# Smart charging of electric vehicles in the Netherlands

*An ecosystem perspective*


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## Preface

We are at the dawn of the sustainable electric-mobility transition. This is a pivotal moment to determine the role electric vehicles will play within our energy system and how they will influence the energy transition. Through this thesis, I aim to have provided valuable insights into strategies for advancing from simple charging to smart charging of electric vehicles. Thus, I hope that the sustainable and forward-thinking decisions we make today will yield positive outcomes for the future.

The process of completing this thesis has been both challenging and rewarding, marked by significant discipline and personal development. This research was conducted as part of my thesis internship at Arcadis in the Urban Energy Systems team. The engaging and practical environment provided a unique opportunity for professional and personal development, as well as a meaningful contribution for this study.

I want to thank Koen Frenken for his excellent guidance throughout this process, which consistently challenged my thinking, encouraged a critical approach and greatly contributed to the depth of this thesis. Also from Utrecht university, I want to thank Adriaan van der Loos for his valuable feedback on the thesis proposal, which greatly contributed to refining the direction of this research. I would like to sincerely thank my internship supervisor, Hanna Kreuger, for her constant support, feedback, and encouragement. Your guidance through every stage of my thesis allowed me to gain valuable experience and learn new skills that I will carry with me in my future career. I am grateful to the interviewees and focus group participants for sharing their perspectives and thoughtful contributions to the study. Additionally, I would also like to express my appreciation for the entire Urban Energy System and Sustainable Mobility team at Arcadis – the dedication and expertise are truly inspiring! It's a pleasure to work alongside such passionate and skilled colleagues. Lastly, I want to thank Matthijs Crouwers for his invaluable help during the focus group.

## Abstract

The transition to sustainable electric mobility requires two key challenges to be addressed, the integration of renewable energy sources, and the mitigation of congestion on the electrical grid infrastructure. Although total energy consumption in the Netherlands has remained stable, congestion arises from the simultaneous peak demand arising from electric vehicle adoption and renewable energy deployment. This trend places significant strain on the grid, leading to substantial social and economic impacts. Consequently, both costly and timely investments in grid infrastructure are required. An immediate solution, however, can be provided by smart charging, in which the electric vehicle battery charging practices are optimised to create synergy between the available resources and grid capacity to avoid congestion issues.

A lack of coordination has resulted in insufficient incentives for the involved actors to adopt smart charging practices, as the value proposition of smart charging depends on the alignment structure of a multilateral set of partners. To address this coordination issue, ecosystem theories of Adner (2012) were presented to provide strategies for managing these dependencies. Accordingly, this research offers actionable insights on how to create a successful smart charging ecosystem for public charging infrastructure by reconfiguring the structure to provide adequate incentives for adoption.

The study involved semi-structured interviews with all actors that need to interact in order for the smart charging value proposition to materialise. This offered valuable insights to gain a deeper understanding of the current ecosystem and enables to highlight the existing risks. Three risks were identified: missing clear accountability for managing the charging session, a lack of transparency in charge scheduling and pricing, and potential displacement of the charging point operator's business model. Collectively the three risks impede the adoption of smart charging across all ecosystem actors.

Where all actors agreed on the shared value proposition—charging based on dynamic energy prices—addressing these three risks is essential to enable the development of a smart charging market. Three reconfigured ecosystems were designed to address these risks, articulated in three distinct ecosystem blueprints. Subsequently, a focus group was organised to inform the creation of a smart charging market, and strategies derived from it. This discussion demonstrated varying levels of support across all participants across the three blueprints. Building on these insights, a final reconfigured blueprint was developed, offering a recommendation to address the identified risks within the current ecosystem and providing proper incentives for smart charging.

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## Executive summary

Arcadis is driving the energy transition, addressing the challenges of posed by grid congestion in the Netherlands. The integration of renewable energy sources, as well as the electrification of heating and mobility in urban areas, necessitates new innovative solutions that take an integrated approach. In the context of this study, this encompassed the two distinct areas of mobility and (urban) energy systems in which Arcadis operates. The current scarcity of grid capacity causes significant delays as projects must await grid reinforcements, leading to increased costs for grid investments and related initiatives, such as new housing developments. In some cases, this constraint may even result in the complete abandonment of such projects. An immediate solution, however, can be provided by smart charging, in which the electric vehicle battery charging practices are optimised to create synergy between the available resources and grid capacity, alleviating congestion problems and demonstrating the effectiveness of an integrated approach.

In this regard, Arcadis wanted to gain a deeper understanding of the mechanisms hindering the provision of incentives for smart charging, particularly in the urban context where electric vehicle charging infrastructure is part of public domain. It was considered a crucial first step for further integration into the energy system, and could inform strategies for related solutions including energy hubs. However, the current mechanism lacks effective coordination to establish an alignment structure among a multilateral set of actors to create synergy through smart charging, resulting in significant underutilisation of the potential benefits. To resolve this, ecosystem theories of Adner (2012) were presented to offer strategies for managing these interdependencies.

The research involved interviews with all actors that need to interact in order for the smart charging value proposition to materialise, providing a detailed understanding of the current ecosystem structure, as illustrated in Figure A with the blueprint below [1].

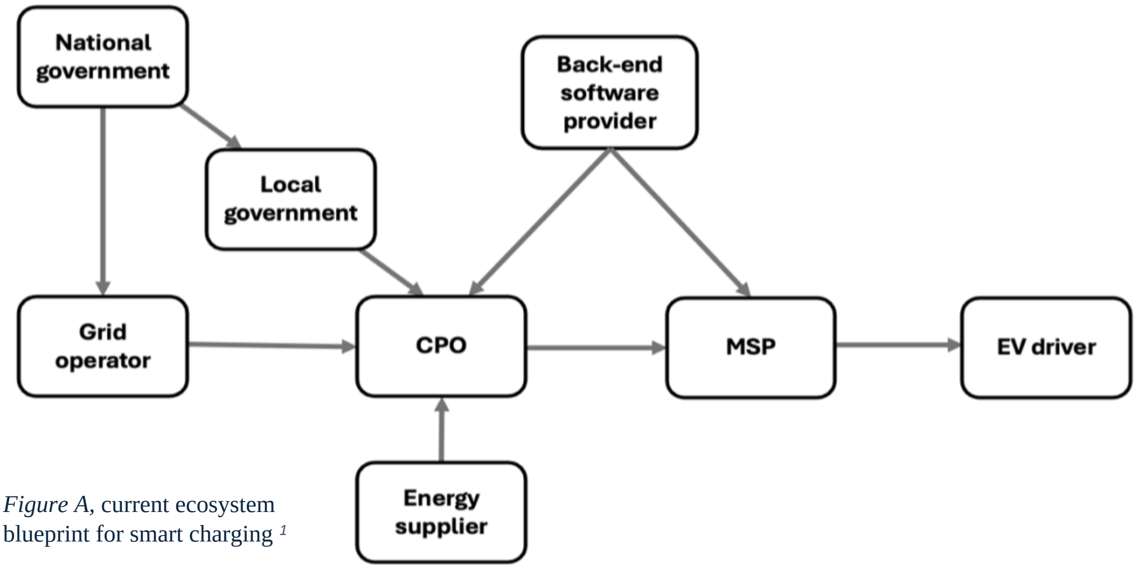


*Figure A*, current ecosystem blueprint for smart charging [1]

The ecosystem analysis identified three key adoption risks that obstructed actors within the ecosystem from adopting the smart charging innovation, highlighting a broken link. This mechanism hinders the provision of smart charging, which prevents electric vehicle drivers to even have a chance to assess its value proposition. The first risk involved a lack of transparency regarding both charging schedules and pricing, which not only made drivers hesitant to adopt smart charging, but also

[1] Corresponds to blueprint 1 illustrated in Figure 6 in the thesis, where it is also discussed in detail

discouraged actors within the charging infrastructure industry to engage. Second, long-term concession agreements with the charge point operator for operating charging stations at fixed pricing impede the transition to dynamic pricing in new concessions, as this would lead to the displacement of their current fixed-price charging stations. Third, in the absence of clear agreements concerning the accountability of the charging session, its flexibility potential remains underutilised. The charge point operator has authority to control the charging session through as the holder of the energy contract, the mobility service provider holds access to essential driver information, and the energy supplier manages grid balance, creating a situation where no entity can fully coordinate the process.

Where all actors agreed on the shared value proposition—charging based on dynamic energy prices—addressing these three risks is essential to enable the development of a smart charging market. In the subsequent focus group discussion, participants, representing all ecosystem actors, expressed varying levels of support across the three reconfigured ecosystem blueprints designed to address these risks. All participants showed support for at least one ecosystem blueprint, except the charge point operator, who preferred maintaining the status quo. This preference was attributed to concerns over the perceived loss of power, as the current structure grants the charge point operator exclusive control over the energy contract, thereby retaining authority over managing the charging session, effectively ensuring a monopolistic power position.

Building on these insights, an extra final reconfigured blueprint was developed shown in Figure B, offering a recommendation [2]. It addresses the identified risks within the current ecosystem, and manages the risk discussed during the focus group, including the monopoly power of the charge point operator, while securing their position. The following three reconfigured elements were proposed as strategies to provide proper incentives for all ecosystem actors to adopt smart charging. This entails relocation of the energy contract from the charge point operator to the mobility service provider. Consequently, the relocation of responsibility for managing the charging session to the mobility service provider. Lastly, to accommodate the new role of the mobility service provider, the starting tariff as compensation to the charge point operator for the use of the charging station could be included as a key criterion in concession contracts, replacing the fixed kWh price criterion to enable dynamic energy pricing models managed by the mobility service provider.

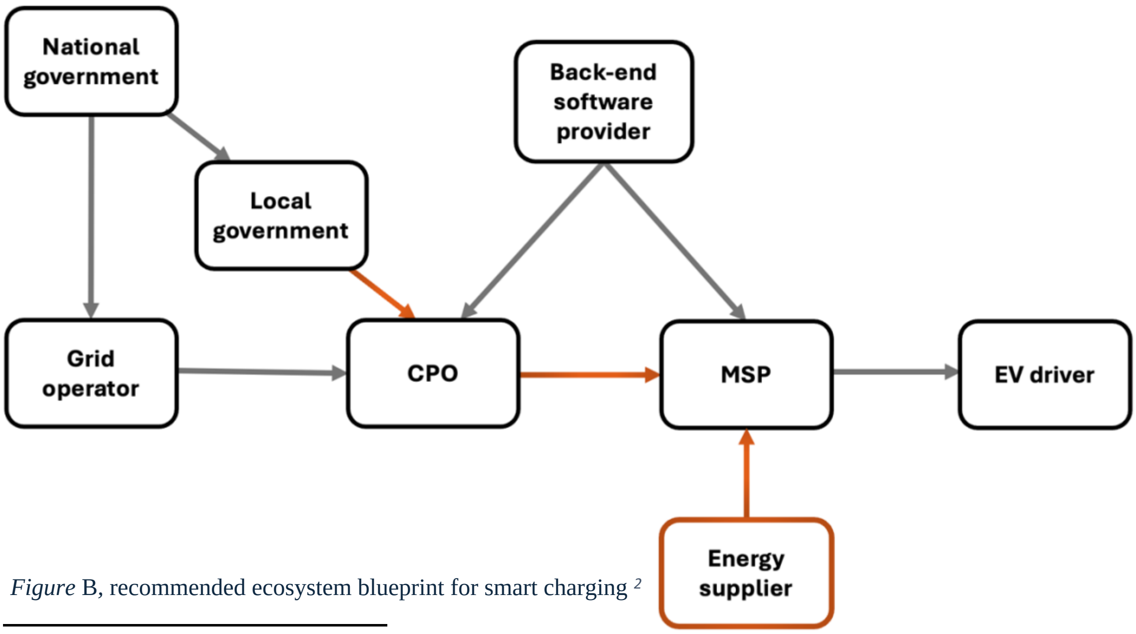


*Figure* B, recommended ecosystem blueprint for smart charging [2]

[2] Corresponds top blueprint 5 illustrated in Figure 15 in the thesis, where it is also discussed in detail.

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## List of Abbreviations

| | |
|---|---|
| BRP | Balancing Responsible Party |
| CPO | Charge Point Operator |
| EAN | European Article Number |
| EV | Electric Vehicle |
| LAN | Landelijk Actieprogramma Netcongestie |
| MLP | Multi-level Perspective |
| MSP | Mobility Service Provider |
| NAL | Nationale Agenda Laadinfrastructuur |
| OCPI | Open Charge Point Interface |
| OCPP | Open Charge Point Protocol |
| RES | Renewable Energy Sources |
| SLVI | Slim Laden Voor Iedereen |
| SoC | State of Charge |
| SCSP | Smart Charging Service Provider |

## 1. Introduction

The necessity to tackle climate change has risen to a worldwide priority, prompting societies to revise their current practices. Mobility, responsible for almost 20% of the total greenhouse gas emissions in the Netherlands, is one of these practices (RVO, 2021). There are two key challenges that need to be addressed to shift towards sustainable electric-powered mobility: (a) grid infrastructure capacity, and (b) sustainably sourced electricity through widespread integration of renewable energy sources (RES) (IEA, 2021). However, the simultaneous growth of EVs and RES increases the risk of grid congestion, defined as the inability of the grid to transport electricity when demand or input surpass its capacity (Netbeheer Nederland, 2022). This forces large investments, both costly and timely, in electricity grid infrastructure (Netbeheer Nederland, 2022). The mass RES and Electric Vehicle (EV) penetration in the Netherlands creates various challenges for the existing electrical infrastructure, including energy shortages, unacceptable voltage fluctuations, and transformer overloading, particularly in the low-voltage distribution networks (Habib et al., 2015; Khalid et al., 2019; Zou et al., 2020). Although total energy consumption in the Netherlands has remained stable since 2008, the simultaneous energy demand from EVs or the input from RES introduce substantial challenges for the grid infrastructure, resulting in queues for grid connections with major social and economic impact (CLO, 2023; Netbeheer Nederland, 2024). This thesis focusses on the pivoting role of how EV charging practices on public charging infrastructure can enable a transition to sustainable mobility by responding to grid congestion issues.

From a technical viewpoint, the role of EVs remains ambiguous; on the one hand, uncoordinated charging can strain a smooth operating grid due to its high peak charging capacity, but on the other hand, the flexibility of the car battery energy storage gives a certain amount of control over the charging process with respect to the grid (Deb et al., 2022). By adjusting the power and/or timing of charging, also known as smart charging, EVs can manage charging power to meet the needs of the power system as well as EV users' preferences. EVs are highly suitable to support the electricity grid because they possess a significant peak capacity that can be strategically managed or curtailed. Furthermore, EV charging provides substantial demand-side flexibility, as most EVs are plugged in for extended periods, but only need a few hours to fully charge, allowing timing adjustments without user inconvenience or additional battery degradation (Luo et al., 2020). Having said this, the extra load of EVs was not considered when designing the electricity grid (Brinkel et al., 2020). Thus, increased adoption of EVs with uncontrolled charging leads to more congestion issues, highlighting the urgent need for smart charging practices to ensure stable EV charging infrastructure (Ucer et al., 2018).

In addition to the grid infrastructure related technical need for smart charging to transition towards sustainable electric mobility, there is also a need for sustainably sourced electricity through the widespread integration of RES. EVs are key assets for a sustainable energy future, as their batteries offer an untapped opportunity to store surplus electricity from fluctuating RES (Dupont et al., 2014; MacDonald & Eyre, 2018; Anthony, 2021; Cai et al., 2022; Barman et al, 2023). By aligning with EV drivers' charging needs with renewable energy supply, smart charging can support the transition from a centralised, demand-oriented energy system to a decentralised, supply-oriented system with RES. Moreover, since RES provide electricity at a lower cost than conventional fossil fuel sources, overall electricity costs can be reduced through smart charging based on spot market prices (Abdulkadir et al., 2015; Jian et al., 2018; Deb et al., 2022; Matisoff et al., 2020). Accordingly, this indicates a win-win intervention.

Nonetheless, a study of RVO (2024) reveals only 23% of the EV drivers adopts smart charging on public charging stations, compared to 84% in the private home market. This significant disparity suggests that, despite the technical capabilities available, adoption rates remain low in the public charging sector, pointing to a lack of sufficient incentives. The difference in adoption between the public and private charging markets highlights critical distinctions that must be understood for the effective integration of EVs into the broader energy system.

The first disparity between the private and public charging markets can be attributed to the limitations of the price mechanism, which fails to fully account for the associated costs and benefits. This is evident in the public charging market, where the price mechanism appears unable to provide adequate incentives for smart charging. Therefore, traditional economic theories concerning transaction costs and welfare economic principles are employed which help to identify areas of market failure to determine whether resource allocation optimises societal welfare (Coase, 1937; Williamson, 1975; Dyer & Singh 1998).

The second aspect that sets the public market apart from the private market is the involvement of numerous actors in the public charging ecosystem, each with distinct interests and priorities. This multiplicity of actors significantly complicates the coordination required for the widespread implementation of smart charging on public charging infrastructure. These relationships cannot be decomposed into bilateral interactions, which could be discussed utilising traditional economic theories, but require an approach that enhances collaboration and coordination across multiple actors and stages of value creation. To address this ecosystem theories are incorporated (Adner, 2012) as the second theory to examine effective coordination mechanisms among interdependent actors, providing a deeper understanding of collective value creation in a dynamic environment. In doing so, it offers guidance on how to effectively implement smart charging incentives, recognising the interconnectedness and interdependencies among actors within a complex multilateral smart charging ecosystem.

In this context, success relies not on a single autonomous innovator, but on creating an alignment structure to partners who must contribute different capabilities, resources, or perspectives to a shared goal in order to transform a winning idea to a market success. Smart charging increases the complexity in business environments and requires cooperation with firms that have complementary assets (Zott et al., 2011; Tang & Rai, 2014). It shifts the focus on discrete products to integrated systems of interconnected products and services, often necessitating partnerships to address product gaps (Porter & Heppelmann, 2015). This necessitates effective management of interdependencies, but prior to managing these, it is essential to recognise and understand the dependencies first. The ecosystem approach is designed to expose hidden dependencies, and subsequently tries to find new methods to bring the existing elements together. In doing so, it helps in understanding how to develop robust strategies for an innovation to increase the odds of success. To address this the following research question was established:

**"How to create a successful EV smart charging ecosystem in the Netherlands?"**

*SQ 1: What is the current structure of the smart charging ecosystem in the Netherlands?*
*SQ 2: What are the main risks for the creation of a smart charging market in the Netherlands?*
*SQ3: How can an ecosystem reconfiguration, and strategies derived from it, support the creation of smart charging market in the Netherlands?*

In order to answer the first and second sub-question interviews were conducted with ecosystem actors involved in public charging in the Netherlands. This approach facilitated the investigation of the ecosystem structure with its interdependencies and ecosystem risks. The empirical findings were further analysed with Adner's (2017) ecosystem-as-structure lens, which enables critical examination of the role of ecosystem actors in delivering the shared value proposition. Building on the empirical findings from the interviews and insights from ecosystem literature, a three-fold alternative ecosystem model is conceptualised to address the third sub-question. To evaluate these alternative models, a focus group comprising all ecosystem actors was convened to discuss how resources can be optimised by strategically positioning different actors within the ecosystem. This focus group discussion facilitated a deeper understanding of alternative strategies for reconfiguring the smart charging ecosystem.

This research provides valuable contributions to both theory and practice. Specifically, it advances theoretical understanding on fostering innovation through collaborative efforts within a multilateral environment. While innovation ecosystems may hold the answer, there is little theoretical guidance on how to navigate in an interdependent innovation system. Moreover, many actors lack a comprehensive understanding of participating in or assessing the value proposition in an innovation ecosystem. This lack of knowledge creates an implementation gap between the intended co-benefits and the distribution of value. Additionally, the empirical insights support ecosystem literature by addressing dependencies in value creation and offer new insight into approaches for managing these dependencies. This offers guidance to firms on prioritising resources allocation when ensuring a strong value proposition to all ecosystem actors. Lastly, the empirical findings from the interviews were synthesised into a three-fold reconfigured ecosystem framework, which was further refined through discussions in the focus group. This led to the development of a final reconfigured ecosystem designed to offer an alternative reconfiguration for addressing and mitigating existing risks. Thereby, the study aims to provide strategic insights for decision-makers enhancing their understanding of the current challenges. Furthermore, it offers recommendations for future direction which contributes to both theory and practice. Collectively, this supports the formulation of a long-term smart charging strategy to drive a sustainable mobility transition.

# 2. Theory

## 2.1 Economic theory

From the perspective of economic theory, the low adoption of smart charging can be attributed to the limitations of the price mechanism, which fails to fully account for the associated costs and benefits. The grid infrastructure and energy market form the basis for analysing cost structure of EV charging, which, under perfect market conditions, is supposed to give a price incentive for smart charging. However, such perfect conditions are currently not met.

According to economic theory, homogeneous goods such as electricity for EV charging, being indistinguishable from one another, generally lead to highly competitive markets as consumers do not differentiate between products based on characteristics other than price and availability (Samuelson, 1954). Consequently, these markets drive intense competition among firms, typically resulting in lower prices and efficient outcomes through market provision. Conversely, significant congestion problems indicate that grid infrastructure suffers from design flaws, resulting in inefficient resource allocation due to market failures. Addressing these is crucial to establish an efficient EV smart charging market. Three market failures occurring within the Dutch grid infrastructure market are outlined.

**Market failures**

(a) Public good, a type of commodity or service that is non-excludable, meaning that individuals cannot be effectively excluded from its use, and non-rivalrous indicating that the consumption by one person does not reduce its availability for others (Samuelson, 1954). Grid infrastructure exhibits characteristics of a pure public good. Grid infrastructure is non-excludable due to regulations as a "connection service is provided by a system operator to any connected party that has or requests a connection to the system operated by that system operator" and "the system operator is obliged to provide the connected party with the desired connection capacity" (Overheid, 2024). Additionally, grid infrastructure is non-rival before congestion sets in, meaning that the marginal cost per additional user is very low until the point of congestion, at which substantial costs are imposed on other users. The latter classifies it as a unique type of public good, which Adams & McCormick (1987) characterise as a non-marketable impure public good, as illustrated in the matrix in Figure 1.

| | | Exclusion: Feasible | Exclusion: Non-Feasible |
|---|---|---|---|
| Consumption | Rival | 1 Private Goods | 2 Common Property Resources |
| | Congestible | 5 Club Goods | 6 Non-Marketable Impurely Public Goods |
| | Non-Rival | 3 Marketable Public Goods | 4 Non-Marketable Public Goods |

*Figure 1, Musgraves matrix including congestible goods (Adams & McCormick, 1987)*

(b) A lack of competition, as seen in monopolistic markets, can result in market failures as it follows monopolies to leverage their market power. Theory of monopoly argues that monopolies are inefficient and can lead to higher prices, reduced outputs, barriers to entry and inefficient allocation of resources (Samuelson, 1948). An exception to this is markets where a single firm can supply the market demand at a lower cost than having multiple competing firms, also referred to as a natural monopoly. Natural monopolies emerge in industries that involve high sunk costs and economies of scale (Samuelson, 1948). Entry under these conditions requires reproduction of substantial fixed costs of construction. As such, grid infrastructure has adopted a monopolistic structure. In the Dutch context, each operator granted exclusive rights to serve a distinct geographical area is strictly regulated to prevent the monopolistic exploitation of market dominance, thereby ensuring efficient operation in the public interest.

(c) Externalities, a theory developed by Pigou (1920) which explains the activity by an agent has an impact on other unrelated third party. They represent a by-product of otherwise legitimate economic consumption or production, and can be seen as a market failure where the price mechanism fails to fully account for the associated costs or benefits. In the context of this study, externalities arise from the fact that consumer do not take into account that their consumption may cause congestion for others (similar to road congestion). The presence of externalities then implies that the private level and societal optimal level of provision diverge.

In the context of this study, high peak power demand of EVs strain the grid and increase the risk of grid congestion. Under first-best pricing—an ideal economic scenario where prices perfectly reflect all costs, including marginal and external costs—the final cost function of interest to grid infrastructure is the marginal cost, which represents the increase in total cost following from the addition of one consumer. The average cost of this congestible good is nearly flat. However, if grid use intensifies, the average costs become increasingly steep, and at the point of grid congestion nearly vertical. The marginal cost of consumption therefore exceeds the average costs. These reflect the costs associated with managing and mitigating grid congestion to meet electricity demand. The inability to charge a dynamic tariff for grid infrastructure on charging stations introduces a gap between marginal private cost and marginal societal cost, and thus lead to a situation in which a free-market does not achieve an efficient outcome. This issue stems from the fixed flat grid infrastructure tariff for (public charging) grid connections (Overheid, 2024), which has two inherent shortcomings: it does not allow to discriminate based time of consumption and place of consumption. As a result of imperfections in the pricing mechanism for grid infrastructure, EV charging rates that do not account for the marginal external costs of congestion, which in turn incentivises consumers to make suboptimal decisions from a societal perspective.

In short, economic theories provide valuable insights into the current economic environment that hinder the adoption of effective EV smart charging solutions, in response renewable energy integration and ongoing associated congestion challenges. It provides a deeper understanding of the prevailing market failures that hinder the establishment of adequate price incentives, leaving the actors involved with insufficient incentives to adopt it. Nonetheless, the solutions economists suggest such as new regulatory policies, additional provisions or corrective (Pigouvian) taxes or subsidies to restore efficiency seem ineffective due to the interconnectedness of market failures (Coase, 1937; Pigou, 1951; Williamson, 1975; Dyer & Singh 1998). The existing regulations and structures not only induce the problems resulting from market failures, but are also unable to deal with a situation where the success of a value proposition depends on creating an alignment among partners who need to work together for turning a promising idea into a market success. Smart charging operates in a multilateral environment, including a diversity of partners or entities. These relationships cannot be decomposed into bilateral interactions, which can be discussed utilising transaction costs economics (Coase, 1937; Williamson, 1975; Dyer & Singh 1998). Instead, they necessitate an approach that fosters collaboration and coordination across multiple actors and stages of value creation. Addressing this complexity requires a theory that emphasises actor interdependencies and provides guidance on strategies to manage these dependencies. Accordingly, Adner's (2012) ecosystem theory is outlined in the following section.

## 2.2 Ecosystem theories

In recent years, the concept of ecosystems has gained significant traction in the field of innovation management. Moore (1996) introduced a view on ecosystems as an economic community supported by a network of institutions, organisations and individuals that collectively create value for the customer by working cooperatively and competitively as well. He states that by collaborating over time the participants of an ecosystem "will co-evolve their capabilities and roles, and tend to align themselves with the direction set by one or more central companies" (Moore, 1996). While Moore was the pioneer of the ecosystem concept, many interpretations and definitions of ecosystems in relation to innovation were found in literature. Three characteristics are consistently emphasised: (1) stakeholder interdependency in terms of their performance and effectiveness, (2) an aligned vision of value creation and joint functional goals and objectives, and (3) partner complementarity in assets and capabilities, allowing highly integrated customer-focused solutions (Moore 1996; Iansiti & Levien, 2004; Adner 2012; Jackson 2011; Autio & Thomas, 2014).

To elaborate on the concept of ecosystems, two views were distinguished. First the perspective of Moore (1996) and other authors (Autio & Thomas, 2014; Iansiti & Levien, 2004) which focusses on what Adner (2017) describes as ecosystems-as-affiliations. This approach starts with identifying actors, usually defined by their connection to a focal actor, explores the relationships among them, and ends with the possible value propositions and enhancements that the ecosystem can generate (Adner, 2017). In follow-up research Adner (2017) developed another concept, ecosystem-as-structure. In contrast to the first view, this second view begins with the value proposition, examines the activities required for its materialization, and ends with aligning the actors involved (Adner, 2017). The latter view emphasises the central position of value proposition in the ecosystem, whereas ecosystem-as-affiliation focusses on the actors. Ecosystem-as-structure is applicable to smart charging, as it starts with a value proposition and aims to identify a group of actors that need interact for the proposition to materialise. This structural perspective highlights the importance of alignment between partners as a critical strategic challenge since resource allocation is interdependent. Ecosystem-as-structure gives rise to a specific view on the relationships across actors that collectively contribute to the creation and delivery of value.

Based on the ecosystem-as-structure view the following definition of ecosystems was formulated by Adner (2017) — the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialise.

The structural approach to ecosystems of Adner (2017) can be outlined in four key elements: actors, activities, positions and links. Firstly, actors are the entities that carry out the activities in an ecosystem. The activities being the second element, describing specific actions which have to be undertaken to materialise the value proposition. Positions indicate where in the activities flow within the system actors are located and characterise who transfers to whom. Finally, links refer to transfers between actors, containing matériel, influence, information or funds. These four elements together describe how value collectively is created through a set of interactions that arises in multilateral settings and that can only be described with reference to the specific structure of interdependence.

In order to develop a proper strategy for smart charging, ecosystem theories were presented to get a better understanding. This section consists of three main elements; (a) understanding the problem by revealing hidden dependencies (b) mapping the ecosystem and exploring roles and relationships, (c) develop strategies for building a new ecosystem by reconfiguring the structure of dependence.

**A) Understanding the problem by revealing hidden dependencies**

In the context of ecosystem, the innovation strategy focuses on three aspects: value creation, value capture, and risk management (Adner, 2012). This implies that the emphasis is on integrated solution rather than standalone products, making value delivery reliant on the collective efforts of multiple partners. Consequently, when innovation implementation hinges on collaboration, the success of the innovation relies not only on your own efforts but also on the ability, willingness, and likelihood of your partners within the innovation ecosystem to succeed. It is crucial to recognise elements that uphold the value proposition for all stakeholders to achieve full market potential. Not being aware of these elements can lead to partner misalignment and unexpected innovation risks.

During the development and implementation phases of an innovation, three main risks were identified by Adner (2012) in his book "The Wide Lens": execution risk, co-innovation risk, and co-adoption risk (Figure 2). Traditionally, firms tend to focus on internal risk, the challenges encountered in realising the innovation to the necessary specifications and within the specified timeframe, also referred to as execution risk. Managing this is a precondition, but not sufficient in an interdependent ecosystem.

- **Execution risk:** *The challenges you face in bringing about your innovation to the required specifications, within the required time* (Adner, 2012, p. 33). Furthermore, the focal firm must ensure that the innovation meets customer demands and that competitors do no offer superior alternatives. Failure to do so may result in the focal firm and its partners being unable to bring the innovation to market as planned meeting necessary specifications (Adner, 2012). The key challenge is how to deliver the innovation better than the competition.

Understanding the dynamics of an ecosystem is about the interplay between an individual's execution risk and the external risks introduced by ecosystem partners. These reveal hidden dependencies, and thereby help to understand and develop a robust strategy that is more likely to lead to success. Two types of external risks can be distinguished, namely co-innovation risk and co- adoption risk.

- **Co-innovation Risk:** *The extent to which the successful commercialization of your innovation depends on the successful commercialisation of other innovations* (Adner, 2012, p. 33*)*. Hence, the focal firm must evaluate the interdependence risk associated with the coordination of complementary innovators. The success of the innovator becomes dependent on the odds of complementary partners not meeting their innovation commitments. Hence, the odds of success of all interdependent innovations by complementary partners must be taken into account (Adner, 2012; Thomas & Autio, 2013). Co-innovation risks make it necessary to consider who else needs to innovate for the innovation to be significant.

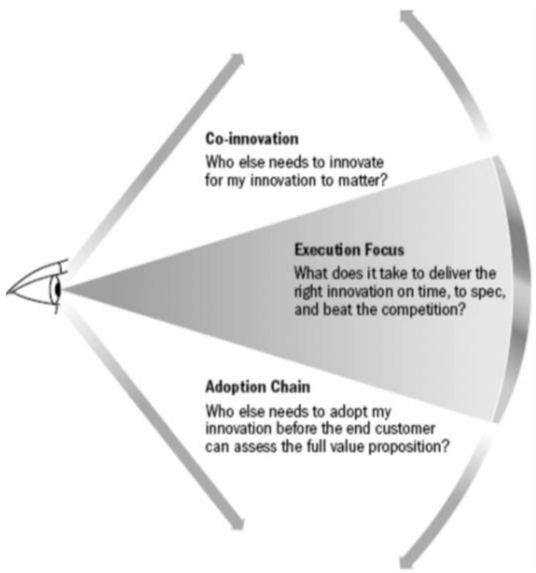


*Figure 2, The wide-lens perspective on innovation strategy (Ander, 2012)*

- **Adoption Risk:** *The extent to which partners will need to adopt your innovation before end consumers have a chance to assess the full value proposition (Adner, 2012, p. 34).* This means managing the entire value chain and assessment of the integration risk associated with the innovation by the focal firm. Therefore, each actor must weigh the costs and benefits of adoption. If the benefits for each intermediary in the chain do not exceed the costs, it is unlikely that the innovation will ever reach the end-user. Adner (2012) uncovers a difference in perspective of "costs" and "benefits" between the innovator and customers, which is outlined in Table 1. To reduce adoption risk it is crucial to take a wider perspective then just the focal firm, as the surplus of the other partners in the chain, who also need to adopt the innovation, needs to be considered as well before the end-user can assess the full value proposition.

*Table 1, different perspectives of costs and benefits (Adner, 2012)*

| | Innovator | Customer |
|---|---|---|
| Benefits | The absolute benefit delivered to customer. | The relative benefit delivered by the product compared to the available alternatives. |
| Costs | The price charged for the innovation | Customers conceive of cost in terms of that price PLUS all the other changes they need to undertake in order to use the innovation (cost of retraining, equipment upgrades, etc.) |

In an ecosystem external risks become more prevalent due to the greater dependence on partners. An important implication of participating in an ecosystem is that the odds of success not only depend on the company's own efforts, but also on the contributions of its collaborators. Recognising these external risks introduced by partners is crucial for proactively managing these interactions and to drive ecosystem success.

**B) Mapping the ecosystem**

The primary challenge for ecosystem creation is to translate a vision into a shared value proposition. In ecosystems, value is co-created, actors should co-evolve their capabilities to generate value (Adner & Kapoor, 2010; Autio and Thomas, 2014). While value is collaboratively created in an ecosystem, value capture predominantly occurs at the firm-level. This is a potential source of friction (Ritala et al., 2013), and hence requires a shared vision that aligns partners to collaboratively create and distribute value (Adner, 2017; Autio & Thomas, 2014; Hellström et al., 2015). In order to coordinate an effective co-alignment structure between partners, it is first crucial to also understand the links of interdependence.

Heterogenous actors within the ecosystem are connected through interdependencies, three main types were identified. Technological dependencies, an ecosystem in which heterogenous actors are cospecialised, often employing modular architectures or shared platforms (Adner, 2017; Autio & Thomas, 2018; Jacobides et al., 2018). Economic dependencies, where the value each actor gains from the ecosystem relies on the simultaneous availability of compatible offering from others, such as in economies of scale and scope (Thomas et al., 2014; Autio & Thomas, 2018; Jacobides et al, 2018).

Lastly, cognitive interdependence in ecosystems involves participants that have a set of "socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules … which provide the formal and informal rules of action, interaction, and interpretation that guide and constrain decision makers" (Thornton & Ocasio, 1999, p.804). In particular, in contexts where heterogenous actors in an ecosystem exhibit worlds and economic views that are not necessarily widely shared with others in the ecosystem, promoting ecosystem cohesion is crucial. Moreover, cognitive distance can be increased due to differing self-interest and expertise among actors in the ecosystem (Wareham et al., 2014).

Ecosystems feature unique coordination mechanism that primarily based on role definitions, super modular complementarity and alignment structures —technological, economic, and cognitive— that find a middle ground between change and stability (Autio & Thomas, 2018; Jacobides et al., 2018). An ecosystem co-alignment structure represents the power relations, and the interdependencies of actors that characterise an ecosystem. As opposed to supply chains, ecosystems primarily depend on noncontractual (Autio & Thomas, 2021). Instead of one-to-one contracts that specify contributory obligations, ecosystem achieve coherence by establishing roles that set normative expectations to guide anticipated behaviours. Actors join the ecosystem in a specific role, with the understanding that any violation of the associated role expectations may result in exclusion. This compliance is obtained through a shared vision that outlines the objectives and used in order to gain stakeholder buy-in.

Adner (2012) developed a tool to map an ecosystem, the value blueprint, it articulates who does what by explicitly describing the specific location and links of complementors that are critical for success. This vision and value proposition define the ecosystem's structure and strategy according to the ecosystem-as-structure perspective (Adner, 2017). In the context of ecosystems, a value proposition requires multiple elements to converge, with different permutations needing to work together simultaneously. A value proposition articulates the value that an innovation effort will produce, as well as who this value will be created for. The value blueprint tool enables the assessment of alternative configurations and generates shared understanding and agreement among partners. Through clear communication of a common vision, stakeholders can be engaged to collaborate, and the risk of information asymmetries is reduced, fostering trust among partners (Ritala et al., 2009). Therefore, the ecosystem's vision is the starting point of ecosystem creation.

A fundamental concept of Adner's (2017) ecosystem perspective is the alignment structure, where actors in the ecosystem mutually agree on their positions in the ecosystem. The central actor within the ecosystem is identified as the focal firm, commonly known as the ecosystem leader. The focal firm initiates the ecosystem's structure and governs its overall functionality. The primary challenge for the ecosystem leader is translate its vision into a value blueprint that creates value for the customer. As the blueprint makes explicit, there is rarely one customer. The leader must ensure fair standards and consistency, and create benefits for all ecosystem partners to justify their participation (Adner, 2012). The leader incentivises partners to adapt their business operations by sharing common business model elements that drive value creation, not only for themselves, but for their partners as well (Hellström et al., 2015).

**(C) Develop strategies for building a new ecosystem**

The previous parts A and B provided clear grammar for discussing the risks and structure of interdependence. This part examines to the choice of intervention, and introduces new strategies for building and shaping ecosystems.

According to Adner (2017) ecosystem-as-structure perspective, the value proposition is the cornerstone ecosystem creation. By analysing the value creation process of an ecosystem, the analysis shifts from a stand-alone innovation of a single firm to a system of interdependent innovations, where the focal actor is dependent on the other partners in the ecosystem (Adner & Kapoor, 2010). Their success depends on value creating activities of its partners and the underlying business model that drives the innovation ecosystem. Therefore, for a value proposition to be fruitful, an ecosystem actor must recognise, understand and manage its dependencies as to then be able to translate these dependencies into an ecosystem-focused business model, in which each actor benefits from adopting the innovation (Adner, 2012).

From investigation of business model literature it is evident that there is growing emphasis on external focussed business model. However, these studies mainly address business networks which are structured differently compared to ecosystems (Osterwalder, 2004; Zott & Amit, 2008; Osterwalder & Pigneur, 2010; Teece, 2010; Peters et al., 2015). Sniukas (2013) argued for an extended model version of the commonly used the business model canvas (Osterwalder & Pigneur, 2010), incorporating partners, suppliers and other parties. However, this approach lacks the ability to include (interdependent) risks. While business networks and ecosystems both involve communities of organisations interacting to enhance performance by leveraging complementary resources, technologies, or market access (Shipilov & Gawer, 2020), significant differences occur concerning relationships and their view on interdependence.

Interorganisational cooperation of actors within an ecosystem are not hierarchically managed but is instead bound by a shared value proposition (Adner, 2017; Jacobides et al., 2018). In contrast, business networks are often transactional and focus on actor ties through a formalised structure of mutually binding contracts (Shipilov & Gawer, 2020). Further, ecosystems involve a multilateral setting of actors and encompasses a network of relationships that cannot be reduced to a simple collection of bilateral interactions, an interaction between only two actors. As traditional business model literature provides an incomplete perspective regarding multilateral setting of innovative ventures characterised by joint value creation, an alternative approach was chosen.

The ecosystem concept has raised awareness and focused attention on innovative models of value creation and value capture. The work that is best suited in this setting is the value blueprint of Adner (2012), which is developed to identify the risks associated with ecosystem design, particularly focusing on risks associated with implicit and explicit dependencies. A well-designed, reconfigured value blueprint structures the ecosystem to minimise co-innovation and adoption chain risks (Adner, 2012). The objective is not to eliminate risk, as uncertainty is inherent in any innovation effort, but to shift risk to areas where it can be managed most effectively. Innovating within ecosystem involves more than innovating individual elements alone; it also requires innovation in how these elements come together, that is, innovation in the blueprint itself (Adner, 2012). In this regard, economic theories have revealed several limitations of the current system that are associated with market failures. Ecosystem theories offer a novel perspective by acknowledging the limitations of existing elements and focussing on finding new way to bring them together.

Adner (2012) outlines five levers for reconfiguration ecosystems, which involve taking the existing elements and finding a way to rearrange them. By accepting the limitations of existing elements and subsequently finding new methods to integrate them, by changing the pattern of interaction among the elements in the system, the odds of success can be significantly increased. Taking any value blueprint and examining the arrangement of activities, actors, and links; five fundamental questions can be posed to identify a new configuration capable of resolving problematic bottlenecks, an overview is presented in Table 2 (Adner, 2012).

*Table 2, five levers for reconfiguration of ecosystems (Adner, 2012)*

| | |
|---|---|
| 1. What can be **separated**? | Is there an opportunity to decouple elements that are currently bundled in a way that can create new value and move the value proposition forward? |
| 2. What can be **combined**? | Is there an opportunity to bundle elements that are currently uncoupled in a way that can create new value and move the value proposition forward? |
| 3. What can be **relocated?** | Is there an opportunity to shift existing elements to new positions in the ecosystem in a way that can create new value and move the value proposition forward? |
| 4. What can be **added**? | Are there elements that are currently absent but whose introduction to the ecosystem can create new value and move the value proposition forward? |
| 5. What can be **subtracted**? | Are there existing elements whose elimination from the ecosystem could be accommodated in a way that would allow for the creation of new value and move the value proposition forward? |

# 3. Methodology

## 3.1 System description

The objective of this research is to offer guidance on reconfiguring the smart charging ecosystem in the Netherlands to ensure widespread adoption in the public charging domain, taking an innovation ecosystem approach. To do so, it is essential to first understand the existing ecosystem. Smart charging adopts a structuralist approach on ecosystems, beginning with a value proposition and aims to identify a group of actors that need interact for the proposition to materialise. Emphasizing the value proposition naturally expands the analysis to explicitly include partners. Hence, partners are defined as actors whose participation is essential for the value proposition, irrespective of whether they have a direct link to the focal firm (Adner, 2017). Adopting the ecosystem-as-structure construct highlights the significance of the structure of alignment as the same set of actors, structured in two different configurations, form two distinct ecosystems.

In that regard, the following blueprint was illustrated in Figure 3, based on the following value proposition for smart charging: "the anticipated benefits that actors in the ecosystem receive by intelligently adjusting the timing of the EV charging process." The objectives may vary per actor and consist of optimising charging schedules based on availability of renewable energy, minimising costs for users through off-peak charging, or reducing strain on the electricity grid by balancing charging loads. The blueprint is explicit about the specific location and links of complementors that make up the ecosystem. The eight-step approach of Adner (2012) was utilised to establish the blueprints.

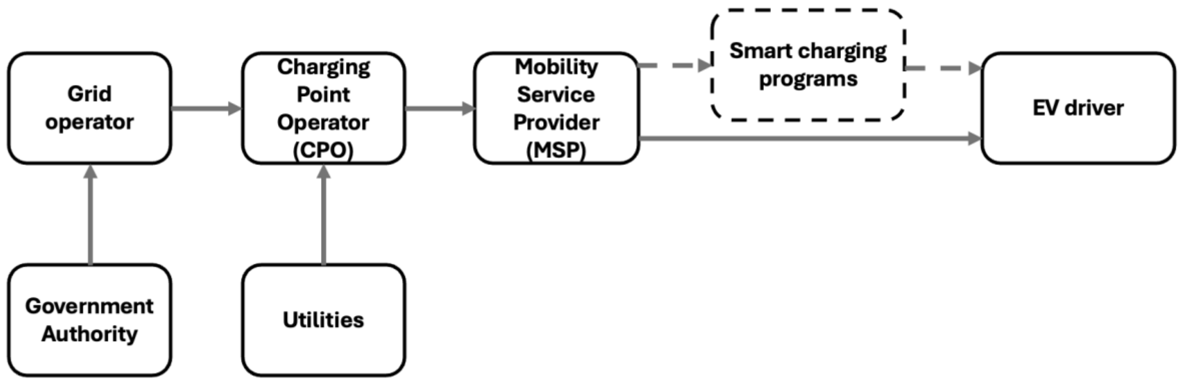


*Figure 3, value blueprint of smart charging at public charging station*

## 3.2 Research design

This research aims to provide guidance on redesigning the smart charging ecosystem, thereby enabling a sustainable mobility transition in the Netherlands. Despite the technical feasibility of smart charging, there appears to be a lack of alignment among the involved actors regarding the establishment of a smart charging market in the Netherlands. The theory section has elaborated on different concepts related to ecosystems and described various tools and frameworks to support value creation based on the structure of the interdependent activities that underlie a value proposition. These tools are meant to be used iteratively and to help the researcher (a) understand the current ecosystem structure, (b) identify the main challenges and risks, and (c) converge on the best ecosystem strategy for the creation of a smart charging market.

A qualitative approach was chosen to collect rich and detailed data to investigate the interactions, the perspectives and the conjunction of perspectives of key actors (Braun & Clarke, 2006). This approach is most suitable as perspectives are subjective in nature. Qualitative methods allow for in-depth interviews generating new insight and understandings which is necessary to explore the perspectives of ecosystem actors. Qualitative research is appropriate in this case because it aims at understanding the complexity of the multi-actor nature of an ecosystem. It offers the opportunity to delve deeper by asking for underlying motives and reasons in order to understand their perspectives (Hay, 2016). Furthermore, it enables inclusion of contextual elements, as the interviewer can ask for explanations by touching upon a particular concern in the given context. This enhances the interviewers' understanding and interpretation of the perspectives of the interviewees (Bryman, 2016). The following five-step research design, as illustrated in Figure 5, was developed.

The **first step** involved developing the baseline smart charging blueprint (Figure 2) to guide the study. This blueprint was established through a combination of desk research and scoping interviews conducted with experts from Arcadis, following the eight-step approach of Adner (2012). Desk research provided a comprehensive review of existing literature and frameworks related to smart charging ecosystems, while the interviews offered practical insights and expert perspectives to refine the ecosystem blueprint. The blueprint not only provided a comprehensive framework for understanding the smart charging ecosystem, but also served as a basis for selecting interview participants which will be further elaborated upon in Section 3.4.

The **second step** (section 4.1-4.3) included semi-structured interviews with ecosystem actors, questions were asked about the four basic elements that underlie the structuralist approach (Adner 2012). Besides, the interview reveals hidden risks related to smart charging innovation efforts. The status of the identified co-innovation and adoption risks was described according to a traffic light continuum (Table 3). This qualitative approach provides insights into the identified risks for each actor, enabling a deeper understanding of the root causes. With regards to the interdependencies, the interviewer aims to investigate specific stakeholder characteristics in order to identify those characteristics that influence how partners reach alignment. This approach enables detailed mapping of the current ecosystem structure, clearly outlining the existing dependencies and challenges faced within the Dutch context.

*Table 3 description of traffic light continuum (Adner, 2012)*

| | Co-innovation risk | Adoption risk |
|---|---|---|
| Red | Not in place, and there is no clear plan | They have clear reasons to prefer the status quo and prefer not to participate in the proposition as it stands |
| Yellow | Not yet in place, but that there is a plan | Neutral but open to inducement |
| Green | Ready and in place | Partners are eager to participate and see clear surplus from their involvement |

The **third step** (section 4.4) entails developing new blueprints to reconfigure the ecosystem by changing the pattern of interaction among the elements in the system, thus aiming for a viable solution for those actors that are currently not eager to participate. We do so by following the five levers articulated in Table 2 above. Adner (2006) highlights that this process for developing a strategy in an innovation ecosystem is iterative, and consists of the following stages. It starts with the development of an ecosystem vision with a value proposition that presents a tentative agreement on the performance expectations. Subsequently, the target market is determined, the roles are defined, and the risks associated with that vision are assessed. To then outline alignment structure of the ecosystem, the multilateral set of partners that need to interact in order for a focal value proposition to materialise (Adner, 2017). The focal firm is often forced to revise their expectations or plan which takes them back to the first stage, developing a vision. A schematic representation of the process of reconfiguring an innovation ecosystem is shown in Figure 4. This approach was employed to develop three alternative reconfigured blueprints in consultation with experts from Arcadis.

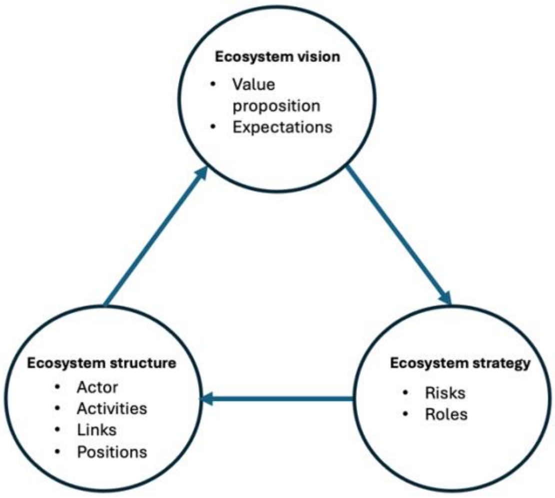


*Figure 4, innovation ecosystem reconfiguration*

In the **fourth step** (section 4.5), the three reconfigured ecosystems were discussed with the ecosystem actors by means of a focus group. To enhance the quality of the focus group, the presentation detailing the structure of the focus group was shared in advance, along with explanations of the three reconfigured ecosystems, in order to manage participants' expectations. Three reconfigured ecosystem strategies were discussed in de focus group, with the aim to provide ecosystem actors with ownership and a deeper involvement in shaping the future direction. Thereby yielding more comprehensive insights into how to create a successful smart charging ecosystem.

In the final **fifth step** (section 4.6), the focus group discussions of the blueprints were analysed and discussed again with experts from Arcadis. Applying Adner's (2017) ecosystem theory, we then used the analysis of the focus group to develop a recommendation for all ecosystem actors on how the ecosystem can be reconfigured to advance smart charging in the Netherlands in the short-term.


*Figure 5, five-step research design*

### 3.3 Data Collection and Operationalisation

Semi-structured interviews

Semi-structured interviews were conducted to capture unique insights into the perspectives of the key actors regarding the three objectives of this study. It was chosen because it can provide both structure, and flexibility to elaborate on topics, change order or to divert (Clark et al., 2021). At the same time it allowed for comparison of answers both across actors within the same organisation and between different organisations (Clark et al., 2021). This strategy enhances the interpretation of answers from interviewees, thereby contributing to a more detailed understanding (Leech, 2002). The interview guide is included in Appendix A and was structured as follows. It aims to (a) understand the four basic elements that underlie the structuralist approach of the smart charging ecosystem, (b) the ecosystem strategy, and (c) assess the ecosystem vision. This gives a deeper understanding of the current ecosystem and enables the researcher to highlight the existing risks. This process informed the development of three reconfigured ecosystem blueprints, also leveraging the ecosystem visions conducted in the interviews. This is further detailed in the subsequent section on the focus group.

Focus group

Following the interviews, a focus group with representatives of all ecosystem actors was employed to address the third research question of this study, converging the best ecosystem strategy for the creation of a smart charging market. The focus group consisted of a presentation of the researcher, offering a general introduction to the study to ensure everyone had the same level of prior knowledge. Additionally, the presentation outlined the results of the interviews using the blueprint, including the identified risks. (Sections 4.1-4.3). Subsequently, the three reconfigured ecosystem blueprints were explained individually, followed by a plenary discussion.

Reconfiguring an ecosystem is an iterative process (Adner, 2006), the focus group was structured using the three-step approach for reconfiguring an ecosystem (Figure 4). The ecosystem strategy, which includes the risks identified in the interviews, was taken as a starting point, as these uphold widespread adoption of smart charging. To address these risks, three alternative reconfigured ecosystem structures were developed, represented as blueprints 1, 2, and 3, leveraging the five levers for ecosystem reconfiguration (Table 2). First, the reconfigured ecosystems structures, articulated in the blueprints, were tailored to each participant, outlining the actor, activities, positions and links. Subsequently, a shared ecosystem vision was developed in accordance with the findings from the interviews, with no distinction made between the three blueprints. Lastly, to assess the ecosystem strategy, participants were asked to identify the risks they perceived within the context of the reconfigured ecosystem blueprints. These include execution, adoption and co-innovation risks, with the latter two evaluated using the traffic light continuum outlined in Table 3.

To encourage active participation and ensure all perspectives were represented, paper worksheets were distributed to collect data on the identified risks from each participant, including their reasoning. To create a comfortable environment for open discussion, no recordings were made during the session. Instead, the worksheets captured individual inputs, and an additional researcher assisted by taking detailed notes throughout the session. Participants from organisations that represent multiple actors were asked to complete multiple worksheets from the different perspectives. An empty sheet to illustrate the format is provided in Table 4 below, with the participant-specific worksheets for the three visions available in Appendix B. This approach facilitated equal involvement from all participants and provided valuable insights to inform the subsequent plenary discussion. The identified adoption and co-innovation risks are categorised using the traffic light continuum on the worksheet. This visual tool forms the basis for the focus group analysis, with the plenary discussion providing a more in-depth exploration of the identified risks.

*Table 4, focus group worksheet format*

| | | |
|---|---|---|
| **A. Ecosystem vision** | Shared value proposition | |
| | Individual value proposition | |
| | Expectations | |
| | | |
| **B. Ecosystem strategy** | Role | |
| | Execution risk | Are there any practical or execution-related obstacles that are holding you back from implementing smart charging practices?<br><br>**Explain:**____________________ |
| | Adoption risk | How willing are you to undertake the required activities for smart charging?<br>**Circle the colour.**<br>- Green: you are eager to participate and see clear surplus from their involvement<br>- Yellow: Neutral, but open to inducement<br>- Red: clear reason to prefer the status quo and prefer not to participate in the proposition as it stands<br><br>**Explain:**____________________ |
| | Co-innovation risk | How able are you to undertake the required activities?<br>**Circle the colour.**<br>- Green: is ready and in place<br>- Yellow: is not yet in place, but there is a plan to get there<br>- Red: is not in place, there is no clear plan to get there<br><br>**Explain:**____________________ |
| | | |
| **C. Ecosystem structure** | Actors | |
| | Activities | |
| | Links | |
| | Positions | |

After all participants filled in the risks on the paper worksheet, each individual blueprint was discussed in plenary. To simulate the dynamics of the ecosystem, the focus group structured participants' positions in the room according to the ecosystem blueprint. Moreover, responses were restricted to actors with a direct link to the previous actor that spoke up, as defined by the ecosystem blueprint, emphasising an approach that closely mirrors real-world dynamics. The discussion on the ecosystem strategy for each blueprint started with an industry actor (CPO, MSP, utility, or backend software provider). The researcher could intervene in the focus group discussion to ensure that all perspectives were adequately represented, particularly when the discussion was concentrated on one part of the ecosystem, thereby fostering a more balanced dialogue. This intervention helps to prevent dominant voices from overshadowing others and ensures that the diversity of opinions and insights, crucial for capturing the complexity of the topic, is thoroughly explored. Lastly, the discussion on each blueprint was concluded with a closing statement from the national government.

This focus group was chosen to study the interaction between the ecosystem partners and to examine ways in which partners in conjunction with one another construct meaning (Clark et al., 2021). It reveals valuable additional information, particularly concerning on reasons rationalisations and arguments underlying the participants understanding (Poortinga et al., 2004). In an interview setting, an interviewee statically provides his or her reasons for holding a particular view, while the dynamics of a focus group allow participant to probe each other’s reasons. These can be interesting for the researcher, but, as the participant listens to others’ answers, they may want to modify their view; or alternatively may want to reach an agreement that the participant would not have thought of without the discussion (Clark et al., 2021). Given that the ecosystem structure changes within the distinct blueprints, along with the interdependence among stakeholders, a focus group provides a unique opportunity to capture these dynamics and enrich the findings with greater nuance. A focus group reflects the way meaning is constructed in everyday life, and to some extent, they are considered more naturalistic than individual interviews (Wilkinson, 1998).

### 3.4 Sampling strategy

Interview sampling strategy

A stratified sampling strategy was employed, this form of purposive sampling implies that the researcher selects specific kinds or groups of participants that need to be part of the study (Bogdan & Biklen, 1982; Glaser & Strauss, 1968). The reason for this is the better matching of the sample to the aim and objective of the study, thereby it improves the rigor of the study and the reliability of the data and findings (Kelly et al., 2010). Besides, it serves as a method to identify and selects participant in a manner that optimally uses limited research resources (Palinkas et al., 2015). The sample is selected according to the informants' knowledge are known to have been involved (smart) charging infrastructure, and hence these people hold different and important views that need to be included in the sample (Robinson, 2014; Trost, 1986).

The sample was stratified based on its link to the ecosystem. This study adopts a structuralist approach to the ecosystem, defined by the alignment structure of a multilateral set of partners that need to interact in order for a focal value proposition to materialise (Adner, 2017). These actors represent all perspectives under investigation. To obtain a reliable reflection of an ecosystem actor's interests as well as an opportunity to identify any intra-organisational differences, this study conducted a minimum three interviews per ecosystem actor. Moreover, during the recruitment of interviewees, particular attention was given to selecting employees within the organisation who were well-informed about smart charging, ensuring they could adequately respond to the interview questions.

In addition to the actors presented in the ecosystem (Figure 3), two adjustments were made during the interviews to include new actors, who are incorporated into the stratified sample. First, the "government authority" was split up into "local government" and "national government". Second, the "backend software provider" was added to the ecosystem. These actors play a distinct role in the ecosystem and must interact for the focal value proposition to materialise, in accordance with the structuralist approach. Table 5 provides an overview of the distribution of the 28 of interviews conducted, categorised by ecosystem actor. The total number of interviews does not correspond directly to the sum of the actors, as various organisations represent multiple actors within the ecosystem.

*Table 5, breakdown of interviews by ecosystem actor*

| Ecosystem actor | Number of interviews |
|---|---|
| National government | 5 |
| Local government | 4 |
| Grid operator | 4 |
| CPO | 6 |
| Utility | 4 |
| MSP | 5 |
| Backend software provider | 5 |
| EV driver (representative) | 3 |

<u>Focus group sampling strategy</u>

The focus group consisted of nine participants, selected to ensure a balance between maintaining a manageable group size conducive to dynamic discussions and achieving representation of all key actors. Given that the lack of adoption by a single actor can disrupt the adoption chain, prioritising the inclusion of all actor categories was critical. However, as many participants represented multiple actor roles, double representation was strategically applied to streamline participation. All ecosystem actors listed in Table 5 were represented by two organisations except for the grid operator and local government which had only one representative. The reason for this was that the national government shared similar interests with these actors. This approach allowed the number of participants to be minimised while preserving comprehensive representation. Thereby, it gives each participant sufficient time to discuss their perspectives and experiences on topics in which they were highly involved in (Morgan, 1996). Participants were invited to join the focus group immediately following their individual interviews. This resulted in most participants were previously interviewed, and only one substitute that was not interviewed, but was familiar with smart charging and engaged with it in their daily work

### 3.5 Data analysis

The interviews were transcribed and analysed using a dual approach, integrating both inductive and deductive analysis to establish connection with pre-existing theories and explore new conceptual pathways (Saldaña, 2013). Deductive analysis formed the first step, employing existing theoretical concepts related to ecosystems to organise and interpret the data. A predefined framework was applied, which is shown in Appendix C. This predefined framework allows systematic categorisation of the data obtained from the semi-structured interviews, facilitating the identification of underlying patterns within the dataset. In doing so, it provides insights into the structure, interdependencies, and relationships among ecosystem actors, while aiding in the identification of innovation ecosystem risks present within the current configuration. Throughout the results section, interviewee quotes are integrated to provide a direct representation of their responses, offering clarity and context to the analysis. Building on these empirically derived insights, the second step involved an inductive approach, in which the ecosystem was refined to enhance its design. The inductive approach also included the development of three reconfigured ecosystems. Data on ecosystem risks was collected from focus group participants through paper worksheets, complemented by notes taken by an additional researcher capturing the insights shared during the plenary discussion. The identified adoption and co-innovation risks are categorised using the traffic light continuum, shown in Table 3, provided on the worksheet. This method enables the colour-coding of ecosystems, offering a clear visual representation of the risks associated with each of the three reconfigured blueprints.

### 3.6 Research quality indicators

The framework of Yin (2018), shown in Table 6, is to structure the given construct validity, internal validity, external validity, and reliability.

*Table 6, research quality indicators*

| | |
|---|---|
| **Construct validity** | Construct validity refers to the degree to which a measurement accurately assesses its intended measure. In research, it is crucial to translate constructs into specific, measurable characteristics (Bhandari, 2022). To ensure construct validity, a deep understanding of the topic is required, while also being receptive to unexpected findings. This is achieved by using multiple sources of data collection also referred to as triangulation, including interviews, a focus group and document analysis (Moon, 2019). |
| **Internal validity** | Internal validity refers to the degree to which evidence supports a causal claim within the specific context of a study (Patino & Ferreira, 2018). The validity of literature is assessed based on factors such as the number of citations, publication year, and authority. Additionally, a member check where data and interpretation derived from interviews are shared to the persons from whom these were originally obtained was done, to validate accuracy and credibility of the data collected. Lastly, as a researcher it is important to reflect and be aware of your own biases, to avoid these also peer feedback from other scholars was asked relating to different parts of the research. |
| **External validity** | External validity refers to the extent to which the findings of a study can be generalised to other situations, people, setting, and measures. It involves investigation whether the findings can be applied to a broader context (Bhandari, 2022). The study provides theoretical guidance on ecosystem creation, aiming to contribute to an inclusive design process for all ecosystem actors. The conclusions are supported by data from multiple sources, experts, and organisations, ensuring consistent findings, enhancing external validity. |
| **Reliability** | Reliability refers to the extent to which a research method generates consistent and stable results (McLeod, 2023). To ensure reliability, thorough documentation of the research process is maintained, with transparent descriptions provided for each step, commonly referred to as an audit trail. |

### 3.7 Ethical considerations

This research was conducted with a thorough dedication to ethical considerations that covers multiple aspects throughout the study. Emphasising the potential impact on both individuals and organisations. Active engagement with key stakeholders ensures a comprehensive perspective and enhances the study's significance. The invitation included information about the nature of the research in which the participant is involved.

The interviews were recorded in the event that it is permitted by the participant. Strict measures are in place to safeguard data privacy and security, including verification procedures to restrict access to data specifics. A careful consideration was made between utility and confidentiality of the interview data. To guarantee the privacy of the interviewee, pseudonymisation is employed. This is a common practice in qualitative research to protect participants' identities. It involves replacing participants' real names with the actor they represent to anonymise their identities while still allowing the researcher to analyse and interpret the data effectively (Clark et al., 2021). This promotes research integrity by allowing researchers to analyse sensitive data without compromising the privacy of participants. The informed consent form is attached in Appendix D, which was sent as an attachment with the invitation to interviewee.

# 4. Results

The finding gathered from both the interviews and focus group with ecosystem actors are presented in six distinct sub-chapters. The first sub-chapter outlines the current structure of the public smart charging ecosystem in the Netherlands is described to answer the first sub-question. Followed sub-chapter two on the ecosystem risks and sub-chapter three that helps to understand them by revealing the hidden dependencies, thereby answering the second sub-question. Subsequently, sub-chapter four develops three new ecosystem configurations that eliminate existing bottlenecks based on the interviews, the results of which were discussed in a focus group and are outlined in sub-chapter five, addressing sub question three. Lastly, a recommendation based on the focus group discussion is formulated in sub-chapter six.

Before delving into sub-chapter one, it is important to distinguish between three types of smart charging programs that will be analysed throughout the following chapters. These types of programs align with the definition of adjusting the power and/or timing of charging, but vary in their primary objectives, focusing on cost optimisation, environmental impact, or grid efficiency, with an overview is provided in Table 7. Understanding these distinctions is essential for properly analysing the ecosystem structure and risks discussed in the subsequent sections.

*Table 7, types of smart charging programming in the Netherlands*

| Smart charging program | Mechanism and purpose |
|---|---|
| Grid-conscious charging | Optimises EV charging to avoid grid congestion by aligning charging times with periods of high demand. The goal is to prevent overloading the electrical grid by reducing or shifting the charging load during peak hours or when the grid is nearing capacity. Most recent concession contracts obligate the CPO to engage in grid-conscious charging programming, often at predetermined times, without financial compensation. An opt-out button is available to the EV driver to discontinue grid-conscious charging, allowing them to charge without any restrictions. |
| Sustainable charging | Optimises EV charging to minimise environmental impact by aligning charging times with periods of high renewable energy generation. This decision is made at the discretion of the EV driver. |
| Economic charging | Optimises EV charging by considering electricity price fluctuations and trading flexibility with energy suppliers or their balancing responsible parties (BRP) to reduce charging costs for the EV driver. This decision is made at the discretion of the EV driver. |

In the context of this study, without financial incentives for smart charging, the cost-benefit balance between innovator and customer will not shift towards adoption for all ecosystem actors. Given that each intermediary in the adoption chain needs to see a surplus from adoption, it is unlikely that these smart charging programs will ever reach the end-costumer, following the logic of the adoption risk outlined by Adner (2012). Therefore, both sustainable and grid-conscious smart charging schedules, which lack financial incentives, will only be used to describe the current ecosystem structure and its underlying relationships. Particularly, the obligation to implement grid-conscious charging scheduling led to tensions in the relationships between ecosystem actors. At the same time, the need to consider grid-conscious and sustainable smart charging programs separately is limited, as interviewees noted that they strongly correlate with economic charging. This is because flexible energy supplies added during peak hours are predominantly fossil-based and incur high variable costs.

Therefore, the analysis will focus on economic smart charging programming. The definition provided in Table 7 is adopted, representing the minimum configuration of essential elements required to deliver a unique value proposition. This aligns with Adner's (2012) concept of the minimum viable footprint, which emphasises the smallest arrangement of core components necessary for achieving the intended functionality. Identifying this configuration is the sole objective of this study, serving as a foundation for understanding and designing effective ecosystems. Follow up steps related to stage expansion, in which additional elements are added to the MVF, are excluded from this study.

## 4.1 Ecosystem Structure

The first part of the interviews aimed at understanding the structure current ecosystem, thereby addressing the first research question: "*what is the current structure of the smart charging ecosystem in the Netherlands?*"

Questions were asked about the four basic elements that underlie the ecosystem-as-structure approach consisting of actors, activities, positions and links. These four elements are presented in a descriptive manner to provide a clear and detailed understanding of the current ecosystem structure. This section is subdivided into two parts: first, a description of the ecosystem actors and core activities related to smart charging; and second, a refined value blueprint that outlines the positions and links of interdependence in the ecosystem.

### 4.1.1 Actors and activities

#### 4.1.1.1 National government

The activities of the national government in the context of smart charging are driven by two main factors. One the one hand, the government acts as a regulator, market facilitator, and protector of public interest in energy markets, grid infrastructure and charging infrastructure to accommodate citizens basic needs. On the other hand, it works towards the goals outlined in the climate agreement.

Three ministries from the national government are mainly involved in smart charging. Key activities include governance and policy making, as well as offering direction for future developments. This involves establishing targets, monitoring these targets and ensuring their realization. Table 8 describes the main specific activities and responsibilities for each ministry, including strategic committees that are most relevant to this study.

*Table 8, list of relevant ministries*

| Ministry | Responsibilities and activities |
|---|---|
| Ministry of economic affairs (referred to as EZ) | • Responsible for the energy legislation that governs the compliance of grid operators and energy markets. |
| Ministry of climate policy and green growth (referred to as KGG) | • Responsible for climate policy and energy policy<br>• Strategic committee: The LAN (national grid congestion action programme) – a collaboration of grid operators, governments and market players with the common goal: to ensure access to electricity so that social goals are safeguarded as much as possible.<br>○ The LAN established a task force SLVI (Smart charging for everyone) |
| Ministry of infrastructure and water management (referred to as I&W) | • Responsible for making road transport more sustainable<br>• Strategic committee: the NAL (National agenda charging infrastructure) – a partnership between the central government, provinces, municipalities for the deployment of EV charging infrastructure, which will be further explained under the actor 'local government'. |

#### 4.1.1.2 Local government

The national government is primarily focused on governing energy policy and climate strategy, while the local government assumes a distinct role in the local implementation of charging infrastructure. This distinction underlies the separation of these actors in the refined ecosystem blueprint. The local government consists of mobility teams from municipalities and NAL-regions. The latter refers to six regional subcommittees of the NAL, each covering a certain area which have direct contact with the municipalities. The local government primarily focusses on two tasks: (a) improving charging facilities to address the chicken-and-egg problem, (b) ensuring transparent and affordable charging prices.

The local government have acted proactively to build the charging infrastructure, according to the principle "charging station follows EV". This approach allows for the request of public charging stations in areas where none are nearby, helping to overcome the chicken-and-egg dilemma. Two main approaches are utilised when it comes to the deployment of public charging infrastructure (NKL, 2022).

First, according to interviewees, a minority of the municipality adopts the open market model, giving market parties the opportunity to install charging stations within generous conditions, including no control over charging tariffs. The construction and management of the charging stations is a responsibility of the contractor. Market parties request permission, a permit, from the municipality for installing and maintaining charging infrastructure. Activities of the municipalities consists of granting permit for placement of charging infrastructure, and taking traffic control decisions.

Second, most municipalities have given the mandate to grant permits for charging infrastructure to the NAL-regions through a concession model. The activities of the NAL-regions include ongoing dialogues with grid operators, public authorities, and market stakeholders to facilitate the shift towards EVs. Through these conversations, efforts are being made to accommodate EVs within grid capacity, while also addressing the uniformity of smart charging offerings and ensuring interoperability. In this light, conditions will be embedded in the concession contracts the NAL puts into the market. This contract outlines the specific requirements the concession holder is expected to fulfil, providing them the (exclusive) right and obligation to install and manage public charging infrastructure in certain areas. An important criterion for evaluating concession holders when they submit their proposals is the lowest fixed price they can offer.

#### 4.1.1.3 Grid operator

Grid infrastructure in the Netherlands operates in a monopolistic structure, which is considered optimal for this sector, as explained in Section 2.1 on market failures. The grid operator is responsible for securing a safe, stable and reliable transport of electricity on the grid. Additionally, connection services are provided by a grid operator to any connected party that is connected to or requests a connection within its system operating area, and the grid operator is obliged to provide the connected party with the desired connection capacity (Overheid, 2024).

Grid operators' activities include: (a) balancing the grid, matching supply and demand in real-time, a function they outsourced by creating a market mechanism through a BRP; (b) maintaining grid infrastructure; (c) facilitating connections; and (d) managing grid capacity. Interviewees pointed out that proceedings concerning managing capacity have changed over the recent years. The grid regulations prescribe that if there was insufficient capacity, the grid can be reinforced. However, with the accelerated energy transition and the insufficient speed of expansion efforts, grid operators are increasingly tasked with new activities; (e) construct strategic scenarios that aim to optimise grid utilisation and resource allocation in the context of constrained grid capacity.

#### 4.1.1.4 Charging point operator (CPO)

A CPO is responsible for the installation, management, and maintenance of EV charging stations, ensuring optimal functionality and are accessibility for EV drivers. CPOs may obtain authorization to install charging stations by either applying for a permit from the municipality or by participating in concession agreements. A strong business case is vital for CPOs aiming to compete in concessions, with smart charging models offering key opportunities for cost reduction.

#### 4.1.1.5 Utility

The primary function of a utility is to sell electricity to their customers. Electricity can either be bought on the wholesale market or produced with the companies own assets such as wind, solar, gas, coal or nuclear power plant. In addition to supplying energy and maintaining assets, another key activity is optimising and trading electricity across various energy markets.

In the Netherlands, utilities are commonly a BRP, an entity responsible for maintaining the balance between the electricity it produces or procures and the electricity consumed by its customers in the market. The BRP submits schedules to the grid operator and is accountable for any imbalances that arise. It is required to generate or procure sufficient electricity to meet customer demand, maintaining grid stability and avoiding penalties for imbalances. Charging demands of EVs can be strategically managed to match these.

#### 4.1.1.6 Electric Mobility service provider (MSP)

In this study, the term *MSP* is used consistently by the researcher, while the term *eMSP* (electric mobility service provider) appears in quotes of actors, though both terms refer to the same concept. An MSP facilitates roaming services by integrating various charging networks and enabling users to access, manage and pay multiple charging stations through a single platform including a charging card. Thus, it optimises the payment method for EV charging.

#### 4.1.1.7 Backend software provider

During the interviews, the backend service provider was added to the ecosystem, specialising in software platforms that facilitate management and operation of different products and (roaming) services of CPOs and MSPs. While some large CPOs that are also MSP develop this internally, there are also companies whose core business is providing backend software. The specialised software solutions offered by this actor are pivotal in materialising the smart charging value proposition. Therefore this actor was added to the ecosystem, according to the structuralist approach (Adner, 2017). This includes functionalities such as real-time monitoring of charging stations, user authentication and payment processing, data analytics for usage patterns, and interoperability between different charging networks.

#### 4.1.1.8 EV end-user

This actor represents organizations who advocate for the interests of electric EV end-users. Its activities involve providing information to EV drivers, advocating for their interests, and collecting feedback to ensure their needs and concerns are addressed.

**4.1.2 Links and positions**

This section describes the positions and links through interdependencies. Three types of interdependencies—technical, economic, and cognitive—were identified in Section 2.2B of the theory and are used to categorise the results. Interviewees were asked questions to understand the interactions and dynamics within the ecosystem. Based on these insights, Figure 5 presents the refined ecosystem blueprint, in which two actors were added, as previously described. Furthermore, the interrelations between actors was studied to gain a deeper understanding of the nature of their relationships. This characterisation provides valuable insights into collaboration patterns, and roles of each actor, which are essential for analysing the ecosystem's structure and informs the reconfiguration process. This section is structured according to the links and positions, reflected by arrows in Figure 6, and is described below.

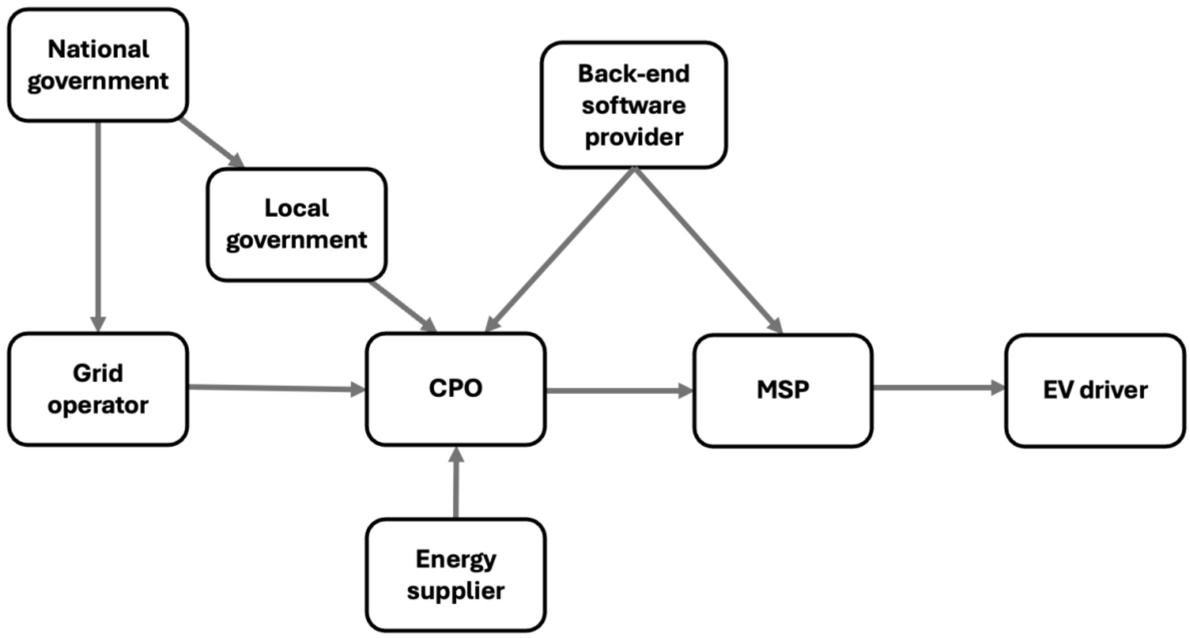


*Figure 6, refined smart charging value blueprint*

**4.1.2.1 National government – Local government**

The link between national and local government can be characterised as a cognitive relationship, which is based upon institutional logics. The national government, composed of the three aforementioned ministries, assigns responsibilities to the local government, primarily represented by the NAL, which has been granted the mandate of the municipalities. The NAL-regions are provided with resources by the national government and are expected to contribute implementation capacity in return. This provides the formal and informal rules of interaction that guide and constrain decision makers.

The relationship was defined by close collaboration and shared interests, as both parties aim to facilitate the transition to sustainable mobility while responding to congestion challenges. Joint steering committee meetings are organised in cooperation with ecosystem actors linked to them (see Figure 6) complemented by the inclusion of representatives of the EV driver. Since smart charging involves heterogeneous actors within the ecosystem, these participants often possess distinct worldviews and economic perspectives that may not be widely shared across the ecosystem. Cognitive distance can be increased due to differing self-interest and expertise among actors (Wareham et al., 2014). Therefore, the steering group aimed to facilitate collaboration among participants, ensuring effective cooperation in response to evolving market conditions and technological advancements, thus fostering ecosystem cohesion. Moreover, local and national governments support the technological ecosystem by mandating specific smart charging platforms to orchestrate a diverse range of contributions from the independent actors compromise an ecosystem of heterogeneous complementors (Wareham et al., 2014)

*"So, yes, knowledge and expertise are exchanged. When the principles are established, they are shared with the core team. Then, we ask the charging point operators, in consultation with *name of industry actor*, to provide their perspective on it."* – National government

#### 4.1.2.2 National government – grid operator

The link between national government and grid operator can be characterised as a cognitive relationship, which is based upon institutional logics. These logics are developed over time through historical practices and agreements, shaping the way national governments perceive their choices in how to shape the sustainable mobility transition while considering congestion issues. Thereby, they influence not only rules governing smart charging, but also how other actors interpret challenges such as congestion and interact with others within this context. Besides, this link also encompasses funding provided by the national government to the grid operator.

The relationship was considered cooperative by the actors. Though, it was noted that it can be dependent on the individuals involved, with some aspects being influenced by legacy of existing structures or long-standing personal relationships.

*"These are the same individuals for several years who then think along about the representation of charging and smart charging for each grid operator. A concrete example is difficult to provide, I think. But you can clearly see that one of these guys, for instance, is relatively stubborn, while the other is open to everything, just as an example. It's not necessarily completely like that, but you do see significant differences, for example, in the types of pilots they are willing to pursue. How willing they are to get involved in something, for instance"*. – National government

#### 4.1.2.3 Local government – CPO

The link between local government and CPO can be characterised as a cognitive dependency, which is based upon institutional logics. The local government, as responsible for the public space, issues concessions for charging point installations, often through the NAL regions, allowing CPOs to submit bids. The procurement process is evaluated based on both quality and the lowest kWh price.

Both parties described it as a professional relationship characterised by strong mutual collaboration. This collaboration primarily contains the exchange of information and data, which is essential for the proper placement and installation of charging stations. Additionally, the government acts as an intermediary between the public interest of the grid operator and the CPO, fulfilling this role through the terms established in the concession agreements, thereby giving the government influence over the CPO.

*"Yes, it's sometimes a bit strange. You have an agreement with a contract or with a government to provide a certain service. And then, from the side lines, a condition from a grid operator is added. You think, well, it should actually be agreed directly with the grid operator as partners in a chain, rather than through such a convoluted route via a procurement contract. It sometimes feels a bit odd."* – CPO

#### 4.1.2.4 Grid operator – CPO

Economic dependency between the grid operator and the CPO is rooted in the grid tariff, where the CPO relies on the grid operator for a grid connection. This highlights the second dependency, a technical dependency, in which both actor have a distinct role. Typically, this connection involves a straightforward transactional arrangement for obtaining the requested grid connection. However, in the Netherlands, the current scarcity of grid capacity caused by congestion add further complexity, especially in relation to grid-conscious charging strategies. Due to the threat of grid congestion, the grid operator is granted additional authority to restrict the charging capacity of charging stations during such periods. As a result, the link now also involves the influence of the grid operator in managing charging capacity, thereby indirectly affecting the control of charging sessions.

This new transfer, driven by the threat of congestion, forms the basis for the poor relationship between the two actors. While both parties stand to benefit from a stable grid, the failure to align strategies leads to tension, hindering collaboration and mutual benefit through efficient coordination of operations within the ecosystem. The following quotes illustrate the dynamics of this relationship.

*"To be honest, I always find the role of a CPO a bit lazy. They often seem to quickly adopt the attitude of, 'I'll just hold out my hand, and you can compensate me for it. That's not really my style."* – Grid operator

*"Yeah, hello grid operator, you're not the boss of us. You have no authority over our work, so to speak."* – CPO

#### 4.1.2.5 Energy supplier – CPO

The links between energy supplier and the CPO can be characterised as a cognitive relationship, which is based upon institutional logics. In this context, the historical patterns of interaction which provide formal and informal rules of interaction of consuming energy through a fixed energy offtake points connected to an EAN (European Article Numbering). This historical structure establishes the relationship between the CPO and the energy supplier as the norm. The connection can also be described in an economic dependency rooted in the energy contract, where the value each actor derives from the ecosystem depends on the concurrent availability of compatible offering from others.

The energy supplier described the relationship as a regular customer interaction. Conversely, the CPO described communication as difficult, with occasional friction arising.

*“I do find it quite difficult because you notice, it's a developing market. Everyone is very busy getting their core process in place. So you have to innovate here as well. It is quite customised often per location or even per charging station sometimes... It is a struggle to really get this done here.”* – CPO

#### 4.1.2.6 CPO – MSP

The links between CPO and MSP can be characterised as a technical dependency, in which actors are cospecialised. In this context, specialised in either facilitating charging infrastructure or managing payment solutions for EVs. Although, certain actors take on both roles within the ecosystem. Moreover, in the context of smart charging, MSPs have a direct touchpoint with the EV driver, providing them with the potential access to crucial driver information such as departure time, state of charge, and charging speed, which are essential for determining the level of flexibility. The exchange of this information with the CPO, which manages the charging session, creates a second interdependency essential for smart charging.

Additionally, the EV charging payment structure can be characterised as a cognitive interdependency, which is based upon institutional logics. The CPO initially sets the energy price per kWh as it holds the energy contract, and often is tied to concession contracts. The MSP relies on the initial price set by the CPO, but independently establishes the retail price for the EV driver. This creates an interdependency within the pricing structure.

*"We pass this pricing on to the MSP. However, the market worker ensures that an eMSP can create something for their end customer, so there is an interdependency."* – CPO

The relationship was generally viewed positively by interviewees, who noted effective communication. However, there seems to be tension regarding the management structure of the charging session.

*“Further we see, I think, a kind of struggle between the MSP and the CPO. In which the CPO says: 'We would like to offer smart charging', because of the flexibility. Flexibility is worth money."* – CPO

#### 4.1.2.7 Backend software provider – CPO & MSP

The dependency between backend software provider, and CPO and MSP can be described as economic, where the value of all actors is directly tied to the activities of another for smart charging.

Additionally, the interdependency between CPO and MSP is categorised as a technological dependency, in which heterogenous actors are cospecialised. These often operate modular architectures and platforms. While the local government mandates a modular platform, it does not impose requirements on the underlying architectures. Consequently, this is where complexity arises between two distinct type of actor groups: incumbent CPOs with in-house software developers, only operating software plug-ins, and specialised backend software developers. Both provide MSP services as a supplementary aspect of their operations. The absence of modularity in architectures impedes the effective integration of high-end smart charging software solutions from specialised backend software providers. In turn, this limits the transfer of information and its effective use in managing smart charging by the incumbent actors. In short, the link primarily involves data exchange, but this is constrained by the absence of modular architectures.

This also resulted in tensions in the relationships between these actors. The following quotes illustrate this.

*"I think it's quite challenging because you notice it's an emerging market. Everyone is very busy getting their core processes in order. So, you really have to innovate here as well. It's often quite tailored … And that's because many other things take priority. And we can see that on the back-end side."* – CPO.

*"Many CPOs and MSPs also struggle to manage their data properly. As a result, they can't exchange much data on their apps. These are also the parties that slow down the market."* – Backend software provider

#### 4.1.2.8 MSP – EV driver

The link between the MSP and EV driver can be described as an economic dependency, as the MSP relies on the driver for revenue, while the driver depends on the MSP for seamless payment solutions, including roaming services. The value gained by each actor depends on the simultaneous availability of a compatible offering from the other actor. The link also involves the exchange of information. In the context of smart charging, this includes data such as departure time, state of charge, and charging speed, which are critical for optimising the flexibility of a charging session.

Although the MSP market allows for freedom of choice, the relationship is strained by a lack of price transparency, as noted by the EV driver, which undermines trust and satisfaction. In contrast, the MSP perceived the relationship as predominantly transactional, while also demonstrating a willingness to participate in smart charging.

*"We are not the party that just complains about this being bad, and that being bad, and so on. We are happy to come up with solutions ourselves. At the same time, we are not overly accommodating to CPOs and MSPs; we are also critical, particularly because there are still significant issues with price transparency. And yes, we need to be able to express that criticism clearly to them."* – EV driver

## 4.2 Ecosystem risks

This chapter describes the interview questions that were designed to reveal the three main risks that were outlined in the theory section: execution risk, co-innovation risk, and co-adoption risk. These help to understand the main challenges for the creation of a smart charging market on public charging infrastructure by revealing (hidden) dependencies, as regards the second research question: *"what are the main risks for the creation of a smart charging market in the Netherlands?"*

In examining these risks, it is noteworthy that co-innovation risk was not mentioned by the interviewees. This absence of reference suggests a lack of perceived relevance of this type of risk. This aligns with observations in the private home charging market, where smart charging is more widely adopted. The successful implementation of smart charging innovations in the home charging market suggests a similarly low co-innovation risk for the public sector. Although some differences exist, interview results support the assumption that co-innovation risks associated with smart charging are minimal. Consequently, the results presented below focus on the two remaining types of risk, which were consistently highlighted across the interviews. The following sections structures these risks by ecosystem actor, beginning each section the identified execution risks, followed by adoption risk. The status assigned to each actor reflects the identified adoption risk and is interpreted through the traffic light continuum as described in Table 3.

To gain a comprehensive understanding of the adoption risk, the extent to which partners will need to adopt your innovation, it is essential to manage the entire value chain and assess the integration risks associated with the innovation. Consequently, each actor must evaluate the costs and benefits of adoption. It is crucial to recognise elements that uphold the value proposition for all stakeholders to achieve full market potential. Not being aware of these elements can lead to partner misalignment. Thus, following Adner (2012), the cost-benefit balance between innovator and customer (see Table 1) was used to identify misalignments that could lead to unexpected risks in the current smart charging proposition. Recognising these external risks introduced by partners is crucial for proactively managing these interactions and to drive ecosystem success.

#### 4.2.1 National government

The national government, acting in the public interest, aims to address and accommodate the needs of its citizens while simultaneously striving to achieve the goals outlined in the climate agreement. Tensions may arise between different ministries, primarily due to differing priorities—whether to emphasise expanding charging infrastructure or mitigating grid congestion. However, smart charging has the potential to support both goals, provided activities are effectively coordinated. The establishment of various steering committees by different ministries fosters collaboration across governmental bodies and key actors within the smart charging ecosystem. These committees align strategies and priorities, ensuring that smart charging solutions effectively balance infrastructure development with grid stability, thereby mitigating potential conflicts and inefficiencies. As such, it does not constitute an adoption risk.

**Main observations:**

<u>Execution risk:</u>
- Not identified.

<u>Adoption risk:</u>
- Not identified.

#### 4.2.2. Local government

The local government has acted proactively to build the charging infrastructure, addressing the chicken-and-egg dilemma. To ensure the charging infrastructure is future-proof, the tender process mandated that charging stations be smart charging ready, comply with interoperability requirements and compatibility with software standards; Open Charge Point Protocol (OCPP) and Open Charge Point Interface (OCPI). This proactive approach not only addresses immediate infrastructure needs, but also reduces future adoption and co-innovation risks.

The policy lowered the adoption risk by changing the balance of the total cost compared to relative benefit. By making smart charging-ready stations a prerequisite for participation in tenders, the relative benefits of installing such infrastructure increased, thereby shifting the overall cost-benefit in favour of adoption. Meanwhile, this approach enables efficient future deployment, as recent charging infrastructure comply with the smart charging-readiness criteria specified in concession contracts. According to the interviewees, only very few older EV models showed problems when charging power was reduced to less than 1.75 ampere or 4kW, but this is outside the control of the local government. Besides, in retrospect, it could be argued that this has mitigated co-innovation risks in de supply chain, as both charging station manufacturers and software developers were able to effectively allocate their resources toward the development of smart charging solutions.

*"I think ten years ago we were already installing the first Smart Charging Ready charging stations, but in the end almost nothing happens."* – CPO

While the local government provides clear and explicit requirements regarding the interoperability and compatibility of hardware and software, its stance on the implementation process is less definitive. The local government exhibited considerable ambivalence about whether and how to approach smart charging. This uncertainty particularly affected their two primary activities outlined in section 4.1.1.2: (a) facilitating charging infrastructure and (b) ensuring price transparency. The following sections outline the uncertainties related to smart charging that the local government needs to carefully examine, and relates these to the two adoption risks involved.

With regards to the first activity of the local government, (a) facilitating charging infrastructure, grid congestion presents a significant challenge for the local government in facilitating the development of the charging network. Firstly, the available capacity for installing additional charging infrastructure is becoming more limited. Secondly, the impact of grid-conscious charging is worsening, in which the grid operator signals to reduce power output to avoid congestion, as its use is more often compelled. These two are interconnected, promoting more frequent use of grid-conscious charging creates greater capacity for the installation of additional charging infrastructure, but it simultaneously reduces charging reliability. It presents a dilemma for the local government, as neither option is advantageous in terms of facilitating charging infrastructure.

Interviews revealed that de current development, in which grid-conscious charging is increasingly being utilised as a broad strategy to alleviate congestion, involves continuously extending the peak-hour timeframe to accommodate additional grid connections, appears to be irreversible. Consequently, this reduces the potential for implementing economic smart charging, as it overrules any other charging schedule, in addition to the limitations on the installation of extra charging stations. The current developments and associated uncertainty undermine the progress of charging facilities, particularly the ability to ensure that EV drivers can always reliably charge, which is a fundamental aspect of the local government primary function. The agreement currently established in the concession contracts requires that 30 kWh be delivered within the first six hours of charging. While it guarantees only 50% of the 11 kW potential power output on average, it simultaneously limits the potential for flexibility. This compromise highlights the ambiguity and challenges faced by the local government. Although this measure provides some degree of charging certainty, the underlying problem remains unresolved: the lack of scheduling transparency. This issue forms the **first adoption risk**, as it undermines the local government's primary activity of facilitating charging infrastructure;

addressing scheduling transparency is therefore essential for enabling further expansion through adoption economic smart charging. **Yellow light.**

As for the second task of the local government, (b) ensuring transparent and affordable charging prices, it was observed that fixed prices in concessions were gradually declining, when adjusted for the electricity purchase price. This was due to the latest propositions of CPOs that started to transition towards economic smart charging programming, which involves a brief reduction in charging power of 15 to 30 minutes that is hardly noticeable to the EV driver. This allows for savings on energy purchases at expensive time intervals and is indirectly returned to the EV driver through slightly lower tariff bids at concessions. This provided a positive perspective for the local government regarding the affordability of charging.

*"Through all the smart charging pilots we have done over the years, the CPOs have also learned that they have to sell less power at those peak hours and, as a result, they were bidding with a lower price for our concessions. So in that way, EV drivers already benefit. Over the past few years, we have been dropping further and further down with the price."* – Local government

Nonetheless, the **second adoption risk** pertains to specifically to the price transparency, which local government attributes to shortcomings in the current market structure. Price transparency is a critical factor for the acceptance and further utilisation of smart charging, which may not go unnoticed by EV drivers. In the current market structure, the CPO sets the pricing at the charging station in line with the concession contract. If the payment is made directly at the charging terminal through 'direct payment' or using a charge card issued by the same operator that owns the charging station, the tariff corresponds to the concession contract. However, in most cases, the charge card, provided by the MSP, is not issued by the same operator as the charging station. Roaming services provided by MSP enable EV drivers to access and pay for charging at stations operated by various CPOs using a single charge card or app, ensuring interoperability across networks. This is where the lack of price transparency originates, since the MSP decides what price is passed on to the end consumer. Hence, the pricing model of an MSP may differ from the rates established in the concession agreement. This means that the price at the same charging station can vary based on the charging card, depending on the agreements established between different MSPs and CPOs.

Building on the prior argument, a second pricing risk was highlighted concerning the MSP's interference in communicating with EV drivers about the specific smart charging programs, and whether the direct benefits these programs would be shared with the EV driver. As illustrated in the refined ecosystem (Figure 6), the local government lacks a direct link to the MSP and has limited clarity regarding the MSP's role, as evidenced by the following quotes.

*"Certainly for a government, the MSP is positioned really hidden behind the CPO, so to speak. So, you never actually have a direct relationship with an MSP. That is also how we ask for it."* – Local government

*"Then the CPO says, it can't be done, because we have to collaborate with third parties, so we can't guarantee that that data will come that way, or things like that Then frictions arise between the municipality, between the CPO and between the MSP. That's possible, yes. And then the municipality experiences consequence of that through the CPO, because that's your point of contact."* – Local government

*"Well, within the NAL, documents are shared, also within working groups. There's another one next week, so we'll do that as well. Yes, and through that, we hope to reach an MSP, but there's a loophole in how smart charging is currently being discussed, as MSPs are somewhat left out. It would be beneficial to involve them more and give them a role in the system."* – CPO

To address the problems of the current market structure between CPO and MSP, which results in limited price transparency, concessionaires are encouraged to collaborate in developing potential solutions. Each concessionaire is required, as part of the concession agreements, to either provide its own MSP service or maintain a close partnership with an existing MSP. Therefore, they were considered suitable to contribute toward developing a solution, as illustrated by the quote below. This issue is frequently discussed in various steering committees in collaboration with them. Concessionaires are challenged to propose their own ideas, and several pilot programs have been established.

*"The CPOs are very willing, as they are often also MSPs, so they understand what's behind it and can see the opportunities that exist. Of course, they are still observing the situation, as they are carefully managing the timing in terms of business, in my opinion."* – Local government

*"What sometimes happens is setting requirements around transparency, so how do you communicate to the user about the smart charging you offer. But what you more often see is that this is integrated into the approach, so the municipality says: 'Dear market party, how are you going to implement smart charging?' and then you evaluate their submission based on that".* – Local government

Nonetheless, price transparency has yet to be achieved, one explanation for this could be their limited access to the MSPs, resulting in a blind spot. The only connection the local government has to the MSPs is through concession-holding CPOs. Although interviews indicate that the government perceives this as sufficient access, these operators hold only a limited share of the MSP market. Furthermore, from a niche versus incumbent perspective, this leads to a skewed representation, which will be elaborated in Section 4.2.6. Consequently, the failure to recognise the importance of a direct link with an MSP was identified as the 'steering committee blind spot', a topic that will be further explored after the description of all ecosystem actors in Section 4.3.

In conclusion, regarding the second activity of the local government, while the affordability of charging is moving in the right direction, the challenge lies in mitigating the adoption risk associated with ensuring price transparency. Hence, ambivalence toward smart charging persisted. **Yellow light.**

**Main observations:**

Execution risk:

- Not identified

Adoption risk:

- Resolving scheduling transparency is essential for enabling the further expansion of smart charging, as the local government cannot effectively fulfil its primary activity of facilitating charging infrastructure without reliable and transparent scheduling mechanisms. Yellow light.
- With regards to the second activity, the affordability of charging is progressing positively through smart charging, the main challenge is addressing the adoption risk linked to price transparency. Yellow light.

#### 4.2.3. Grid operator

Regarding the grid operator, no adoption or execution risks were identified.

However, a nuance perspective must be provided, as this study opted for economic smart charging due to existing limitations. As Adner (2012, p. 177) states, "success came from accepting the limitations of the existing elements and then finding a new way to bring them together". This refers to the limitations identified in Section 2.1 of the theory, specifically the limitations of static tariffs for grid infrastructure, which make it impossible to differentiate based on the time and location of energy consumption. This limitation was considered inherent in the existing ecosystem, as adjustments to the pricing structure are anticipated only between 2028 and 2030, given the complexity of this regulated market.

In response to the infeasibility of implementing perfectly differentiated pricing, new congestion markets have emerged, such as GOPACS an initiative of the grid operators. This approach can be viewed as a second-best solution, as it offers a pricing mechanism for grid congestion that compensates for the limitations in the grid tariff structure. By using congestion pricing, the GOPACS market improves the allocation of electricity usage while still working within the limitations of the existing system. This approach thus ensures that the system remains as efficient as possible, given the constraints, and helps to address market failures arising from congestion.

Nevertheless, based on the interviewee's responses, incorporating congestion pricing, such as through GOPACS markets, was seen as a way to enrich current economic smart charging practices by providing an additional incentive alongside the differentiation in the energy tariff. These markets are still in their infancy, and as a result, they do not function optimally due to insufficient and inaccurate data. While grid operators themselves stated in the interviews that this did not pose a risk, as they were able to model it effectively, this was questioned by other ecosystem actors. They highlighted that grid operators face a critical tension between reinforcing and expanding the physical infrastructure of the grid and improving its efficiency through enhanced data collection and analysis. Given the limited resources available, grid operators must prioritise and allocate their time and efforts between these two objectives. This balancing act underscores a potential risk for grid operators.

In short, a more nuanced perspective is provided, indicating that risks for the grid operator do exist. However, risks related to congestion data information will not be included in the subsequent analysis, as the scope is limited to the minimum viable footprint, focusing exclusively on dynamic pricing based on energy prices, as outlined at the beginning of the results section. Given that the limitations associated with the fixed grid tariffs imposed by the grid operator are not expected to change in the coming years, these constraints were accepted, and will be addressed through alternative solutions. Since the responsibility for dynamic energy pricing models lies with the energy supplier, no adoption or execution risks were identified concerning the grid operator.

**Main observations:**

<u>Execution risk:</u>

- Not identified.

<u>Adoption risk:</u>

- Not identified.

#### 4.2.4. CPO

When analysing the risks, it is important to differentiate between different relationships that CPOs hold, as these links entail distinct risk profiles. Two primary types of CPOs were identified:

(a) Large incumbent firms that integrate charging station departments into their broader business operations. These CPOs typically engage through concessions (explained in section 4.1.1.3.) for public charging infrastructure and either provide their own MSP service or partners closely with an external MSP.

(b) Niche operators that specialise exclusively in charging infrastructure. These CPOs typically engage in the open market model (explained in section 4.1.1.3.) for public charging infrastructure, without a close partnership with an MSP.

**The first execution risk** mentioned by the CPOs the lack of driver information as there is no direct touchpoint with the EV driver. The information concerns the departure time, charging speed (1-phase or 3-phase charging), and the state of charge (SoC) of the car. Together, these three factors determine the degree of flexibility of the charging session. Only the MSP maintains direct contact with the EV driver and thus has the capacity to acquire this critical information. Since the majority of charging sessions involve an MSP that is owned by a different entity than the CPO, this discrepancy creates a barrier to information exchange. Therefore, the barrier to information exchange poses a significant execution risk, as it leaves the degree of flexibility in the charging session unknown due to the lack of information from the driver. Nonetheless, even if this information were accessible, additional complexities arise regarding its integration and application.

*"But if we know those three things—charging speed, charging volume, and departure time—then we know exactly how much flexibility we have and what room we have to play with. Those are the things we actually want to know from the user. However, the MSP is the logical party to retrieve that information from the user."* – CPO

**The second execution risk** identified by interviewees involves software limitations in processing critical data, presenting additional challenges for effective implementation. This critical data encompasses driver information in instances where such details are available, or the processing of multiple price updates from a CPO towards an MSP, a process for which a standard architecture protocol is currently lacking. It was noted that this process could take several days, thereby making it not feasible to accommodate dynamic energy pricing within smart charging propositions.

*"At the moment, it sometimes takes a week after we have adjusted the price at our charging station. We do this based on the indexation agreements per concession. Once we have adjusted the price, it can sometimes take up to a week before this is visible to all MSPs"* – CPO

With regard to software development, a notable difference was observed in the attitude of niches compared to incumbent CPOs. Niche operators exhibit a greater openness to developing software, either independently or in partnership with third parties, while incumbents primarily emphasise cost concerns and uncertainties regarding potential benefits.

*"Then we would need to consider this as a strategic choice we are making regarding those charging profiles. How will you create them? How will you manage and implement smart controlling? You can do this yourself or have a third party do it, such as a smart charging provider like *backend software provider name* or *backend software provider name*, for example. That could also be a collaboration partner, but it seems we are going to make the choice to do it ourselves." – CPO*

*"But there are also so many costs associated with arranging something like this. So what you ultimately have left is quite minimal. It remains to be seen whether this will yield significant benefits."* – CPO

CPOs mentioned that older charging stations are not compatible with smart charging, an adoption risk similarly raised by the local government. These charging stations do not have the space to be upgraded with the integration of a smart meter. It involves only a very small number of old charging stations, which are slowly being phased out by smart charging ready charging stations. **Green light.**

*"Some are from 2008 and 2009, not that long ago at all, those are somewhat more compact models, and they don't fit a smart meter."* – CPO

*"Those smart meters are just too big, it doesn't fit."* – CPO

A more substantial challenge, however, lies in the ambivalence CPOs express regarding the adoption of smart charging, driven by (a) economic uncertainties, (b) the lack transparency, and (c) legal considerations within concession and energy contracts. The following sections will explore both issues in depth."

**The first adoption risk** is related to the economic value of smart charging which is defined by the value of flexibility and the degree of flexibility, both of which entail a degree of uncertainty, which all CPOs perceived as an obstacle. The value of flexibility is dependent upon the specific flexibility market in which it is offered. As many of these markets are still in their early stages of development, particularly for EVs, CPOs remained uncertain about the value that can be derived from such markets. Moreover, the distribution of these margins across the value chain, which is essential for incentivising EV drivers, remains a critical issue.

*"If we still cannot pass that on to the charge card provider, then for us there is less of an incentive because fewer people are going to use it anyway."* – CPO

The uncertainty about the degree of flexibility with smart charging is closely interlinked with the first execution risk, the lack of information exchange, which is similarly constrained by the absence of a direct point of contact between the CPO and the EV driver. The lack of information from EV drivers, such as departure time, charging speed, and SoC available to the CPO not only introduces an execution risk but also an economic uncertainty regarding the degree of charging flexibility. In absence of driver information, it introduces uncertainty and risks misalignment with the driver's needs and charging optimisation. Consequently, this ecosystem structure currently leads to a conservative approach to managing the charging session, allowing for only slight reductions in charging power over short time frames to ensure that the driver remains unaware. The CPO would not commit to smart charging with dynamic pricing until these economic concerns related to the value of flexibility and degree of flexibility were settled, thereby indicating the presence of adoption risk.

*"Well I mean there is potential in my making money out of it, but not right now because we now control so conservatively in Rotterdam… But anyway, as soon as we know when people are leaving, we can start controlling the charging session so much more aggressively that we do start to create serious value, also noticeable per kilowatt hour."* – CPO

Conversely, CPOs also observed a decline in the current situation, as the implementation of additional charging restrictions, driven by grid-conscious practices enforced in new concessions, adds further uncertainty. Although the introduction of this risk section concludes that grid-conscious charging alone will never create a uniform "green light" in the adoption chain. It highlights the current dynamic where CPOs must consider the implications of increased grid constraints when assessing the willingness to adopt smart charging propositions based on dynamic energy pricing that anticipate these challenges. Nevertheless, CPOs exhibited a steadfast reluctance to adapt to these grid-conscious charging requirements, viewing the measures as unjust and perceiving an infringement on their right to fully utilise their grid connections. With growing congestion problems, the available capacity for installing additional charging stations is becoming more limited, while at the same time, the impact of grid-conscious charging is worsening as the peak hour timeframe expands. This affects their business model, prompting them to firmly position themselves for compensation to offset the consequences of grid-conscious charging practices. These tensions are illustrated in the following quotes.

*"Everywhere we adopt in grid-conscious charging protocols, there is up to 5% revenue loss"* – CPO

*"And that is exactly a somewhat sensitive topic nationally right now, but it is a process that is ongoing, and yes, I can't say much more about it at this point. However, there is a call for some sort of compensation for that... And yes, I believe this is something that needs to be discussed, because at the moment, it is essentially being taken from us by the grid operators."* – CPO

*"Because we can't copy the signal from the grid operator without being compensated for it, because then we no longer have a business case."* – CPO

In summary, there is significant economic uncertainty, both regarding the new dynamic pricing smart charging propositions and the strain that the existing business model will experience as a result of grid-conscious charging obligations. **Yellow light.**

**The second adoption risk**, a lack of price transparency, similarly originates from the absence of a direct point of contact between the CPO and the EV driver. From interviews with CPOs, price transparency emerged essential for encouraging user acceptance of smart charging. However, CPOs faced challenges in communicating charging prices, as they only set rates at the charging stations, while the final price charged to the consumer is determined by the MSP. Without direct access to EV drivers' payment information, CPOs must rely on the MSP to manage these transactions. **Yellow light.**

*"And also a bit of price transparency… and transparency in general is of course – I think – the most important thing in smart charging. For this, we are now also going to deploy charging stations with screens in the MRAe area together with Alfen, with a display on it through which we can communicate more to the end user."* – CPO

Whereas the adoption risks concerning economic uncertainty and price transparency both urge a closer relationship between CPO and MSP, the distance between the parties appears to be substantial. The structure, outlined in detail in Section 4.1.2.6, described the link between the CPO and MSP as a technical interdependency, in which the activities of the MSP included facilitating payment for EV charging and the CPO operating charging facilities. Since some of the incumbent CPOs also offer their own MSP services, they may be expected to relate to this role. However, the relationship with their own MSP is not sufficient, as effective utilisation of smart charging requires seamless data exchange with all MSPs. Despite recognising that the absence of information exchange between these actors was identified as the root cause of the lack of price transparency and the inability to utilise EV charging flexibility, no actions or initiatives were proposed to promote such exchange. In fact, the opposite was mentioned by the CPOs, with four out of five reporting that contact with MSPs had not yet been established. Noteworthy, one CPO with an MSP service within the same company indicated that communication was very limited or non-existent.

*"And a very practical one is just the conversation with the MSP that is just starting up now, but that collaboration with the MSP on smart charging has not yet been established"* – CPO

*"I think it is very important that more is partnered, but at the moment, it is just another third party for us"* – CPO

Moreover, questions were raised about the role of the MSP and its potential added value. It appears that there is competition between these actors, similar to tension previously described in the Section 4.1.2.6 on links and positions.

*"Can you also kick people out? In my opinion, an eMSP is, for example, a worthless role. Literally worthless."* – CPO

**The third adoption risk** concerned legal aspects, with energy contracts and concession agreements being closely interlinked.

The majority of the CPOs mentioned long-term energy contract as an obstacle to leveraging the benefits of smart charging. All CPOs demonstrate reluctance to modify their energy contracts, as their procurement strategies are closely tied to the fixed charging rates, a key criterion for securing concession agreements. While dynamic day-ahead pricing has the potential to lower costs, it simultaneously increases procurement risk due to the inherent price volatility in the electricity market. The local government specifically urged CPOs to integrate smart charging solutions into new concessions. Whereas CPOs demonstrated a willingness to incorporate smart charging into new concessions, they continued to cling to their traditional business models, proposing proposed only incremental changes of an additional 15 min on reduced charging power. **Yellow light.**

*"Is still so that there are contracts where we don't want to run that risk, because of course it is also a risk if you say we want to be judged on day-ahead, and those contracts we are just stuck with for the time being. So there will be no immediate income from these for now"* – CPO

*"With new concessions we might say we do want to run that procurement risk, because then we can manage it. So there is definitely value in that and of course it is something you can use smart charging for, particularly to create economic value"* – CPO

*"So the CPO that is installing those 17,500 charging stations over the next few years, we arranged that we actually challenged the charging station operators to all come up with their own smart charging plan. We really obliged them to implement smart charging on all the charging stations, and so we do have a leading role in this."* – Local government

Additionally, a **fourth adoption risk** emerged from interviews with CPOs, revealing that certain provisions in concession contracts constrain the possibilities for smart charging in two key ways. Firstly, concession agreements require a minimum of 30 kWh to be charged within the first six hours. While this was seen as an improvement over previous requirements mandating a minimum power level—since it permits flexibility, such as temporarily reducing power to 0 kW—CPOs noted that, under this new regulation, most charging sessions are still completed within a few hours. This limits the potential to leverage the lowest-cost charging periods, which typically occur midday or at night. Secondly, fixed pricing is required for participation in concessions, which restricts the ability to provide price incentives to EV drivers for smart charging. **Yellow light.**

*"We also saw that, especially in those older contracts, the room to do other smart charging things was actually quite limited. In fact, there were still requirements, for example, as a CPO, you must always provide a minimum power of 16 amperes. Well, this basically means you can't do smart charging, because you can't adjust the charging power. Often, it was also with a fixed price."* – CPO

*"You still encounter the fact that a concessionaire, so a government, for example, demands that there is a fixed price. Yes, that then offers us a bit less room to actually return value to the end customer."* - CPO

In short, the aforementioned economic uncertainties, lack of price transparency, and legal aspects concerning both energy contracts and concession contracts constitute four distinct adoption risks, indicated with a yellow flag—neutral but open to inducement. Despite multiple smart charging pilots with dynamic pricing have demonstrated success, the widespread adoption of smart charging on public infrastructure lags behind. According to Adner (2012) It is essential to address these adoption risks from the beginning as successful pilot outcomes do not eliminate the substantial challenge of securing coordinated, simultaneous commitment from interdependent partners for a full-scale rollout (Adner, 2012).

The discrepancy between the activities required for smart charging to materialise and the actions currently being undertaken can be understood based on the cost-benefit balance (Table 1) of the smart charging value proposition. An adopter of an innovation evaluates the innovation by considering the relative advantages and disadvantages (Adner, 2012). If this principle is applied in the context of the study, charging stations deployed through new concessions that adopt smart charging with dynamic energy pricing propositions are expected to outcompete and eventually displace those operating under older concession contracts with fixed prices. This is because EV drivers are likely to delay charging sessions to take advantage of lower-cost periods under dynamic energy pricing, rather than utilising chargers with higher fixed tariffs, which are generally more expensive throughout the day except during off-peak hours. Conversely, chargers with fixed tariffs will only be utilised during peak hours, when they are less profitable due to high energy prices. This poses a twofold threat to CPOs with charging stations operating under older concession models, which hold a dominant position in the market owing to their significant market share.

Consequently, a **fifth adoption risk** was identified, with the benefits of the new smart charging value proposition not providing adequate compensation for the displacement of all charging stations operating under older concessions. Since only incumbent CPOs can be competitive in concession bids and they are all attached to old concessions, none of them have an incentive to move towards a new smart charging value proposition, particularly considering the aforementioned risks. Incumbent CPOs have clear reasons to prefer the status quo, resulting in adopting risk. Through highly conservative smart charging propositions, they technically meet the concession requirements for smart charging. Therefore, this contributes to achieving the NAL's goal of ensuring that over 60% of charging sessions are smart by 2025. However, in fact, they tend to refrain from engaging with new propositions that leverage a greater portion of the EV's flexibility potential, choosing instead to adhere to their traditional business model, which focuses on charging EVs nearly as fast as possible. **Red light.**

*"That's not stopping us from implementing smart charging, but the benefit to us, to the EV driver and hence to the MSP is still very limited, so there's a bit less pressure to implement it then quickly."* – CPO

**Main observations:**

<u>Execution risk:</u>

- Constraints on the exchange of driver information leave the degree of flexibility in the charging session unknown.
- Software limitations in utilising driver information and processing dynamic price updates.

<u>Adoption risk:</u>

- Charging stations are compatible with smart charging or slowly being replaced. Green light.
- Economic uncertainties rooted in value of flexibility and degree of flexibility contribute to the reluctance among CPOs. Yellow light.
- Lack of price transparency originating from the absence of touchpoint with EV driver. Yellow light.
- Legal aspects related to the long-term energy contracts foster only small incremental adaptations. Yellow light.
- Legal aspects related to the provisions of the concession contract constrain smart charging. Yellow light.
- Engagement in smart charging propositions with dynamic pricing displaces charging stations tied to long-term concession contracts. Red light.

#### 4.2.5. Utility company

The utility company reported no execution risks related to smart charging, as balancing supply and demand through dynamic conditions aligns closely with their core operations as BRP.

The **first adoption risk**, however, was linked to energy contract terms concerning the activities of balancing the grid as BRP. The energy supplier's perspective on the role of smart charging revealed ambiguity; it has the potential to improve supply-demand balance, yet in the absence of such communication and coordination agreements, it may instead increase unpredictability. Traditionally, energy consumption patterns were relatively predictable on a macro scale, attributed to the law of large numbers, which suggests that despite individual fluctuations, aggregate demand across a large user base remains consistent and predictable. This predictability enabled energy suppliers to forecast demand with a high degree of accuracy to avoid financial penalties imposed for grid imbalances.

However, smart charging disrupts established consumption patterns by allowing charging programs, under the authority of the CPO, to respond to external factors. This shift poses increased difficulties in forecasting demand, elevating the risk of supply-demand imbalances. As a result, this drives a need for carefully structured agreement between utilities and CPOs, where imbalance risks are clearly allocated. Utilities seek to transfer these risks to the CPOs, who control the charging session. While smart charging provides an additional opportunity to reduce imbalance penalties or enter to imbalance markets, interviewees highlighted resistance in efforts to establish additional agreements for effective coordination of charging schedules. The question of who bears the risks associated with maintaining supply-demand balance remains a central point of discussion.

*"What's difficult again from an energy supplier's point of view is that public CPOs are very tricky for an energy supplier... Now you get a CPO with 10,000 connections all small, all shit connections, through telecom networks… They then also want to have nice low risk, because from a concession they need to offer a very low fixed price to customers. That's a very tricky package, so your supplier has to go and do very complex things and deliver as much service as possible at very high risks that lie with the supplier itself. Because otherwise that business case will never materialise." – Utility*

The allocation of imbalance risk is closely interlinked with dynamic energy contracts, as both are rooted in the relationship between price signals and demand fluctuations. Although dynamic prices are directly passed on to the CPOs, eliminating buy-side risk for the utility, demand tends to increase as EV drivers respond to these favourable conditions. Consequently, utilities may encounter difficulties in maintaining a stable supply-demand balance, which could result in potential penalties due to imbalances caused by unanticipated high demand. Thus, dynamic energy contracts and imbalance are closely interconnected and accumulate risk. Utilities have identified this interrelationship as a factor that further complicates the contracting process with CPOs, hindering the ability to profit from smart charging. **Yellow light.**

*"Yeah sure, that's actually in the contract process. So a great example is by saying, CPO, if you guys want to start doing smart charging, that's nice, but if you want to start controlling that yourself and you want to start adjusting your energy procurement yourself, then you're also going to have the risks with that yourself... We as suppliers and the CPO's BRP, we get the imbalance risk, but we say, listen, you can do all kinds of nice things and control it all nicely, but we have procured energy for you. You say you're going to do that and you're going to adjust it, so anything you get wrong we are going to give the imbalance risk to you. So the penalty we get we will pass on to you one-to-one."* – Utility

**A second adoption risk** was identified, related to the economic value of flexibility. While the value to the EV driver of charging in off-peak hours based on dynamic prices is more settled, the economic value of flexibility is less straightforward. Interviewees reported numerous flexibility markets that are emerging. However, three out of four indicated that these flexibility markets remain in early, pioneering stages, with the roles and potential use cases of EVs not yet fully established or tested. Furthermore, the time investment required to develop and to fully optimise the value of flexibility adds uncertainty to its economic potential. **Yellow light.**

*"You simply have your purchasing, so you can arbitrage over your day-ahead and intraday markets, then you have your bids in your flexibility market and FCR, NFR, AFR, and then you have your imbalance settlement. Plus, nowadays, network congestion is also starting to become very interesting, so GOPACS is also an interesting option. However, not many people are engaging with these yet"* – Utility

*"But I think that we are still really in the first innovation sphere. And that we still have to see to what extent this will materialise in euros before you can make the major investments in it."* – Utility

*"I think that many BRPs are still searching for the right approach to flexibility management. So, for us, that makes things a bit challenging, right? You turn off the car. Yes, how much do you earn from that? And is all the hassle and implementation worth it? Yes or no? There is also an aspect of innovation involved. So it still needs to prove itself, right? That this flexibility will actually deliver significant benefits, so there's a lot of belief in it, but we cannot yet demonstrate hard euros. Yes, that is where uncertainty arises."* – Utility

**Main observations:**

Execution risk:

- Not identified

Adoption risk:

- Who bears the risks associated with maintaining supply-demand balance remains a central point of discussion. Yellow light.
- Flexibility markets are emerging but economic benefits remain uncertain, with use cases for EVs under development. Yellow light.

#### 4.2.6. MSP

When analysing the risks, it is important to differentiate between different relationships that CPOs hold, as these links entail distinct risk profiles. Two main types of MSPs were identified:

(a) Part of an incumbent, frequently also operating as a CPO, in which issuing charge cards is integrated into their broader business operations.
(b) Niche providers, exclusively consisting of backend software providers, in which issuing charge cards is integrated into their broader business operations.

The **first execution risk** for the MSP is rooted in the challenge that the MSP is not permitted to control the charging session, as the energy contract utilised during that session is established with the CPO. Although the MSP has direct contact with the EV driver and is thus positioned to gather the most relevant information for managing the charging session, the CPO retains responsibility for the energy contract. This responsibility relates to the obligation discussed in previous section (4.2.5), which involves ensuring that the supply and demand within their designated portfolio remains balanced in real-time. Leaving the same question, who bears the risks associated with maintaining supply-demand balance continues to be a fundamental concern in our discussions.

*"But yes, we do want to stay in control of our sessions. So we don't want to give full control over all our charging stations to the MSP, since we hold the energy contract. We don't want the MSP to start managing our energy consumption. So that's the tricky part… The alternative is to collaborate with the MSPs and say, 'Hey MSPs, if you could collect the charging preferences and pass them on to us, we'll decide how to manage the session. Of course, involving an extra party means there's another entity taking a share." – CPO*

*"But they are very reluctant to give us control over that charging session. That's where friction arises"* – MSP

Two solutions were proposed by the interviewees: the first involves the CPO and MSP establish additional agreements to address supply-demand risks, while the second involves the CPO purchasing driver information from the MSP, as indicated in the quote above. However, in the absence of agreements, the CPO retains the authority to withhold the MSP from undertaking smart charging activities, as it holds the energy contract. This ongoing dispute highlights the underlying issue on the driver's information between the CPO and MSP.

Despite the MPS' willingness and capabilities to contribute to a solution for the EV driver information exchange, the incumbent actor adopted a different strategy, resulting in frustration among niche MSPs. The public charging market is dominated by incumbent CPOs operating through concession agreements; MSPs are dependent on them in two critical ways. First, the CPO sets the price the MSP must pay, limiting the MSP's pricing flexibility. At the same time, CPOs are tied to fixed charging prices established in concession contract. Second, the CPO, as the energy contract holder, retains authority over the charging session, restricting the MSP's ability to implement smart charging activities.

Interviews with incumbents signal low commitment to collaboration, reflected in low financial offers for driver information. This perspective among niche providers was reinforced by instances of subtle, 15-30 minute adjustments to charging sessions—characterised by niche providers as 'sneaky' manipulation —where controlling the charging session occurs without transparent communication. This dynamic further reduces the incentive for CPOs to engage with MSPs, reflecting a power structure created by existing cognitive interdependencies that enable incumbent to maintain autonomy. As a result, the niche actor's potential contributions remain underutilised, and the incumbent retains control over the initiative without fully engaging available resources. Thereby, inhibiting innovation and limiting the effectiveness of collaborative efforts.

*"That is the struggle of the market. From a purely economic perspective, according to economic theory, price signals are most effective when information symmetry is removed. So, we do share the state of charge and the departure time, but we certainly don't do that for free or merely for a pittance. This information must be paid, corresponding to the value it provides."* – MSP

*"*name CPO company* just don't want to share. And they say, we will charge intelligently behind the driver's back. So we will secretly adjust those charging sessions, and even though we do not have the state of charge and departure time and are therefore just guessing. We will do this exclusively."* – MSP

A similar restraint was identified concerning software, **the second execution risk** noted, raised exclusively by incumbents. As outlined in the section 4.2.4., incumbent CPOs emphasise the significant financial investments for software development, whereas niche providers considered these risks as limited and or even negligible, particularly drawing from experiences with smart charging in the private home domain. This divergence in perspective is further examined in section 4.2.7., which discusses backend software developers.

*"However, it is possible that an MSP may not yet have the technical capability to process a time-of-use rate, and as a result, they might set a fixed price instead"* – CPO

*"So with smart charging, if I tell a CPO, 'Look, I have data that no one else has. I have the state of charge and the departure time.' All CPOs want this because it allows them to improve load management. They could even go to Tennet for a flex trading deal, but they actually don't want to pay for that information. So even if the software can handle the information exchange—which is often already a problem—they are reluctant to pay for it or will only pay a very small amount. They are afraid that the MSP will take control of the charging session."* – Backend software provider

Transparency emerged as a crucial **adoption risk**, a critical factor in fostering both user acceptance and the effectiveness of smart charging. Everyone pointed towards the need of clear communication on prices. Besides, niche providers specifically emphasised the importance of transparency in scheduling practices concerning drivers' negative sentiments about smart charging.

Charging price transparency is deemed essential, particularly in the context of smart charging, where it serves as a critical factor in fostering user acceptance. The charging price is initially determined by the CPO and varies not only between different CPOs but also within the same CPO. This variability is primarily attributed to the placement of charging stations across diverse concessions, each with distinct maturities and specific fixed-price agreements. The MSP, responsible for ensuring payment interoperability across charging networks through roaming services, determines its charging rates based on either the CPO's tariff plus a small margin, a standardised fixed rate across all CPOs, or through negotiated (long-term) agreements among itself. Hence, within the context of ecosystem characterised by permutations, it is essential for CPOs and MSPs to engage in collaborative effort simultaneously to successfully pass on price incentives. Nonetheless, the complexity of the current payment structure complicates this process. Although incumbent CPOs closely align with the perspective of MSPs, offering their own MSP services or collaborating with external MSPs, they do not dominate the MSP market. This difference in dominance of different parties in the CPO and MSP market contributes to a clear separation between these two groups of actors. This separation became apparent during the interviews, as demonstrated in the following quote.

*"And then a certain portion would certainly remain with the charging card provider. How large that portion is, I do not know, but they will also extract a margin from it."* – MSP

*"But there is also the issue of price transparency, and many charging card providers strongly advocate for this transparency. If smart charging is not implemented correctly, it can make it even less clear what you are paying per kilowatt-hour. This could be a reason for MSPs to refrain from participating, or for example, MSPs that always offer a flat rate as their unique selling point"* – MSP

The second issue with regards to the lack of transparency was highlighted by niche provides pointed towards the negative sentiment about smart charging due to in transparency in scheduling practices.

Currently, EV drivers primarily experience the drawbacks of smart charging—such as extended charging times—without perceiving any direct benefits of participating. Smart charging refers in this case to the 15-30 minute adjustments in charging power, or to grid-conscious charging where power output is reduced for longer time intervals to avoid grid congestion (explained in detail in Table 7). The only means of communication regarding smart charging at these stations is a sticker indicating it, along with a reference to a website in certain cities. Besides, an opt-out button is provided to users who require immediate charging. Despite obtaining lower prices indirectly through concessions, there is no direct incentive associated with either smart or non-smart charging which contributes to the negative sentiment. Insights from the interviews suggest that the lack of transparency regarding the charging scheduling introduces uncertainty regarding the reliability of charging—specifically, whether the battery will be fully charged at the time of departure—leading to decreased willingness among individuals to offer their flexibility. Consequently, this undermines the effectiveness of smart charging practices.

*"Let's not forget the whole component of what the eMSP is supposed to do for their end users. That is also completely unclear. Yes, I need to inform them that there might not be any restrictions or that smart charging will take place. And many people see this as something negative because the positive aspect is simply missing; most people don't earn anything from it. To put it simply, a price incentive component is currently not being realised."* – MSP

In sum, the lack of both price transparency and smart charging scheduling practices represents a critical factor that undermines user acceptance, consequently contributing to a negative sentiment and potentially reducing the overall effectiveness of smart charging efforts. **Yellow light.**

**Main observations:**

Execution risk:

- The MSP is not permitted to control the smart charging session because the energy contract is held by the CPO.
- Incumbents raised concerns about the costs of software development.

Adoption risk:

- The lack of both price transparency and scheduling practices contribute to a negative sentiment around smart charging. Yellow light.

**4.2.7. Backend software provider**

Software emerged as a frequently cited execution risk for smart charging, a concern that can largely be attributed to the type of backend software provider. In this context, two main types of providers can be distinguished: incumbents and niche providers.

(a) Incumbents are well-established companies that tend to take a conservative approach. Incumbent CPOs typically develop much of their software internally and tend to have limited flexibility for integrating external plug-in options.
(b) Niche providers, exclusively consisting of backend software providers, in which issuing charge cards is integrated into their broader business operations. Typically smaller or emerging firms that are more agile and innovative. With the niche providers there are two distinct approaches:
   I. Responsive niche providers, developing innovative software primarily in response to market demand
   II. Proactive niche providers, who actively develop new software solutions to enhance their market position and promote adoption of their innovations.

   Both types of niche providers tend to be open to integrating external plug-in systems.

*"… for demand response, unilateral charging, all the ingredients are present"* – Backend software provider

The following sections will explore how distinct characteristics among these types of backend software developers shape the perceived execution risks within the smart charging ecosystem.

As quotes highlighted in earlier sections through statements from CPOs and MSPs, software-related issues were frequently identified among incumbents. To address execution related software-related issues, incumbents have actively engaged in various pilot projects, most of which have achieved successful outcomes. Although pilot demonstrations may prove successful, aligning interdependent partners to simultaneously commit to a scaled rollout can be extremely difficult. In the absence of a clear path for achieving full system integration, ecosystem pilots often stall and fail to advance beyond the initial stages (Adner, 2012).

*"And, of course, with a pilot like this, we often find parties that are interested in participating. They join in as well, so our backend provider *company name*, also sees it as an opportunity…"* – Backend software provider

The smart charging ecosystem has predominantly concentrated on incumbents, overlooking the potential of niche providers who already offer viable solutions. This emphasis has led to niche providers being side-lined, even though they consistently reported a wide range of opportunities for the development and implementation of smart charging software. Consequently, few niche providers persist in their efforts to enter the public charging sector, while others shifted their focus to other markets. Notably, those who pursued alternative markets, such as the private home charging market or semi-public EV charging infrastructure at business parks, indicated successful outcomes related to their smart charging initiatives during the interviews.

*"There are CPOs that don't want to collaborate. Look, sometimes they have their own MSP app and charging card, and then I suggest improving things with my MSP app so that *name MSP companies**

*can offer cheaper charging. And then they say, 'Yes, great idea if your app can do that, but ours can't, then we'll be left looking foolish, so we're not going to do it.* – Backend software provider

*"Additionally, smart charging already possible, and we are already doing this with a large number of private parties."* – Backend software provider

*"Well, we need access to charging stations or cars to control charging at scale, but these backends are not always open to third parties… So there is a practical element to this: access to systems to enable smart charging, as well as access to energy providers"* – Backend software provider

Additionally, the interviews revealed a lack of awareness among niche providers regarding the adoption chain in the public charging market. As the adoption chain makes explicit, there is rarely only one customer. Ignoring the need for intermediaries within the ecosystem to see a surplus from adopting the innovation presents a significant risk (Adner, 2012). Niche software providers pointed out that there was no demand by the end-customer for smart charging on the public charging market. This observation contrasts with experiences of EV-drivers who utilise private and semi-public charging infrastructure and actively engage in smart charging initiatives.

*"It's all technically possible, but it's a lot of coding, and the end-user demand is also not there or hardly there at all"* – Backend software provider

*"If the market really demands it, yes, then we will go there as well."* – Backend software provider

The primary distinction lies in the recognition of the presence of an intermediary customer in the adoption chain, the CPO, that operates as a separate entity in the public charging market, as opposed to the semi-public and private market where it is owned by the employers or EV-drivers themselves. Recognising the sources of adoption risk can provide insights into potential strategies to address these. In this context, the lack of demand for smart charging within the public market can be understood by examining the adoption risks of the CPO. As indicated in section 4.2.4, the 'red light' classification underscores the reluctance of incumbent CPOs to engage with smart charging initiatives, thereby providing an explanation for the lagging internal software development of incumbents. Moreover, this observation aligns with insights from niche providers, who indicate their difficulties in accessing the public charging market–dominated by incumbent CPOs–with smart charging propositions similar to those in the semi-public and private markets.

*"Well, the technology is there. Not everyone can handle that technology, so from a user point of view, could I technically have the same user experience at every charging station? No, because depending on the charging station, you need a certain skill level for managing the charging station. But the technology does exist. Its implementation is simply a matter of both parties being willing to do it."* – Backend software provider

In short, although execution-related software obstacles were highlighted by interviewees, mostly by incumbents, the key factor for success lies in the willingness to adopt the proposed innovative software solutions proposed by niche developers.

**Main observations:**

Execution risk:

- Although incumbent CPOs and MSPs highlighted perceived software execution risk, it was ultimately non-existent, as niche developers offered effective solutions to mitigate these concerns.

Adoption risk:

- Not identified

#### 4.2.8. EV-driver

The representatives of EV drivers did not mention any execution risks associated with smart charging. However, the lack of a designated point of contact has created fragmented communication with the EV driver has led to two related adoption risks: restricted exchange of user information and limiting price transparency.

The **first adoption risk** is related to the dual user interface—both at the charging station and through the MSP's application—which restricts effective information exchange. Although the CPO leads in managing the charging session, the absence of a screen on the charging station was noted as a significant barrier to effective communication. While the MSP provides a more user-friendly interface, it is unable to communicate user preferences or the charging schedule effectively to the charging station. The emergence of various apps developed by different MSPs and CPOs was mentioned as a potential obstacle. It introduces a layer of complexity, potentially complicating the user experience and hindering the integration of smart charging platforms. This fragmentation may pose challenges in terms of standardisation or usability. **Yellow light.**

*"Should that consumer start downloading seven apps for all these charging stations in the near future. We just had a fantastic system that you can charge anywhere in the Netherlands with only one charging card" – EV-driver*

*"Because it also sounds very nice, we are going to provide a new offer ourselves through our own app, but people are just not looking for that."* – EV driver

The **second adoption risk** is the lack of price transparency, which similarly originates from the lack of a single clear interface. It was noted that charging prices can vary not only between different charging stations on the same street but also depending on the charging card used. This variability is linked to the pricing structure, as explained in section 4.2.2. The lack of price transparency has negative impact on overall perceived reliability of EV charging efforts and particularly hinders the transition to dynamic energy pricing, thereby representing an adoption risk. **Yellow light.**

In contrast to these adoption risks observed in the public charging market, the private home charging market exhibits a markedly different dynamic. In this context, the integration of economic smart charging with dynamic pricing has encountered fewer barriers. This argument was raised by the same actor, who noted that user-friendly platforms have already been established alongside the successful introduction of economic smart charging schemes with dynamic pricing. The private home charging sector demonstrates that it is feasible to develop streamlined platforms that integrate seamlessly with diverse technologies. This indicates that, with appropriate coordination and standardisation, similar user-friendly solutions could be implemented for public smart charging.

*“Meanwhile, if you look at home charging, steering by price works very well.”* – EV-driver

While the private market shows willingness to adopt economic smart charging, the absence of this proposition on the public charging market demonstrates a broken link in the adoption chain, as described by Adner (2012), “The extent to which partners will need to adopt your innovation before the end consumers have a chance to assess the full value proposition.” (p. 6). The focus shifts from whether partners are capable of delivering the necessary innovation to whether they perceive the value proposition as beneficial not only to the end consumer but also to their own interests. The challenge is convincing critical partners that there is positive value for themselves in economic smart charging, particularly when they perceive their current position as sufficient or advantageous.

**Main observations:**

Execution risk:

- Not identified

Adoption risk:

- The dual user interface of MSP and CPO restricts information flow, affecting communication of driver information and scheduling preferences. Yellow light.
- Price variability and lack of transparency undermines user trust and hinders dynamic pricing in smart charging propositions. Yellow light.

### 4.2.9. Categorisation of risks

The aforementioned main observations of each actor, including the identified execution and adoption risks, were systematically categorised into overarching themes to construct meaning from these individual risks. Table 9 presents the five main categories and subcategories along with corresponding risk descriptions, as outlined in each actor's main observation textbox at the bottom of each actors' section. If a risk was relevant to multiple categories, it was logged separately for each category. The status of the identified adoption risks was described according to the traffic light continuum (Table 3).

*Table 9, Categorisation of ecosystem risks*

| **Risks** | **Sub-category** | **Risks** |
|---|---|---|
| 1. Software | Software issue | Execution risk: Software limitations in utilising driver information and processing dynamic price updates. (CPO) |
| | | Execution risk: Incumbents raised concerns about the costs of software development. (MSP) |
| 2. Transparency | Scheduling transparency | Adoption risk: The lack of both price transparency and scheduling practices contribute to a negative sentiment around smart charging. Yellow light. (MSP) |
| | | Adoption risk: Resolving scheduling transparency is essential for enabling the further expansion of smart charging, as the local government cannot effectively fulfil its primary activity of facilitating charging infrastructure without reliable and transparent scheduling mechanisms. Yellow light. (Local government) |
| | | Adoption risk: The dual user interface of MSP and CPO restricts information flow, affecting communication of driver information and scheduling preferences. Yellow light. (EV driver) |
| | Price transparency | Adoption risk: Lack of price transparency originating from the absence of touchpoint with EV driver. Yellow light. (CPO) |
| | | Adoption risk: With regards to the second activity, the affordability of charging is progressing positively through smart charging, the main challenge is addressing the adoption risk linked to price transparency. Yellow light. (Local government) |

| | | |
|---|---|---|
| | | Adoption risk: The lack of both price transparency and scheduling practices contribute to a negative sentiment around smart charging. Yellow light. (MSP) |
| | | Adoption risk: Price variability and lack of transparency undermines user trust and hinders dynamic pricing in smart charging propositions. Yellow light. (EV driver) |
| 3. Business model | Long-term energy contract | Adoption risk: Legal aspects related to the long-term energy contracts foster only small incremental adaptations. Yellow light (CPO) |
| | (Long-term) concession contract | Adoption risk: Legal aspects related to the provisions of the concession contract constrain smart charging. Yellow light. (CPO) |
| | | Adoption risk: Engagement in smart charging propositions with dynamic pricing displaces charging stations tied to long-term concession contracts. Red light. (CPO) |
| 4. Accountability | Information exchange | Execution risk: Constraints on the exchange of driver information leave the degree of flexibility in the charging session unknown (CPO) |
| | | Adoption risk: The dual user interface of MSP and CPO restricts information flow, affecting communication of driver information and scheduling preferences. Yellow light. (EV driver) |
| | Balancing responsible party | Adoption risk: Who bears the risks associated with maintaining supply-demand balance remains a central point of discussion. Yellow light. (Utility) |
| | | Execution risk: The MSP is not permitted to control the smart charging session because the energy contract is held by the CPO. (MSP) |
| 5. Economic | Value of flexibility | Adoption risk: Economic uncertainties rooted in value of flexibility and degree of flexibility contribute to the reluctance among CPOs. Yellow light. (CPO) |
| | | Adoption risk: Flexibility markets are emerging but economic benefits remain uncertain, with use cases for EVs under development. Yellow light. (Utility) |

## 4.3 Understanding the problem

In Section 4.1, the structure of the ecosystem is outlined, followed by an analysis of the associated risks in Section 4.2. In this section, the interconnections between the ecosystem structure and these risks are examined. Understanding the dynamics of an ecosystem is about the interplay between an actor's execution risk and the external risks introduced by ecosystem partners. These reveal hidden dependencies, and thereby help to understand and develop a robust strategy that is more likely to lead to success. It distinguishes between the identified risks (indicated in bold) and the underlying problems driving these implications, providing insight into the core issue that must be addressed as a crucial first step before proceeding with the reconfiguration of the ecosystem. This chapter begins by illustrating a blind spot, which becomes evident through an examination of the ecosystem structure and associated risks. Subsequently, the five risk categories outlined in Table 9, are interpreted within this context, following the order in which they are presented.

### 4.3.1 A blind spot

The steering committee blind spot originates from the lack of a direct link between individual niche MSPs working with, backend software providers with charge card services offered as an additional capability on the one hand, and the local or national government authorities on the other hand, as shown in the refined ecosystem, Figure 6. This results in the underutilisation of two critical contributions from (niche) MSPs to smart charging: (a) smart charging ready software, and (b) the integration of driver information to optimise charging sessions using this software.

Whereas a CPO relies on the local government for concession grants, no formal dependency exists between the local government and an MSP. Although the local government highlighted that intends to initiate conversations with niche MSPs in the near future, these providers operate solely at the national level and are shaped entirely by national conditions, with limited connection to the local context. Similarly, steering committees organised by the national government include industry representation solely through trade associations, primarily to adhere to antitrust regulations. As both niche and incumbent CPOs and MSPs are predominantly represented within the same trade association, the specific perspectives of niche MSPs become diluted. In short, the absence of contact of the local government with MSPs, coupled with discussions at the national government level conducted through trade organisations, results in the contributions of niche MSPs being unheard, thereby creating a blind spot within the steering committees.

### 4.3.2 Misperceptions

The following section examines two misperceptions that exemplify the prevailing dynamics. It provides context for the blind spot and the measure that is implemented accordingly, which is characterised by a linear, step-by-step approach.

The first indication of this blind spot is evident in the differing perceptions regarding the exchange of information and the software to transfer this information enabling smart charging. Incumbents highlight two key challenges: a lack of driver information due to the complex structure involving MSPs, which they claim hinders effective information exchange (**2. Transparency/4. accountability**), and software-related issues that obstruct the deployment of smart charging solutions (**1. Software**). In contrast, niche providers argue that they can address both challenges through their specialised software and facilitate exchange driver information to optimise charging sessions. Nevertheless, the local government has thus far deemed the existing connections through incumbent CPOs and their affiliated MSPs to be adequate for the ecosystem's needs.

A second indication of this blind spot concerns the limited engagement of the local government with niche actors. Instead of engaging with niche providers and utilising their resources, they continue to rely solely on the incumbent perspective limiting innovation and potential improvements in smart charging infrastructure without establishing a clear path forward. Although incumbents provide their own MSP services, these often serve more as a formal requirement to meet concession criteria rather than representing a significant market position. Hence, the conclusions of their latest steering group meetings were based on these perspectives, as shown in the quote below. In short, while niche MSPs highlight their ability to address both software-related issues and driver information by communicating them to CPOs, they are often labelled as the problem—a perception driven by the steering committee's blind spot, rather than being recognised as a potential solution. These software-related issues are not inherently a risk but arise largely from the inadequate integration between niche actors and incumbents, but a result of the blind spot and the measures that reinforce this (**1. Software**).

*"So, two weeks ago the conclusion was, the chain needs to be shorter, that's just it, and the MSP has to go"* – anonymous[3]

The second divergence in perception lies in the unannounced control of smart charging sessions, driven by the absence of driver information, with the disregard for this blind spot leading to significant repercussions that reinforce the existing lock-in. This was illustrated by the contrasting perspectives of the local government and niche MSPs on the 15-30 minute smart charging power adjustments implemented by the CPO. The government regarded these adjustments positively, noting a slight decrease in tariff bids for the concessions, which it interpreted as an indirect outcome. Furthermore, this contributes to achieving the NAL's goal of ensuring that over 60% of charging sessions are smart by 2025.

However, at the same time, the niche providers point at the underutilisation of the degree of flexibility, which stems from the lack of the driver information exchange, as discussed previously (**4. Accountability**). This issue is not inherently a risk but arises primarily from the inadequate integration of specialised software designed to facilitate the exchange driver information and optimise charging sessions between niche actors and incumbents (**1. Software**). Niche MSPs expressed concern, emphasising that the lack of transparency about these adjustments introduces uncertainty about the reliability of charging (**2. Transparency)**. This uncertainty, in turn, diminishes EV drivers' willingness to offer their flexibility. Consequently, this undermines the overall effectiveness and adoption of smart charging practices. Additionally, MSPs highlighted that this dynamic further diminishes the incentive for CPOs to engage with them, reflecting a power structure sustained by existing cognitive interdependencies that allow incumbents to maintain their autonomy. It appears that the local government does not recognise the potential losses associated with this dynamic. Although the overall

[3] *Due to the limited number of participants in steering committees and a commitment to confidential, anonymous data handling, the position of this ecosystem actor cannot be disclosed.

objectives of the niche MSPs and the government align closely on the increased utilisation of smart charging, their perspectives diverge on the approach to achieving this goal.

#### 4.3.3 Concession agreements

The steering committee blind spot is reflected by the new concession terms established by the local government. Although the agreements were originally designed to facilitate the deployment of charging infrastructure, in the context of smart charging, resulted in unintended consequences that impede its effective implementation. The aforementioned section highlighted the differing perspectives on the current smart charging trend resulting from the blind spot; however, the underlying issue of utilising specialised software and inadequate exchange of information stemming from the underutilisation of MSP's contributions remains unresolved. The conditions outlined in the new concession contracts—formulated without representation from niche MSPs—have resulted compromised agreements drawn up as alternative solutions, culminating in notable repercussions that further reinforce the lock-in of the prevailing situation for three reasons.

First, in response to the lack of scheduling transparency resulting from unannounced power adjustments by the CPO—whether due to grid-conscious charging practices or minor smart charging adjustments—the government has established a requirement of 30 kWh within the initial six hours of charging in the concession agreements (**2. Transparency**). While this measure enhances the predictability of charging scheduling, it simultaneously restricts the potential for the use flexibility. The latter was highlighted as an obstacle to utilise smart charging. The underlying issue of transparent communication regarding charging scheduling, resulting from the lack of communication of driver preferences such as departure time, needs to be addressed to ensure charge reliability.

Second, concerning price transparency, local government has established fixed prices as a criterion for concession evaluation (**2. Transparency**). Although this approach ensures that CPOs adopt competitive prices despite the absence of transparency, it does not directly affect the pricing mechanisms of MSPs, as they operate beyond the sphere of influence. As a result of this compromised agreement, CPOs are inadvertently hindered from relaying dynamic price signals, which has been identified as an adoption risk. The core problem of price transparency, originating from price formation influenced by the concession contract, the CPO, and the MSP, remains.

Third, concerning the displacement of the business model, a direct consequence, similarly originating from old concession agreements with fixed pricing, is their hindrance to the transition to dynamic pricing (**3. Business model**). A sudden shift to dynamic pricing would be hindered, as it is anticipated that dynamic pricing models would outcompete and eventually displace charging stations operating under older concession contracts. This adoption risk for CPOs, outlined in Section 4.2.4, can be seen as an indirect consequence of the steering group blind spot. A second argument was mentioned with regards to displacement of the business concerns long-term energy contracts. Since the long-term energy contracts were based on the fixed-price conditions established in the concessions, this is considered a side effect. The root cause that needs to be addressed is the transition phase to dynamic pricing, during which CPOs remain committed to fixed pricing.

#### 4.3.4 Accountability and economic risk

While the risks related to software, transparency, and the displacement of business models were explained with reference to the blind spot, the risks concerning the accountability of the charging session and the economic uncertainty surrounding flexibility, labelled as risk four and risk five in Table 9, are stand-alone and remain underexplored, and are addressed below.

In the absence of clear agreements concerning the accountability of the charging session, unannounced power adjustments are limited to 15-30 minutes, leading to a persistent underutilisation of EV smart charging flexibility (**4. Accountability**). Several repercussions were experienced in this context, as previously outlined. Each individual actor has distinct reasons for controlling the charging session: the energy supplier is responsible for balancing supply and demand; the CPO manages the energy contract and associated risks; and the MSP maintains contact with the EV driver, granting them access to critical driver information (departure time, state of charge, and charging speed). Consequently, two primary issues need to be addressed: (a) the establishment of agreements regarding imbalance penalties for the BRP, and (b) transparent communication of driver preferences similar to the discussion on risk two, to enable accountability for managing the charging session effectively.

Lastly, the economic value of flexibility remains uncertain (**5. Economics**). Empirical evidence suggested this and highlighted that it will only become apparent over the long term. This uncertainty was further underscored by the lack of concrete suggestions to resolve this uncertainty from interviewees, indicating that it represents an intrinsic uncertainty rather than actionable risk. Furthermore, this type of uncertainty cannot be mitigated or influenced through the reconfiguration of elements, a key mechanism for risk management in ecosystem theories. Consequently, the uncertainty of value of flexibility falls outside the scope of the risk analysis.

Although there are strong indications that the transition from a centrally demand-driven energy system to a decentralised supply-driven system, facilitated by fluctuating renewable energy integration, will increase the value of flexibility, addressing this issue extends beyond the scope of this study.

#### 4.3.4 Closing reflection

In summary, the local government's failure to recognise the contributions of niche MSPs, along with a tendency to think in terms of linear supply chains, has led to the current path becoming a dead end. In a linear supply chain, there is a straightforward, step-by-step transfer of responsibilities or tasks, where one actor hands off to the next, which then passes it to a further actor, with each stage occurring sequentially. Awareness of the steering committee's blind spot provides a clearer understanding of the step-by-step approach being implemented and the subsequent repercussions that follow. This linear approach is limiting because it oversimplifies the complex nature of the smart charging ecosystem, where multiple stakeholders play interconnected roles. The use of a linear model ignores the dynamic, interdependent relationships and the need for collaboration across different actors, hindering the innovation within the ecosystem required for economic smart charging. Although partners have agreed on the final vision of smart charging with economic incentives, consensus on the path to achieve it has not yet been reached. This emphasises the need for coordinated collaboration within the ecosystem marked by multiple permutations, where the potential configurations of roles expand substantially. Therefore, the following section will outline three approaches to reconfiguring the ecosystem to eliminate existing bottlenecks and foster successful outcomes.

**Main observations:**

- The steering committee blind spot can be described as the failure to recognise the importance of a direct link between individual niche MSPs and the government.

Risk interpretation:

1. Software in itself is not a risk, underutilisation of smart ready software is a result of the blind spot and related conflicting measures that reinforce it.
2. Lack of transparency:
   - In communicating charging schedules, including driver preferences.
   - Originating from price build up through concessions, CPO and MSP.
3. Concession contract limitations displacing business model:
   - facilitating the transition phase for CPOs to dynamic pricing, during which they remain tied to fixed pricing in charging stations operating older concession, to mitigate risks of displacing their business model.
4. Accountability for managing charging sessions:
   - Formulating agreements on imbalance penalties for the BRP.
   - Communication on charging schedules, including driver preferences.
5. Risk induced by the economic uncertainty of value of flexibility lies beyond the scope of this study.

## 4.4 Developing a new ecosystem blueprints

Ecosystems are characterised by permutations, requiring all components to work together simultaneously. Interview findings indicate that while ecosystem actors largely align on end-vision, no consensus yet exists on a unified path to achieve it. Therefore, three new ecosystem blueprints were developed to address the identified risks and were subsequently discussed during the focus group. This approach allows to assess alternative configurations and generate shared understanding and agreement among the on how these elements should come together.

The reconfiguration process follows a structured three-step approach—outlined in Section 3.2 of the methodology and illustrated in Figure 7 —comprising the ecosystem vision, ecosystem strategy, and ecosystem structure, which will be elaborated upon in the following section. Thereby, it provides an insight into research question three: *"how can an ecosystem reconfiguration, and strategies derived from it, support the creation of smart charging market in the Netherlands?"*

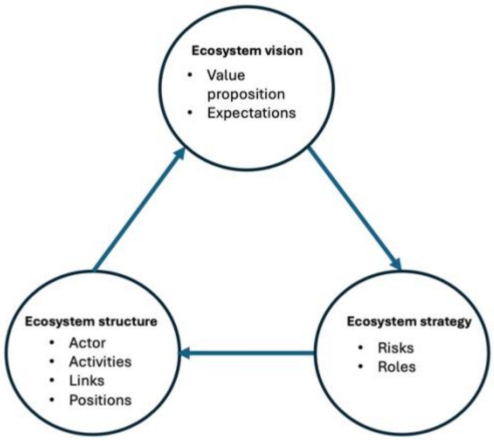


*Figure 7, innovation ecosystem reconfiguration*

### 4.4.1 Ecosystem vision

The reconfiguration of the ecosystem begins with defining a vision consisting of expectations and shared value proposition, providing a clear pathway for its implementation.

The expectations are structured around four central aspects: (a) increased uptake of EVs (b) powered by renewable energy, while (c) maintaining a stable and reliable grid, (d) utilising smart charging technology that maintains charging reliability, ensuring a fully charged battery by the time of departure. A shared ecosystem vision helps attenuate the negative effect of cognitive distance by encouraging commonality in perspectives towards the ecosystem. An ecosystem vision fosters shared understandings of ecosystem objectives and the strategies to achieve them. In an ecosystem, such a vision serves as a common cognitive framework that enables a balance between the individual and the collective within the ecosystem (Wareham et al., 2014). Each actor holds a distinct individual value proposition, shaped by their specific roles and contributions. While diversity in value propositions is an inherent characteristic of ecosystems, it is crucial that these individual propositions align with the overarching shared value proposition of the ecosystem in order to promote collaborative success. The shared value proposition for economic charging leverages dynamic energy price and trades flexibility, while maintaining a static grid infrastructure tariff. Interviews with grid operators revealed that a dynamic grid infrastructure tariff would not be feasible until approximately 2028–2030, making this timeline static grid tariffs a limitation factored into the reconfiguration strategy. The latter aligns with Adner's (2012) ecosystem reconfiguration principles, which accept the limitations of existing elements and focus on changing the patterns of interaction among these elements in the ecosystem.

**Expectations**
a. Increased uptake of EVs
b. Powered by renewable energy
c. Maintaining a stable and reliable grid
d. Charge reliability, full by the time of departure

**Value proposition**
I. Static grid infrastructure tariff
II. Dynamic energy tariff
III. Flexibility trading

### 4.4.2. Ecosystem strategy

The ecosystem strategy consists of managing internal and external risks, as well as defining roles within the context of the value proposition created.

Through interviews with the smart charging ecosystem actors it became clear that smart charging creates an entire new role of managing the charging session—one that multiple ecosystem actors were eager to assume. The non-adoption of this role, due to the lack of agreements on accountability for managing charging sessions, was a key risk to the success of smart charging. In addition, two other risks were identified: the lack of transparency charging scheduling and pricing; the displacement of the business model, in which the individual value proposition is not congruent with the shared ecosystem value proposition. These risks were thoroughly discussed in Section 4.3 and must be addressed and positioned in a way that allows for pro-active management during reconfiguring of the ecosystem.

**Roles**
Smart charging introduces a new role in managing the charging session

**Risks**
- Accountability for managing the charging session
- Transparency
- Displacement of business model

### 4.4.3 Ecosystem structure

Reconfiguring an ecosystem involves altering the interaction patterns among elements. Or in the words of Adner (2012): *"Innovating in ecosystems demands not just innovation in the discrete elements but also innovation in the way in which the elements come together–innovation in the blueprint itself"* (p. 164)

Using the refined ecosystem blueprint depicted in Figure 6 as a starting point, an examination of the arrangement of activities, actors, links, and positions, fundamental questions can be raised to uncover a more effective configuration. The approach aims to navigate around key bottlenecks, guided by the five levers for ecosystem reconfiguration detailed in Table 2 (Adner, 2012). This process provides a clear overview of all elements and helps the researcher to address and effectively manage the internal and external risks identified, indicated with "yellow light" and "red light" in section 4.2. Ultimately, this results in the creation of three distinct value blueprints, which are based on the shared ecosystem vision with an ecosystem strategy developed to address key bottlenecks by reconfiguring the ecosystem's structure. The original ecosystem blueprint served as the starting point, with adjustments to the ecosystem structure highlighted in orange.

<u>Ecosystem blueprint 1:</u>

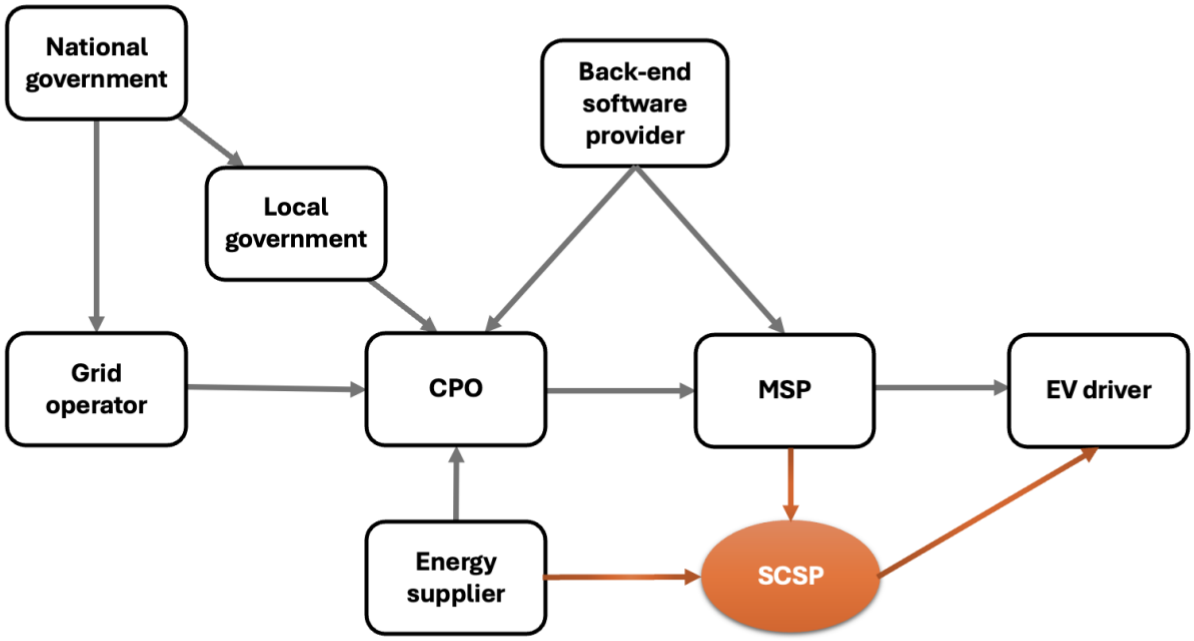


*Figure 8, ecosystem blueprint 1*

Ecosystem blueprint 1, illustrated in Figure 8, aims to resolve the risks concerning transparency and accountability in managing the charging session. This blueprint utilises the lever "what can be **added**?" (Adner, 2012, p.177) to eliminate these bottlenecks. The absence of an actor that is able to properly manage the charging session leaves room for the introduction of a new actor to create value, the Smart Charging Service Provider (SCSP) who will take on this role, following the example set by the private home charging market. This means that the SCSP is responsible for managing supply and demand of electricity contracts of CPOs, with imbalance penalties being passed on by the energy supplier. Thereby the price build up changes, the SCSP trades the energy and flexibility while paying the CPO and MSP a fixed fee per kWh. For CPOs, this functions as a criterion for evaluation in concession agreements. Activities of the SCSP include managing a smart charging platform that facilitates communication with the MSPs on pricing. Furthermore, a user interface is maintained to facilitate the exchange of driver information, scheduling preferences and ensure price transparency for the driver.

Ecosystem blueprint 2:

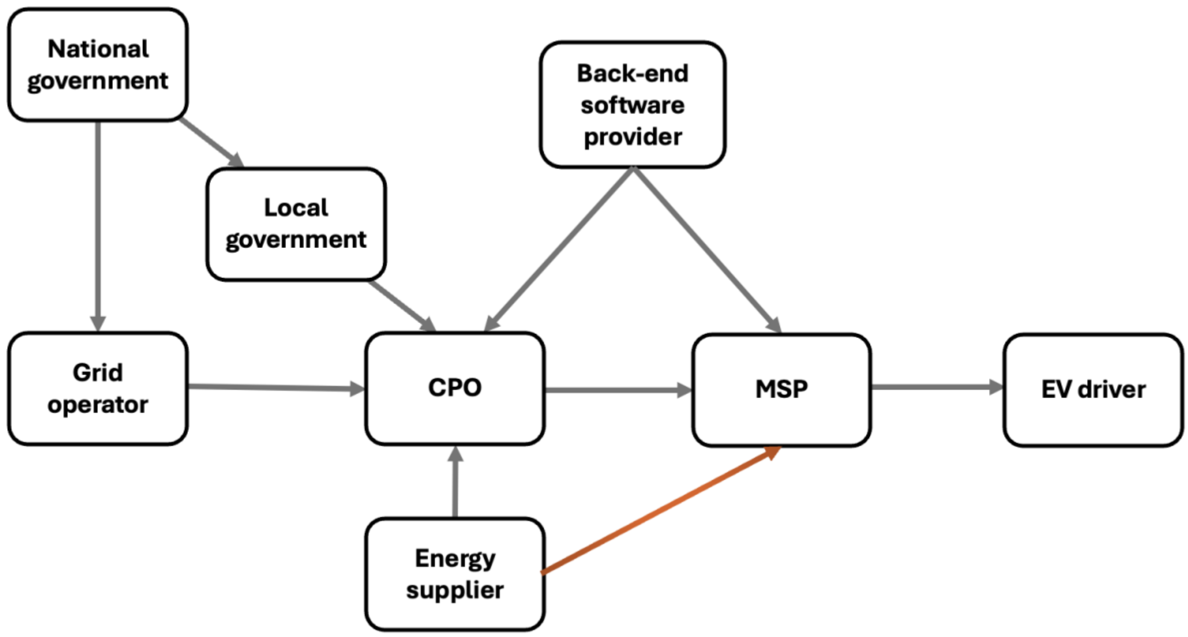


*Figure 9, ecosystem blueprint 2*

Ecosystem blueprint 2, illustrated in Figure 9, similarly aims to resolve the risks concerning transparency and accountability in managing the charging session. This blueprint utilises the lever "what can be **relocated**?" (Adner, 2012, p.177) twice to eliminate these bottlenecks. First, by shifting the BRP services from the energy supplier to the MSP, value is created through effective coordination between supply and demand. This highlights the second relocation, as it is achieved by the MSP managing the charging session instead of the CPO to align with this balance. By maintaining direct contact with the driver, the MSP has access to more detailed information about the driver, enabling more effective management of the charging session. This reduces imbalance penalties and facilitates the integration of renewable energy sources, thereby moving the smart charging value proposition forward. Since the MSP is responsible for managing supply and demand, the burden of the imbalance penalties on these electricity contracts is shifted to the MSP. As a result, the price build up changes, it allows the MSP to trade energy and flexibility while paying the CPO a fixed fee per kWh, which will then serve as an assessment criterion for CPOs in concessions. Activities of the MSP include managing a smart charging platform that facilitates communication with other MSPs on pricing. Furthermore, a user interface is maintained to facilitate the exchange of driver information, scheduling preferences and ensure price transparency for the driver.

Ecosystem blueprint 3:

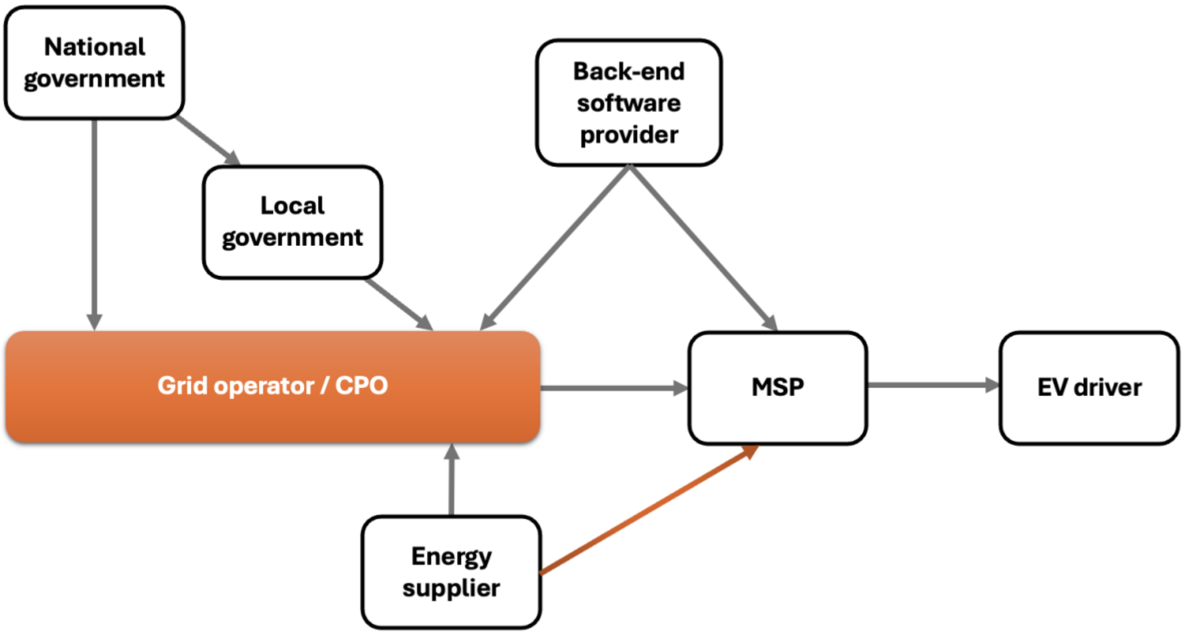


*Figure 10, ecosystem blueprint 3*

Ecosystem blueprint 3, illustrated in Figure 10, aims to resolve all three risks concerning transparency, accountability in managing the charging session, and displacement of the business model. First, this blueprint utilises the lever "what can be **relocated**?" (Adner, 2012, p.177) to eliminate bottlenecks concerning transparency and accountability for managing the charging session. These relocations are identical to those outlined in the previous described ecosystem blueprint two. Ecosystem blueprint three extends the reconfiguration by utilising the lever "what can be **combined**?" (Adner, 2012, p.177) to eliminate bottlenecks regarding the displacement of the business model of the CPO. By extending the responsibilities of the grid operator to include the management of charging infrastructure, combined with their existing responsibility for managing grid infrastructure, a more integrated approach is achieved. This neutralises the risk of displacing the CPO's business model and opens new ways for MSPs to create value. Since a grid operator is not permitted to trade in energy, the responsibility of trading energy and flexibility naturally shifts to MSPs. Resistance regarding the business model of the CPO is addressed, as they now function as a department under the authority and legislation of the grid operator, receiving a fixed fee per kWh sold at the charging station. Activities of the CPO department regarding the installation and maintenance of charging infrastructure remain unchanged.

## 4.5. Focus group results

Identifying the most promising blueprint is an iterative process aimed at converging the optimal innovation strategy. The reconfigured ecosystem structures were discussed during focus group with all ecosystem actors, including both niches and incumbents to overcome the steering committee blind spot. The focus group was structured using the three-step approach for reconfiguring an ecosystem (Figure 7).

Below, the main findings from the paper worksheets and the discussion of the three reconfigured ecosystem blueprints were presented, with each outlined individually. A discussion on the reconfigured ecosystem structure begins with a blueprint coloured using the traffic light continuum, where a "half-half" colouring is applied if two representatives of a single ecosystem actor provide different responses. After the discussion on the three visions, a participant proposed a fourth vision. The discussion on this was presented under the heading "ecosystem blueprint 4".

**Focus group result ecosystem blueprint 1:**

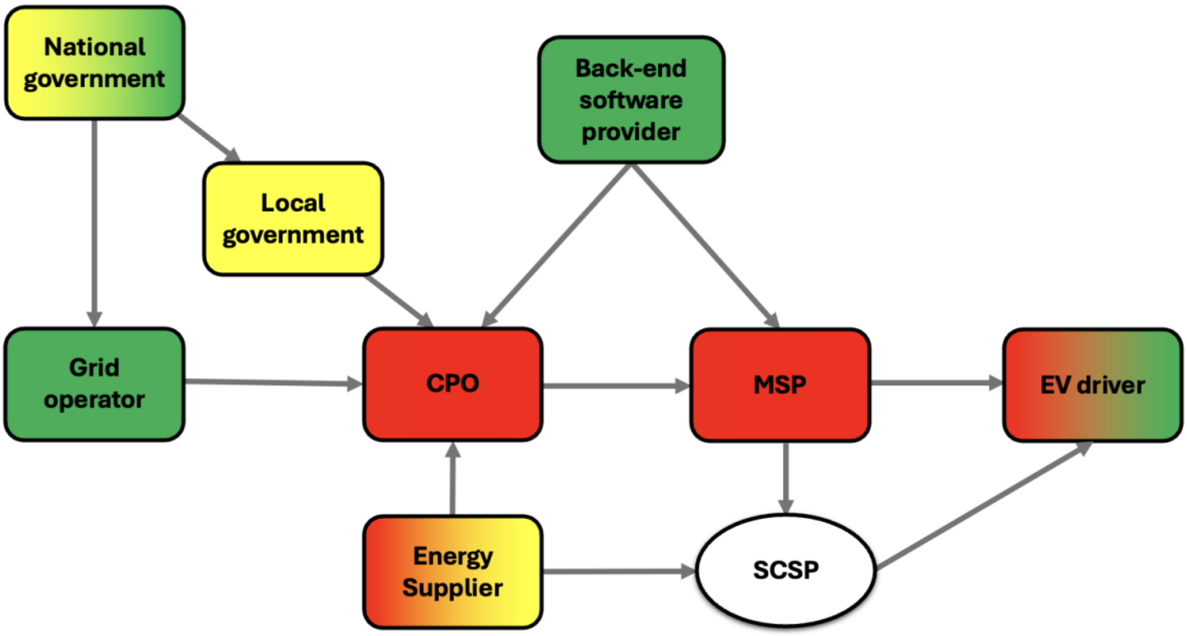


*Figure 11, results ecosystem blueprint 1*

Ecosystem blueprint 1 aims to address the risks related to the lack of transparency and accountability in managing the charging session, with the overarching conclusion being that the responsibilities assigned to the SCSP could also be fulfilled by the existing ecosystem actors; they saw no necessity to introduce an additional market player, as this would only serve to increase complexity. This explains the "red light" adoption risk associated with the actors surrounding the SCSP, who indicated to prefer the status quo, visualised in Figure 11.

Besides, the CPO emphasised that the incentives underlying their value proposition were misaligned with those of the MSP. This arises from the concern that MSPs may prioritise generating profit from utilising flexibility rather than maximising the sale of kWh. Given that the CPO receives a fixed fee per kWh, this interest may potentially be conflicting. In the discussion, a fixed starting fee for the CPO was proposed as an alternative in response to the misaligned incentives.

**Focus group result ecosystem blueprint 2:**

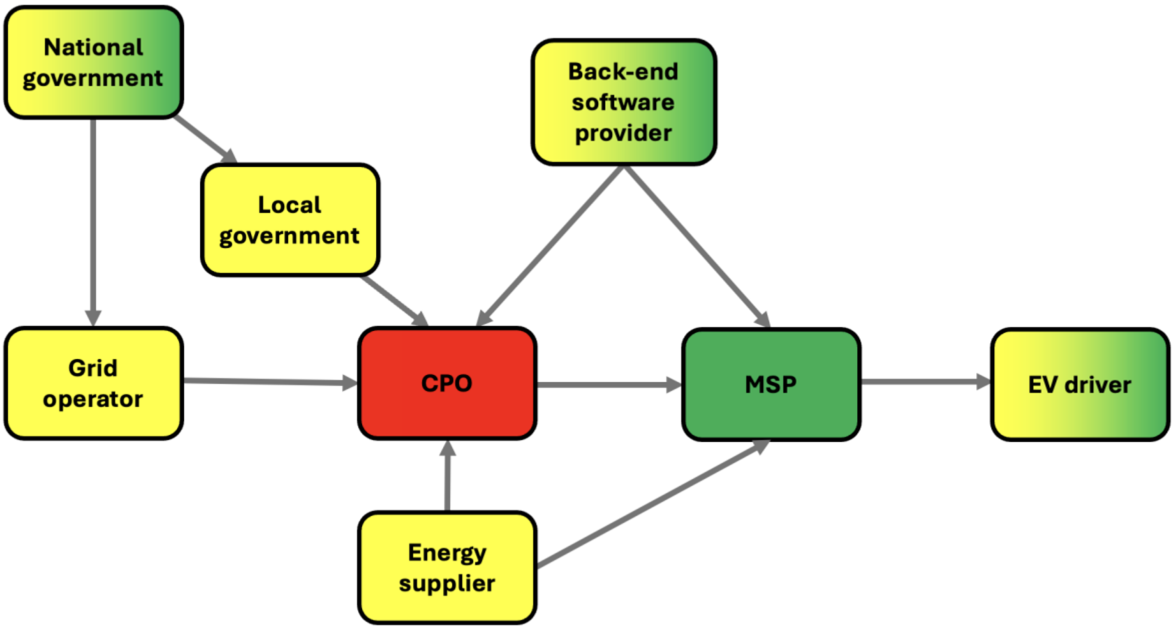


*Figure 12, results ecosystem blueprint 2*

Ecosystem blueprint 2 aims to address the risks related to the lack of transparency and accountability in managing the charging session, with the majority of the actors being neutral or seeing clear benefits from adoption, as shown in Figure 12. The CPO, however, reiterated that the incentives underlying their value proposition were misaligned with those of the MSP, similar to the issue described under ecosystem blueprint 1, hence the "red light" indication. Additionally, the energy supplier initially indicated a "red light" on the paper worksheet, but this changed during the discussion to a "yellow light", as there was a misunderstanding on that the blueprint was developed in the national context instead of local context. The energy supplier maintained a neutral stance, remaining open to potential inducements, as a supplementary agreement would be required with the MSP to manage the value of flexibility inherent to smart charging.

The EV driver expressed execution risk about the possibility of inconvenient charging sessions with frequent interruptions if the MSP were to manage the charging session based on dynamic pricing and flexibility. In response, it was argued that various options could be offered, such as preventing the complete break of the charging session once it has started. The private home charging market already showcases these possibilities.

**Focus group result ecosystem blueprint 3:**

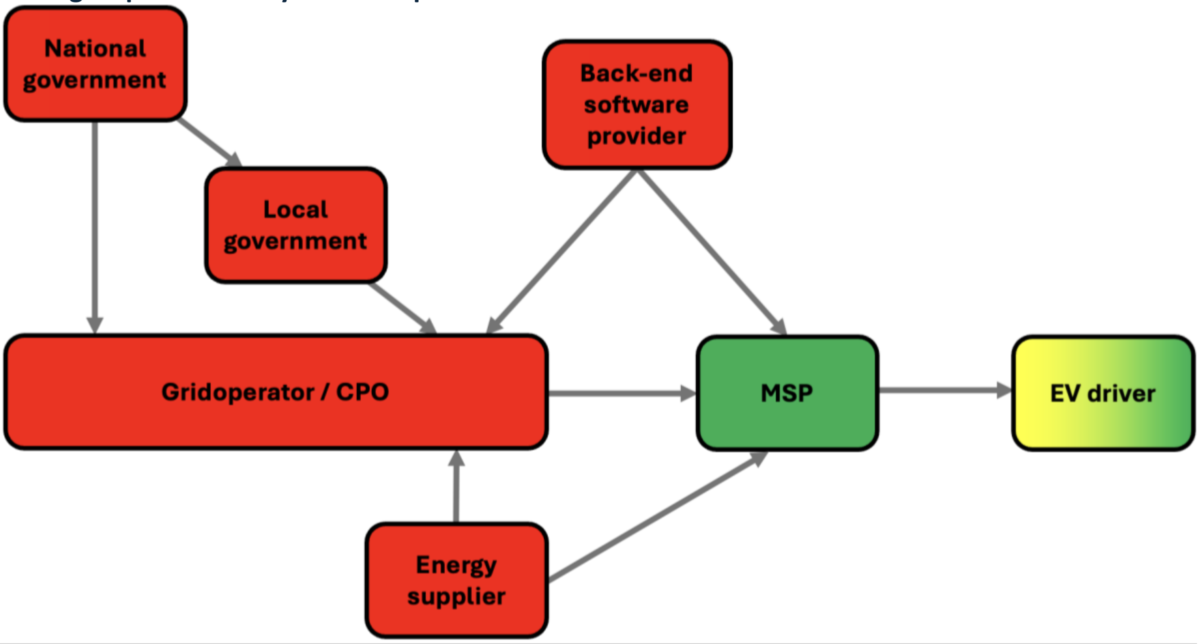


*Figure 13, results ecosystem blueprint 3*

Ecosystem blueprint 3 aims to address all three risks related to lack of transparency, accountability in managing the charging session and displacement of the business model. Three concerns were expressed with regards to this ecosystem blueprint. Firstly, concerns were raised about the grid operator's potential inability to install charging stations as efficiently and swiftly as market players. Currently, the local government facilitates the expansion of charging infrastructure by engaging with multiple CPOs operating the same area. Therefore, combining a single CPO with grid operator would likely lack sufficient charging station installation capacity, while combining multiple CPOs would introduce additional complexity. Secondly, the backend software provider expressed concerns about potentially losing its business relationship with the CPO. Thirdly, limitations in the current regulations made this approach seem unfeasible by participants. The existing regulatory limitations pertain to (a) restrictions the of grid operators installing charging stations and (b) prohibition on their involvement in energy trading. These three concerns were raised by the actors involved in the reconfiguration, resulting in the adoption risk being marked with a "red light" by those actors, as shown in Figure 13.

While many of the participants perceived this blueprint not viable, there was support for the business model based on a fixed fee for the CPO. This was understood within the context of a utility-like model, the CPO would earn a predictable recurring income stream from the fixed fee, which covers operational costs and providing stable business model. It was argued that this utility-like model changes the perception on charging infrastructure, positioning it merely as a point of sale for energy within a larger smart service network. The CPO’s role evolves to a static charging infrastructure provider. There was no specific reference or involvement of the CPOs in this discussion; therefore, their stance remains indifferent.

In addition, during the discussion, an alternative, fourth configuration was proposed by participants to address the regulatory restriction prohibiting the grid operator from engaging in energy trading. This involved the MSP assuming ownership of the energy contract, utilising the lever “what can be **relocated**?”. The structure of the MSP holding the energy contract is unconventional from a historical perspective, as traditional energy supply models typically operate with fixed grid connections linked to an electric meter cabinet identified by an EAN number. Nonetheless, this shift could mitigate risks concerning transparency and accountability for managing the charging session, leveraging the principle of "what can be **relocated**" (Adner, 2012, p.177) once more. The relocation of responsibility naturally transfers the management of the charging session from the CPO to the MSP, which now holds the energy contract and already serves as the primary touchpoint for the EV driver. In this way, MSPs are able to gain insights into driver preferences and determine the level of flexibility in the charging session. By strengthening their capacity to manage the charging sessions efficiently, they generate value for the ecosystem as a whole and foster more effective agreements with the BRP. This reconfiguration eliminates the need for CPO intervention in scheduling which resolves the communication gap and addressing both associated risks. Furthermore, it makes the pricing structure more straightforward, with only the energy price changing alongside a fixed fee for the CPO, addressing the complexity in the price build up and enhancing transparency.

While two risks are mitigated, the energy supplier noted that this introduces an execution risk for the practical implementation of operating without a fixed EAN. This is due to the need for restructuring the historically aligned framework between energy supply, fixed points of consumption, and the associated technical infrastructure. Specifically, with regard to the technical infrastructure, there is a dependency on the smart meters of grid operators, as they are responsible for allocation at private home grid connections.

**Focus group result ecosystem blueprint 4:**

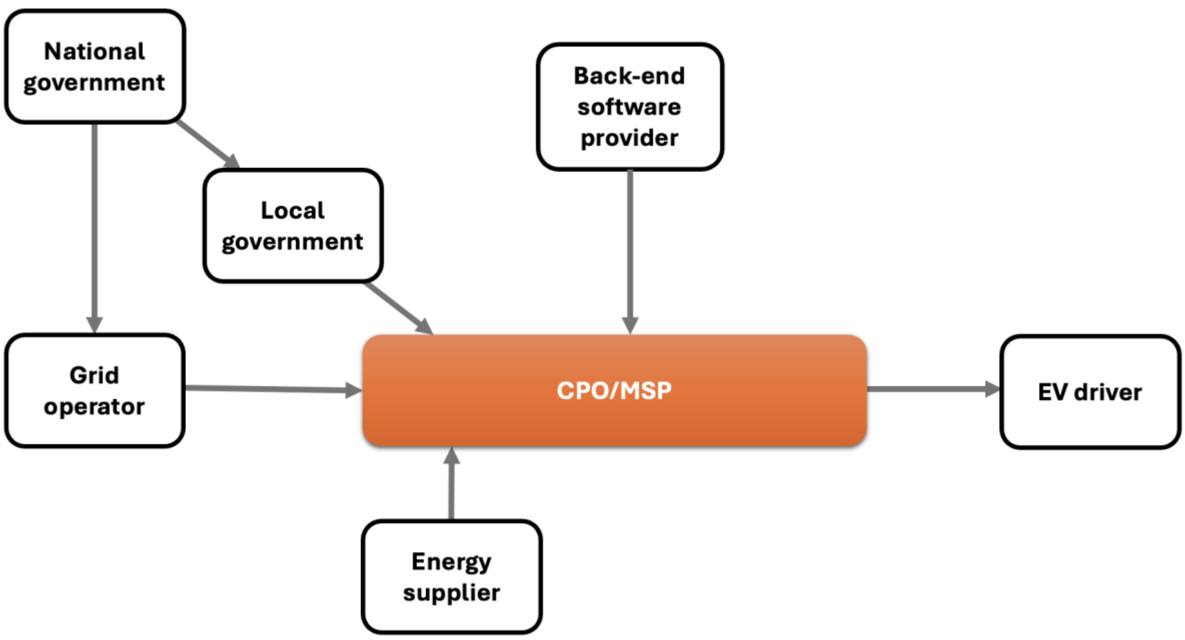


*Figure 14, results ecosystem blueprint 4*

As the fourth blueprint, illustrated in Figure 14, was spontaneously introduced verbally by the CPO in consultation with the national government, it was not possible to provide the participants with a paper worksheet to document their perceived execution and adoption risks, along with the corresponding traffic light continuum.

Ecosystem blueprint 4, similarly aims to resolve the risks concerning transparency and accountability for managing the charging session. This blueprint utilises the lever "what can be **combined**?" (Adner, 2012, p.177) to eliminate these bottlenecks. By combing the activities of the CPO and MSP, challenges related to the lack of communication are resolved due to this integrated approach, which concerns both bottlenecks. As a result of improved communication, driver preferences become known, and hence the degree of flexibility. This, in turn, improves the ability to manage the charging session and facilitates more effective agreements with the BRP. Lastly, it simplifies the price build up by combining these actors, thereby increasing transparency.

Although this blueprint addresses the risks related to transparency and accountability in managing the charging session, adoption risks emerge from the EV driver's perspective. The EV driver pointed out that, in practice, drivers tend to opt for the nearest charging station, which results in their reliance on only a few available stations. This dependency is further reinforced as local governments often allocate the deployment of charging stations in certain areas to a single CPO through concession agreements. The absence of a separately operating MSP actor could potentially limit the freedom of choice for EV drivers. Red light.

A discussion with mobility experts on this vision highlighted the limitations of this blueprint from an economic perspective, supporting the “red light” indication. The well-functioning MSP market in the Netherlands allows for the availability of roaming services. This enables seamless access to various charging stations across different networks, giving EV drivers the flexibility to select any MSP that suits their preferences. This fosters competition among MSPs, leading to lower prices, improved services, and increased innovation. By combining the MSP and CPO roles, this freedom of choice is effectively eliminated. This is particularly relevant considering the aforementioned argument that drivers tend to choose the nearest charging stations, and that most regions are dominated by a single CPO due to historical concession agreements. Consequently, this blueprint leans towards a monopolistic market structure, which is typically associated with inefficiency and higher costs.

**4.6 Recommendations**

In conclusion, blueprints 1, 2, and 3 were presented to the focus group, with each blueprint receiving a “red light” from one or more participants. However, the CPO was the only actor to consistently indicate a “red light” across all blueprints. The current ecosystem structure grants the CPO exclusive control over the energy contract, which enables them to block any reconfigurations within the ecosystem, even in a blueprint where a clear surplus exists for CPOs to participate, as was demonstrated by the focus group. As the holder of the energy contract, they maintain authority over managing the charging session. There are significant barriers to entry for new CPOs, as concessions are typically issued only for large volumes of charging stations, which require significant capital investment. Moreover, the existing business model, which relies on fixed pricing per kWh as a key evaluation criterion, faces intense competition, posing difficulties for new entrants to establish themselves. Since all incumbents are tied to concessions, none of them have an interest in disrupting or displacing their current business model.

According to the written explanation provided by the CPO, the “red light” indication was attributed to the perceived loss of power. Notably, only blueprint 4, which enhanced the CPO's power, elicited enthusiasm from the CPO, as this was the blueprint they proposed themselves. Although blueprint 4 does not resolve the issue of displacement of the business model, power appears to be the primary concern. Nonetheless, both the input from EV drivers and the discussion with experts indicated a “red light" as previously discussed. While the perspectives of other focus group actors on blueprint 4 were not captured, it can still be concluded that no single blueprint is expected to achieve consensus.

Therefore, to advance smart charging, this signifies a transition from a centralised dependency on the CPO to a more distributed or balanced power structure. The monopoly position of the CPO over the energy contract must be restructured in the ecosystem, hence a fifth blueprint was developed. Besides restructuring the blueprint to address the monopoly, it incorporates reconfigured elements that participants recognised added value in prior discussions. This presents an overview of the empirical results from the focus group and forms the basis for the recommendation. Accordingly, it aims to develop an enhanced ecosystem structure to support the creation of a public smart charging market in the Netherlands.

**Focus group result ecosystem blueprint 5:**

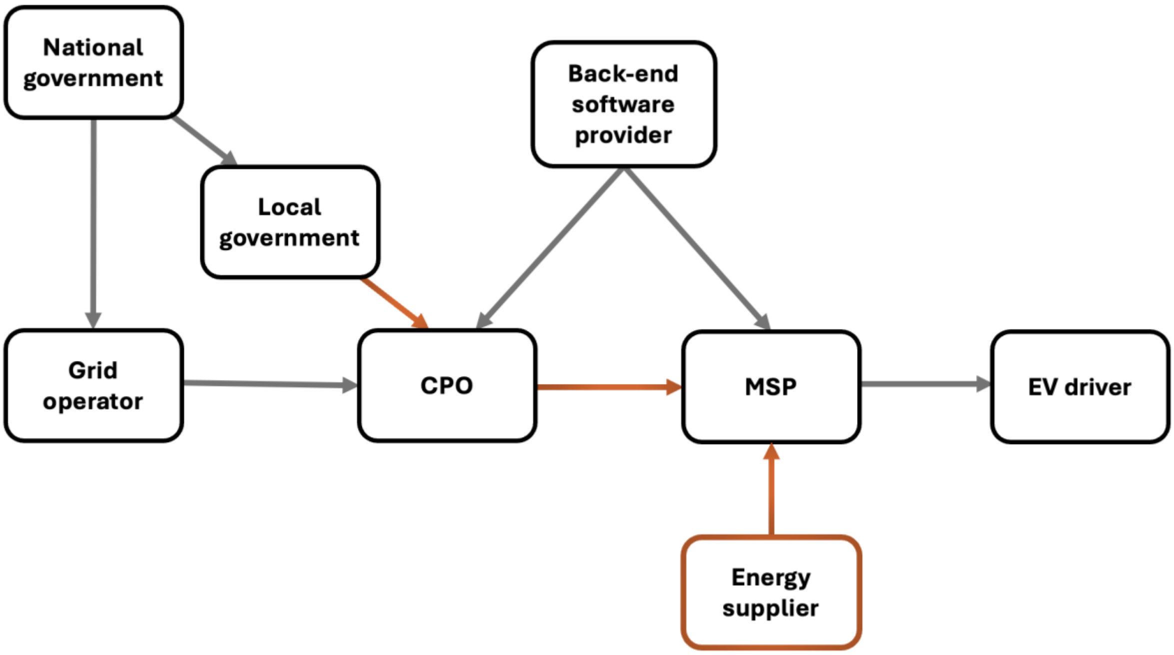


*Figure 15, empirical result of the focus group discussion*

The fifth reconfigured ecosystem blueprint marks three changes to the structure, thereby aiming to resolve all three risks concerning transparency, accountability for managing the charging session, and displacement of the business model. The first two reconfigurations refer to the relocation of the energy supplier and the responsibility of managing the charging session. This is followed by a third reconfiguration element, focusing on the concession agreements aimed at managing interdependencies. Figure 15 provides a visual representation of blueprint 5.

The fifth blueprint utilises the lever "what can be **relocated**?" (Adner, 2012, p.177) twice to eliminate bottlenecks concerning transparency and accountability for managing the charging session. The relocation shifts ownership of the energy contract from the CPO to the MSP, and consequently relocates the responsibility of managing the charging session in the same manner, thereby addressing both risks. These two relocations are consistent with the discussion detailed in the last paragraph of blueprint 3, where this reconfiguration was proposed by participants in the focus group.

With the MSP now able to secure energy contracts independently, the monopoly is broken, redistributing power and reducing reliance on the CPO. Although the structure of the MSP holding the energy contract without a fixed EAN number is unconventional, the interests of MSPs and energy suppliers in the context of smart charging closely align. By holding the energy contract, the MSP can better collaborate on shared activities and responsibilities related to optimising charging schedules based on stability and predictability in (renewable) energy provision. Furthermore, several energy suppliers already operate their own MSP services, demonstrating the natural alignment of these roles. This integration allows energy suppliers, in their role as MSPs, to leverage their expertise in energy markets and demand-side flexibility. Thereby, strengthening the connection between energy procurement and charging session management, creating added value by streamlining processes, reducing inefficiencies, and driving progress across the entire smart charging ecosystem. Nonetheless, as discussed earlier in blueprint 3, the energy supplier did highlight an execution risk in operating without a fixed EAN.

"*Once you identify what current relationships within the organisation need to change to allow your initiative to succeed, you can start strategizing about how to manage the dependencies.*" – (Adner, 2012, p. 79)

As the quote emphasises, identifying which elements need to change is only one part of achieving success; a strategy must also be formulated based on the interdependencies. The reconfiguration mentioned above grants the MSP autonomy in managing the charging process by taking ownership of the energy contract in collaboration with the energy supplier. This transition of the MSPs managing energy contracts signifies a shift from established norms centred on fixed energy offtake points, reflecting the evolving needs of a nationwide energy consumer based ecosystem. Such a shift challenges the historically aligned structures, not only internally through a technical execution risk but also externally due to a dependency for adoption, as the price is initially determined by the CPO through the concession agreements in the current ecosystem, which must be managed. These agreements compel the CPO to submit with the lowest fixed price per kWh, a practice rooted in the fact that they have traditionally held the energy contract. Therefore, within the context of ecosystem characterised by permutations, it is essential for the MSPs to engage with the concessionaire in collaborative efforts to manage this dependency, and eliminate the CPO's price setting power through these concession terms, which grants them the right to set the initial fixed kWh price. Simultaneous efforts by the MSPs and the concessionaire, the local government, contribute to the development of smart charging.

Blueprint 5 shifts part of the power in the ecosystem from the CPO to the MSP. Thus, if the business model of the CPO is not secured in this new blueprint, the CPO will continue to block ecosystem changes as their position, power and surpluses would be challenged. Therefore, the third element of reconfiguration concerns the concession agreements. Reconfiguration of the concession agreements is required to accommodate the new role of the MSP, while ensuring a stable business model for the CPO, where they can clearly see a surplus from their involvement. During the discussion on blueprints 1 and 2, concerns were raised that MSPs might prioritise generating profit from utilising flexibility over maximising kWh sales. To address these misaligned incentives, a fixed starting tariff for the CPO was considered positively in blueprint 3. Consequently, the price of the starting tariff could be included as a key evaluation criterion for concession contracts in blueprint 5, replacing the fixed kWh price criterion. At the same time, prior concession terms mandating fixed pricing for the CPO and minimum charge of 30 kWh within the first six hours have become obsolete, as they hinder the adoption of smart charging practices envisioned in blueprint 5. To further accelerate this process, a transitional arrangement could be implemented for CPOs linked to these old concessions, enabling them to co-exist with the new dynamic pricing models during the transition period.

In summary, blueprint 5 reconfigures the ecosystem by:
(a) relocating of the energy supplier with the ownership of the energy contract;
(b) relocating the responsibility of managing the charging session;
(c) restructuring historically aligned frameworks related to fixed pricing agreement in concessions through introduction of a fixed starting tariff.

As a result, the monopoly position of the CPO is eliminated, and the risks regarding transparency and accountability in managing the charging session are resolved, yet the issue of displacing the CPOs' business model remains a challenge. The reconfigurations do not directly mitigate the risk for incumbent CPOs, but offers an alternative pathway that enables new actors to enter the ecosystem, thereby reducing the dependency on incumbents. The restructured ecosystem lowers the barriers to entry, by introducing a stable business model with a predictable income stream, particularly for the CPOs currently operating exclusively in the private market for two main reasons. First, the business model closely aligns as revenue is generated from selling the charging station, rather than from the number of kWh sold. Although the CPO role remains capital-intensive due to the upfront costs of deploying charging stations, the predictability and stability of the business model with fixed starting tariffs helps reduce barriers to entry by making it easier for potential entrants to secure financing and plan for long-term investments. Second, CPOs that have previously only been active in the private home charging market are not constrained by old concession agreement, allowing them to adopt the new business models that displace those of competitors. This dynamic creates opportunities for innovation within the smart charging ecosystem, fostering a more competitive and adaptive ecosystem that accommodates evolving business models.

# 5. Discussion

### 5.1 Conclusion

This research focusses on the pivoting role of EV smart charging practices to enable the transition to sustainable mobility. Widespread adoption of high demanding EVs and fluctuating renewable energy sources to power them leads to one major challenge, grid congestion. Smart charging can provide an immediate solution to grid congestion while awaiting grid reinforcements by creating synergy through the optimisation of EV battery charging with available resources and managing grid demand. While the private home charging market shows widespread adoption of smart charging, the public charging infrastructure continues to lag behind. Economic theory indicates that market failures on grid infrastructure underly the congestion issue, leaving the actors involved with insufficient incentives to adopt smart charging. Existing regulations and structures not only contribute to these issues but are also unable to deal with this situation where the success of an innovation depends on the alignment structure of the multilateral set of partners. To address this coordination issue, Adner's (2017) ecosystem theory is applied to derive strategies for managing dependencies between partners. Accordingly, this study aimed to offer guidance on reconfiguring the smart charging ecosystem in the Netherlands to ensure widespread adoption in the public charging domain, addressing the following research question: *"How to create a successful EV smart charging ecosystem in the Netherlands?"*

Through a two-step qualitative study including interviews with all ecosystem actors and a multi-actor workshop, the current ecosystem structure was analysed based on actors, activities, positions, and links, resulting in a refined blueprint. The analysis underscores the central position of the Charge Point Operator (CPO), which serves as the key intermediary between various actors within the ecosystem. Additionally, the analysis of the ecosystem identified three main adoption risks that hindered actors within the innovation ecosystem from adopting smart charging practices. As a result, a broken link emerged, which prevented EV drivers to even have a chance to fully assess the value proposition of smart charging. The first risks consisted of a lack of transparency in both charging scheduling practices and charging prices. Second, long-term concession agreements with the CPO for operating charging stations at fixed pricing hinder the transition to dynamic pricing in new concessions, as this would result in the displacement of their existing fixed-price charging stations. Third, due to a lack of mutual agreements between actors, no one is accountable and thereby able to manage the charging session properly, leading to significant underutilisation of the flexibility potential. These adoption risks create resistance from one or more actors who prefer the status quo, ultimately perpetuating the broken link.

Where all actors agreed on the value proposition underlying the ecosystem vision—charging based on dynamic energy prices—addressing these risks is crucial to enable the development of a smart charging market. In the focus group discussions, participants expressed varying levels of support across the three reconfigured ecosystem blueprints designed to address these risks, with all participants—except the CPO—showing support for at least one blueprint, as well as strategies derived from them. The consistent "red light" from the CPO, indicating a preference for the status quo, was attributed to the perceived loss of power. This was understood through the ecosystem structure which grants the CPO exclusive control over the energy contract giving them monopoly power. As the holder of the energy contract, they maintain authority over managing the charging session.

Thus, if the CPO's business model is not adequately integrated into the new blueprint, the CPO will continue to resist ecosystem changes as their position, power and surpluses would be challenged. The following three reconfigurations of ecosystem elements were recommended as strategies to facilitate the development of smart charging, as outlined in blueprint 5. This includes relocation of the energy contract, shifting from the CPO to the Mobility Service Provider (MSP), and consequently the relocation of responsibility for managing the charging session in the same manner. Lastly, to accommodate the new role of the MSP, the starting tariff for charging could be included as a key criterion in concession contracts with the CPO, replacing the fixed kWh price criterion to enable dynamic energy pricing models managed by the MSP. This reconfiguration addresses the three identified risks within the current ecosystem and manages the risk discussed during the focus group, including the monopoly power of the CPO, while securing their position. At the same time, from an economic standpoint, dynamic energy prices indirectly account for the pricing of the negative externality of congestion due to their high correlation. Consequently, resolving the underlying economic misalignments of the smart charging ecosystem.

### 5.2 Theoretical implications

#### 5.2.1 From to actors to activities

In this study, multiple reconfigured value blueprints were developed to make assessment of how a new ecosystem reconfiguration, and strategies derived from it, can support the creation of a successful smart charging ecosystem. The blueprint implements the ecosystem-as-structure following the definition of ecosystems as formulated by Adner (2017) — the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialise. The structural approach to ecosystems of Adner (2017) underlies four key elements: actors, activities, positions and links. These four elements together describe how value collectively is created through a set of interactions that arises in multilateral settings and that can only be described with reference to the specific structure of interdependence.

This study further contributed to Adner's (2017) ecosystem framework by incorporating an activity-centric as opposed to an actor-centric viewpoint. A focus on roles rather than the actors who undertake these roles carries broader conceptual applicability. The activity-centric perspective suggests the introduction of roles into the ecosystem blueprint. Roles consist of sets of activities commonly performed across different ecosystems, which enhances their transferability and helps explain their evolution. Since roles operate at a higher level of abstraction, they are not limited by the context of any particular ecosystem. In contrast to actors, their activities and links are inherently tied to the specific ecosystem context. By adopting an activity-centric approach, it would become easier to compare different case studies of innovation ecosystems, and to draw theoretical and empirical lessons across cases.

Secondly, adopting an activity-centric rather than an actor-centric perspective sharpens the boundaries of the ecosystem by focusing on the roles that actors play rather than the organisations themselves and the departments tied to those roles. While there are only eight actors drawn in the smart charging ecosystem blueprint, there is a wide variety of actor types, as a single actor can assume multiple roles, which are continuously changing as the ecosystem evolves. By elevating the analysis to a higher level of abstraction, interference of ancillary activities associated with individual actors or organisations is removed, redirecting the focus to the set of activities necessary to fulfil the role required for the focal value proposition to materialise. Setting boundaries for an ecosystem does not eliminate external influences, nor should it ignore the system's effect on external elements, as the potential consequences can be substantial. The primary reason for defining boundaries lies in its advantages for coordination and its strategic implications.

In the present study, the activity-centric approach helped to better map the ecosystem in question. Two adjustments were made to the original blueprint based on the interviews. First, the actor "government authority" was split into "local government" and "national government". Indeed, the necessity of splitting them can be understood by focusing on their respective roles. The local government facilitates the deployment of charging infrastructure, while the national government acts as a regulator, market facilitator, and protector of public interest in energy and grid infrastructure markets. Second, the "backend software provider" was added to the ecosystem blueprint. The inclusion of this actor similarly stems from a new role focused on the development of smart charging software and managing the backend system, which was crucial for the smart charging value proposition to materialise. Furthermore, a refinement of the ecosystem boundaries pertains to the inclusion of supply chain partners in the blueprint. Charging station manufacturers were not represented in the blueprint, while energy suppliers were. Both deliver a homogeneous good, yet the difference lies in their roles, as energy supplier is included due to its role as the BRP, which is critical for the value proposition to materialise. As opposed to the charging station manufacturer, which is simply a supplier without a critical role in this context.

In short, the activity-centric perspective, which focuses on roles rather than actors makes the assumptions regarding the ecosystem boundaries explicit, thereby providing a deeper understanding of the current ecosystem structure, as regards research question one. This approach resulted in the development of a refined definition of the ecosystem-as-structure–the alignment structure of the multilateral set **of distinct roles conducted** by partners that need to interact in order for a focal value proposition to materialise.

Building on this refined understanding of the current ecosystem structure, the focus shifts to the implications for future strategies, highlighting how the activity-centric perspective focusing on roles can inform the development ecosystem strategies. A blueprint based on an activity-centric perspective does not allow for the combination of actors unless it is tailored to a specific organisation that undertakes both activities or when the actor becomes obsolete due to reconfiguration. To make the blueprint applicable to all actors with differing roles, it requires considerable generalisation, with distinct actors that in practice are often fulfilled by a single organisation. Therefore, the activity-centric approach starts by identifying which activities can be effectively combined, focusing on roles that actors play rather than the organisations themselves. In the context of this study, the activity-centric provides a different perspective on the reconfigured blueprint five, concerning the relocation of the link of energy supplier to the MSP. The crux of this reconfiguration lies in the relocation of the activities: those related the BRP, associated with energy supplier, and the management of the charging session, which have been shifted to the MSP. The activity-centric view allows to combine two activities of distinct actors into one new role. The role of "strategic energy management", consisting of activities of the BRP and managing the charging session, utilising the lever "what can be **combined**?" (Adner, 2012, p.177). This perspective, illustrated in Figure 16, provides a blueprint based on roles.

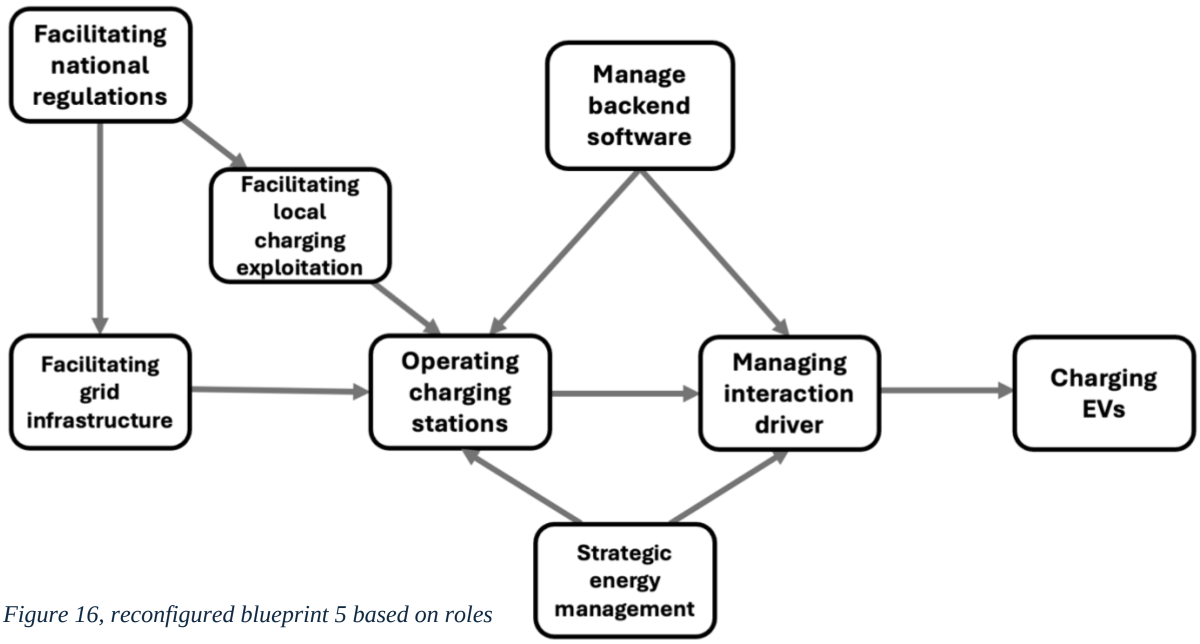


*Figure 16, reconfigured blueprint 5 based on roles*

### 5.2.2 Governance legacy impacts on public infrastructure ecosystems

Adner's (2017) ecosystem theory is typically applied in open markets, emphasising the alignment of roles and activities, as well as collaboration among interdependent actors. However, a distinct context arises in public infrastructure markets due to its strict regulatory environment, coupled with the emergence of monopoly power, with implications that are not explicitly addressed in Adner's (2017) framework. Monopoly power in such regulated context is often rooted in the historical legacy of regulations governing public infrastructure, driven by the accumulation of legal, institutional, and practical factors stemming from previous policy decisions and regulatory frameworks. This phenomenon is referred to as a "lock-in", a situation where the system becomes dependent on a particular technology, practice or business model, making it difficult to transition to alternatives, even when superior options emerge. A lock-in has profound implications for innovation, competition, and market dynamics, as it may stifle the adoption of new solutions. This dynamic is characteristic of regulated sectors in transition, such as public charging infrastructure.

In this context, the historical legacy of regulations has resulted in monopoly power for the CPO, as it remains the exclusive actor in the ecosystem with the ability to hold an energy contract. Consequently, it restricts the reconfiguration of ecosystem strategies by limiting competition and maintaining control over this key resource. This dominance can prevent the emergence of alternative business models for smart charging, as the CPO resist changes that threatens their established position. The focus group demonstrated this dynamic: the CPO acts as a pivotal connector between the MSP and the energy supplier but exhibits resistance to change, which poses significant challenges in addressing transparency risk (Risk 2) establishing accountability for the management of charging sessions (Risk 4). In ecosystems where one actor holds monopoly power, the options for reconfiguring activities, roles or partnerships are diminished, thereby stifling the adaptability and flexibility needed to evolve the ecosystem.

The "Leadership Prism" tool, developed by Adner (2012), provides a framework for identifying which actor within an ecosystem is best suited to assume the leadership role and initiate the transition. The leadership prism leverages the total-cost/relative benefit logic, as was outlined in Table 1, to evaluate the expected surplus. By using this tool, actors with sufficient expected surplus are identified to opt for leadership efforts. However, since the CPOs holds monopoly power, they are able to obstruct any reconfiguration, consequently undermining the role of the leader. This prevents Adner's (2012) Leadership Prism from functioning effectively within this structure. As the issue here lies primarily in the inadequate organisation of interactions between levels, namely the institutions that determine the 'rules of the game' and market players facilitating charging infrastructure. As a result, the potential for innovation and strategic reconfiguration is constrained, hindering the ecosystem's ability to respond to new market dynamics or technological advancements. Therefore, exploring the interplay between the Multi-Level Perspective (MLP) of Geels (2002) and ecosystem theory of Adner (2017) would enhance understanding of how to accelerate and expand the deployment of the smart charging innovation.

### 5.2.3 Exploring the connection between multi-level perspective and ecosystems

The empirical case in this study concerned smart charging of EVs. This innovation is often considered as part of the transition from gasoline-based car regime to electric car regime. However, smart charging can also be considered as part of a transition within the electric car mobility regime from simple charging to smart charging. Theoretically, one can pose the question how Adner's (2017) ecosystem system framework applied in this study, related to, and can be combined with, the influential MLP (Geels, 2002) and Adner's innovation ecosystem framework in transition studies. The MLP provides an analytical framework to further understanding the interactions across different levels of change:

- The micro-level represents niches where radical innovations emerge; in our case the development of advanced smart charging algorithms by backend software developers can be considered such an innovation.
- The meso-level corresponds to the current urban electric car regime dominated by incumbents; the established energy and mobility infrastructure systems, including utilities, grid operators, and CPOs
- The macro-level encompasses the broader socio-technical landscape; the climate targets and renewable energy policies drive demand for smart charging

Recent advancement positions the MLP within the wider academic debate on sustainability transformations, and elaborates on the MLP with regard to transition pathways (Geels, 2007). Scholars have progressed beyond the notion of singular, bottom-up disruptive transitions, instead advancing more nuanced perspectives on transition pathways that have resulted in the creation of diverse typologies. According to the transition pathway of Geels & Schot (2007) niche innovations and landscape developments interact with the regime in a reinforcing or disruptive manner. This aids in understanding transition as outcomes of alignments between developments at multiple levels and characteristics of unfolding transitions.

While Adner (2017) effectively describes the interactions between different actors, the key idea of MLP is that transitions are broad about by interactions between processes at different levels. These are processes of co-evolution and mutual adaption within and between levels (Shove & Walker, 2007). Adner (2017) emphasises actors in his analysis, while Geels (2002) examines the levels formed by groups of actors, taking a higher level of abstraction. This could inform the analysis by recognising that the same actor can operate at different levels, with their influence on the ecosystem can differ substantially, as demonstrated by the empirical findings of the CPO, MSP and backend software provider. Additionally, the analysis further contributes to ecosystem theory by incorporating leadership dynamics in the ecosystem's transition, taking into account processes occurring at multiple levels, particularly when a transition requires government intervention. The macro-level stresses importance of the external context, including overarching structures, institutions and regulations that obstruct the transition in highly regulated public infrastructure ecosystems, as discussed in the previous section (5.2.1). While ecosystem theory provides insights on the alignment structure of interdependent partners, the MLP, in the context of these publicly regulated markets, helps by including broader processes and forces occurring on different levels necessary to bring about an actual transformation.

Smart charging can be said to unfold and evolve with only moderate landscape pressure, while niche innovators have not yet been sufficiently developed and cannot take advantage of landscape pressure on the regime. Therefore, this transition pathway can be characterised, then, as *regime transformation*, where incumbent actors reorient in response by modifying the direction of development paths and innovation activities, shown in Figure 17 (Geels, 2007). These typically involve conflicts and contestations, as observed, for example, with the obligated implementation of grid-conscious charging due to pressures from the landscape. Regime actors showed resistance to the transition while using their adaptive capacity to reorient and responded with the small 15-30 minute power adjustments. These mutations are characterised by gradual adjustments and changes within the regime.

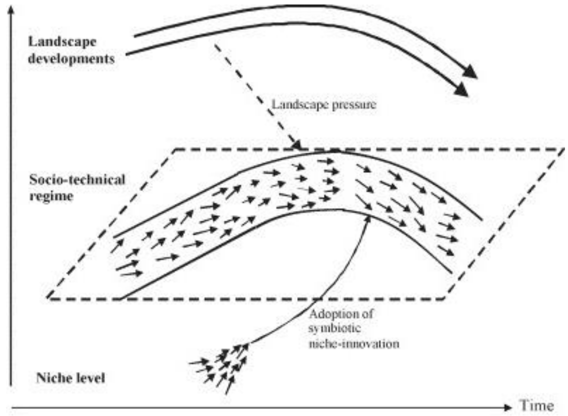


*Figure 17, transition pathway (Geels, 2007)*

The alternations described, rooted in an activity-centric ecosystem perspective, complement this view on the transition pathway. Both perspectives align on acknowledging that the regime remains intact. According to the MLP, such symbiotic niche innovations integrate into the regime without disrupting its basic architecture. The activity-centric ecosystem perspective provides a distinct, yet complementary lens by emphasising activities which supports this view, as existing activities will persist during the transition, with only additional activities being introduced. Since the activities of regime actors remain essential during and after the transition, these actors themselves will continue to play a key role.

### 5.2.4 A broader lens for governance strategies

This section incorporates Smith et al. (2005), which builds upon Geels' (2002) MLP, to enhance the understanding of why the current policy path is unsustainable and is still uncertain whether it will lead to success, even after the reconfigured ecosystem blueprint is established. The MLP (Geels, 2002) serves primarily as an analytical and explanatory tool, while Smith et al. (2005) extends this approach by providing practical insights into the role of governance in shaping transitions through deliberate interventions, addressing governance structures that either enable or constrain a transition. By focusing on actionable concepts, Smith et al. (2005) offer policymakers guidance fostering or steering transitions, moving beyond simply describing how they unfold. In this study, a notable example of this dynamic was the fixed charging prices stipulated in concession agreements, which acted as a significant constraint on the transition process. This is exemplary for public infrastructure, which is subject to strict regulations, and, as such, requires regulatory intervention of ecosystem elements to enable the transition.

Smith et al. (2005) complements Adner's (2012) ecosystem approach in transitions involving multiple levels, such as in public infrastructure, by offering guidance on how interactions on different levels can provide the most effective leverage for steering change in a desirable direction. Particularly in the context of public infrastructure, where the leadership prism may not be effective due to strict regulations, regulatory intervention is necessary to enable the transition of ecosystem elements. Smith et al. (2005) offer a valuable perspective that facilitates the reconfiguration proposed through ecosystem theory, as outlined in the reconfigured ecosystem blueprint, leveraging multiple levels to increase the chance for success. Smith et al. (2005) places a greater emphasis on governance and agency within transitions, offering a broader governance framework that enhances its practical applicability for actors involved in managing real-world transitions.

Smith et al. (2005) introduced the heuristic typology within the MLP framework, organised into two dimensions with four distinct quadrants, shown in Figure 18. The first dimension addresses whether resources are sourced internally within the regime or rely on capabilities provided externally from (niche) actors. The second dimension measures whether change is envisaged and actively coordinated. *"The art of governing transitions becomes one of recognising which context for transformation prevails [Lever 1], and which drivers offer the best leverage for guiding change in a desirable direction [Lever 2]"* (Smith et al., 2005, p. 1498).

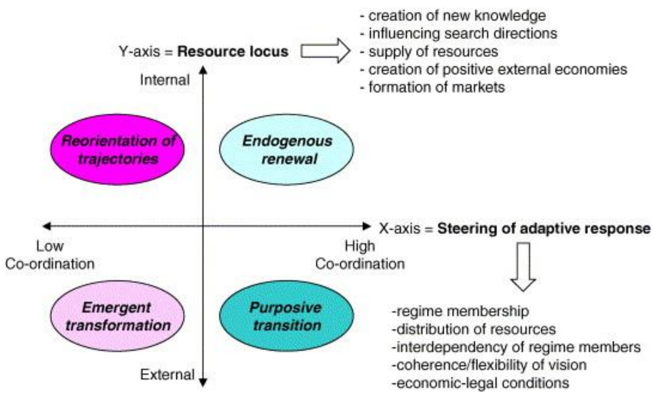


*Figure 18, fourfold mapping of transition contexts (Smith et al. 2005)*

Firstly, this typology lends itself to use as an analytical device to identify the particular context and type of transition that is underway. Secondly, under more normative usage, the typology can serve not only to diagnose transition processes, but also to help prescribe appropriate governance interventions. As demonstrated by the steering group blind spot, this requires interventions that are either additional or different from those already in place. Translating it to this study, this involves different interventions related to the blind spot of the steering committee, or, additional interventions, concerning the recommendations outlined in the reconfigured blueprint 5.

Analysing the **ongoing** transition process in relation to the first dimension of coordination indicates that the transition of smart charging involves high levels of coordination. This was evident as it is an intended changed and purposively guided by the government through active coordination, evident through the concession agreement that obligate the CPO to engage with the innovation. This resulted in only 15-30 minute smart charging power adjustments. More impactful changes were hindered due to obstruction of the steering committees. However, the blind spot here is that only incumbents were invited fostering incremental changes, while ignoring niche contributions, which undermines the adaptive capacity of the system, referred to as the second lever by Smith et al. (2005). Furthermore, the rigidity of actor and technological configurations limits their ability to adapt, thereby decreasing the probability of significant structural changes (Smith et al., 2005). These prevailing circumstances and established governance practices condition an *endogenous renewal* transition (Figure 18).

As *endogenous renewal* provides limited support to the achievement of the transition goals, it was determined to be insufficiently sustainable. To better understand the recommendation in Section 4.6, it is beneficial to incorporate the different levels of the MLP, particularly by adding an additional dimension that shifts resources sourced externally, niche actors included, beyond the incumbent regime. This approach thereby facilitates a *purposive transition*, adding a normative approach on how governance can actively shape transition to achieve the desired sustainable outcomes (Figure 18). Central to the *purposive transition* as **proposed** in this study is the enhanced role played by external niche actors, who not only exert pressure for change [Lever 1] but also supply the resources, capability and networks that shape their responses [Lever 2]. More specifically, facilitating the development of emerging niche MSPs, freed from the limitations imposed by incumbent CPO monopolies, is supported by an enabling regulatory environment. For example, the recommended fixed starting tariff, rather than a fixed kWh concession requirement, acting respectively as a constrainer or enabler of the transition.

The heuristic typology of Smith et al. (2005) serves as a valuable tool for policy-makers seeking to intervene in transition processes in a more informed way. This involves altering the given context and adaptive capacity, to modify transition processes, in terms of their pace and direction. Also in this study *“the appropriate governance strategies are not those that best assist some prevailing process of regime change, but those which best foster an alternative transformation process oriented towards a more desirable outcome.”* (Smith et al. 2005, p. 1499).

### 5.2.5 Evolving roles in the transition to smart charging

Ecosystem theory (Adner, 2012) and both advancements of the MLP (Geels, 2007; Smith et al. 2005) hold a different perspective on the status of the dominant actor in the transition. A more nuanced perspective with broader conceptual applicability is better captured in terms of orchestrator and complementor. An orchestrator coordinates and oversees the actions of various actors within a system, or a complementor contributes resources or capabilities that augment the value of the main offering.

Given the incumbents’ lack of access to driver information and expertise in software and data management, it raises the question of whether the niche will merely integrate as an add-on to the existing regime, as described Section 5.3 on the *regime transformation* (Geels, 2007). Smith et al. (2005) are less explicit about who takes the dominant position in the system, and lets it depend on the leverage of the particular actor to successfully set the transition in motion. This perspective on the dominant position could be informed using the ecosystem-activity approach, which suggests that the activities of an actor determine which activities are aligned with the responsibilities of an orchestrator. Since data handling is at the core of the value proposition underlying the structuralist ecosystem approach (Adner, 2017), this perspective suggests that the responsibility of the orchestrator should lie with the actor managing the activity of coordinating the charging sessions. As the activities required for smart charging, which primarily involving software development and data management, fall outside the incumbents’ areas of expertise, it is unlikely they will continue to assume the role of orchestrator. Instead, within the transition to smart charging, the responsibilities of incumbents are more likely to align with those of a complementor within the ecosystem. While the niche innovations (e.g., data actors) do not disrupt the regime’s basic architecture, they may actually redefine the dynamics, becoming the regime orchestrators. This diverges from the *regime transformation* perspective in the MLP (Geels, 2007), where the incumbents retains its role as orchestrator.

In the context of the ecosystem under study, the recommendation in Blueprint 5 (Figure 15) places the activity of coordinating the charging session under the MSP, keeping it separate from the incumbent CPO. In this blueprint, the MSP takes on the role of orchestrator, while other actors, including the CPO, serve as complementors to the smart charging value proposition. As a complementor, it becomes more challenging for the CPO to differentiate itself from competitors, increasing its vulnerability to being replaced by lower-cost alternatives, including those from international markets such as China. As a complementor, the CPO contributes in the supportive role of operating charging infrastructure, but no longer retains the central coordinating authority.

### 5.3 Limitations

This study has a number of limitations. The first limitation was found with respect to the activity-centric approach, where the sampling strategy could be improved. The purposive sampling strategy was stratified based on their link to the ecosystem, the multilateral set of partners that need to interact in order for a focal value proposition to materialise (Adner, 2017). However, as previously discussed, adopting an activity-centric rather than actor-centric perspective places roles at the centre for the purposive sampling strategy, as opposed to actors. Hence, in retrospect, employing a purposive sampling strategy stratified by roles would further enhance the validity of the sample. This results in two corresponding limitations:

I. Although the purposive sampling strategy was stratified according to an actor-centric perspective, all roles were adequately represented except for one, the SCSP. This actor does not exist in the public charging market as opposed to its role. The activity-centric perspective focusing on the roles reveals that this role is relevant when adopting the structuralist approach. Consequently, its inclusion would represent a valuable addition to the sample. Only one interview was conducted with the SCSP, active in the private home charging market, and was included incidentally as part of an interview with another ecosystem actor fulfilling both roles.
II. Since many actors assumed multiple roles, incorporating a more diverse combination of roles would have further strengthened the validity of the sample.

A second limitation of the focus group relates to the representation of the ecosystem. Although some firms were, on paper, positioned to represent multiple ecosystem actors due to their broad scope of activities, this did not guarantee that the individual participants could fully capture or articulate all perspectives and activities associated with the firm. The extent to which an individual could effectively represent the breadth of the firm's roles and functions depended significantly on their personal background, expertise, and familiarity with the firm's diverse roles within the ecosystem. Consequently, despite the carefully selected actors, the focus group exhibited a slight underrepresentation of energy suppliers and backend software providers.

A third limitation concerns the recommendation, as derived in this study, to transfer ownership of the energy contract from the CPO, with a fixed grid connection and EAN, to the MSP, which lacks a fixed grid connection. This recommendation, however, may have limited practical and legal feasibility. Experts from Arcadis indicated that practical and legal solutions are possible, albeit potentially requiring indirect or alternative approaches. An initiative in Germany, namely "LichtBlick eMobility GmbH" and "decarbon1ze," was referenced, which addresses challenges similar to those encountered in the Netherlands while operating under standard market conditions (Ecomento, 2024). Further research is required to explore whether such practical and legal solutions can be effectively implemented in the Netherlands under its specific market conditions.

### 5.4 Avenues for future research

The limited ability to address public infrastructure markets, where governance and regulation play a dominant role, shaped by institutional frameworks, as discussed in Section 5.2.2, suggest potential avenues for future research. Exploring whether similar patterns and typical characteristics observed in the analysis of public infrastructure intersect with ecosystems would be a valuable area of research. This could involve investigating whether the same dynamics, such as monopolies, legacy systems, and long-term contracts and commitments, emerge across other type of public infrastructure markets, thereby expanding and enriching ecosystem theories within the framework of "public infrastructure ecosystem".

Another potential avenue for future research lies in conducting comparative studies to examine the emergence of different smart charging ecosystems across countries. Such studies could explore how varying institutional and policy interventions shape the evolution of smart charging within different contextual frameworks. Particular attention could be given to identifying the key factors that define success within these ecosystems, especially considering their heavy reliance on public infrastructure, which is often highly regulated. Investigating the role of factors such as path dependency and structural influences related to regulations and institutional actors (e.g., ministries and the public sector) in shaping the development of these ecosystem, and identifying the key factors contributing to their success, could provide valuable insights. By comparing these cross-country ecosystems, researchers could identify factors that enable or hinder the scaling of smart charging solutions, as well as explore how countries can learn from one another.

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# Appendix

## Appendix A: Interview guide

| Theory | Concepts | Questions: |
| --- | --- | --- |
| a) Ecosystem structure | Actors | Can you desribe the entity you are working for? |
| | | Who are your your buyers and suppliers? (vertical) |
| | | Who are your competitors? (Horizontal) |
| | Activities | What are the core activities of your entity with regards to smart charging? |
| | | Who are the beneficiaries of your activities? |
| | | What is your role in smart charging? Describe your contribution |
| | Positions | Who are you collaborating with to offer smart charging? |
| | | --> what are common interests? |
| | | --> where do interests differ? |
| | Links | What is do you need from those collaborators? --> transfers can vary—matériel, information, influence, funds |
| | | How would you characterise the business relationships? |
| | | Who stands between you and the end-consumer? Whom do they pass it on the way to the end-customer? |
| | | Do you interact with the government? If so, what is their role? |
| b) Ecosystem risks | Execution risk | Are there any execution-related obstacles that are holding you back from implementing smart charging practices? |
| | | What do you think is necessary to ensure that the value proposition of smart charging materialises? |
| | Co-innovation risk | How able are your partners to undertake smart charging activities? |
| | | To what extent does the success of you innovation depends on the commercialisation of other innovations? |
| | Co-adoption risk | How willing are you to undertake smart charging efforts? |
| | | Who else needs to adopt smart charging before the end user has a chance to assess the the full value proposition? |
| c) Ecosystem vision | Value creation | What value do you deliver? |
| | | Who is the final target customer of your value proposition? |
| | Value capture | How do you capture those benefits offered through smart charging services? |
| | | --> How do you get returns through smart charging? |
| | | What is your perspective on the current distribution of value among partners involved in smart charging? |
| | Expectations | What is your perspective on the future of smart charging? |
| | | What is your perspective on the future distribution of value among partners involved in smart charging? |

**Appendix B: Focus group actor-specific worksheets**

**Visie 1, nationale overheid**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie | ○ - |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**______________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br>**Leg uit:**______________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Nationale overheid |
| | Activiteiten | ○ Optreden als regulator, marktfacilitator en beschermer van het algemeen belang in energiemarkten, het elektriciteitsnet en laadinfrastructuur om aan de basisbehoeften van burgers te voldoen.<br>○ Klimaat doelen nastreven |
| | Links | De netbeheerder en lokale overheid |
| | Positie | Zie ecosysteem visie 1 |

**Visie 1, Lokale overheid/NAL**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen, flexibiliteit verkopen |
| | Individuele waarde propositie | ○ - |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**___________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br><br>**Leg uit:**___________ |
| | | |
| **Ecosysteem structuur** | Actors | Lokale overheid/NAL |
| | Activiteiten **(nieuw)** | ○ Verbeteren van de laadfaciliteiten om het kip-ei-probleem te doorbreken<br>○ Zorgen voor transparante en betaalbare laadprijzen<br>○ Concessies in de markt zetten, **nieuwe concessie voorwaarde: (a) tussenkomst SCSP verplicht stellen, (b) dynamische laadtarieven** |
| | Links | Nationale overheid, netbeheerder en CPO |
| | Positie | Zie ecosysteem visie 1 |

**Visie 1, Netbeheerder**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie | ○ Verkopen van klein verbruik aansluitingen met vast nettarief |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden?<br>**Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br><br>**Leg uit:**________________________________________________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Netbeheerder |
| | Activiteiten | ○ Balanceren van het net in samenwerking met PV/BRP<br>○ Onderhouden van de netinfrastructuur<br>○ Beheren van de netcapaciteit & faciliteren van nieuwe netaansluitingen<br>○ Strategische scenario's opstellen die tot doel hebben het netgebruik en de toewijzing van middelen te optimaliseren in de context van beperkte netcapaciteit. |
| | Links | Nationale overheid, lokale overheid en CPO |
| | Positie | Zie ecosysteem visie 1 |

**Visie 1, CPO**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Vaste vergoeding per kWh te ontvangen van SCSP** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br><br>**Leg uit:**________________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | CPO |
| | Activiteiten **(nieuw)** | Installeren, beheren en onderhouden van laadpalen. **De laadsessie sturen wordt gedaan door de SCSP, die tevens de risico's draagt van de dynamische stroominkoop.** |
| | Links **(nieuw)** | Netbeheerder, lokale overheid/NAL, backend software provider, MSP, energie leverancier, **en SCSP** |
| | Positie | Zie ecosysteem visie 1 |

**Visie 1, Energieleverancier**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen, flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ Verkopen van kWh<br>○ **SCSP is programma verantwoordelijk/BRP voor energiecontracten met CPO's** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Energieleverancier |
| | Activiteiten | ○ Leveren van elektriciteit, facturering en klantenservice<br>○ Tussenpersoon tussen energieproducenten en eindgebruikers<br>○ Elektriciteit inkopen op groothandelsmarkt<br>○ (Zelf energie opwekken) |
| | Links **(Nieuw)** | CPO, **SCSP** |
| | Positie | Zie ecosysteem visie 1 |

**Visie 1, MSP**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Vaste vergoeding per kWh ongeacht te ontvangen van SCSP** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br><br>**Leg uit:**________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | MSP |
| | Activiteiten (**Nieuw**) | Roaming services aanbieden, betaalmethode faciliteren, laadpas aanbieden, **rijder informatie verzamelen en uitwisselen met SCSP (vertrektijd, state of charge en laadsnelheid). De laadsessie sturen wordt gedaan door de SCSP.** |
| | Links (**Nieuw**) | CPO, backend software provider, EV-rijder en **smart charging service provider (SCSP)** |
| | Positie | Zie ecosysteem visie 1 |

**Visie 1, Backend software leverancier**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ Abonnement structuur voor het leveren van software<br>○ **Vaste vergoeding per kWh geladen voor roaming diensten onafhankelijk van MSP** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Backend software leverancier |
| | Activiteiten | Roaming services aanbieden, software ontwikkelen, monitoren van laadpalen, klantenservice, data analyse en betalingsverwerkingen |
| | Links | MSP en CPO |
| | Positie | Zie ecosysteem visie 1 |

**Visie 1, EV rijder**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Dynamische laadtarieven voor consumenten en leasemaatschappijen** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Consument |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**_______________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 1<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 1<br><br>**Leg uit:**_______________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | EV rijder |
| | Activiteiten **(nieuw)** | ○ Verstrekken van informatie aan e-rijders, opkomen voor belangen e-rijder, verzamelen van feedback om rekening te houden met hun behoeften<br>○ **User interface via SCSP: (a) delen van prijsinformatie, (b) delen van rijders informatie (vertrektijd, state of charge en laadsnelheid)** |
| | Links **(nieuw)** | MSP en **smart charging service provider** |
| | Positie | Zie ecosysteem visie 1 |

**Visie 2, Nationale overheid**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie | ○ - |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**_______________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden?<br>**Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**_______________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Nationale overheid |
| | Activiteiten | ○ Optreden als regulator, marktfacilitator en beschermer van het algemeen belang in energiemarkten, het elektriciteitsnet en laadinfrastructuur om aan de basisbehoeften van burgers te voldoen.<br>○ Klimaat doelen nastreven |
| | Links | De netbeheerder en lokale overheid |
| | Positie | Zie ecosysteem visie 2 |

**Visie 2, Lokale overheid**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen, flexibiliteit verkopen |
| | Individuele waarde propositie | ○ - |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**_______________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**_______________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Lokale overheid/NAL |
| | Activiteiten **(nieuw)** | ○ Verbeteren van de laadfaciliteiten om het kip-ei-probleem te doorbreken<br>○ Zorgen voor transparante en betaalbare laadprijzen<br>~~○ Concessies in de markt zetten~~<br>○ **Data gestuurd locaties aanwijzen voor nieuwe laadpalen** |
| | Links **(nieuw)** | Nationale overheid, netbeheerder en ~~CPO~~ |
| | Positie | Zie ecosysteem visie 2 |

**Visie 2, Netbeheerder**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ~~○ Verkopen van klein verbruik aansluitingen met vast nettarief~~<br>○ **Ontvangt vast bedrag met geladen kWh bij de laadpaal** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden?<br>**Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Netbeheerder / CPO |
| | Activiteiten **(nieuw)** | ○ Balanceren van het net in samenwerking met PV/BRP<br>○ Onderhouden van de netinfrastructuur + **plaatsen laadpalen (via aannemers van CPO)**<br>○ Beheren van de netcapaciteit & faciliteren van nieuwe netaansluitingen<br>○ Strategische scenario's opstellen die tot doel hebben het netgebruik en de toewijzing van middelen te optimaliseren in de context van beperkte netcapaciteit. |
| | Links | Nationale overheid, lokale overheid |

**Visie 2, CPO**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Bestaande laadpalen worden overgenomen door netbeheerder**<br>○ **CPO als geïntegreerd departement in een netbeheerder; laadpalen als publieke voorziening gefinancierd vanuit de netbeheerder** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol **(nieuw)** | **Facilitator** |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | CPO |
| | Activiteiten | Installeren, beheren en onderhouden van laadpalen. |
| | Links | Netbeheerder, lokale overheid/NAL, backend software provider, MSP, energie leverancier |
| | Positie | Zie ecosysteem visie 2 |

**Visie 2, Energieleverancier**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen, flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ Verkopen van kWh<br>○ **MSP is programma verantwoordelijk/BRP voor energiecontracten met laadpaal** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Energieleverancier |
| | Activiteiten | ○ Leveren van elektriciteit, facturering en klantenservice<br>○ Tussenpersoon tussen energieproducenten en eindgebruikers<br>○ Elektriciteit inkopen op groothandelsmarkt<br>○ (Zelf energie opwekken) |
| | Links **(Nieuw)** | **Netbeheerder, MSP** |
| | Positie | Zie ecosysteem visie 2 |

**Visie 2, MSP**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | o Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | o **Inkoop: Vast tarief aan netbeheerder/CPO voor gebruik laadpaal per geladen kWh**<br>o **Inkoop: Dynamisch stroom inkopen**<br>o **Inkomsten: Verhandelen van flexibiliteit + flexibele marge op laadtarief** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**______________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**______________________________ |
| | | |
| **Ecosysteem structuur** | Actors | MSP |
| | Activiteiten (**Nieuw**) | o Roaming services aanbieden, betaalmethode faciliteren, laadpas aanbieden,<br>o **User interface ontwikkelen voor (a) prijstransparantie, (b) rijder informatie ophalen (vertrektijd, state of charge en laadsnelheid).**<br>o **De laadsessie aansturen + programma verantwoordelijke/BRP** |
| | Links (**Nieuw**) | CPO, backend software provider en EV-rijder |

**Visie 2, Backend software leverancier**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ Abonnement structuur voor het leveren van software<br>○ **Vaste vergoeding per kWh geladen voor roaming diensten onafhankelijk van MSP** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden?<br>**Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Backend software leverancier |
| | Activiteiten | Roaming services aanbieden, software ontwikkelen, monitoren van laadpalen, klantenservice, data analyse en betalingsverwerkingen |
| | Links | MSP en CPO |
| | Positie | Zie ecosysteem visie 2 |

**Visie 2, EV-rijder**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Dynamische laadtarieven voor consumenten en leasemaatschappijen** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Consument |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**______________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 2<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 2<br><br>**Leg uit:**______________________________ |
| | | |
| **Ecosysteem structuur** | Actors | EV rijder |
| | Activiteiten **(nieuw)** | ○ Verstrekken van informatie aan e-rijders, opkomen voor belangen e-rijder, verzamelen van feedback om rekening te houden met hun behoeften<br>○ **User interface via MSP: (a) delen van prijsinformatie, (b) delen van rijders informatie (vertrektijd, state of charge en laadsnelheid)** |
| | Links | MSP |
| | Positie | Zie ecosysteem visie 2 |

**Visie 3, Nationale overheid**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie | ○ - |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**______________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie<br><br>**Leg uit:**______________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Nationale overheid |
| | Activiteiten | ○ Optreden als regulator, marktfacilitator en beschermer van het algemeen belang in energiemarkten, het elektriciteitsnet en laadinfrastructuur om aan de basisbehoeften van burgers te voldoen.<br>○ Klimaat doelen nastreven |
| | Links | De netbeheerder en lokale overheid |
| | Positie | Zie ecosysteem visie 3 |

**Visie 3, Lokale overheid**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen, flexibiliteit verkopen |
| | Individuele waarde propositie | ○ - |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden?<br>**Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 3<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Lokale overheid/NAL |
| | Activiteiten **(nieuw)** | ○ Verbeteren van de laadfaciliteiten om het kip-ei-probleem te doorbreken<br>○ Zorgen voor transparante en betaalbare laadprijzen<br>○ Concessies in de markt zetten, **nieuwe concessie voorwaarde: dynamische laadtarieven** |
| | Links | Nationale overheid, netbeheerder en CPO |
| | Positie | Zie ecosysteem visie 3 |

**Visie 3, Netbeheerder**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie | ○ Verkopen van klein verbruik aansluitingen met vast nettarief |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Facilitator |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden?<br>**Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 3<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Netbeheerder |
| | Activiteiten | ○ Balanceren van het net in samenwerking met PV/BRP<br>○ Onderhouden van de netinfrastructuur<br>○ Beheren van de netcapaciteit & faciliteren van nieuwe netaansluitingen<br>○ Strategische scenario's opstellen die tot doel hebben het netgebruik en de toewijzing van middelen te optimaliseren in de context van beperkte netcapaciteit. |
| | Links | Nationale overheid, lokale overheid en CPO |
| | Positie | Zie ecosysteem visie 3 |

**Visie 3, CPO**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Vaste vergoeding per kWh te ontvangen van MSP** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 3<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | CPO |
| | Activiteiten **(nieuw)** | Installeren, beheren en onderhouden van laadpalen. **De laadsessie sturen wordt gedaan door de MSP, die tevens de risico's draagt van de dynamische stroominkoop.** |
| | Links **(nieuw)** | Netbeheerder, lokale overheid/NAL, backend software provider, MSP en energie leverancier |
| | Positie | Zie ecosysteem visie 3 |

**Visie 3, Energieleverancier**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | o Statisch nettarief, dynamisch energie prijzen, flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | o Verkopen van kWh<br>o **MSP is programma verantwoordelijk/BRP voor energiecontracten met CPO's** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 3<br><br>**Leg uit:**________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Energieleverancier |
| | Activiteiten | o Leveren van elektriciteit, facturering en klantenservice<br>o Tussenpersoon tussen energieproducenten en eindgebruikers<br>o Elektriciteit inkopen op groothandelsmarkt<br>o (Zelf energie opwekken) |
| | Links **(Nieuw)** | CPO, **MSP** |
| | Positie | Zie ecosysteem visie 3 |

**Visie 3, MSP**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Inkoop: Vast tarief CPO voor gebruik laadpaal per geladen kWh**<br>○ **Inkoop: Dynamisch stroom inkopen**<br>○ **Inkomsten: Verhandelen van flexibiliteit + flexibele marge op laadtarief** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**______________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 3<br><br>**Leg uit:**______________________________ |
| | | |
| **Ecosysteem structuur** | Actors | MSP |
| | Activiteiten (**Nieuw**) | ○ Roaming services aanbieden, betaalmethode faciliteren, laad pas aanbieden<br>○ **User interface ontwikkelen voor (a) prijstransparantie, (b) rijder informatie ophalen (vertrektijd, state of charge en laadsnelheid).**<br>○ **De laadsessie aansturen + programma verantwoordelijke/BRP** |
| | Links (**Nieuw**) | CPO, backend software provider, EV-rijder en **energieleverancier** |

**Visie 3, Backend software leverancier**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ Abonnement structuur voor het leveren van software<br>○ **Vaste vergoeding per kWh geladen voor roaming diensten onafhankelijk van MSP** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Industrie |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**______________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 3<br><br>**Leg uit:**______________________________ |
| | | |
| **Ecosysteem structuur** | Actors | Backend software leverancier |
| | Activiteiten | Roaming services aanbieden, software ontwikkelen, monitoren van laadpalen, klantenservice, data analyse en betalingsverwerkingen |
| | Links | MSP en CPO |
| | Positie | Zie ecosysteem visie 3 |

**Visie 3, EV-rijder**

| | | |
|---|---|---|
| **Ecosysteem visie** | Gedeelde waarde propositie | ○ Statisch nettarief, dynamisch energie prijzen en flexibiliteit verkopen |
| | Individuele waarde propositie **(nieuw)** | ○ **Dynamische laadtarieven voor consumenten en leasemaatschappijen** |
| | Uitganspunten | • Meer EV's<br>• Hernieuwbare energiebronnen integreren; $CO_2$ uitstoot reduceren<br>• Stabiel, betrouwbaar elektriciteitsnet (Laadzekerheid)<br>• Laadzekerheid = EV vol op moment van vertrek<br>• Gelijkwaardige behandelen publiek vs privé laden<br>• Slim laden software is beschikbaar |
| | | |
| **Ecosysteem strategie** | Rol | Consument |
| | Uitvoeringsrisico's | Zijn er praktische of uitvoerings-gerelateerde obstakels die u ervan weerhouden om uw rol en bijbehorende activiteiten voor slim opladen te vervullen?<br><br>**Leg uit:**____________________________________________ |
| | Adoptie risico's | Hoe bereid bent u of zijn uw partners om inspanningen te leveren op het vlak van slim laden? **Omcirkel de kleur.**<br>- Groen: Ik zie duidelijke meerwaarde en wil graag deelnemen aan visie 3<br>- Geel: Neutraal, maar open voor beïnvloeding<br>- Rood: duidelijke redenen om de voorkeur te geven aan de status quo; liever geen deelname aan visie 3<br><br>**Leg uit:**____________________________________________ |
| | | |
| **Ecosysteem structuur** | Actors | EV rijder |
| | Activiteiten **(nieuw)** | ○ Verstrekken van informatie aan e-rijders, opkomen voor belangen e-rijder, verzamelen van feedback om rekening te houden met hun behoeften<br>○ **User interface via MSP: (a) delen van prijsinformatie, (b) delen van rijders informatie (vertrektijd, state of charge en laadsnelheid)** |
| | Links | MSP |
| | Positie | Zie ecosysteem visie 3 |

## Appendix C: Overview deductive theoretical concepts

| Theory | Theorectical concept | Sub-concept | Sub-category |
|---|---|---|---|
| **Ecosystem-as-structure** | **a) Ecosystem structure** | Actors | |
| | | Activities | |
| | | Links | Technological interdependencies |
| | | | Economic interdependencies |
| | | | Cognitive interdependencies |
| | | Positions | |
| | **b) Ecosystem risks** | Execution (internal) | |
| | | Co-innovation (external) | Green Light |
| | | | Yellow Light |
| | | | Red Light |
| | | Adoption chain (external) | Green Light |
| | | | Yellow Light |
| | | | Red Light |
| | **c) Ecosystem vision** | Value proposition | Individual value proposition |
| | | | Shared value proposition |
| | | Expectations | |

**Appendix D: Informed consent and ethical statement**

## INFORMED CONSENT FORM (INTERVIEW)

In this study we want to learn about smart charging. Participation in this interview is voluntary and you can quit the interview at any time without giving a reason and without penalty. Your answers to the questions will be shared with the research team. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act). Please respond to the questions honestly and feel free to say or write anything you like.

Everything you say or write will be confidential, and anonymous (pseudonymised). This means that we do not ask for your name, and no one will know which respondent said what.

I confirm that:

- I am satisfied with the received information about the research;
- I have no further questions about the research at this moment;
- I had the opportunity to think carefully about participating in the study;
- I will give an honest answer to the questions asked.

I agree that:

- the data to be collected will be obtained and stored for scientific purposes;
- the collected, completely anonymous, research data can be shared and re-used by scientists to answer other research questions;

I understand that:

- I have the right to see the research report afterwards.

**Do you agree to participate?** o Yes  o No

## INFORMATION SHEET (INTERVIEW)

### INTRODUCTION

You are invited to take part in this study on smart charging. The purpose of the study is to learn about the smart charging ecosystem. The study is conducted by Daan Pelgrim, a student in the Msc programme Sustainable Business and Innovation at the Department of Sustainable Development, Utrecht University. The study is supervised by Peter Mulder.

### PARTICIPATION

Your participation in this interview is completely voluntary. You can quit at any time without providing any reason and without any penalty. Your contribution to the study is very valuable to us and we greatly appreciate your time taken to complete this interview. We estimate that it will take approximately 60 minutes to complete the interview. The questions will be read out to you by the interviewer. Some of the questions require little time to complete, while other questions might need more careful consideration. Please feel free to skip questions you do not feel comfortable answering. You can also ask the interviewer to clarify or explain questions you find unclear before providing an answer. Your answers will be noted by the interviewer in an answer template. The data you provide will be used for writing a Master thesis report and may be used for other scientific purposes such as a publication in a scientific journal or presentation at academic conferences. Only patterns in the data will be reported through these outlets. Your individual responses will not be presented or published.

## DATA PROTECTION

The interview is also audio taped for transcription purposes. The audio recordings will be available to the Master student and academic supervisors. We will process your data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

In case audio recordings will not be deleted: Audio recordings will only be stored on a secured and encrypted server of Utrecht University

Everything you say in this interview will be confidential and completely anonymous (pseudonymised). This means that we will not ask for your name, date of birth, or other personal information that can be traced to you by us or a third party. We will process your data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act)