Figures 4.5 and 4.6. On the supply side, the congestion is less pressing in Amsterdam (Netbeheer Nederland, 2025). Demand congestion refers to insufficient capacity to deliver electricity to users, while feed-in congestion refers to insufficient capacity to feed electricity produced by generators back into the grid.



Figure 4.5: Amsterdam Capacity Map Electricity Demand National High-Voltage Grid (Netbeheer Nederland, 2025)

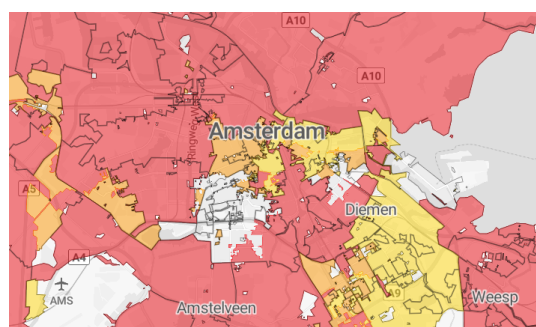


Figure 4.6: Amsterdam Capacity Map Electricity Demand Regional Distribution Grid (Netbeheer Nederland, 2025)

4.2.1. Technical System Components

The technical components of the system in Amsterdam refer to the grid infrastructure and both the demand and supply electricity flow. The high-voltage grid infrastructure (high-voltage stations and cables (150 kV - 380 kV)) is managed by TenneT, which is responsible for transporting large volumes of electricity across the country. This ensures overall system stability. At the interface between the national and regional grid, high-voltage substations convert electricity from 150 kV to lower voltage levels. Depending on the configuration, these substations can be operated by either TenneT, Liander or both (Gemeente Amsterdam & Liander, 2024). For some exceptions, TenneT delivers immediately to large-scale consumers like the industry. The medium to low voltage grid infrastructure (substations, transformer houses and cable networks (230 V - 150 kV)' is managed by Liander, which converts high-voltage electricity all the way to low voltage electricity which can be directly used by end users. This low-voltage grid connects households, Small and Medium-sized Enterprises (SME), public buildings, data centers and charging infrastructure for electric vehicles (Gemeente Amsterdam & Liander, 2024).

On the supply side, decentralized generation sources such as rooftop solar installations and other local renewable energy projects, but also wind mills and solar parks, feed electricity back into the distribution

grid. This bidirectional flow of electricity adds complexity to the system, as the grid was originally designed for one-directional transport from central generation to consumers. Because of this growth in both demand and supply, the grid needs to be expanded. Figure 4.7 presents the future layout of Amsterdam's grid infrastructure, as well as the expansion goals for the coming years.

Amsterdam

Toekomstige situatie

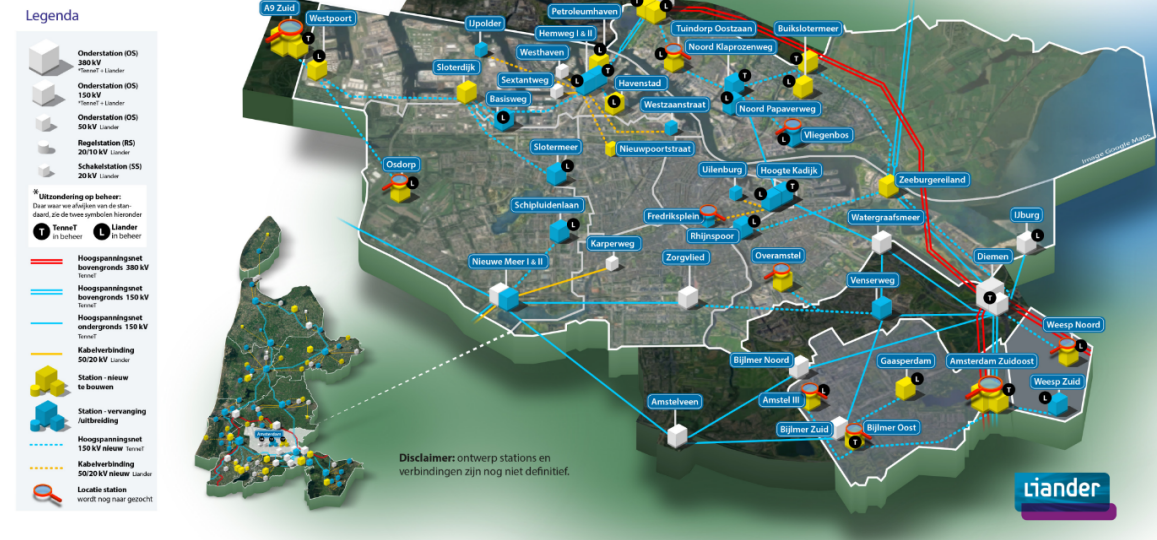


Figure 4.7: Future Grid Infrastructure Amsterdam (concept) (Liander, 2026)

As shown in the Figure 4.7, the locations of 10 planned stations have not yet been determined. In total, the goal is to construct 18 new stations at different locations, renovate or expand 16 existing stations, realize more than 20 new high- and medium-voltage cable connections, and build around 2600 new transformer houses and lay low voltage cables (not shown in the figure). This indicates that the technical response to congestion in Amsterdam is strongly focused on the infrastructure expansion. An interview-based estimate from Tennet suggests that high-voltage grid expansion in Amsterdam could require approximately 2.7 million square meters for cabling and stations, excluding additional spatial requirements from Liander (Appendix G.5). This illustrates the magnitude of the expansion challenge.

4.2.2. Social and Economic System Components

The growing demand and supply can be seen as a result of social and economic components. For example, many households have adopted electric vehicles, heating installations and induction cooking plates, which result in a growing electricity demand (Rovers & Kooger, 2026). In the industrial sector, trends are also visible where processes are gradually shifting from fossil fuels to electricity in order to reduce emissions and meet climate targets. Additionally, according to Gemeente Amsterdam and Liander (2024), the city is projected to grow by approximately 128,000 inhabitants by 2039, which will require the construction of around 7,500 new houses per year. This population growth directly leads to higher electricity demand, particularly as residential areas become increasingly electrified.

Economic growth and digitization also contribute to electricity demand in Amsterdam. Data centers are a key part of digital infrastructure and Amsterdam has developed into a major European data hub. However, data centers require substantial amounts of electricity and space, which increases pressure on both the grid and urban spatial planning (Gemeente Amsterdam, 2020). As a result, Amsterdam has introduced policies to limit their growth. Since June 11, 2025, new large data centers are no longer permitted and expansions are subject to strict conditions (Teesink, 2025).

4.3. Governance and Stakeholder Structure Amsterdam

In this section, the governance and stakeholder structure in Amsterdam is described. The institutional environment, and interactions are discussed and visualized, to further understand the electricity system of Amsterdam..

4.3.1. Institutional Environment

The institutional environment relevant for Amsterdam is described in Table 4.2. More background information on all laws and mechanisms and additional local and regional frameworks can be found in Appendix C.

Table 4.2: Key local and regional frameworks relevant to grid expansion in Amsterdam

Framework / arrangement	Main focus	Relevance for Amsterdam
Municipal spatial and climate policy	Urban development and electrification	Frameworks such as the Omgevingsvisie, Routekaart Amsterdam Klimaatneutraal and Transitievisie Warmte shape urban growth, sustainability ambitions and future electricity demand. They create the spatial and demand-side context for grid expansion.
Themastudie Elektriciteitsnetwerk Amsterdam (TSA) and Ontwikkelingskader Elektriciteitsvoorziening Amsterdam 2035	Technical and spatial grid expansion planning	Provide the technical and spatial basis for expected grid expansion needs, including substations, transformer houses and cable routes. They connect future electricity demand to concrete spatial claims in Amsterdam.
Protocol Ruimtelijke Inpassing	Spatial integration process	Structures the process for integrating electricity infrastructure into scarce urban space and is directly relevant for location decisions and coordination between the municipality and grid operators.
TFCA governance arrangement	Multi-actor coordination	Provides the collaborative platform through which the Municipality of Amsterdam, Liander, TenneT and other actors coordinate grid expansion. It is not a single actor, but a governance arrangement consisting of participating organizations, workstreams, the Kernteam, administrative consultation and independent facilitation.
Regional and provincial energy governance	Regional alignment and infrastructure prioritization	Structures such as the RES Noord-Holland Zuid, Energyboard North-Holland, Energievisie Noord-Holland Zuid and PMIEK connect Amsterdam's grid expansion needs to regional energy planning, renewable generation, storage, flexibility and infrastructure prioritization.

4.3.2. Stakeholder Identification

The stakeholder analysis describes the values, needs and interests of different stakeholders in the electricity system of Amsterdam. These interests can later be transformed into the most important criteria of the system which will be placed in the CLD. Also, by understanding how these stakeholders interact with each other, the way policy is shaped and implemented can be illustrated.

Stakeholders and mapping

In Amsterdam there is a large network of stakeholders operating within the Dutch multi-level electricity system. These stakeholders are mapped using a formal chart (Appendix D) and a power-interest grid (Figure 4.8). Given the nature of grid congestion as a wicked problem, characterized by high uncertainty and conflicting values, identifying and categorizing these actors is important for understanding governance interdependencies.

The stakeholder structure in Amsterdam consists of several interdependent actor groups. Public authorities, including the national government, the Province of North-Holland and the Municipality of Amsterdam, shape the legal, policy and spatial planning context, but do not directly manage the electricity infrastructure. Additionally, the municipality of Amsterdam consists of several municipal departments with hold responsibility for different subjects. The cluster spatial planning and economy is the most important for this context. Several sub-departments exists within this cluster, such as ground and development, spatial planning and sustainability, housing, and infrastructure and energy. Elektriciteit voor Amsterdam (EVA) exists within the infrastructure and energy department (Gemeente Amsterdam, 2026). Grid operators, in Amsterdam these are TenneT and Liander, are responsible for the physical grid and depend on public authorities for spatial integration, permits and policy alignment (Appendix G.5). Technical contractors

such as Qirion and Reddyn support the realization of infrastructure, while large consumers, residents and local energy initiatives influence the system through demand, participation, lobbying or resistance. This creates a governance setting in which no single actor can resolve grid congestion independently. Grid operators have the technical responsibility and investment task, while governing bodies control important spatial and policy conditions. The ACM acts as an independent regulator, and independent facilitators within the TFCA governance arrangement support coordination, expectation management and escalation between actors.

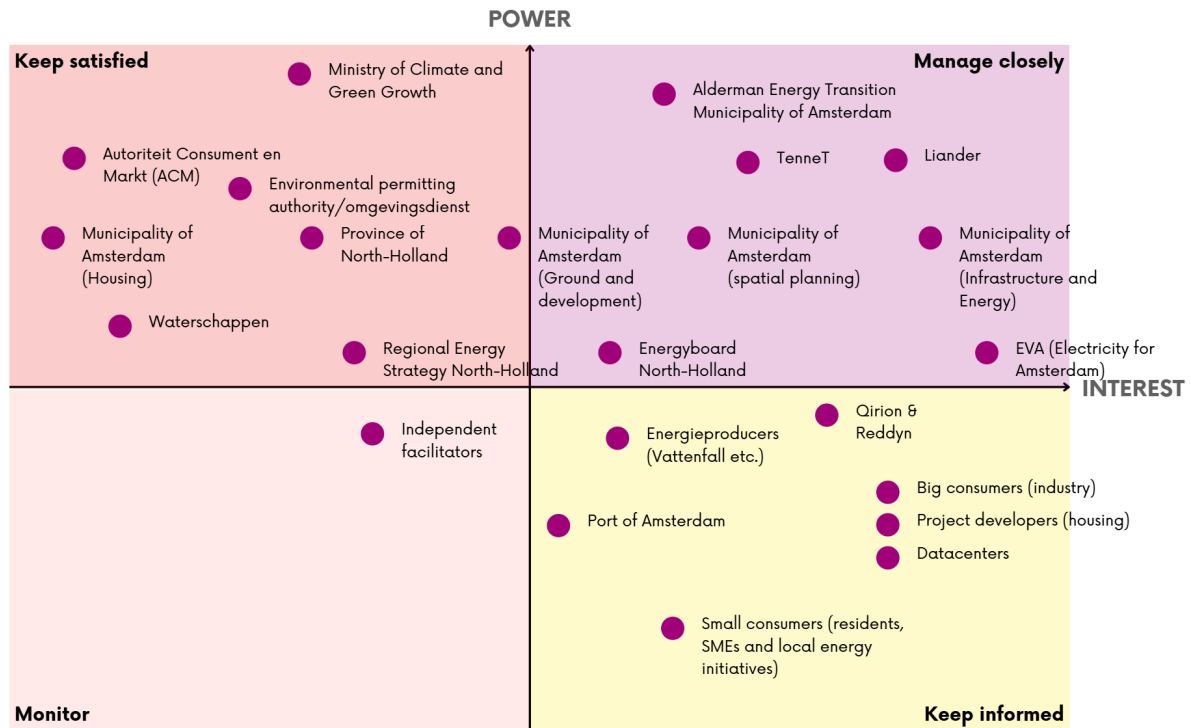


Figure 4.8: Power-Interest Grid Involved Stakeholders (own illustration)

The Power-Interest Grid (Figure 4.8) serves as a diagnostic tool to evaluate a part of the starting conditions of the collaboration, as defined in the framework by Ansell and Gash (2008). In this power-interest grid, power refers to the combination of formal mandate and practical influence over grid expansion decisions, spatial integration, permitting, regulation or implementation. Interest refers to the extent to which the actor is directly affected by, or actively involved in, grid congestion and grid expansion in the Amsterdam context. The TFCA itself is not included as a separate stakeholder, because it is a collaborative governance arrangement rather than as a single actor with one mandate or interest. The grid identifies the key players who should be managed closely, the actors who should be kept satisfied, and the ones who should be kept informed.

Liander, TenneT and several municipal departments are positioned in the high power–high interest quadrant, because they are directly involved in grid expansion, spatial integration and implementation. Elektriciteit voor Amsterdam (EVA) also has a high interest in the Amsterdam context, but its formal influence depends on its internal municipal mandate and its ability to align different municipal departments. Actors such as the Ministry of Climate and Green Growth, the ACM, the Province of North-Holland and the Omgevingsdienst mainly shape the broader legal, policy or permitting context. Their influence is important, but less directly connected to day-to-day coordination in Amsterdam (Appendix G.5).

Demand-side actors, such as industry, project developers, data centers, energy producers, residents and local energy initiatives, are highly affected by grid congestion but have limited formal decision-making authority over grid expansion. This illustrates a central governance tension: actors that depend on grid capacity are not necessarily the actors that control different conditions for expanding it. At the same time, implementation actors such as Qirion and Reddyn become increasingly relevant when projects

move from location choice towards execution.

4.3.3. TFCA Governance Arrangement

The TFCA governance arrangement in Amsterdam is a joint task force between Liander, TenneT and the Municipality of Amsterdam. The TFCA was established in 2021 to improve coordination and predictability in addressing grid congestion in Amsterdam. The TFCA was and is a multi-actor governance arrangement between the municipality of Amsterdam, TenneT, Liander to address grid congestion in Amsterdam. From 2021 to 2023 the Port of Amsterdam was also involved as a partner. When on March 9th 2022, the Amsterdam Energy Supply Development Framework (Elektriciteit voor Amsterdam (EVA)) 2035 was adopted, it became clear that by 2035 a lot of new infrastructure would have to be realized (both stations and cables). To tackle this reinforcement, the TFCA was developed. The goal of the TFCA is to resolve grid congestion where possible, and prevent as much new congestion and delays as possible.

Province of North-Holland

The TFCA is embedded in a broader provincial and regional governance context (Interview G.5). Provincial structures such as the Energyboard North-Holland and the provincial grid congestion taskforce support knowledge exchange, monitoring and escalation when dependencies cross municipal boundaries (Figure 4.9). This makes the TFCA part of a broader MLG structure. However, they do not replace the local coordination and spatial decision-making processes in Amsterdam.

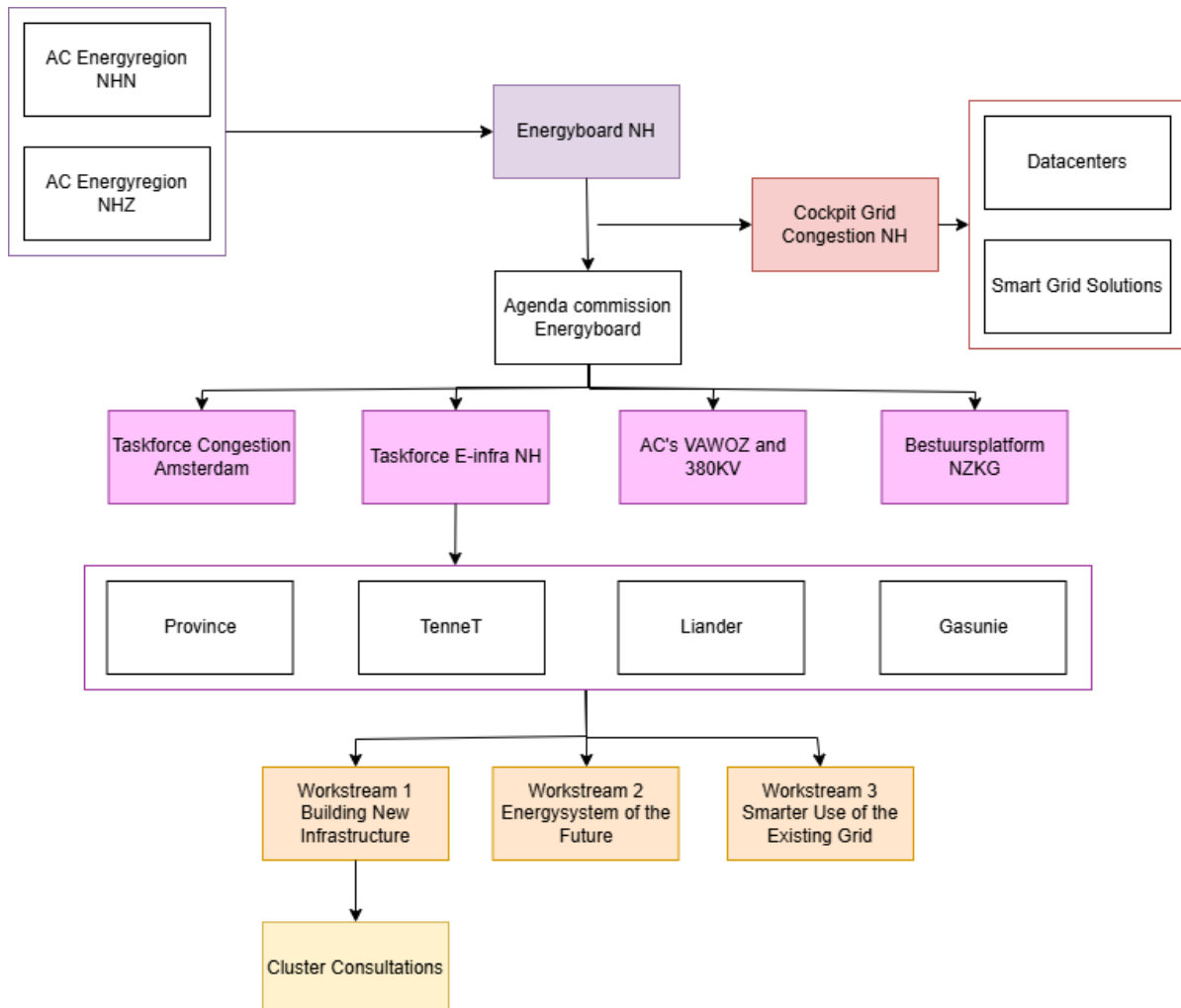


Figure 4.9: Provincial Task Force Structure (Appendix E)

This structure is relevant for the Amsterdam case because the TFCA is not fully isolated from provincial

governance. Amsterdam has its own taskforce due to the scale and complexity of the urban grid congestion challenge, but regular knowledge exchange takes place within and with the provincial taskforce. In addition, Amsterdam also depends on electricity infrastructure outside the city, particularly in relation to high-voltage stations and regional grid connections. Provincial structures such as the Energyboard North-Holland and the provincial taskforce do not replace municipal decision-making authority, especially regarding location choices, but they can support alignment, milestone monitoring, knowledge exchange and escalation when bottlenecks cross municipal boundaries or become politically sensitive.

Governance Arrangement

The TFCA governance arrangement was set up with a very specific governance arrangement, consisting of an Administrative Consultation (AC) (board members), Kernteam (KT) (higher management), Overarching Coordination Consultation (OCC) (coordination layer), workstreams (groups who meet frequently and are specialized in one topic) and coordination teams (focus exclusively on one project). The AC meets once every three months, the KT once every four weeks and workstreams once every two weeks. Since the establishment, the TFCA has undergone a few changes. The initial governance arrangement of the TFCA is described in Appendix D, as well as the achievements from the past years. Figure 4.10 shows the current consultation structure of the TFCA governance arrangement. The figure should be read from top to bottom, moving from Administrative Consultation (AC) to the Kernteam (KT), the Overarching Coordination Consultation (OCC), workstreams and project-level coordination teams.

From a collaborative governance perspective, this structure is relevant because it shapes the institutional design of the collaboration: who meets, at what level, how issues are prepared and where escalation can take place.

Within Liander, different functions become relevant in different project phases. Client & Design (K&O) is mainly connected to the earlier preparation and design phases of distribution grid projects, while Asset Product Management (APM) becomes more relevant when projects move towards implementation and asset-related execution risks need to be connected to the TFCA process.

Planning Procedure Stations and Cables

The planning procedure for stations and cables is quite complex and consists of several steps. Figure 4.11 therefore shows a simplified version of the different phases in the planning of a station. The municipality is mainly involved in the selection of locations for substations and in the permitting process. Location decisions are prepared and taken within the municipal organization after consultation with the grid operator. Depending on whether a change to the environmental plan is required, decision-making may involve the district council or the responsible alderman in the Municipal Executive. Together with the grid operators, the substation is integrated into the spatial plan. This results in a building envelope and a package of requirements determined by the municipality. In parallel, the environmental planning procedure is prepared. After the design phase done by the grid operators, the municipality commissions the Environmental Service to process the permit applications. Once the environmental permit has been issued, land allocation is, where relevant, formalized under private law through a long-term lease agreement. The TFCA is currently not intensively involved after IV/Gate 1. In this context, IV/Gate 1 refers to an internal investment decision moment at which the grid operator decides whether a project can move forward into further design and preparation.

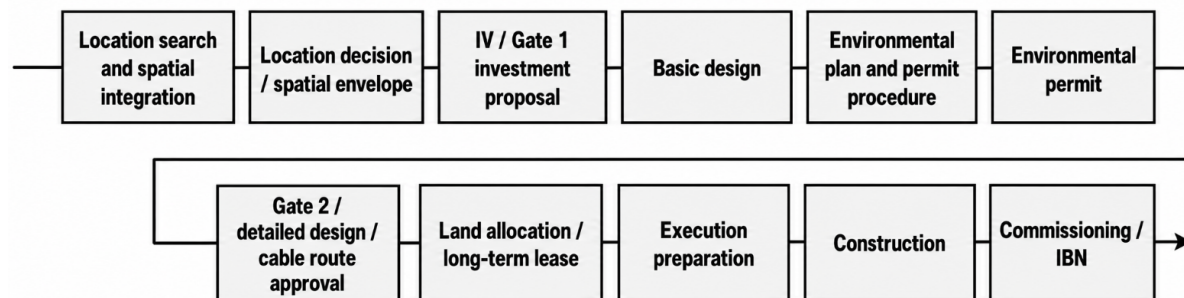


Figure 4.11: Simplified Planning and Implementation Procedure for Electricity Stations (own illustration)

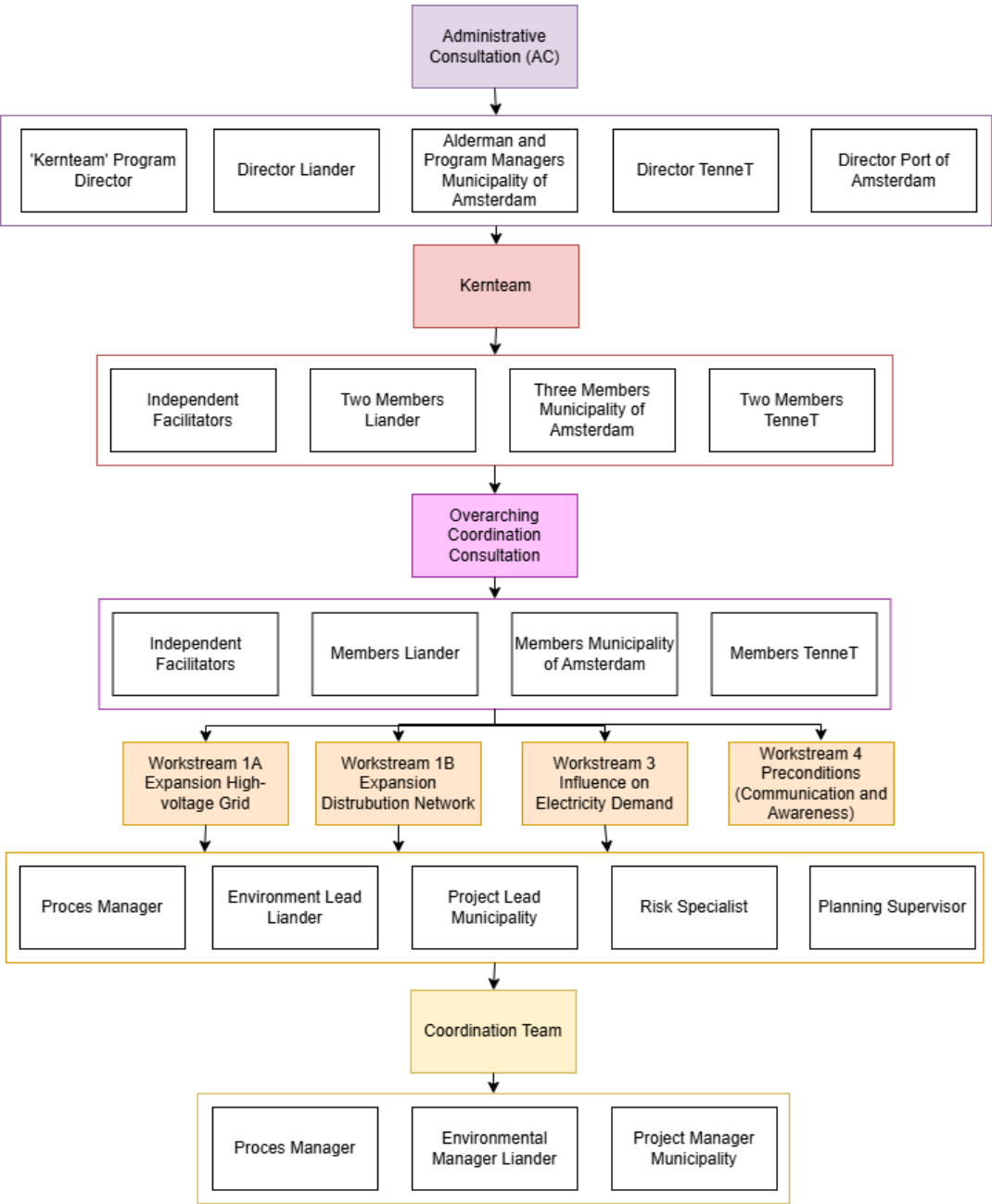


Figure 4.10: Current Governance Arrangement TFC Appendix G.5)

4.4. System Integration

In the preceding sections, the various components of Amsterdam’s electricity system were analyzed separately. However, to understand how grid congestion arises and persists, it is necessary to consider these elements as an integrated whole. In this section, the interactions between these components are described using system dynamics and visualized in an integrated CLD.

4.4.1. System Dynamics

Amsterdam’s electricity system is shaped by different interacting dynamics. Growing electrification increases pressure on the grid, while the expansion of infrastructure is slowed down by spatial scarcity, long planning procedures and institutional dependencies. As a result, congestion is not caused by one isolated bottleneck, but by feedback loops between demand growth, limited grid capacity, spatial integration, delays in issue preparation, escalation and implementation constraints.

4.4.2. Causal Loop Diagram (CLD)

A CLD has been developed to illustrate the relationships between the technical, spatial, social and governance variables discussed in this chapter. The diagram should be read as a qualitative map of interdependencies, not as a quantitative model. It shows how variables influence each other and where reinforcing or delaying mechanisms may occur. A larger and more readable version of the diagram, including an explanation of the feedback loops, is provided in Appendix B.

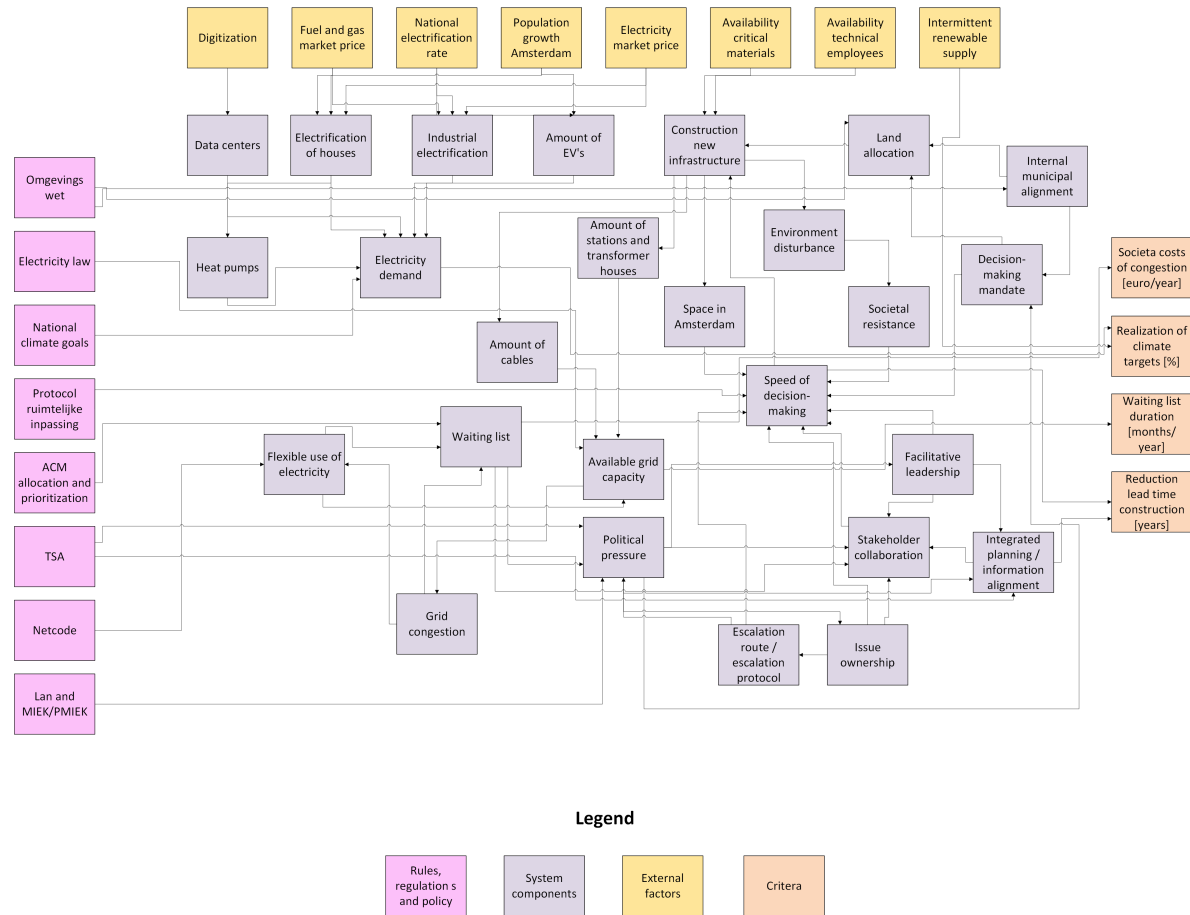


Figure 4.12: Causal Loop Diagram (CLD) of Grid Congestion Dynamics in Amsterdam (own illustration)

This system analysis provides a structured understanding of how different components jointly shape grid congestion in Amsterdam. The diagram highlights several key feedback mechanisms that drive system behavior. For instance, increasing waiting lists generate political pressure to accelerate issue preparation, decision routes and formal decision-making and strengthen collaboration. At the same time, infrastructure development in a dense urban environment often leads to societal resistance, which can slow down implementation and counteract these efforts. In addition, grid congestion itself can trigger adaptive responses, such as more flexible electricity use, which may temporarily relieve pressure on the system. By making these interdependencies explicit, the CLD not only clarifies how the system currently functions, but also allows for the exploration of how specific interventions may influence system outcomes. In this way, it serves as a tool for assessing potential leverage points and anticipating the effects of governance adjustments.

4.5. Conclusion

This chapter has answered sub-question 1 by showing how grid congestion in Amsterdam emerges from the interaction between technical grid constraints, increasing electricity demand, spatial scarcity, stakeholder dependencies and institutional arrangements. The CLD makes these interdependencies visible and shows why grid expansion cannot be understood as a purely technical task. It also shows

that governance variables, such as stakeholder collaboration, issue ownership, escalation routes, facilitative leadership and internal alignment, influence the pace at which grid expansion can move forward. The system analysis points to several system-level tensions: the tension between technical grid requirements and spatial scarcity, the tension between formal organizational responsibilities and shared coordination needs, and the tension between local implementation and multi-level dependencies. In this way, the chapter provides the system-level foundation for the problem definition.

However, it cannot fully explain why coordination challenges persist in practice or which governance arrangements are considered legitimate and feasible by actors involved. This highlights the need to complement the system perspective with empirical insights into stakeholder perceptions and empirical findings. The next chapter therefore moves towards a more focused problem definition by integrating the findings from the system analysis with results from the survey, and interviews. This step is essential to move from understanding system dynamics towards identifying the core governance challenges that need to be addressed in the design phase.

5 | Problem Definition

Building on the system analysis, this chapter further refines the understanding of grid congestion governance by incorporating empirical insights from the survey and semi-structured interviews, thereby answering sub-question 2. While the previous chapter provided a systemic perspective on the interactions and feedback loops within the electricity system, this chapter focuses on how these dynamics are perceived, experienced, and interpreted by stakeholders involved in practice. The purpose of this chapter is to translate these empirical findings into a focused governance problem definition for the design phase.

These findings are subsequently synthesized and linked to the collaborative governance framework of Ansell and Gash (2008) and a Multi-Level Governance (MLG) perspective. This chapter therefore does not only describe stakeholder perceptions, but translates them into a problem definition that identifies which governance tensions need to be addressed in the following design phase.

5.1. Results

This section presents descriptive patterns from the survey together with qualitative insights from the semi-structured interviews. The survey results are used to identify recurring perceptions across stakeholder groups, while the interviews are used to interpret these patterns in more depth.

5.1.1. Survey

This subsection presents the key findings from the survey and provides a concise summary of the main insights. A more detailed overview of the survey design, including all questions and complete results, can be found in Appendix F.

The survey is used as an exploratory instrument to capture stakeholder perceptions and identify recurring patterns across actors, rather than as a basis for statistical generalization. Given the relatively small and targeted sample of respondents, the results are not intended to support statistically significant conclusions. Instead, the survey functions as a “thermometer” of stakeholder perspectives, providing directional insights that are triangulated with findings from interviews and the system analysis. This approach is consistent with the design-oriented nature of the research, in which the emphasis lies on understanding governance challenges and informing the development of practical solutions, rather than on hypothesis testing or statistical inference.

Respondent Characteristics

The respondents are distributed across different organizations and institutional levels, with a relatively large share coming from EVA and the municipality (Figure 5.1). Other stakeholders, such as TenneT, Liander, and Qirion/Reddyn, are also represented, but to a lesser extent. In addition, respondents are spread across different hierarchical levels within organizations, allowing for comparison between perspectives from strategic and operational roles.

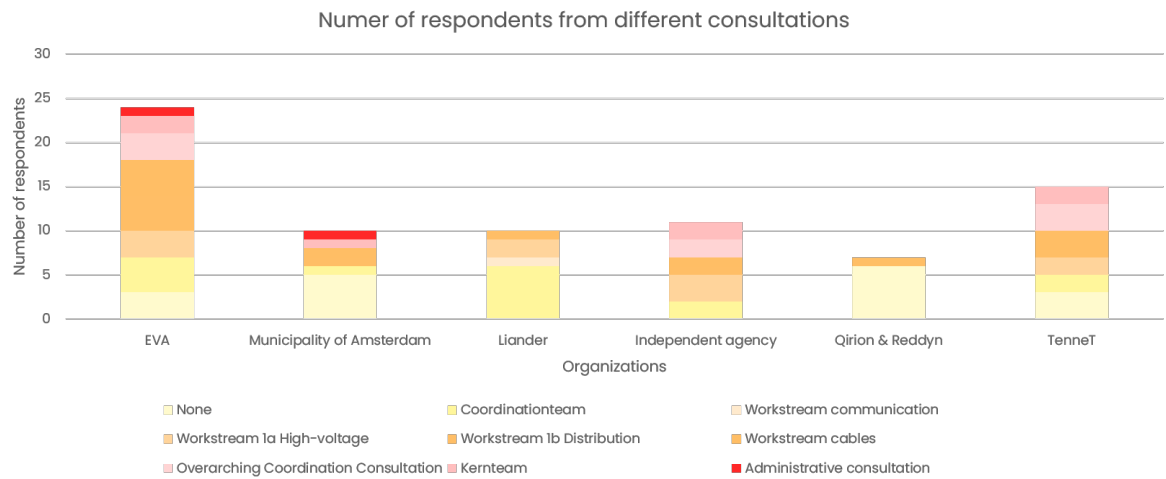


Figure 5.1: Overview of Respondents (Respondents Could Chose Multiple Consultations)

Evaluation of Collaboration within the TFCA Governance Arrangement
Respondents are generally positive about the overall collaboration within the TFCA. The average scores indicate that most stakeholders assess the collaboration positively, although not uniformly across all elements. The results show variation across hierarchical levels (Figure 5.2). Respondents in higher-level positions tend to evaluate the governance arrangement more positively compared to those in more operational roles. This difference suggests that the perceived effectiveness of collaboration depends on where actors are positioned in the governance arrangement: strategic actors may experience alignment, while operational actors are more directly confronted with unresolved implementation bottlenecks.

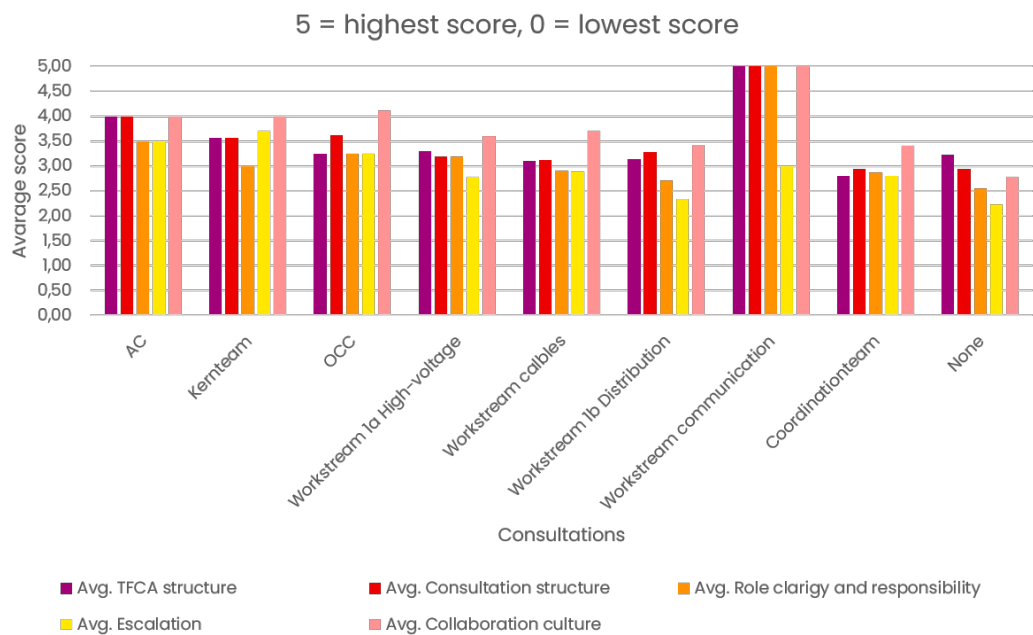


Figure 5.2: Average Evaluation of TFCA Consultation Layers

Perceptions of collaboration and governance differ across organizations (Figure 5.3). Respondents from EVA are generally the most positive about the TFCA, while respondents from Qirion and Reddyn are more critical. In addition, grid operators and the municipality show relatively critical views on escalation of bottlenecks. This indicates that experiences with governance processes are not shared equally across stakeholders, but are influenced by organizational position and role within the system.

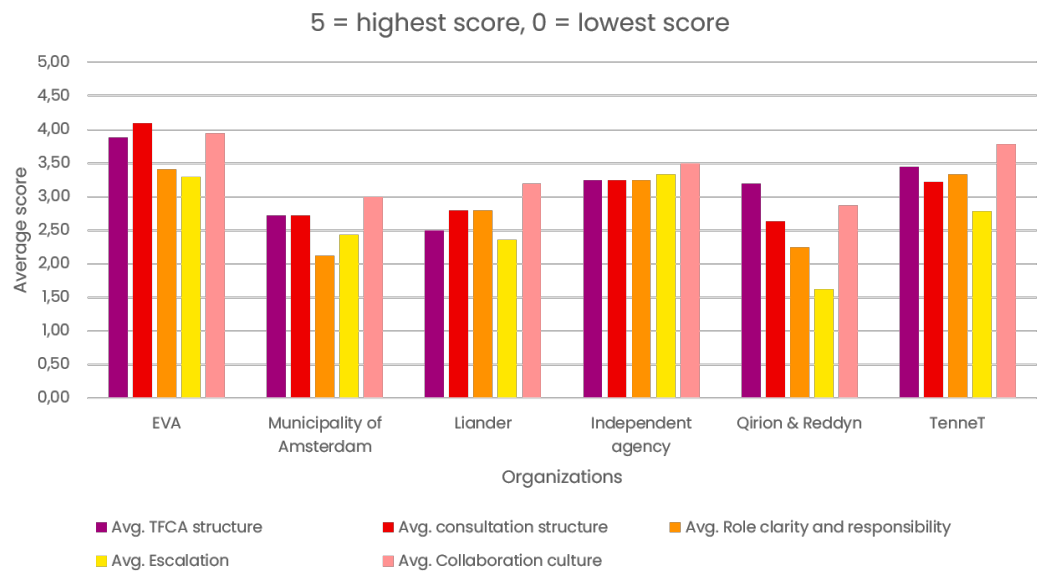


Figure 5.3: Average Score TFCA per Organization

When comparing different TFCA elements, respondents are most positive about collaboration culture and less positive about the escalation of bottlenecks (Figure 5.4). Scores related to issue preparation, decision routes, and clarity of roles and responsibilities are more moderate. A more detailed comparison across organizations (Figure 5.5) shows that this pattern is consistent, but varies in intensity. EVA and TenneT respondents report relatively high scores on both collaboration culture and escalation, while Qirion & Reddyn stand out with significantly lower scores, particularly regarding the escalation of bottlenecks. In general, collaboration culture is rated higher than escalation across all organizations, reinforcing the observation that while relationships and communication are perceived as relatively strong, translating these into effective action and decision-making remains a challenge.

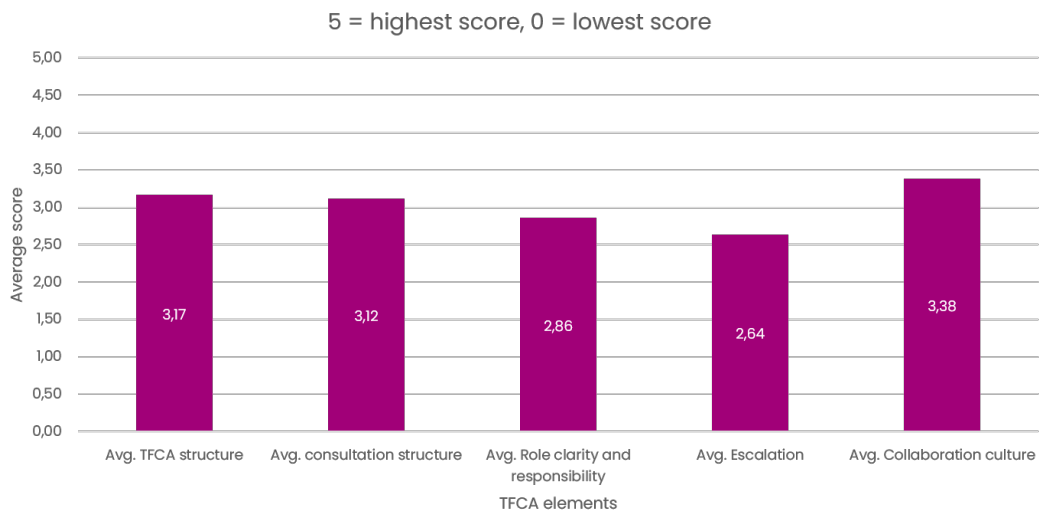


Figure 5.4: Average Score of TFCA Elements

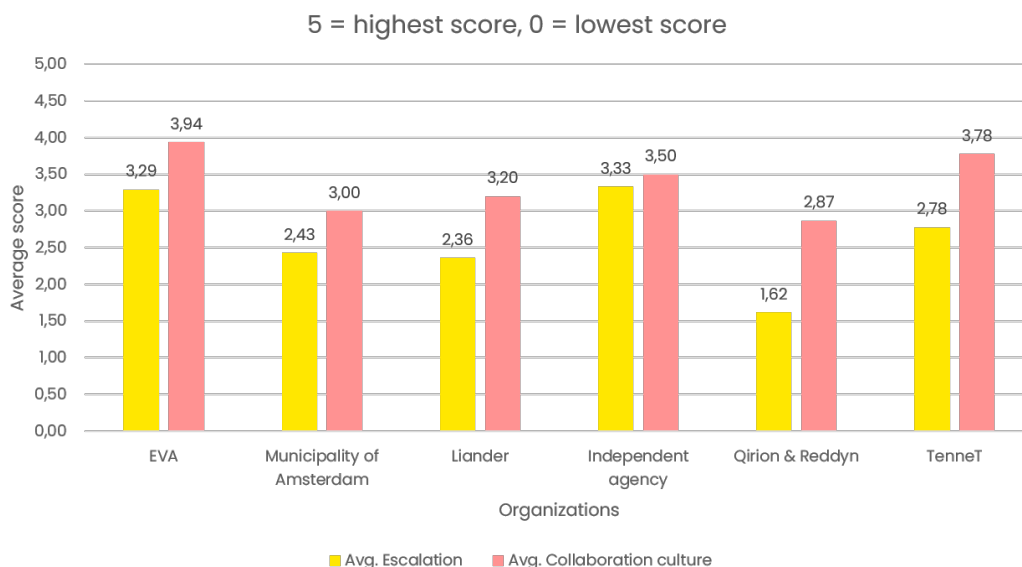


Figure 5.5: Evaluation of TFCA Elements between Organizations

Key Bottlenecks Identified from the Survey

Across the survey, three recurring bottlenecks stand out. These should be interpreted as perceived governance bottlenecks rather than as direct measurements of TFCA performance.

- **Unclear mandate and decision-making structures:** Respondents indicate that it is often unclear how formal decision-making is organized within the TFCA. This is mainly the case for respondents further away from the administrative level. As a result, they indicate that insufficient decisions are taken, and organizations tend to act independently, which can lead to delays.
- **Unclear roles and responsibilities:** There is ambiguity regarding who is responsible for what, when escalation should take place, and who ultimately makes decisions. This lack of clarity contributes to inefficiencies in coordination since respondents indicate that escalation doesn't happen often enough and that they sometimes do not know who is responsible for what.
- **Conflicting interests:** Respondents highlight the presence of competing interests both between and within organizations. These conflicting priorities make it difficult to reach clear decisions and slow down the overall process.

Overall, the survey results indicate that stakeholders are generally positive about the collaboration within the TFCA, particularly in terms of collaboration culture. At the same time, several structural governance challenges are identified, including unclear formal decision-making processes, ambiguity in roles and responsibilities, and conflicting interests between and within organizations. In addition, differences in perceptions between organizations and hierarchical levels suggest that governance processes are experienced differently across the system. These findings underline the importance of not only strengthening collaboration, but also improving the clarity of the governance arrangement.

5.1.2. Interview Analysis

This subsection presents the key findings from the interviews and provides a concise summary of the main insights. The interviews were analyzed through qualitative coding in ATLAS.ti. ATLAS.ti was used as a tool to organize and compare codes, while the analytical interpretation was carried out by the researcher. The collaborative governance framework and MLG were used as an analytical lens rather than as a fixed coding template. This means that concepts such as starting conditions, institutional design, facilitative leadership and collaborative process guided the interpretation, while new empirical codes were also added when they emerged from the interviews. A more detailed overview of the interviews can be found in Appendix G, and a more detailed overview of the code books used in Atlas.ti can be found in Appendix H.

Qualitative Coding analysis

The interviews were analyzed through qualitative coding, using the collaborative governance framework as an analytical lens Ansell and Gash (2008), complemented with MLG concepts and empirically derived codes. The aim of the interview analysis is not to quantify stakeholder perceptions statistically, but to identify recurring patterns, tensions, and governance mechanisms across the interviews. The code frequencies are therefore used as indicative signals of recurring themes, while the interpretation is based on the underlying interview content and supporting quotes.

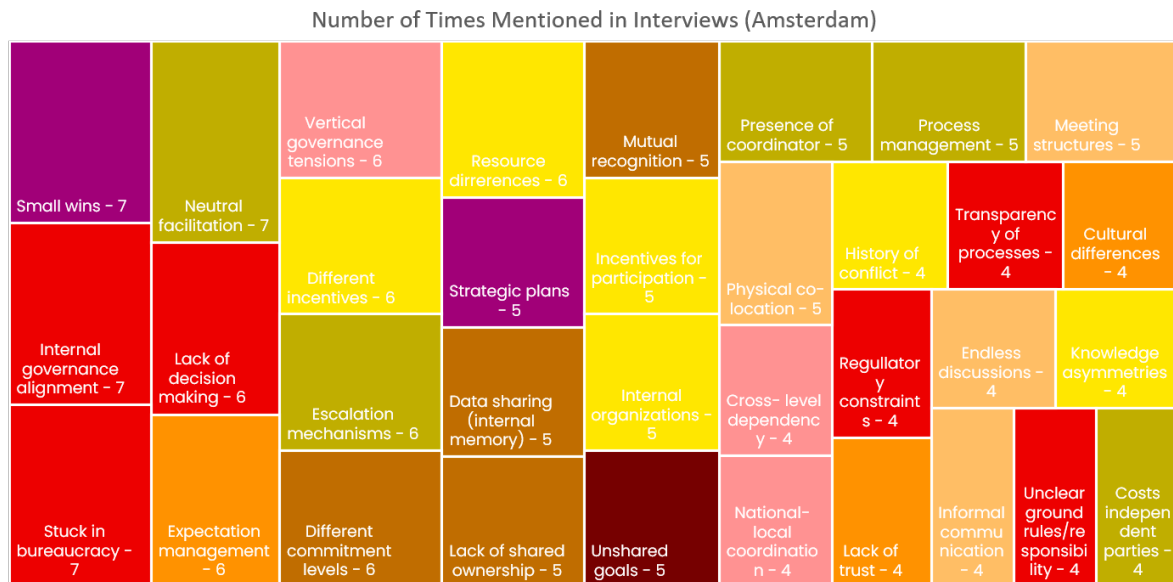


Figure 5.6: Heatmap of the Most Frequent Codes (*Amsterdam Interviews*) (numbers indicate frequency)

The coding patterns in Figure 5.6 show that the interviews were dominated by themes related to collaboration processes, governance design, and multi-level coordination. Frequently recurring themes include small wins, internal governance alignment, stuck in bureaucracy, neutral facilitation and lack of issue preparation, clear decision routes and formal decision-making. In addition, governance tensions related to vertical coordination, expectation management, different incentives and commitment levels, resource differences, and escalation mechanisms are mentioned relatively often. This suggests that stakeholders primarily experience grid congestion as a coordination and governance challenge in which multiple actors, responsibilities, and institutional interests must continuously be aligned. The heatmap should not be read as a direct ranking of importance, but as an indication of which themes recurred most often in the interview material.

The figure also highlights that collaborative governance within the TFCA produces both positive and constraining dynamics. On the one hand, themes such as small wins, neutral facilitation, strategic plans, data sharing and mutual recognition indicate that the TFCA contributes to improved communication, coordination, and mutual understanding between actors. On the other hand, themes such as stuck in bureaucracy, different commitment levels, lack of shared ownership and lack of experienced decision-making show that collaboration does not automatically translate into decisive action or accelerated implementation. Overall, the results suggest that the TFCA functions primarily as a coordination and alignment platform that strengthens interaction between actors, while structural implementation bottlenecks remain strongly influenced by fragmented mandates, institutional complexity, and dependencies across governance levels.

Municipalities vs. Grid Operators

The interviews also suggest that municipalities and grid operators partly frame the congestion problem differently. This distinction should not be interpreted as an absolute opposition between municipalities and grid operators, but as a recurring difference in emphasis across the interviews. Municipal respondents more frequently emphasize spatial constraints, internal governance alignment, political-administrative

complexity, and the challenge of coordinating competing policy objectives such as housing, sustainability, mobility, and spatial planning. From this perspective, grid congestion is not only a technical infrastructure problem, but also a spatial and governance challenge embedded within broader urban development processes.

Grid operators, in contrast, appear to focus more strongly on implementation feasibility, coordination efficiency, and dependencies that slow down infrastructure realization. Their perspective emphasizes the urgency of faster issue preparation, decision routes and formal decision-making, clearer mandates, earlier spatial reservation, and reducing procedural delays. Several interviews suggest frustration with fragmented decision-making structures and the slow pace of municipal procedures, particularly regarding location selection, permitting, and prioritization.

At the same time, the interviews indicate strong mutual interdependence between both actor groups. Municipalities depend on grid operators for technical expertise and investment planning, while grid operators depend on municipalities for spatial integration, permitting, and political support. This creates a recurring governance tension in which both sides recognize the urgency of collaboration, but operate from different institutional logic, time horizons, and accountability structures.

Key Bottlenecks Identified from the Interviews

Respondents identify several recurring bottlenecks across the interviews:

- **Spatial constraints and competing land use:** Respondents consistently emphasize that the availability of space forms a fundamental bottleneck. The realization of substations and cable routes is hindered by competing spatial claims, regulatory restrictions, and local resistance, making grid expansion not only a technical challenge, but also a spatial and political one.
- **Unclear mandates, fragmented responsibilities, and limited formal decision-making authority:** Respondents indicate that it is often unclear how formal decision-making is organized, who is responsible for escalation, and which actors have the authority to make final decisions. In addition, fragmentation within and between organizations complicates alignment and slows down implementation. As a result, insufficient decisions are taken, escalation is limited, and processes are delayed.
- **Misalignment in priorities and problem framing:** Stakeholders differ in how they define the problem, what they prioritize, and how urgent they perceive the issue to be. These differences lead to prolonged discussions and hinder collective action.
- **Capacity and resource constraints:** A lack of technical personnel, limited municipal capacity, and shortages of materials constrain the ability to implement projects, regardless of governance arrangements.
- **Institutional rigidity, coordination complexity, and bureaucratic procedures:** Existing organizational structures, regulations, and permitting procedures limit flexibility and slow down formal decision-making processes, particularly in later project phases. Several respondents also indicate that the large number of actors and coordination layers can prolong discussions and increase governance complexity.
- **Multi-level governance tensions and cross-level dependencies:** Differences between local, regional, and national actors, regarding roles, responsibilities, and interests, create coordination challenges and can either delay or complicate issue preparation, decision routes and formal decision-making processes. While the TFCA helps identify bottlenecks, it does not control all relevant decision-making arenas, limiting its ability to directly resolve implementation barriers.

5.2. Synthesis

This section synthesizes the findings from the survey and interview analysis using the collaborative governance framework of Ansell and Gash (2008). By structuring the results along key dimensions from this framework and MLG, this section provides an integrated understanding of how collaboration within the TFCA functions in practice. The synthesis highlights both the limitations of the current governance arrangement and identifies the key challenges that hinder effective issue preparation, decision routes and formal decision-making and implementation. These insights form the basis for this section, which defines the problem definition. Figure 5.7 summarizes the empirically enriched

collaborative governance framework and highlights the main governance challenges identified in this phase. For every dimension of the Ansell and Gash (2008) and the MLG framework, a short synthesis is provided in this section.

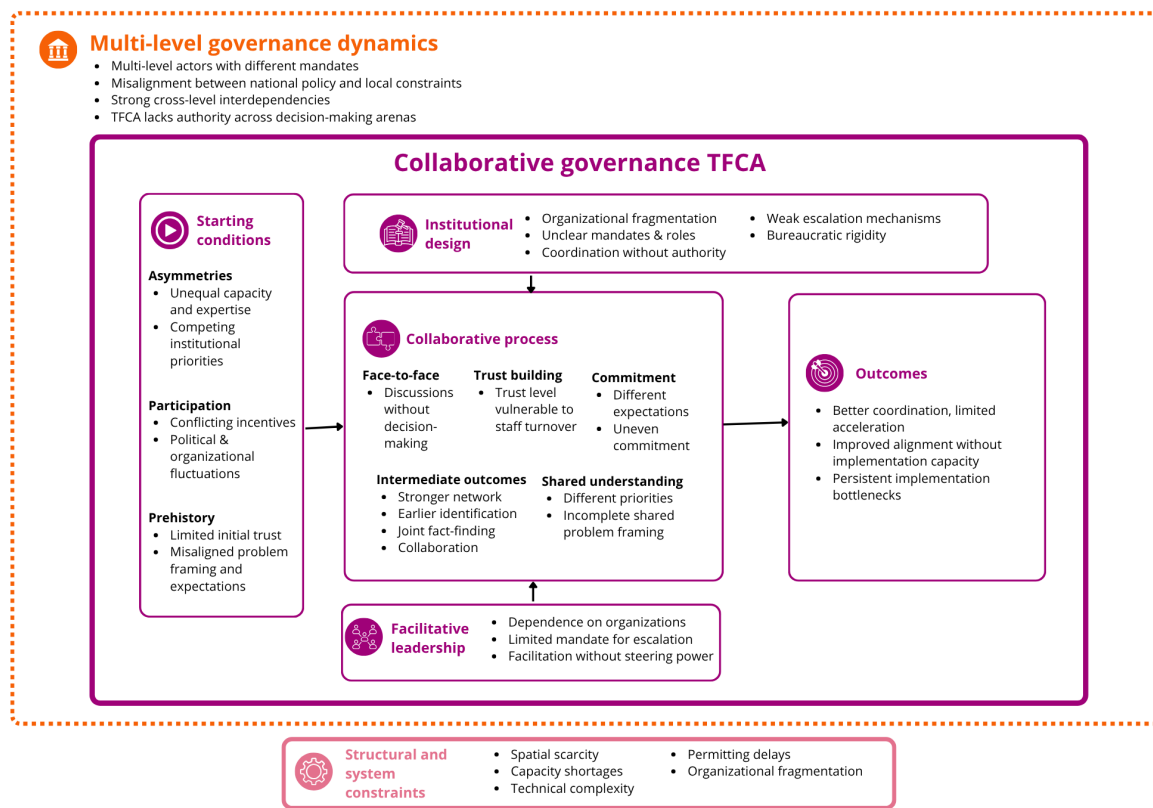


Figure 5.7: Empirically enriched Ansell & Gash Framework (own illustration)

5.2.1. Starting Conditions

The survey and interview findings show that the starting conditions for collaboration within the TFCA governance arrangement are characterized by strong interdependence, but also by asymmetries in power, knowledge, capacity and organizational interests. Actors recognize grid congestion as an urgent and structural problem, which creates a clear incentive to collaborate. At the same time, grid operators, municipal departments and provincial actors operate from different responsibilities, planning horizons and institutional positions, while independent facilitators support the process from a more neutral position.

These differences complicate collaboration from the outset. Technically oriented grid operators and spatially oriented municipal departments do not always define the problem in the same way, while smaller or less directly involved organizations may lack the capacity or expertise to participate equally. The findings therefore suggest that collaboration is necessary, but not self-evident. Misalignment in expectations, interests and responsibilities is already present at the starting point of the collaboration.

5.2.2. Institutional Design

Institutional design emerges as one of the most discussed governance themes in both the survey and interviews. Respondents experience unclear decision-making structures, ambiguous mandates and uncertainty about roles and responsibilities. This does not mean that formal structures are absent, but that their practical interpretation is not always clear to the actors involved.

The interviews further show that a recurring tension exists between the formal role of the TFCA governance arrangement and the expectations actors have of it in practice. The TFCA is primarily a coordination

structure, while formal decision-making authority remains with the participating organizations. However, actors sometimes expect the arrangement to steer, accelerate or resolve decisions. This mismatch between formal authority and practical expectations contributes to ambiguity, especially when bottlenecks require escalation or when decisions depend on internal municipal or grid operator processes.

5.2.3. Facilitative Leadership

The findings show that facilitative leadership is important for keeping the collaboration functioning. Facilitative leadership refers to the role of process managers and independent facilitators in structuring collaboration, maintaining momentum and supporting alignment between actors. Independent facilitators, coordinators and process managers are valued because they structure meetings, align stakeholders, maintain momentum and support escalation when necessary. Their relatively independent position also helps them mediate tensions between organizations.

At the same time, facilitative leadership has clear limits. Process managers can support collaboration, but they cannot replace formal decision-making authority, organizational commitment or internal mandate. This means that facilitation can improve coordination and mutual understanding, but cannot by itself ensure that decisions are made or implemented.

5.2.4. Collaborative Process

The collaborative process within the TFCA governance arrangement is generally evaluated positively in terms of communication, relationships and mutual understanding. Survey results indicate a relatively strong collaboration culture, and the interviews confirm that face-to-face interaction, informal contact and physical co-location have helped actors understand each other better.

However, this positive collaboration culture does not automatically translate into effective joint action. The findings show that discussions can continue for a long time without leading to decisions, and that trust and commitment remain uneven across organizations and hierarchical levels. Collaboration is also vulnerable to staff turnover, internal reorganizations and shifting organizational priorities. As a result, the TFCA has strengthened interaction and alignment, but the step from discussion to decision-making and implementation remains difficult.

5.2.5. Multi-level Governance

The findings show that governance challenges are not only horizontal, between organizations, but also vertical, across governance levels. Local, regional, provincial and national actors are interdependent, but they operate with different mandates, interests and decision-making arenas. National policies and regulatory frameworks influence local possibilities, while municipal spatial decisions directly affect the feasibility of grid expansion.

A recurring finding is that the TFCA governance arrangement is closely connected to implementation bottlenecks, but does not control all arenas in which relevant decisions are made. Bottlenecks may be located within municipal departments, grid operator organizations, provincial structures, national regulation or permitting authorities. This reinforces the conclusion that the main challenge is not the absence of collaboration, but the limited ability to translate coordination into binding decisions and implementation capacity.

5.2.6. Collaborative outcomes

The collaborative outcomes of the collaboration are mixed. On the one hand, the TFCA governance arrangement has improved communication, mutual understanding, information sharing and coordination between actors. It has also created shorter communication lines and helped identify bottlenecks earlier in the process.

On the other hand, these improvements have not automatically resulted in faster implementation or accelerated grid expansion. It is, however hard to say to what extent the TFCA has helped in preventing further delays. Structural constraints such as spatial scarcity, limited technical capacity, permitting procedures, regulatory processes and organizational fragmentation continue to determine the pace of implementation. Overall, collaborative governance improves the conditions for coordination, but does not by itself resolve the structural and implementation constraints behind grid congestion.

5.2.7. Overall Problem Definition

The combined survey and interview findings show that the TFCA governance arrangement has strengthened collaboration, alignment and mutual understanding between actors, but that this has not yet consistently translated into timely issue preparation, clear follow-up or implementation-oriented action. The governance system is characterized by strong interdependence, but also by unclear mandates, fragmented responsibilities, differences in commitment and persistent misalignment across organizational and governance levels.

The core challenge is therefore not the absence of collaboration, but the limited ability of the current governance arrangement to organize, guide and prioritize collective action under conditions of scarcity and complexity. The TFCA is valued as a platform for coordination, trust building and shared problem understanding, but its impact remains constrained by bottlenecks that extend beyond the collaboration itself. Improving governance for grid congestion therefore requires more than strengthening collaboration alone. It also requires clearer role definition, more effective escalation mechanisms, stronger internal anchoring within participating organizations, and closer alignment between governance arrangements and implementation capacity.

5.2.8. The Influence of the TFCA in the System Diagram

The influence of the TFCA governance arrangement can also be related to the system diagram introduced in Chapter 4. Figure 5.8 shows the system diagram with an overlay of the main governance effects associated with the TFCA. The red element indicates where the TFCA primarily influences the system. A larger and more readable version can be found in Appendix B.

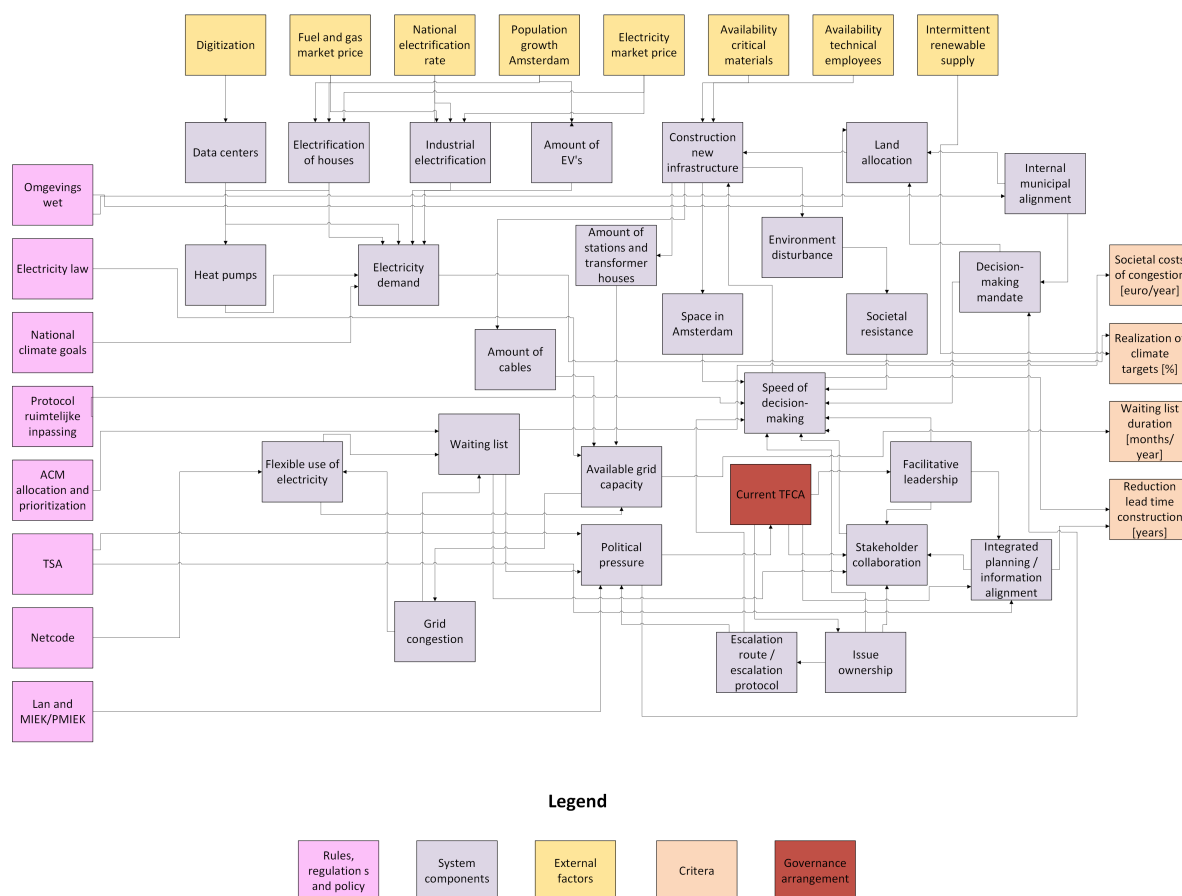


Figure 5.8: System diagram with TFCA governance influence

The influence of the TFCA is mainly visible in governance variables such as coordination and alignment, facilitative leadership, shared understanding, escalation and mandate clarity. Through these mechanisms, the arrangement can support earlier identification of bottlenecks and better alignment between actors.

However, the diagram also shows that its influence on physical system outcomes is indirect. Spatial planning procedures, local resistance, regulatory processes, shortages of technical personnel and material constraints continue to limit the speed of implementation. The TFCA in its current form therefore does not directly solve grid congestion, but creates governance conditions under which acceleration becomes more feasible.

5.3. Governance Tensions and Implied Design Criteria

The governance tensions in Table 5.1 synthesize insights from the conceptual framework, system analysis, and problem definition. They do not yet include findings from the focus groups, co-creation session or validation interviews, because these are used later in the design and evaluation phase. The table therefore functions as the bridge between the problem definition and the design principles developed in Chapter 6.

Governance tension	How it appears in the findings	Main basis	Implied evaluation criterion
Coordination vs. issue preparation	The TFCA is valued as a platform for alignment, but coordination does not always lead to prepared issues, clear decision routes or follow-up.	Conceptual framework (collaborative governance (Ansell & Gash, 2008)); survey; interviews	Actionability of coordination
Formal responsibility vs. shared governance expectations	Actors expect the TFCA, KT or program director to create breakthroughs, while formal mandates remain within individual organizations.	System analysis; survey; interviews	Role and mandate clarity
Dialogue and inclusion vs. escalation and closure	Issues can be discussed repeatedly, while escalation is used late or inconsistently.	Conceptual framework (opening-up and closing-down (Ruiten et al., 2023)); survey; interviews	Escalation and closure capacity
Shared urgency vs. different incentives and priorities	Actors recognize grid congestion as urgent, but municipalities, grid operators and other actors prioritize different spatial, technical and organizational interests.	Conceptual framework (infrastructure planning (Kooij et al., 2025)); survey; interviews	Ability to manage conflicting interests
Energy system requirements vs. spatial scarcity	Technical grid expansion requires substations, transformer houses and cable routes, while public space in Amsterdam is scarce and contested.	Conceptual framework (infrastructure planning (Kooij et al., 2025)); system analysis; interviews	Spatial and system integration
Strategic alignment vs. implementation capacity	The TFCA improves coordination and planning, but permitting, land allocation, technical capacity and execution constraints continue to delay realization.	System analysis; survey; interviews	Implementation feasibility
Local implementation vs. multi-level dependency	Amsterdam depends on municipal departments, grid operators, the province, national regulation and permitting authorities.	Conceptual framework (MLG (Hooghe & Marks, 2003)); system analysis; interviews	Multi-level and organizational anchoring
Structure vs. flexibility	The current arrangement provides overview and alignment, but multiple coordination layers can also slow down action or create unclear routes.	Conceptual framework (collaborative governance (Ansell & Gash, 2008)); survey; interviews	Proportionality and adaptability
Organizational information control vs. shared transparency	Shared data, planning information and decision status are needed to create a common factual basis and maintain support, but information often remains within line organizations because sharing, updating and interpreting it requires time, ownership and agreement.	System analysis; survey; interviews	Transparency and shared information quality

Table 5.1: Governance tensions and implied criteria for governance design

The final column of Table 5.1 identifies the evaluation criteria that follow from the problem definition. These criteria are further operationalized in Chapter 6, where alternative governance archetypes will

be scored based on these criteria. In this way, the criteria are not introduced as external evaluation standards, but are derived from the conceptual framework, system analysis, survey and interview findings.

5.4. Conclusion

This chapter has shown that the TFCA governance arrangement has improved collaboration, alignment and shared understanding, but that these collaborative gains do not automatically lead to clear ownership, escalation, issue preparation, decision routes or implementation-oriented action. The core problem is therefore the gap between collaborative alignment and implementation-oriented action under conditions of spatial scarcity, fragmented responsibilities and multi-level dependency. The governance tensions identified in this chapter show what the design needs to address and provide the basis for the evaluation criteria used in Chapter 6. This problem definition answers sub-question 2 and forms the starting point for the development and evaluation of governance design directions.

6 | Ideate and Test

This chapter translates the problem definition from Chapter 5 into possible governance archetypes. The problem definition showed that the TFCA governance arrangement has improved collaboration, alignment and shared understanding, but that these collaborative gains do not automatically lead to clear ownership, escalation, issue preparation, decision routes or implementation-oriented action. The core problem is therefore not the absence of collaboration, but the gap between collaborative alignment and implementation-oriented action.

Following the Double Diamond logic, the chapter first broadens the design space by translating the governance tensions into design principles and using the focus groups and co-creation session to generate possible governance actions. It then converges by structuring these actions in a morphological chart, combining them into four governance archetypes and evaluating these archetypes through an Multi-Criteria Analysis (MCA) based on the criteria defined in Chapter 5.

The chapter therefore forms the bridge between the problem definition and the final governance design. The focus groups and co-creation session are used as generative design input, while the criteria from Chapter 5 are used to evaluate the archetypes. In doing so, this chapter answers sub-question 3: Which governance design principles and governance actions can be combined to strengthen the TFCA governance arrangement?

6.1. From Problem Definition to Design Principles

The design principles are derived from the governance tensions identified in Chapter 5. Table 6.1 shows how the governance tensions and implied criteria from Chapter 5 are translated into design principles. They define what the future governance arrangement should be able to address.

The table shows that the design challenge is not to increase collaboration in general. Instead, the design should make collaboration more actionable, clarify roles and mandates, connect coordination to implementation, and remain proportional to the complexity of the Amsterdam context.

6.2. Broadening the Design Space

The design principles were used to structure the focus groups and co-creation session. These sessions formed the diverging part of the design process. Their purpose was not to evaluate the final design, but to generate possible governance actions that could respond to the design principles.

6.2.1. Focus Groups

Two focus groups were organized with actors involved in the TFCA governance arrangement. The first focus group focused on workstream 1a (high-voltage stations). The second focus group focused on workstream 1b (distribution grid). The focus groups were used to explore how participants perceived the current governance arrangement, which bottlenecks were most urgent, and which changes could make collaboration more effective.

The focus groups generated ideas related to clearer role division, escalation, internal municipal alignment, implementation capacity, communication and the future scope of the TFCA. Several participants emphasized that the TFCA should not simply add more meetings, but should clarify the function of existing consultation layers and improve the connection between coordination and implementation.

The impact-effort matrix was used as an exploratory exercise to identify which ideas were perceived as both promising and feasible. The matrix was not used to select the final design directly, but to inform the later formulation of governance actions in the morphological chart. A detailed overview of the focus group results is provided in Appendix I.

Based on the focus groups, the following ideas were taken forward into governance actions:

Governance tension	Evaluation criterion	Design principle	Design function
Coordination vs. issue preparation	Actionability of coordination	Link coordination to issue preparation and follow-up	Make collaboration more actionable
Dialogue and inclusion vs. escalation and closure	Actionability of coordination	Create clearer moments for escalation, closure and follow-up	Prevent issues from circulating too long
Formal responsibility vs. shared governance expectations	Role and mandate clarity	Clarify what the TFCA can prepare, coordinate and escalate	Make roles and mandates visible
Shared urgency vs. different incentives and priorities	Ability to manage conflicting interests	Support prioritization without assuming identical interests	Enable explicit trade-off preparation
Energy system requirements vs. spatial scarcity	Spatial and system integration	Integrate energy planning with spatial planning earlier	Connect technical and spatial choices
Strategic alignment vs. implementation capacity	Implementation feasibility and capacity	Connect governance to project phases and implementation risks	Strengthen the implementation interface
Local implementation vs. multi-level dependency	Institutional, multi-level and organizational anchoring	Keep Amsterdam-specific coordination connected to regional and organizational dependencies	Anchor decisions across levels and organizations
Structure vs. flexibility	Proportionality and adaptability	Improve governance without adding unnecessary complexity	Balance structure and flexibility
Organizational information control vs. shared transparency	Transparency and shared information quality	Create shared information and collective memory	Shared data, transparency and collective memory

Table 6.1: Translation of governance tensions into design principles

- **Clarify roles and mandate:** make the roles of the TFCA, EVA, program director and participating organizations more explicit.
- **Strengthen issue preparation and follow-up:** clarify how issues are prepared before they move between consultation layers and how follow-up is organized after agreements are made.
- **Improve escalation routes:** clarify when issues should be escalated and how escalation should move issues forward.
- **Strengthen internal municipal alignment:** ensure that municipal positions are prepared internally before issues enter the TFCA process.
- **Create a shared task and objective:** formulate a clearer joint assignment for the actors involved in the TFCA.
- **Improve communication routes:** develop clearer and more consistent communication, especially when projects move towards implementation and public disruption.
- **Use flexible expert support:** organize independent expertise for complex bottlenecks without creating unnecessary permanent structures.
- **Strengthen data sharing and documentation:** create a more shared factual basis and record agreements more clearly, so that outcomes are not continuously reopened.
- **Support prioritization:** create clearer ways to discuss priorities when spatial, technical and organizational interests conflict.
- **Explore more integrated program organization:** consider whether stronger program-level organization, such as an Amsterdam Energy Company or integrated program organization, could improve coordination and communication.

6.2.2. Co-creation Session

The co-creation session further developed the design space by asking participants to reflect on possible changes to the current TFCA governance arrangement. The session was organized around different parts of the current arrangement, including roles and responsibilities, collaboration culture, governance arrangement and capacity. Participants discussed which elements should be maintained, adapted, reduced or further developed.

The co-creation session produced concrete ideas about phase-dependent actor involvement, earlier involvement of implementation actors, clearer ownership of issues, better documentation of decisions and agreements, and a stronger connection between communication, environmental management and implementation. It also showed that not all topics fit equally well within the immediate redesign of the TFCA. Better grid use and future energy system topics were considered relevant, but less developed and therefore more suitable as exploratory or pilot directions.

Based on the co-creation session, the following ideas were taken forward into governance actions:

- **Clarify phase-dependent roles:** define which actors are needed before and after the investment proposal phase, and how responsibilities shift between planning and implementation.
- **Assign internal owners:** make sure that agreed TFCA actions land within the participating organizations and do not remain isolated in the collaboration platform.
- **Strengthen escalation and closure:** introduce clearer escalation moments and follow-up mechanisms when issues remain unresolved.
- **Involve implementation actors earlier:** include actors such as Liander APM, Qirion/Reddyn, contractors, project teams and environmental managers when projects move towards execution.
- **Connect implementation planning to integral planning:** include project-level implementation planning more clearly in the broader planning process.
- **Differentiate between stations and cable routes:** avoid treating stations and cables as one uniform governance task, because they may require different routes after location choices have been made.
- **Clarify permitting responsibilities:** make clearer which actor prepares permit applications, when municipal escalation is needed, and how permitting actors are involved.
- **Strengthen communication and environmental management:** treat communication and environmental management as part of implementation preparation, rather than as a late-stage activity.
- **Use area-based communication where needed:** organize communication and environmental management around areas where multiple projects and public-space claims come together.
- **Improve collective memory:** secure agreements, decisions, planning information and environmental knowledge in a shared issue, decision and planning log.
- **Strengthen shared data use:** develop clearer agreements on data sharing and shared factual information between TenneT, Liander and the municipality.
- **Reduce unnecessary consultation layers:** avoid adding permanent governance layers and clarify the purpose, frequency and agenda of existing consultation layers.
- **Use temporary support selectively:** add expert support or additional capacity only when specific bottlenecks require it.
- **Plan reflection moments:** use fixed collaboration or reflection moments to support learning, alignment and continuity.
- **Secure communication capacity and budget earlier:** organize communication and environmental management capacity before residents experience disruption.

The governance actions generated through the focus groups and co-creation session were then structured in the morphological chart in the next section. The chart does not include every idea as a separate action, but groups related ideas into alternative governance choices per design principle or function.

6.3. Structuring the Design Space

After broadening the design space through the focus groups and co-creation session, this section starts the converging part of the design process. The generated ideas are first structured in a morphological chart and then combined into coherent governance archetypes for evaluation.

6.3.1. Morphological Chart

A morphological chart was used to structure the generated ideas from the focus groups and co-creation session into alternative governance options. The first column of the chart corresponds to the design principles, while the other columns present alternative governance actions for each principle. The options within each row are formulated as mutually exclusive choices as much as possible, so that they can be combined into coherent governance archetypes.

Table 6.2 presents the morphological chart. For every design principle, four mutually exclusive governance actions are written down, based on the focus groups and co-creation session. The chart shows how each archetype is constructed by selecting one option per row, using the color coding for the four governance directions.

Design principle / function	Option A	Option B	Option C	Option D
Link coordination to issue preparation and follow-up	Maintain current coordination mainly as alignment platform	Strengthen KT and program director for issue preparation, monitoring and follow-up	Shift issue preparation to line organizations and EVA before issues enter the TFCA	Create an Amsterdam energy board for strategic issue preparation
Create clearer moments for escalation, closure and follow-up	Introduce escalation triggers and a standard issue format	Use line-organization and provincial escalation routes	Keep existing process-manager support and informal escalation	Centralize escalation in an integrated program route with decisions, owners, deadlines and follow-up status
Clarify what the TFCA can prepare, coordinate and escalate	Keep roles flexible and informal	Use RACI and assign internal owners for agreed TFCA actions	Integrate the main organizations in one Amsterdam energy program	Return responsibility mainly to line organizations
Support prioritization without assuming identical interests	Use one integrated progra-wide prioritization framework	Keep prioritization within individual organizations	Move cross-organizational prioritization to provincial routes	Use shared prioritization and a bottleneck budget with activation criteria
Integrate energy planning with spatial planning earlier	Secure spatial reservations mainly through policy and legal instruments	Integrate energy, spatial and housing planning in one program framework	Continue the current spatial alignment process	Add 10 kV, 50 kV and MSR planning and clarify permitting routes where needed
Connect governance to project phases and implementation risks	Keep implementation planning in line organizations	Create a permanent implementation and delivery workstream	Use phase-gate planning with Qirion, APM, contractors and communication actors	Use current implementation involvement through existing workstreams
Create shared information and collective memory	Create a joint data protocol, decision log and planning dashboard. Also include an independent planner and communication director/lead	Keep using current SharePoint and communication workstream	Create an integrated program data and communication office	Keep data sharing mainly within line organizations
Connect Amsterdam-specific coordination to regional and national learning	Embed Amsterdam coordination in a formal multi-level energy program like the energyboard	Use provincial taskforce routes where possible	Organize regional learning and national knowledge sharing between taskforces	Keep the TFCA fully Amsterdam-focused
Improve governance without adding unnecessary complexity	Simplify by reducing TFCA consultation layers	Keep the current arrangement unchanged	Clarify layer purpose and add activation-based expert support and reflection sessions	Replace separate layers with an integrated program office

Table 6.2: Morphological chart of governance options per design principle

6.3.2. Development of Governance Archetypes

Four governance archetypes were developed from the morphological chart. Each archetype represents a different governance direction which is a combination of governance actions. The archetypes are constructed by selecting one governance action for each design principle or function. In practice, some options may later be combined in the final design.

The four archetypes differ in how aspects such as coordination, issue preparation, implementation,

information sharing and escalation are organized. The first archetype (purple) moves responsibility back to the line organizations (original organizations) as much as possible. The second archetype (red) keeps the current TFCA governance arrangement largely unchanged. The third archetype (orange) strengthens the current arrangement by making it more actionable, without replacing it. The fourth archetype (yellow) moves furthest towards an integrated program structure in which the main organizations work together almost as one joint program.

Archetype 1: Line-Organization Coordination Model

The first archetype reduces the role of the TFCA and returns more responsibility to the line organizations of the participating actors. In this model, the TFCA remains available as a light alignment platform, but issue preparation, prioritization, escalation, data sharing and implementation planning are mainly organized within the municipality, TenneT, Liander and other participating organizations. Where coordination is still needed beyond individual organizations, this archetype relies more strongly on existing line-organization routes and provincial taskforce routes.

This archetype tests whether the current TFCA governance arrangement is still needed as a central coordination platform, or whether the participating organizations can organize coordination sufficiently through their own structures. Its potential advantage is simplicity, because it avoids adding new consultation layers, shared instruments or joint support structures. Its main risk is that shared overview, independent facilitation, collective memory and structured escalation may be weakened. In conclusion, it may reduce governance complexity, but it also risks reinforcing the fragmentation identified in the problem definition.

Archetype 2: Current TFCA Continuation Model

The second archetype keeps the current TFCA governance arrangement largely unchanged. Coordination remains mainly organized through the existing consultation layers, workstreams, process managers, informal escalation routes and current alignment processes. Data sharing and communication also remain close to the current practice, for example through the existing SharePoint use and the communication workstream. The aim of this archetype is to minimize organizational change and avoid additional effort, costs or complexity.

This archetype tests whether the current governance arrangement is sufficient if actors continue to use it as it is now. Its potential advantage is feasibility, because it does not require new mandates, new structures or major changes in working routines. Its main risk is that the current problems remain unresolved. If the TFCA continues mainly as an alignment platform, it may keep supporting collaboration and shared understanding, but may still not provide enough issue preparation, follow-up, escalation, shared information or implementation orientation.

Archetype 3: Strengthened TFCA Governance Arrangement

The third archetype keeps the current TFCA governance arrangement, but strengthens its ability to prepare issues, clarify roles, organize follow-up and connect coordination to implementation. In this model, the existing arrangement is not replaced, but made more actionable. Consultation layers are used more deliberately to prepare issues, monitor follow-up, organize escalation and connect strategic alignment to project-level implementation.

This archetype also strengthens the information and implementation side of the current arrangement. It includes clearer internal ownership of agreed TFCA actions, escalation triggers, a standard issue format, a shared decision and issue log, a planning dashboard and better integration of implementation planning with Qirion, APM, contractors and communication actors. It also allows for temporary expert support or a bottleneck budget, but only when specific activation criteria are met.

This archetype responds most directly to the problem definition. It builds on the existing collaborative capacity of the TFCA, while addressing the main weaknesses identified in Chapter 5: unclear roles, weak follow-up, limited escalation, fragmented information and insufficient connection to implementation. Its potential advantage is that it improves the current arrangement without requiring a full institutional redesign. Its main risk is that it can still become too complex if additional mechanisms, dashboards, expert support or budgets are not activated selectively.

Archetype 4: Integrated Amsterdam Energy Program Model

The fourth archetype moves furthest away from the current TFCA governance arrangement and towards an integrated Amsterdam energy program. In this model, the main participating organizations work together much more structurally, almost as one joint program organization. Issue preparation, prioritization, communication, implementation planning, data sharing and bottleneck support are organized through integrated program structures rather than through separate line organizations and loose coordination.

This archetype includes the strongest form of joint organization. Strategic issue preparation is organized through an Amsterdam energy board, prioritization is handled through one program-wide framework, and energy, spatial and housing planning are connected in one program structure. Implementation and delivery are also organized more structurally, for example through a permanent implementation workstream and an integrated program data and communication office.

This archetype tests whether a more integrated organizational form could overcome the fragmentation between the municipality, TenneT, Liander and other actors. Its potential advantage is that it creates strong joint ownership, shared program capacity and clearer integrated steering. Its main risk is institutional feasibility. Formal responsibilities remain with the participating organizations, and a highly integrated program model may blur mandates, require substantial resources and become difficult to embed in existing legal and organizational structures. It is therefore useful as a boundary-testing archetype, but may be difficult to implement in full.

6.4. Evaluation of Governance Archetypes

After the development of the governance archetypes, a MCA method was applied to compare the archetypes based on a set of criteria derived from the problem definition and governance tensions in Chapter 5. This allowed for a structured evaluation of the relative strengths and weaknesses of each archetype. The focus groups and co-creation session informed the governance actions, but did not define the evaluation criteria. This ensures that the MCA assesses the archetypes against the problem definition rather than against preferences generated during the design sessions.

6.4.1. Evaluation Criteria

Table 6.3 presents the criteria used in the MCA. Each criterion is formulated as a scoring question to make the assessment more transparent.

Criterion	Scoring question
Actionability of coordination	Does the archetype help move issues from discussion to issue preparation, escalation, follow-up or closure?
Role and mandate clarity	Does the archetype clarify what the TFCA can coordinate, prepare or escalate, and what remains with formal organizations?
Ability to manage conflicting interests	Does the archetype help actors deal with conflicting spatial, technical and organizational priorities?
Spatial and system integration	Does the archetype connect grid expansion more clearly to spatial planning and system-level dependencies?
Implementation feasibility and capacity	Does the archetype connect governance to implementation capacity, project phases and execution risks?
Institutional, multi-level and organizational anchoring	Does the archetype fit within municipal, regional, provincial and organizational responsibilities?
Proportionality and adaptability	Does the archetype improve governance without adding unnecessary layers, costs or rigidity?
Transparency and shared information quality	Does the archetype improve transparency and creates qualitative shared information options?

Table 6.3: Evaluation criteria for the MCA

6.4.2. MCA Approach

The MCA was used as a structured comparison tool. It does not produce an objective calculation of the best governance model, but helps make the assessment transparent. Each archetype was scored on the eight criteria using a scale from 1 to 4, where 1 indicates a weak performance on the criterion and 4 indicates a strong performance. The scores were based on the problem definition, the design principles, the generated governance actions and the expected fit with the Amsterdam context.

The weights were assigned based on how strongly each criterion relates to the core problem identified in Chapter 5: the gap between collaborative alignment and implementation-oriented action. Criteria that directly address this gap, such as actionability of coordination, implementation feasibility and role and mandate clarity, received the highest weights. Criteria that mainly enable or safeguard the design, such as transparency, proportionality and multi-level anchoring, received slightly lower weights. The weighting should therefore be read as a structured judgment based on the problem definition and ideation findings, rather than as a statistically measured priority score. The MCA was used to compare governance directions, not individual measures. This is important because the final design in Chapter 7 is not a direct copy of one governance archetype. Instead, the MCA identifies the most suitable overall direction, which is then refined into a final design.

6.4.3. MCA Results

Table 6.4 presents the results of the MCA. The weighted score was calculated by multiplying the score by the criterion weight. The total weighted score provides an indication of the relative performance of each archetype. The table shows that archetype 3 scores highest overall.

Criterion	Weight	A1	A2	A3	A4
Actionability of coordination	0.18	0.18	0.36	0.54	0.72
Role and mandate clarity	0.14	0.56	0.14	0.28	0.42
Ability to manage conflicting interests	0.10	0.10	0.20	0.30	0.40
Spatial and system integration	0.12	0.12	0.24	0.36	0.48
Implementation feasibility and capacity	0.16	0.64	0.32	0.48	0.16
Institutional, multi-level and organizational anchoring	0.12	0.36	0.24	0.48	0.12
Proportionality and adaptability	0.08	0.24	0.16	0.32	0.08
Transparency and shared information quality	0.10	0.10	0.20	0.30	0.40
Total score	1.00	2.30	1.86	3.06	2.78

Table 6.4: Multi-criteria analysis of governance archetypes

The results indicate that the strengthened TFCA governance arrangement is the most suitable governance direction for Amsterdam. This archetype has the highest total score because it builds on the existing collaborative capacity of the TFCA, while directly addressing the main weaknesses identified in the problem definition: weak issue preparation, unclear follow-up, limited escalation, fragmented information and insufficient connection to implementation.

The current TFCA continuation model scores lowest because it leaves many of the current bottlenecks unresolved. The line-organization coordination model scores better on role clarity and implementation feasibility, because responsibilities are moved back to formal organizations, but it risks weakening shared overview, independent facilitation and collective alignment. The integrated Amsterdam energy program model scores strongly on actionability, prioritization, spatial integration and shared information, but scores lower on implementation feasibility, institutional anchoring and proportionality because it would require a much more far-reaching organizational change. The higher score of A4 on several integration-related criteria should therefore be interpreted as theoretical governance capacity, while its lower feasibility, anchoring and proportionality scores limit its suitability as the selected direction. The strengthened TFCA archetype therefore represents the most balanced direction: it improves the current arrangement without replacing it entirely.

6.4.4. Stakeholder Reflection on the Selected Direction

After the MCA, the selected governance direction was discussed in the evaluation and validation interviews. These interviews were not used to determine the MCA scores, but to reflect on whether the

selected direction was plausible and which conditions should be taken into account in the final design. The detailed refinement of the design components is therefore presented in Chapter 7.

The interviewees generally indicated that the current TFCA governance arrangement should not be stopped or replaced entirely. The respondents pointed out that the arrangement provides shared overview, independent facilitation and a structured basis for collaboration. At the same time, they also indicated that the arrangement should be sharpened. From their perspective, the main challenge is not to create more coordination, but to make the existing coordination more purposeful, actionable and connected to implementation.

Several points from the interviews are especially relevant for refining the selected direction. First, interviewees indicated that simplification should not automatically mean removing consultation layers, because these layers can also provide overview, informal alignment and low-threshold escalation. Their purpose, frequency and agenda should therefore be clarified before they are removed. Second, respondents emphasized that escalation only works when issues are prepared clearly, including the problem, possible options and the required follow-up. This supports the need for escalation triggers, a standard issue format and an issue log. Third, interviewees indicated that workstreams can identify, prepare and escalate issues, but that agreed improvements still need to be anchored in the line organizations of the participating actors.

The interviews also suggested that additional support mechanisms should be used selectively. Some respondents saw value in a shared bottleneck budget or expert support when small financial disputes or specific knowledge gaps block progress. However, respondents also warned that these mechanisms should not become a new permanent layer. They should therefore only be activated when regular workstreams cannot resolve an issue. Similarly, interviewees indicated that the TFCA should not take over regular execution processes. Instead, phase-gate governance could help identify implementation risks earlier, while execution responsibility remains with the formal project organizations.

Finally, the interviews added nuance to the boundaries of the selected direction. Respondents indicated that EVA can strengthen internal municipal alignment, but should not replace formal departmental responsibilities. Provincial and regional arrangements were seen as useful for alignment and knowledge exchange, but not as a replacement for Amsterdam-specific coordination. Better grid use and future energy system planning were also mentioned as relevant, but interviewees indicated that the right actors and governance level are not yet clear. These topics are therefore treated as longer-term exploratory or pilot directions rather than as the core of the immediate redesign.

The stakeholder reflection therefore supports the MCA result, while also defining conditions for the final design. The strengthened TFCA archetype appears to be a suitable direction if it clarifies existing consultation layers, strengthens issue preparation and escalation, connects coordination to implementation risks, uses additional support mechanisms selectively, and experiments with a pilot for smart grid usage. These points are taken forward in Chapter 7.

6.5. Conclusion

This chapter translated the problem definition into a structured design process and answered sub-question 3. The governance tensions from Chapter 5 were translated into design principles, broadened into governance actions through the focus groups and co-creation session, structured in a morphological chart and combined into four governance archetypes.

The MCA and stakeholder reflection indicate that the strengthened TFCA governance arrangement is the most suitable direction. This direction combines the existing collaborative capacity of the TFCA with clearer issue preparation, stronger escalation, better role and mandate clarity, improved shared information and a stronger link to implementation. Elements from other archetypes remain useful as refinements, especially phase-sensitive implementation, clearer municipal integration, selective regional alignment and exploratory attention to better grid use. Chapter 7 translates this selected direction into the final governance design and thereby answers the main research question.

7 | Final Governance Design and Recommendations

This chapter answers the main research question: how can the TFCA governance arrangement be adjusted to better fit the current Amsterdam context and support collaboration, coordination and implementation of long-term grid expansion? Building on the selected governance direction from Chapter 6, the chapter translates the strengthened TFCA governance arrangement into a final governance design, implementation roadmap and set of implementation risks and conditions.

The aim is not to replace the existing TFCA with a new institution. Instead, the proposed design strengthens the current arrangement by making coordination more purposeful, issue preparation more explicit, escalation more actionable and implementation risks visible earlier. Formal responsibilities remain with the participating organizations, while the TFCA governance arrangement is adjusted to better connect collaboration, decision routes, follow-up and implementation-oriented action. The governance actions from the morphological chart linked to this archetype form the basis for this design.

7.1. Proposed Governance Design for TFCA

Figure 7.1 presents the proposed governance design for the TFCA. The figure is based on the governance actions linked to the selected archetype in the morphological chart. These actions are shown in the final design as adjusted consultation layers, clearer issue preparation and escalation mechanisms, shared information structures, phase-sensitive implementation links, activation-based expert resources and a pilot direction for better grid use.

The figure also includes refinements from the evaluation and validation interviews. These interviews indicated that simplification should not automatically mean removing consultation layers, that escalation requires better issue preparation, that workstream outcomes need internal owners, and that implementation actors should be involved selectively when execution risks emerge. The operational and delivery layer should therefore be understood as an interface with the formal project organizations, not as a transfer of execution responsibility to the TFCA.

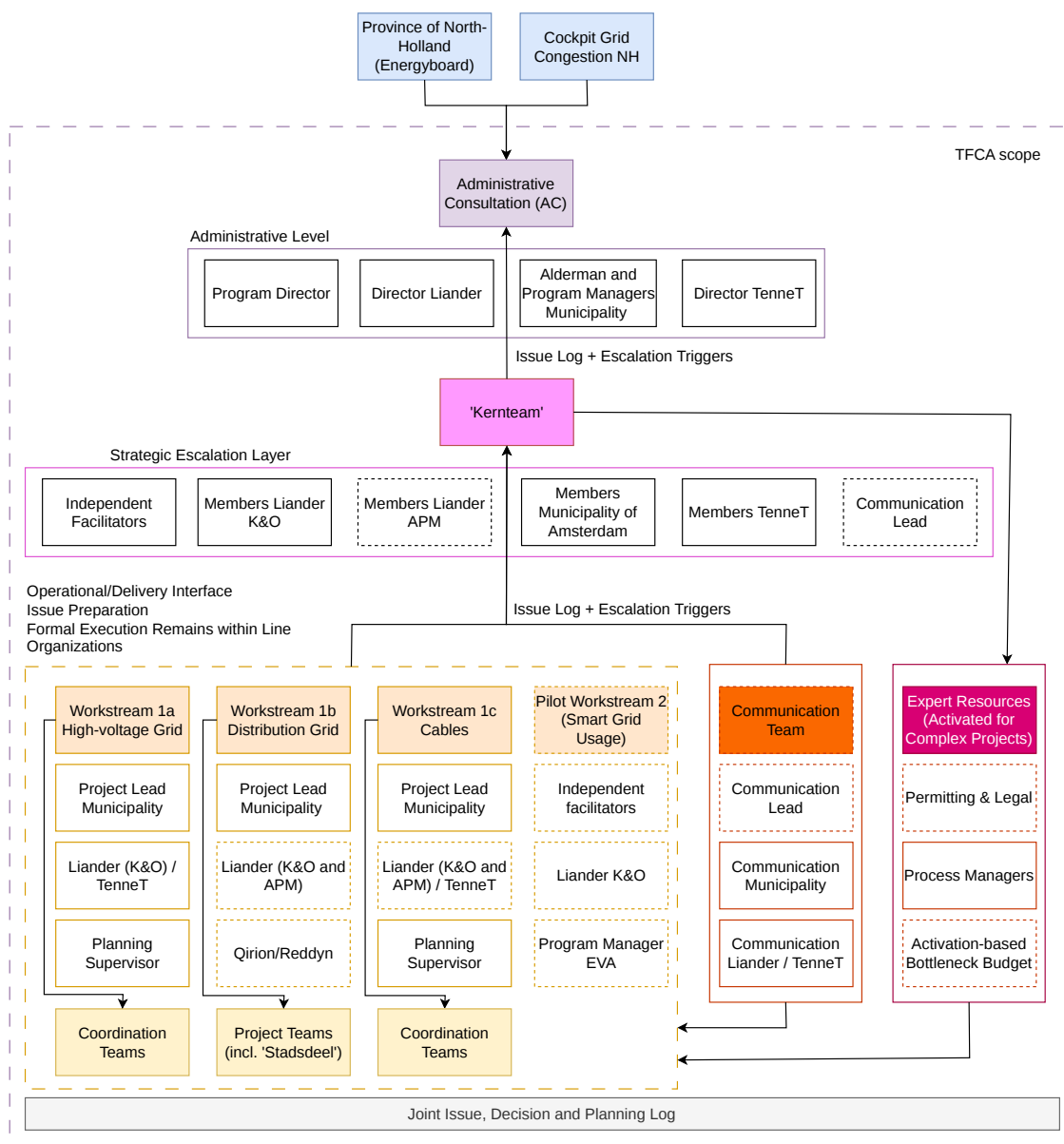


Figure 7.1: Proposed Governance Design for TFCA (own illustration)

The design is also translated into a website where TFCA members can login and see relevant information to them. For example, it consists of an issue log, a planning dashboard and regional knowledge exchange through a governance-self assessment. The concept website can be accessed through <https://governing-grid-congestion.lovable.app>, and more details can be found in Appendix J.

The following sections explain the main design components. For each component, the link to the design principle, the selected governance action and the refinement from the evaluation and validation interviews are made explicit.

7.1.1. Clarified Consultation Layers and Issue Preparation

This component is based on the design principles to link coordination to issue preparation and follow-up, and to create clearer moments for escalation, closure and follow-up. In the selected archetype, this is translated into a stronger role for the KT and program director in preparing issues, monitoring follow-up

and organizing escalation. It is also translated into escalation triggers and a standard issue format.

In the final design, the KT and workstreams are maintained, but their function is made more explicit. They should each have a clearer purpose, frequency and agenda. Issues should not move between layers only because they are difficult, but because they have been prepared in a way that makes follow-up possible. This means that each issue should include a short problem description, possible options, involved actors, required follow-up and the decision route or escalation route that is needed. The OCC is removed to clarify the processes and remove the complexity of the TFCA.

The evaluation and validation interviews sharpened this component. Interviewees indicated that simplification should not automatically mean removing consultation layers, because these layers also provide overview, informal alignment and low-threshold escalation. The design therefore only removes the OCC layer, and clarifies when the other consultations are needed and what they should produce.

7.1.2. Escalation Triggers and Issue Log

This component is also based on the design principle to create clearer moments for escalation, closure and follow-up. The selected governance action is to introduce escalation triggers and a standard issue format. In the final design, this is connected to an issue log that records which issues are open, who owns them, what has already been discussed and what follow-up is required.

The issue log should prevent unresolved issues from circulating between consultation layers without closure. It should not become a separate administrative tool, but should be used as part of the regular agenda of the KT and relevant workstreams. Escalation should be triggered when an issue cannot be solved within the agreed time, when responsibilities remain unclear, or when a decision route outside the workstream is needed.

The validation interviews sharpened this point by showing that escalation only works when issues are prepared clearly. Escalation should therefore be treated as a normal governance function, not as a failure of collaboration. Its purpose is to clarify options, responsibilities and required follow-up when regular coordination is no longer sufficient.

7.1.3. Role and Mandate Clarity through Internal Ownership

This component is based on the design principle to clarify what the TFCA can prepare, coordinate and escalate. In the selected archetype, the related governance action is to use a RACI logic and assign internal owners for agreed TFCA actions.

In the final design, this means that the TFCA can help prepare issues, create overview, organize escalation and monitor follow-up, but it does not take over formal responsibilities from the participating organizations. Each agreed action should therefore have an internal owner within the relevant organization. This owner is responsible for bringing the issue into the internal planning, decision route or project process of that organization.

The evaluation and validation interviews sharpened this component by emphasizing that workstreams can identify, prepare and escalate issues, but cannot carry implementation responsibility alone. Agreed improvements must therefore be anchored within the line organizations of the participating organizations through clear ownership.

7.1.4. Shared Information and Collective Memory

This component is based on the design principle to create shared information and collective memory. In the selected archetype, this was translated into a joint data protocol, decision log and planning dashboard. In the final design, this becomes a joint issue, decision and planning log in the form of a website where you can login as a TFCA member. Appendix J shows examples of the possibilities of this website.

The purpose of this log is to create one shared information basis for the TFCA. It should record current issues, agreements, decision routes, planning information and relevant follow-up. This helps prevent decisions or agreements from being reopened because information is unclear, incomplete or only available within one organization.

The validation interviews sharpened this component by showing that shared information only works

if it is maintained and trusted. The final design therefore requires clear ownership of the log, update routines and agreements on what information can be shared. Each organization remains responsible for the quality of its own input, while the TFCA uses the log to support transparency, follow-up and collective memory. Optionally, an independent website owner could be assigned to regulate the data and input.

7.1.5. Spatial and System Integration

This component is based on the design principle to integrate energy planning with spatial planning earlier. In the selected archetype, the related governance action is to include 10 kV, 50 kV and MSR planning more explicitly and to clarify permitting routes where needed.

In the final design, this is reflected in separate workstreams for high-voltage grid, distribution grid and cables, which is how they were already organized. This distinction is important because these tasks do not follow the same planning and implementation logic. The design therefore avoids treating grid expansion as one uniform governance task. Instead, it creates clearer routes for different types of spatial and technical dependencies.

The evaluation and validation interviews sharpened this component by emphasizing that permitting, legal questions and spatial bottlenecks may require specific support. This is why permitting and legal expertise are included as activation-based expert resources. They are not meant to become a permanent layer, but can be used when regular workstreams cannot resolve a specific spatial or permitting bottleneck.

7.1.6. Phase-sensitive Implementation Interface

This component is based on the design principle to connect governance to project phases and implementation risks. In the selected archetype, the related governance action is to use phase-gate planning with Qirion/Reddyn, APM, contractors and communication actors.

In the final design, the operational and delivery layer is included as an implementation interface. This means that implementation actors are connected to the TFCA when their input is needed, especially when projects move from planning towards execution. Actors such as APM, Qirion/Reddyn, contractors, project teams, environmental managers and communication actors should therefore be involved selectively at phase-gate moments or when specific execution risks emerge.

The validation interviews sharpened this component by emphasizing that the TFCA should not take over regular execution processes. Formal execution responsibility remains with the line organizations and project teams. The role of the TFCA is to identify implementation risks earlier, make them visible in coordination, and help organize follow-up through the responsible organizations.

7.1.7. Communication and Environmental Management

This component is connected to the design principle on implementation feasibility and capacity. In the selected archetype, implementation planning is connected more explicitly to communication actors and project-level risks. In the final design, this is translated into a communication team that connects municipal communication, Liander/TenneT communication and a designated communication lead.

The purpose of this component is to involve communication and environmental management earlier, especially when multiple projects create disruption in the same area. Communication should not only be treated as an activity after decisions are made, but as part of implementation preparation. This is important because residents, businesses and local stakeholders experience the combined effects of construction, spatial claims and temporary disruption.

The evaluation and validation interviews sharpened this point by indicating that communication and environmental management become more important when projects move towards execution. The design therefore links communication to the phase-sensitive implementation interface and to the joint issue, decision and planning log.

7.1.8. Activation-based Expert Resources and Bottleneck Support

This component is based on the design principles to support prioritization without assuming identical interests and to improve governance without adding unnecessary complexity. In the selected archetype,

this is translated into shared prioritization, a bottleneck budget with activation criteria and activation-based expert support.

In the final design, expert resources are positioned outside the regular consultation layers. They can be activated for complex projects or unresolved bottlenecks, for example when legal, permitting, spatial, financial or process-related issues block progress. The same applies to the activation-based bottleneck budget. This budget should not become a general funding instrument, but should be used only when small financial disputes or specific bottlenecks prevent agreed actions from moving forward.

The validation interviews sharpened this component by warning that support mechanisms should not become a new permanent layer. Expert resources and shared budget should therefore be temporary, issue-specific and based on clear activation criteria. Their function is to support the existing arrangement when regular workstreams cannot resolve an issue, not to replace the workstreams.

7.1.9. Municipal Integration through EVA

This component is based on the design principle to clarify roles and mandates and to anchor Amsterdam-specific coordination within organizational dependencies. In the final design, EVA is positioned as a municipal integrator, the same role they currently have. Its role is to help prepare clearer municipal positions before issues enter the TFCA process.

This is important because many bottlenecks in the TFCA are not only inter-organizational, but also internal to the municipality. Spatial planning, permitting, public space, housing and political-administrative priorities may not automatically align. EVA can help connect these municipal perspectives and reduce the risk that unclear municipal positions delay issue preparation in the TFCA.

The validation interviews sharpened this component by emphasizing that EVA should not replace formal departmental responsibilities. Municipal departments remain responsible for their own input, decisions and follow-up. The role of EVA is to support municipal integration, not to become a new decision-making body.

7.1.10. Regional Alignment and Knowledge Exchange

This component is based on the design principle to connect Amsterdam-specific coordination to regional and organizational dependencies. In the selected archetype, the related governance action is to organize regional learning and knowledge sharing between task forces.

In the final design, the Province of North-Holland and the Cockpit Grid Congestion North-Holland are positioned as alignment and knowledge exchange structures. They can help connect Amsterdam-specific coordination to regional dependencies, but they do not replace the Amsterdam-focused role of the TFCA. The design therefore keeps Amsterdam-specific coordination in place, while creating a clearer link to regional and provincial structures where this is useful. The website can also be used for knowledge exchange with the province, as well as other regions. Appendix J shows the possibilities for this knowledge exchange.

This component was sharpened by the evaluation and validation interviews, which indicated that provincial and regional structures are useful for alignment and learning, but should not take over Amsterdam's local coordination challenges.

7.1.11. Pilot Workstream for Better Grid Use

This component is based on the design principle to keep the governance arrangement adaptive without adding unnecessary complexity. Better grid use and smart grid use were discussed as relevant longer-term directions, but not as the core of the immediate redesign.

In the final design, this is therefore included as a pilot workstream. The pilot can explore whether and how better grid use, flexibility, local energy solutions or smart grid use should become part of the TFCA governance arrangement. It should not immediately become a permanent task, because the right actors, mandate and governance level are not yet fully clear.

The validation interviews sharpened this component by indicating that better grid use is relevant, but still institutionally unclear. The pilot should therefore be evaluated separately before a decision is made on whether it should be embedded in the TFCA governance arrangement.

7.2. Implementation Strategy

The roadmap in Figure 7.2 presents the implementation pathway for the proposed governance design. The roadmap distinguishes between three phases: short-term clarification, medium-term connection to implementation, and long-term institutional embedding. This sequence is important because later design components depend on earlier conditions.

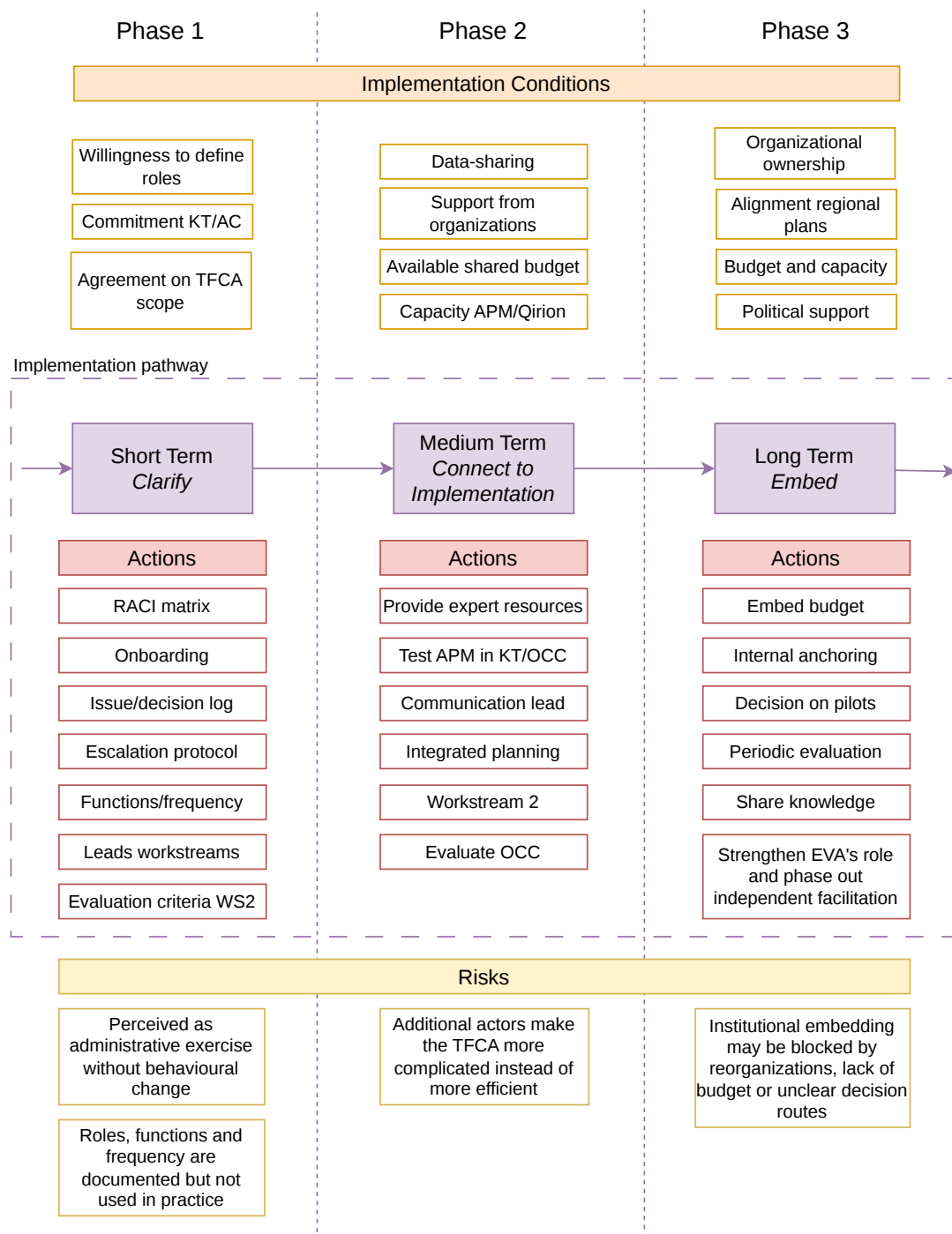


Figure 7.2: Governance Transition Roadmap: From clarification to Institutional Embedding (own illustration)

The implementation roadmap follows the same logic as the proposed governance design. The aim is not to replace the current TFCA governance arrangement at once, but to clarify, test and embed targeted improvements over time. In the short term, the priority is to clarify the function, frequency and ownership of the existing consultation layers and workstreams. This includes appointing clear leads, introducing a RACI matrix, standardizing issue preparation and defining when escalation is required.

In the medium term, the focus shifts towards connecting coordination more explicitly to implementation. This phase tests whether earlier involvement of implementation actors, a communication lead, expert resources, a shared strategic budget and a joint planning tool improve the ability to identify and resolve bottlenecks. The pilot workstream on smart grid use is also positioned in this phase, because its added value and required participants still need to be tested.

In the long term, the emphasis is on embedding the elements that prove useful. This includes strengthening EVA as municipal integrator, phasing out independent facilitation, anchoring responsibilities within the participating organizations, deciding whether expert resources and the shared budget should become structural, and evaluating whether smart grid use should remain within the TFCA scope. The roadmap therefore treats implementation as a learning process: the design is introduced step by step, evaluated in practice and adjusted before being institutionalized.

7.3. Implementation Risks and Conditions

The proposed design strengthens the current TFCA governance arrangement, but its effect depends on how it is implemented in practice. The design does not create a new formal authority and does not transfer execution responsibility to the TFCA. Instead, it relies on clearer roles, sharper issue preparation, better use of existing consultation layers and stronger links to the formal organizations. This also means that the design can only work if the participating organizations use the proposed mechanisms consistently and anchor agreed actions internally.

A first implementation risk is that the design becomes an administrative exercise without changing actual working routines. Instruments such as a RACI matrix, issue log, escalation protocol or decision log can improve clarity, but only if they are actively used in meetings and project preparation. If they are only documented but not applied, the design may add paperwork without making coordination more actionable. A key condition is therefore that the KT and workstreams use these instruments as part of their regular agenda and follow-up process.

A second risk is that issue preparation improves within the TFCA, but that ownership remains unclear once actions have to be implemented. Workstreams can identify, prepare and escalate issues, but they cannot carry implementation responsibility alone. Agreed actions need an owner within the participating organizations, with enough mandate and capacity to follow up internally. The design therefore depends on organizational ownership: each actor should be able to translate TFCA agreements into its own internal planning, decision routes and project processes.

A third risk concerns escalation. Escalation triggers and issue formats can help prevent issues from circulating too long, but they only work when actors are willing to use them. If escalation is seen as conflict or failure, it may still be postponed until problems have already become difficult to solve. Escalation should therefore be treated as a normal governance function: a way to clarify options, responsibilities and required follow-up when regular coordination is no longer sufficient.

A fourth risk is that the implementation interface becomes too broad. The design proposes earlier involvement of actors such as APM, Qirion/Reddyn, contractors, environmental managers and communication actors, but this should not turn the TFCA into an execution organization. Formal project execution should remain with the responsible line organizations and project teams. The condition is therefore that implementation actors are involved selectively, for example at phase-gate moments or when specific execution risks emerge.

A fifth risk is that activation-based support becomes a permanent extra layer. Expert resources, additional process support or a bottleneck budget can help when regular workstreams cannot solve a specific problem, but they should not become a parallel governance arrangement. Their use should be temporary, issue-specific and based on clear activation criteria. Otherwise, the design may increase complexity instead of reducing it.

A sixth risk concerns shared information. A joint issue, decision and planning log can strengthen transparency and collective memory, but only if the information is kept up to date and if actors agree on what can be shared. Without clear ownership of the log, update routines and data-sharing agreements, the tool may become incomplete or outdated. A practical condition is therefore that one actor or support role is made responsible for maintaining the shared information basis, while each organization remains responsible for the quality of its own input.

A seventh risk is that EVA is expected to solve internal municipal fragmentation on its own. The design positions EVA as a municipal integrator that can help prepare clearer municipal positions before issues enter the TFCA. However, EVA cannot replace formal departmental responsibilities or political-administrative decision routes. Its role only works if municipal departments remain responsible for their own input, decisions and follow-up.

Finally, the pilot on decentral solutions and smart grid use should remain clearly bounded. The topic is relevant for the longer-term energy system, but the right actors, mandate and governance level are not yet fully clear. If the pilot becomes part of the core TFCA arrangement too quickly, it may broaden the scope before the current governance issues are solved. The condition is therefore that the pilot is evaluated separately before a decision is made on whether and how it should be embedded.

Overall, the main implementation condition is that the design is used to make the existing TFCA governance arrangement more actionable, not heavier. This requires commitment from the KT and AC, clear internal ownership within the participating organizations, sufficient capacity for issue preparation and follow-up, and periodic evaluation of whether the added mechanisms still serve their intended function.

7.4. Conclusion

This chapter answered the main research question by proposing a strengthened and phase-sensitive TFCA governance arrangement for Amsterdam. The current arrangement should not be replaced, because it provides shared overview, independent facilitation and a structured basis for collaboration. However, it should be adjusted by clarifying the function of consultation layers, strengthening issue preparation and escalation, assigning clearer ownership of follow-up, improving shared information and connecting coordination earlier to implementation risks.

The proposed design fits the Amsterdam context because it keeps Amsterdam-specific coordination in place, while strengthening internal alignment, selective involvement of implementation actors, activation-based expert resources, a joint planning and decision log, and a pilot for smart grid use. Formal responsibilities remain with the participating organizations. The role of the TFCA is therefore not to take over decision-making or execution, but to improve the governance conditions under which collaboration, coordination and long-term grid expansion can become more actionable.

8 | Discussion

This research explored how the TFCA governance arrangement can be adjusted to better fit the current Amsterdam context and support collaboration, coordination and implementation of long-term grid expansion. The study provides insight into both the functioning of the current governance arrangement and possible pathways for improvement. This chapter reflects on the main insights, relates the findings to the literature reviewed in Chapter 2 and practice, discusses the limitations of the research and outlines directions for future research.

8.1. Key Insights

The main insight of this research is that the governance challenge around grid congestion in Amsterdam is not primarily the absence of collaboration. The TFCA governance arrangement already brings together the main organizations involved in grid expansion, including the Municipality of Amsterdam, EVA, Liander, TenneT, and Qirion/Reddyn. The arrangement has contributed to improved communication, stronger networks, more mutual understanding and a shared overview of the grid expansion task. However, the findings also show that collaboration does not automatically lead to clear issue preparation, effective escalation or implementation capacity.

The Amsterdam case illustrates the tension between opening-up and closing-down in infrastructure planning. The TFCA creates space for opening-up by bringing actors together, supporting dialogue and building shared understanding. However, the findings show that opening-up needs to be complemented by mechanisms for closing-down, such as issue preparation, escalation triggers, decision routes and documented closure. Without these mechanisms, collaboration can remain open-ended and unresolved issues may continue to circulate between consultation layers.

This points to a central gap between coordination and implementation. The TFCA governance arrangement can support alignment and issue identification, but it does not have formal decision-making authority. Formal responsibilities remain with the participating organizations and their internal decision-making structures. This creates a recurring tension: actors may expect the TFCA to accelerate or steer decisions, while the arrangement itself can only coordinate, prepare and escalate issues. As a result, bottlenecks can remain unresolved when it is unclear who owns an issue, where a decision route is located, or when escalation is required.

A second important insight is that grid congestion in Amsterdam is not only a technical capacity problem, but also a spatial and institutional problem. The expansion of substations, transformer houses and cable routes requires scarce urban space, while the electricity system is embedded in municipal spatial planning, permitting procedures, political priorities and local resistance. The system analysis and interviews indicate that the physical realization of grid infrastructure depends on coordination between technical planning and spatial decision-making. This means that the effectiveness of governance cannot be assessed only by whether actors collaborate, but also by whether collaboration helps organize spatial choices, implementation capacity and closure of agreed issues.

A third insight is that implementation capacity has to be treated as a governance issue. The interviews, focus groups and co-creation session showed that grid expansion is increasingly moving from location choice towards permitting, detailed design, environmental management, communication and construction preparation. This changes the type of collaboration that is needed. Actors such as Liander APM, Qirion/Reddyn, project teams, contractors, environmental managers and communication specialists become more relevant as projects move towards execution. However, involving these actors too early or too broadly can also make the governance arrangement more complex. The challenge is therefore not simply to add more actors, but to involve the right actors at the right phase and for the right issue.

A fourth insight concerns the internal role of the municipality. Several bottlenecks are not only located between organizations, but also within organizations. This is particularly visible within the municipality,

where energy infrastructure has to be aligned with spatial planning, public space, land development, housing, mobility and permitting. If these perspectives are not aligned before entering the TFCA process, the municipality may not participate with one clear position. This strengthens the importance of EVA as a municipal integrator, not as a new decision-making body, but as a function that helps prepare internal alignment and clarify which municipal department or administrative level is responsible for resolving conflicts.

Finally, the research shows why the final governance design had to strengthen the existing TFCA governance arrangement rather than replace it. The MCA selected the strengthened TFCA governance arrangement as the most suitable direction, because it provided the most balanced response to the problem definition. However, the validation interviews also showed that this direction needed further refinement. Phase-sensitive implementation, activation-based expert resources, municipal integration through EVA, regional alignment and a pilot on better grid use were therefore included as refinements within the selected direction. The final design is not a new hybrid model, but a strengthened and phase-sensitive TFCA governance arrangement that keeps the existing collaborative capacity in place while making coordination more actionable and implementation-oriented.

8.2. Reflection on Literature and Practice

The findings confirm several elements of the collaborative governance framework by Ansell and Gash (2008), while also showing its limits in the context of urgent infrastructure expansion. The framework emphasizes starting conditions, institutional design, facilitative leadership and collaborative processes. These dimensions were all visible in the Amsterdam case. Starting conditions were shaped by strong interdependence, unequal resources, different institutional positions and varying levels of trust. Institutional design mattered because unclear roles, mandates and escalation routes affected the ability to move from discussion to issue preparation and follow-up. Facilitative leadership was important because independent facilitators helped structure collaboration, maintain overview and support escalation. The collaborative process improved communication, mutual understanding and shared problem recognition.

However, the findings also nuance the idea that stronger collaboration automatically produces better outcomes. In the Amsterdam case, the TFCA governance arrangement improved the conditions for collaboration, but did not remove the structural constraints that shape implementation. Spatial scarcity, permitting procedures, workforce shortages, material constraints and internal organizational fragmentation continued to determine the pace of grid expansion. This suggests that collaborative governance should not be understood as a complete solution to governing grid congestion, since it does not automatically results in achieved milestones.

The research also contributes to multi-level governance literature. Grid congestion in Amsterdam is shaped by dependencies between local, regional, provincial and national levels. National regulation determines important rules for grid access and congestion management, grid operators operate within regulated investment frameworks, the province supports regional alignment and energy system planning, and the municipality controls crucial spatial and permitting conditions. The TFCA operates close to the implementation problem, but does not control all relevant decision-making arenas. This shows that grid congestion governance is both horizontal and vertical: actors have to coordinate across organizations, but also across governance levels with different mandates, time horizons and responsibilities. This means that in the case of governing grid congestion in Amsterdam, both type I and type II governance are needed.

The findings further support literature on the interaction between energy planning and spatial planning. The Amsterdam case illustrates how technical grid requirements and local spatial processes are increasingly forced to interact. Grid operators need space for infrastructure, while municipalities have to balance this with housing, mobility, public space, green space and local participation. This creates a tension between technical system logic and urban planning logic. The research shows that this tension cannot be resolved only through better technical planning. It requires governance arrangements that make spatial trade-offs visible, clarify decision routes and help close discussions when decisions are needed.

The tension between opening up and closing down is also relevant. Infrastructure planning requires the inclusion of multiple perspectives, especially because grid expansion affects public space, residents and other urban functions. At the same time, the research shows that collaboration can become

ineffective when discussions remain open for too long, agreements are repeatedly reopened, or escalation is avoided. A key governance challenge is therefore to organize both inclusion and closure: actors need space to exchange perspectives and identify risks, but there must also be moments where issues are prepared, decision routes are activated and agreements are documented.

From a governance design perspective, this thesis adds insight into how an existing collaborative governance arrangement can be adjusted when collaboration is already present but insufficiently connected to implementation. The design does not focus on creating a completely new institution, but on adjusting rules, roles, routines, escalation routes, interfaces and implementation pathways within and around the existing TFCA governance arrangement. This is important because many governance problems in practice are not caused by the absence of platforms, but by unclear functions, weak ownership, unclear mandate boundaries and insufficient connection between coordination and delivery.

8.3. Limitations

Several limitations influence the interpretation of the results. These limitations are analytical, empirical, design-related and contextual.

8.3.1. Analytical Limitations

The system analysis conducted in this research is based on a conceptual interpretation of Amsterdam's electricity system and governance arrangement. The system analysis provides a useful overview of actors, relationships and feedback mechanisms, but it inevitably simplifies reality. Certain dependencies or feedback loops may have been overlooked, especially given the complexity of the socio-technical system. In addition, the system analysis is tailored to the Amsterdam context and cannot be directly transferred to other regions without adaptation.

The integration of **multiple data sources** also required interpretative choices. Interviews, survey results, focus groups, co-creation outcomes and policy documents were combined to identify bottlenecks, leverage points and governance actions. Although triangulation strengthens the robustness of the findings, it does not remove researcher interpretation. The way themes were selected, grouped and translated into design principles may have influenced the final design.

The multi-criteria analysis has similar limitations. The criteria and weights were informed by the problem definition, literature and empirical findings, but the scoring remained a structured judgment by the researcher. Alternative weights or interpretations could lead to different rankings of the archetypes. The MCA should therefore be interpreted as a comparative and reflective tool, not as an objective calculation of the best governance model. Its value lies in making trade-offs visible rather than producing a definitive answer.

8.3.2. Empirical Limitations

The empirical data collection provided valuable insight into stakeholder perceptions, but it also has limitations. **The interviews** were conducted in different phases and served different purposes, including exploration, system and futuring, exploratory regional reflection, and evaluation and validation. As a result, different interview guides were used. This was appropriate for the iterative research design, but it limits direct comparability between interviews using the coding structure in ATLAS.ti. The course of each interview was also partly person-dependent, as semi-structured interviews allow respondents to emphasize topics they consider most important.

The number of interviews outside Amsterdam was limited. This means that the exploratory regional reflections should not be interpreted as a full comparative case study. The reflections on Rotterdam, Holland-Rijnland and North-Holland helped identify alternative governance logic and contextual differences, but the number and diversity of respondents were not sufficient to draw strong conclusions about all regional governance arrangements.

Within Amsterdam, **the respondent group** was also not fully balanced. The research included many perspectives from public actors, grid operators and actors close to the TFCA governance arrangement, but fewer perspectives from market parties, industry, residents or local communities. In addition, there was only one full interview with Liander in one part of the research process. This may have limited the depth of insight into Liander's internal perspectives, especially given Liander's central role in distribution

grid expansion. This limitation was partly mitigated by supplementary informal input from Liander during the final design phase. However, because this input was not collected through a full semi-structured interview and was not included in the coding process, it should be interpreted as additional practical validation rather than as equivalent empirical interview data.

The survey was designed as an exploratory instrument to identify patterns in stakeholder perceptions. It was not intended to produce statistically representative results. The sample was purposively selected, and the survey included many open questions. This allowed respondents to provide nuance, but also required qualitative interpretation. In addition, it was not always possible to know precisely who the respondents were or what their exact role within their organization was. This limits the extent to which differences between organizational levels or functions can be interpreted.

The coding process in ATLAS.ti also depended on researcher interpretation. Although a structured coding framework was used, decisions about how statements were categorized, which themes were emphasized and how patterns were interpreted could have been made differently by another researcher. This is especially relevant because the research combines stakeholder perceptions with the researcher's own synthesis into design principles and governance archetypes.

Finally, **the role of the researcher** and the connection to AEF may have influenced both access and interpretation. The professional network helped create access to relevant stakeholders and practical knowledge, but it may also have shaped which actors were reached and how certain issues were interpreted. This does not invalidate the findings, but it should be acknowledged as part of the research context.

8.3.3. Design and Methodological Limitations

This research follows a design-oriented approach. The aim was not only to analyze the current governance system, but also to develop and evaluate possible governance improvements. This means that the final governance design is conceptual and stakeholder-informed, but **not yet implemented in practice**. Its effectiveness in improving issue preparation, escalation, implementation readiness or lead times therefore remains uncertain.

The development of the morphological chart, archetypes, MCA and final governance design was based on the researcher's synthesis of empirical and theoretical insights. Although the design process was informed by interviews, focus groups, a co-creation session and validation interviews, it remains **interpretative**. Different combinations of design options could have resulted in different archetypes or another final design.

The focus groups and co-creation session also have limitations. **Group dynamics** may have influenced the outcomes, as more vocal participants may have shaped the discussion more strongly than quieter participants. The sessions were limited in time, which constrained the depth of exploration. In particular, better grid use, decentralized solutions and the future energy system were not substantially discussed during the co-creation session. This means that the smart grid use component in the final design should be treated as exploratory and boundary-testing rather than as a strongly validated design element.

The transition from analysis to design was iterative rather than strictly linear. This fits the design-oriented nature of the research, but it also means that **not every design choice can be traced back to one single data point**. The final design should therefore be interpreted as a reasoned synthesis of multiple sources, not as a direct output of one method.

8.3.4. Contextual Limitations

The research is strongly embedded in the Amsterdam context. Amsterdam is characterized by high urban density, severe spatial scarcity, large electricity demand growth and a complex municipal organization. These conditions shape both the problem and the feasibility of possible solutions. As a result, **the proposed governance design cannot be transferred** directly to regions with different spatial, institutional or organizational conditions.

Grid congestion is also a **rapidly changing policy field**. New national policies, regulatory changes, investment plans, prioritization frameworks and technological developments may alter the relevance of certain findings. The governance arrangements analyzed in this research therefore represent a

snapshot in time. This is especially relevant because several developments around grid congestion, smart grid use, congestion management and infrastructure planning are still evolving.

Finally, several implementation constraints operate partly **outside the scope** of the TFCA governance arrangement. Workforce shortages, material scarcity, permitting rules, legal procedures, political decisions and national regulation can all limit implementation speed. Even if the governance design improves coordination, it cannot fully resolve these external constraints. The design should therefore be understood as improving the conditions for acceleration, not as guaranteeing faster grid expansion.

8.4. Transferability

The proposed governance design is developed for Amsterdam and should not be interpreted as a universal model for grid congestion governance. The exact TFCA governance arrangement, including its consultation layers, workstreams and independent facilitation, is specific to Amsterdam. It reflects the city's scale, spatial complexity, institutional fragmentation and urgency of the grid expansion task.

However, the governance logic behind the design may be transferable. Other regions facing grid congestion may also benefit from clearer roles and responsibilities, time-bound escalation, stronger issue ownership, integrated planning, earlier involvement of implementation actors and better links between technical and spatial decision-making. These principles are not unique to Amsterdam, but they need to be translated into forms that fit the local context.

This means that the contribution of this research lies mainly in transferable design principles rather than in the exact organizational form. The core logic is that collaborative governance arrangements should not only bring actors together, but should also organize clear decision routes, implementation readiness, issue ownership and adaptive coordination across project phases. In Amsterdam this leads to a strengthened and phase-sensitive TFCA governance arrangement. In other regions, the same logic could result in a smaller project-based taskforce, a municipal steering group, a regional support team or another form of coordination.

8.5. Future Research

Several directions for future research follow from this study. First, the proposed governance design should be tested in practice. Future research could evaluate whether the clarified roles, escalation routes, issue log, joint issue, decision and planning log, expert resources and communication function actually improve coordination and implementation readiness. This could be done through a pilot implementation within the TFCA governance arrangement or through monitoring specific projects before and after the introduction of the new arrangement. A planned follow-up session with members of the OCC could provide an opportunity to test and further specify these instruments in practice.

Second, future research could study whether the involvement of implementation actors such as Liander APM, Qirion/Reddyn, contractors and environmental managers improves the transition from location choice to execution. This is particularly relevant because the proposed design suggests involving these actors selectively at phase-gate moments. Empirical research could examine whether this reduces delays, improves planning accuracy or helps identify implementation risks earlier.

Third, the governance of shared budgets or common pots for infrastructure bottlenecks deserves further research. The validation interviews suggested that relatively small financial disagreements can block progress even when actors agree that action is needed. Future research could explore how such a budget should be funded, governed, activated and evaluated, and how it can be designed without replacing regular project financing.

Fourth, further research is needed on better grid use, smart grid use, flexibility, decentralized solutions and the future energy system. Since this topic was not substantially elaborated during the co-creation session, it remains unclear whether it belongs within the TFCA, within EVA, within provincial structures, or within another governance arena. A pilot workstream could help identify which actors are needed, what governance questions arise and whether better grid use should become part of the TFCA scope.

Fifth, future research could turn the exploratory regional reflections into a more systematic comparative study. This study used Rotterdam, Holland-Rijnland and North-Holland as reflective cases, but a

broader comparison with more regions and more respondents could strengthen understanding of how governance arrangements differ across contexts. This could include regions with similar urban density, port areas, industrial clusters or rapidly growing housing demand. Including actors from national government and ministries would also help better understand the vertical multi-level governance dynamics that influence local implementation.

Sixth, more research is needed on internal municipal organization around electricity infrastructure. The Amsterdam case suggests that internal municipal fragmentation can be a major bottleneck. Future research could examine how municipalities organize energy-spatial integration, how internal mandate holders are appointed, and how departments such as spatial planning, land development, public space, housing and permitting can be aligned around electricity infrastructure.

Finally, future research could develop and test practical governance instruments. This includes a detailed RACI document, a clear overview of which meetings take place when and with whom, an escalation protocol, an onboarding and training program for new participants, and a joint issue, decision and planning log. These instruments could be developed together with TFCA participants and then evaluated in practice. Such research would help move from governance design as a conceptual model towards governance design as an implemented and learning-oriented practice.

8.6. Concluding Reflection

This chapter reflected on the meaning, limitations and wider relevance of the findings. It showed that collaborative governance helps explain the value of the TFCA, but also its limits: collaboration can create shared understanding, but does not automatically lead to issue preparation, escalation, ownership or implementation readiness. The discussion also showed that the proposed design should be interpreted carefully, because it is stakeholder-informed and theoretically grounded, but not yet implemented in practice. Its effectiveness therefore depends on organizational commitment, internal ownership and the willingness of actors to use the proposed instruments. The transferability of the design lies mainly in its governance logic rather than its exact organizational form, and future research should therefore test the design in practice, study the involvement of implementation actors and further explore the governance of better grid use. These insights lead to the final conclusion of this thesis.

9 | Conclusion

This research examined how the Taskforce Congestion Amsterdam (TFCA) governance arrangement can be adjusted to better fit the current Amsterdam context and support collaboration, coordination and implementation of long-term grid expansion. Grid congestion in Amsterdam is not only a technical capacity problem, but also a spatial, institutional and governance challenge. Therefore, this thesis combined system analysis, stakeholder analysis, survey results, interviews, exploratory regional reflections and design-oriented methods to understand the current governance arrangement and develop a context-sensitive governance design.

9.1. Answer to the Research Questions

The main research question of this thesis was:

How can the Taskforce Congestion Amsterdam (TFCA) governance arrangement be adjusted to better fit the current Amsterdam context and support collaboration, coordination and implementation of long-term grid expansion?

The findings show that the TFCA governance arrangement can be adjusted by strengthening the existing governance arrangement rather than replacing it. The TFCA already contributes to coordination, alignment and shared understanding between the participating organizations. However, the research also shows that collaboration does not automatically translate into issue preparation, escalation, follow-up or implementation. The main governance challenge is therefore not the absence of collaboration, but the limited ability of the current arrangement to connect coordination to clear decision routes, issue ownership and implementation capacity.

The proposed governance design responds to this challenge through a strengthened and phase-sensitive TFCA governance arrangement. This arrangement keeps the existing TFCA layers largely in place, including the AC, KT and the workstreams, but clarifies their function, frequency, leadership and escalation role. Each layer and workstream should have a clear lead. The TFCA governance arrangement should not take over formal decision-making authority or implementation responsibility from the participating organizations. Instead, it should clarify where decisions must be made, who owns follow-up, and when escalation is required.

The design further strengthens the link to implementation by involving actors such as Liander APM, Qirion/Reddyn, project teams, environmental managers and communication actors more selectively and earlier in the process. EVA is positioned as a municipal integrator, helping the municipality align spatial planning, public space, permitting and energy interests before issues enter the TFCA process. The design also introduces a joint issue, decision and planning log to create one shared overview of project status, dependencies, decisions and unresolved issues. For complex bottlenecks, flexible expert resources can be activated, including additional process support and an activation-based bottleneck budget. Finally, a pilot workstream on better grid use and smart grid use is included to explore whether the TFCA governance arrangement can contribute to better grid use, decentralized solutions and the future energy system.

In short, the TFCA governance arrangement can be improved by making the existing arrangement more explicit, phase-sensitive and implementation-oriented, while keeping formal responsibilities with the participating organizations.

9.1.1. Sub-question 1: How do the technical, social, and institutional variables of the Amsterdam electricity system interact and influence the pace of grid expansion?

The system analysis shows that the pace of grid expansion in Amsterdam is influenced by a combination of technical, social and institutional variables. Technically, electricity demand is increasing due to electrification, housing development, mobility, heat transition and economic activity. This increases pressure on the electricity grid and requires the construction of new substations, transformer houses and cable routes. However, these technical requirements depend on spatial and institutional conditions.

The social and spatial context of Amsterdam strongly affects implementation. New electricity infrastructure requires scarce urban space and can conflict with housing, public space, mobility, green space and local preferences. As a result, grid expansion is not only dependent on technical planning by grid operators, but also on municipal spatial planning, permitting and political-administrative prioritization.

Institutionally, the system is characterized by interdependence between actors. Grid operators are responsible for the physical grid, but depend on public authorities for spatial integration, permits and policy alignment. The municipality has control over crucial spatial conditions, but depends on grid operators for technical knowledge and investment planning. The system analysis therefore shows that grid expansion is slowed down when technical planning, spatial decision-making and institutional coordination are not sufficiently aligned.

9.1.2. Sub-question 2: How do stakeholders perceive and evaluate the current TFCA governance arrangement and collaboration processes in addressing grid expansion in Amsterdam?

The survey, interviews and qualitative coding show that stakeholders generally value the TFCA governance arrangement as a platform for collaboration, alignment and mutual understanding. The TFCA has improved communication between the municipality, grid operators and other involved actors, and has helped create a shared overview of the grid expansion task.

At the same time, stakeholders also identify several bottlenecks. The survey and interviews indicate uncertainty about roles, responsibilities, mandate and escalation. Respondents pointed to unclear decision routes, weak issue ownership, fragmented responsibilities and repeated discussions. The interviews also show that expectations of the TFCA sometimes differ from its formal role. While some actors expect the arrangement to accelerate or steer decisions, the TFCA itself does not have formal decision-making authority.

Stakeholders also emphasized that bottlenecks are not only located between organizations, but also within organizations. Internal municipal fragmentation was identified as an important constraint, because grid expansion requires alignment between energy, spatial planning, public space, housing and permitting. In addition, the findings show that the transition from location choice towards execution creates new coordination needs, especially around implementation capacity, environmental management, communication and contractor involvement.

9.1.3. Sub-question 3: Which governance design principles and governance actions can be combined to strengthen the TFCA governance arrangement?

The design phase translated the problem definition into design principles, governance actions and four governance archetypes. The main design principles were to link coordination to issue preparation and follow-up, create clearer moments for escalation and closure, clarify roles and mandate boundaries, support prioritization, connect energy and spatial planning earlier, strengthen the implementation interface, anchor Amsterdam-specific coordination across organizations and levels, improve shared information and avoid unnecessary complexity.

The morphological chart structured the possible governance actions per design principle. The MCA then compared four governance archetypes and selected the strengthened TFCA governance arrangement as the most suitable direction. This archetype was selected because it keeps the existing collaborative capacity of the TFCA, while improving issue preparation, escalation, role clarity, shared information and the connection to implementation.

The final design therefore builds on this selected archetype. Elements such as phase-sensitive implementation, EVA as municipal integrator, activation-based expert resources, regional alignment and a pilot workstream on better grid use are used as refinements within the selected direction. The result is not a full institutional redesign, but a strengthened and phase-sensitive TFCA governance arrangement that better fits the Amsterdam context.

9.2. Main Contribution

This thesis contributes to both academic understanding and governance practice.

The scientific contribution lies in showing that collaborative governance is useful for coordination, trust-building and shared understanding, but is not sufficient when decision routes, mandate boundaries, escalation and implementation capacity remain unclear. The TFCA case shows that the main challenge in an existing collaborative governance arrangement is not always how to bring actors together, but how to ensure that collaboration leads to ownership, issue preparation and implementation readiness. This adds to collaborative governance literature by focusing on the adjustment of an existing arrangement rather than the creation of a new collaboration platform.

The research also connects collaborative governance, multi-level governance and governance design in the context of grid congestion. The Amsterdam case shows how grid expansion is shaped by both horizontal interdependencies between organizations and vertical dependencies between local, regional, provincial and national governance levels. By translating these insights into design principles, archetypes and a final governance design, the thesis shows how governance design can be used to develop practical interventions such as clearer roles, escalation routes, issue logs, phase-gate moments and expert resources.

The practical contribution is a concrete governance design and implementation roadmap for the Amsterdam TFCA context. The design provides practical directions for clarifying existing consultation layers, appointing leads, involving implementation actors at the right moment, strengthening EVA as municipal integrator, developing a joint issue, decision and planning log, activating expert resources for complex bottlenecks, and testing a pilot workstream on better grid use. These elements are intended to improve the governance conditions for long-term grid expansion, while recognizing that the TFCA cannot solve all technical, spatial or capacity constraints on its own.

9.3. Final Reflection

The conclusion of this research is that governance for grid congestion is not only about bringing actors together. In Amsterdam, the TFCA governance arrangement already provides an important platform for collaboration, but collaboration alone does not guarantee timely decision routes or implementation. The key challenge is to organize the conditions under which collaboration can become actionable: clear roles, issue ownership, shared information, escalation, decision routes, closure and implementation readiness.

The proposed governance design does not solve grid congestion by itself. Spatial scarcity, permitting procedures, workforce shortages, material constraints and political-administrative choices remain important constraints. However, the design can improve the way actors coordinate around these constraints. By strengthening the connection between collaboration, decision routes and implementation phases, the TFCA governance arrangement can better support long-term grid expansion in Amsterdam. In this sense, the proposed design does not reduce collaboration, but makes it more purposeful. It keeps the opening-up function of the TFCA, while strengthening the closing-down mechanisms needed for escalation, follow-up and implementation readiness.

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A | Method Flowchart

In this appendix, a readable version of the method flowchart is shown in Figure A.1.

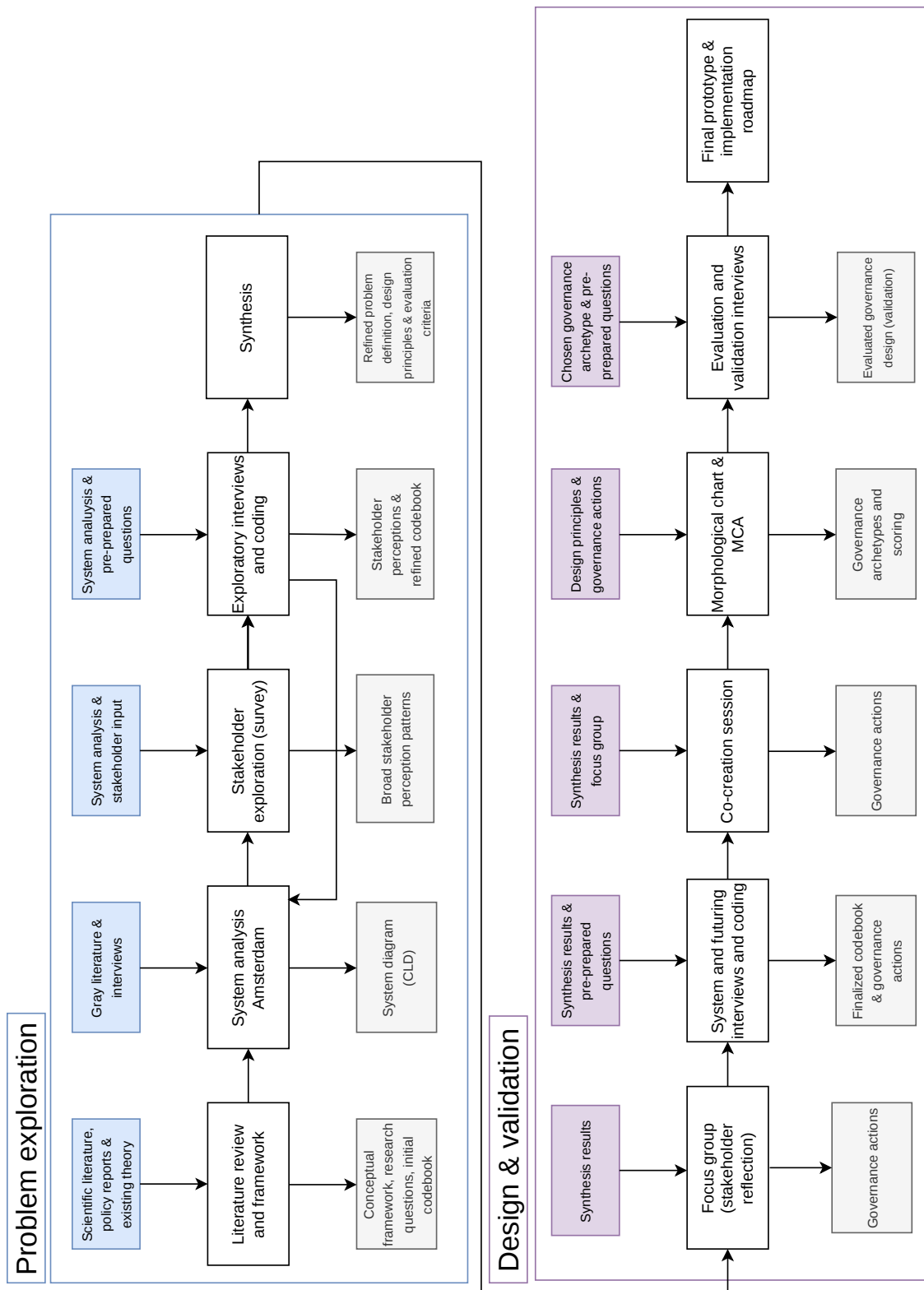


Figure A.1: Readable Method Flowchart (Own Illustration)

B | Context of Grid Congestion in the Netherlands

This appendix provides background information that supports the system analysis in Chapter 4. It includes additional context on the development of grid congestion in the Netherlands, existing intervention strategies, the development of congestion in Amsterdam, the full list of variables used for the CLD, and readable versions of the CLD. The appendix is not intended as a separate analysis, but as supporting material for the main argument in Chapter 4.

B.1. Development of Grid Congestion in the Netherlands

At the end of November 2019, the Dutch Parliament addressed grid congestion for the first time. In addition to the congestion on the demand side, there is also congestion on the feed-in side. In several rural areas, there was insufficient capacity to connect new solar fields and wind turbines, even though these projects were supported by government subsidies. For the first time, regional grid operators were forced to say ‘no’ to new connection requests (Tiekstra, 2024). Now, seven years later, grid congestion has become a far more urgent and structural problem. Waiting lists already exist for both electricity demand and feed-in to the grid, as shown in Figures B.1 and B.2. The blue bars represent the total number of unique applications, while the orange line indicates the corresponding electricity volume in megawatts (Landelijk Actieprogramma Netcongestie, 2025). In Figures B.3 and B.4, the spatial visualization of this problem is shown. These waiting lists are expected to grow further, since expanding grid infrastructure typically takes several years. This not only raises questions about the pace and organization of grid expansion, but also about how efficiently we are using the capacity that is currently available.

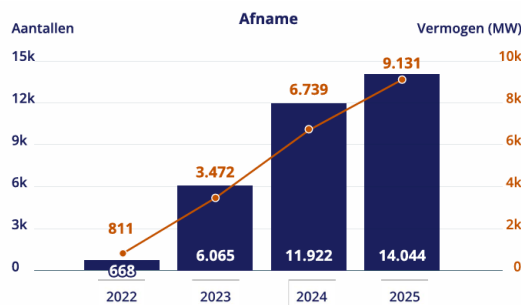


Figure B.1: Waiting list Demand (Landelijk Actieprogramma Netcongestie, 2025)

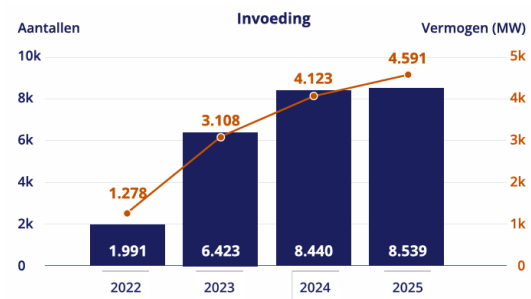


Figure B.2: Waiting list Feed-in (Landelijk Actieprogramma Netcongestie, 2025)

Besides the main drivers mentioned in Chapter 4, there are several other drivers behind the rapid growth in both electricity demand and feed-in. Over the past few years, the Netherlands has invested heavily in wind and solar energy. This strong expansion of renewable generation supports national sustainability targets, but it also introduces new challenges. Wind turbines and solar parks are often located in rural areas, where local electricity demand is relatively low. In addition, their output depends on weather conditions, which makes the feed-in of renewable energy variable and less predictable. As a result, the grid infrastructure can become overloaded, especially when production peaks do not align with local demand (Eneco, 2025).

At the same time, electricity demand is increasing due to electrification. Because many people follow similar daily routines, demand tends to concentrate at specific moments. For example, when people return home from work, plug in their electric vehicle, and start cooking on an induction stove, peak loads

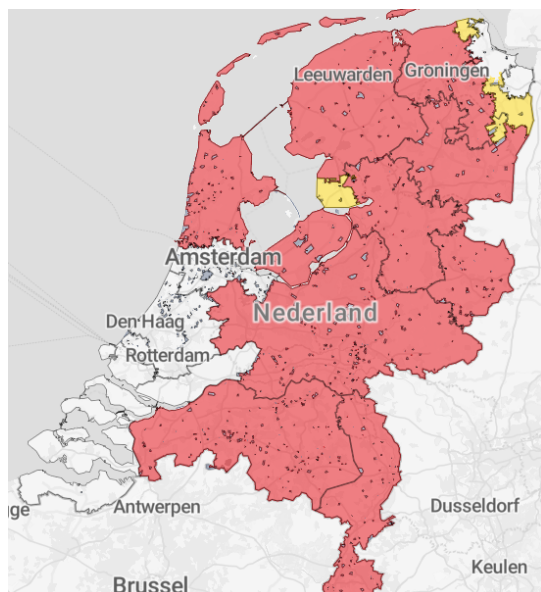


Figure B.3: Capacity Map Electricity Feed-in National High-Voltage Grid (Netbeheer Nederland, 2025)

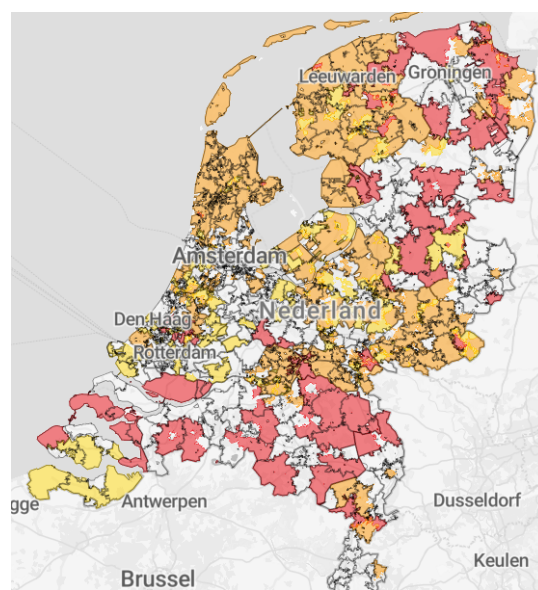


Figure B.4: Capacity Map Electricity Feed-in Regional Distribution Grid (Netbeheer Nederland, 2025)



Figure B.5: Legend Capacity Maps (Netbeheer Nederland, 2025)

can arise (Eneco, 2025). The existing grid infrastructure was not designed for this level of decentralized consumption, nor for large-scale decentralized feed-in from wind turbines, solar parks, and rooftop solar installations—especially when significant peak moments occur on both the feed-in and demand side (Eneco, 2025).

Lastly, a relatively recent development has further increased electricity consumption: data centers. There are currently around 200 data centers in the Netherlands, together consuming as much electricity as approximately 2,000,000 households. Moreover, the total electricity use of data centers has increased by 37% compared to 2021. This growth is mainly driven by large-scale facilities operated by cloud providers and major technology companies (Hendriksma, 2025).

B.2. Existing Interventions

Now that the development of grid congestion has been described, the main types of interventions can be discussed. This appendix focuses on interventions that relate directly to grid capacity and grid use: grid expansion, grid optimization and electricity storage. Policy and regulatory instruments are discussed in more detail in Appendix C, because they are part of the broader institutional environment.

B.2.1. Grid Expansion

Grid expansion focuses on physically increasing grid capacity. This includes the construction of new substations, transformer houses and cables, as well as the reinforcement or replacement of existing infrastructure. Existing cables can, for example, be replaced by cables with a larger cross-section, transformer stations can be expanded with additional transformers, and in some cases entirely new connections are needed to serve areas with high demand or to connect new energy sources (INNSO, 2025). Both regional and national grid operators are involved in this process.

Compared to capacity optimization, grid expansion requires long-term investment planning and close alignment with spatial planning processes. It therefore involves different actor constellations and governance challenges than short-term optimization mechanisms (Klijn et al., 2016). Expansion projects depend not only on technical design, but also on land allocation, permitting, spatial integration, construction capacity and coordination between grid operators, municipalities and other involved actors. This makes

grid expansion especially relevant for this thesis, because it directly connects technical infrastructure needs to governance and spatial decision-making.

B.2.2. Grid Optimization

Grid optimization focuses on making better use of the existing grid. These interventions include congestion management mechanisms, tariff reforms, technical adjustments, congestion management contracts and, in some cases, real-time control of electricity use (Landelijk Actieprogramma Netcongestie, 2025; Planbureau voor de Leefomgeving, 2023). Their main aim is to optimize and redistribute available capacity within the current network configuration. This can provide short-term relief while larger grid expansion projects are being prepared or implemented (INNSO, 2025).

Grid optimization often depends on real-time data and flexible demand response. For example, large consumers can be asked to temporarily reduce their consumption when the grid is under heavy load, while charging stations for electric vehicles can be managed through smart charging. AI-based systems can also help recognize patterns and predict where congestion may occur (INNSO, 2025). In this way, flexibility can help prevent peak demand from exceeding available grid capacity.

Optimization can also be linked to decentralized energy developments. By coordinating electricity demand and feed-in across time and space, less electricity may need to be transported over longer distances, which can reduce pressure on the grid. If this also reduces peak loads, it may decrease the need for some grid investments. TNO estimates that decentralized developments could lead to savings of 4.5 to 24.5 billion euros in electricity grid investments between 2025 and 2040 (Westerga et al., 2025). This does not replace the need for structural grid expansion, but it shows why better use of the existing grid is increasingly discussed as a complementary intervention.

B.2.3. Electricity Storage

Electricity storage is another way to manage congestion and balance electricity supply and demand. Batteries can store electricity when there is excess capacity and release it during peak hours (INNSO, 2025). Large battery systems near substations can therefore help alleviate local congestion, especially when peak demand or renewable feed-in creates temporary pressure on the grid.

However, storage should also be seen as a complementary intervention. It can reduce local or temporary congestion, but it does not remove the need for long-term grid expansion in areas where electricity demand continues to grow. For this reason, storage is relevant to the broader discussion on better use of the grid, but it is not the main focus of the governance design developed in this thesis.

B.3. Variables used for the CLD

The full set of variables used to construct the CLD is provided in Table B.1.

B.4. Full Causal Loop Diagram (CLD)

In this section, readable versions of the CLD are shown in Figures B.6 and B.7.

B.4.1. Explanation of feedback loops in the CLD

The CLD visualizes several hypothesized feedback loops that shape grid congestion governance in Amsterdam. These loops should not be interpreted as quantified causal relationships, but as conceptual mechanisms that help explain how technical, spatial and governance-related variables interact over time. The purpose of the diagram is therefore to support system understanding and to identify possible leverage points for governance redesign.

First, the diagram shows a *demand-growth and congestion loop*. Population growth, digitization, electrification of houses, industrial electrification, heat pumps and electric vehicles increase electricity demand. When this demand grows faster than available grid capacity, grid congestion increases and waiting lists become longer. This creates societal costs and political pressure to accelerate grid expansion. In principle, new grid infrastructure can increase available grid capacity and reduce congestion. However, because grid expansion is delayed by spatial, procedural, material and organizational constraints, this balancing effect only materializes over time.

Category	System components / factors	Relevance for the system analysis
External factors	Availability of technical employees; availability of critical materials; spatial planning governance and decision-making; intermittent renewable supply; digitization; population growth in Amsterdam; national electrification rate; fuel and gas market prices; electricity market prices.	These factors are largely outside the direct scope of the TFCA governance arrangement, but influence the pace, feasibility and urgency of grid expansion. They shape the broader context in which local and regional governance takes place.
Technical components	Available grid capacity; grid congestion; flexible use of electricity; number of stations and transformer houses; amount of cables; construction of new infrastructure.	These components describe the physical electricity system and determine whether demand can be accommodated. They also create dependencies between technical planning, spatial integration and implementation capacity.
Social and economic components	Industrial electrification; data centers; number of electric vehicles; electrification of housing; heat pumps; waiting lists; available space in Amsterdam; decision-making time; stakeholder collaboration; electricity demand; environmental disturbance; land allocation; societal resistance; political pressure.	These components explain how electricity demand, urban development and societal pressures interact with grid expansion. They show why congestion affects broader spatial, economic and political priorities.
Institutional components	Data center policy Amsterdam; national climate goals; Transitievisie Warmte; ACM regulation; congestion management contracts; TFCA governance arrangement; Development Perspective Amsterdam; Protocol Ruimtelijke Inpassing.	These components shape the formal and informal rules, policies and governance arrangements through which actors coordinate grid expansion. They influence mandates, responsibilities, prioritization and decision-making processes.

Table B.1: Overview of system components and external factors included in the system analysis

Second, the diagram includes an *implementation-delay loop*. Grid congestion and waiting lists increase the urgency to construct new infrastructure, such as cables, transformer houses and substations. However, construction requires land allocation, sufficient space in Amsterdam, technical employees, materials, permits and coordination between multiple actors. Environmental disturbance and societal resistance can further slow down decision-making and implementation. As a result, delays in construction limit the increase in available grid capacity, which can cause congestion and waiting lists to persist.

Third, the diagram visualizes a *spatial scarcity and land allocation loop*. Amsterdam's dense urban context creates competition for scarce space between electricity infrastructure, housing, mobility, public space and other urban functions. Limited space makes land allocation for grid infrastructure more difficult, which can slow down the construction of new infrastructure. This reduces the speed at which available grid capacity can be increased. Continued congestion then increases political and societal pressure to find locations for infrastructure, reinforcing the importance of spatial decision-making in grid congestion governance.

Fourth, the diagram includes a *governance coordination loop*. The TFCA governance arrangement can support stakeholder collaboration, integrated planning and information alignment. These mechanisms can help clarify issue ownership, identify bottlenecks earlier and create clearer escalation routes. In turn, this may improve the speed and quality of decision-making and strengthen the connection between coordination and implementation. However, this loop should be interpreted carefully: the TFCA does not directly reduce grid congestion, but may improve the governance conditions under which congestion-related bottlenecks can be addressed.

Fifth, the diagram also points to a possible *coordination-overload loop*. Collaboration is necessary because grid congestion involves many interdependent actors, but more collaboration does not automatically lead to faster implementation. If roles, mandates and escalation routes are unclear, additional coordination can increase complexity and slow down decision-making. This may lead to unresolved bottlenecks, which in turn create a need for even more coordination. This loop highlights why the redesign of the TFCA should not simply focus on adding more meetings or actors, but on clarifying roles, responsibilities, decision routes and implementation interfaces.

Finally, the diagram includes a *flexible electricity use loop*. Flexible use of electricity and congestion management can temporarily reduce pressure on the grid by making better use of existing capacity. This may help reduce congestion in the short term. However, flexibility does not replace the need for structural grid expansion, especially in a context of continued demand growth. The loop therefore represents a balancing mechanism, but one with limited scope if underlying capacity constraints are not addressed.

Together, these feedback loops show that grid congestion in Amsterdam is shaped by the interaction between demand growth, infrastructure expansion, spatial scarcity, institutional constraints and governance capacity. The proposed redesign of the TFCA governance arrangement is therefore conceptualized as a possible leverage point within this broader system. Its expected contribution lies primarily in improving information alignment, issue ownership, escalation and implementation readiness, rather than in directly increasing grid capacity.

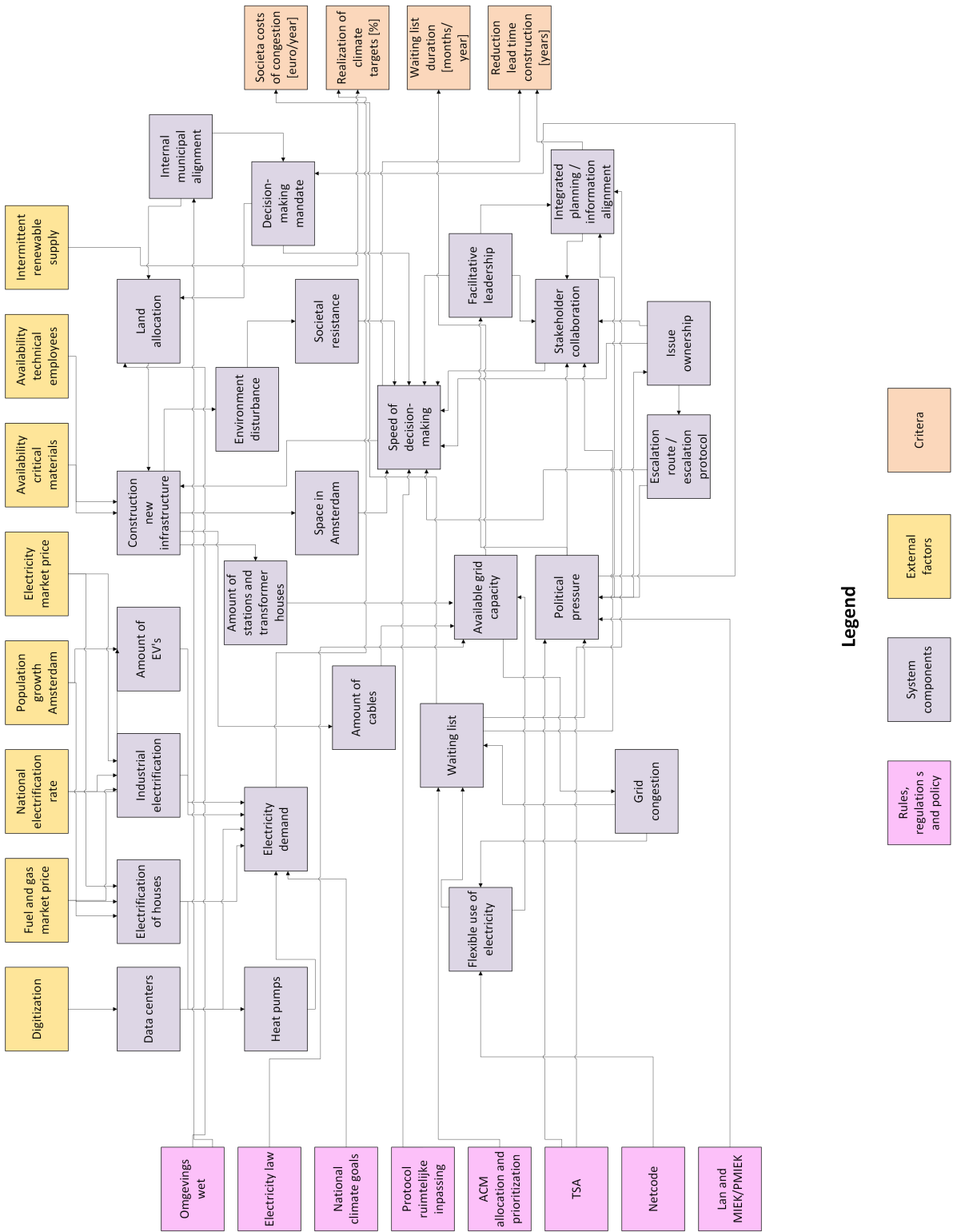


Figure B.6: Readable CLD

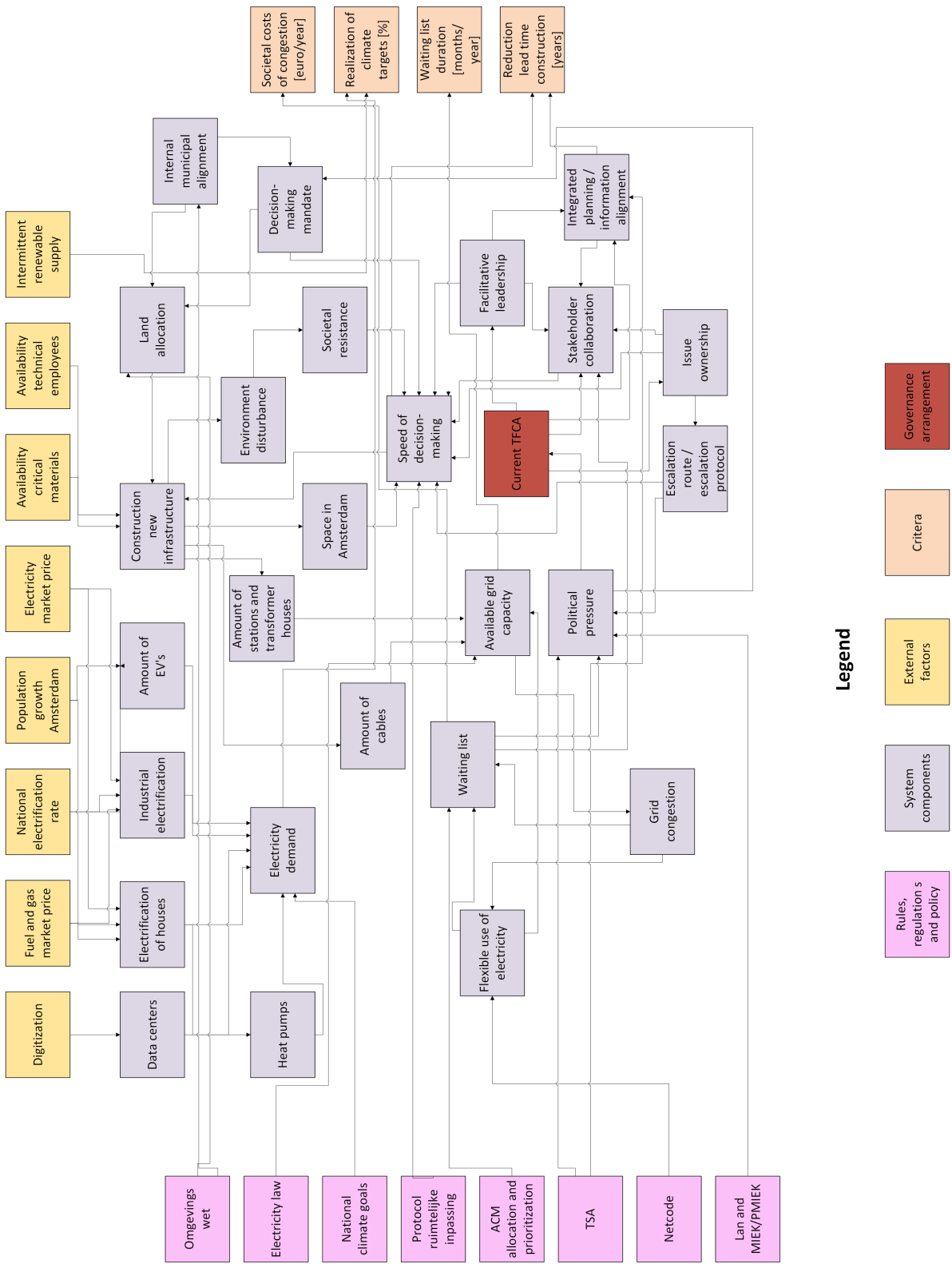


Figure B.7: Readable CLD incl. TFCA

C | Background to the Institutional Environment

This appendix provides additional background to the institutional environment discussed in Subsection 4.3.1. It explains the main laws, policy frameworks, planning instruments and governance arrangements that shape grid expansion and grid congestion governance in Amsterdam. The appendix is intended as supporting material for Chapter 4, where the institutional environment is summarized as part of the system analysis.

C.1. National Legal and Policy Framework

The national legal and policy framework is important because it shapes the institutional conditions under which the Municipality of Amsterdam, grid operators and other actors operate. It defines the statutory tasks of grid operators, the rules for grid access and congestion management, and the broader policy context for accelerating grid expansion.

- **Electriciteitswet 1998:** The Electricity Act of 1998 forms the traditional legal framework for the organization of the Dutch electricity market. The law defines the roles and responsibilities of different actors within the electricity system, including grid operators, electricity suppliers and consumers. It establishes the obligation for grid operators to provide non-discriminatory access to the electricity grid and regulates tariffs through supervision by the ACM. The law also introduced the unbundling of energy production and grid operation. For Amsterdam, this is relevant because it defines the statutory duties of grid operators, while congestion increasingly complicates timely realization of connections and transport capacity.
- **Connection and transport obligation:** A central principle in the electricity system is that grid operators have a duty to provide a connection upon request. However, actual transport capacity may be constrained when the grid is congested. This distinction is important for Amsterdam, because it shows that a physical connection and sufficient transport capacity are not always the same. In congested areas, users may therefore receive a connection while still being placed on a waiting list for transport capacity.
- **Netcode Elektriciteit:** The Netcode Elektriciteit provides technical and procedural rules for connection, transport, congestion management and the allocation of scarce transport capacity. It specifies how grid operators should deal with connection requests, waiting lists and congestion areas. For Amsterdam, the Netcode is relevant because it structures how grid access is managed under scarcity and how congestion management instruments can be applied.
- **Energiewet:** The Energiewet modernizes the regulatory framework for the electricity and gas system. The law introduces updated rules regarding congestion management, flexible grid use, data exchange and the allocation of transport capacity. For Amsterdam, this law is relevant because grid congestion is an existing problem in the area and because the law provides a legal basis for managing limited grid capacity, improving transparency and facilitating flexibility (Snitselaar, 2026). The revised law is built around three main themes:
 - *Strengthening the consumer position:* This includes clearer rules on price transparency and the possibility for consumers to conclude contracts with dynamic electricity prices (de Haan, 2025).
 - *A future-proof system:* System operators are no longer obliged to realize a connection immediately if no transport capacity is available. In addition, the *Commission v Belgium* ruling of the European Court of Justice (ECLI:EU:C:2020:984) clarified that the interpretation of connection deadlines falls under the exclusive competence of the national regulatory

authority, the Autoriteit Consument en Markt. Furthermore, grid operators are required to be more transparent about available capacity and waiting times (de Haan, 2025).

- **Data exchange:** The law provides for the establishment of a central data exchange entity by system operators, responsible for managing and facilitating the exchange of energy data between different parties (de Haan, 2025).
- **ACM allocation and prioritization rules:** Historically, scarce transport capacity was largely allocated according to the first-come-first-served principle. In congested regions, this contributed to waiting lists and limited the ability to prioritize projects based on broader societal objectives. The ACM prioritization framework introduces the possibility of prioritizing grid access for projects with societal importance. In congested areas, certain categories, such as projects that relieve congestion or projects with high societal importance, can receive priority access to grid capacity. However, prioritization mainly changes the order of the waiting list rather than immediately creating additional capacity. This shows that grid capacity allocation is not purely market-driven, but also reflects broader societal priorities.
- **Omgevingswet:** The Omgevingswet is the main Dutch law governing spatial planning, environmental policy and infrastructure development. The law integrates multiple existing regulations into a single framework that guides spatial development and environmental quality. It introduces instruments such as the *omgevingsvisie* and *omgevingsplan* (Ministerie van Infrastructuur en Waterstaat, 2025). For Amsterdam, the Omgevingswet is important because energy infrastructure such as substations, transformer houses and cable routes must be integrated into urban development plans. The law therefore plays a key role in linking spatial planning and electricity grid expansion.
- **Landelijk Actieprogramma Netcongestie (LAN):** The National Action Program for Grid Congestion is a collaboration between the Dutch government, grid operators, regulators and regional authorities. The program focuses on addressing grid congestion through both infrastructure expansion and more efficient grid use. Measures include accelerating permit procedures, encouraging flexible electricity consumption and improving coordination between stakeholders (Landelijk Actieprogramma Netcongestie, 2025). For Amsterdam, the LAN supports both national and regional efforts to expand the grid and improve flexibility in electricity use.
- **MIEK:** The Multi-Year Infrastructure Program for Energy and Climate is a national planning instrument aimed at coordinating the development of large-scale energy infrastructure. The program identifies priority infrastructure projects that are necessary to support the Dutch energy transition. It focuses on accelerating decision-making and improving coordination between national government, regional authorities and grid operators. For Amsterdam, the MIEK is relevant because it helps align local grid expansion needs with national energy infrastructure planning (Ministerie van Klimaat en Groene Groei, 2026).
- **Aansluitoffensief netcongestie:** The Aansluitoffensief Netcongestie is a national initiative introduced to reduce waiting lists for electricity connections. The program contains measures aimed at improving grid utilization, accelerating connection procedures and strengthening coordination. For Amsterdam, the program is relevant because many companies, public facilities and infrastructure projects depend on faster grid connections (Arcadis, 2026).
- **Investment plans of grid operators:** Grid operators periodically publish investment plans that define planned reinforcements and investment timelines. These plans shape the timing and feasibility of infrastructure expansion in Amsterdam and need to be aligned with municipal spatial planning. For this research, these investment plans are important because they show that grid expansion is not only a local spatial issue, but also depends on long-term technical and financial planning by grid operators.

C.2. Local and Regional Policy, Planning and Governance Frameworks

The local and regional frameworks are important because they shape the specific institutional environment in Amsterdam. They influence electricity demand, spatial integration, regional alignment and the way grid expansion is coordinated in practice.

- **Omgevingsvisie Amsterdam 2050:** The Omgevingsvisie Amsterdam 2050 is the long-term spatial development strategy of the municipality. It describes how the city will grow while addressing

challenges such as climate change, the energy transition and urban densification. Energy infrastructure such as substations, transformer houses and cable routes must be spatially integrated within this vision. As a result, the electricity grid becomes an important spatial planning issue in Amsterdam (van den Beuken & Kuijt, 2021).

- **Routekaart Amsterdam Klimaatneutraal:** The Routekaart Amsterdam Klimaatneutraal outlines the strategy for making the city climate neutral by 2050. The roadmap focuses on reducing greenhouse gas emissions through electrification, renewable energy and energy efficiency. These measures increase electricity demand in the city, especially in buildings, mobility and industry (Roda, 2019). As a result, the roadmap indirectly increases the need for grid expansion and infrastructure planning.
- **Transitievisie Warmte:** The Transitievisie Warmte outlines how Amsterdam will phase out natural gas for heating. It identifies alternative heating solutions such as district heating, heat pumps and other sustainable technologies. The shift towards electric heat pumps increases electricity demand in the built environment and therefore adds pressure to the electricity grid (Duin & Koelemij, 2020).
- **Data center policy:** Amsterdam has introduced specific policies regulating the development of data centers in the city. Large data centers require substantial electricity capacity and space. Due to grid congestion and spatial limitations, the municipality restricts the development of new large data centers. The policy aims to balance the economic importance of digital infrastructure with the constraints of the electricity grid and urban space (Teesink, 2025).
- **RES** The RES is a collaborative framework between municipalities, provinces and grid operators. It identifies suitable locations for renewable energy generation, such as wind and solar, and addresses how these projects can be integrated into the electricity grid (Noord Hollandse Energie Regio, 2021). For Amsterdam, the RES is relevant because local energy ambitions are linked to regional grid capacity and spatial constraints.
- **Energievisie Noord-Holland Zuid / provincial energy planning:** Regional and provincial energy planning provides a broader perspective on electricity, heat, gas, storage and flexibility. It helps connect Amsterdam's local grid challenges to the wider regional energy system. This is relevant because Amsterdam depends not only on infrastructure within the city, but also on regional and national grid connections.
- **PMIEK / MIEK:** The Provincial Multi-Year Infrastructure Program for Energy and Climate supports the prioritization and coordination of major energy infrastructure projects at provincial and national levels. For Amsterdam, this is relevant because local grid expansion needs must be aligned with regional and national infrastructure planning.
- **Ontwikkelingskader Elektriciteitsvoorziening Amsterdam 2035:** The Ontwikkelingskader is a joint spatial planning framework developed by the Municipality of Amsterdam, Liander, TenneT and the Port of Amsterdam. It identifies the spatial implications of new and expanded electricity stations and cable routes in Amsterdam. The framework is essential for aligning grid expansion with urban development and spatial planning (Gemeente Amsterdam, Liander, Port of Amsterdam, & TenneT, 2025).
- **TSA / Toekomstbestendige Stroomvoorziening Amsterdam:** The TSA provides the technical basis for expected grid expansion needs in Amsterdam. It helps identify where substations, transformer houses and cable routes are required. For this research, the TSA is important because it connects future electricity demand to concrete infrastructure requirements.
- **Protocol Ruimtelijke Inpassing:** The Protocol Ruimtelijke Inpassing structures the process for integrating electricity infrastructure into scarce urban space. It is directly relevant for location decisions and coordination between the municipality and grid operators. For this research, the protocol is important because it formalizes part of the interface between technical infrastructure planning and municipal spatial planning.
- **TFCA governance arrangement:** The TFCA is a collaborative governance arrangement between the Municipality of Amsterdam, Liander, TenneT and other involved actors. It provides a platform for coordinating grid expansion, monitoring progress, preparing decisions and escalating bottlenecks

where needed. The TFCA is not a single actor, but a governance arrangement consisting of participating organizations, workstreams, KT, AC and independent facilitation.

- **Investment plans of Liander and TenneT:** The investment plans of Liander and TenneT define planned reinforcements and investment timelines. Alignment with municipal spatial planning is necessary because technical planning and land-use decisions are mutually dependent.
- **Congestion management contracts:** Congestion management contracts are formal instruments, based on ACM and Netcode rules, through which large users can reduce or shift electricity use to relieve congestion. They are relevant as a complementary measure, but fall outside the main focus of this research on physical grid expansion.
- **Energy hubs and local energy cooperation:** Energy hubs allow businesses or local actors to coordinate demand, supply and storage locally. They can improve local flexibility and efficient grid use. In this research, they are relevant as complementary strategies for better grid use, but not as the core focus of the TFCA grid expansion design.

D | Stakeholder Background

This appendix provides additional background to the stakeholder analysis in Chapter 4. It describes the main actors involved in grid congestion governance in Amsterdam and explains their roles, interests and relevance for the electricity system. The appendix should be read as supporting material for the power-interest grid and the discussion of the TFCA governance arrangement in the main text. The formal stakeholder chart is shown in Figure D.1.

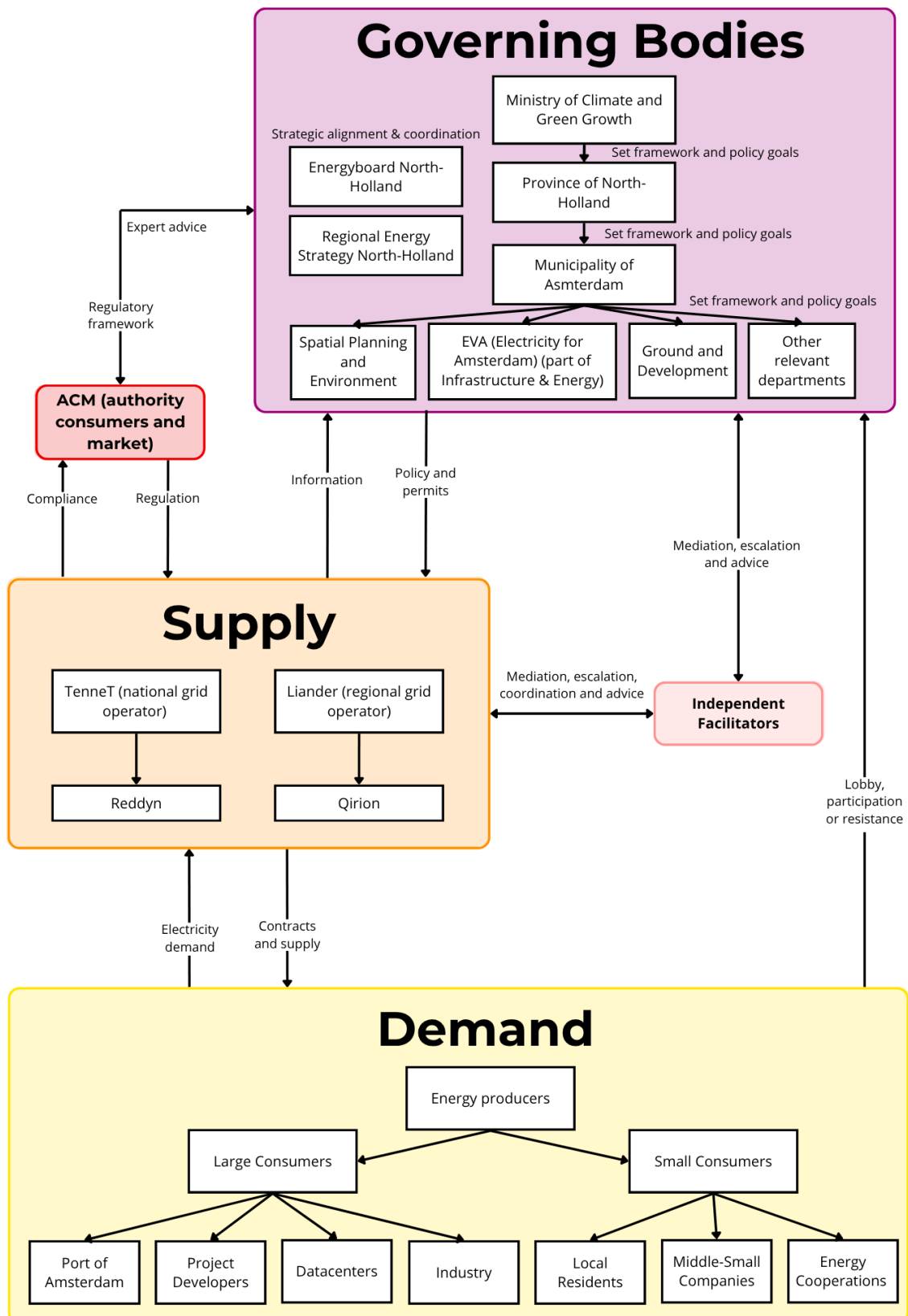


Figure D.1: Formal chart of stakeholders involved in grid congestion governance in Amsterdam

The stakeholder structure consists of governing bodies, grid operators, demand-side actors, regulatory actors, and independent facilitators. The layer of governing bodies consists of policy-making and coordinating bodies, such as the national ministry responsible for energy policy, the Province of North-Holland and the Municipality of Amsterdam. These actors establish legal frameworks, policy objectives and spatial planning conditions. Within the Municipality of Amsterdam, several departments are relevant, including Infrastructure and Energy, Spatial Planning and Environment, Ground and Development, Housing, and other departments involved in public space, permitting and implementation. EVA is positioned within this municipal context and plays an important role in coordinating the electricity infrastructure challenge from the municipal side.

At the provincial and regional level, the Energyboard North-Holland and the RES-region North-Holland South play a coordinating role in the energy transition. These actors do not directly manage electricity infrastructure or decide on grid investments, but they influence decision-making through strategic planning, regional coordination and alignment between stakeholders. The grid operators TenneT and Liander form the core of the supply side. They are responsible for the physical electricity infrastructure and are supported by technical and implementation parties such as Qirion and Reddyn. Their relationship with governing bodies is characterized by mutual dependency: grid operators provide technical information and investment planning, while governing bodies influence spatial integration, permitting and policy alignment.

The demand side consists of large-scale consumers, such as the Port of Amsterdam, industry and data centers, as well as project developers, residents, SME and local energy initiatives. These actors are strongly affected by grid congestion because their activities depend on sufficient grid capacity. Their influence is often expressed through demand, lobbying, participation or, in some cases, resistance to new infrastructure projects. The ACM acts as the independent regulator that monitors the electricity market and sets rules for grid access, tariffs and congestion management. Finally, independent facilitators, including the TFCA program director and process managers, play a process-oriented role through mediation, expectation management, coordination and escalation support.

The TFCA itself is not treated as a single stakeholder in this appendix. Instead, it is understood as a collaborative governance arrangement in which several of the actors described below participate. This distinction is important because the TFCA does not have one unified mandate, interest or formal decision-making authority. Formal decision-making authority remains with the participating organizations.

D.1. Governing Bodies

There are several governing bodies involved in the electricity system of Amsterdam, which are listed below:

- **National Ministry of Climate and Green Growth:** The national government is responsible for the overall policy framework of the Dutch energy system. Through legislation and national climate policy, it sets targets for the energy transition, electrification and emission reduction. One of its main values is ensuring a reliable, affordable and sustainable energy system for the Netherlands. Decisions made at the national level influence how the electricity system develops in cities such as Amsterdam, for example through regulation, infrastructure prioritization and national energy policy.
- **Province of North-Holland:** The Province of North-Holland acts as an intermediate governance level between national government and municipalities. It is involved in regional spatial planning and plays a coordinating role in energy infrastructure development. The province is also involved in regional energy strategies and infrastructure programming. Its interests include balancing economic development, sustainability, spatial planning and regional energy system needs. For Amsterdam, the province helps connect local grid expansion challenges to broader regional energy infrastructure planning.
- **Energyboard North-Holland:** The Energyboard North-Holland functions as a regional coordination platform for energy-related issues. It brings together actors involved in the regional energy transition and supports alignment between local, regional and provincial developments. For Amsterdam, the Energyboard is relevant because grid congestion and grid expansion are not only local challenges, but are also connected to regional energy system planning and infrastructure

priorities.

- **RES-region North-Holland South:** The Regional Energy Strategy (RES) North-Holland South is a collaborative framework between municipalities, the province and grid operators in the region. The strategy identifies locations for renewable electricity generation, such as wind and solar, and examines how these projects can be integrated into the electricity grid. The main goal is to contribute to national climate targets while coordinating renewable energy production at the regional level. For Amsterdam, the RES influences where renewable energy projects are developed and how they relate to regional grid capacity (Noord Hollandse Energie Regio, 2021).
- **Municipality of Amsterdam:** The Municipality of Amsterdam plays an important role in spatial planning, permitting, public space and local energy policy. Through instruments such as the Omgevingsvisie and sustainability strategies, the municipality guides urban development and climate policy within the city. In the context of grid congestion, the municipality is crucial because substations, transformer houses and cable routes require scarce urban space. The municipality must therefore coordinate closely with grid operators to ensure that electricity infrastructure can be integrated into the urban environment.
- **Alderman responsible for the energy transition:** The alderman responsible for the energy transition has political responsibility for relevant municipal energy ambitions and helps provide political direction for grid-related issues. This role is important because grid expansion often requires trade-offs between energy infrastructure, housing, public space, mobility and sustainability. The alderman does not replace the formal responsibilities of departments or grid operators, but can provide political support and escalation when competing municipal priorities need to be balanced.
- **Infrastructure and Energy Department Municipality:** The Infrastructure and Energy Department is directly involved in the municipal side of electricity infrastructure planning. Within this context, EVA supports coordination around Amsterdam's electricity supply and grid expansion challenge. EVA should be understood as a municipal coordination function or integrator, rather than as the spatial framework itself. The Ontwikkelingskader Elektriciteitsvoorziening Amsterdam 2035 is the planning framework developed by the municipality together with Liander and TenneT to outline where and how the electricity grid in Amsterdam needs to be expanded and reinforced (de Jager, 2024).
- **Spatial Planning and Environment:** Spatial Planning and Environment is relevant because electricity infrastructure must be integrated into the urban environment. This includes the spatial planning of substations, transformer houses and cable routes, as well as the balancing of energy infrastructure with housing, green space, mobility and other urban functions.
- **Ground and Development:** Ground and Development is relevant because land ownership, land allocation and area development strongly influence where energy infrastructure can be realized. This department plays an important role when substations or transformer houses need to be integrated into development areas or when land must be reserved for future infrastructure.
- **Housing:** Housing is relevant because housing development depends on sufficient grid capacity, while new housing also increases electricity demand. This creates an interdependency between housing ambitions and electricity infrastructure planning. Housing actors within the municipality therefore have an indirect but important interest in grid expansion.
- **Environmental permitting authority / Omgevingsdienst:** The Omgevingsdienst is involved in permitting and environmental procedures. Although it does not determine grid investment decisions, it can influence the timing and feasibility of infrastructure projects through permitting requirements and environmental assessments.
- **Water authorities:** Water authorities are relevant where cable routes, substations or other infrastructure interact with water systems, flood protection, groundwater or public works. Their role is usually not central in strategic grid planning, but they can become important in specific spatial and permitting processes.

D.2. Grid Operators and Regulatory Actors

Besides governing bodies, there are also grid operators and regulatory actors that form the basis of the electricity system:

- **TenneT:** TenneT is the national transmission system operator responsible for the high-voltage electricity grid in the Netherlands. The organization manages the transport of electricity over long distances and ensures the stability of the national electricity system. One of its main values is maintaining a reliable and balanced electricity system. To do this, TenneT needs accurate forecasts of electricity demand, sufficient spatial possibilities for high-voltage infrastructure and strong coordination with regional grid operators and public authorities. In the Amsterdam region, TenneT is responsible for high-voltage infrastructure that connects the city to the wider national grid (Gemeente Amsterdam et al., 2025).
- **Liander:** Liander is the regional distribution grid operator responsible for the medium- and low-voltage electricity network in Amsterdam. The company manages the distribution grid and is responsible for connecting households, companies and infrastructure to the electricity network. Due to increasing electricity demand and electrification, Liander faces significant challenges related to grid congestion. Its main interest is ensuring a reliable and safe electricity supply while expanding the grid to accommodate future demand (Gemeente Amsterdam et al., 2025). To achieve this, Liander requires sufficient investment capacity, technical personnel, spatial planning cooperation and regulatory support. Liander is also one of the key participating organizations in the TFCA governance arrangement.
- **Qirion:** Qirion is an implementation and engineering actor involved in the realization of electricity infrastructure. In the Amsterdam context, Qirion becomes particularly relevant when projects move from planning and location choice towards detailed design, preparation and execution. Its role is therefore important for understanding the shift from coordination towards implementation.
- **Reddyn:** Reddyn is a technical implementation actor involved in high-voltage infrastructure projects. Similar to Qirion, its relevance increases when projects move closer to execution. Reddyn contributes technical expertise, engineering and realization capacity, and therefore forms part of the implementation side of grid expansion.
- **Technical workforce:** The technical workforce consists of engineers, planners, technicians, contractors and other professionals needed to design, build and maintain electricity infrastructure. Although this is not a stakeholder in the same way as organizations such as TenneT or Liander, it is an important system constraint. Shortages of technical personnel can delay implementation even when governance alignment has been achieved.
- **ACM:** The ACM regulates the Dutch electricity market and supervises grid operators. The ACM determines rules related to grid access, tariffs and congestion management mechanisms (Koel, 2020). Its main goal is to ensure fair competition and protect consumers while maintaining a reliable electricity system. In the case of grid congestion, the ACM influences how grid capacity is allocated and under which conditions prioritization or congestion management can take place.

D.3. Demand-Side and Other Stakeholders

Besides governing bodies and grid operators, there are several demand-side and societal stakeholders involved in the electricity system of Amsterdam:

- **Port of Amsterdam:** The Port of Amsterdam is an important economic actor within the electricity system of the city. The port area hosts industrial activities, logistics companies and energy-related businesses that depend on reliable electricity supply. Increasing electrification of industrial processes and transport in the port area leads to growing electricity demand. The Port of Amsterdam therefore requires sufficient grid capacity, close cooperation with grid operators and clear long-term infrastructure planning (Consultancy.nl, 2025).
- **Large electricity consumers and industry:** Large electricity consumers in Amsterdam include industrial companies, large commercial buildings and other energy-intensive facilities. These actors depend heavily on reliable and affordable electricity supply for their daily operations (Gemeente Amsterdam et al., 2025). Their main interest is obtaining sufficient grid capacity to support

electrification, production processes and business expansion. Due to grid congestion, many large consumers face waiting lists for new or upgraded grid connections.

- **Data center operators:** Data centers form an important part of the digital infrastructure in Amsterdam. These facilities require large amounts of electricity to operate servers, cooling systems and network equipment (Gemeente Amsterdam & Liander, 2024). Their main interest is securing stable and long-term electricity connections. At the same time, their high electricity demand has become an important issue in the debate about grid congestion and spatial pressure. As a result, policy measures have been introduced to regulate the development of new large data centers in the city.
- **Project developers and housing developers:** Project developers and housing developers are responsible for developing new residential and mixed-use areas in Amsterdam. These developments require electricity connections and additional grid infrastructure (de Jager, 2024). Their main interest is ensuring that grid capacity is available for new development projects. Grid congestion can therefore delay or complicate housing and area development.
- **Energy producers:** Energy producers, such as companies involved in electricity production or local generation, depend on access to the electricity grid to feed electricity into the system. They are relevant because renewable generation and local production can both contribute to the energy transition and create additional pressure on grid capacity.
- **Small consumers, SME and local residents:** Small consumers include households, SME and local residents. They are end users of electricity and are therefore directly affected by developments in the electricity system. Their main values include affordability, reliability and sustainability of electricity supply. As electrification increases, households and SME become more dependent on electricity for heating, mobility and daily activities. They usually have limited formal decision-making power, but can influence infrastructure projects through participation, local concerns or resistance.
- **Energy cooperatives and local energy initiatives:** Local energy cooperatives represent citizens or local actors who collectively invest in renewable energy projects, local energy systems or flexibility solutions. Their interests include access to the electricity grid and supportive policy frameworks. Grid congestion can limit the ability of these initiatives to connect renewable energy projects. As a result, they often advocate for more flexible and decentralized energy systems (van der Woude et al., 2024). Amsterdam recognizes these initiatives as important actors in the local energy transition (Sandee, 2024).

D.4. TFCA Governance Arrangement and Independent Facilitation

The TFCA is not a single stakeholder, but a collaborative governance arrangement in which several organizations participate. It includes actors such as the Municipality of Amsterdam, Liander, TenneT and other relevant parties, depending on the workstream or issue. The purpose of the TFCA is to coordinate the grid congestion challenge in Amsterdam in a structured way, improve alignment between actors and support the preparation, monitoring and escalation of decisions (Consultancy.nl, 2025). The initial governance arrangement of the TFCA is shown in Figure D.2.

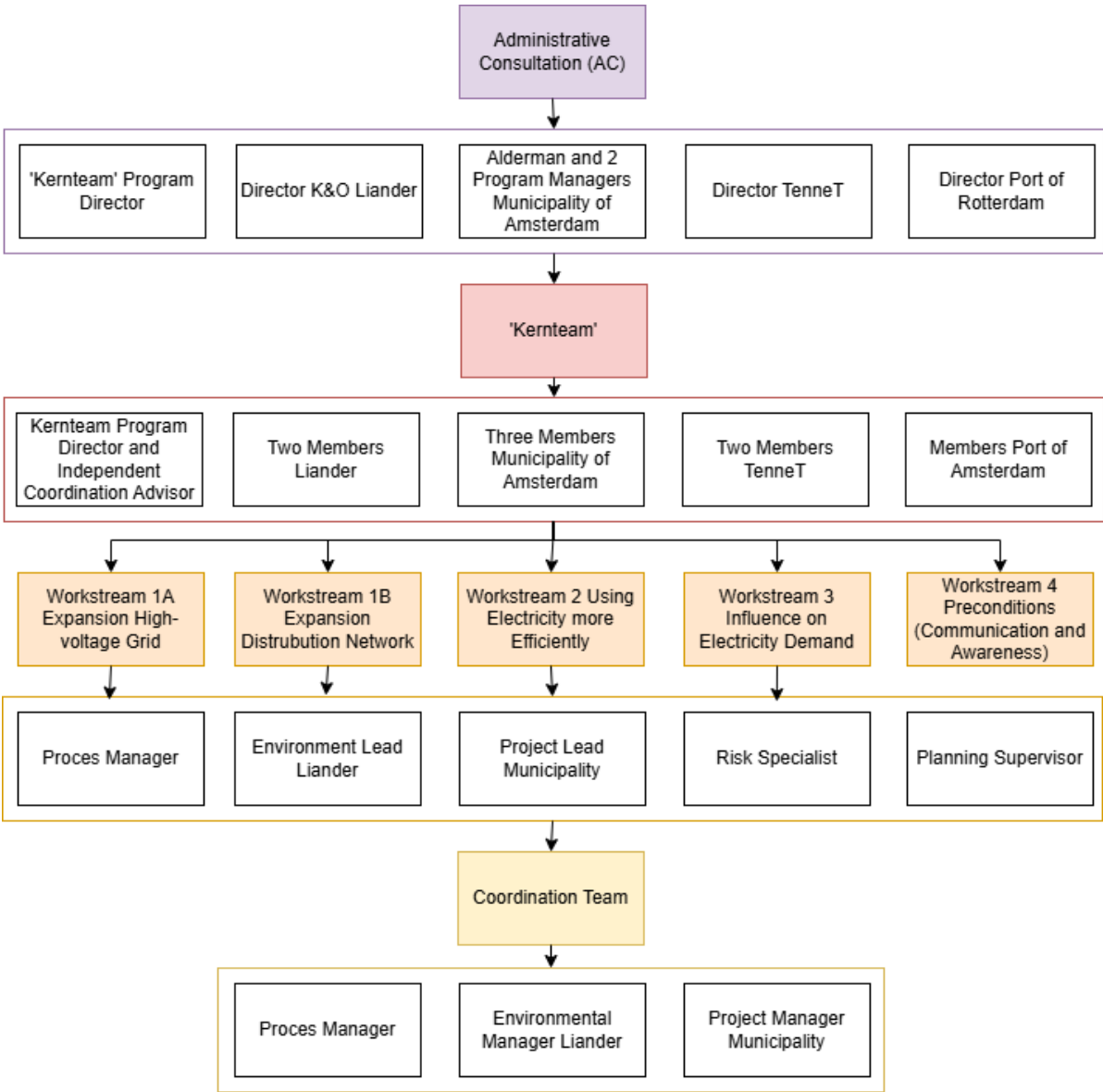


Figure D.2: Initial Governance Arrangement TFCA

The independent facilitators, including the program director and process managers, play a process-oriented role within this arrangement. They do not hold formal decision-making authority over grid investments, spatial planning or permits. Instead, their role is to support coordination, structure discussions, manage expectations, mediate between actors and prepare escalation when issues cannot be resolved at the working level. This makes them important for the functioning of the collaboration, even though formal mandate remains with the participating organizations.

Achievements TFCA

To complete the background description of the TFCA, this section briefly summarizes several reported achievements. Since the beginning of the TFCA, there have been several achievements, which are shown in Table D.1.

A key initial outcome of the TFCA is that the organizations involved are increasingly working on planning based on a shared understanding of the system. In this way, the TFCA helps ensure that all parties perceive the same reality and operate from the same systemic perspective. This prevents debates over starting points and objectives and, among other things, enables faster issue preparation, decision routes and formal decision-making. Another benefit is that the process has become clearer, more

transparent, and better organized. Thanks to defined roles, agreements, and process structures, work is better organized and bottlenecks can be resolved more quickly. More conscious and strategic decisions are made regarding projects and capacity, resulting in more effective use of resources.

The TFCA has also led to a clear improvement in collaboration between organizations and people. Through structural collaboration and personal contact, trust between organizations has grown, making collaboration smoother and above all, more informal. Finally, the TFCA has also led to concrete steps to strengthen the network. This has been achieved through the earlier mentioned governance arrangements, processes, and collaboration.

Table D.1: Achievements TFCA

Subject	Achievements
Joint overview, shared reality and documents	Integrated planning Council information letter Requirements and preferences documents Development perspective and development framework Periodic thematic studies Protocol and evaluation Independent director and process managers
Strong collaboration and trust	People know each other and have informal contact Physical day at the office on Wednesday Mutual understanding Signing documents together Joint preparation of documents and decisions Facilitating collaboration (agenda, notes, meetings etc.)
Strengthening the network	Location choice and construction of stations Location choice and construction of substations Location choice and construction of cables Lead time reduction

Together, these stakeholder descriptions show that grid congestion governance in Amsterdam depends on actors with different responsibilities, interests and forms of influence. This supports the system analysis in Chapter 4, where these relationships are analyzed in terms of power, interest and interdependence.

E | Exploratory Regional Reflection

This appendix provides background to the exploratory regional interviews that were conducted in addition to the Amsterdam case. These interviews were held with stakeholders from Holland-Rijnland, Rotterdam and the Province of North-Holland. The exploratory regional reflection is not used as a full comparative case study or as a benchmark for Amsterdam. Instead, it is used as reflective input to understand how governance arrangements around grid congestion differ across regional contexts.

The main reason for including these regional descriptions is that the organization of grid congestion governance is highly context-dependent. Amsterdam, Holland-Rijnland and Rotterdam all operate within the same national institutional framework, but differ in spatial pressure, organizational capacity, scale of the task and the way coordination is organized. For that reason, the experiences from other regions cannot be directly copied to Amsterdam. They can, however, help to make the specific characteristics of Amsterdam more visible and support reflection on which governance elements may or may not be useful in other contexts.

The interviews from Holland-Rijnland and Rotterdam were therefore used in an exploratory way. They helped to identify alternative ways of organizing coordination, implementation and issue preparation, but they were not used to make causal claims about outcomes. The findings from these interviews mainly informed the ideation phase and the final deliverable, by showing that governance design should not prescribe one fixed organizational model, but should help regions assess what kind of governance support fits their own context.

E.1. Purpose of the Exploratory Regional Reflection

The exploratory regional reflection had three purposes. First, it helped to contextualize the Amsterdam case by showing how governance arrangements differ in regions with different spatial and organizational conditions. Second, it provided reflective input for the ideation phase, especially regarding the role of independent facilitation, pragmatic coordination and early involvement of implementation actors. Third, it helped to position the final deliverable as a tool that can also be used by other regions to reflect on their own governance arrangement.

This means that Holland-Rijnland and Rotterdam are not treated as best-practice cases. They are used as reflective cases. Their value lies in showing that different governance arrangements may be suitable under different conditions. This supports one of the central assumptions of this thesis: that collaborative governance around grid congestion cannot be designed as a universal structure, but must be adapted to the scale, capacity and spatial complexity of the context.

E.2. Holland-Rijnland

The Holland-Rijnland region differs from Amsterdam in scale, spatial pressure and municipal capacity. The task is distributed across several municipalities rather than concentrated in one large urban area. The scale of the infrastructure task is also smaller than in Amsterdam, although the region still faces several station projects with spatial, technical or landscape-related bottlenecks.

The regional taskforce in Holland-Rijnland was partly established because municipalities in the region have limited internal knowledge and capacity to deal with grid congestion and grid expansion. The taskforce therefore provides support to municipalities and helps them work with Liander, the province and other involved actors. Its role is not to take over formal responsibilities, but to mediate, clarify the process and intervene when projects get stuck.

The interviews show that the taskforce in Holland-Rijnland focuses mainly on larger regional infrastructure projects, such as high-voltage stations and medium-voltage stations. Local transformer houses and low-voltage issues are generally left to the municipalities themselves. TenneT plays a smaller role than

in Amsterdam, because the number of TenneT-related projects in the region is more limited.

A central characteristic of the Holland-Rijnland approach is independent facilitation. The taskforce can step in as a neutral party when municipalities and grid operators have difficulty aligning their views. This is useful because actors may recognize the urgency of grid expansion, but still disagree about priorities, spatial trade-offs and the route towards implementation. The taskforce helps to bring actors together earlier, clarify what needs to be decided and prevent projects from getting stuck in bilateral tensions.

Compared to Amsterdam, the Holland-Rijnland approach is less formalized and more adaptive. It is more strongly focused on project-specific intervention and mediation. This does not mean that it would be directly suitable for Amsterdam, because Amsterdam has a larger and more complex task, stronger spatial pressure and more institutionalized coordination structures. However, the case does highlight the potential value of early-stage intervention, independent facilitation and flexible expert support, especially when municipal capacity is limited.

E.3. Rotterdam

Rotterdam differs from Amsterdam in the way grid congestion governance is organized. Rotterdam does not work through a joint taskforce arrangement comparable to the TFCA. Instead, grid congestion is organized within the municipal organization through a grid congestion program. This program includes different tracks, including grid expansion, smarter grid use and support for external parties.

The task in Rotterdam is also spatially different from Amsterdam. A large part of the grid expansion challenge is concentrated in the port area. The Port of Rotterdam is responsible for organizing many infrastructure-related activities in that area, with the exception of permitting. As a result, the municipality mainly focuses on the urban area, where several stations need to be built or renovated. This makes the municipal task more limited in scope than in Amsterdam, where the spatial pressure, number of actors and number of parallel infrastructure projects are higher.

Rotterdam works more through existing municipal departments and project-based steering. Collaboration with Stedin and TenneT takes place per project. A central element in the Rotterdam approach is the use of a start document and location study. The municipality and grid operators try to develop a shortlist of possible locations at the beginning of the process, so that both the technical and spatial perspectives are included earlier. This is intended to prevent resistance or political discussion from arising only at a late stage.

The Rotterdam approach is therefore more pragmatic and project-based than the Amsterdam approach. The lines between actors are shorter and escalation can take place through existing municipal routes. At the same time, the approach is less institutionalized as a long-term joint governance arrangement. This works in Rotterdam partly because the municipal task is more limited and because many large infrastructure projects are connected to the port context.

For Amsterdam, the Rotterdam case does not provide a direct model to copy. Amsterdam's task is more spatially constrained and more institutionally complex. However, Rotterdam does show the value of a more pragmatic project approach, especially the use of early joint location work, standardized project starts and short coordination lines between spatial planning and energy departments.

E.4. Comparison of Regional Governance Contexts

Table E.1 summarizes the main differences between Amsterdam, Holland-Rijnland and Rotterdam. The table should be read as a reflective comparison of governance contexts, not as an evaluation of which region performs best.

Dimension	Amsterdam	Holland-Rijnland	Rotterdam
Scope & Complexity	Highly urbanized; complex spatial planning; high volume of new infrastructure needed	Smaller volume of new infrastructure needed; across different municipalities varying in complexity	Highest volume of new infrastructure in the port; Small volume within the city
Governance structure & organization	Highly formalized; multi-layered; protocols; structured taskforce	Regional taskforce; project- and station-oriented; external facilitation	Municipal-led; no joint taskforce; project-based collaboration
Decision-making & steering	Slow; unclear mandates; limited escalation	More direct; supported escalation; project-driven	Short lines; pragmatic steering through existing departments; limited formal escalation
Coordination approach	Formal alignment; integrated planning; protocols	Early mediation; proactive coordination	Standardized projects; shortlisting; project-based coordination
Flexibility vs structure	High structure; limited flexibility; procedure-oriented	High flexibility; adaptive; case-specific	Moderate flexibility; pragmatic; semi-structured
Role of actors & capacity	High capacity; fragmented across organizations	Low municipal capacity; external support/taskforce	Moderate capacity; mainly municipal coordination; port handles own projects
Collaboration dynamics	Strong culture; many actors; high complexity	Trust-based; relationship-driven; varies per case	Direct collaboration; fewer projects; less complex
Spatial & system constraints	Very high pressure; competing policy goals	More spatial flexibility than Amsterdam; still context-dependent	Large-scale port and industrial projects; spatial issue less dominant; project-specific
Main strength	Strong alignment; shared understanding; comprehensive planning	Effective early-stage intervention; mediation; helps with capacity	Pragmatic execution; fast coordination in projects; one way of working
Main limitation	Limited decisiveness; slow implementation; institutional complexity	Reliance on voluntary cooperation; variation between municipalities	Less institutionalized long-term coordination; smaller municipal scope

Table E.1: Reflective comparison of governance contexts in Amsterdam, Holland-Rijnland and Rotterdam

E.5. Reflective Insights for Amsterdam

The exploratory regional reflection shows that there is no single ideal governance model for grid congestion. Governance arrangements need to fit the scale, capacity and spatial complexity of the region. Amsterdam requires a more structured arrangement than Holland-Rijnland or Rotterdam because of the number of actors involved, the pressure on public space and the scale of the infrastructure task. At the same time, the regional interviews also show that structure alone is not sufficient.

The Holland-Rijnland interviews show the value of independent facilitation and early-stage intervention

when projects get stuck. This is relevant for Amsterdam because several bottlenecks also occur before formal decisions are made, for example around location search, spatial integration and responsibilities between actors. The difference is that Amsterdam already has a more institutionalized arrangement through the TFCA. The insight is therefore not that Amsterdam should copy the Holland-Rijnland taskforce, but that the TFCA could benefit from clearer intervention moments and more flexible expert support.

The Rotterdam interviews show the value of pragmatic coordination and project-based steering. The use of start documents, location studies and shortlists illustrates how technical and spatial perspectives can be brought together early in the process. For Amsterdam, this does not mean replacing the TFCA with a municipal program. It does suggest that the TFCA governance arrangement should remain connected to concrete project preparation and implementation processes, rather than becoming only a coordination platform.

The Amsterdam case shows the opposite risk. A structured collaborative arrangement can support shared understanding and alignment, but it may also become slow when roles, mandates and escalation routes are unclear. This means that the governance design should not simply add more meetings or actors. It should clarify where coordination is needed, who owns specific bottlenecks, when implementation actors should be involved and how issues move from discussion towards issue preparation and execution.

E.6. Use for the Final Deliverable

The exploratory regional reflection also informed the way the final deliverable is positioned. Because governance arrangements are context-dependent, the deliverable should not prescribe the Amsterdam TFCA model to other regions. Instead, it can function as a reflection tool that helps regions assess their own governance arrangement.

Other regions can use the deliverable to ask which parts of their governance are sufficiently organized and which parts may need adjustment. For example, a region with low municipal capacity may need more independent facilitation or expert support. A region with short coordination lines may not need a large taskforce, but may still need clearer escalation routes or better links between spatial planning and grid operator processes. A highly urbanized region may need more formalized coordination and integrated planning, but should still avoid creating unnecessary complexity.

For this reason, the exploratory regional reflection supports a context-sensitive use of the final design. The goal is not to transfer one organizational structure, but to provide governance elements and reflection questions that can be adapted to different regional conditions.

E.7. Conclusion

The exploratory regional reflection shows that grid congestion governance is strongly shaped by regional context. Holland-Rijnland illustrates the value of independent facilitation and early intervention in a region with limited municipal capacity and distributed responsibilities. Rotterdam illustrates the value of pragmatic municipal coordination, project-based steering and early location work. Amsterdam illustrates the need for structured alignment in a highly complex and spatially constrained urban context, but also shows the risk that structure becomes slow when mandates and implementation links are unclear.

These insights were therefore not used to copy governance arrangements from one region to another. Instead, they were used as reflective input for the design phase. The main conclusion is that the final governance design should be context-sensitive: it should strengthen the TFCA in Amsterdam, while also providing elements and reflection questions that other regions can use to assess and adapt their own governance arrangements.

F | Survey Results

This appendix provides a detailed overview of the survey used in this study. It includes the questionnaire structure, respondent characteristics, descriptive Likert-scale results and a thematic summary of the open-ended responses. The appendix supports the survey findings discussed in Chapter 5, where the results are used to inform the problem definition. There were 59 respondents in total.

F.1. Survey Design

The survey was distributed among actors involved in or closely connected to the Amsterdam electricity system and the TFCA governance arrangement. The survey was exploratory in nature and aimed to identify recurring stakeholder perceptions rather than to produce statistically representative results. The Likert-scale questions were analyzed descriptively by comparing response distributions across organizations and coordination structures. The open-ended questions were summarized thematically and used to identify recurring bottlenecks, perceived strengths and suggested improvements.

The survey consists of three types of questions:

1. Descriptive questions to capture respondent characteristics,
2. Likert-scale questions to assess perceptions of governance and collaboration.
3. Open-ended questions to capture qualitative insights.

The survey is structured around key themes derived from the conceptual framework, including collaboration, governance effectiveness and perceived bottlenecks. Table F.1 shows the full set of questions. The Likert-scale questions were answered on a five-point scale, ranging from low to high evaluations, depending on the question formulation.

Theme	Survey question	Response type
Respondent characteristics	<i>At which organization do you work?</i>	Multiple choice
Respondent characteristics	<i>At which consultations do you participate within the TFCA on a structural basis?</i>	Multiple choice
Respondent characteristics	<i>For how long have you been part of one or more of these consultations?</i>	Multiple choice
Respondent characteristics	<i>What task/tasks are you primarily focused on in your daily work? (e.g. as project manager/environmental manager or from Qirion/Reddyn)</i>	Multiple choice
Cables	<i>What are some common or major challenges you face in your daily work when installing cables?</i>	Open-ended
Cables	<i>How would you rate working with staff from other partner organizations on a daily basis?</i>	5-point Likert scale
MSR/transformer houses	<i>What are some common or major challenges you face in your daily work when installing MSR/transformer houses?</i>	Open-ended
MSR/transformer houses	<i>How would you rate working with staff from other partner organizations on a daily basis?</i>	5-point Likert scale
Stations	<i>What are some common or major challenges you face in your daily work when installing stations?</i>	Open-ended
Stations	<i>How would you rate working with staff from other partner organizations on a daily basis?</i>	5-point Likert scale
The joint task	<i>What do you see as the joint task of the different partner organizations?</i>	Open-ended
The joint task	<i>How well does the TFCA's current structure align with this joint task?</i>	5-point Likert scale
The joint task	<i>How do you feel the consultation structures align with the joint task?</i>	5-point Likert scale
The joint task	<i>How do you perceive the clarity of the roles and responsibilities of the partner organizations in the joint task?</i>	5-point Likert scale
The joint task	<i>How do you perceive the escalation of bottlenecks within the TFCA?</i>	5-point Likert scale
The joint task	<i>How do you perceive the culture of collaboration within the TFCA?</i>	5-point Likert scale
Collaboration within projects	<i>What are the key factors for success in the collaboration between partner organizations within the projects?</i>	Open-ended
Collaboration within projects	<i>What are the obstacles to collaboration within the projects?</i>	Open-ended
Collaboration within projects	<i>What can be done to make collaboration within the projects even more effective?</i>	Open-ended
Collaboration within the TFCA	<i>What are the key factors for success in the collaboration between partner organizations within the TFCA?</i>	Open-ended
Collaboration within the TFCA	<i>What are the obstacles to collaboration within the TFCA?</i>	Open-ended
Collaboration within the TFCA	<i>What can be done to make collaboration within the TFCA even more effective?</i>	Open-ended
Future task	<i>What do you see as the most important developments for this challenge over the next five years?</i>	Open-ended
Future task	<i>How can collaboration among the partner organizations contribute to this (evolving) future task?</i>	Open-ended

Table F.1: Overview of survey questions and response types

F.2. Respondent Characteristics

This section provides an overview of the respondents who participated in the survey. The aim is to give context to the findings by illustrating the distribution of respondents across organizations, involvement in the governance arrangement, and experience within the system.

The respondents are distributed across multiple organizations involved in the Amsterdam electricity system (Figure F.1). The largest share of respondents is affiliated with EVA (18 respondents), followed by Liander (12) and TenneT (9). The municipality of Amsterdam and Qirion & Reddyn are each represented by 8 respondents, while the independent facilitators account for 4 respondents. This distribution shows that the survey captures perspectives from a broad range of stakeholders, although respondents from EVA are relatively overrepresented. This means that the survey should be interpreted as a targeted stakeholder perception survey, rather than as a representative assessment of all actors involved in grid congestion governance in Amsterdam.

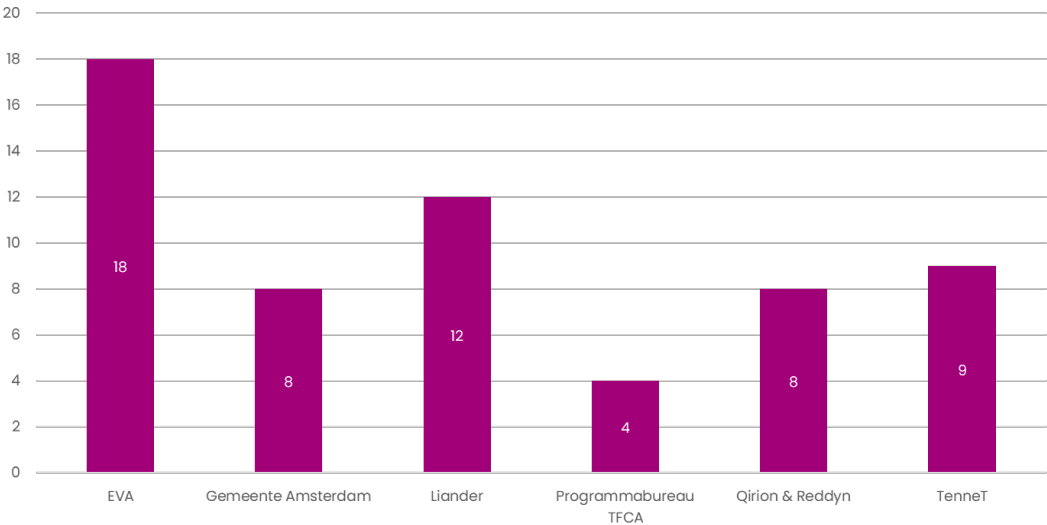


Figure F.1: Survey Respondents by Organization

Respondents are involved in different coordination structures within the TFCA. The results show that a significant portion of respondents participate in multiple governance layers, including coordination teams, workstreams, and overarching coordination structures. In particular, coordination teams and workstreams (such as HS, MSR, and cables) are well represented. Participation in higher-level consultation layers, such as the KT and AC, is more limited. This indicates that the survey primarily reflects perspectives from actors involved in operational and coordination-level activities, rather than exclusively strategic decision-making levels.

The respondents vary in their level of experience within the electricity system (Figure F.2). A substantial share of respondents has been involved for less than two years, particularly within EVA. At the same time, a smaller group of respondents has more extensive experience, with several individuals reporting over three to five years of involvement. This distribution suggests that the dataset includes both relatively new and more experienced stakeholders, which may influence how governance processes are perceived.

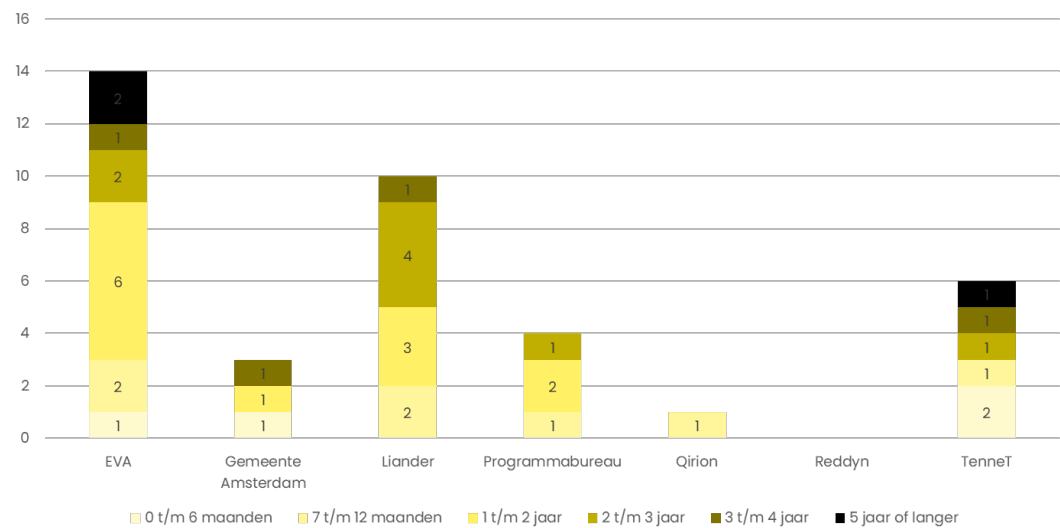


Figure F.2: Experience Level of Survey Respondents

F.3. Likert-Scale Questions

Likert-scale questions were mainly used to assess collaboration in practice, across cables, MSR and stations, and to evaluate perceptions of the TFCA governance arrangement.

F.3.1. Collaboration in Practice

This section presents the results regarding how respondents experience daily collaboration with partner organizations across different infrastructure domains: cables, MSR, and stations. Overall, the results show that collaboration is generally evaluated positively across all domains. Most responses are concentrated in the higher range of the Likert scale (scores 3–5), indicating that respondents experience day-to-day collaboration as constructive (Figures F.3, F.4, F.5).

When comparing the different domains, collaboration around MSR appears to be evaluated most positively, with a strong concentration of high scores. Collaboration around cables and stations also receives relatively positive evaluations, although with slightly more variation between organizations. Differences between organizations are visible. Respondents from EVA, Liander, and TenneT tend to report relatively positive experiences, while smaller groups (such as Qirion and Reddyn) show more variation in their assessments. This suggests that collaboration experiences may depend on organizational position within the system and level of involvement. In addition, the results show that respondents who are more actively involved in coordination structures (such as coordination teams and workstreams) tend to evaluate collaboration more positively than respondents who are less directly involved.

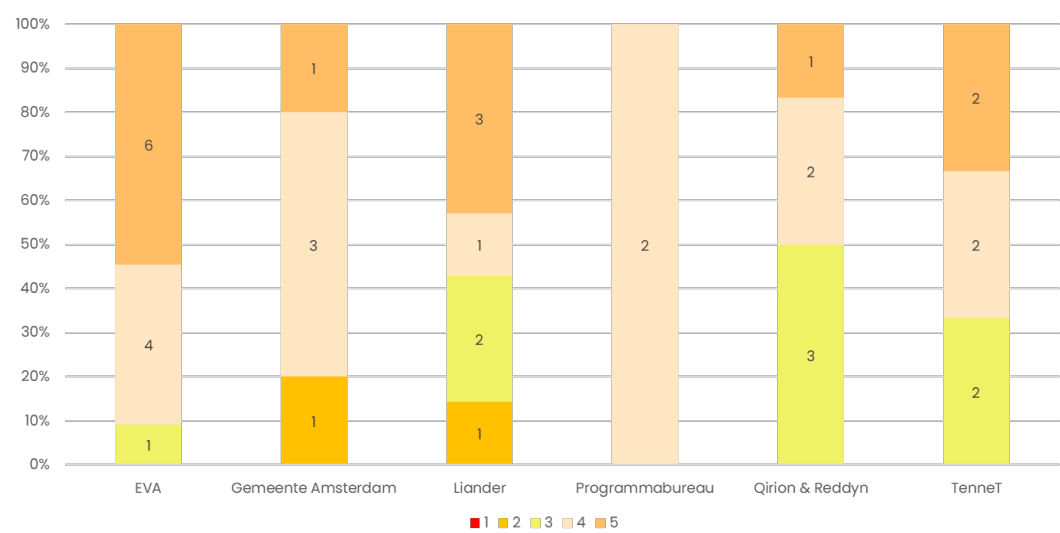


Figure F.3: Evaluation of Collaboration (Cables), N=37

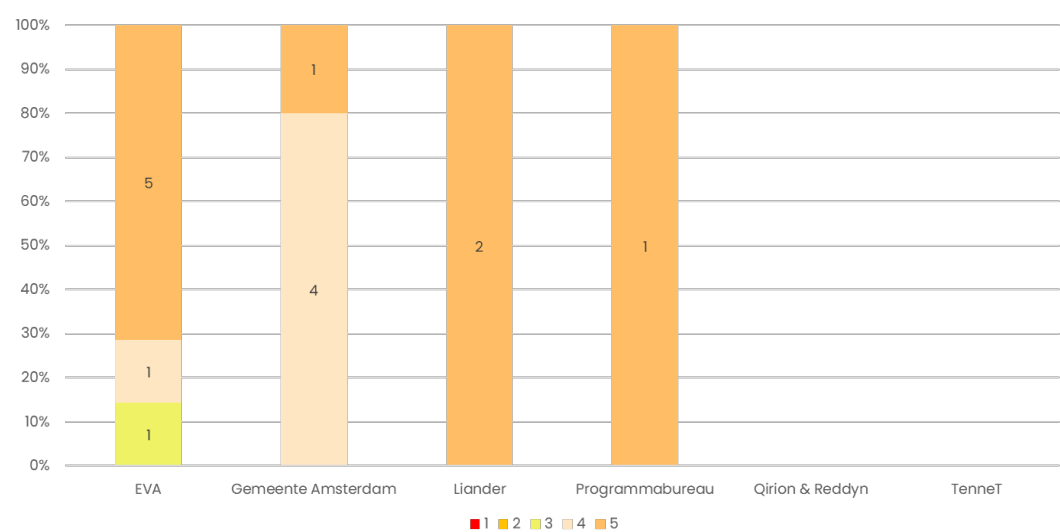


Figure F.4: Evaluation of Collaboration (MSR), N=15

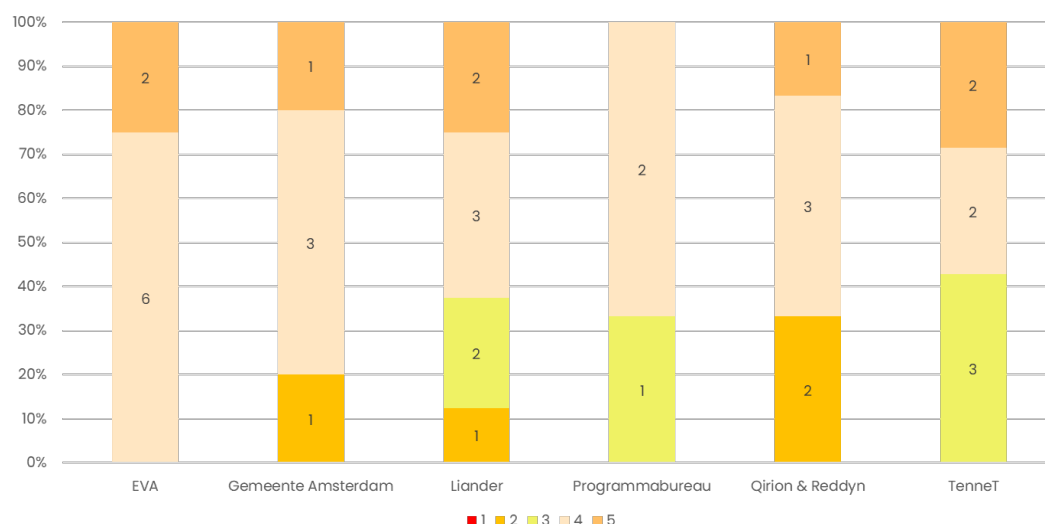


Figure F.5: Evaluation of Collaboration (Stations), N=37

F.3.2. Evaluation of TFCA Governance Arrangement

The second set of questions focuses on the evaluation of the TFCA governance arrangement, including structure, alignment between consultation layers, role clarity, escalation and collaboration culture. Compared to day-to-day collaboration, these results show a more mixed picture. The figures below present the results by consultation layer.

Structure and Coordination

Figure F.6 shows that respondents generally evaluate the overall structure of the TFCA governance arrangement moderately to positively. Higher scores are particularly observed among respondents involved in central coordination structures, suggesting that proximity to formal decision-making processes may influence perceptions of effectiveness. At the same time, there is noticeable variation across organizations, indicating that the perceived effectiveness of the governance arrangement is not uniform.

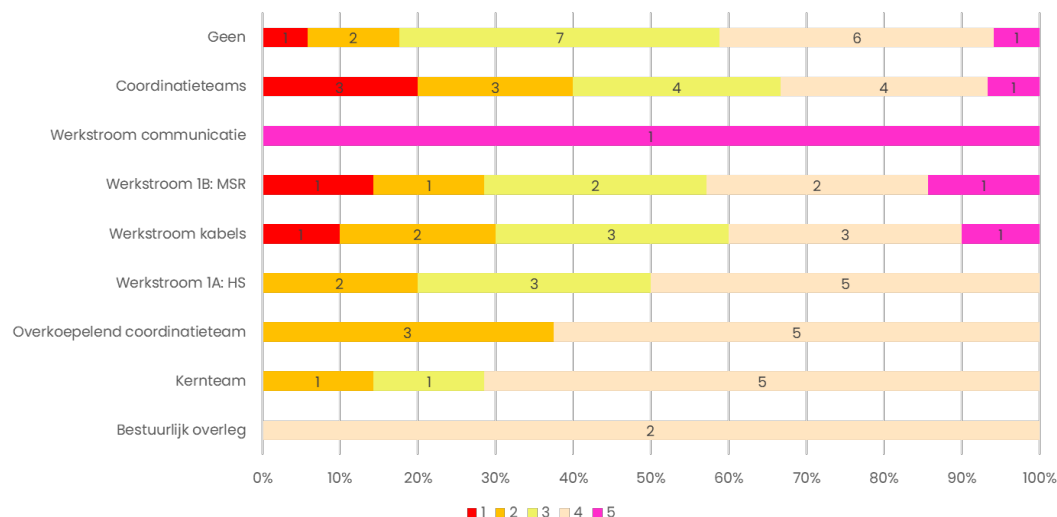


Figure F.6: Evaluation of the TFCA Governance Arrangement

Alignment of Consultative Layers

Figure F.7 shows that the alignment between different consultative layers is evaluated more critically. Responses are more evenly distributed across the scale, with a significant share of respondents indicating

only moderate alignment. This suggests that while coordination mechanisms exist, they are not always experienced as fully coherent or well-integrated.

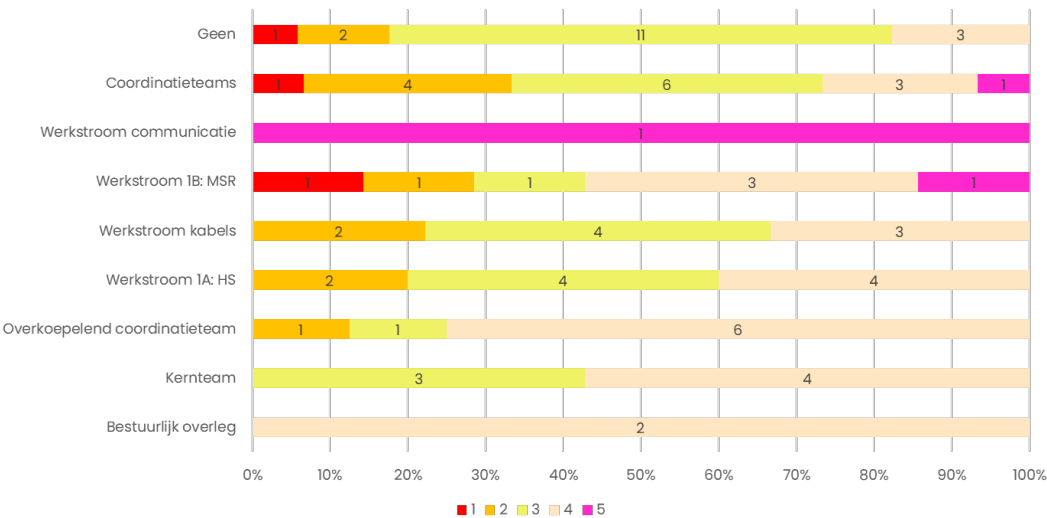


Figure F.7: Evaluation of Alignment between TFCA Consultation Layers

Clarity of Roles and Responsibilities

Figure F.8 shows that the results indicate that clarity regarding roles and responsibilities is a key challenge. Responses are widely distributed, with relatively few high scores and a substantial number of moderate and low evaluations. This suggests that ambiguity in responsibilities remains an important bottleneck within the governance arrangement.

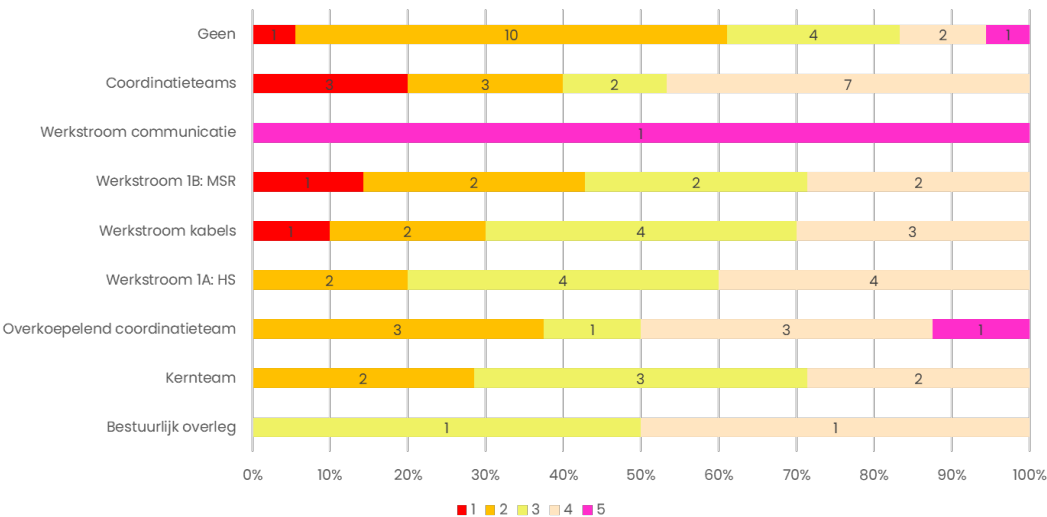


Figure F.8: Evaluation of Role Clarity and Responsibilities

Escalation of Bottlenecks

Figure F.9 shows that escalation mechanisms are evaluated most critically. Compared to other aspects, this category shows the highest share of low scores. This suggests that although collaboration is perceived as relatively strong, stakeholders experience difficulties in effectively addressing and resolving bottlenecks when they arise.

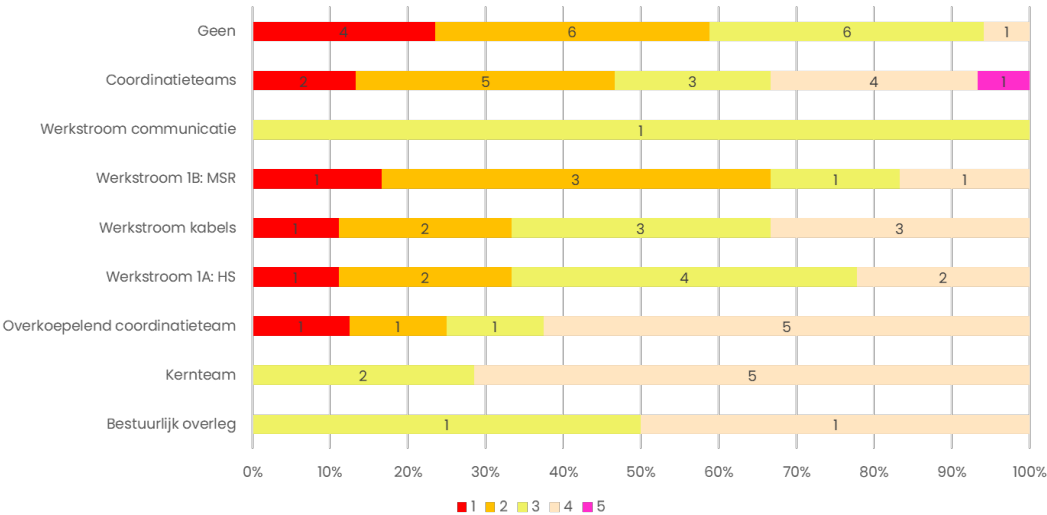


Figure F.9: Evaluation of Escalation of Bottlenecks

Collaboration Culture

Figure F.10, in contrast, shows that the collaboration culture within the TFCA governance arrangement is evaluated relatively positively. Most respondents assign moderate to high scores, indicating that interpersonal relations and willingness to collaborate are generally strong. This highlights an important distinction: while the social dimension of collaboration functions well, institutional mechanisms for decision-making and escalation appear less effective.

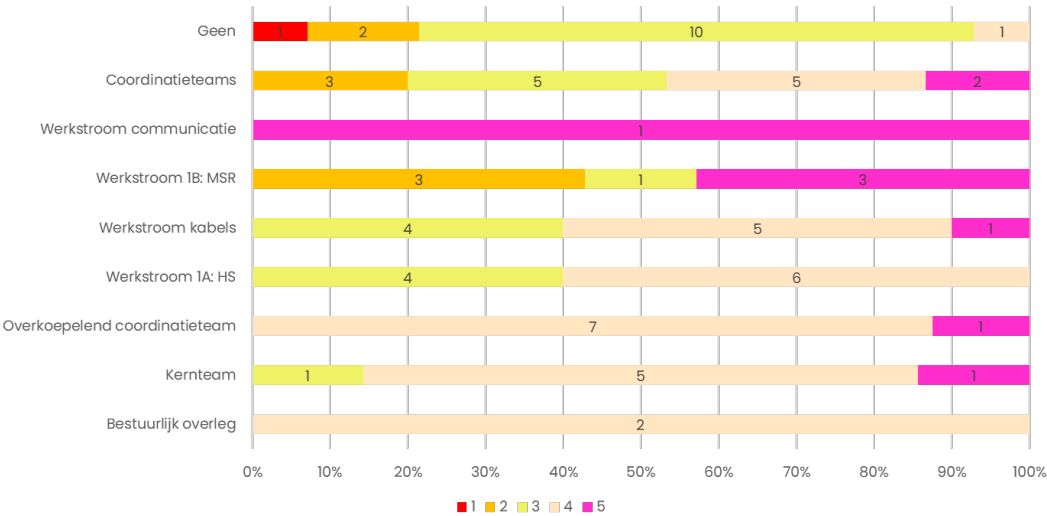


Figure F.10: Evaluation of Collaboration Culture within the TFCA

F.4. Open Questions

Open-ended questions were used to capture nuances and recurring patterns in stakeholder perceptions. A summary of the recurring themes in the open-ended questions can be found in Table F.2.

Open-ended question theme	Main recurring themes
Bottlenecks in cables, stations and MSR	Spatial scarcity, unclear decision routes, perceived lack of mandate, capacity shortages, technical complexity and information gaps.
Project-level collaboration	Strong interpersonal relations and short communication lines, but limited by unclear roles, lack of decision authority and organizational complexity.
TFCA-level collaboration	Added value in bringing actors together, but limited by unclear mandate, complex decision-making and difficulty moving from coordination to action.
Future role of the TFCA	Need for stronger steering, clearer prioritization, improved communication, knowledge sharing and better alignment with execution.

Table F.2: Summary of recurring themes in open-ended survey responses

F.4.1. Bottlenecks in Cables, Stations and MSR

The open-ended responses show that bottlenecks in the realization of cables, stations, and MSR are primarily driven by a combination of spatial constraints and governance complexity. The most frequently mentioned issue is the scarcity of physical space, both above and below ground, which complicates the spatial integration of infrastructure in a dense urban environment. In addition, respondents emphasize the presence of many stakeholders with competing interests, leading to fragmented issue preparation, decision routes, formal decision-making and delays.

Governance-related challenges are equally prominent. Respondents point to unclear formal decision-making structures, especially within the municipality, and a lack of clear roles and mandates across organizations. This is reinforced by coordination issues, where insufficient alignment between teams and organizations leads to inefficiencies. Furthermore, capacity shortages, technical complexity, and a lack of transparent and up-to-date information contribute to delays in project realization. Overall, the results indicate that bottlenecks are not only technical or spatial in nature, but are strongly shaped by institutional fragmentation and coordination challenges.

F.4.2. Collaboration within Projects (Operational Level)

At the project level, collaboration is generally perceived as functioning relatively well, particularly when strong interpersonal relationships and direct communication are present. Respondents highlight that successful collaboration is driven by factors such as mutual understanding, short communication lines, a shared sense of urgency, and physical co-location.

However, this positive experience is contrasted by structural barriers. The main challenges relate to unclear roles and responsibilities, lack of formal decision-making authority, and complex organizational structures behind the project teams. Respondents note that decisions are often taken outside the immediate project context, limiting the effectiveness of collaboration within the project itself. This points to a tension between the “soft” and “hard” dimensions of collaboration: while trust, communication, and relationships enable effective day-to-day cooperation, formal structures, mandates, and procedures often constrain the ability to act decisively.

F.4.3. Collaboration within the TFCA Governance Arrangement

At the level of the TFCA as a governance arrangement, a similar pattern emerges. Respondents generally recognize the added value of the TFCA in bringing stakeholders together and facilitating collaboration. The importance of personal relationships, communication, and a shared goal is consistently emphasized.

At the same time, significant barriers remain. The most frequently mentioned issues relate to unclear roles, insufficient mandate, and complex decision-making processes. Respondents indicate that the TFCA is often perceived as more facilitative than directive, with limited authority to enforce decisions or resolve conflicts. Additionally, underlying organizational interests and institutional complexity continue

to influence collaboration, sometimes undermining collective action.

Interestingly, many of the proposed improvements directly mirror the identified bottlenecks. Respondents call for clearer roles and responsibilities, stronger mandate and formal decision-making power, improved communication and transparency, and more integrated planning and coordination. This suggests that the perceived challenges are well understood by stakeholders, but not yet structurally addressed.

F.4.4. Developments and Future of the TFCA

Looking towards the future, respondents highlight several developments that will further increase the pressure on the system. These include growing energy demand, increasing spatial constraints, limited capacity and resources, and rising complexity in project execution. These developments reinforce the need for more effective coordination and governance.

In terms of the future role of the TFCA, respondents emphasize the importance of strengthening collaboration, improving issue preparation, decision routes, formal decision-making and prioritization, and enhancing alignment between processes and organizations. There is a clear call for stronger steering, clearer prioritization, and more decisive action, particularly in relation to spatial choices and investment decisions.

At the same time, respondents stress the need for better communication, expectation management, and knowledge sharing, both between organizations and towards the broader environment. Ensuring societal support and managing the impact on the urban environment are seen as critical conditions for successful implementation. Overall, the open-ended responses show that respondents value the TFCA as a platform for collaboration, but also point to recurring concerns about role clarity, mandate, prioritization and alignment with execution. These findings provide background to the problem definition in Chapter 5.

G | Interview Overview and Summaries

This appendix provides an overview of the interviews conducted for this research. It includes the interview types, guiding questions and summarized interview insights. The appendix does not include full transcripts. Instead, the interviews are summarized to show how the empirical material contributed to the system analysis, problem definition, ideation phase and validation of the governance design.

Respondents are referred to by interview codes rather than by personal names. This is done to reduce identifiability and to keep the focus on the analytical contribution of the interviews rather than on individual respondents. The full interview material was used for qualitative analysis, but the appendix only presents the parts that are relevant for understanding the research process and the main empirical findings.

G.1. Interview Types and Purpose

As described in the methodology, interviews were used at different stages of the research. The interviews did not all have the same function. Some interviews were exploratory and helped to understand the development of the TFCA and the Amsterdam context. Other interviews were used to reflect on regional governance arrangements, to explore future developments or to evaluate and refine the proposed governance design.

Table G.1 gives an overview of the interview types and their role in the research.

Interview type	Respondent codes	Purpose in the research
Exploratory Amsterdam interviews	E1–E5	To understand the development of the TFCA, the Amsterdam grid congestion context, perceived bottlenecks, and the role of collaboration, coordination and escalation in practice.
Exploratory regional interviews	R1–R6	To understand how grid congestion governance is organized in other regional contexts. These interviews were used as reflective input, not as a full comparative case study or benchmark.
System and futuring interviews	S1–S4	To explore how the Amsterdam grid congestion task may change in the coming years and what this means for the future role and organization of the TFCA governance arrangement.
Evaluation and validation interviews	V1–V2	To evaluate and refine the proposed governance design, identify practical risks and assess whether the design components were recognizable, feasible and useful.

Table G.1: Overview of interview types and their role in the research

G.2. Guiding Questions

The interviews were semi-structured. This means that guiding questions were prepared beforehand, but the interviews also allowed respondents to elaborate on issues that they considered important. Because the interviews had different roles in the research, different question sets were used.

G.2.1. Exploratory Amsterdam Interviews

The exploratory Amsterdam interviews were relatively open. They focused on the development of the TFCA, the main bottlenecks in the Amsterdam grid congestion context and the perceived value and limitations of the current collaboration. The guiding topics included:

- How has the TFCA developed over the past years?
- What were important milestones in the collaboration?
- What are the main bottlenecks in grid expansion in Amsterdam?
- What is the added value of the TFCA governance arrangement?
- Where does the current collaboration reach its limits?
- How are decisions, escalation and responsibilities organized in practice?

G.2.2. Exploratory Regional Interviews

The regional interviews were conducted with respondents from Rotterdam, Holland-Rijnland and the Province of North-Holland. These interviews were used to understand how collaboration around grid congestion and grid expansion is organized in other contexts. They were not used as a direct comparison or as best-practice cases for Amsterdam. The guiding topics included:

- What is the main grid expansion or congestion-related task in the region?
- Which actors are mainly involved?
- How is collaboration organized?
- Is an independent party involved in the collaboration?
- How has the collaboration developed over time?
- What are the main strengths and limitations of the regional approach?
- Which lessons may be relevant for reflecting on Amsterdam, without directly copying the regional arrangement?

G.2.3. System and Futuring Interviews

The system and futuring interviews focused on how the Amsterdam task may change towards 2030 and what this could mean for the future role of the TFCA. The guiding topics included:

- What are the main expected developments in the grid congestion task towards 2030?
- Which substantive changes may affect the collaboration?
- How may the balance between grid expansion, better grid use and implementation change?
- What does this mean for the role of the municipality, grid operators and other actors?
- Which issues will require more or less attention in the coming years?
- Which form of collaboration would fit the future task best?

G.2.4. Evaluation and Validation Interviews

The evaluation and validation interviews focused on the proposed governance design. These interviews were conducted with independent facilitators involved in the TFCA governance arrangement. The guiding topics included:

- How do you evaluate the proposed governance design based on your experience with the TFCA?
- Which elements are recognizable and useful?
- Which elements may be difficult or unrealistic to implement?
- Which risks or missing elements do you see?
- How do you evaluate possible interventions such as role clarification, escalation triggers, shared information structures and expert support?
- How do you reflect on the possibility of stopping or reducing parts of the current arrangement?
- How should better grid use and future energy system topics be positioned in relation to the TFCA?

G.3. Interview Overview

Table G.2 provides a summarized overview of the interviews. The respondent codes are used throughout the appendix and in the analytical coding process.

G.4. Summary of Exploratory Amsterdam Interviews

The exploratory Amsterdam interviews were used to better understand the development, strengths and limitations of the TFCA governance arrangement. Several recurring themes emerged.

G.4.1. Shared Understanding and Coordination

Respondents described the TFCA as valuable because it helped actors develop a more shared understanding of the grid congestion challenge. The arrangement brought the municipality, grid operators and other actors together around a common problem. This helped reduce misunderstandings and created a clearer basis for coordination. Integrated planning, process management and shared information were repeatedly mentioned as important contributions.

At the same time, respondents also indicated that shared understanding does not automatically lead to implementation. The TFCA can create alignment and improve coordination, but formal decisions and implementation responsibilities remain within the participating organizations.

G.4.2. Mandates, Responsibilities and Escalation

A recurring theme in the exploratory interviews was the tension between collaboration and formal responsibility. Respondents noted that actors sometimes expect the TFCA, the KT or the program director to create breakthroughs, while the formal mandates remain with individual organizations. This creates uncertainty about what the TFCA can actually decide, prepare or escalate.

Several respondents emphasized that escalation needs to become sharper and more structured. Issues can remain under discussion for a long time, while it is not always clear when they should be escalated or who should take ownership. Independent facilitation was seen as useful because it can help put issues on the agenda and prevent actors from avoiding difficult discussions.

G.4.3. Spatial Scarcity and Public Space

The interviews confirmed that grid congestion in Amsterdam is closely connected to spatial scarcity. Grid expansion requires space for substations, transformer houses and cable routes, but public space is already contested by housing, mobility, greening, climate adaptation and other urban priorities. Respondents emphasized that this means Amsterdam must make explicit spatial choices if it wants to realize the required infrastructure.

This also means that grid expansion is not only a technical challenge. It is also a spatial planning and governance challenge. Coordination between energy, public space, permitting, planning and implementation actors is therefore essential.

G.4.4. Implementation and Capacity Constraints

Respondents also pointed to constraints that the TFCA cannot directly solve. These include shortages of technical personnel, permitting procedures, material constraints, internal organizational procedures and limited execution capacity. The TFCA can help identify and prepare bottlenecks, but it does not itself control all conditions required for implementation.

Several interviews suggested that the added value of the TFCA is strongest in the early planning and location decision phases. Once projects move towards implementation, other actors and project organizations become more important. This raises the question of how the TFCA should remain connected to implementation without taking over formal project responsibilities.

G.4.5. Communication and Institutional Memory

Respondents also emphasized the importance of communication and continuity. Collaboration has improved partly because people know each other and have built informal relationships. However, staff turnover makes this fragile. When people leave, knowledge and trust can easily be lost. External

facilitation and shared documentation were therefore seen as important for maintaining collective memory and continuity in the collaboration.

G.5. Summary of Exploratory Regional Interviews

The exploratory regional interviews were used as reflective input. They are not treated as a formal comparative case study. The interviews show that governance arrangements around grid congestion differ strongly across regional contexts and that organizational structures cannot be copied directly from one region to another.

G.5.1. Holland-Rijnland

The Holland-Rijnland interviews show a more flexible and facilitation-oriented approach. The regional taskforce supports municipalities that have limited internal knowledge and capacity to work on grid congestion and grid expansion. The taskforce does not take over formal responsibilities, but helps to clarify the process, support municipalities and mediate between actors when projects get stuck.

Independent facilitation is especially important in this context. Respondents emphasized that grid congestion governance often depends on human interaction, trust and the ability to create a shared overview. The taskforce helps actors understand what needs to happen, who should be involved and when issues should be escalated.

For Amsterdam, the Holland-Rijnland experience cannot be directly copied because the scale, spatial pressure and institutional complexity are different. However, it does show the potential value of early-stage intervention, independent facilitation and flexible expert support.

G.5.2. Rotterdam

The Rotterdam interviews show a more municipal and project-based way of organizing grid congestion governance. Rotterdam does not use a dedicated taskforce comparable to the TFCA. Instead, coordination is organized through the municipal organization and existing departments. Collaboration with grid operators takes place mainly through specific projects and location decisions.

A central element in the Rotterdam approach is early project preparation, including start documents, location studies and shortlists of possible locations. This helps combine technical and spatial perspectives earlier in the process. The port context also matters, because a large part of the infrastructure task is concentrated in the port area, while the municipality focuses more on the urban area.

For Amsterdam, Rotterdam does not provide a direct model. Amsterdam has a larger and more spatially constrained task, with more actors and more complex coordination needs. However, the Rotterdam interviews show the value of pragmatic coordination, early location work and shorter lines between spatial planning and energy departments.

G.5.3. Province of North-Holland

The interview with the provincial E-infrastructure taskforce provided insight into the broader regional governance context. The provincial structure supports coordination between grid operators, municipalities and the province. It works with different work tracks, including infrastructure realization, energy vision and better grid use. Regional clusters are used to monitor progress and identify when escalation may be needed.

This is relevant for Amsterdam because grid congestion does not stop at municipal boundaries. At the same time, the provincial structure does not replace Amsterdam's local decision-making authority or spatial planning responsibility. The Amsterdam TFCA governance arrangement therefore needs to remain locally focused while staying connected to provincial and regional coordination where dependencies arise.

G.6. Summary of System and Futuring Interviews

The system and futuring interviews focused on how the task may change in the coming years and what this means for the future role of the TFCA. These interviews show that the collaboration is moving from early alignment and location decision-making towards implementation, execution and possible future

topics such as better grid use.

G.6.1. Shift Towards Implementation

Several respondents emphasized that the number of location decisions is decreasing and that the focus is shifting towards implementation. This changes the actor constellation. In later phases, actors such as project managers, implementation teams, contractors, permitting authorities and environmental managers become more important. This suggests that the TFCA should not only focus on early planning, but should also create clearer links to implementation risks and project phases.

At the same time, respondents warned that the TFCA should not take over regular execution processes. Formal implementation responsibility remains with the project organizations of the grid operators and the municipality. The governance challenge is therefore to create better interfaces between coordination and implementation, not to turn the TFCA into an execution organization.

G.6.2. Need for Sharper Issue Preparation

The system and futuring interviews also showed that the current collaboration sometimes lacks sharpness. Some issues continue to circulate between meetings without becoming sufficiently concrete for escalation or issue preparation. Respondents suggested that problems should be formulated more clearly, including the decision needed, the responsible actors, possible options and the consequences of delay.

This supports the need for clearer issue preparation, escalation triggers and documentation of decisions and agreements. It also connects to the broader need for collective memory and shared information structures.

G.6.3. Future Role of the TFCA

Respondents saw continued value in the TFCA, but also questioned how its role should evolve. The current arrangement has improved mutual understanding and alignment, but its ability to accelerate implementation remains limited. The future role of the TFCA should therefore focus on strengthening the conditions for acceleration: clearer roles, better escalation, improved internal anchoring and earlier identification of implementation risks.

Better grid use and future energy system topics were mentioned as relevant, but less developed than the physical grid expansion task. These topics may require different actors, different knowledge and possibly a different governance level. For that reason, they are better treated as exploratory or pilot topics rather than as the immediate core of the redesign.

G.7. Summary of Evaluation and Validation Interviews

The evaluation and validation interviews were used to assess and refine the proposed governance design. These interviews were conducted after the main problem definition and ideation activities. They therefore did not form the basis for the governance tensions in Chapter 5, but were used to evaluate the feasibility, clarity and risks of the proposed design.

G.7.1. General Evaluation of the Proposed Design

The proposed design was generally recognized as relevant, but respondents emphasized that each design choice needs to be clearly justified. It should be clear why a specific workstream, consultation layer or intervention is added, changed or removed. Without this reasoning, the design risks becoming another layer of governance rather than a clearer arrangement.

Respondents also warned against combining topics too easily. For example, stations and cable routes are connected, but they involve partly different actors, issues and coordination needs. A design that combines them too strongly may become less workable in practice.

G.7.2. Function of Existing Coordination Layers

The validation interviews also showed that existing coordination layers should not be removed too quickly. Some meetings may appear to add complexity, but they also provide overview, informal alignment and low-threshold escalation. The question is therefore not only whether a meeting should exist, but what its purpose, frequency, agenda and decision-preparation function should be.

This supports the design direction of adapting and sharpening the current TFCA governance arrangement rather than replacing or stopping it entirely.

G.7.3. Expert Support, Budget and Escalation

Respondents were cautious about adding permanent expert resources or shared budgets without clear activation criteria. Expert support can be useful, but not every bottleneck is caused by a lack of expertise. Some bottlenecks are caused by unclear ownership, lack of capacity, internal organizational constraints or unresolved decision-making.

A shared strategic budget or common pot may help when small financial disputes block progress, but it should be linked to clear escalation and decision rules. Otherwise, it may create new ambiguity about ownership and responsibility.

G.7.4. Implementation Actors and Phase Sensitivity

The validation interviews confirmed that implementation actors become more relevant as projects move towards later phases. However, they should be involved selectively and at the right moments, rather than permanently added to all coordination structures. This supports a phase-sensitive design approach, in which actors are involved when their role becomes relevant to a specific project phase or bottleneck.

G.7.5. Regional and Provincial Alignment

The validation interviews also clarified the relation between the Amsterdam TFCA and the provincial governance context. Amsterdam should not be presented as subordinate to provincial structures, because spatial planning decisions remain local. Provincial structures are useful for knowledge exchange, regional alignment and broader energy system discussions, but they do not replace the Amsterdam-specific governance arrangement.

This supports the design principle that the TFCA should remain focused on Amsterdam, while maintaining links to regional and provincial structures where dependencies arise.

G.8. Use of Interview Material in the Thesis

The interview material was used in different ways throughout the thesis. The exploratory Amsterdam interviews informed the understanding of the TFCA, the stakeholder analysis and the problem definition. The exploratory regional interviews were used as reflective input for understanding context-dependence and for positioning the final deliverable. The system and futuring interviews informed the design requirements and the expected future role of the TFCA. The evaluation and validation interviews were used to refine the final governance design and identify implementation risks.

G.9. Conclusion

The interviews provide the main qualitative basis for understanding how grid congestion governance is experienced in practice. Across the interviews, several recurring themes emerge: the TFCA has improved coordination and shared understanding, but formal mandates, escalation, implementation capacity and spatial constraints continue to limit acceleration. The regional interviews show that governance arrangements are context-dependent and cannot be copied directly across regions. The system and futuring interviews show that the task is shifting towards implementation and may require more phase-sensitive governance. The validation interviews confirm that the final design should strengthen and clarify the existing TFCA governance arrangement rather than simply adding more meetings, actors or procedures.

Code	Respondent type	Main contribution to the research
E1	Grid operator representative	Highlighted the spatial implications of grid expansion, the limits of the TFCA in changing internal municipal procedures, and the need for explicit spatial choices in Amsterdam.
E2	Municipality of Amsterdam representative	Explained the development of the TFCA, the importance of joint problem analysis, integrated planning, process management and shared information.
E3	Municipal public space / infrastructure perspective	Emphasized that collaboration can become too complex when roles, decision routes and information systems remain unclear. Also stressed the importance of escalation and shared information.
E4	Planning advisor	Highlighted the added value of the TFCA in early planning phases, while noting that later implementation phases are still shaped by capacity, permitting and execution constraints.
E5	Strategic communication perspective	Emphasized improved collaboration and informal networks, but also pointed to staff turnover, the need for collective memory and the limited effect of collaboration on actual acceleration.
R1	Holland-Rijnland taskforce perspective	Explained the regional taskforce approach, the role of independent facilitation and the importance of supporting municipalities with limited capacity.
R2	Holland-Rijnland energy planning perspective	Highlighted that regional collaboration depends strongly on relationships, early alignment and the ability to create a shared overview between municipalities, province and grid operators.
R3	Regional energy system / scenario perspective	Provided broader reflection on regional energy system planning, scenario work and the need to connect system insights to implementation and governance capacity.
R4	Rotterdam municipal energy planning perspective	Explained the Rotterdam approach, where coordination is organized through the municipal organization rather than through a dedicated taskforce.
R5	Rotterdam grid congestion program perspective	Described Rotterdam's project-based way of working, including start documents, location studies and the role of existing municipal departments.
R6	Provincial E-infrastructure taskforce perspective	Explained the provincial coordination structure in North-Holland, including work tracks, regional clusters, monitoring and escalation.
S1	Municipality of Amsterdam representative	Reflected on the difficulty of bringing different grid operator tasks together and the importance of trust, information sharing and clearer collaboration routines.
S2	Municipality of Amsterdam representatives	Discussed the usefulness of the current structure, but also the need for sharper issue preparation, clearer escalation and better handling of small financial or organizational bottlenecks.
S3	Regional grid operator representative	Emphasized the shift from location decisions towards implementation, and the need to involve implementation actors such as project teams, contractors and environmental managers at the right moment.
S4	National grid operator representative	Reflected that the TFCA has created shared understanding, but has not automatically created acceleration. Also emphasized the tension between legal tasks, municipal ambitions and execution.
V1	Independent facilitator	Evaluated the proposed design and emphasized the need to justify each design choice, avoid unnecessary combinations of workstreams and keep expert support selective.
V2	Independent facilitator / program director role	Refined the proposed design by stressing Amsterdam's local autonomy, the importance of the current coordination arrangement and the need to connect but not subordinate Amsterdam to provincial structures.

Table G.2: Overview of interview respondents and main contributions

H | Qualitative Coding Analysis

This appendix presents the qualitative coding analysis conducted for the interview data. It explains how the initial coding framework was developed, how it was refined during the analysis, and how the final coding structure was used to support the interpretation of governance dynamics, collaboration challenges and implementation bottlenecks in Chapter 5. The appendix should be read as supporting material for the interview analysis, not as a separate results chapter.

The interviews were analyzed through thematic coding in ATLAS.ti. ATLAS.ti was used as a tool to organize, compare and retrieve coded interview segments. The interpretation of the codes was carried out by the researcher. The coding structure combines theoretical insights from collaborative governance and Multi-Level Governance (MLG) literature with empirically grounded themes that emerged during the interviews. Together, this provides transparency into the analytical process underlying the interpretation of governance dynamics within the electricity system.

The coding process was inspired by the logic of moving from first-order codes to broader themes and aggregate dimensions. First-order codes were kept close to the language and meaning of respondents. These codes were then iteratively compared, refined and grouped into broader themes. Finally, these themes were related to aggregate dimensions such as starting conditions, institutional design, facilitative leadership, collaborative process, intermediate outcomes, MLG and operational constraints. This process followed an abductive logic, in which theoretical concepts and empirical observations were iteratively aligned.

H.1. Coding Approach

The qualitative interview data collected in this study were analyzed using thematic analysis. Thematic analysis is a qualitative method for identifying, analyzing and interpreting patterns in textual data. It allows the researcher to systematically examine stakeholder perspectives while remaining sensitive to emerging insights from the data.

The qualitative analysis was guided by the collaborative governance framework of Ansell and Gash (2008), which was used as an analytical lens rather than as a strictly deductive coding template. The main components of this framework, including starting conditions, institutional design, facilitative leadership, collaborative process and outcomes, informed the analysis. At the same time, the coding structure remained open to refinement and extension based on the empirical material.

In addition to the Ansell Gash framework, a MLG perspective was incorporated to capture interactions across administrative levels. Codes such as national-local coordination, vertical governance tensions and role clarity across levels were included to reflect the layered nature of governance in the Dutch electricity system. This was important because grid congestion governance does not only take place between organizations at the local level, but also depends on regional, provincial and national actors, regulations and responsibilities.

The coding process therefore combined deductive and inductive elements. The deductive component was based on the collaborative governance framework and MLG theory. The inductive component emerged from recurring themes and patterns identified during the interviews, such as mandate clarity, internal governance alignment, spatial constraints, implementation capacity, information gaps and recommendations for improving the current collaboration.

H.2. Development of the Coding Framework

H.2.1. Initial Coding Framework

The initial codebook provided a structured starting point for coding and reflected both theoretical insights and system-specific considerations. These codes were first tested on the exploratory interviews.

The development of the initial codebook was primarily guided by the collaborative governance framework of Ansell and Gash (2008). The main dimensions of this framework were translated into main code categories: starting conditions, institutional design, facilitative leadership, collaborative process and outcomes. These categories structured the analysis and allowed for a systematic examination of how collaboration within the electricity system was perceived and organized.

Within each category, more specific codes were developed to capture relevant sub-dimensions. For example, within starting conditions, codes such as power asymmetries, resource differences, knowledge asymmetries and initial trust levels were included. Institutional design captured elements such as stakeholder inclusiveness, clarity of roles and responsibilities, governance structures and regulatory constraints. The collaborative process was further operationalized through codes related to dialogue, trust-building, shared understanding and commitment to the process.

The initial codebook was intentionally designed to remain flexible. During the analysis, codes were refined, merged or expanded based on emerging empirical insights. This reflects the abductive research approach of this study, in which theoretical concepts and empirical observations were continuously aligned.

H.2.2. Refinement of the Coding Framework

After the initial codebook was developed and tested on the exploratory interviews, it was iteratively refined based on insights emerging from the interview data. During the coding of the first set of interviews, several additional themes emerged that were not fully captured by the initial, theory-driven coding structure. In particular, respondents frequently referred to practical constraints, organizational dynamics and system-specific challenges that extend beyond the core dimensions of the collaborative governance framework. To account for these insights, additional codes were introduced and existing codes were further specified.

A first important refinement related to the role of organizational context and internal governance structures. While the initial codebook included general categories such as institutional design and facilitative leadership, the interviews revealed more specific challenges related to mandate, internal governance alignment and the position of actors within their own organizations. Respondents highlighted the limited mandate of certain actors and the dependency on internal organizational structures, such as access to funding, political support and alignment with internal policies. These insights were incorporated by refining existing codes and adding more explicit attention to mandate and organizational backing.

Second, the interviews emphasized the importance of legal and institutional interpretations, particularly regarding the formal responsibilities of grid operators and municipalities. Differences in how actors interpret their formal role and responsibilities were found to influence both collaboration and issue preparation. This was therefore incorporated within the codes related to institutional design and starting conditions.

Third, additional attention was given to political and administrative dynamics. Respondents indicated that political priorities, administrative changes and external events can affect prioritization, decision routes and the stability of collaboration. These dynamics were incorporated into the coding structure by extending the interpretation of starting conditions and institutional design.

Fourth, the analysis highlighted the importance of practical collaboration mechanisms, such as frequency of interaction, physical co-location and informal communication. While these elements were partly captured under collaborative process and facilitative leadership, the coding was refined to more explicitly include the role of day-to-day interaction practices in enabling or constraining collaboration.

Finally, a set of more inductive, empirically grounded codes was added to capture recurring operational challenges and suggested improvements. These included spatial constraints, capacity shortages, technical complexity, information gaps, planning instability and recommendations for improving collaboration. Although these codes are not directly derived from the collaborative governance framework, they provide important context for understanding how governance challenges manifest in practice.

Overall, the refinement of the codebook resulted in a more comprehensive and context-sensitive coding structure, in which both theoretical dimensions and empirically observed themes are integrated. This

strengthened the ability to capture the complexity of governance dynamics in the Amsterdam electricity system.

H.2.3. Final Coding Structure

After multiple rounds of coding and comparison between interviews, the coding structure was further refined into a final version. This final version reflects the transition from an initially theory-driven coding framework towards a more empirically grounded coding structure. Several codes were merged, specified, renamed or removed in order to better capture recurring governance dynamics observed in the interviews. At the same time, several highly abstract or overlapping codes were removed or merged in order to improve analytical clarity and reduce redundancy.

Tables H.1 and H.2 present the final coding structure used for the analysis of the interviews. The tables show which codes were retained, which codes were added or refined and which codes were removed or merged into broader analytical categories.

Main code	Old codes retained	New or refined codes	Deleted or merged codes
Stakeholder	TenneT, DSO, Municipality, Province, EVA, Independent facilitator	–	Ministry
Part of TFCA	Bestuurlijk overleg, Coordinatieteam, Kernteam, Overkoepelend coordinatieoverleg, Workstream	–	–
Starting conditions	Power asymmetries, Resource differences, Knowledge asymmetries, Different incentives, Incentives for participation, History of cooperation/conflict	Political context, Internal organization	Constraints on incentives, Legal mandate interpretation, Initial trust
Institutional design	Stakeholder inclusiveness, Formal exclusiveness, Transparency of process, Regulatory constraints, Clear and unclear ground rules/responsibility	Mandate clarity, Internal governance alignment, Stuck in bureaucracy / existing structures, Lack of decision making	Formal governance structures, Decision-making structure, Stuck in existing structures
Facilitative leadership	Presence of coordinator, Neutral facilitation, Process management, Empowerment of actors	Escalation mechanisms, Costs independent parties, Lack of escalation	Conflict mediation, Creative problem solving, Data sharing, Long-term involvement, Regie / steering
Face-to-face dialogue	Meeting structures, Negotiation quality, Endless discussions	Physical co-location, Informal communication	Frequency of interaction
Trust building	Building mutual trust, Lack of trust	Cultural differences, Expectation management	Collaboration norms, Shared ownership, Lack of shared ownership, Shared commitment, Different commitment levels, Mutual recognition
Commitment to process	–	Shared ownership, Data sharing (internal memory), Lack of shared ownership, Shared commitment, Different commitment levels, Mutual recognition	Problem framing, Expectation management, Alignment, Misalignment

Table H.1: Final coding structure, part 1

Main code	Old codes retained	New or refined codes	Deleted or merged codes
Shared understanding	–	Shared goals, Unshared goals	Learning effects, Joint fact-finding, Separate fact-finding, Strategic plans, Different strategic plans
Intermediate outcomes	–	Small wins, Strategic plans, Different strategic plans, Joint fact-finding, Separate fact-finding	Policy effectiveness, Governance innovation, Implementation capacity, Faster decision-making, Improved coordination
MLG	National-local coordination, Vertical governance tensions, Network tensions (too many people involved)	Cross-level dependency	–
Operational and system constraints	Spatial constraints, Capacity shortages (people and/or material), Technical complexity, Information/communication gaps	Determining what has priority, Varying municipal departments, System- or organization-level constraint	Planning instability
Recommendations and improvements	Stronger coordination (steering or alignment), Improve integrated planning	Future focus recommendation, Governance recommendation, Improve current collaboration	Process flexibility, Role clarity improvements
Region	Amsterdam, Holland-Rijnland, Rotterdam, North-Holland	–	–

Table H.2: Final coding structure, part 2

The final iteration does not imply that deleted codes were irrelevant, but that they were either merged into broader analytical categories or removed because they overlapped with other codes. Several codes were moved between categories to better match their analytical meaning. For instance, shared ownership was treated as part of commitment to process rather than as a trust-building code.

The final coding structure was subsequently used as the basis for the thematic analysis of the interviews. Through systematic coding and comparison across respondents, governance levels and regions, the analysis identified recurring bottlenecks, tensions, collaboration mechanisms and perceived governance improvements.

H.3. Coding Frequency Outputs for Amsterdam Interviews

This section presents the main coding frequency outputs for the Amsterdam interviews. These figures are used as supporting material for the problem definition in Chapter 5. The figures should be interpreted as indicative patterns, not as statistical evidence. A higher frequency means that a theme was mentioned more often in the coded material, but not necessarily that it is objectively more important. The interpretation of the figures is therefore based on both frequency patterns and the underlying interview content.

H.3.1. Starting Conditions

Figure H.1 presents the coding frequencies related to starting conditions across stakeholder groups. The results suggest that municipalities and independent facilitators refer relatively frequently to resource differences, incentives and knowledge asymmetries. This indicates that collaboration starts from unequal organizational positions and capacities.

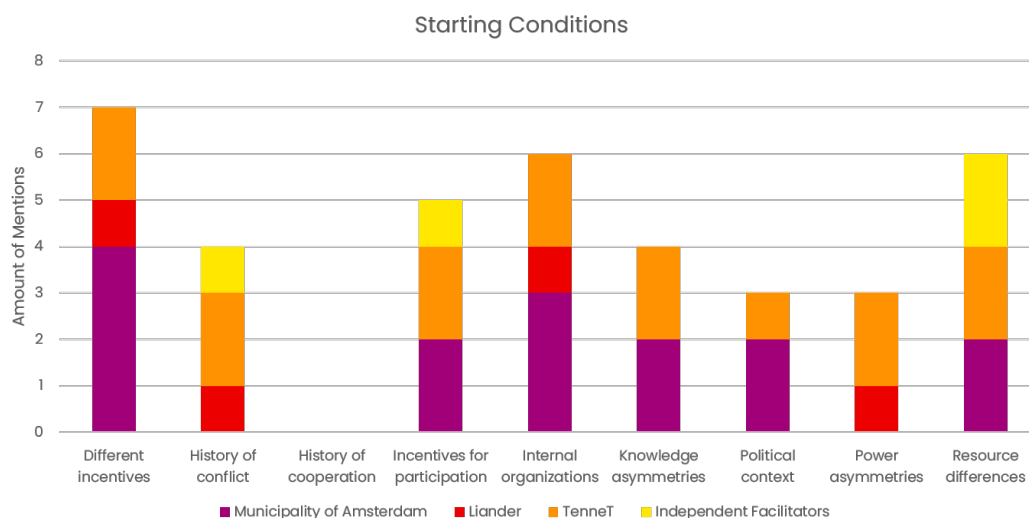


Figure H.1: Code frequencies for starting conditions in the Amsterdam interviews

The findings also indicate that collaboration is strongly driven by urgency and interdependence, as incentives for participation are mentioned across multiple stakeholder groups. At the same time, relatively limited references to trust and prior cooperation suggest that collaboration is not primarily rooted in long-standing collaborative relationships, but rather emerges from the necessity to jointly address grid congestion. The grid operator interviews further nuance these findings by showing that starting conditions are also shaped by internal capacity constraints, technical staffing shortages, project prioritization, and differences between strategic and implementation departments. Grid operator respondents recognize the need for collaboration, but also emphasize that collaboration must contribute to timely decisions and project realization.

H.3.2. Institutional Design

Figure H.2 shows the coding frequencies related to institutional design. Across stakeholder groups, recurring themes concern unclear responsibilities, lack of experienced issue preparation, internal governance alignment and bureaucratic rigidity. Municipal respondents most frequently emphasize challenges related to internal alignment and existing organizational structures.

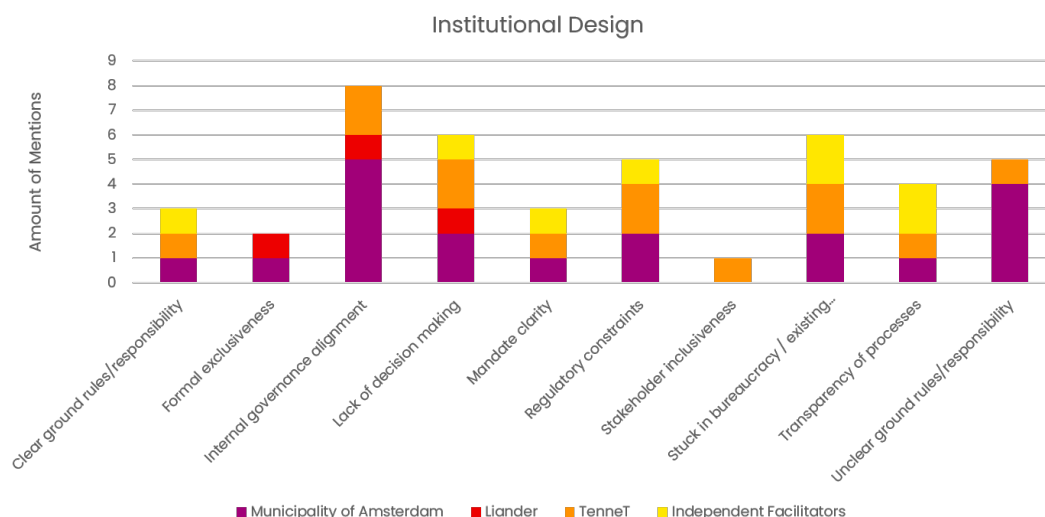


Figure H.2: Code frequencies for institutional design in the Amsterdam interviews

The results suggest that the governance arrangement is perceived as relatively well organized in terms of coordination, but less effective in enabling decisive follow-up and escalation. This supports the finding in Chapter 5 that the main governance problem is not the absence of collaboration, but the difficulty of translating coordination into clear ownership, escalation and follow-up.

H.3.3. Facilitative Leadership

Figure H.3 presents the coding frequencies related to facilitative leadership. The results indicate that process management, neutral facilitation and the presence of coordinators are recognized across stakeholder groups as important enabling conditions for collaboration.

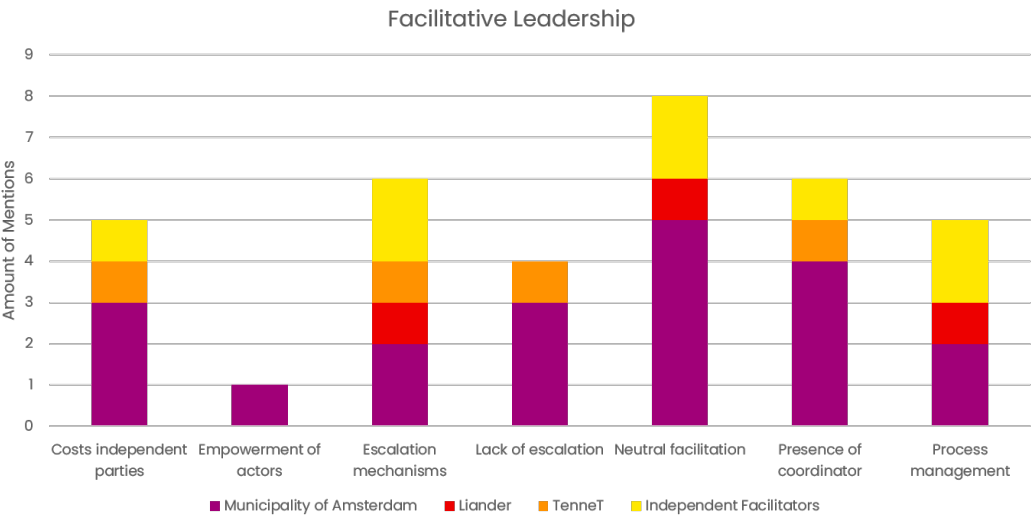


Figure H.3: Code frequencies for facilitative leadership in the Amsterdam interviews

At the same time, references to escalation mechanisms suggest that facilitation alone cannot compensate for unclear mandates or insufficient organizational authority. Facilitative leadership can help structure issues and maintain alignment, but it cannot replace formal responsibilities within the participating organizations.

H.3.4. Collaborative Process

Figures H.4, H.5, H.6 and H.7 present the coding frequencies related to the collaborative process, including face-to-face dialogue, trust building, commitment to process and shared understanding. The results indicate that municipalities and independent facilitators refer frequently to communication, meeting structures, expectation management and shared commitment. This suggests that collaboration is strongly dependent on relational dynamics, interpersonal interaction and continuous alignment between actors.

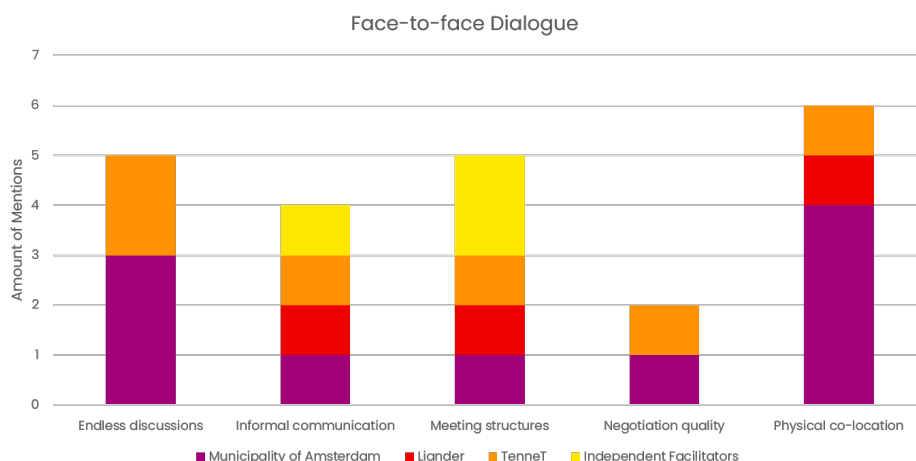


Figure H.4: Code frequencies for face-to-face dialogue in the Amsterdam interviews

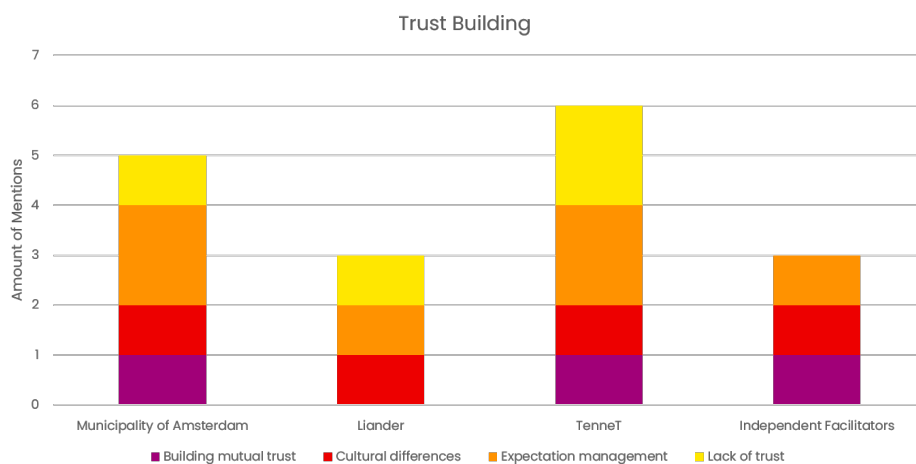


Figure H.5: Code frequencies for trust building in the Amsterdam interviews

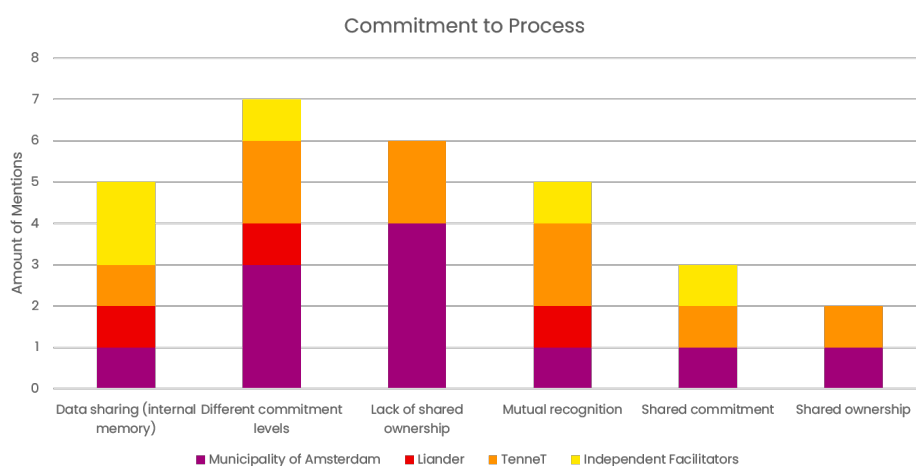


Figure H.6: Code frequencies for commitment to process in the Amsterdam interviews

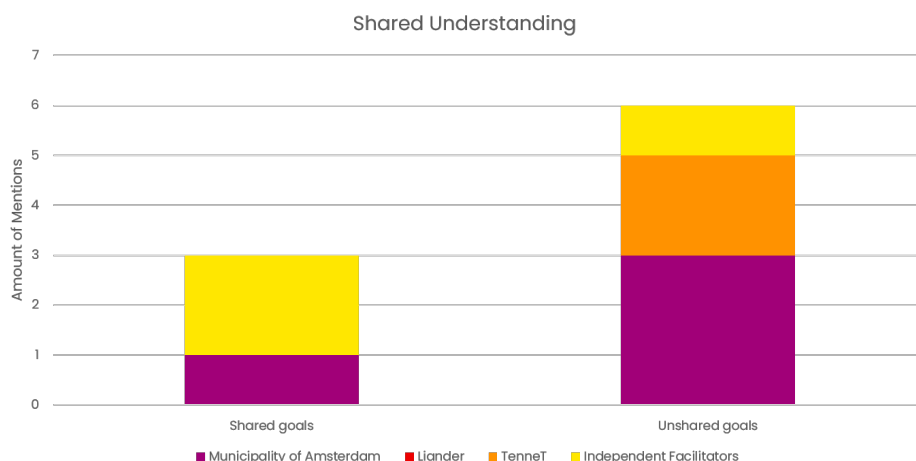


Figure H.7: Code frequencies for shared understanding in the Amsterdam interviews

The figures also show recurring references to cultural differences, lack of trust, unshared goals and endless discussions. These findings indicate that collaboration does not automatically lead to consensus or effective follow-up. Instead, collaboration can improve coordination and mutual understanding while also creating additional consultation needs when decision routes remain unclear.

H.3.5. Intermediate Outcomes

Figure H.8 presents the coding frequencies related to intermediate outcomes. Across stakeholder groups, small wins and strategic plans are mentioned most frequently. This suggests that collaboration mainly contributes to incremental progress, shared planning and improved coordination conditions.

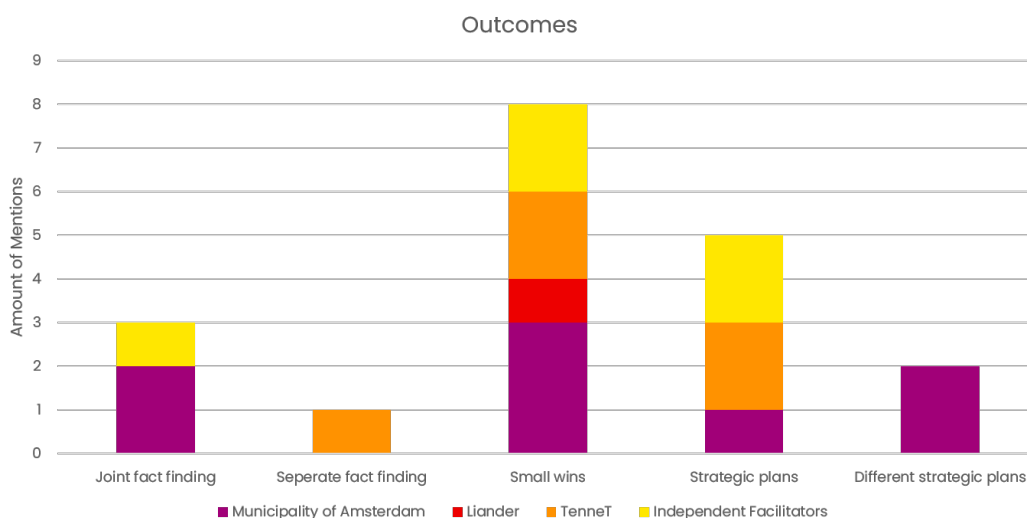


Figure H.8: Code frequencies for intermediate outcomes in the Amsterdam interviews

References to joint fact-finding also indicate that collaboration contributes to the development of shared knowledge and improved understanding between actors. Overall, the findings indicate that the TFCA mainly generates intermediate governance outcomes that improve coordination conditions, rather than direct physical grid capacity outcomes.

H.3.6. Multi-Level Governance (MLG)

Figure H.9 presents the coding frequencies related to MLG dynamics. The results show that municipalities refer relatively frequently to vertical governance tensions and cross-level dependencies, indicating that coordination across governance levels is experienced as a major challenge.

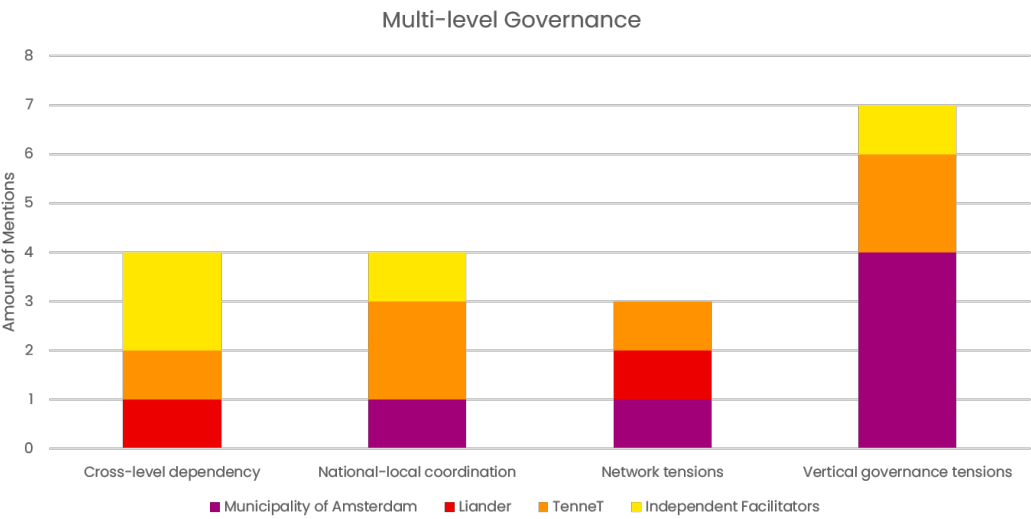


Figure H.9: Code frequencies for multi-level governance in the Amsterdam interviews

These findings reinforce the broader conclusion that governance complexity in grid congestion is not only horizontal between organizations, but also vertical across governance levels. The grid operator interviews show that these dependencies are particularly visible where technical infrastructure planning meets municipal spatial planning, permitting procedures and national regulatory frameworks.

H.4. Use of the Coding Analysis in the Thesis

The coding analysis was used to support the interpretation of the interview findings in Chapter 5. The coding outputs helped identify recurring themes such as unclear mandates, internal governance alignment, escalation, shared understanding, implementation constraints and multi-level dependencies. These themes were then synthesized into the governance tensions presented in Chapter 5. The coding analysis therefore provides transparency on how the qualitative interview material contributed to the problem definition and the later design phase.

I | Ideation Materials

This appendix provides a detailed overview of the focus groups and co-creation session held as part of the ideation phase. The sessions were organized to explore possible governance actions for strengthening the TFCA governance arrangement. They were not used to redefine the problem definition or the evaluation criteria from Chapter 5. Instead, they were used as generative design input for Chapter 6, where the governance tensions are translated into design principles, governance actions, archetypes and an MCA.

The sessions were not transcribed. The analysis is based on session notes, Mentimeter results, post-its and visual material produced during the exercises. The purpose of this appendix is therefore to document the main session outputs and to show how these outputs informed the later morphological chart and governance archetypes. Table I.1 gives an overview of the different focus groups and the co-creation session.

Session	Date	Participants	Method	Output
Focus Group 1	April 22	9 participants from the municipality, Liander, TenneT and Qirion	Future visioning and impact-effort matrix	Future collaboration principles and initial design ideas
Focus Group 2	May 18	10 participants from the municipality and Liander	Future visioning using Mentimeter	Governance, culture, data and planning requirements
Co-creation session	May 20	Around 36 participants from Liander, TenneT, EVA, Municipality of Amsterdam and APM	Group work, post-its and reflection rounds	Design requirements per task and collaboration category

Table I.1: Overview of ideation sessions

I.1. Focus Group 1: Workstream 1a

The first focus group was organized with participants of Workstream 1a, which focuses on high-voltage stations. The session took place on April 22 with 9 participants, consisting of environmental managers and project leaders from the Municipality of Amsterdam, Liander, TenneT and Qirion. The session had two objectives: to gather broad insights on what ideal future collaboration could look like, and to encourage participants to critically reflect on possible changes within the TFCA governance arrangement. The session was led by an independent facilitator and was divided into three parts:

1. A future exploration using Mentimeter.
2. An in-depth breakout session with an impact-effort matrix.
3. A plenary synthesis.

I.1.1. Future Visioning

Participants first engaged in a future visioning exercise. They were presented with the context that it is 2035, grid congestion in Amsterdam has been resolved, and collaboration between the parties is strong and natural. Using Mentimeter, participants reflected on what characterizes this collaboration and what it looks like in daily practice.

The results in Figures I.1 and I.2 show that participants envisioned a future in which collaboration is characterized by routine, trust and mutual understanding. The collaboration was described as a “good marriage”, in which people know each other well and are able to navigate irritations smoothly. In the desired future, internal coordination between the municipality and grid operators has decreased

because earlier agreements are being implemented, while more attention is given to communication with residents, press and local stakeholders.

The first session showed a shared vision along three key directions:

- **Working as one integrated team:** Participants emphasized the importance of operating as one team with a shared task, clear communication lines and a common understanding of how issues are prepared, escalated and followed up.
- **Clear roles and mandate:** An effective governance arrangement requires clearly defined roles and responsibilities, supported by sufficient mandate within the participating organizations.
- **Shift towards execution:** The desired future focuses less on repeated discussion and more on implementation, with increased attention to environmental management and communication during large-scale and simultaneous projects.

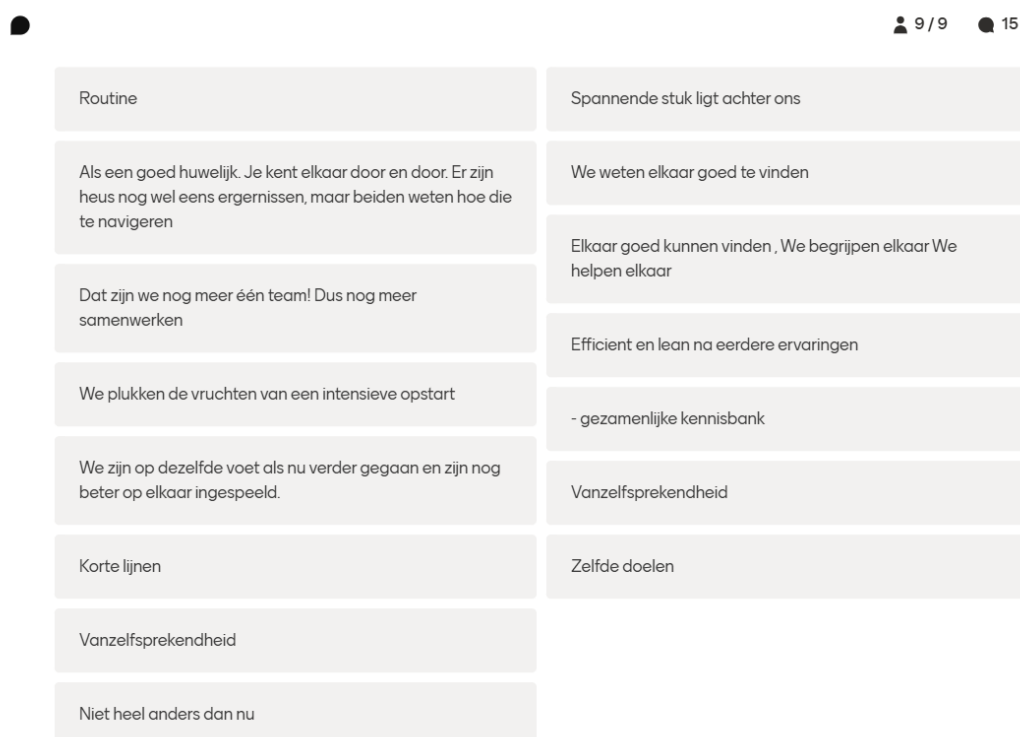


Figure I.1: Mentimeter Results from Focus Group 1 on Future Collaboration

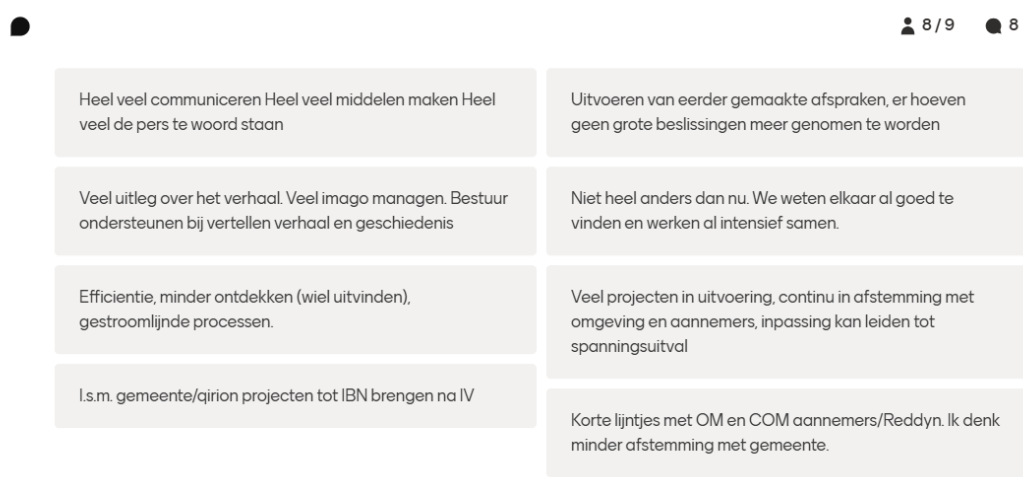


Figure I.2: Mentimeter Results from Focus Group 1 on Future Collaboration in Daily Practice

I.1.2. Impact-Effort Analysis

In the second part of the session, participants split into subgroups to identify what needs to change from 2026 onwards to achieve the envisioned future scenario for 2035. The results of this brainstorming exercise were plotted on an impact-effort matrix, distinguishing between the expected impact of a measure and the required effort in terms of time, money and people.

The impact-effort matrix resulted in a distinction between high-impact structural interventions and more immediately implementable improvements. The detailed visual results are shown in Figures J.1, I.4 and I.5. Table I.2 summarizes the main outcomes.

Big projects: high impact, higher effort	Quick wins: high impact, lower effort
Stronger mandate: Strengthen mandate for EVA, the TFCA and the program director	Joint assignment: Formulate a shared task and objective
Integrated program organization: Establish an integrated program organization, such as an Amsterdam Energy Company, including contractors and an overarching communication team	Crisis communication preparation: Develop communication strategies for high-pressure situations
Integrated area approach: Strengthen environmental management and communication at area level	Flexible expert pool: Organize independent expertise to quickly support complex projects
Involve implementation parties earlier: Strengthen the role of execution parties such as Liander asset management	Single communication line: Improve clarity and consistency in communication
Clarify governance structure: Define roles, responsibilities, escalation lines and increase transparency	Better decision communication: Improve how decisions are explained and justified

Table I.2: Outcomes of the impact-effort matrix

The ideas in Table I.2 should be interpreted as exploratory design directions rather than directly implementable recommendations. They provided input for the later formulation of governance actions in the morphological chart.

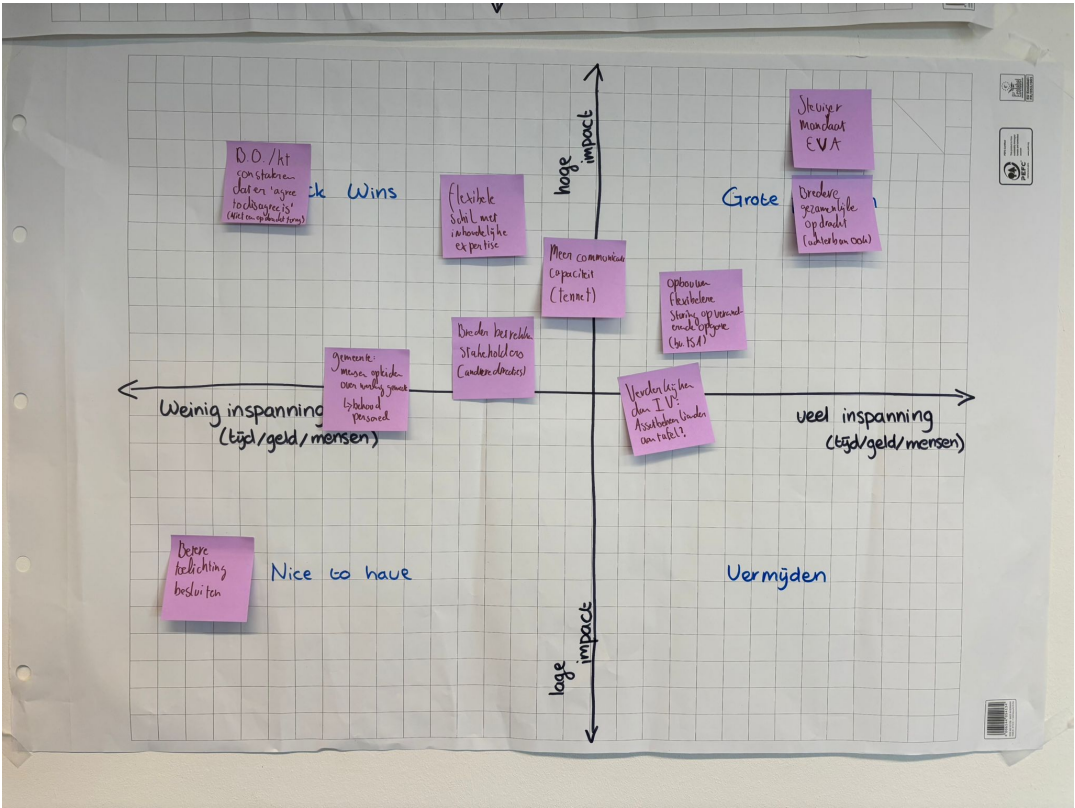


Figure 1.3: Impact-effort Matrix Results from Focus Group 1, Group 1

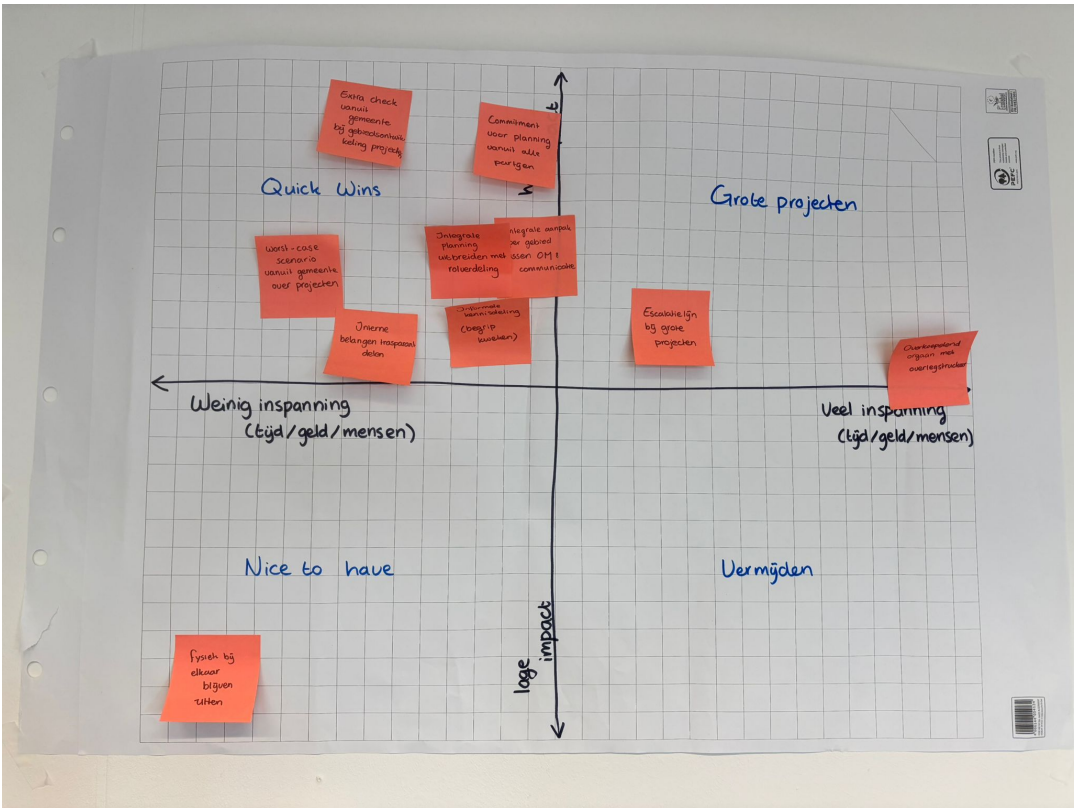


Figure 1.4: Impact-effort Matrix Results from Focus Group 1, Group 2



Figure I.5: Impact-effort Matrix Results from Focus Group 1, Group 3

I.1.3. Synthesis of Focus Group 1

The outcomes of the first focus group show that the current TFCA governance arrangement is valued for its collaboration culture, but that participants also see a need for clearer roles, stronger issue preparation, more actionable escalation and better connection to implementation. The ideas generated in the session therefore mainly informed governance options related to mandate, escalation, communication, expert support and implementation capacity.

I.2. Focus Group 2: Workstream 1b

The second focus group was organized with participants of Workstream 1b, which focuses on the distribution grid. The working session took place on May 18 with 10 participants from the Municipality of Amsterdam and Liander. The original session design included both future visioning and an additional structuring exercise, but due to time constraints only the future visioning part was executed. The session was led by an independent facilitator and was built around four Mentimeter questions:

1. If you were to describe collaboration in 2035, what would characterize it?
2. What will this collaboration look like in practice in 2035?
3. What would need to change between now and 2026 to achieve the situation in 2035?
4. What are the mutual expectations in this collaboration?

I.2.1. Future Visioning

Participants were again presented with the context that it is 2035, grid congestion in Amsterdam has been resolved, and collaboration between the parties is strong and natural. The results in Figures I.6 and I.7 show that participants envisioned a future in which governance is clearer, decision routes are more direct, and responsibilities are better understood by all actors involved.

The second session showed a vision along four key directions:

- **Clear governance:** Participants experienced the current governance arrangement as complex, with issues passing through several consultation layers. They also noted that actors without formal decision-making authority can still influence discussions because they are affected by the outcomes. Although a governance chart exists, participants indicated that its practical implementation remains difficult.
- **Culture:** The TFCA governance arrangement should support shared goal formation and make sure that people understand each other and speak the same language. Participants also stressed that the TFCA cannot take over the internal responsibilities of participating organizations. Honesty and openness are expected from all organizations.
- **Data:** Participants emphasized the need for data-driven working to create one shared factual basis and reduce room for individual interpretation. They also stressed that decisions should be clearly recorded once they are final, so that outcomes are not continuously reopened.
- **Internal municipal organization:** Participants emphasized that it is unclear how far actors are planning ahead together. Municipal participants explained that it is difficult to plan further than two to three years ahead when prioritization is not decided at the administrative level. Liander participants then questioned how strategic long-term planning can function if long-term spatial prioritization is not feasible.

The Mentimeter results also revealed two possible directions for improving collaboration. One direction is to further integrate the TFCA way of working by organizing actors more as one team, preferably supported by one shared location and one shared data source. The other direction is to simplify collaboration by strengthening the direct working relationship between Liander and the municipality, especially where issues mainly concern these two actors. Across both directions, participants emphasized the need for clearer municipal points of contact, stronger mandate for integrated spatial prioritization and better alignment between TFCA workflows and the internal organizations involved.

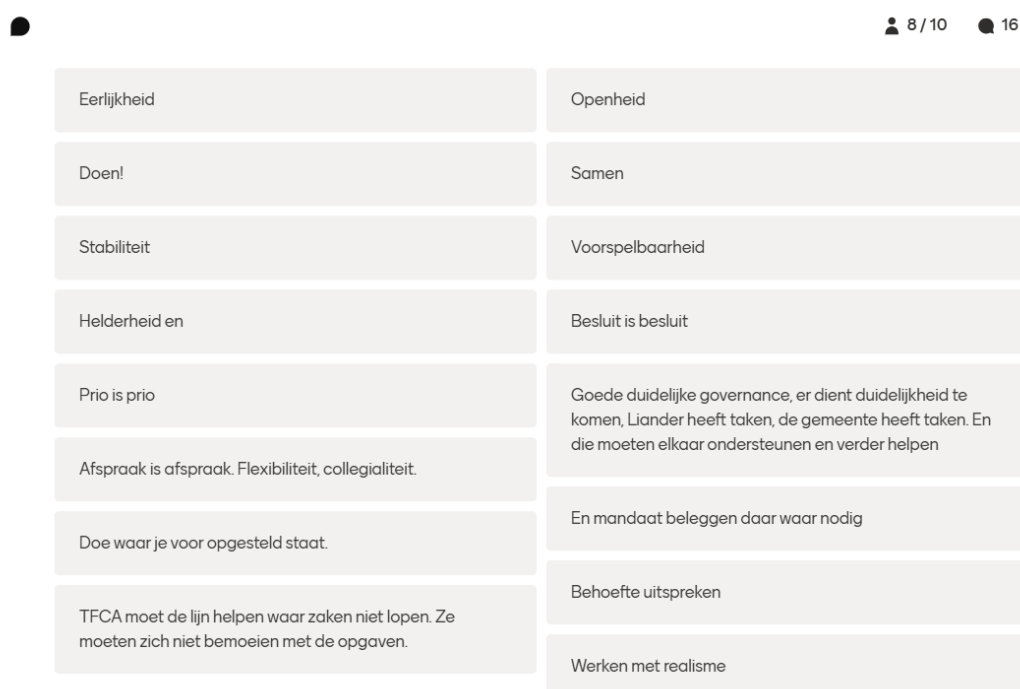


Figure I.6: Mentimeter Results from Focus Group 2 on Future Collaboration

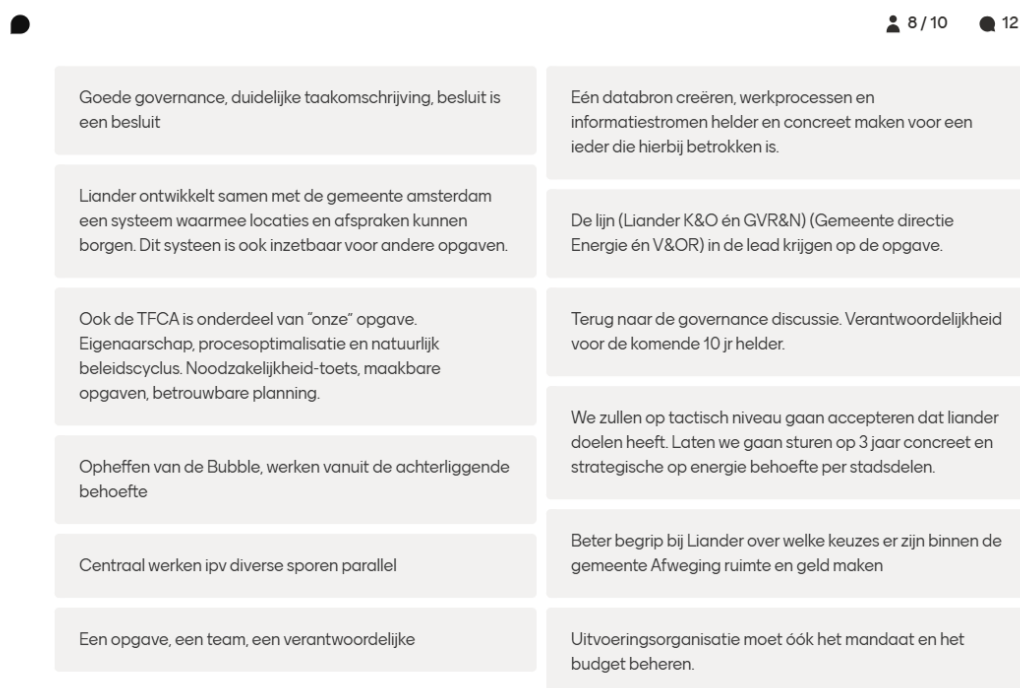


Figure I.7: Mentimeter Results from Focus Group 2 on Future Collaboration in Daily Practice

After exploring the future vision, participants discussed which steps would be needed to reach that vision. The results in Figures I.8 and I.9 show that participants emphasized several concrete points. First, the governance arrangement should be clarified, including a clearer RACI division and mandate for the implementing organizations. Second, collaboration should be supported by one shared data source, so that decisions, planning information and project status are based on the same information. Third, participants stressed the need to clarify at which level the TFCA operates: strategic, tactical or operational. Mutual expectations were also discussed, including honesty, openness, stability in decision routes and delegated authority where necessary.

A broader discussion point concerned the relation between the TFCA and Workstream 1b. While bottom-up collaboration appears to be relatively well organized, the top-down role of the TFCA still requires clarification. This is especially important because the TFCA is sometimes expected to make decisions or intervene operationally, while its added value lies mainly in strategic alignment, coordination and development-oriented issue preparation.



Figure I.8: Mentimeter Results from Focus Group 2 on Required Changes Towards 2035

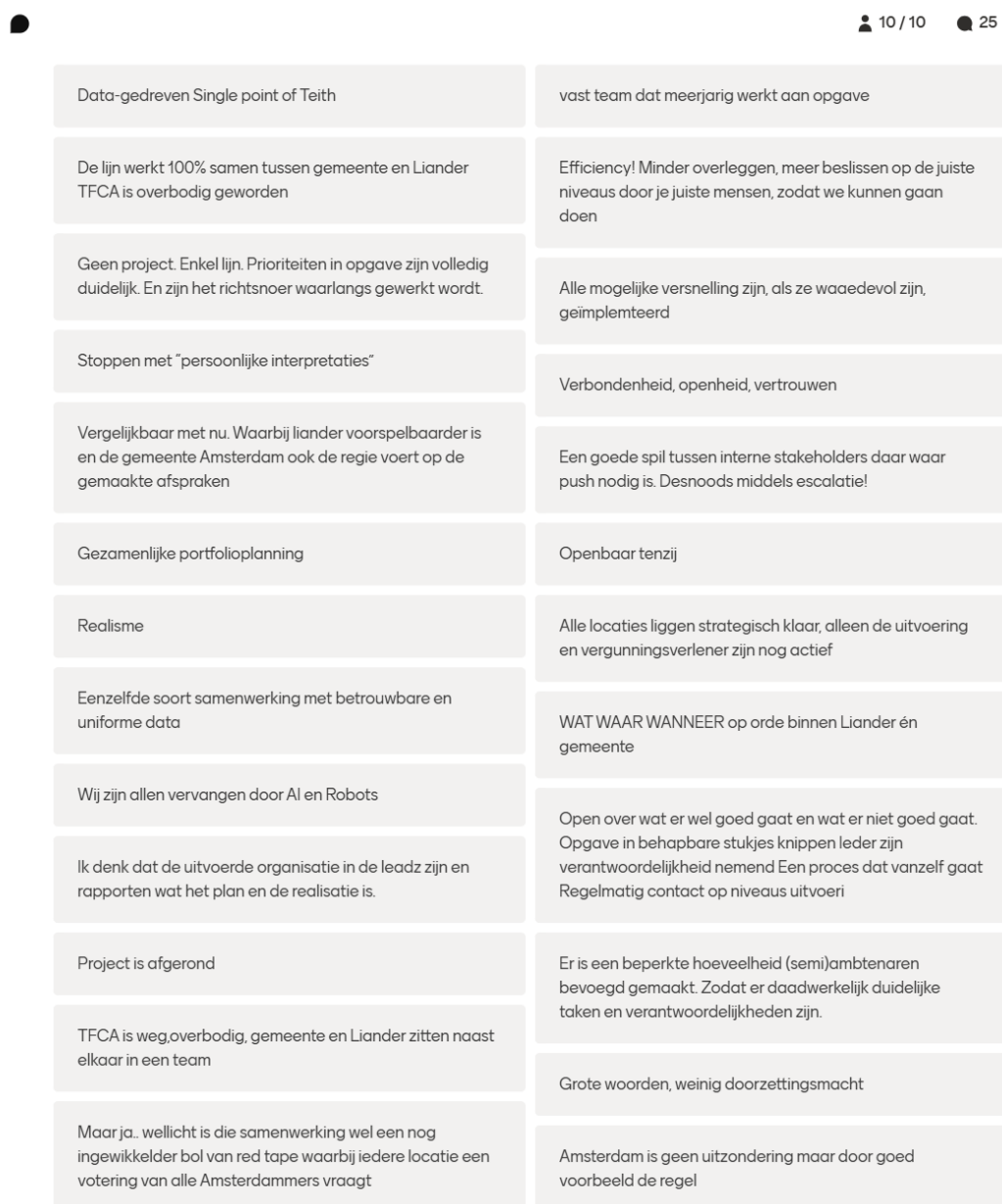


Figure I.9: Mentimeter Results from Focus Group 2 on Mutual Expectations

I.2.2. Synthesis of Focus Group 2

The second focus group strengthened the idea that the TFCA governance arrangement needs clearer roles, clearer data structures, clearer decision routes and stronger internal municipal alignment. It also showed a tension between integration and simplification: participants saw value in working more as one team, but also saw the need for simpler direct collaboration between Liander and the municipality where issues mainly concern these two actors.

I.3. Co-creation Session

As an additional input step in the ideation phase, a co-creation session was organized to explore what different future tasks would require from the collaboration around the TFCA. The aim of this session was not to select a final governance model, but to collect practical ideas, tensions and design requirements from the involved actors. The session therefore functioned as a bridge between the problem definition

and the development of governance options.

The co-creation session took place on May 20 with around 36 participants. Participants worked in three substantive groups, each focusing on a different task: high-voltage stations and cable routes, medium-voltage rooms and transformer houses, and communication. Although the original session design also included a broader task on better grid use and the electricity system of the future, this topic was not substantially elaborated during the session. The results therefore mainly informed the governance design for the current TFCA scope and the expected shift towards execution and delivery.

I.3.1. Co-creation Session Design

The objective of the session was to explore how different future tasks could be organized within or around the TFCA, and what this implies for collaboration between the involved actors. The session focused on three types of tasks that emerged from the survey, interviews and earlier workshops. These tasks represent possible shifts in the role and scope of the TFCA, ranging from the current focus on grid expansion towards execution and broader energy system questions.

Central Tasks

Three main tasks were used as the starting point for the session. These tasks were selected because they reflect different possible directions for the future role of the TFCA. The first task concerns the current scope of the TFCA, the second task concerns a possible shift towards implementation, and the third task concerns a broader role in the future energy system.

Task	Description
Current scope	Focus on the current role of the TFCA, including location choice up to the investment proposal phase. This includes the integration of transformer houses, substations, station expansions and cable routes.
Expansion towards execution	Focus on the phases after the investment proposal, including communication, environmental management, participation, implementation planning and execution-related coordination.
Broader future energy system	Focus on broader system questions, such as better use of the existing grid, decentralized energy solutions, local generation and storage, demand-supply alignment, freeing up capacity and long-term energy system planning.

Table I.3: Central tasks discussed during the co-creation session

Design Choices for Collaboration

For each task, participants reflected on four design choices for collaboration. These design choices were used to make the discussion more concrete and to connect the session directly to the governance design developed in this thesis.

Design choice	Guiding question
Roles and responsibilities	Who does what? Where are responsibilities located? Which role should different organizations take?
Collaboration culture	What attitude, way of working and mutual agreements are needed for effective collaboration?
Governance structure	How should steering, coordination, issue preparation and escalation be organized?
Capacity	What capacity is needed, where is capacity currently lacking, and what can actors expect from each other?

Table I.4: Design choices used to structure the co-creation session

Group Structure

Participants were divided into four groups. Each group started from one or two of the central tasks and discussed what that task would require from future collaboration. The fourth group, originally intended

to discuss better grid use and the future energy system, was not substantially developed during the session.

Group	Focus	Current scope	Execution	Future system
Group 1	Workstream 1a, cables, 150kV	Yes	Yes	No
Group 2	Workstream 1b	Yes	Yes	No
Group 3	Communication	Yes	Yes	No
Group 4	Better grid use / future energy system	No	No	Planned, but not substantially elaborated

Table I.5: Group structure of the co-creation session

Working Method

The main question for each group was:

Given this task, what needs to change in the collaboration so that the involved actors can deal with it effectively?

Each group discussed this question using the four design choices: roles and responsibilities, collaboration culture, governance structure and capacity. Participants first wrote down individual ideas, concerns and points of attention on post-its. These were then discussed, clustered and further developed within the group. This resulted in a set of ideas and tensions per task and per design choice.

After the first working round, two participants remained at each table to explain the group's outcomes. The other participants rotated to other groups in two reflection rounds. During these rounds, participants asked questions, added feedback and reflected on whether the proposed ideas were recognizable, feasible and relevant. This allowed the initial ideas to be tested and enriched by participants from other perspectives.

Guiding Questions

The guiding questions in Table I.6 were used to support the group discussions. The questions were not intended as a strict questionnaire, but as prompts to help participants reflect on different dimensions of collaboration.

Roles and responsibilities	Collaboration culture	Governance structure	Capacity
Which organization is responsible for what?	When are physical meetings necessary?	When should escalation take place, and how should the escalation route work?	What new capacity is needed?
Where is there shared responsibility?	How often should different meetings take place?	Which decisions can be made by one party and which require joint issue preparation?	Where is there currently too little capacity?
Which tasks belong to organizations outside the TFCA?	Where should physical meetings take place?	Where are clear decision moments missing?	Which scarcity lies outside the control of the organizations?
Who should be involved, and when?	How should communication be organized?	Who should prepare issues when interests conflict?	Where should investment be prioritized first?
Where should the focus be in the short and long term?	What should not be lost in the collaboration?	Which meetings are necessary and which are redundant?	Which capacity could be organized jointly?
		Who keeps overview of overall progress?	Where is additional support needed?

Table I.6: Guiding questions used during the co-creation session

I.3.2. Co-creation Session Results

During the co-creation session, participants worked in three substantive groups: high-voltage stations and cable routes, medium-voltage rooms and transformer houses, and communication. Table I.7

summarizes the main findings per group and category. More detailed notes and visual outputs are discussed in the following subsections.

Group	Roles and responsibilities	Collaboration culture	Governance structure	Capacity
High-voltage stations and cable routes	Clarify phase-dependent roles; involve Qirion/Reddyn, APM and project teams after IV; clarify permitting and municipal escalation.	More mutual understanding, continuity and informal contact; fixed collaboration moments and feedback to internal teams.	Adapt workstream after IV; distinguish stations, cables and area-development routes; clarify mandates of implementation actors.	Prioritize projects; ensure continuity of people; reduce double work; closer cooperation during location studies.
Medium-voltage rooms / transformer houses	Secure location decisions; strengthen ownership; municipality balances public space, Liander realizes infrastructure.	One shared task; proactive behavior; keep agreements; improve internal alignment within Liander and municipality.	Clear escalation lines and commissioning; reduce distance between TFCA and implementation; improvement initiatives must land in line organizations.	Capacity depends on prioritization, shared focus and clear responsibilities, not only on the number of people.
Communication	Translate roles into mandate; involve contractors, realization teams and environmental managers earlier; organize shared communication.	More physical and informal contact; direct communication; trust and respect; avoid unnecessary meetings; more creative sessions.	Escalate earlier; improve documentation and collective memory; clear route to Kernteam; communicate externally as one collective.	Organize communication and environmental management capacity earlier; secure budget before residents experience disruption.

Table I.7: Main findings from the co-creation session per group and design category

Group 1: High-voltage Stations and Cable Routes

For high-voltage stations and cable routes, participants emphasized the need to better embed the task within the administrative organization of the Municipality of Amsterdam. Before projects move forward, internal municipal agreement should be secured earlier to prevent delays later in the process. Participants also stressed that the municipality, TenneT and Liander need to work more closely with engineering firms and permitting actors to find feasible solutions earlier.

A recurring point was that responsibilities change across project phases. Up to the investment proposal phase, the TFCA can still play a strong coordinating role. After this phase, implementation actors such as Qirion/Reddyn, Liander APM and project teams become more important. Participants therefore questioned whether EVA or the TFCA should still have the same role in the execution phase, or whether responsibility should shift more clearly to implementation organizations.

Permitting was identified as a key area where responsibilities need to be clarified. TenneT and Liander were seen as responsible for submitting timely and complete permit applications, while the municipality needs to organize internal escalation and involve relevant departments and city districts when decisions are required. Participants also emphasized the need for one clear point of contact when issues arise, as well as better monitoring of post-investment-proposal planning by the municipality.

The group emphasized mutual understanding, trust and continuity. Participants argued that collaboration should be based on better understanding of each other's interests, work processes and urgency. A recurring suggestion was to create more fixed moments for collaboration, possibly by working together on a regular day and rotating between the offices of the municipality, Liander and TenneT.

Participants also stressed the importance of informal contact and feedback loops. Project teams and other internal departments should be updated more consistently, so that agreements made within the TFCA do not remain isolated within a small group. The collaboration culture should therefore focus not only on formal meetings, but also on helping each other, sharing needs openly and maintaining relationships across organizations.

The group discussed whether a new workstream should be created for projects after the investment proposal phase. This reflects the observation that the governance needs of projects change once they move from location choice and planning towards detailed design and execution. Participants also emphasized the need to consciously design the teams involved per organization, including required capacity, knowledge, mandate and role division.

Another important point was the distinction between the organization of stations and cables. Participants indicated that the governance arrangement should not assume that these projects follow the same logic. In some cases, especially in urban redevelopment areas, it may be more effective to use existing area

development structures after a location decision has been made, rather than keeping the project fully within the TFCA governance arrangement.

Capacity was discussed as a major constraint. Participants emphasized the need to prioritize projects when capacity is limited, especially in relation to uncertainty around future grid scenarios. They also stressed the importance of continuity in personnel throughout the process, as knowledge loss between phases can create delays and repeated discussions. The group noted that too much time and capacity is currently lost due to double work. Closer cooperation between the municipality and grid operators during location studies could improve mutual understanding and lead to faster results.

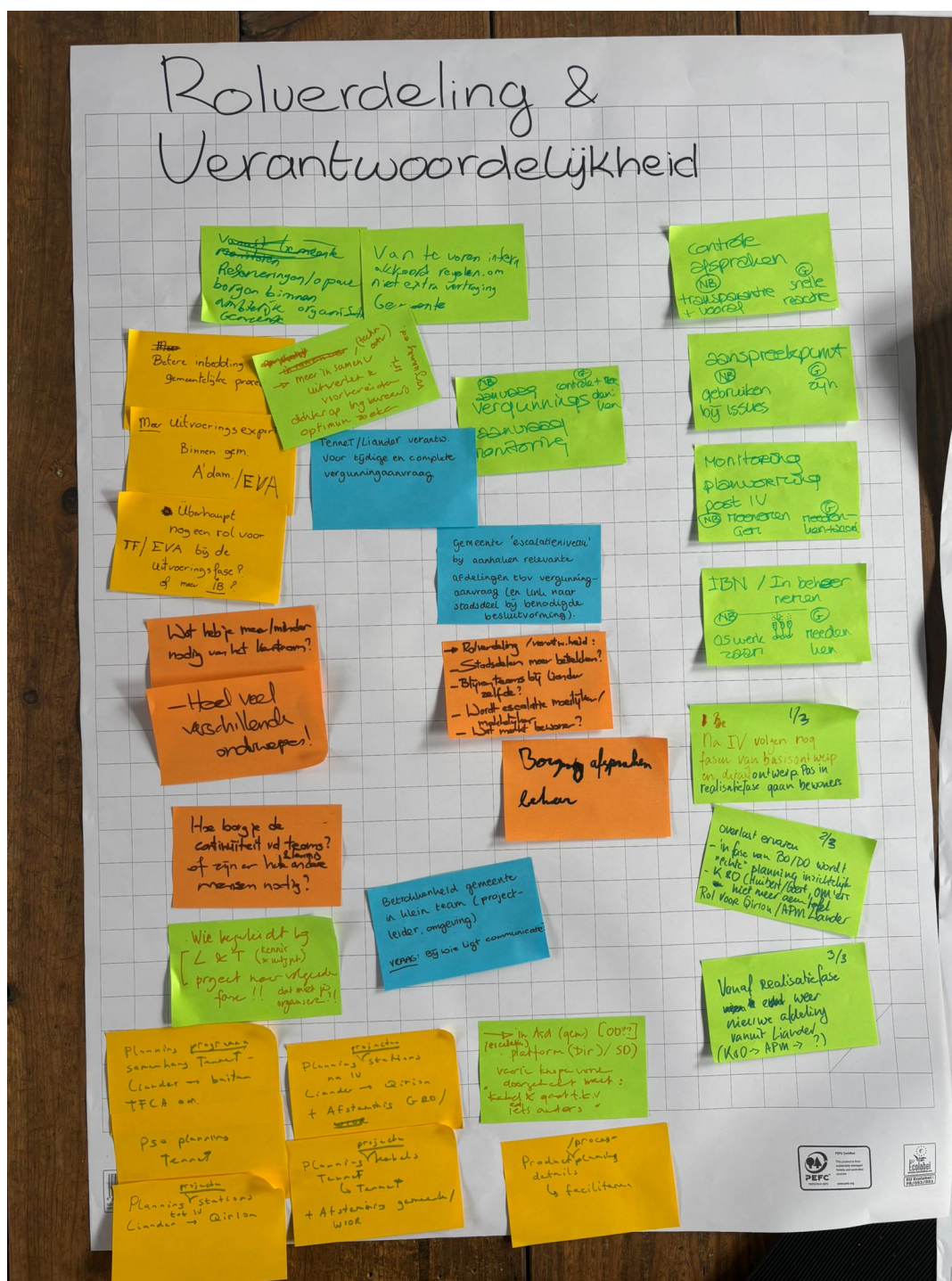


Figure I.10: Co-creation results for high-voltage stations and cables on roles and responsibilities

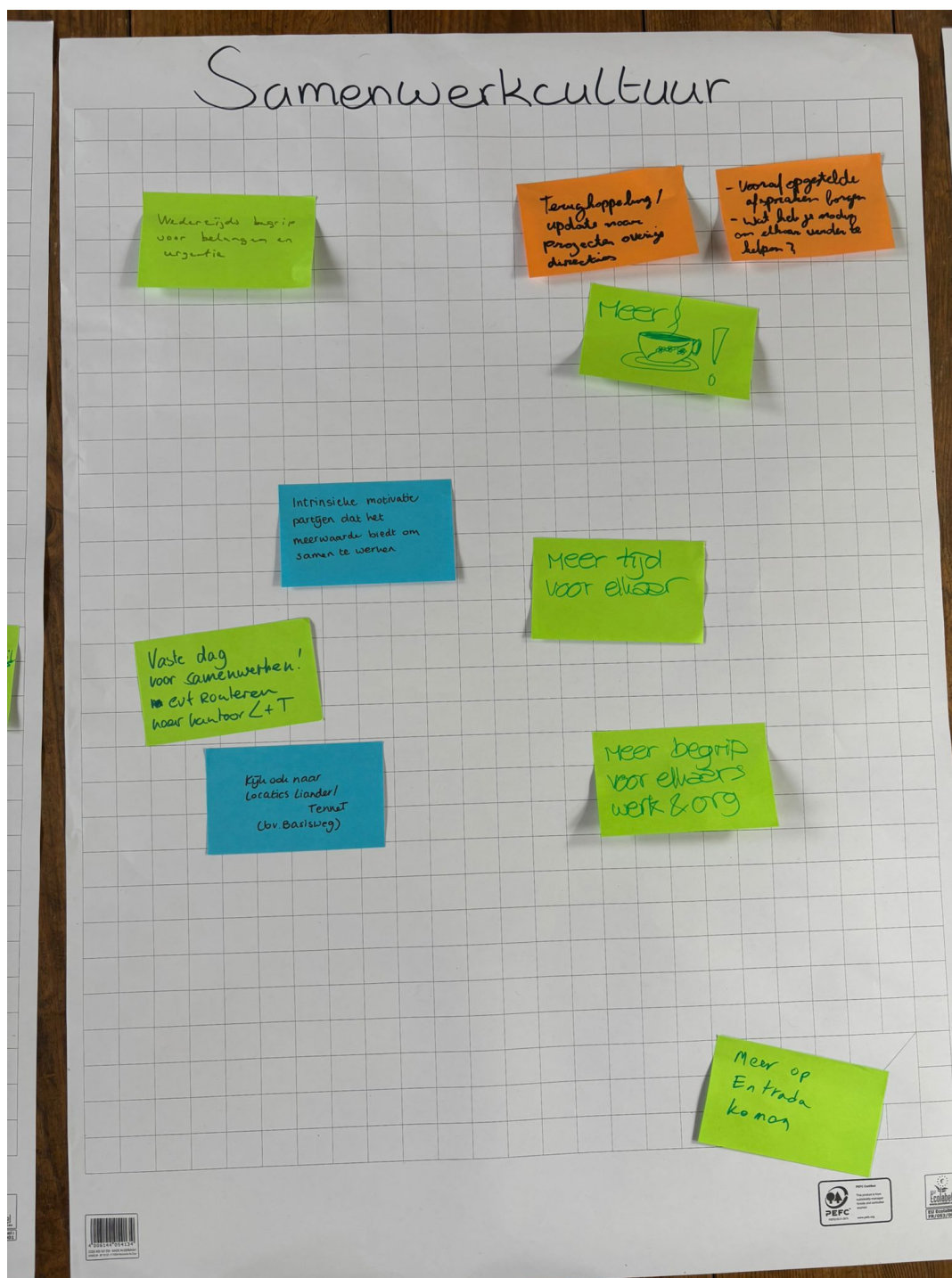


Figure I.11: Co-creation results for high-voltage stations and cables on collaboration culture

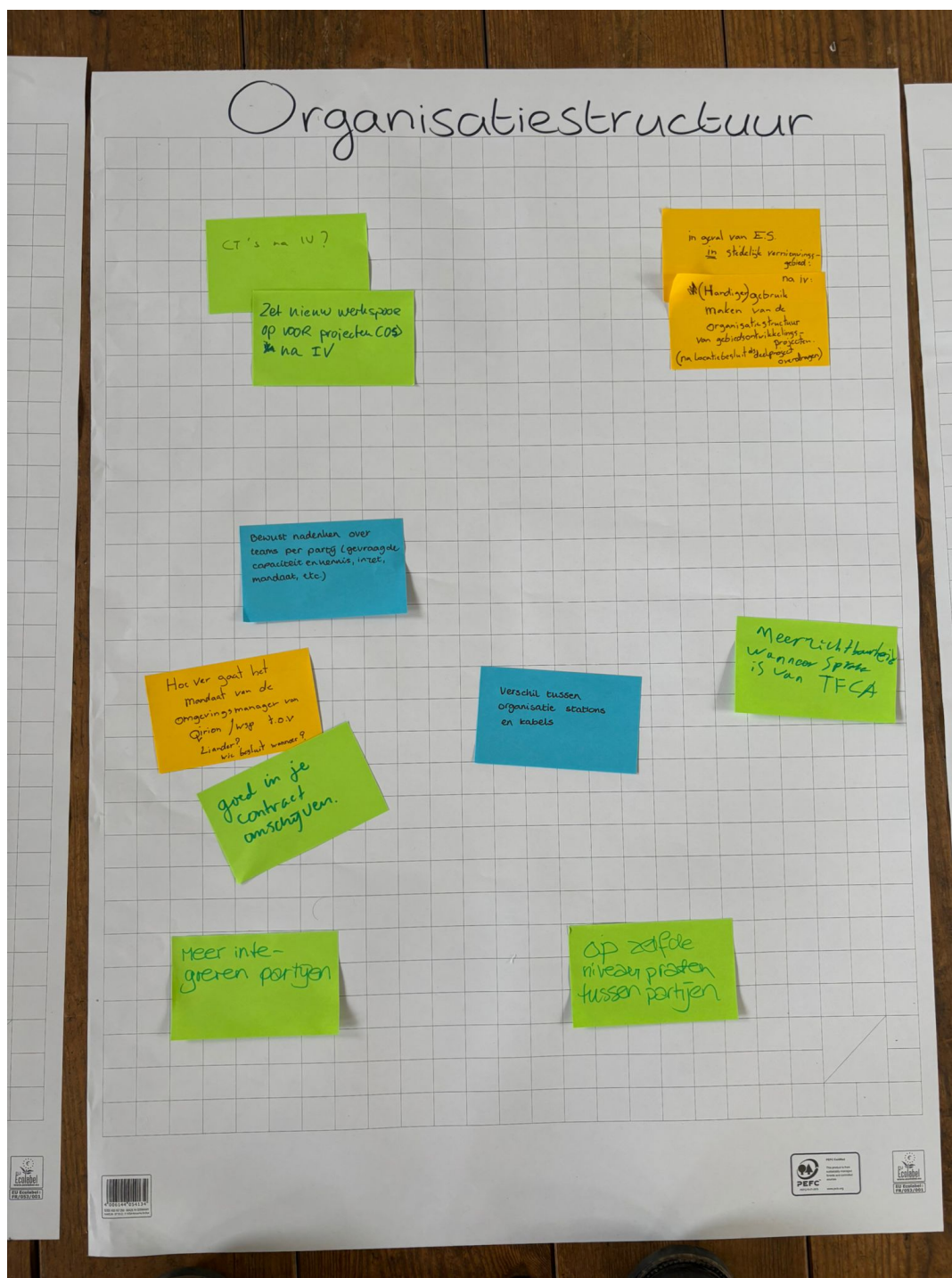


Figure I.12: Co-creation results for high-voltage stations and cables on governance structure

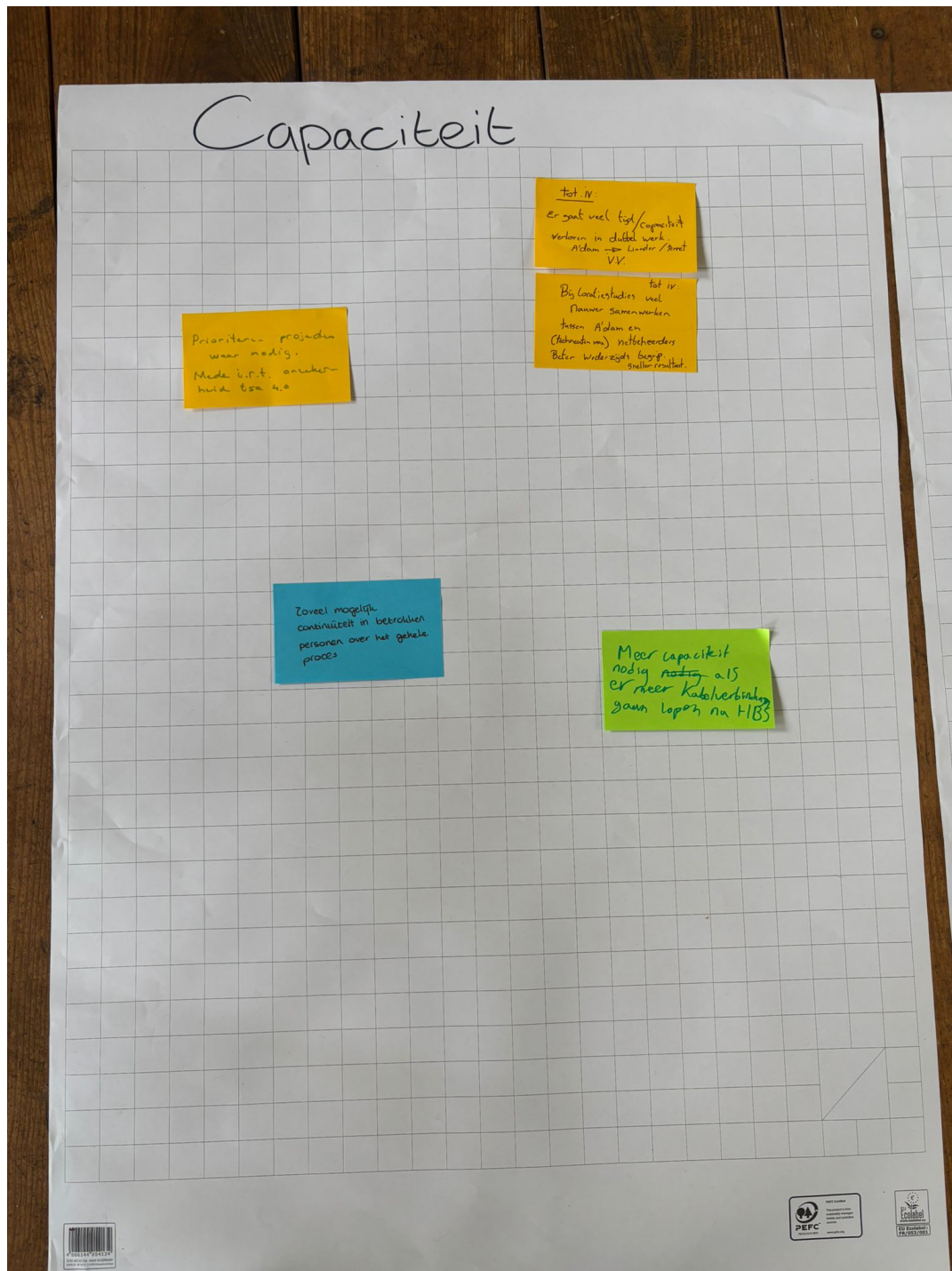


Figure I.13: Co-creation results for high-voltage stations and cables on capacity

Group 2: Medium-voltage Rooms and Transformer Houses

For medium-voltage rooms and transformer houses, participants emphasized the importance of clearer ownership and stronger securing of decisions. A key point was that agreements, such as location decisions, should be secured more firmly: once a decision has been made, it should not be reopened without clear reason. Participants described this as “decision = decision”.

The municipality was seen as having an important role as referee of public space, because transformer houses compete with many other spatial claims. At the same time, Liander remains responsible for building the infrastructure and supporting the process with technical knowledge. Participants also noted

that within Liander itself, there should be more unity: one goal and one approach, rather than multiple parallel programmes in Amsterdam.

Escalation was discussed as a functional instrument rather than a failure. Participants argued that escalation should be used more actively to remind actors of their responsibilities and to move issues forward when they remain unresolved. The municipality was also seen as responsible for legally, administratively and physically securing decisions once they have been made.

The group emphasized a need for more proactive behavior and clearer agreements. Participants described collaboration as a shared task, but also pointed to the need for stronger internal alignment within both Liander and the municipality. Between organizations, participants saw a need for stronger connection with other municipal departments, such as Ground and Development. The collaboration culture should therefore be less fragmented and more focused on joint ownership of the task.

The group also emphasized the need for clearer escalation lines, clearer commissioning and a stronger link between TFCA governance arrangements and implementation. Participants suggested that the distance between the TFCA and operational practice should be reduced, so that improvement initiatives can actually land in the line organizations.

A recurring point was that the governance arrangement should have a clear objective and should steer resources accordingly. Unclear goals and unclear means were seen as leading to different directions and fragmented efforts. Participants also noted that improvement initiatives should not become isolated projects, but should contribute directly to the realization of transformer houses.

Although this group discussed capacity less extensively than the high-voltage group, participants did point to the need for clearer prioritization and better use of available organizational capacity. The discussion suggests that capacity issues are not only about the number of people available, but also about whether people are working towards the same objective and whether responsibilities are sufficiently clear.

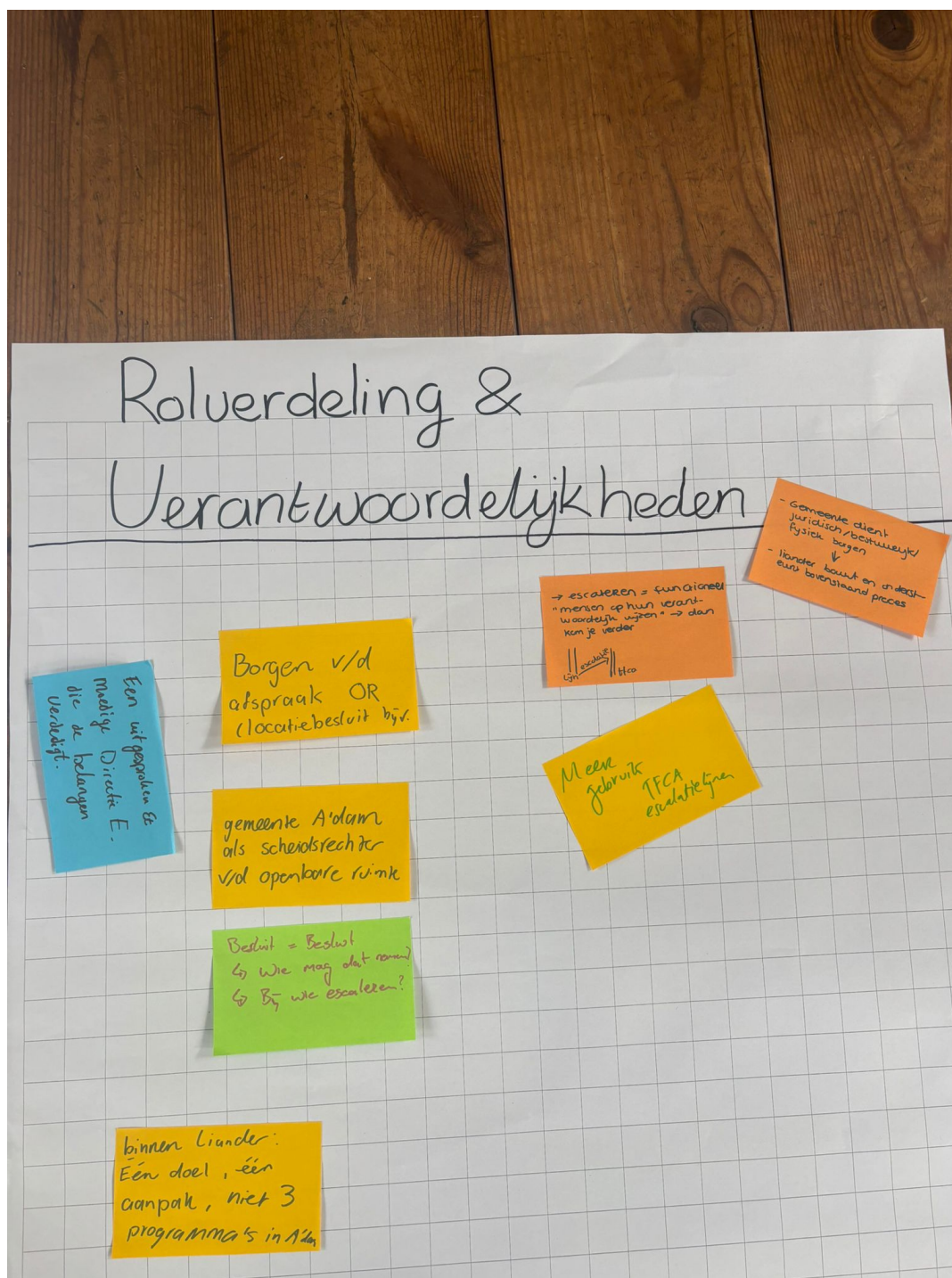


Figure I.14: Co-creation results for medium-voltage rooms and transformer houses on roles and responsibilities

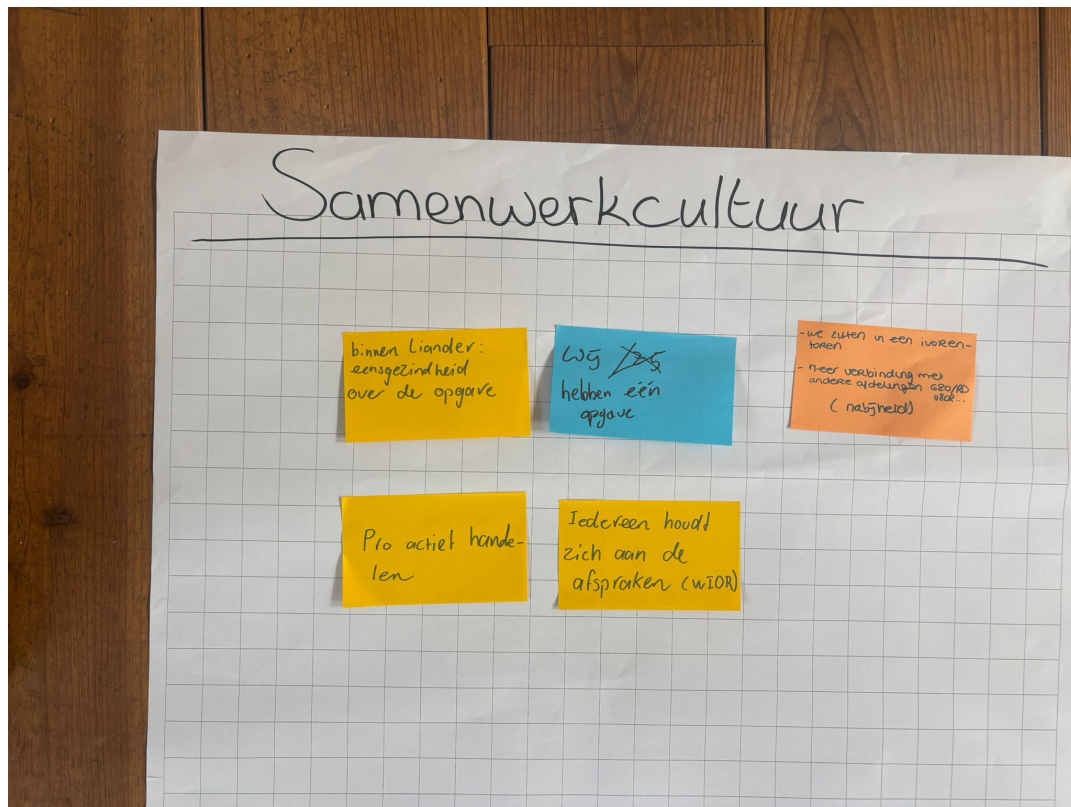


Figure I.15: Co-creation results for medium-voltage rooms and transformer houses on collaboration culture

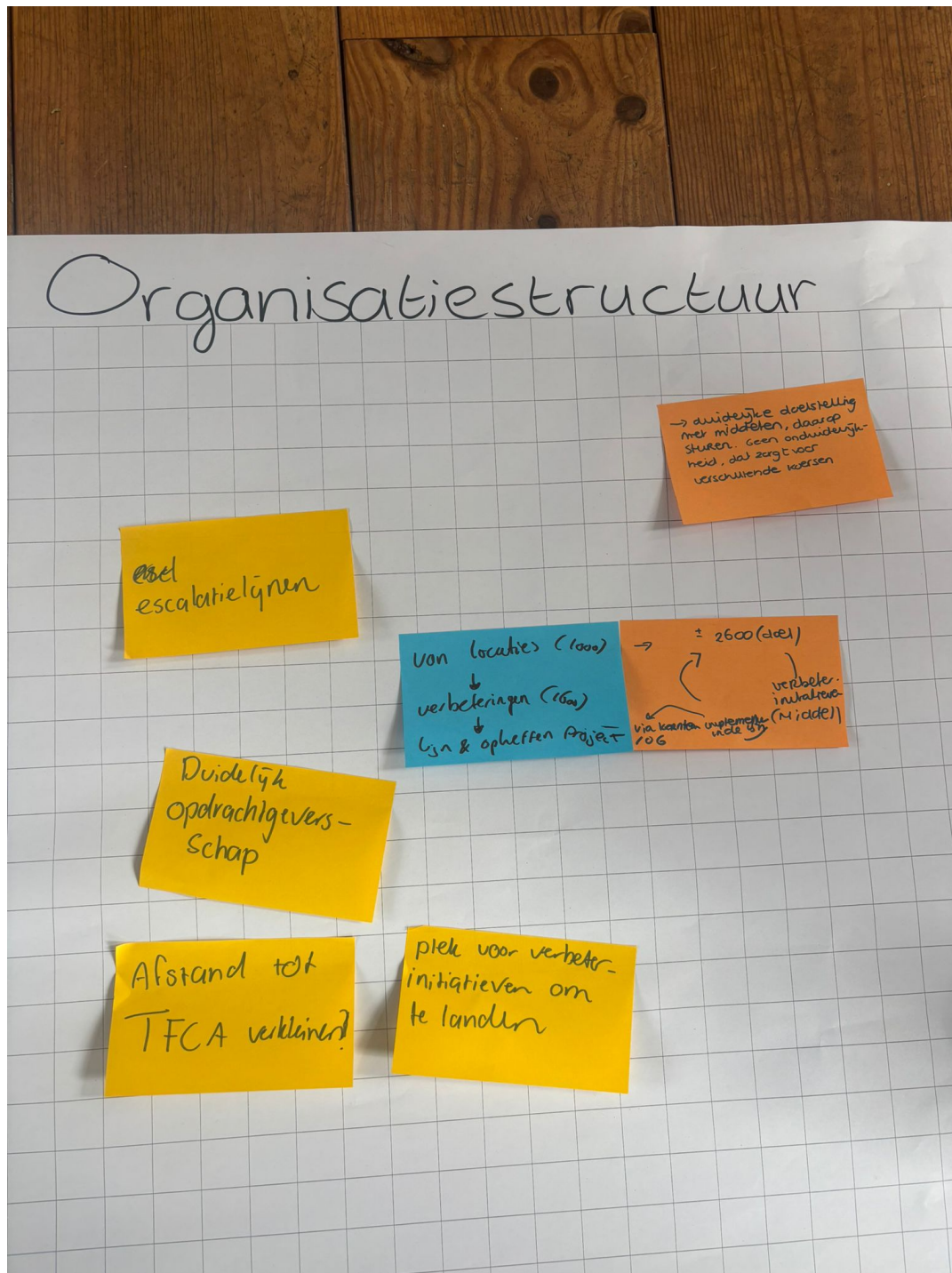


Figure I.16: Co-creation results for medium-voltage rooms and transformer houses on governance structure

Group 3: Communication

The communication group emphasized that roles and responsibilities are partly already clear, but that they need to be translated more explicitly into mandate and boundaries. Participants indicated that the TFCA should focus on process improvement and issue escalation, rather than becoming too involved in the direct relationship between organizations and their stakeholders.

A key point was that implementation actors should be involved earlier, including contractors, Liander realization teams and environmental managers. As projects move towards execution, communication and environmental management become more important because residents will increasingly experience

disruption. Participants therefore stressed the need to connect communication more directly to concrete projects, construction planning and public space impacts.

The group also emphasized that the municipality has responsibility for communication with the city and residents, while Liander is responsible for realization. At the same time, communication should be organized jointly where projects affect the same areas or residents. Participants suggested one shared contact point or “loket” for projects, better coordination of public communication, and clearer agreements about who communicates what.

Another important point was that environmental knowledge and agreements with residents should not be lost between project phases or organizations. This requires better documentation, shared ownership of information and continuity in communication.

The communication group strongly emphasized the importance of physical and informal collaboration. Participants preferred more in-person meetings and less online communication, especially when dealing with complex issues or external pressure. At the same time, they warned against too many recurring meetings without clear added value. Meetings should have prepared agendas and should be used when they help solve issues.

Participants also emphasized trust, respect for each other's interests and direct communication. Issues should not wait until formal meetings if they can be addressed earlier through direct contact. Informal communication, such as calling or messaging during urgent situations, was seen as important for effective collaboration. Several participants suggested rotating meetings between the offices of the participating organizations and using creative sessions to strengthen collaboration.

The communication group identified several governance improvements. First, escalation should happen earlier when an impasse occurs. Participants stressed that actors should recognize when discussions are stuck and should not continue talking without progress. Escalation was described as something that can and should be learned.

Second, participants emphasized the need for better collective memory and documentation. Without proper dossier-building, agreements, environmental knowledge and earlier decisions are easily lost. This is especially problematic when projects move between phases or when new actors become involved.

Third, the group argued that the organization structure is not always clear. There should be clearer responsibility for issue preparation, possibly at program manager or project manager level, and a clearer route towards the KT when consensus cannot be reached. At the same time, participants warned against creating too many weekly project meetings or recurring consultation layers. The structure should support progress, not create additional complexity.

Capacity was discussed mainly in relation to communication and environmental management. Participants indicated that communication capacity should be organized earlier and more structurally, especially before residents begin to experience disruption. There is a need for sufficient communication and environmental management capacity at the front end of projects, rather than only after problems arise. Participants also pointed to the need for budget. Communication, participation and environmental management require dedicated resources, not only incidental budgets.

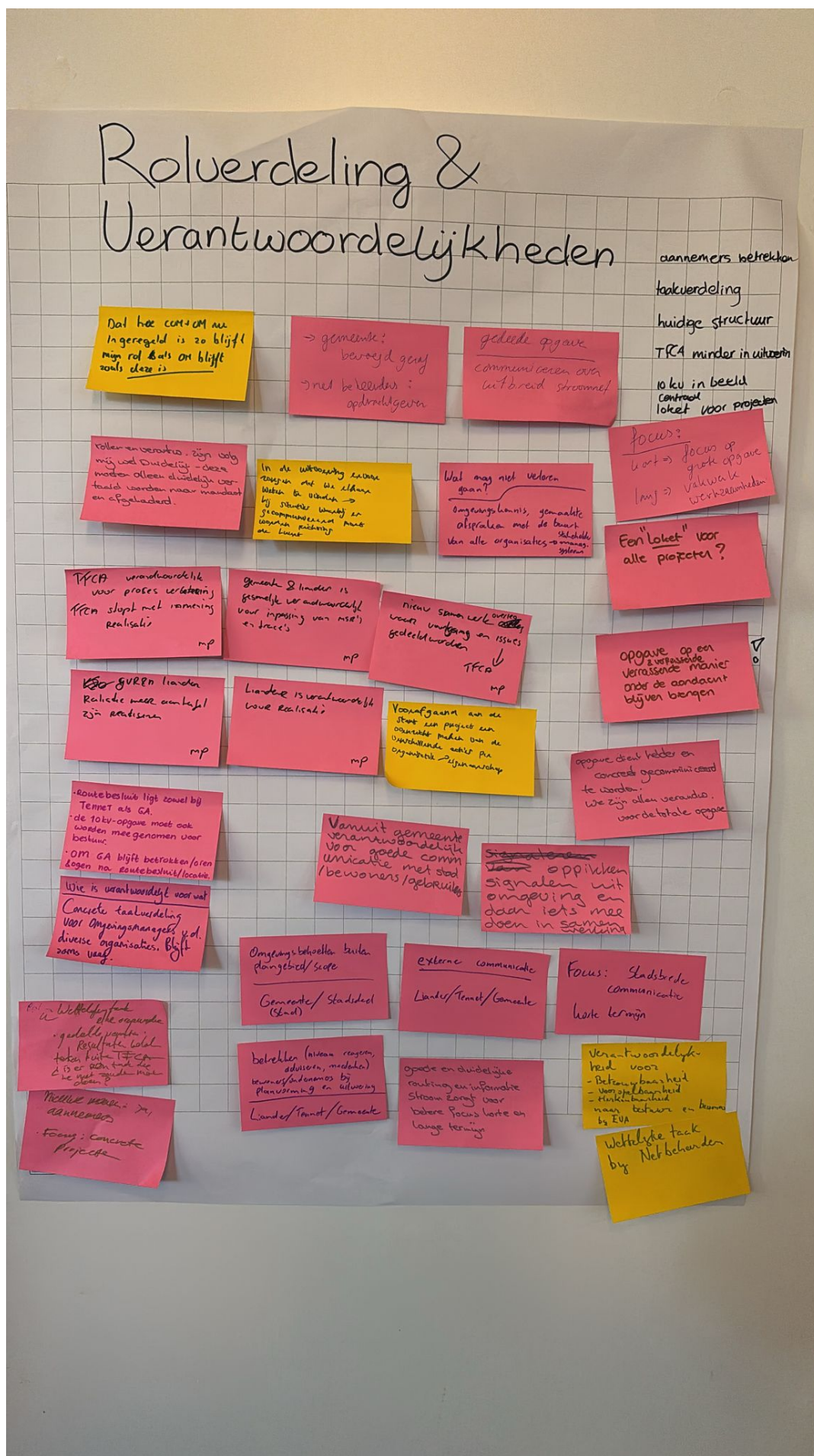


Figure I.17: Co-creation results for communication on roles and responsibilities



Figure I.18: Co-creation results for communication on collaboration culture

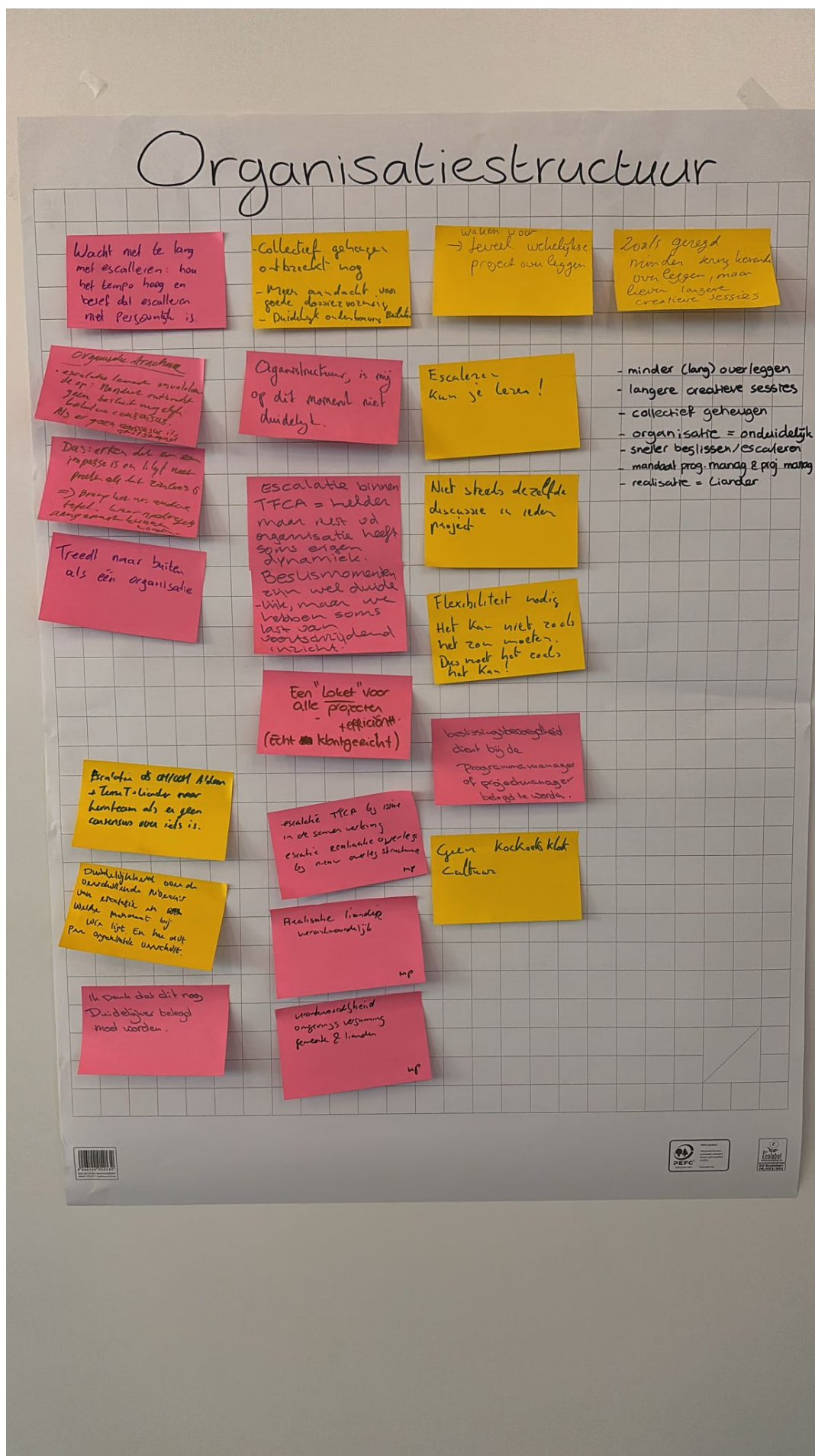


Figure I.19: Co-creation results for communication on governance structure

Rolverdeling & verantwoordelijkheid

- rolverdeling vtu opschrijven + uitgangspunt
- data deling (ook voor 10 & 50 kv) → communicatie
 - ↳ planning Liander moet duidelijk zijn voor gemeente
 - ↳ samen voegen met MSR portaal (naast de OVIOR)
- duidelijk bij wie bewoners moeten zijn en water in hun omgeving gebeurt

Samenwerking

- frequent overleg
- persoonlijk contact (+ informeel)
- creatieve sessies (op inspirerende locatie)
- OM Liander/Tennet betrekken (minder frequent)
 - ↳ duidelijke planning & doel → van tevoren plannen
- Klantreis standaard document (1B)
 - ↳ integraal behandelen

Organisatiestructuur

- HS station, - beheerder mist aan tafel → project kick-off met iedereen andersom missen mensen van de gemeentes die besluit nemen
- om eerder betrekken
- besluit door BO/RT moet leidend zijn
- structuur moet duidelijk zijn

Capaciteit

- geld in geval van overlast (wisselgeld)
- niet alleen maar incidenteel budget
- gescheiden omgevings- en communicatie budget
- transparante discussie over geld
- Meer geld/capaciteit aan de voorkant, zodat het achteraf

Figure I.20: Co-creation results for communication on capacity and summary points

I.3.3. Recurring Patterns Across the Co-creation Session

Across the three groups, several recurring patterns emerged. First, participants emphasized the need for clearer roles, responsibilities and mandates. Many ideas focused on clarifying who is responsible for what, who has authority to prepare or escalate issues, and when issues should be escalated. This supports the idea that the TFCA should not only coordinate, but also create clearer routes towards issue preparation, escalation and follow-up.

Second, the transition from planning to execution requires a different governance setup. Across the groups, participants pointed to the need to involve implementation actors earlier, including APM, Qirion/Reddyn, contractors, environmental managers and communication teams. This supports the idea that governance around the TFCA should become more phase-sensitive.

Third, collaboration culture remains important, but it should be more purposeful. Participants valued physical meetings, informal contact, trust and mutual understanding, but also warned against too many meetings and repeated discussions. Collaboration should therefore be organized around concrete issues, project phases and issue resolution.

Fourth, information management and collective memory emerged as important themes. Participants stressed that agreements, planning information, environmental knowledge and decisions should be documented better and shared across organizations. This provided input for ideas such as a shared issue, decision and planning log.

Finally, capacity was not only discussed as a shortage of people, but also as a question of prioritization, continuity and efficient use of existing capacity. Participants repeatedly pointed to the need to avoid double work, involve the right expertise at the right moment and ensure continuity of people across project phases.

A notable limitation of the session is that the broader task related to better grid use and the electricity system of the future was not substantially elaborated. As a result, the session mainly enriched the governance design for the current TFCA scope and the shift towards execution, rather than for a broader future energy system role.

I.4. Use of Ideation Materials in Chapter 6

The focus groups and co-creation session were used as design input for Chapter 6. The sessions did not redefine the governance tensions or evaluation criteria from Chapter 5. Instead, they generated possible governance actions for the design principles derived from those tensions.

The session outputs contributed to the morphological chart in four ways. First, they generated options for clarifying roles, responsibilities and mandates. Second, they generated options for improving escalation, issue preparation and follow-up. Third, they generated options for connecting coordination to implementation and communication. Fourth, they showed that better grid use and the future energy system should be treated carefully, because this topic was not substantively developed in the co-creation session.

I.5. Conclusion

The ideation materials show that participants see value in the current TFCA governance arrangement, but also identify several areas where it should be sharpened. The focus groups generated future-oriented ideas around integrated collaboration, clearer roles, stronger mandate, shared data, communication and execution. The co-creation session translated these ideas into more concrete design requirements around phase-dependent roles, implementation actors, communication, escalation, collective memory and capacity.

These findings were used in Chapter 6 to populate the morphological chart and develop governance archetypes. They should therefore be understood as generative design input, not as final design choices.

J | Conceptual Work Portal for the TFCA

As an additional design component, a conceptual website was developed with Lovable AI to translate the governance design into a more practical and visual format. The website should be understood as a prototype and communication tool, not as an implemented system or official TFCA platform. Its purpose is to show how the proposed governance components could be made more accessible for practitioners, for example through project overviews, issue tracking, meeting guidance and governance self-assessment. The url of de website is as follows: <https://governing-grid-congestion.lovable.app>. A readable version of all the Figures can be found there.



Figure J.1: Homepage Conceptual Work Portal

The prototype includes several elements that follow from the final governance design. The project cards and planning overview illustrate how shared project information, dependencies, status and timelines could be brought together in one place (Figures J.2 and J.3). The issue log translates the proposed issue-preparation and escalation logic into a practical overview of open issues, owners, risks, deadlines and next steps (Figure J.4). The consultation overview shows where different types of issues could be discussed within the TFCA consultation layers, such as the AC, KT, workstreams, communication team or pilot workstream (Figure J.5). The governance map and self-assessment tool are included to make the governance arrangement easier to understand and to support reflection on the maturity of regional governance arrangements (Figures J.6 and J.7). Finally, the conflict and mitigation library provides an example of how recurring bottlenecks, early warning signals, involved actors and possible mitigation measures could be documented (Figure J.8).

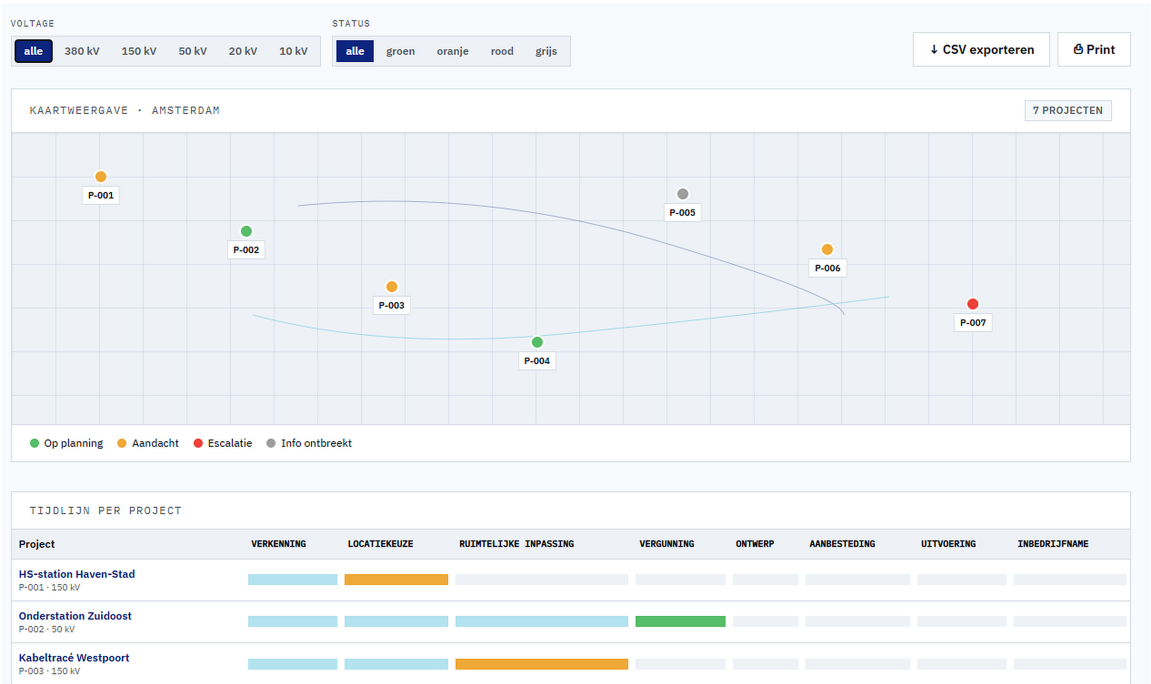


Figure J.2: Planning Overview Conceptual Work Portal

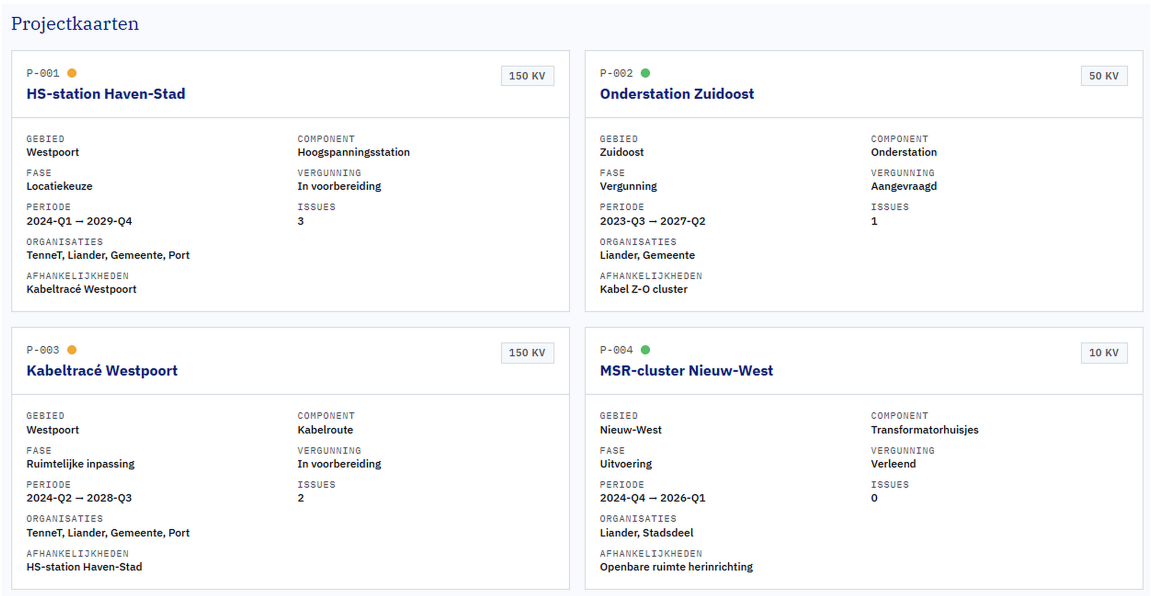


Figure J.3: Project Cards Conceptual Work Portal

E. Issue log

Voorbeelddata - beheerders houden dit actueel.

ID	ISSUE	STATUS	EIGENAAR	WERKSTROOM	ESCALATIE	DEADLINE	RISICO	VOLGENDE STAP
I-014	Locatie alternatief HS Haven-Stad	Naar KT	P. Jansen TenneT	WS 1a	KT	2025-04-15	HOOG	Vorbereiding KT-agenda
I-019	Vergunningvertraging Onderstation Zuidoost	In KT	M. de Vries Liander	WS 1b	KT	2025-04-01	MIDDEN	Afstemming Omgevingsdienst
I-022	Samenloop Westpoort kabel + station	In voorbereiding	L. Bakker Gemeente	WS 1c	KT	2025-03-25	HOOG	Tracé-overleg
I-027	Capaciteit aannemers MSR Nieuw-West	Nieuw	F. Smit Liander	WS 1b	—	2025-05-01	MIDDEN	Aanbesteding herzien
I-031	Mandaat bestuurlijke keuze Diemen	Naar AC	K. Visser TenneT	WS 1a	AC	2025-06-10	HOOG	AC-besluit
I-033	Hinder binnenstad cumulatief	In KT	E. Pieters Gemeente	Communication	KT	2025-04-20	HOOG	Communicatiekalender
I-036	Tracékeuze Buiksloterham	Besluit genomen	S. Hendriks Liander	WS 1c	—	2025-03-15	LAAG	Implementatie

Figure J.4: Governance-map Conceptual Work Portal

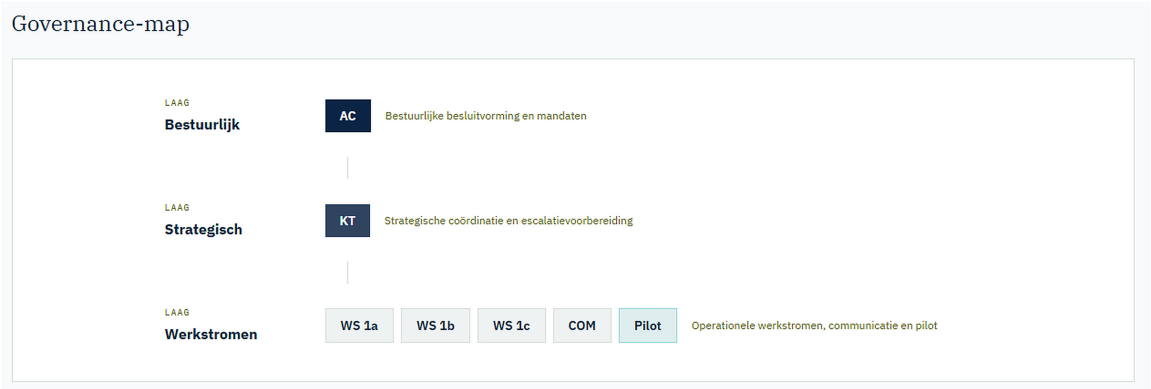


Figure J.5: Governance-map Conceptual Work Portal

WAAR KAN IK MIJN ISSUE BESPREKEN?

Zoek op onderwerp, deelnemer of doel...

Alle lagen AC KT Werkstroom Communicatie Pilot

AC VIER KEER PER JAAR

Administrative Consultation

Strategische en bestuurlijke afstemming, besluitroutes, bestuurlijke escalatie, mandaatvragen en politiek gevoelige kwesties.

KT EENS PER VIER WEKEN ESCALEERT NAAR AC

Kernteam

Strategische coördinatie, opvolging van issues, voorbereiding bestuurlijke escalatie, prioritering en monitoring van afspraken.

WS 1A EENS PER TWEE WEKEN ESCALEERT NAAR KT

Workstream 1a – High-voltage Grid

Voorbereiding en coördinatie van hoogspanningsstations, ruimtelijke keuzes, afhankelijkheden en planning.

WS 1B EENS PER TWEE WEKEN ESCALEERT NAAR KT

Workstream 1b – Distribution Grid

Coördinatie rond middenspanning, onderstations, transformatorhuisjes en uitvoeringsplanning.

WS 1C EENS PER TWEE WEKEN ESCALEERT NAAR KT

Workstream 1c – Cables

Afstemming over kabeltracés, openbare ruimte, vergunningen, fasering en hinder.

Figure J.6: Consultation Overview Layers Conceptual Work Portal

Governance self-assessment

"Hoe volwassen is jouw governance arrangement?" – Vink aan wat in jouw regio aanwezig is.

☐ Zijn rollen en mandaten duidelijk?

☒ Is er een gedeelde planning?

☒ Is er een escalatieprotocol?

☐ Is er een issue log?

☐ Worden uitvoeringsactoren tijdig betrokken?

☒ Is er regionale kennisuitwisseling?

☐ Is communicatie gekoppeld aan uitvoeringsplanning?

☐ Is er intern eigenaarschap per organisatie?

SCORE

3/8

Projectgerichte governance

Per project georganiseerd, weinig overstijging.

- Ad hoc governance
- Projectgerichte governance**
- Gecoördineerde governance
- Uitvoeringsgerichte governance
- Adaptieve governance

Figure J.7: Governance Self-Assessment Conceptual Work Portal

Conflict & mitigation library

Terugkerende conflictpatronen rond netuitbreiding, met vroege signalen, betrokken actoren en mogelijke mitigerende maatregelen. Geen vertrouwelijke details — beheerders koppelen regio-specifieke voorbeelden.

Locatiekeuze voor stations —	
Geen overeenstemming over plek voor hoogspanningsstation of onderstation.	
VROEG SIGNAAL Meerdere afgewezen locaties zonder alternatief.	BETROKKEN ACTOREN Gemeente RO, netbeheerders, provincie, bewoners
RELEVANT OVERLEG WS 1a → KT	TEMPLATE Escalatieformat + shortlist-template
MITIGERENDE MAATREGELEN VROEGE LOCATIEVERKENNING SHORTLIST MET MULTICRITERIA ONAFHANKELIJKE FACILITATIE	
Ruimtedruk in openbare ruimte +	
Concurrerende claims voor dezelfde m².	
Kabeltracés vs ondergrondse claims +	
Conflicten met andere kabels, leidingen, riolering.	
Onduidelijk mandaat +	
Geen besluit doordat niemand mandaat heeft.	
Trage vergunningroute +	
Doorlooptijd vergunningen overschrijdt planning.	

Figure J.8: Conflict and Mitigation Library Conceptual Work Portal

All information shown in the prototype is illustrative. The project names, issue examples, dates, owners and status labels are example data and should not be interpreted as official or complete project information. In a future version, real data could be added by the responsible organizations, provided that agreements are made on data ownership, confidentiality, updating routines and access rights. The prototype therefore mainly demonstrates how the proposed governance design could be operationalized in a digital work environment. Its value lies in making the design more concrete, but further development and testing with TFCA participants would be needed before such a tool could be used in practice.