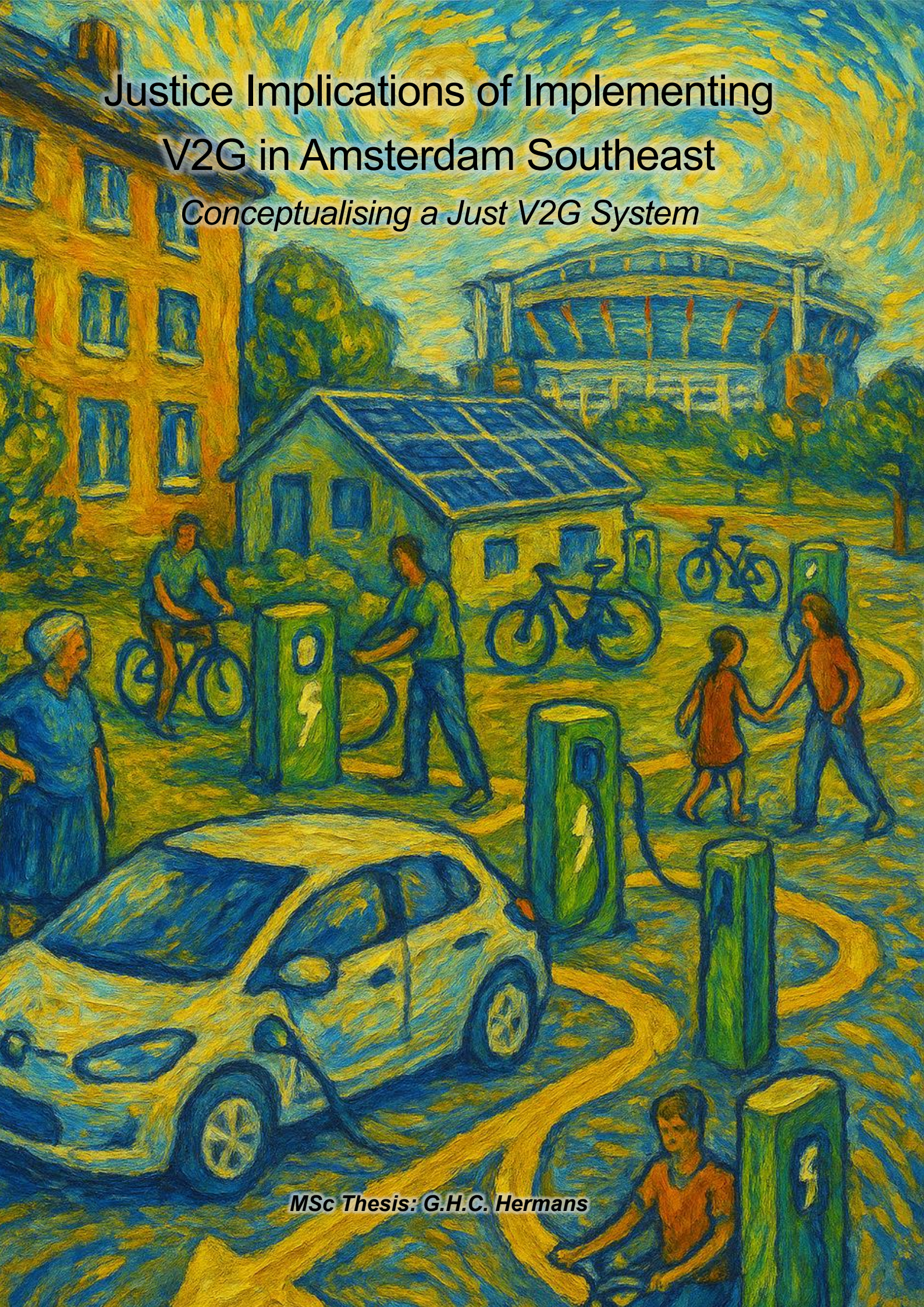
Justice Implications of Implementing V2G in Amsterdam Southeast

Conceptualising a Just V2G System



MSc Thesis: G.H.C. Hermans

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Preface

This thesis marks the end of my academic journey. A period full of challenges, but above all a period where I learned a great deal about the academic domains I studied and about myself. When I arrived at TU Delft for my BSc in Civil Engineering, I had one major goal: working on things that people can touch and make impact to everyday life. Along the way that goal remained, but my understanding of what truly makes impact deepened during my MSc 'Metropolitan Analysis, Design & Engineering' at the AMS institute. It is not about what we build, but how, for whom, and why are also important factors for long term impact. This perspective is embedded throughout this research.

Conducting this research sharpened my view on energy and mobility systems not just as something technical, but as something that is intertwined in complex social systems. Tracing literature, talking to stakeholders active in ASE, and diving into justice theory forced me to put data next to lived experience. This thesis really broadened my understanding of the energy and mobility sector and leaves me with a more critical perspective on technological transitions.

Therefore, I want to express my sincere appreciation to my supervisors from TU Delft, Dr. Jan Anne Annema and Dr. Thomas Verbeek. They encouraged me to work step-by-step to see if my ambitious planning was achievable. Keeping me on track with specific and honest feedback gave me a lot of confidence. Their feedback and expertise were invaluable for this thesis and improved the work overall significantly.

Furthermore, my internship at the Johan Cruijff ArenA was very much enjoyable. I want to sincerely thank my supervisors Ydze Rijff and Huib Pasman for their help, involving me in the deployment of a real-life V2G pilot, and providing me with their knowledge and JCA's extensive network. I had a great time writing my thesis in the stadium thanks to nice colleagues and guidance.

Last but not least, I would like to thank my family, girlfriend, roommates and all friends that supported me massively: drinking coffee, sitting on the balcony, and talking with me about my thesis too often. They helped me greatly to put things in perspective and take it easy sometimes.

Gilles Hermans - Amsterdam, July 2025

"Justice is the first virtue of social institutions, as truth is of systems of thought. A theory however elegant and economical must be rejected or revised if it is untrue; likewise, laws and institutions no matter how efficient and well-arranged must be reformed or abolished if they are unjust."

John Rawls's book "A theory of justice" (1971)

Abstract

This thesis explores the justice implications of implementing Vehicle-to-grid (V2G) systems in Amsterdam South-east (ASE). ASE is characterised as a rapidly developing and socioeconomically diverse urban district in Amsterdam, the Netherlands. While V2G is often presented as a technological solution to net congestion and renewable integration, this study argues that its implementation must be critically examined through the lens of social justice. Furthermore, this study emphasises the importance of integrating justice principles into theories for socio-technical transition. Therefore, this study combines the Multi-Level-Perspective on socio-technical transitions with theories on distributive, recognition, and procedural justice in the energy and mobility transition. This helps to conceptualise what a just V2G system could look like over time.

The study is designed as a single-case qualitative analysis. A literature review, stakeholder analysis, and semi-structured interviews reveal justice implications of V2G implementation. The empirical insights are used to develop two contrasting narrative scenarios, a business-as-usual and a just V2G scenario. These scenarios are complemented by user personas to make the justice dynamics tangible and relatable.

The findings of this study highlight that current V2G pathways risk reinforcement of existing injustice through how public infrastructure is allocated and financed, benefit concentration around affluent EV owners, and limited procedural inclusion of vulnerable groups or people with different mobility behaviour. This study conceptualises a just implementation of V2G as a system with a hybrid governance structure: standardisation and technical feasibility combined with decentralised ownership, equitable revenue sharing, and meaningful citizen engagement. Central to this is a multi-stakeholder core, able to balance community, technical, and institutional interests, ensuring that V2G becomes a shared asset. This thesis contributes to current literature on V2G through proposing a framework to assess justice implications of urban socio-technical transitions, in this case V2G. Next to that, the research provides strategies for just deployment of V2G technology for ASE, its stakeholders, and can be applied in similar contexts.

List of Abbreviations

Abbreviation	Meaning
ASE	Amsterdam Southeast
BAU	Business-As-Usual
CBS	Centraal Bureau voor de Statistiek (Statistics agency Netherlands)
DSO	Distribution System Operator
EV	Electric Vehicle
GIS	Geographic Information System
JCA	Johan Cruijff ArenA
KPI	Key Performance Indicator
MLP	Multi-Level-Perspective
NGO	Non-Governmental Organisation
TSO	Transmission System Operator
TU Delft	Delft University of Technology
V2B	Vehicle-to-Building
V2G	Vehicle-to-Grid
V2H	Vehicle-to-Home
V2X	Vehicle-to-Everything
WUR	Wageningen University & Research

List of Figures

List of Tables

Table of Contents

Chapter 1: Introduction

1.1 Context

Worldwide, the energy and mobility sectors are under pressure to decarbonise. Electricity demand is rising as heating, industry, and transport are electrifying rapidly. At the same time, national grids struggle with congestion and reliability as peak loads grow faster than network reinforcements can be built. Policy frameworks in the EU such as the 'Fit-for-55' package explicitly links emissions cuts to a more flexible and smarter electricity system (European Commision, 2019). In this context, stationary batteries and electric vehicles (EVs) are increasingly seen as energy assets that are distributed and can function as a buffer for renewable fluctuations and to stabilise the grid. This underscores the connectedness of systems such as the energy and mobility system, to achieve future climate goals.

Moreover, this convergence shows that electrification of mobility can no longer be seen separately from the energy system, but as a central component. The two systems, energy and mobility are becoming increasingly interdependent, while their integration is essential in reaching climate goals. EVs became increasingly popular in recent decades. Vehicle-to-grid (V2G) technology, bidirectional charging that lets parked EVs deliver power back into the grid, can offer a flexible buffer that can simultaneously smooth peaks and create new revenue streams. Thus, V2G has enabled EVs to play the role of moveable power source to support the power grid (Hu et al., 2016; Qin et al., 2020). Ravi & Aziz (2022) states, that next to offering sustainable mobility solutions, EVs can now be seen as energy assets that provide valuable services. Despite the technical promises, the deployment of V2G systems is highly dependent on contextual factors like user participation, infrastructure readiness, and regulatory frameworks (Sovacool et al., 2018).

The Netherlands reflects these trends. The Dutch Climate Act mandates a 55% reduction in greenhouse gasses by 2030. Transport electrification plays a key role in this. National projections indicate that the EV fleet will triple in size by 2030 (Tezel & Hensgens, 2024). However, this rapid electrification also clashes with an electricity network that is already under strain. Grid operators have declared capacity shortages in several provinces of the country already, resulting in connection restrictions for residents and businesses (Liander, 2025). These structural bottlenecks reinforce the search for more flexible alternatives, such as V2G.

These broader transitions converge spatially in Amsterdam Southeast (ASE), depicted as one of the fastest growing, and most diverse districts in the city. Up until 2040, the plan is to develop 51.000 housing units and approximately 33.000 working places in ASE. With these projected numbers the population will double in the area. This goes hand in hand with a strong increase in mobility and energy. To make sure the accessibility and liveability of the area are balanced and well maintained, an integral development plan is needed (Municipality of Amsterdam, 2021a).

Furthermore, the municipality wants to join forces with residents, businesses, and public organisations to create an economically strong and sustainable ASE. ASE has the goal to become climate neutral in 2040, where the development of ASE provides opportunities where sustainability goals go simultaneously with establishing a socially just energy transition, and improving the liveability of the area (Gemeente Amsterdam, 2024).

Because of the increase in supply and demand of energy in the future, the energy network needs to be strengthened. Especially during peak moments of use and supply, the stability and reliability of the network is at stake. Therefore, buffers need to be established to facilitate the future energy supply and demand, this in addition to network expansion by grid operators (Gemeente Amsterdam, 2024). However, the financial and spatial burdens of those grid upgrades will not be experienced equally across households and businesses. Fairly distributing the resource of network capacity now becomes embedded in justice and equity questions (de Winkel et al., 2025).

The electricity demand for Amsterdam in 2050 will be three to four times higher than nowadays, which became clear from scenario studies (Gemeente Amsterdam & Liander, 2019, 2021). This also applies to ASE, where the amount of people and offices rapidly grow. Sustainability movements play a significant role in this, with EVs, heat pumps, and an increase in solar and wind energy. However, the biggest impact is made by factors such as datacentres, economic development, and real estate development (Gemeente Amsterdam et al., 2022). This is not a challenge for 2050, it is happening already. In areas that face congestion, there are already restrictions for new residents or companies to connect to the grid.

To add to that, municipal mobility plans for ASE state that the area faces a significant growth in car usage in the future (Chantal Inia et al., 2021). Without additional measures beyond current urban policies, projections show that car usage will increase by 31% in 2040 compared to 2020. The significant development of the EV market presents a potential for creating a cleaner and transformative new energy carrier. For these reasons, V2G is projected to play an important role in reducing the impact of renewable energy and aerial development projects on the local energy grid (Dik et al., 2022).

Taken together, ASE's projected growth, the strain that is already present on the electricity grid, and the emergence of V2G as a potential buffer exposes a clear opportunity with some essential gaps still to be addressed. The question is not merely whether V2G can alleviate congestion, but whether it will be a system where everyone benefits from, and a system that does not clash with the goal of achieving a just energy transition in ASE. Accordingly, the following problem statement emphasises the need for assessing justice when rolling out a V2G system in ASE.

1.2 Problem Statement

As discussed before, ASE is rapidly expanding, with 51,000 new homes and 33,000 workplaces planned by 2040, doubling the population, and increasing energy demand and car usage by 31% (Municipality of Amsterdam, 2021a). By 2050, electricity demand is expected to triple or quadruple, putting strain on an already congested grid (Obrecht et al., 2020; Sovacool et al., 2019a). V2G technology presents a solution by turning EVs into mobile energy storage units, supporting grid stability while reducing reliance on fossil fuels (Hu et al., 2016; Ravi & Aziz, 2022).

However, the potential impact of V2G extends beyond technical and economic feasibility. It significantly relies on its wider societal impact, which remains underexamined (Sovacool et al., 2018). While V2G has the potential to increase energy resilience, support the renewable energy transition, and optimize urban mobility, questions like who participates, who benefits, and who is excluded remain (Sovacool et al., 2018). To add to that, in the changing environment of increasing consumer power on sustainable energy, to make it truly sustainable, the social dimension must be integrated (Obrecht et al., 2020). A sociotechnical approach on what V2G can mean for society, to make sure V2G systems do not exacerbate existing injustices, is needed (Noel et al., 2019).

Assessing the justice implications of V2G is particularly urgent in a diverse urban area like ASE. The area awaits rapid development, has high rates of social housing, and is marked as car oriented, with residents, commuters and event- and leisure visitors coming to the area. All these characteristics co-exist with ongoing energy and mobility transitions in the area (Gemeente Amsterdam, 2024). As the implementation of V2G gets more attention, also in ASE, it is essential to examine how the technology can be implemented not only efficiently but also in a socially just way. This thesis addresses that gap by exploring how V2G can support a socially just energy- and mobility system in ASE.

In conclusion, the pressing matter of grid congestion, the rollout of V2G as a flexible buffer, and justice concerns leave a clear knowledge gap. The next section therefore explains why closing that gap advances energy justice scholarship and support Amsterdam's ambitions towards a just energy transition in ASE.

1.3 Research Aim

This research aims to conceptualise how V2G systems can be deployed in ASE, in a way that not only looks at the technical and economic feasibility, but a system that is also socially just and supportive of broader liveability and development goals in the area. The study focuses on the use phase of V2G, where questions of participation, access, and benefit distribution become tangible. Through an analysis of stakeholder perspectives, the study aims to identify enablers and barriers for inclusive V2G implementation.

The ultimate objective is to envision a V2G system that contributes to true sustainability, better liveability, and a more equitable system that complies with different mobility behaviour. This corresponds with the municipal plans for ASE, to increase liveability, stimulate alternatives for car usage, and to make space for other functions in the area (Chantal Inia et al., 2021). This includes enabling participation beyond EV-owners and aligning V2G with energy and mobility futures that prioritise shared infrastructure, collectivity, and the reallocation of space for public amenities.

To achieve this, the study will make use of narrative scenarios and persona-based methods, to investigate how different users perceive the system, and what roles different actors play, and what interventions can enhance a just and inclusive implementation of V2G in ASE. The goal is to describe this technical complex system in a way that make the results accessible for everyone. Accordingly, the research is guided by the research questions in the next section.

1.4 Research Questions

To determine how V2G can alleviate grid pressures and safeguard justice, this research poses the following research questions:

Main Research Question:

What are the justice implications of implementing V2G in Amsterdam Southeast, and how can a just V2G system be conceptualised?

Sub-Research Questions:

1) *What are the key justice implications identified in literature for V2G systems?*
2) *How are distributive, procedural, and recognition justice concerns observed in the context of ASE, and how do different stakeholders perceive a just system?*
3) *What future scenarios for ASE can be envisioned that follow from the identified justice implications?*
4) *How do different stakeholders interact with a just V2G system, and which strategies can make this happen?*

By answering these questions, the study will produce practical information and different user roles in a future system that can guide the deployment of V2G technology in ASE, and safeguard inclusion and equity in V2G's potential.

1.5 Academic Relevance

Research on V2G technology has largely focused on technical feasibility, grid stability, and economic benefits, often overlooking social, behavioural, and equity-related challenges (Sovacool et al., 2018; Veza et al., 2024). Current studies do not sufficiently incorporate how socio-economic status, infrastructure accessibility, and urban mobility behaviours influence V2G adoption (Campos et al., 2024). This is particularly the case in diverse metropolitan areas like ASE. There is a need for socio-technical research that examines how to conceptualise an inclusive form of transition, and questions like; 'who wins, who loses, how and why' could be considered in this research (Moss et al., 2015; Newell & Mulvaney, 2013).

Additionally, energy justice concerns related to V2G remain insufficiently studied. Sovacool et al. (2019a) argue that subsidies and infrastructure investments in electric mobility often benefit wealthier consumers, while lower-income groups face barriers to participation. Without targeted interventions, V2G risks reinforcing existing inequalities in access to energy savings and mobility benefits. The role and agency of non-users is another understudied topic in sustainability transitions and should be included, alongside the role of users (Kahma & Matschoss, 2017; Schot, 2016). When shaping a sustainable transition, marginalised groups, such as non-users, non-dominant, and non-state-based actors, should get the attention that they deserve (Seyfang & Smith, 2007).

By bridging the technical and social dimensions of V2G, this research aligns with calls for a more holistic, interdisciplinary approach to energy transitions, and especially V2G technology (Sovacool et al., 2018).

1.6 Societal Relevance

V2G has the potential to improve energy resilience, support renewable integration, and optimize urban mobility, but its benefits are not equitably distributed (Sovacool et al., 2018). Lower-income communities, renters, and users of public/shared mobility often lack access to charging infrastructure and financial incentives, limiting their ability to participate in and benefit from V2G (Chabot & Liebovitz, 2025). If these barriers are not addressed, V2G could exacerbate spatial, mobility, and energy injustices, particularly in a diverse urban area like Amsterdam Southeast.

This research examines how different potential user groups (residents, commuters, visitors) engage with V2G and whether implementation of V2G has justice implications. Addressing these challenges is crucial to ensure that V2G supports public and shared, energy and mobility solutions, rather than reinforcing exclusionary patterns in urban energy transitions (Sovacool et al., 2019a).

Commissioned by the Johan Cruijff ArenA (JCA), this research uses institutional support to promote a community centred strategy in Amsterdam Southeast. Capturing the perspectives of different groups in the area, the study will enhance strategy combined with direct experience from the field. This study grounds the commitment of the area and the JCA, that technology like V2G aligns with broader societal goals, and facilitates a just transition.

1.7 Structure of the Thesis

This thesis is structured as follows: Chapter 2 presents the theoretical framework, where the conceptual framework consists of a combination of socio-technical transition theory and justice theories. Chapter 3 outlines the methodology, including the research design, data-collection, and data-analysis methods. Chapter 4 provides the empirical results, based on literature, interviews, spatial data, and stakeholder analysis. Chapter 5 discusses these findings using the theoretical concepts from chapter 2 and broader literature. The chapter also gives actor roles for a just V2G system together with policy recommendations. Finally, Chapter 6 gives the conclusion.

Chapter 2: Theoretical Framework

The widespread adoption of new technologies such as V2G and EVs will require the technologies to be accepted, understood, and to be of value to vehicle owners, service providers in the electricity-transport system, and society more broadly (Jones et al., 2021). There are various frameworks that assist in understanding technology adoption and wider socio-technical change (Sovacool & Hess, 2017).

When looking at V2G implementation in Amsterdam South-East, this study uses an integrated theoretical framework, that connects socio-technical transition theories with normative perspectives on strong sustainability and justice. At the base of this framework, Multi-Level-Perspective (MLP) (Geels, 2002), is used, which specifies how an innovation like V2G emerges at niche level, interact with and possibly disrupt established mobility and energy systems, and are ultimately influenced by landscape pressures like climate change and socio-economic factors. The MLP enables to capture the debatable dynamics of established systems, either resist or adjust to radical innovations, in addition to the technical and institutional aspects of transition.

Furthermore, given the need for transitions that are not only technically viable, but also include strong sustainability and justice principles, the framework also includes theories of strong sustainability and various justice perspectives. The concept of strong sustainability highlight that environmental, economic, and social dimensions are non-substitutable. It emphasises the importance of ecological limits while progressing social well-being (Grossmann et al., 2022a). In parallel, justice frameworks are applied, which consist of three dimensions of justice, including distributive, procedural and recognition justice (Fraser, 1996; Rawls, 2017).

These three pillars provide normative standards for assessing whether the implementation of V2G promotes equitable benefits- and disadvantages distribution, inclusive decision-making, and the acknowledgment of diverse identities and experiences in society. For applying social justice theory to changes in the energy and mobility system, the concepts of energy justice and mobility justice are used. By integrating these dimensions, the framework presents a critical lens through which we can assess who benefits or loses in a future transition, but also how institutional practices, and systemic power relations either exacerbate or help mitigate urban justice concerns.

2.1 The Multi-Level-Perspective (MLP)

The MLP (Geels, 2002)is a widely used framework to study systemic changes and contestations as innovations become part of the already established socio-technical system. The MLP has been positioned as a valuable framework to study sociotechnical transition in the automotive and energy sector (Berkeley et al., 2017; Malinen et al., 2013). A socio-technological transition happens in three distinct levels according to Geels (2002):

1. **The niche level**, where radical innovations like V2G emerge through experimentation and early adoption.
2. **The regime level**, which consists of established system, such as the traditional energy- and mobility system. The established system shape or resist the change, and consists of knowledge, rules, infrastructure, markets, policymakers etc.

3. **The landscape level**, which includes broader environmental, political, and socio-economic pressures that can influence transitions. A good example of pressure that drives radical change like V2G, is climate change.

The MLP framework can be seen in Figure 1, where the interactions between levels is clearly visible. Ultimately these interactions shape a transition over time.

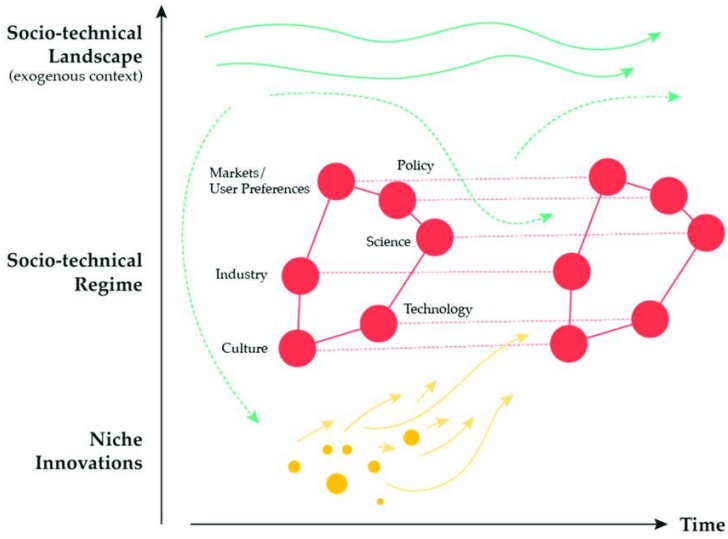

Figure 1. Transition dynamics in the Multi-Level Perspective framework, visual by (Reyes et al., 2020).

In the case of V2G, niche level experiments like pilot projects, and subsidies by governments (landscape level), compete with existing energy and transport systems at regime level. Those favour conventional grid and mobility management. However, the landscape level is currently characterized by more strict climate policies, rising electricity demand, and urban congestion, this creates pressure for system-wide transformation (Geels, 2002; Ryghaug & Skjølsvold, 2023).

In this study, the MLP framework is used to investigate how V2G integrates into existing energy and transportation systems, and to identify the system-level barriers and opportunities that influence just implementation of V2G. The theory can be used to identify the level where specific intervention points are needed after critically assessing the justice implications of V2G during this research. This positions the recommendations that follow from this study in the current system, which makes them easier to tackle, and thus more realistic.

2.2 Sustainability and Justice Frameworks

2.2.1 Theory of Strong Sustainability

The wide variety of conceptualisations of sustainability, are based on various assumptions about what is considered as important. They range from narrow, instrumental, economic views to holistic ethical ideals (Grossmann et al., 2022b). The most common sustainability approach is focused on green capitalism and economic growth, this is also the most adopted approach (Pezzey, 1992). On the other side, environmental sustainability is often focused on the limits to the use of natural resources, the approach mostly prioritises environmental protection according to Asha S. et al. (2023). Finally, the third dimension of sustainability, social sustainability, is the least studied, most underdeveloped, and the most difficult to define (Condie & Cooper, 2015; Eizenberg & Jabareen, 2017). These three dimensions together, one not interchangeable for the

other, are considered strong sustainability. The concept of strong sustainability is adopted as essential in this research. Looking into social justice of the innovation V2G, that appears to enhance economic and environmental sustainability is essential for achieving strong sustainability.

Social sustainability encompasses a broad array of issues ranging from social inclusion and employment to participation in decision-making (Grossmann et al., 2022b). Grossmann et al. (2022b) proposes a paradigm shift from conventional sustainability toward social-ecological justice. This perspective emphasises the urgency to address inequities and normative taboos embedded in socio-technical systems. For instance, challenging the idea that private vehicle use should take priority in urban planning may reveal how infrastructure investments, and lobbying by the automotive industry promote car dependence over more accessible, equitable, and sustainable options like walking, cycling, and public transportation (Verlinghieri & Schwanen, 2020). This framework insists on respecting social sustainability and environmental limits over the pursuit of continuous economic growth.

The above-mentioned justice, equality and equity are in academic discourse often interrelated, yet distinct concepts (Walker et al., 2024). An insightful argument in the domain of inequality is that only justice, rather than equality or equity, can truly address inequality in the long term, because underlying causes are addressed rather than just dealing with outcomes (Heeks, 2021). The definitions of equality, equity, and justice are given in Figure 2 below. These are also the definitions that are adopted in this study when they are discussed.

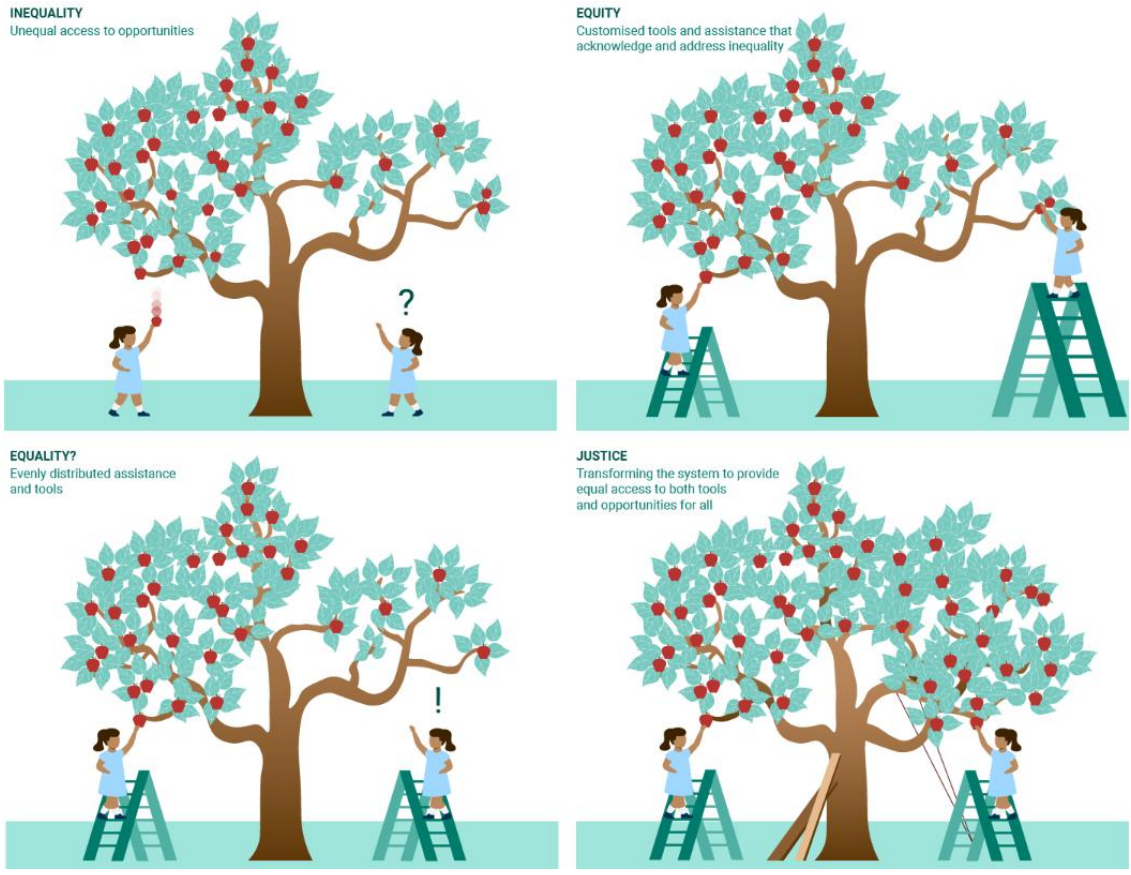

Figure 2. Definitions of (in)equality, equity, and justice (EEA, 2024).

2.2.2 Theories of Justice

Rocco (2023) gives the following definition for social sustainability*:*

"The sustainability in social arrangements, governance and justice"

It again introduces the term justice, which is closely linked with achieving social, and thus strong sustainability. Social justice fundamentally deals with creating a society where equitable access to resources, opportunities, and participation in decision making processes is assured. When discussing how social justice applies in urban spaces we can speak of spatial justice. It clearly highlights the spatial component involved in fair distribution of the burdens and benefits resulting from human coexistence in cities and communities (Rocco, 2023). For this research, the framework of spatial justice is highly relevant since this research addresses a high-density urban area, namely ASE, and as (Fraser, 1996; Rawls, 2017; Rocco & Newton, 2022) describe:

"Spatial Justice is a core dimension of transitions to sustainability, encompassing issues such as climate justice, mobility justice, participation, democracy, access and more."

Furthermore, it provides a valuable framework to guide decision making, to identify (spatial) inequalities, and evaluate policy interventions. Spatial justice is presented in three crucial dimensions that are interdependent and can reinforce each other. The following definitions will be used in this research (Fraser, 1996; Rawls, 2017; Rocco & Newton, 2022):

Distributive justice: refers to the equitable allocation of resources, opportunities, and burdens across society.

Procedural justice: concerned with the fairness and inclusiveness of the decision-making processes that allocate resources and shape policies.

Recognition justice: focuses on the acknowledgement and respect of diverse identities, cultures, and values within society.

Because V2G sits at the intersection of energy services and everyday mobility, the spatial justice framework above can be elaborated with literature about energy- and mobility-justice. These theories define the same dimensions, while giving a more domain-specific explanation of how justice is perceived. This makes the theories complementary as lenses for analysing V2G from a justice perspective.

Energy Justice

The energy transition is a sociotechnical transition, which is a combination of sociotechnical system shifts (Geels & Schot, 2010). Such a transition involves changes along different dimensions; technological, material, organisational, institutional, political, economic and socio-cultural. All this occurs with a wide variety of actors involved. Therefore, social justice is at stake with the energy transition, and we can speak of energy justice which holds the same three pillars.

Energy justice is described by Sovacool & Dworkin (2015) as:

"a global energy system that fairly disseminates both the benefits and costs of energy services, and one that has representative and impartial energy decision-making.".

The distribution of benefits and burdens of energy service can be considered a matter of distributive justice. Distributive justice, in this case, refers to the fair allocation of systemic benefits and burdens among all stakeholders in the system. Decision-making processes can be considered a matter of procedural justice (i.e. having diverse parties included in the decision-making and the process leading up to it). Recognition justice is based on acknowledging the various needs, interests, histories and aspirations of every social group. It focuses on the ongoing marginalisation in society and thus equity.

In this way energy justice can be considered a form of social justice, and in an urban context spatial justice, focussing on energy (services). As distributive, procedural, and recognition justice all need to be considered in the socio-technical transition of energy and thud V2G (Rocco & Newton, 2022).

Mobility Justice

Mobility justice represents an addition to the traditional transport justice frameworks by broadening the analytical lens to include the socially constructed processes of mobility. Traditional approaches solely assess mobility in terms of measurable (quantitative) indicators, such as travel time, distances to opportunities, and route efficiency. Sheller (2018) argues that these metrics fail to comprehensively understand the lived experiences, power dynamics, and socio-cultural dimension, that mostly shape who moves, how, and under what circumstances.

Whereas traditional approaches to transport planning and policy are part of the problem, they tend to increase or stimulate car use according to Grossmann et al. (2022a). The research also confirms that literature on transport justice mostly focuses on distributive justice, rather than ecological impacts of transport. Mobility justice also involves the important and emerging research topic 'transport poverty', which aims to investigate social inequalities in everyday mobility needs. Grossmann et al. (2022a) argues to interlink social and ecological problems and difficulties in mobility, while highlighting the economic and governance underlying both.

From a mobility justice perspective, being able to move is not simply a commodity or service to be optimised, but a complex phenomenon that is interlinked with social structures, environmental sustainability, as well as material infrastructures. By situating mobility within its wider socio-technical and geopolitical contexts, mobility justice challenges the privatised, and individualistic notion of mobility.

Ultimately, using the lens of mobility justice, entails rethinking urban planning and policy making for a just transition. When we acknowledge that mobility is both a technical service, next to a social practice, mobility justice provides us with a lens for a strong sustainable future system.

2.3 Integration of Theories – Conceptual Framework

Using the MLP framework together with the three dimensions of social justice, makes it possible to understand how injustices occur, and can be mitigated during a transition. In this case the implementation of V2G technology. A framework including both theories is needed to critically look at data and develop a conceptual scenario for the future, wherefrom the research question can be answered.

MLP delivers an analytical tool to research systemic transitions from niche- to regime-level, influenced by landscape pressures. In these processes, justice implications are encountered within all three levels of the MLP. Justice implications (negative or positive) can be in the form of pressure from the landscape level. Next to that, justice implications are embedded in the current socio-technical regime and new or already existing in the future regime over time. Finally, justice implications can be found in the niches that break through and shape the future regime. These are however not present in the current MLP framework.

The three dimensions of justice provide a framework to assess and map injustices during sustainable transitions. Looking at the current regime level, which is characterised by established policies, market rules and infrastructure, there will be existing justice implications incorporated. The regime level often reinforces existing power dynamics that can keep inequalities in place (Geels, 2002).

Furthermore, Geels (2002) also states that systemic transitions occur through interaction between the three different levels, thus this interplay also shapes justice outcomes since justice implications appear in each level. In this way new injustices can occur through the landscape and niche level, or existing injustices can be reshaped. Low carbon transitions like V2G and EVs, can create new injustices, while also failing to address already existing injustices in energy markets and the wider socio-economy (Sovacool et al., 2019c).

The results of research on temporalities of injustice by de Looze et al. (2024), conclude that the understanding of justice is timebound and contextual, shaped by historical events, external events, and incremental pressures. The research states that specific events and policy pathways in the past have impacted how we see principles of justice nowadays, and in the future. Conceptualising a just system for the future, therefore, needs the perspectives from multiple levels, and from the past, to be able to account for the pressures and events that shape the perceived justice of the entire system in the future.

Moreover, recent studies further underscore that justice concerns must be incorporated into every tier of the MLP, rather than treated as a separate add-on. Jenkins et al. (2018) argue that the three dimensions of justice surface at every level of the MLP and tend to intensify when any of them is ignored. Their findings justify this conceptual framework and confirm that:

1) the concept of justice can expose (in)justice in niches before they fully develop
2) justice frameworks provide a way for actors to normatively judge regimes
3) framing (in)justice as a landscape pressure can put pressure on the regime below

Integrating justice theory with the MLP is therefore not optional but essential for an equitable V2G transition.

With this conceptual framework a justice lens is provided to critically analyse socio-technical transitions. It shows that justice is a product of cross-level interactions within an entire socio-technical system. Principles of justice are present in the established regime, in the niche innovations that drive transitions, and can be in the form of a pressure from landscape level. A visual describing the conceptual framework can be seen in Figure 3.

Ultimately, this interplay of justice and injustice across levels can lead to the alleviation of some injustices while it can also create new ones. The aim of the conceptual framework is to serve as a strategic map; by locating the justice implications encountered in this research on the hierarchy level of the MLP, and by looking at the interplay between them, it reveals where V2G could intensify injustice, where it possibly alleviates injustices, and where targeted interventions might be needed.

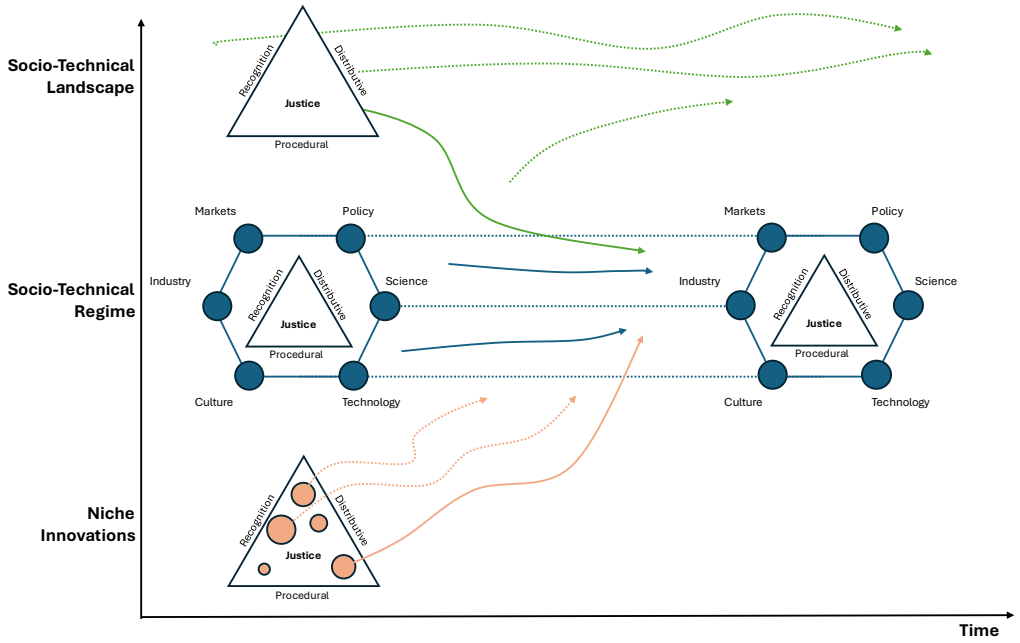

Figure 3. Conceptual Framework, (a set of) justice dimensions is present in each level and their dynamics shape the degree of justice over time. (Made by author, 2025)

Chapter 3: Methodology

In order to find justice implications and conceptualise a just V2G system for ASE, this study used several well-matched methods, these methods were deployed in a single case study. Stakeholder interviews and local data guided the work from theory to future narratives and their personas. This flow is steered by the double diamond method which formed the basis for designing this research.

3.1 Research Design

The research design was structured around a primary area of focus, namely ASE. This single case study in ASE was organised according to the double diamond logic, Discover-Define-Develop-Deliver. The work moved from a broad scan of V2G justice in literature, to context-specific justice analysis in ASE, then to future scenarios and finally personas that made the findings tangible and relatable for stakeholders (Design Council, 2021).

The double-diamond approach was used to tackle two important knowledge gaps in V2G literature and serves the social value of striving for justice in the energy transition. Namely, the first diamond was used to identify key justice implications of V2G implementation. The second diamond was used to conceptualise a just V2G system. A schematic overview of the research design using the double diamond method is visualised in Figure 4.

Phase 1: Concept of V2G and its justice implications from theory (Discover)

In this initial phase, the discovery phase, the emphasis was on establishing a comprehensive understanding of the concept of V2G, and its justice implications that follow from theoretical research. In this phase, a literature review and the general actors for a system where V2G is deployed were identified. This phase was aimed at providing a strong foundation on justice implications and the actors of a V2G ecosystem. This ensured the research is rooted in theory in both technical and social perspectives.

Phase 2: Triangulate justice implications for ASE (Define phase)

In the second phase, distributive, recognition, and procedural justice implications are gathered and assessed for ASE. To start with, a context analysis is done, complemented by a thorough stakeholder analysis, this gave insights in the various stakeholders active in the energy and mobility ecosystem in ASE. After that stakeholders were categorised according to their salience. Based on the stakeholder analysis, interview candidates were selected. Qualitative empirical data was obtained through semi-structured interviews, specifically addressing justice implications and future visions.

Phase 3: Normative narrative scenario development (Develop phase)

In the third phase, the research shifted towards the creation of future scenarios, based on the found justice implications in the earlier phases. Vision-based narrative scenarios were presented in this phase. The goal of this phase is to translate abstract justice implications into tangible and accessible real-life experiences. By providing two contradictory narratives, the aim is to show stakeholders the practical shape those justice principles might take. Furthermore, it puts emphasis on policy and design that can drive change.

Phase 4: Conceptualising a just system (Deliver phase)

In the final phase, the insights from the previous phases were gathered to inform personas. These personas turned the more abstract design of the scenarios into stories people recognise or can challenge. The scenarios describe the scene of a desirable future, while the personas operate as dialogic starters, where stakeholders can interrogate the proposed outcomes against their own experiences. In this way, the research remains an iterative, co-creative design.

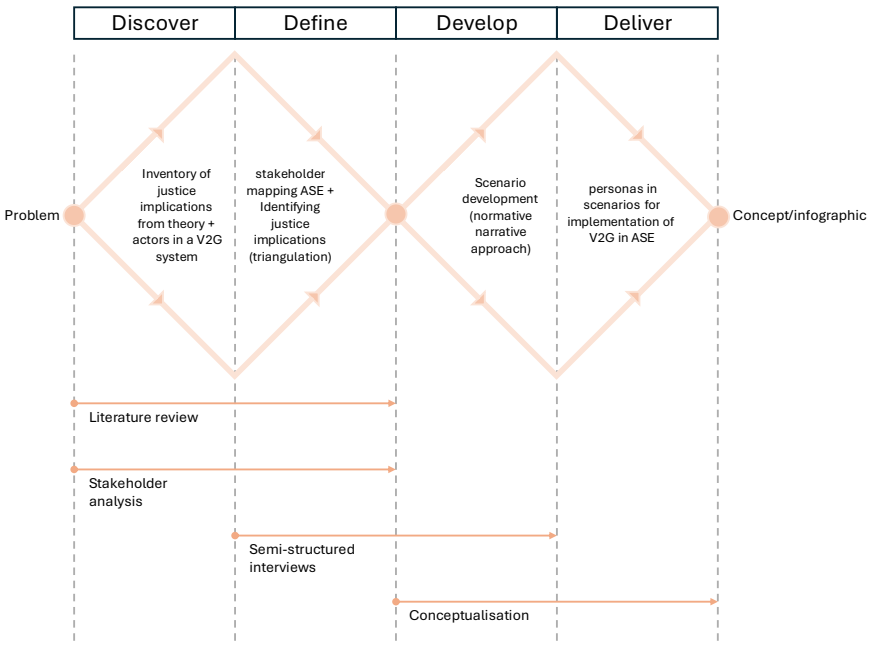

Figure 4. Research design scheme, according to double diamond method by Design Council (2021)

3.2 Data Collection

As qualitative and some supportive spatial quantitative data was collected in this research, the data collection section is split into qualitative and quantitative data. This includes obtaining empirical data, next to secondary data.

3.2.1 Qualitative Data Collection

The qualitative component of the study began with an extensive literature review, with the aim to establish a solid theoretical foundation on V2G technology, its potential advantages, and theoretically identified justice implications. The broader theme related to energy transition and mobility transition, and its justice implications were also considered in the literature review. This review was based on academic research, policy documents, industry reports, municipal plans for Amsterdam and relevant case studies.

For the literature review, a snowball search method (also known as citation chaining) was used. Relevant key papers regarding the topic were first identified using Boolean searches in Scopus and google scholar, Table 1 shows the key papers addressed in this research:

Paper	Authors	Publication Year
Energy Injustice and Nordic Electric Mobility	BK Sovacool, J Kester, L Noel, GZ de Rubens	2019
Realizing and Problematizing a V2G Future	L Noel, GZ de Rubens, J Kester, BK Sovacool	2019
The neglected social dimensions to a vehicle-to-grid (V2G) transition: a critical and systematic review	BK Sovacool, LNoel, J Axsen and W Kempton	2018
Actors, business models, and innovation activity systems for vehicle-to-grid (V2G) technology: A comprehensive review	BK Sovacool, J kester, L Noel, GZ de Rubens	2020
From Cost Savings to Community Benefits: The Equity Potential of V2G Solutions	A Chabot, L Liebovitz	2025

Table 1. Key literature for literature review (Made by author, 2025)

Boolean strings such as: *("vehicle-to-grid" OR V2G OR V2X) AND ("energy justice" OR "mobility justice")*, *("vehicle-to-grid" OR V2G OR V2X) AND actors*, provided the key papers, from where the citation chaining began. The references these authors used, were used to find further relevant information for this research. This method is called backward snowballing, which results in older papers related to the topic of interest. Looking at papers where the key papers are “cited by” is forward snowballing and will generate more recent papers of potential interest (TU Delft, n.d.). EU and Dutch policy files (AFIR, Dutch Climate Agreement) and municipal plans for Amsterdam and ASE, were collected separately to ground the case context.

Furthermore, actors in a general V2G system, identified during the desk research were collected. After applying the stakeholder salience model by Mitchell et al. (1997), assigning the attributes power, legitimacy, and urgency to each actor, this list of actors served as a basis for the interviews. This framework informed the selection of interview participants by identifying which stakeholders are most likely to influence, be affected by, or represent concerns within the system. The final interview sample reflects this spread in salience.

Next, semi-structured interviews were held, with key stakeholders identified by a thorough stakeholder analysis. Interview questions were designed to provide a deeper understanding of decision-making processes, dynamics between actors, and identifying barriers and opportunities for just implementation of V2G. The questions to collect the necessary information were structured along the three dimensions of justice as noted in the theoretical framework. The interviews concluded with the interviewee giving an impression of a just V2G system. When an interviewee was not familiar with the dimensions of justice, further explanation was given. All actors were active in the field of energy and at least had some understanding of V2G prior to the interview, if they required more information, explanation could be provided. For if the dimension of justice were not directly addressed, the interviewer could use prompt-style questions to steer the conversation. For a full protocol of the interviews conducted, see Appendix A.

Moreover, a combination of deductive and inductive coding was used. This approach made sure to maintain a level of structure for data collection, based on the previous work in the literature review and research questions, while still allowing for flexibility in gathering the insights. In all interviews enough space was provided for respondents to give additional insights and comments. In total 8 interviews were conducted, all in Dutch, with participants from each main actor group as defined by the stakeholder analysis. They were all approached through professional networks. Before starting the formal interview, consent for recording and use of data for research was given by all interviewees. Interviews were transcribed, anonymised and coded using the software programme Atlas.Ti, through a license for the program provided by TU Delft. A full overview of the interview respondents can be found in Table 2, matched with their description which shows their relevance for this research.

Actor group	Respondent	Description
Policy and governance bodies	R1	Project employee charging infrastructure
	R2	Senior advisor energy and circular development
Citizens and end users	R3	PHD student working on establishing a local energy cooperation in ASE, closely working with residents
Energy system actors	R4	Data driven energy consultant, (was) active in multiple V2G pilots
Advocacy, researchers and intermediaries	R5	Professor with extensive research on V2G, advocate for including the social perspective
	R6	PHD student with extensive research on justice in ASE
Commercial and market players	R7	Innovation officer local business
	R8	New business and mobility manager from automotive

Table 2. List of interview respondents with corresponding description (Made by author, 2025)

3.2.2 Quantitative Data Collection

To examine the distribution of charging infrastructure and relevant socioeconomic indicators that influence justice (e.g. demographics, EV ownership, and energy demand) throughout ASE. Data was gathered from national statistical agencies (such as CBS data) and municipal open data portals. This quantitative data fulfilled a supportive role in this research, meaning that it is used to provide context for the case study enhanced with visuals by using the online Geographic information system (GIS) ArcGIS pro. By complementing this context with data, it provided a more complete understanding for the reader. The quantitative data is mainly used to support, enrich and nuance what was found analysing qualitative data, where the research is mainly characterised by qualitative research.

3.3 Data Analysis and Synthesis

In the analysis phase, a comprehensive literature review was conducted to establish the theoretical foundations and empirical evidence related to V2G, energy transitions, and justice. Relevant academic articles, policy documents, and industry reports were systematically analysed by identifying justice implications of the implementation of V2G. Lastly, the justice implications found were divided into the three dimensions of justice as presented in the theoretical framework.

In addition, qualitative data from the semi-structured interviews were examined using thematic analysis to identify the justice implications for the implementation of V2G and to uncover opportunities for a just implementation of the technology. This involved developing a coding frame, which contained a list of predefined themes and codes based on the research questions and the literature study. Themes included distributive, recognition, and procedural justice; current system design & governance; conceptualizing a just transition. Transcripts were then coded using Atlas.ti, tagging segments corresponding to each theme, and tagging them with a code from the codebook, or if no matching code was found a new one was created. After coding all the interviews, thematic analysis was conducted per actor group, per theme. This made it possible to easily identify cross-actor and cross-theme patterns next to trends in the data.

Furthermore, stakeholder analysis was carried out using stakeholder mapping, which was derived from both desk research and interviews. From the general stakeholders identified from literature, a more specific version applicable to ASE was made. From there, the stakeholder salience model by Mitchell et al. (1997). Using the power–legitimacy–urgency criteria proposed by the model, each actor was assigned the stakeholder attributes, which clarified on power dynamics, and informed for the final interview participants. The insights from the stakeholder analysis were then integrated with the thematic findings from the interviews and literature review, resulting in a comprehensive understanding of the justice implications associated with V2G implementation in ASE. For a full explanation of the stakeholder salience model, see Appendix B.

To make the identified justice implications tangible and open them up for discussion, two design-synthesis techniques were used. This involved combining and analysing data from various sources and methods to create new insights and interpretations.

First, normative narrative scenarios for the future were developed. One ‘Business-as-Usual’ (BAU) scenario and one ‘Just V2G’ scenario was created. These scenarios can be viewed as narratives about alternative futures. As such Beach (2021) argues, that they are:

> *“a formalization of something everybody does naturally as they think about the future, imagine what might happen instead of what they expect to happen, and figure out how to make the alternative happen instead, if it is better than what is expected, or how to make sure it does not happen (or what to do if it does happen), if it is worse than what is expected” - Beach (2021)*

Narrative scenarios have the strength of translating technical detail into stories that people without specialist knowledge can debate and improve (Wilkinson & Kupers, 2013, p. 121). This is exactly the purpose of these synthesis steps, translating V2G implementation into something people can imagine and discuss about.

Finally, personas from the future were created. These personas walk the reader through the scenario and reveal how everyday life experiences are for each scenario. Three personas have been made for each scenario, one for each of the main actor groups; 'policy and governance actor', 'citizens and end users', and 'commercial and market players'. Construction was based on the literature and interview outcomes, bringing the abstract data to life. Recent work from Cherry et al. (2022) emphasised that personas make complex energy transitions far easier for stakeholders to debate, because personas represent a technical vision in stories they can instantly recognise.

Taken together, the complete results set was analysed; all justice implications encountered in literature, interviews, narrative scenarios, and in the personas were distilled to form a set of key justice implications. This set also shows the strong contrast between the 'BAU' and 'Just' scenario. Each implication was then located in the MLP according to level: niche (experimental pilots, current system regime (rules, infrastructure etc.), or landscape (broader contextual environment). Where an implication spanned layers, cross-level arrows were noted down (e.g. N → R, L → R). This analysis made sure the MLP-Justice framework could be used operationally next to theoretically, to develop targeted recommendations from this research.

3.4 Validity and Reliability

In this research, reliability meant following the same processes each time so that work could be repeated, and validity meant making sure the data collected was representative of ASE. First, reaching saturation in interviewee respondents across all actor groups increased accuracy and equal representation of actor groups for the research. All the interviewees were familiar with ASE's context and were experienced in either V2G and/or the justice field. This ensured validity of the answers was strengthened. Next to that, cross checking justice implications through literature and interviews increased reliability and significance of data.

Consistency of data gathering was secured by following a fixed interview protocol, a codebook, and coding logbook (upon request available). Validity of the narrative scenarios and personas was secured by grounding them in the findings from literature and interviews. Furthermore, they were grounded in context demographics.

Together these measures met qualitative standards for trustworthiness and made the findings suitable for further processing.

Chapter 4: Results

This results section brings together findings from the various methods deployed in this research. Findings from a literature review, stakeholder analysis, and semi-structured interviews are used to find justice implications of V2G implementation in ASE. Finally, two contrasting narrative scenarios are developed that make the implications found tangible and relatable. The scenarios are complemented by user personas of V2G in the two scenarios.

4.1 Literature Review

The literature review in this chapter serves as the theoretical foundation for the research. Through the lenses of distributive, recognition, and procedural justice, it analyses the concept and technical potential of V2G, investigates relevant actors and business models, reviews current EU and Dutch policy, and concludes with the justice implications of V2G from literature. Overall, these sections provide a thorough summary of the state of the art and point out important obstacles and possibilities from literature, for the creation a just V2G system.

4.1.1 Why V2G Matters

The EV fleet size across Europe is expected to grow rapidly. The total number of EVs in Europe is projected to triple by 2030. This is mainly due to European Union (EU) regulations that all new cars and vans registered in Europe should be zero emissions, starting from 2035.

Electrification (e.g. from EVs, heat pumps, and other large power consumers) causes higher transport volumes for, which presses the need for the existing networks to be reinforced and extended. Additional costs must be made in the energy sector to facilitate this. These costs are likely to be divided among demand and supply side (Yao et al., 2020).

The World Economic Forum (2025) however, stresses that a shift to a more dynamic, digital and decentralised grid is needed, to avoid unnecessary investments on the existing grid, that will only increase energy prices for the user, and do not provide a more reliable, flexible and equitable energy system for the future.

4.1.2 Concept of V2G

The term vehicle-to-grid (V2G) was first introduced to describe the concept of bidirectional energy transfer between the energy grid and an EV battery by Kempton et al. (2001). The general concept of V2G is described by Figure 5 below. The energy flows from the electricity generating units to the grid, where it is further transferred to charge an EV, this represents the ordinary charging process of EVs. Although the bidirectional arrows represent the concept of V2G, where the V2G capable EV also allows for discharge of its battery back into the grid, to use it for a different purpose (Goncearuc et al., 2024). Appendix C shows a full overview of the varying grid services V2G can provide. Related variants, such as vehicle-to-home are described in detail in Appendix C as well.

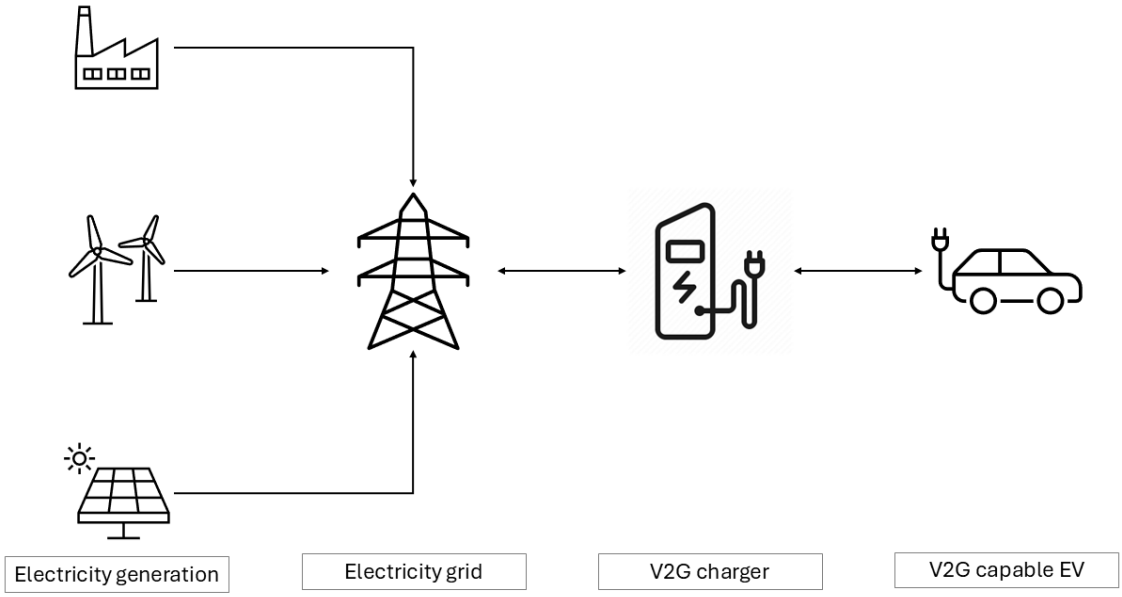

Figure 5. General concept of vehicle-to-grid (Made by author, 2025).

4.1.3 Implications for EV Users

Early adopters of EVs and V2G are frequently middle-to high income individuals or fleet managers, motivated by cost-effectiveness and sustainability considerations (Noel et al., 2019; Sovacool et al., 2018). EV users have the potential to generate additional revenue for the service they provide when using V2G. Research by Tezel & Hensgens (2024) on the Dutch context, states that EV owners in the Netherlands can generate revenues in the order of 7-13% of their charging costs, with controlled charging (only loading when energy price and demand is low), and that this can be even higher when using V2G. However, the business case of V2G is debatable looking at various studies related to the technology. Some studies suggest monetary rewards of up to 454 dollars annually (Li et al., 2015), and some studies suggest rewards are neglectable (Sovacool et al., 2020).

Various other factors that influence the adoption of EVs include social-demographic factors, such as income, age, education, housing situation, urbanisation, and employment (Fluchs, 2020; Rotaris et al., 2021). These EV users tend to possess a combination of characteristics, such as a pro-environmental attitude, and sufficient resources to experiment with new technologies (Sovacool et al., 2018). This makes it a very narrow group that is willing to, and able to engage with V2G technology, something that clashes with the principles of a just system.

4.1.4 Implications for Non-Direct Users

Although V2G and its research primarily focuses on EV owners and grid interactions, its impact extends to non-EV users as well. This poses questions around equity and systemic cost allocation according to Noel et al. (2019).

The implementation of V2G requires initial investment in the grid before it can be integrated into the existing system. You can think of smart meters, aggregator platforms, and new distribution connections to make bidirectional energy sharing possible. Utilities may recover these costs via general rate increases (Sovacool et al., 2019). This could mean that even households not owning a car may help finance the infrastructure needed. In principle however, the more flexible grid that V2G can provide, can improve reliability and prevent expensive peak-capacity expansions and other congestion management services (Tezel & Hensgens, 2024; Wang & Wang, 2013). Consequently, non-direct users of V2G can benefit from reduced blackout-risk and potentially moderated electricity prices as a long-term effect (Noel et al., 2019).

Cost-sharing is seen as a core equity challenge. If wealthy EV owners receive ancillary-service revenue, while grid upgrades costs are socialised, less affluent communities may pay but not directly benefit (Noel et al., 2019; Sovacool et al., 2018). Next to before-mentioned socioeconomic reasons (income, education etc.), practical obstacles to V2G participation include renters without authorization to install V2G chargers, and people in a dense urban area without designated parking (Kahma & Matschoss, 2017). Noel et al. (2019) states that without further policy frameworks that address these imbalances, V2G may unintentionally widen socioeconomic and spatial disparities.

System-wide Implications of V2G

Beyond the direct-user and non-user debate, V2G also makes impact systemwide, and has consequences along the intersection of energy, mobility, and sustainable development.

V2G enables the marginal emissions reduction to be significant, since coal or natural gas generators can be replaced during short term grid services (Sovacool et al., 2018). Areas with high renewable penetration or ambitions like Amsterdam can benefit further, because stored wind or solar energy can be fed back into the grid, which reduces the reliance on fossil fuels even more, and make renewable energy more efficient (Bartolini et al., 2020). Electrification of mobility is also stimulated by technologies such as V2G, and related technologies for charging (Dall-orsoletta et al., 2025; Kumar Kar et al., 2024).

Health benefits could arise from lowering fossil fuel reliance, in both energy and mobility. This would yield public health improvements society-wide, especially in dense urban areas, according to Noel et al., Chapter (2019, Chapter 8).

4.1.5 Actors and Business Models for V2G

The literature around business models for V2G and its actors involved often relate to larger discussions around sociotechnical transitions. These transitions are not just shaped by technology and its economic value, but also social, political, and institutional factors shape this multi-stakeholder environment (Geels, 2002). All stakeholders bring different interests, capacities, and responsibilities (Sovacool et al., 2020).

This creates a highly complex system where V2G operates in, in which it is not always clear who is responsible for what, and who gets to decide on the roll out and revenue structures. Sovacool et al. (2020) identify a diverse business model chain, with actors ranging from automotive manufacturers and fleet operators to aggregators, public transport providers and second-hand markets. These actors and related business models were composed according to 257 interviews and 8 focus-groups in the Nordic countries. However, the non-EV or even car user is not represented here. An overview of this business model chain, stating actors and their related business models by Sovacool et al. (2020) is included in Appendix D.

Sovacool et al. (2020) state that a wide range of V2G business models are currently being explored. A distinction in literature can be seen in centralised utility led systems and decentralised models, where aggregators or community schemes play a role. A schematic overview of how such a system can look like is depicted in Figure 6. Each model offers different opportunities and risks for equity and inclusion of all stakeholders. What is most important to notice is the difference in being directly connected to utilities or via an aggregator.

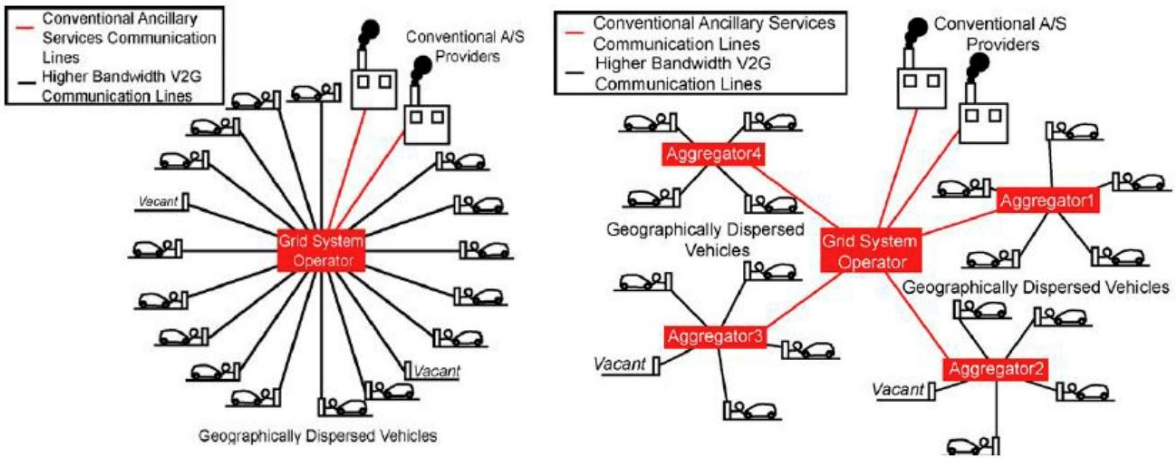

Figure 6. Conventional centralised V2G Grid Architecture (left panel) vs. Aggregated and Decentralised V2G Architecture (right panel). Source: (Quinn et al., 2010)

The way these business models are implemented shapes how justice implications are in practice. For example, a top-down deployment led by the grid operator or OEM may leave little space for community-led initiatives and benefits (Sovacool et al., 2018, 2019a). While cooperative or aggregator led models may offer space, but face challenges in financing and coordination (Kester et al., 2019). As Wentland (2016) notes, decentralised approaches can empower users but also comes with responsibility shifts to those users.

Based on the actor types identified, a general stakeholder classification has been developed to guide the next chapters in this research. This stakeholder classification helps identify interview candidates later, and can be found in Appendix E.

4.1.6 Governance and Policy for V2G

In this section, the distinction is made between European Union (EU) and Dutch policy. Dutch policy is of course influenced by EU policy, nevertheless, each member state of the EU has its own priorities and thus their own approach for policies regarding V2G. Next to that, each member state has its own infrastructure capabilities (Micari & Napoli, 2024).

EU Policy

EU is frontrunner in V2G regulation according to Government UK (2023). EU has comprehensive frameworks that aim to accelerate V2G technology integration into energy systems. To develop future-ready energy systems, guidelines under 'Clean energy for all Europeans' (facilitating a clean energy transition) and 'Fit for 55' (cut emissions with 55% by 2030) packages, set ambitious goals for charging infrastructure, including bidirectional charging capabilities (European Commission, 2019).

Active since 2024, the 'Alternative Fuels Infrastructure Regulation' (AFIR), requires member states in the EU to assess V2G in their resource planning, and to support V2G installations. EU is also looking to incorporate standards for V2G, to increase participation among various stakeholders.

The European Energy Agency (2023), notes that for V2G adoption in Europe, the most pressing barriers were technical and economic, while social, political, legislative, and environmental were assessed to be less important, as can be seen in Figure 7. The main barriers according to the EEA are the lack of infrastructure and the initial investment costs, the uncertainties about battery degradation, and the limited number of compatible EVs.

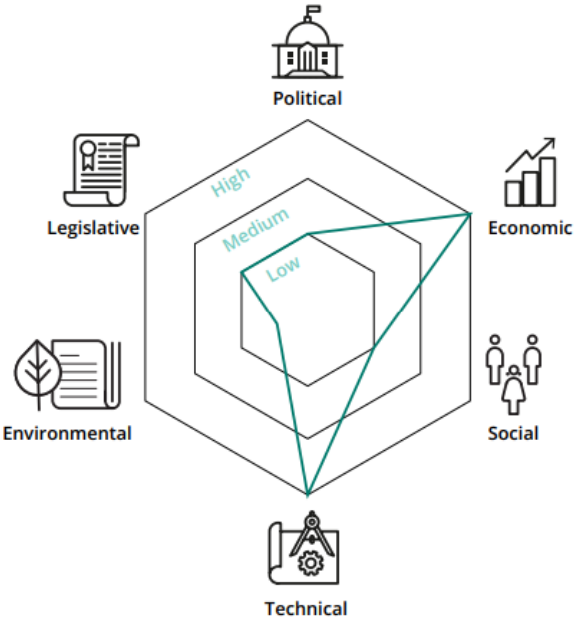

Figure 7. Most pressing barriers for V2G integration (European Energy Agency, 2023).

While these EU policies support technical and market development. These policies do not yet address the justice of the technology. In separate documents energy poverty is discussed, but only isolated from specific strategies around V2G.

Dutch Policy

Dutch government plans to tackle energy related issues more integral. This means that other sectors must be considered when development plans are made, this means that the energy sector also will be more integrated within mobility, and vice versa in the future (RVO, 2023)

V2G is among the proposed solutions to overcome the challenge of net congestion, and therefore co-finances pilot projects like 'Landelijke proeftuin slimme laadpleinen', a national scale project where 46 smart charging hubs were built (ElaadNL, 2022). Next to that, from 2024 group contracts among businesses become available to create 'energy hubs', where energy supply and demand is coordinated in a smart way. In this way, a company can use power from another company when its available (Rijksoverheid, n.d.).

The Dutch government aims to use smart integration such as V2G to alleviate investment needed for the future. In interdepartmental policy research on the investment of electricity infrastructure, conducted by the Dutch National government (Rijksoverheid, 2025), they state that investments costs, and thus an increase in electricity price is inevitable in the coming years.

In Dutch policy plans, the component of justice in the energy transition is added, which is described as "relates to distribution issues, national and international, in the transition to a future energy system" - (Rijksoverheid, 2025). Next to that they highlight the importance of participation from civilians, businesses, and institutions. Thus, all stakeholders are anticipated to have an active role in the future energy system.

The Dutch policy report also states that costs and benefits need to be distributed fairly across different groups and generations. The report proposes three main strategies to distribute costs more fairly: 1) income subsidies for network operators, 2) compensate users targeted, 3) by dividing costs and benefits internationally and use European funds. Measure number two is described as a method to battle energy poverty as well in the report, which is on the agenda within the EU, and Dutch policy (Rijksoverheid, 2025). Something to consider is that decreasing energy prices artificially, lowers the need for stakeholders in the system to lower their consumption, which induces an increase in investment costs, which in its turn can broaden existing investment gaps.

4.1.7 Justice Implications

This section gathers the justice implications that follow from the literature reviewed in the previous sections. Where the earlier parts discussed the concept, technical potential, business models, actor landscape, and policy frameworks of V2G, the focus shifts to what this means in terms of justice from here. This section synthesises how access, participation, and benefit-sharing concerns are addressed or overlooked in existing V2G literature.

In this section the results are presented using the dimensions of justice; distributive, recognition and procedural justice, as presented in the theoretical framework. These insights from literature serve as the basis for the next result sections, to be complementary or to compare to the empirical findings.

Distributive Justice Implications

Distributive justice is about the fair distribution of costs, benefits, and resources among various social groups within a transition. It becomes particularly relevant as the design of the technological innovation V2G can shape who participates, who benefits, and who is excluded from the evolving system of energy and mobility.

Looking at the research that is done for V2G, it is notable that it mostly focuses on the potential direct user and the benefits that come with participating. Indirect benefits and burdens for the non-direct user are seldom discussed, and if discussed it is not particularly addressed to the non-direct user. The adoption potential, and behavioural studies are not taking the non-direct user into account. Furthermore, adoption studies mainly focus on EV users and their willingness to participate, rather than people who might own an EV in the future (Geske & Schumann, 2018; Kubli et al., 2018; Sovacool et al., 2019b). This can give a biased perception of the adoption potential of V2G and its system wide impact, especially since non-direct user benefits and burdens are not specifically addressed.

One key concern is that costs for infrastructure are collectively provided, but benefits are not necessarily. Infrastructure investments in smart charging and V2G are increasingly funded through general electricity tariffs or with government subsidies. This means that all electricity users contribute to their deployment. However, initially only a selected subset can access V2G benefits, namely those who own an EV and can reduce electricity costs or gain revenue. Once market matures the non-direct user might also experience reduced electricity costs since grid expansion development can be reduced in the long term(Noel et al., 2019; Sovacool et al., 2018). This creates a risk of new inequalities, where those that are already in a good position (own an EV) gain more, while those that cannot participate effectively subsidize their participation.

The complexity of V2G business models complicates revenue allocation. The many stakeholders involved in the system can induce power asymmetries in benefit allocation. For example, V2G aggregators are a new actor in the market. They couple the mobility sector with the energy sector, and act as intermediaries that can provide value to EV owners by enabling them to trade on the energy market (Heinekamp & Strunz, 2025; Sovacool et al., 2020). Difference in resources, both financial and technological, can empower certain actors. This can make the system evolve in a system where value consolidates at the top, effectively relying on collective investments as stated before.

Looking at the more decentralised system, next to the difficulties in cost and revenue allocation, access to autonomy can become unequal. In this system it remains that only those with the capital to invest can participate and thus become autonomous. Furthermore, energy self-sufficiency becomes a privilege. Although V2G being environmentally beneficial, decentralisation may create new inequalities by making resilience and independence rely on private investment rather than collective provision (Wentland, 2016).

Infrastructure and demographic distribution also play a critical role in distributive justice regarding EVs, and thus V2G. Spatial equity is at stake when infrastructure is not adequately distributed. It can induce further socio-economic and geographical divides. The allocation of V2G chargers will likely to be concentrated in neighbourhoods where income and EV uptake is already high, leaving out lower income neighbourhoods (Noel et al., 2019).

At the policy level, some efforts have been made to battle the imbalances in the energy transition. For instance, energy poverty, defined by Pye & Dobbins (2015) for the European Commission as: "when a household must reduce its energy consumption to a degree that negatively impacts the inhabitants' health and wellbeing ", is a major area of focus of the EU's 'Clean energy for all Europeans' package. Which requires member states to identify and track changes in energy poverty, especially within vulnerable groups. Specific frameworks on how to act have not yet been completely incorporated. The three division of cost mechanism by the Dutch government provide a solid foundation and step towards the right direction for an inclusive energy transition

Recognition Justice Implications

The degree to which different social groups' needs, values, and lived experiences are considered when designing and implementing new technologies such as V2G is known as recognition justice. Regarding V2G, an increasing amount of literature suggests that the technology, and its current business and policy frameworks, primarily serve a narrow demographic. Namely, wealthy, well-educated, and frequently younger EV owners who privately own a house (Dall-orsoletta et al., 2025; Kester et al., 2019; Noel et al., 2019; Sovacool et al., 2019b). This early adopter profile reflects a pattern, described in the research of Sovacool et al. (2018) as 'EV elitism', in which early access to, and benefits from V2G, are primarily restricted to those who are already privileged.

This kind of exclusion extends beyond issues of physical access to infrastructure (and the benefits that come with it). It includes issues of whose energy and mobility behaviours are valued in design and policy decisions. Non-direct users, who don't/can't participate for various reasons, are rarely addressed in V2G development plans or pilot projects. Nevertheless, they do participate through grid cost sharing, although not being able to pick the fruits because they rent, live in multi-unit dwellings, or just prefer and rely on public transportation. Especially in areas where population is socioeconomically diverse, it poses risk or reinforcing existing divides.

Moreover, the focus on individualised energy autonomy and decentralisation through for example, V2H or V2B applications can marginalise collective and cooperative energy practices. Which in some cases might be more aligned with the needs of underserved communities. When only particular lifestyles and user profiles are recognised as relevant for implementation of V2G systems, the transition not only becomes technologically biased, but socially selective. Recognition justice thus calls for a broader understanding of potential users, both direct, and non-direct.

Procedural Justice Implications

Procedural justice concerns the fairness and transparency in decision making, it copes with who is included in shaping the governance. In the EU and Dutch context, policy around energy were mostly top-down and technocratic.

However, there has been a clear shift towards more inclusive, and participatory governance approaches over time. In the Dutch context, especially a large shift became visible since 2016, where energy policy became more integrated with climate policy and sustainability (de Looze et al., 2024), following international agreements (e.g. the Paris agreement) and domestic societal pressures such as the 'Urgenda' (legal obligation for the government to reduce CO2).

The Dutch government stated that the energy transition, in the first place is a societal transition, and that it should be a transition that is "fair, achievable and affordable for all and considers it important to have a good understanding of the development of the citizen perspective on the transition in the coming years" - (de Looze et al., 2024). This shift is reflected in policies that promote decentralisation of decision making to regional, and local levels. Distribution to lower levels allows for more context specific needs and differences to be addressed. In practical terms, this can facilitate more stakeholder dialogue and attempts to include diverse societal perspectives in (early) planning stages (de Looze et al., 2024).

Policy, using subsidies and incentives, has led to rapid electrification, especially in the Netherlands, although they tend to reinforce the existing system of owning a vehicle and centralised control over energy flows. In this system there is limited space for citizen participation or localised energy democracy (Noel et al., 2019). This focus on stimulating EV adoption, and technologies like V2G through subsidies and incentives, without broader public engagement, reflects of procedural exclusion. It also affirms conventional automobility, which is not necessarily the way forward looking at liveability, sustainability, and municipal development plans (Gemeente Amsterdam, 2024).

Moreover, decentralisation is often presented as a pathway to flexibility and resilience. But as Campos et al. (2024) argue, decentralised systems can still reproduce injustices dependent on the inclusiveness of the governance system. Without mechanisms to ensure transparency, community representation, and local capacity building, decentralisation may only benefit those with the technical and institutional resources to effectively engage. In an interview with someone from network provider 'Alliander' in the Netherlands, she states that a change in mindset is needed and that "When you depart from the community's perspective, solutions emerge that go beyond energy. The social fabric is strengthened, and we create a coherent package in which the energy transition, climate adaptation, and social issues complement one another." - Agterberg, as cited in Platform31 (2024). In this way it becomes visible what is really needed on a more local level, decentralisation is key in this.

Local collective efforts among residents, businesses, and other stakeholders remains difficult due to legal limitations such as for energy sharing, or local energy hubs. Legal frameworks for collective energy management are still complex and out of reach for most stakeholders, despite recent policy developments such as the introduction of group energy contracts in 2024 are a step in the right direction (Rijksoverheid, 2025). These difficulties need to be addressed to enable bottom-up initiatives, and to decrease the dependence on centralised actors. Overcoming this bureaucratic barrier can enable participation and strive for a vision where solutions to the energy transition are developed locally.

Finally, social barriers to participation in V2G are underestimated in a report of the European energy agency about the potential of the technology. While lack of trust, resources, knowledge, and other social barriers are significant according to research (Chen et al., 2020; Huang et al., 2021; Noel et al., 2019; Sovacool et al., 2018)

Summarising the Justice Implications of Implementing V2G

In conclusion, an overview of the identified justice implications from literature is presented in Table 3. The justice implications are divided into the three dimensions of justice as presented in the theoretical framework for energy and mobility justice.

Justice dimension	Justice implication
Distributive justice	Infrastructure is collectively funded (e.g., through tariffs or subsidies), but direct benefits like revenue and lower costs are limited to EV owners
	Business models involve complex actor dynamics where dominant players like aggregators can capture disproportionate value.
	Differences in financial and technological resources allow certain actors to shape the system to their advantage, consolidating benefits at the top
	Decentralisation and energy autonomy are only accessible to those with capital, making energy self-sufficiency a privilege.
Recognition justice	V2G serves a narrow user base: wealthy, highly educated, younger EV owners with private housing. If other social groups are not recognised, there is a risk of reinforcing existing social divides
	Non-direct users' energy and mobility needs (e.g., renters, non-driving populations, public transport users) are overlooked in policy and pilot design.
	Individual autonomy models (V2H/V2B) can become only available for the already privileged, marginalising collective or cooperative energy practices.
Procedural justice	Participation in V2G policy and planning is often superficial, aimed at consensus rather than genuine co-decision making
	Legal frameworks for energy sharing remain inaccessible, limiting the ability of local collectives to act.
	Decentralisation is promoted but not structurally supported; local actors often lack resources and authority.
	Social, political, and legislative barriers (e.g., trust, resources, knowledge) are still underestimated, although being described as important in EU and Dutch policy. In specific report on V2G not acknowledged, despite being critical for (equitable) participation according to research.
	Policies and incentives reinforce automobility by supporting EV ownership models, excluding alternative mobility visions from planning.

Table 3. Summary table of justice implications from V2G literature (Made by author, 2025)

4.2 Context Analysis

ASE is a highly diverse and spatially complex area in the city of Amsterdam. It is known for its typical post-war urban planning strategy, significant levels of ethnic diversity, and relatively large share of social housing. The area is undergoing major redevelopment, particularly in areas like Amstel III and ArenApoort, which have been assigned for large scale housing and office projects. In Figure 8 an overview of the neighbourhoods in ASE can be seen.

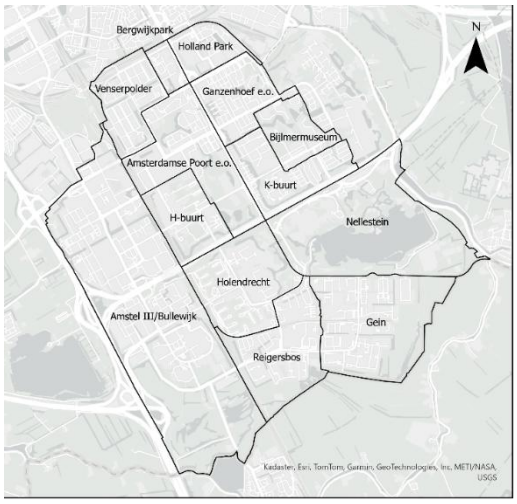

Figure 8. Overview of neighbourhoods in ASE (Made by author, 2025), data from BBGA (2024)

Housing Structure and Ownership

ASE is characterised by a high share of social and rental housing. Many housing corporations own buildings in the area, particularly in older neighbourhoods such as Venserpolder and Bijlmer-centrum. The percentage rent against owner-occupied can be seen in Figure 9. This is clearly different from the rest of Amsterdam, where owner-occupied- and private rental housing occupy a bigger share.

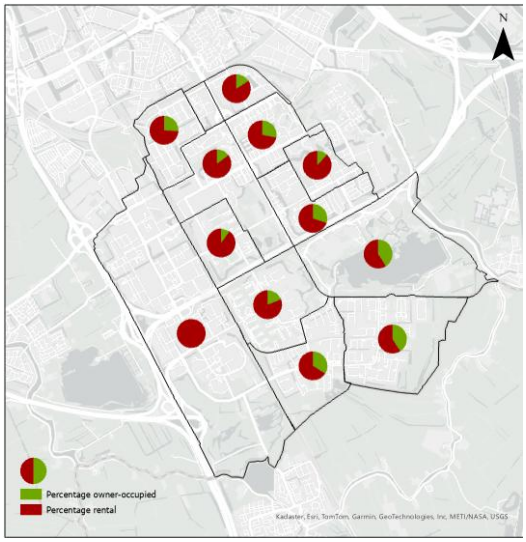

Figure 9. Neighbourhood-level tenure composition in ASE (Made by author, 2025), data from BBGA (2024)

Socio-Economic Status (SES)

ASE exhibits lower average socioeconomic status (SES) than most other districts in Amsterdam. According to the SES data from the municipality, the area has a higher percentage of residents with a low and middle income, and lower levels of education. Standardised household income and education level determine the SES score (Gemeente Amsterdam & CBS, 2022). In Figure 10, the difference in SES between ASE and the rest of the city can be seen spatially.

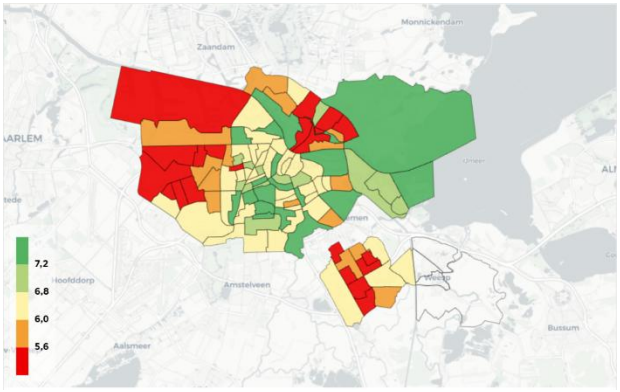

Figure 10. SES-scores in Amsterdam (Gemeente Amsterdam & CBS, 2022)

Energy Poverty

These patterns of SES distribution highlight concerns about energy poverty, the inability to afford adequate energy services, where the energy quote is higher than 10%. ASE has the highest share between districts, of people living in energy poverty, which was 14% in 2021 (Gemeente Amsterdam & O&S, 2022)

Energy and Mobility Context

The network operator TenneT (high voltage) and Liander for (medium voltage) both declared that energy grid in ASE sits at its maximum import capacity with only limited room for reverse flows (Liander, 2025). The same goes for the rest of Amsterdam. This has implications for where infrastructure can be rolled out. The combination of development projects, electrification of (public) transport, and electrification of energy, all reinforce this shortage (Ministerie van Klimaat en Groene Groei & TenneT, 2025).

Mobility in ASE is marked by a higher average of car usage then the rest of Amsterdam. In Figure 11 the distribution of car (56%), bike (16%), and public transport (28%) usage can be seen for both residents and visitors. Car usage is on average only 27% citywide. Especially commuters between the A2 and the 'Holterbergweg', and Amstel III, respectively come for 79% and 68% by car. However, mobility patterns change drastically during events in the area. When events happen at the same time in the venues, an extra 75.000-100.000 people are in the area, wherefrom 60% came by car, and 15.000 cars are parked in the area (Chantal Inia et al., 2021).

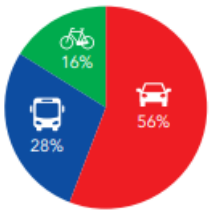

Figure 11. Distribution of mode of transport in ASE. (Chantal Inia et al., 2021)

The municipality aims to change behaviour in the future that stimulates, residents, visitors and commuters to travel differently to increase liveability of the area. Conflicting with this vision is the current mobility policy and infrastructure rollouts, that favour private EV ownership and the car overall. It can also be noted that ASE has little public charging infrastructure compared to the rest of Amsterdam (see Figure 12), although financed through taxes by everyone.

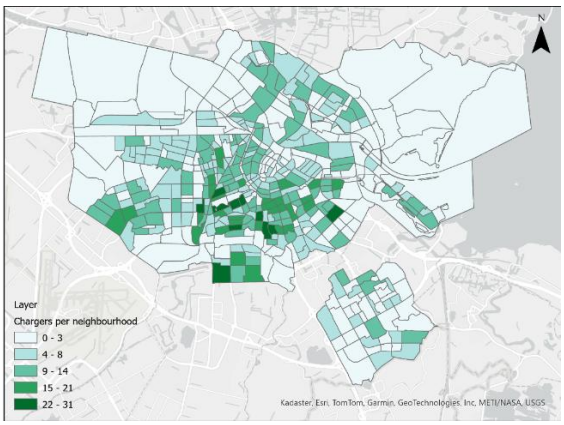

Figure 12. Public charger density Amsterdam (Made by author, 2025), data from BBGA (2024).

In conclusion, a rental dominated housing stock, lower average incomes, increased energy poverty risk, and a car-centred area creates a setting where V2G can go opposing directions. It can relieve grid stress and return tangible benefits to vulnerable groups, or it can reinforce existing justice gaps if deployment does not take justice into account. Recognising these initial conditions is therefore essential for conceptualising a just V2G system.

4.3 Stakeholder Analysis

To start with, an overview of stakeholders in ASE is made. Each stakeholder, the corresponding party (if existent) in ASE, and its function is described. The full overview of stakeholders identified for this case study can be found in Appendix F. This table served as input for the stakeholder salience model by Mitchell et al. (1997). For further categorisation and easier breakdown, the stakeholders are first divided into five main actor groups before assigning attributes.

In Table 4, the results of the stakeholder salience model are presented. The model helps identify actors that should be prioritised for inclusion in the next phase, where empirical data is collected. By categorising stakeholders according to their salience, it becomes clear which groups are most central to the development and implementation of V2G in ASE. Municipal or regional infrastructure providers, with all three attributes are considered highly salient and thus important to approach.

Additionally, actors with strong urgency and legitimacy, but less formal power, such as community organisations and non-direct users need to be included to ensure the concerns of less visible but affected groups. Commercial and market players are also considered because of their power and urge to shape the system design and operation. This mapping serves as a guide for approaching interview participants, ensuring that multiple perspectives on justice implications can be gathered.

Group	Stakeholders	Stakeholder attributes	Salience
Policy and governance bodies	• National Government • Municipality	Power, legitimacy, urgency Power, legitimacy, urgency	Definitive Definitive
Citizens and end users	• Direct users (EV owners) • Non-direct users • Community organisations • Real estate developers • Housing associations • Association of owners (VVE)	Power, legitimacy, urgency Legitimacy, urgency Legitimacy, urgency Legitimacy, urgency Power, legitimacy, urgency Power, legitimacy	Definitive Dependent Dependent Dominant Definitive Dominant
Energy system actors	• Grid operators • Energy suppliers • DSOs / TSOs • Charging infrastructure providers	Power, legitimacy, urgency Power, legitimacy Power, legitimacy, urgency Power, legitimacy, urgency	Definitive Dominant Definitive Definitive
Advocacy, researchers and intermediaries	• Non-Governmental Organisations (NGOs)FD • Academia • Urban Planners	Legitimacy, urgency Legitimacy Power, legitimacy	Dependent Discretionary Dominant

Commercial and market players	• Mobility providers	Legitimacy, urgency	Dependent
	• Financial institutions	Power, legitimacy	Dominant
	• Automotive manufacturers	Power, legitimacy, urgency	Definitive
	• Battery manufacturers	Power, legitimacy	Dominant
	• Local Businesses	Legitimacy, urgency	Dependent

Table 4. Stakeholder salience model applied for V2G, adopted from Mitchell et al. (1997) applied to V2G actors (Made by author, 2025)

4.4 Semi-Structured Interview Results

To understand the justice implications of implementing V2G in ASE, a diverse range of stakeholders is interviewed. This section presents a thematic synthesis of the interview findings, structured around the five predefined themes: distributive justice, recognition justice, procedural justice, system design & governance, and future visions. For each theme, the perspectives of different actor groups: policy and governance bodies, citizens and end users, energy system actors, researchers and intermediaries, and commercial actors, are analysed. The deductive codebook can be seen in Figure 13.

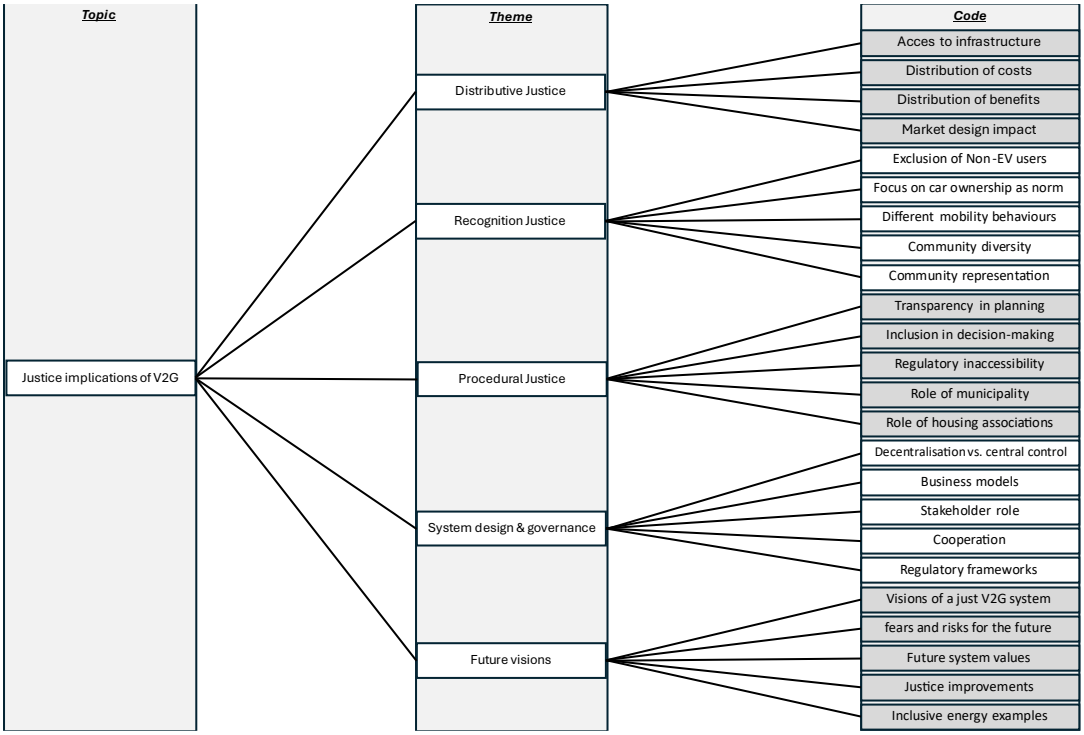

Figure 13. Deductive interview codebook (Made by author, 2025)

The complete thematic analysis per theme, per actor group can be read in Appendix G. This section provides a summary table of the justice implications and future visions found per actor group. Next to that, cross-theme and cross-actor group recurring implications, tensions and gaps are discussed with supportive quotations.

Table 5 on the next page shows the summary of justice implications per predetermined theme, differentiated by actor groups, enriched with quotes.

Theme	Actor Group	Justice Implications	Supportive Quotes
Distributive Justice	Policy and Governance Bodies	• Infrastructure allocation • Public funds disproportional distribution of benefits	"Everyone pays taxes, also in ASE, why do they have fewer public chargers?" – R2
	Citizens and End Users	• Residents prioritise costs • Unlikely to support V2G if no tangible benefits	"First thing that comes to mind are the costs" -R3 "If large businesses improve through the transition and we don't, why would we cooperate?" – R3
	Energy system actors	• Distribution of energy assets	"The four most important energy assets, solar, the EV, heat pump and home batteries, the ones that have them, are the more affluent in society". – R4
	Advocacy, Researchers, and Intermediaries	• Vulnerable groups must be protected from bearing full financial burdens	"It could be that everyone pays except particular vulnerable groups who are exempted or given discounts." – R5
	Commercial and Market Players	• reinforcing existing energy and mobility inequalities	"If you do something (i.e. deploy V2G), you introduce a major advantage, but that comes with collateral damage […] for example a raise in energy rates for people that don't receive benefits.". – R7
Recognition Justice	Policy and Governance Bodies	• Acknowledge marginalisation of residents who cannot afford EVs or adapt to policy	"If we talk about injustice, I think of mobility poverty, a topic we are busy with at the municipality" – R1
	Citizens and End Users	• Underrepresentation of residents in energy transition	"People are not actively engaging in the energy transition at all, for sure not in Venserpolder" – R3
	Energy system actors	• Local energy transition advocates are needed	"Yes guys, we need those local ambassadors, who will pull this carriage, and preferably volunteers" – R4
	Advocacy, Researchers, and Intermediaries	• Recognition of different mobility behaviour • Recognise the need for systemic change	"The system is for 'whoever could own a car'." – R5 "Recognition also takes place at the institutional level" – R6
	Commercial and Market Players	• generational and cultural variation in engagement • V2G-elitism	"Justice depends on how a technology is used and the people implementing it." – R7 "If we would implement more expensive V2G technology now in our cheapest model, the production costs would only increase" – R8

Procedural Justice	Policy and Governance Bodies	•	Institutional mechanisms for justice are often missing	“We talk about justice and write about it in policy, but don’t act [...]” – R2
	Citizens and End Users	•	Residents feel participation efforts are tokenistic, and there’s a lack of trust	“When people have the feeling that something is sold to them nicely, but there’s a catch, they quickly withdraw. They want to be taken seriously.”– R3
		•	Fragmentation and mixed signals	"On one hand the government says: go ahead, start a cooperative. But because of other rules, like around charging stations, you still need the government, and then they say, 'we don't deal with that in this department.” – R3
	Energy system actors	•	Lack of standardisation delays	“I am disappointed that it takes so long [...] that no decision has been made, we put the converter in the car or in the charger” – R4
	Advocacy, Researchers, and Intermediaries	•	Procedural bias in mobility planning	“Norwegian transport policy is still about cars [...] The tax break for a single Tesla owner was equivalent to 20,000 bus tickets.”. – R5
		•	Fragmented governance leads to unclear roles and lack of transparency	“Residents want a piece of control, and want to know why things happen.” – R6
	Commercial and Market Players	•	Engagement for those who can act	“You have to be active [..] if you don’t take the opportunity in this society, then you will be skipped”– R7
		•	Lack of clear guidelines	“A car manufacturer just wants to hear: these are the standards, put this in your car and then we can make it work. But there are none.” – R8
Current System Design & Governance	Policy and Governance Bodies	•	Fragmented departments and disconnected policies hinder just and coordinated system design	“there’s policy for accessibility to public charging, policy for stabilisation of the network, but it is not connected” – R2
		•	Lack of support from automotives	
	Citizens and End Users	•	Exclusion from decision making	“People with lower incomes [...] feel they have less decision power than homeowners.” – R3
		•	Institutional barriers for bottom-up initiative, mixed signals	
	Energy system actors	•	No differentiation network tariffs	“Aunt Sien [...], who uses almost nothing, pays the same fee as a resident with a Tesla and solar panels” – R4
	Advocacy, Researchers, and Intermediaries	•	No clear leader of the energy transition in ASE	“It’s difficult to shape the energy transition, because no party dares to take the lead.” -R6
		•	Scaling V2G requires aggregation and technical standardisation, which conflicts with full decentralisation	“You can't have one neighbourhood using one standard and another using another.” – R5
		•	Innovation dynamics with injustice	“Some innovations create new injustices, and some innovations simply re-entrench existing injustices” – R5
		•	Externalities, cosmopolitan justice	“When you decarbonise transport [...], you buy out the conventional car with an EV, the conventional car doesn’t just disappear. It goes somewhere.” -R5
	Commercial and Market Players	•	System design choices influence justice outcomes	“If you connect to the grid, you create many dependencies.” – R7
		•	Cooperation between actors	“Entirely decentralised, it becomes a matter of checks and balances, profit and loss.” – R7
				“Many automotives know that their vehicles are ready for V2G, they simply don’t ‘turn it on “– R8

Future Visions	Policy and Governance Bodies	•	Planning should be based on community input and shared ownership to ensure equitable outcomes	“It would definitely be something public. Thus, accessible for everyone in Southeast.” – R1
	Citizens and End Users	•	Infrastructure and revenue should be for the neighbourhood, supporting affordability and autonomy.	“Place V2G chargers, and if visitors park there, the neighbourhood gets the profit.” – R3
	Energy system actors	•	Differentiating network tariffs by peak usage	“Because then you are rewarded as a small consumer, and more burden is placed on the major consumers” – R4
	Advocacy, Researchers, and Intermediaries	•	Justice must be embedded across the full lifecycle of V2G systems and enable diverse forms of adoption.	“For V2G, it is these very different parts of the technology supply chain [...] that give you the most intervention points.” – R5
		•	Central control organ	“I think how an ideal system would look like, is that it is on the one hand decentralised, but that there is some control somewhere [...] this centre moves together with its nodes.”. – R6
	Commercial and Market Players	•	V2G can support community goals if paired with reinvestment strategies and local energy loops.	“That you essentially assign micro self-sufficiency [...] where you implement vehicle-to-grid.” – R7
		•	Market stimulation	“Subsidy on EVs that can do V2G is a just solution in this early adopter stage” – R8

Table 5. Summary table of interview results (Made by author, 2025).

4.4.1 Cross-Theme Reflections on Justice in V2G Implementation

The summary table and complete analysis in Appendix G, reveals patterns, cross-cutting implications, and tensions across themes and actor groups. In this section the findings are further analysed and placed into perspective. The section is divided into four subchapters, each describing cross-cutting findings.

Inequality in Access and Benefit Distribution

One of the most consistent patterns across the interviews is the recognition that access to energy assets and mobility technologies befalls the higher-income groups. This comes together with the recognition that infrastructure investment costs are often more broadly shared across society. This emerges clearly in the theme of distributive justice, but also cuts across the themes of recognition, procedural, and current system and governance concerns. As R4 (energy actor) puts it very clearly “The four most important energy assets, solar, the EV, heat pump and home batteries, the ones that have them, are the more affluent in society”.

A consequence of this ownership structure is uneven benefit allocation. Several actors see risk in lower-income residents of areas like ASE may end up funding public investments in infrastructure, without receiving proportional benefits. R7 (commercial actor) warns for this “If you do something (i.e. deploy V2G), you introduce a major advantage, but that comes with collateral damage [...] for example a raise in energy rates for people that don’t receive benefits”. From a resident perspective the costs of the energy transition are considered most important according to R3, when talking with residents “First thing that comes to mind are the costs”. In other words, if the system enables energy flexibility and incentivises based on ownership, but does not enable equitable participation, it risks reinforcing existing injustices.

This theme overlaps with recognition justice, where it becomes clear that V2G adoption studies do not focus on non-EV users and renters. They are consistently left out of policy design and communication. R2 therefore questions “Everyone pays taxes, also in ASE, why do they have fewer public chargers?”, which clearly illustrates of how a lack of infrastructure in areas like ASE reflects a systemic bias. Moreover, without just benefit distribution or alternatives to participation, benefits like lower energy bills or other flexibility-service related payments only befall those who already have the resources to participate.

Procedural Tensions: Empowerment, Agency and Trust

A second major issue encountered is procedural exclusion, especially the disconnect between formal participation mechanisms and actual influence. Citizen and community-involved actors frequently describe engagement as tokenistic (R3, R6). As R3 notes: “When people have the feeling that something is sold to them nicely, but there’s a catch, they quickly withdraw. They want to be taken seriously.”

Dispersed responsibilities among governance actors exacerbate this impression of duplicity. Residents are frequently encouraged to "take initiative" (such as forming a cooperative), but they later run into conflicting regulations or unclear directives. As R3 continues: ““The government says: start a cooperative. But because of other rules, like around charging stations, you still need the government, and then they say, ‘we don’t deal with that in this department.’ “.

From the side of authorities and governmental organisations, R2 acknowledges this implementation gap: “We talk about justice and write about it in policy, but don’t act”. The lack of policy that turns into action undermines trust, particularly in areas like ASE where communities already have some distrust in the municipality.

Governance Fragmentation and Implementation Inertia

Furthermore, a lack of coordination between actors creates inertia in system design and implementation. Multiple actors point out the absence of clear standards, clear leadership, and functional cooperation. R8 provides a clear example of this systemic flaw: “A car manufacturer just wants to hear: these are the standards. But there are none.” Without clarity from regulators, automotives are reluctant to include V2G capabilities, particularly in their more affordable models, because it will only increase production and thus purchase costs.

R2 stresses that fragmented departments and disconnected policy hinder just and coordinated system design: “there’s policy for accessibility to public charging, policy for stabilisation of the network, but it is not connected”. R6 adds to that for the Amsterdam context “It’s difficult to shape the energy transition, because no party dares to take the lead.”.

R1 stresses that there is inertia within pilots because automotives and lease flees operators discourage clients to participate. R4 shares the opinion of the automotive: “I am disappointed that it takes so long [...] that no decision has been made, we put the converter in the car or in the charger”. Current system reinforces distributive and recognition injustices. However, an increase in EV prices would not aid in making adoption of EVs more accessible, and warranty cannot be regulated if there is a lack of guidelines on charging cycles and thus battery degradation of public V2G chargers.

This governance fragmentation is not only procedural but also technically crucial. R5 stresses ““You can’t have one neighbourhood using one standard and another using another. It doesn’t work.”, while desirable from a justice and participation standpoint, this technical limitation describes the limits to decentralisation.

Conflicting Imaginaries: Centralised Efficiency vs. Local Autonomy

When asking about envisioning a just V2G system, conflicting imaginaries, particularly around scale, ownership and governance arise.

Policy actors envision a system rooted in public accessibility and neighbourhood empowerment. As R1 tells “It would definitely be something public. Thus, accessible for everyone in Southeast.”. This reflects a clear distributive and recognition justice approach. V2G should not reinforce existing accessibility inequalities but instead serve as a lever to improve access. R2 envisions a system consisting of local (owned) energy hubs with all sorts of shared mobility “so that people who can’t afford a car in the future [...], can make use of this collective shared transportation.”

Citizen-facing actor (R3) support such decentralised visions, but simultaneously is cautious for decentralisation, because institutional barriers undermine their feasibility. For example, R3 suggests; “Place V2G chargers, and if visitors park there, the neighbourhood gets the profit.” This vision turns existing neighbourhood characteristics into assets. The vision aligns with distributive, recognition and procedural justice, emphasising local revenue sharing, ownership and participatory governance. However, R3 also emphasises the need for tailored solutions, since

bottom-up initiatives don't work for all neighbourhoods, and that people are willing to leave the energy transition to a central organ if they are being well informed of the process.

Meanwhile, commercial actors express their concerns about these local, bottom-up models, primarily due to concerns about reliability, risk and standardisation needs. R8 expresses the lack of national or EU V2G standards, combined with fragmented local implementation, as a barrier to efficient deployment of a functional system. Similarly, R4, R5, and R6 warn for the need of standardisation and leadership.

Hybrid models are starting to appear, even among commercial and energy system stakeholder groups. R7 suggests using microgrids to integrate solar, V2G, and community reinvestment: "Assign micro self-sufficiency, so micro energy management, to places where you also implement V2G." Next to that, R4 emphasizes the importance of community agreements on energy pricing and carsharing fleets in avoiding market swings and fostering fair access.

Academic actors see value in localised initiatives as well. R6 stresses the need for a central organ that governs a V2G transition, with a seat reserved on that table for every stakeholder. This central core has the characteristics of being dynamic and adaptable due to the variety of stakeholders in this core. R5 adds the component of cosmopolitan justice to a just V2G system. The benefits of local decarbonisation through EV adoption must be weighed against global burdens: "The conventional car doesn't just disappear, it goes somewhere.".

These visions reveal that there is not a black-and-white opposition between centralised and decentralised, but that there is a tension between reliability, technical feasibility, and social justice. This tension needs to be addressed in future planning of V2G: enabling local initiative and inclusion without sacrificing coordination and technical feasibility.

Conclusion

The interview results reveal that justice implications in the deployment of V2G systems in ASE are multi-dimensional and that striving for justice in the energy and mobility transition, does not always move from words to action. Distributive concerns centre around who has access to infrastructure and benefit from revenues through flexibility services. The recognition dimension arises in the overlooking of renters, small businesses, and non-EV users. Procedural injustices are apparent from the lack of accessibility, and thus inclusion in decision making. System design decisions, institutional fragmentation, and the dominance of technical viability over social integration all influence these dynamics. To further explore how the justice implications found, look like in practice, the next section introduces two scenarios and a series of personas that humanise these dynamics, and highlight both the risks of implementation and the potential of a just V2G system.

4.5 Narrative Scenarios for a V2G Future

To further explore the implications and deployment of a just V2G system in ASE, two narrative scenarios are constructed based on the results of the literature study and semi-structured interviews. These scenarios aim to translate abstract justice implications, into tangible everyday experiences for different stakeholder groups.

To start with, a Business-as-Usual (BAU) future scenario is presented. In this scenario, governance, infrastructural, and market logics remain unchanged. This portrays a future where implications found in the previous chapters are not addressed. Secondly, a just V2G future is given. In this scenario stakeholder visions and justice concerns are addressed, which are based on the implications from literature and interviews.

These contrasting scenarios reveal the tensions and risks embedded in ongoing transitions, but nevertheless the potential for transformation. These narratives form the foundation for the development of user personas, to make choices around V2G implementation even more vivid and relatable.

4.5.1 Scenario 1: Business-As-Usual V2G Future in ASE

In 2035, V2G has become part of Amsterdam's broader energy and mobility landscape. EV penetration is high, since more affordable models came on the market, and policy from EU level stimulates EV adoption. Most chargers are now V2G-ready, and new chargers have emerged, largely concentrated in higher-income areas and near the offices and event centres in Amstel III and ArenApoort, despite being publicly funded (R2). The smart mobility hub has been realised as well; it attracts commuters and visitors of the area.

The energy transition is progressing, but with uneven participation. V2G-enabled chargers deliver electricity back to the grid, providing flexibility. However, financial benefits befall to people who own an EV and to commercial aggregators. Residents in social housing, like those in Venserpolder, lack access to charging stations and EVs. Many of them are not informed properly about how the system operates, and no tangible benefits are returned. Households that cannot afford EVs, or simply have different mobility behaviour, still pay increasing energy costs, as grid fees rise for infrastructure investments (R7).

Development has lowered EV purchase costs overall (R8), but access to V2G infrastructure and its revenue streams remain car centric. Consequently, V2G remains a privilege, rather than a system that improves the collective. It reinforces what Sovacool et al. (2018) call "EV-elitism". Renters and non-EV users are left out in ASE. Shared mobility options and energy solutions through cooperatives remain underdeveloped or inaccessible because of regulatory complexity or fragmented governance. Efforts by residents are put on hold because of conflicting rules, fragmented departments, and a lack of agency, as R3 illustrates "On one hand the government says: go ahead, start a cooperative. But then they say, 'we don't deal with that in this department.'".

In terms of system governance, there is no coherent framework, nor a clear strategy and cooperation on technical standards. This leads to a rollout that is fragmented and mostly shaped by the strongest market actors, reinforcing top-down technological advancements and control. The lack of central control makes the automotive industry hesitant to cooperate with fleet

operators, governments and local initiatives, as warranty standards and other needs from the demand side cannot be facilitated without transparency in planning.

Visions for a more just energy transition with the implementation of V2G remain unfulfilled. While policy actors aim for a more inclusive design, these visions are not translated into practice yet. Community needs are recognised but remain structurally unsupported, while advancing with other interventions like V2G, which creates new injustices and reinforces distrust (R3, R6). V2G has become another layer in the city's unequal urban system. While being technical functional, but socially selective. As Campos et al. (2024) says, a decentralised system should be accessible for anyone, if it wants to make the energy transition more inclusive, and if it has the aim to aid in affordable end clean energy for all.

4.5.2 Scenario 2: A Just V2G System in ASE

By 2035, ASE is characterised by one of Amsterdam's most inclusive and innovative energy- and mobility ecosystems. A strong component of this is a decentralised yet coordinated V2G system, that is designed around local priorities, community participation, and shared local benefits. The V2G system is guided by a multi-stakeholder core, a dynamic body consisting of residents, private and public actors (R6). This body adapts to local needs, making sure tailored solutions can exist (R3, R6).

Standardised chargers are placed not only in commercially attractive zones, but also near apartment blocks, social housing, and community centres when requested. Community energy cooperatives, for example in Venserpolder, manage and own V2G infrastructure in a way that is desirable for them. With help from a municipality-initiated fund and support from local ambassadors, the cooperative launched shared V2G chargers connected to local energy hubs. In other neighbourhoods, residents have chosen to delegate responsibilities to private and/or public actors, which clearly shows that the energy transition is a collective effort.

Local hubs where community energy and mobility assets are present, become key nodes in the system. These hubs contain shared vehicles, driven by collective solar energy, and are possibly connected to other local energy assets. Event centres, offices and other fleet operators also feed into the local grid, with pre-agreed pricing on energy sharing contracts that benefit surrounding neighbourhoods (R2, R4). Thereby alleviating energy poverty, next to transport poverty in vulnerable neighbourhoods.

Non-EV users can benefit from this V2G system too, through lower local energy costs by keeping the energy in a local loop (R2). Next to that, they can profit from neighbourhood-wide stabilisation of the network and revenue from public charging is reinvested locally (R3, R7). Differentiation in network tariffs reward low consumption households, and local cooperatives can use revenue as they wish, for example by providing more shared mobility services or energy upgrades in social housing blocks.

Moreover, the community has gained more trust in the system. Transparent decision-making processes, open communication, and visible benefits for the community have made residents feel heard and empowered (R1, R3). The decision-making process has been drastically changed. Perceived tokenistic engagement is replaced by active engagement where local voices, from

social renters to energy advocates, hold equal weight as technical experts and commercial actors. As R6 emphasises, recognition needs to take place at the institutional level.

Rather than reinforcing existing inequalities, V2G becomes a means to address them; fair distribution of energy, recognising varied needs and users, and creating an environment where all actors have a voice.

4.6 Creating Future Personas

The six personas created in this section, reveal how justice implications work out differently across social positions, governance roles, and system configurations.

In the BAU scenario, exclusion stands out; residents like Olivia are structurally disconnected from infrastructure, although co-funding it. Smaller actors like Julius are overlooked despite having energy assets and willing to share value with the community. Frank operates with insufficient tools in a fragmented governance structure. Through this approach justice is often overlooked in planning. Each persona reflects a point of view from a user of the V2G system, where current practice reinforces or creates new injustices, identified in the literature and interview data, divided in the three dimensions of justice.

In contrast, the just V2G scenario shows how shifts in governance, infrastructure allocation, and alternative ownership models can reconfigure these dynamics. Co-creation, cooperatives and institutional partnerships, make sure that agency, next to energy is distributed fairly. Residents like Ibrahim can benefit directly without owning an EV, Johan's business serves as an energy sharing node in the V2G system, and municipal strategies have regained steering power by executing justice-based frameworks.

Viewed through the MLP, the patterns behind these persona transformations become visible. Landscape forces like the boost in EV uptake, and pressure of EU and national carbon targets, influence the tempo of change. EU and policy in ASE also steer at justice in the energy transition Yet is becomes clear that the regime layer ultimately decides here who is included or left out in this transition. Flat network tariffs, one-size fits all solutions, fragmentation, and charger allocation policy keep Olivia and Julius paying for a system they can't access. Next to that it leaves Frank with little room to steer. At the niche level, Julius already has the ingredients and willingness to do something but bounce back on the walls of the existing regime and its actors.

Once those walls are torn down, Johan, Ibrahim, and Noor are the example that niche innovations can scale and can become part of the regime level. The personas underline the core MLP lesson running through this research, true justice can only emerge when justice in all three levels is acknowledged and move in harmony rather than in isolation.

Together the personas clearly show where the system has gaps, and where it can be transformed to achieve a just V2G system. The personas provide a grounded lens what a just V2G system requires, while bringing implications and visions from the previous chapters to life through showing user interactions.

The infographic that contains the personas for both scenarios can be found in Figure 14. In Appendix H, the personas can be viewed separately in more detail.

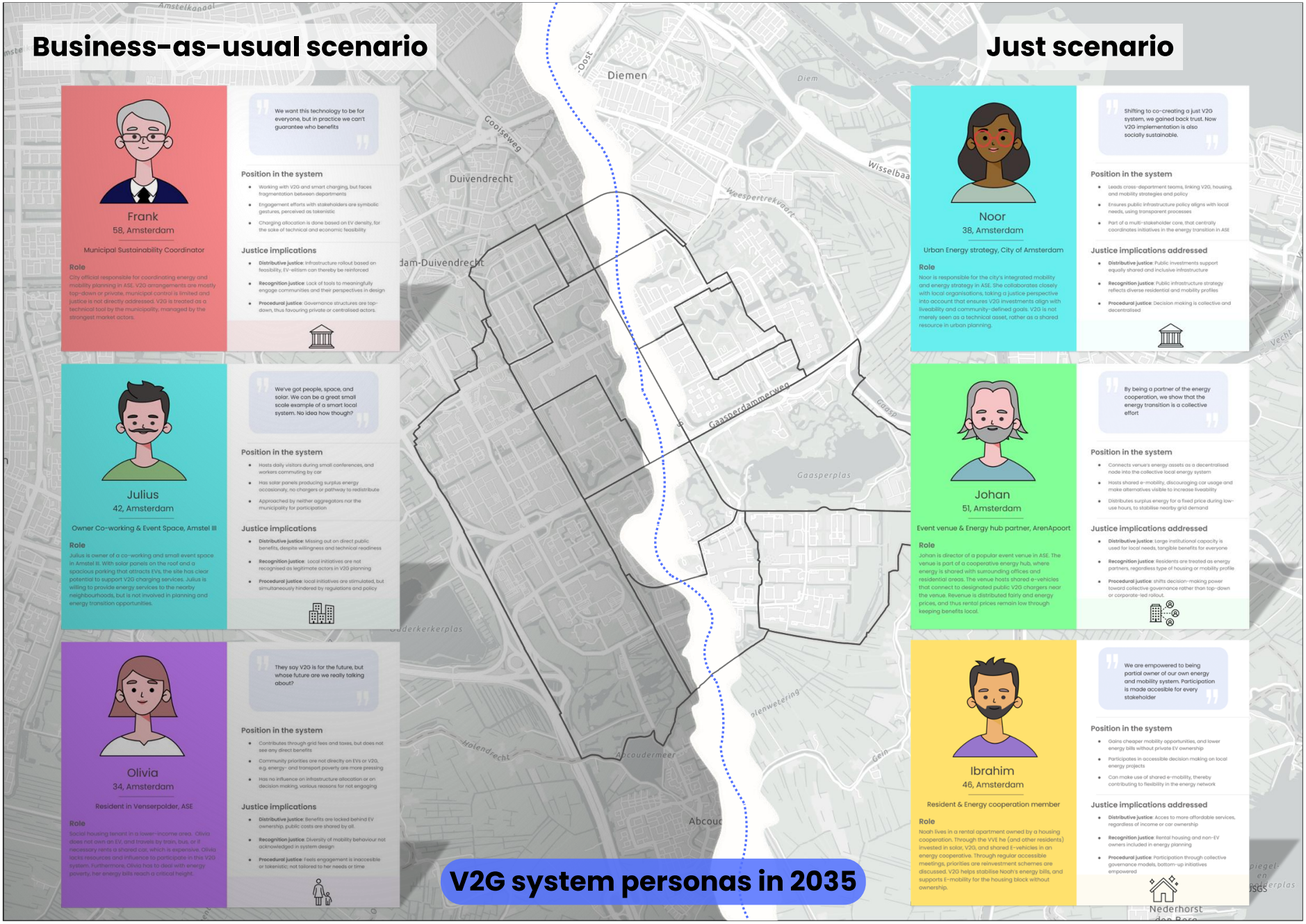

Figure 14. Infographic personas future V2G system (Made by author, 2025)

4.7 Key Justice Implications Identified

In this final results section, Table 6 summarises the key justice implications that mainly distinguish the 'BAU' and 'Just' V2G scenarios. Each implication notable in the narratives and personas is identified through the earlier gathered literature data (see Table 3) and the interview data (see Table 5). In this section the key implications are also tied back to the MLP, to indicate where they primarily occur, which enables to develop targeted recommendations. This mapping clarifies where an implication is rooted: in design choices of the niche (N), in prevailing market or institutional rules (R), or in broader structural conditions (L).

Theme	Key justice implication	BAU → Just scenario	MLP level	Explanation of MLP level
Distributive	Incentives distribution	Incentives captured by EV owners and aggregators → revenue recycled through neighbourhood	R	Set by existing tariff and contract rules
	Infrastructure allocation	Chargers cluster in commercially interesting zones → chargers added to e.g. social housing blocks in combination with carsharing	R	Determined by municipal siting and rollout guidelines
Recognition	Definition of user	Policy frames typical V2G adopter as EV user → renters, people with different mobility behaviour and small businesses acknowledged	R	Framed in current policy and rollout schemes
	Underrepresentation of residents	Technocratic complex procedures sideline communities → residents are represented and actively engaged	L → R	Technocratic planning culture (landscape) shapes regime practices
Procedural	Inclusive decision-making	Tokenistic consultation → multi-stakeholder core facilitates co-decision making	L → R	Tokenistic participation is not just local, this cultural norm that sits in landscape level is visible in the regime
	Fragmentation and lack of standardisation	Fragmented, actor-specific rules, lack of technical standardisation → open technical standards and shared rollout map	N → R	Just, collective pilot standards move into regime and rollout plans
System design & governance	Planning paradigm	Centralised market driven model → hybrid public-, private-, co-op system	R	Ownership model is fixed in governance
Future vision	Success metric	Maximising EV and V2G uptake → V2G as a lever to battle injustices like energy and transport poverty	L	What is the dominant narrative about success & V2G

Table 6. Key justice implications per theme, BAU and just scenario contrast, and MLP level (Made by author, 2025)

Chapter 5: Discussion

The discussion chapter brings together the four different phases of the project and shows why the findings matter for academics and practitioners. Furthermore, it places the results in perspective of the international emergence of V2G in literature and practice. After that, the section looks forward to the next steps.

5.1 Reflection on the Main Results

Literature Review

The literature review revealed a clear paradox in the work encountered. On paper, V2G is described as a technical and economically impressive technology, which has the potential for households and EV owners (which can be fleet operators) to earn money, and create autonomy, while society has the possibility to enjoy cheaper, more flexible, renewable energy. Yet the same sources repeatedly report a narrow group of potential direct users of the technology. In the many quantitative modelling and survey studies, this becomes clear (Sovacool et al., 2018). Bringing this back to the MLP framework, the cause seems structural with such an innovation, rather than accidental. V2G tends to introduce new injustices from niche level and no structural change in alleviating existing injustices.

Most policy guidance documents still assume a centralised or aggregator led model. This model fits homeowners or fleet operators, but leaves little room for renters, non-EV users, and people with totally different mobility behaviours. Proposed decentralised alternatives also do not recognise the absence of a large group in society and its benefits. In the end, every injustice discovered in this review traces back to the consequence of unequal division of costs and benefits. A collectively funded system via tariffs and taxes, while benefits flow to a selected group in society who already own assets. This underpins that the dimensions of justice are all interconnected, as described in the theoretical framework.

Stakeholder Salience Model

Mapping the actors of a V2G system against the attributes power, legitimacy, and urgency from Mitchell et al. (1997) sharpened the picture. It has become clear that four groups; policymakers, the grid operator, automotive firms, and current EV drivers, together hold the ingredients for designing a V2G system of the future. They are all definitive stakeholders holding the technical know-how, capital, and rule-making power to design a system. Tenants, local associations, community energy cooperatives and small businesses possess legitimacy and urgency but lack leverage. Whether those voices are merely consulted or actively invited to co-participate in the system, will largely determine how a future V2G system in ASE can be considered just.

Semi-Structured Interviews

The semi-structured interviews make the justice implications concrete for the case of ASE. The overarching theme was again who bears the expenses of V2G and who eventually reaps the benefits. While residents have concerns about rising tariffs and have questions about access to public infrastructure or tangible benefits in favour of the energy transition, people from the municipality acknowledged current distribution of public chargers and infrastructure favours the already more affluent. Energy system actors confirmed this structural layer and risk of existing

disparities reproducing itself with the introduction of V2G, and the flexibility energy market. People owning the core energy assets such as solar panels, EVs, heat pumps, or home batteries benefit directly.

A second thing that really complemented literature findings was the theme concerning agency and trust. Community intermediaries describe engagement processes for the energy transition in ASE as largely symbolic, which creates distrust. It also becomes clear that engagement in ASE needs unique approaches rather than standardised procedure, since people often prioritise other things above the energy transition. Local initiatives lose enthusiasm when they run into institutional difficulties. Credibility gap widens if stakeholders in ASE have the feeling that decisions are made elsewhere and only communicated top-down, without seeing tangible changes.

Both above mentioned issues feed into the centralisation-decentralisation dilemma of V2G. Interviewees don't frame the issue as choosing between one of them. The need for a backbone that facilitates standards is suggested to keep the automotives and grid operators on board. Next to that, local authority over public infrastructure and legally secured sharing of benefits is suggested. The interviews highlight three concrete mechanisms for enhanced justice: 1) transparent flows of costs and benefits, 2) one coherent set of technical standards that all actors can rely on, and 3) governance that matches local responsibility with real decision-making power, and where needed assistance. This is a hybrid central-decentral model that anchors justice implications mentioned during the interviews, which align mostly with the literature results.

Narratives and Personas

Narratives and personas help to bring readers of this research in the position to feel like how justice implications shape everyday outcomes of a systemic change. It makes the technical implications tangible and relatable. Which opens a platform for discussion, which is the greatest outcome of the narratives and personas. The two narrative scenarios and corresponding personas outlined can be perceived as two extremes. This serves the purpose of showing the contrast and thereby the total impact that a V2G system can have. In a real-life context, a more just V2G scenario could contain components of the described just scenario, which would make it already a step in the right direction. In the end, the personas and narratives are constructed with the purpose of being the foundation for future research. It shows that empirical data of justice, which can be perceived as abstract ethics, can be turned into operational design variables.

Key Justice Implications and Level Mapping

Connecting the key justice implications encountered in this research with the levels of the MLP helps clarifying how and where these implications occur.

Rules in the current regime, such as energy tariff structures, charger rollout strategies, and incentive distribution reinforce and mirror existing patterns in asset ownership. Households that already possess EVs, solar energy, or already act as an aggregator automatically capture flexibility income and can engage with the infrastructure. Recognition gaps are reproduced by the same routines in the regime: policy still acknowledges the private EV owner as typical user for V2G, overlooking renters or people with different mobility behaviour.

However, tokenistic consultation originates higher up. Current energy transition planning procedures are rooted in landscape-level standards, where it relies on complex procedures and technical jargon, which is perceived as a barrier for meaningful engagement and thereby it keeps citizen influence limited. Niche innovations and pilot projects demonstrate an alternative approach, a pathway N → R can be a pathway for more just outcomes if ownership and revenue logic is designed with a focus on justice.

The significant contrast between the two scenarios makes the justice implications lively. The BAU pathway builds upon the incumbent regime and reproduces elitism of technology as identified by Sovacool et al. (2018). The just scenario reshapes who has access to assets and who earns through assets by facilitating a hybrid public-private-co-operative governance model. However, to get there a scenario in between, a 'just-light' configuration would be credible. A scenario in which standards from niche development would stimulate revenue sharing, where the broader narrative probably will still be focussed on private EV-uptake. Advancing beyond this will require the regime to reform steadily, such as adding equity targets and expanding cooperative ownership possibilities, rather than treating them as add-ons. Next to that, constant pressure from landscape at the city and national level to make justice a basic measure of success, not just something we talk about.

Taken together, the results emphasise that the greatest risk to V2G in ASE is about social sustainability and involves spatial justice concerns spanning all three dimensions. On the one hand, it is the possibility that the technology will be perceived as one more thing that extracts value from lower-income households for the benefit of the already affluent. On the other hand, if justice is a design principle, it can fulfil a role as catalyst for engagement in the local energy- and mobility transition and serve as a strong sustainable solution after all.

However, this research does not aim to deliver a silver bullet solution for the implementation of a just V2G system in ASE or beyond. Instead, it offers a grounded and contextualised way forward: a set of empirically informed justice considerations, stakeholder roles, and governance strategies. It can guide further exploration of justice in the energy and mobility transition. The findings provide a reliable starting point for recognising justice implications early, integrating them into urban planning and design, and engaging actors in imagining viable alternatives for the future.

5.2 Reflection on Theories

Reflecting on the theoretical framework that is used in this study, the integration of the MLP together with the three dimensions of justice, proves both necessary and productive. The MLP provides an organised framework to understand how V2G, as a socio-technical innovation (niche), influences and is influenced by changes at the landscape-, regime-, and the niche-level. However, as transition studies have increasingly showed, the MLP itself offers limited understanding of issues of inclusion, power, and distribution. This is pointed out as the ethical aspects of transitions that need to be accounted for (Jenkins et al., 2018; Köhler et al., 2019). Integrating the three dimensions of justice with the MLP and acknowledging the presence of justice implications in all levels of the MLP, provides the missing normative dimension. Therefore, this study not only traces how change happens, but also who it affects and who gets to shape it on each MLP level.

At the same time, using these frameworks together calls for some caution. The implications encountered using the justice framework do not always neatly fit into one MLP level. That is a true difficulty encountered when integrating the two theories.

Distribution, recognition, and procedural justice implications frequently are shaped by all levels, since it is argued that justice implications are present within all levels during transitions, and they can change over time. While the MLP helps to situate patterns of justice and justice theory brings normative clarity, their combination requires careful interpretation to avoid simplification. Ultimately, the approach performs well to identify where and how justice must be addressed to strive for more just transitions. As Romero-Lankao et al. (2023) underscores, the dimensions of justice must be centred in innovations across all levels of the MLP.

5.3 Academic and Societal Relevance

Academic Relevance

This research is unique for V2G research by identifying explicitly the justice implications of the technology, rather than techno-economic modelling which already has been done extensively. This research answers the need for more qualitative research and the dimension of social justice in V2G (Sovacool et al., 2018). Furthermore, the area of study makes it especially a unique case, since diversity, development, and transitions are all a major part of ASE's character. This makes ASE not only an energy and mobility transition hotspot, but also a key study area to deepdive into justice implications of V2G implementation. By using the conceptual framework, taking the lens of the MLP and the dimensions of justice together, the research addresses where justice implications arise and make specific intervention points easier to identify for future research. The stakeholder salience model and semi-structured interviews enrich current literature with empirical data about who is actually holding the power to shape the system in practice.

Finally, translating the justice implications into narratives and future personas bridges the gap between theory and practice for justice scholars. It provides scholars a template for further research that is tangible and accessible, which gives academia the ability to actively engage with non-experts during further research. Next to that, it fulfils the need for conceptualising an inclusive transition, in this case a strong sustainable transition. In sum, the research addresses three gaps; it gives place to justice in V2G research, it operationalises justice inside a well-established transition framework, and it demonstrates a set of research methods for justice that make findings actionable for further co-creative testing (Jenkins et al., 2018; Moss et al., 2015; Noel et al., 2019; Romero-Lankao et al., 2023; Sovacool et al., 2018).

Societal Relevance and Value for Knowledge Users

For planners, grid operators, and municipal employees this research delivers very clear insights; it demonstrates that infrastructure allocation, cost- and revenue distribution, and decision-making processes must be adapted, to account for diverse needs and local conditions, specifically. This research can serve as a call to action for this stakeholder group. The proposed hybrid governance model, where city wide standardisation goes together with local revenue sharing, still offers grid stability goals and thus can be considered a realistic alternative.

Automotives, lease fleets and governments gain clarity on the need of standardisation, a need that affects the effectivity of V2G for lease fleets, brought up by both automotives and

policymakers in this research. The study gives these actors specific points to gain clarity on the need for standardisation, which at first enhances technical feasibility, but can also support more inclusive outcomes when standards are designed to ensure interoperability across shared, public, and community-owned infrastructure. Community organisations and residents receive concrete talking points when engaging and gain access to relatable imaginaries for how a future V2G can look like through this research. This helps overcome the knowledge barrier for participation in the energy transition and should underpin why keeping it simple should be the norm for communication in specific cases.

More broadly, this research not only has value for V2G, but it is an excellent example that one transition can serve as a lever to get other transitions going. In this case V2G has the potential to serve as a lever for addressing systemic injustice in energy and mobility, fair cost distribution, neighbourhood-level empowerment, simultaneously reaching climate targets and social equity policy that is already out there. The research delivers a strong message that sustainable technology alone does not deliver public value, only when access, ownership, and participation are a design component of the system, it can contribute to a fairer and more inclusive transition.

5.4 Actor Roles and Recommendations for Just V2G Implementation

To move from current pathway to a more just V2G future in ASE, different actor groups can take specific roles based on their capabilities, influence, and responsibilities. These roles correspond to justice implications and visions identified in this study. They reflect that socio-technical transitions have a multi-level nature. The stakeholder roles, structured by the main actor groups as done before in this study, are followed by policy recommendations (see Table 7) addressing the key justice implications of this research.

Actor Roles in a Just V2G System

Policy and governance bodies: including municipal authorities and national governments, hold the power to anchor justice within institutional frameworks. Their role is to include justice principles into system design by incorporating justice criteria in tenders, facilitating multi-actor coordination, and harmonising fragmented planning procedures. A leading role for this actor group in enabling hybrid governance models that allow for both standardisation and local autonomy.

Citizens and end users: including renters, non-EV users, and people with different mobility behaviour must be recognised as legitimate stakeholders. They articulate local needs and participate in co-creation of the system through cooperatives, neighbourhood level planning, and during public consultations. This participation must be supported by accessible information and actual influence in planning.

Energy system actors: such as DSOs and municipal energy planners, are the technical backbone of the V2G system. Their responsibility is to ensure that infrastructure serves all socioeconomic groups by planning grid capacity and infrastructure placement with justice in mind. They also have the duty to facilitate neighbourhood-scale flexibility and integrate collective energy assets in a fair and transparent manner.

Advocacy groups, researchers, and intermediaries: crucially act as translators between technical actors and the public. It is their role to draw attention to neglected issues with V2G, make difficult concepts understandable, and co-design participatory methods that enable inclusive engagement. Next to that, they can support local actors by linking them to broader policy and opportunities for funding.

Commercial and market players: among others, consisting of automotives, aggregators, and local businesses, play a critical role in enabling just employment of V2G. Their role is to agree on open standards to ensure interoperability. Aligning business models with inclusive accessibility goals, especially for users beyond private car owners is vital. Rather than steering development alone, they collaborate with community and public actors to support shared infrastructure and develop co-benefits. Local businesses with energy assets can serve as decentralised energy hubs participating in local initiatives.

Although this research mostly focusses on ASE's context, it reveals broader lessons about actor roles and system design for just V2G implementation elsewhere. Firstly, justice outcomes are not solely shaped by who is involved, but rather on how actors are involved. The interview results indicate that tokenistic engagement without real decision-making power risks undermining trust and involvement in transitions. This shows the need for municipalities, commercial and market players, and grid operators to transition from being consultative to co-creative approaches. In this way, local input actually shapes design and governance. Second, private actors, such as automotives, fleet operators, and aggregator platforms cannot be seen as neutral V2G system providers. Their strategy of deployment and design partly decides who participates and who is left out. Therefore, they too carry responsibility for embedding justice principles in their deployment, especially when facilitating in public infrastructure.

Finally, actor roles are dynamic as the system evolves, so roles can differ for every context. ASE is currently a priority are from a top-down perspective and is characterised by a growing number of local initiatives and advocacy groups (e.g. 'Energielab Zuidoost', a knowledge exchange institute for local energy projects in ASE). If this is not the case, municipalities and/or housing corporations need to take more responsibility as facilitator for engagement, to ensure procedural and recognition justice. This can be partly handed over to locals if there is significant community involvement over time.

Policy Recommendations

The policy recommendations in Table 7 respond directly to key justice implications identified in this research, each assigned to a level of the MLP (N = Niche, R = Regime, L = Landscape). The recommendations are grounded in the data collected throughout this study and target concrete system levers in planning, participation, infrastructure rollout and governance. Responsibility is distributed among all actors since this research proposes a hybrid model consisting of a multi stakeholder core. Municipalities and public planning bodies hold a central role in addressing distributive justice implications. They should integrate equity based KPI's in rollout and facilitate revenue sharing mechanism locally. Grid operators that work together closely with the government can make sure that flexibility service revenue is reinvested into underrepresented neighbourhoods. These actions occur mostly at the regime level, which makes them foundational to change and thus priority. Because distributive issues influence who participates in and benefit from the system, they fundamentally shape justice and are essential to avoid reinforcing existing injustices.

Recognition and procedural implications call for more participatory and adaptive approaches. Automotives, mobility providers, and policymakers need to adapt the narrow V2G user definition in design, while municipalities and community advocacy groups are in the best place to improve engagement in transitions and come up with equal representation strategies. These efforts span the regime and landscape levels, targeting both current planning culture and institutional norms. Various governmental organs, from national to local, have a key role in addressing fragmentation, setting standards, and enabling hybrid governance models that makes public, private, and cooperative ownership models possible. Reframing success metrics in V2G befalls to national and advocacy actors, which is essential for long-term policy alignment.

Key justice implication	Policy recommendation	MLP level
Incentives distribution	Introduce local benefit-sharing mechanisms connected to V2G, such as reinvesting revenue from public chargers for community energy projects. Ensure that revenue from flexibility services will be partly reinvested in areas where infrastructure is sited, with special attention for areas where residents are not directly participating. This is in line with Chabot & Liebovitz (2025), enhanced equity in V2G through community benefits.	**R**: targets current structures embedded in rules and market routines
Infrastructure allocation	Develop and integrate equity based KPI's for distribution of public infrastructure (e.g. distance to nearest charger, percentage of V2G revenue reinvested locally). Equity in infrastructure allocation must go beyond economic feasibility and market logic and should account for areas with low EV ownership or mobility poverty. In line with the concern of R2 and R3, stating that the spread of charging infrastructure is unfair.	**R**: addresses current allocation process at the municipality
Definition of user	Recognise non-car ownership profiles in V2G planning models. Make sure different mobility behaviour is considered, e.g. explore concepts like shared V2G capable cars/scooters/cargo-bikes in mobility hubs and energy cooperatives. R2, R5, and R7 stress the need for diverse V2G applications as well. Kahma & Matschoss (2017) add to that by highlighting the importance of the non-user in technological innovation. This also reflects mobility justice theory, by stepping away from car-centric planning (Grossmann et al., 2022a; Verlinghieri & Schwanen, 2020).	**R**: Challenges dominant user assumption in policy, challenges private car use
Underrepresentation of residents	Communication and engagement strategies should be made accessible and understandable for all stakeholders. Establish context specific engagement strategies, such as visual tools or community ambassadors to better match the capacities and priorities of diverse local communities. As argued by Sovacool et al. (2018) social legitimacy in V2G schemes is crucial for equity, trust, and participation. R3 states that the energy transition is often too complicated to engage with for residents.	**L → R**: targets institutional culture through a shift in norms and practice of engagement
Inclusive decision-making	Establish multi-stakeholder decision platforms at the city level. This should link mobility, energy and housing departments with citizens and cooperatives, formalising roles for community groups. Empowering instead of consulting has the potential to discuss issues like siting and ownership of V2G infrastructure. R6 calls for a seat at the table for every stakeholder in V2G planning.	**L → R**: tokenistic participatory planning culture addressed, which stems from culture
Fragmentation and lack of standardisation	Address fragmentation and standardisation by forming cross-departmental units for transition planning. These units should co-develop interoperable standards that apply to private, public, and shared V2G systems, while embedding justice goals directly in the frameworks deployed. Municipal employees, community representatives, researchers, and market players stress the need for this to happen (R1, R3, R6, R8).	**N → R**: standardisation and collective effort helps go from pilot rollout to V2G in the regime, designed with justice
Planning paradigm	Develop and stimulate hybrid governance models, combining central multi-stakeholder control and standardisation, allowing for tailored local ownership. A model where cooperatives, municipalities, and private actors collectively shape V2G projects. This can mitigate power imbalances in rollout and ownership, particularly when collectively funded public infrastructure is used. R2, R3, R6 advocate for local co-ownership of V2G infrastructure. Furthermore, Noel et al. (2019) note that V2G ownership can evolve beyond centralised aggregators over time.	**R**: intervene in the governance and ownership structures in the regime
Success metric	Expand the dominant narrative of successful V2G implementation focussed on adoption rates. Reframe policy success metrics, from only EV uptake to including alleviating energy and mobility poverty.	**L**: aims to revise dominant cultural and political narratives on success in transitions

Table 7. Policy recommendations addressing key justice implications identified through this research (Made by author, 2025)

5.5 Limitations and Future Research

Firstly, the single district focus made sure contextual depth was acquired in the data, but caution is needed when extrapolating the justice implications to other cities or districts. However, it is likely that ASE can be representative and scalable for other similar cities and city districts when looking at justice implications that arise with the implementation of V2G. Applying the proposed just scenario for other areas needs additional research on context specific power dynamics and characteristics.

Furthermore, the eight semi-structured interviews capture cross-actor saturation for the area but do not reveal diversity within actor groups in each case. Resident perspectives were gained through respondents who actively engaged in activities concerning the energy transition in ASE. Due to the limited timeframe of this thesis, it was more convenient to gain data through these channels, since it was noted by preliminary conversations with 'Energielab southeast' and JCA, that approaching residents with technical energy-related questions is not always appreciated and takes a lot of time.

For the creation of scenarios and future personas, only the input of the researcher is used. That means they reflect a single interpretation of the data gathered, instead of being co-created by the voices they represent. Future work should therefore treat this research as a basis for discussion, not a definitive outcome.

Future research in the direction of co-creative workshops can be therefore very valuable to add upon this research. Think of co-creation sessions where tenants, grid operators, municipal workers, and carsharing services sit together and co-create on a just V2G system for the future. In that future research it is also advisable to capture more perspectives from the main actor groups addressed in this research to gain more nuance.

Moreover, future research can also use this research as a basis for evaluating real V2G pilots and assess the justice implications in real-life. Gaining insights into where the money flows and how pilot areas are allocated can be considered very important. This would also make it possible to quantify justice implications or develop measurable KPI's for justice in the energy transition, which make them even more tangible for all stakeholders involved.

Life-cycle work and assessing the justice implications based on scale not on dimensions is also needed. This would for example highlight how justice implications occur on neighbourhood, city, national, and Mondial level. This would expose end-of life logistics and cosmopolitan injustices from what is viewed as 'clean' urban mobility and energy transition.

Chapter 6: Conclusion

This study is answering the main research-question:

What are the justice implications of implementing vehicle-to-grid in Amsterdam Southeast, and how can a just V2G system be conceptualised?

By combining a literature study, the stakeholder salience model, eight semi-structured interviews, and design-based scenarios and personas, now each sub research question can be answered to formulate an overarching answer that provides insights regarding the main research question stated above.

To start with, academic literature about V2G shows a paradoxical pattern: while V2G has the potential to carry clear technical and monetary upsides such as, grid flexibility, higher renewable energy penetration, and new revenue streams, those upsides seem to befall only the already more affluent. Stakeholders like renters, non-EV users help fund public charging through taxes and tariffs yet are seldom recognised as the people who participate and benefit. This mismatch identifies distributive gaps (cost vs. benefits), recognition gaps (who participates, and who is excluded), and procedural gaps (whose voice shapes this system).

Next, the stakeholder salience model in combination with the semi-structured interviews complement those findings for ASE's context. Municipal employees, grid operators, and automotives control the key technical levers. Other stakeholders often lack formal power to demand system design components. Across the interviews four friction points come forward: unequal access to chargers and revenue, low trust in top-down roll-out, fragmented governance without provision of needed standards, a dilemma between centralised efficiency and local autonomy. Residents worry about rising bills and do not see any tangible benefits of the energy transition. Visions for a just V2G system sketch a hybrid system, with a core consisting of multiple stakeholders, and local feedback loops through local tailored cooperative approaches. In short, justice is a design component that needs to be accounted for to establish a future V2G system.

In addition, two narrative future scenarios make these trade-offs tangible. A business-as-usual (BAU) scenario extends todays logic, collectively bearing the costs while revenue streams remain private or unknown, widening and creating new injustices. A just V2G scenario presents a new way: shared hubs, co-ownership models, and transparent revenue division turn parked EVs into community assets. Furthermore, future personas describe the lived experience of various stakeholders in those scenarios. In the BAU scenario, a social tenant and a small entrepreneur willing to participate remain locked out. In the just scenario, a car-free resident, a local business and a municipal strategist all gain a seat at the table.

In conclusion, this research shows that V2G promises two-sided justice implications for ASE. If steered well, it can widen access to cheaper green energy, alleviating energy poverty, turn parked EVs into neighbourhood storage and value, and it can cut costly grid reinforcement that were to be funded collectively. However, the same technology can redirect those benefits only to already affluent people, overlooking renters and people with different mobility behaviours. Next to that, it can reinforce top-down control and therefore reinforce the existing injustices in the regime level.

A just implementation of V2G would mean a hybrid governance model. A central core consisting of various stakeholders facilitates the necessary standardisation for V2G. Furthermore, decentralised context-specific nodes make up the rest of the V2G system, where ownership is mixed and revenue loops remain local. Residents, community organisations and small businesses hold equal power alongside the technical and policy heavyweights. In this configuration, gains in grid flexibility are shared, voices are balanced and V2G becomes a collective asset rather than another elite technology.

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Appendices

Appendix A: Interview Protocol

Interview protocol

Interview Introduction (discussed at start of each interview):

"Thank you for taking the time to participate in this interview. My name is Gilles, and I am currently conducting thesis research as part of the MSc 'Metropolitan Analysis, Design & Engineering' (MADE) programme, at the AMS institute. I'm also completing an internship at the Johan Cruijff ArenA. My research investigates the justice implications of Vehicle-to-Grid (V2G) technologies, with a specific focus on Amsterdam Southeast. This interview will last approximately 30–60 minutes. With your permission, I will record and later transcribe our conversation. All data will be anonymised and used for research purposes only. You are free to skip any question or stop the interview at any time."

Part 1: Introduction and Background

- Can you briefly introduce yourself and describe your current role and connection to this topic?
- How familiar are you with the concept of V2G and with the principles of energy justice (distributive, recognition, and procedural justice)? (If unfamiliar, I provide a short explanation.)

Energy justice	A fair energy system that distributes benefits and costs equitably and ensures inclusive, unbiased decision-making.
V2G	Bidirectional charging, using the car as a battery to provide multiple services for the grid, e.g. flexibility, peak shaving, and renewable storage
Distributive justice	refers to the equitable allocation of resources, opportunities, and burdens across society.
Procedural justice	concerned with the fairness and inclusiveness of the decision-making processes that allocate resources and shape policies.
Recognition justice	focuses on the acknowledgement and respect of diverse identities, cultures, and values within society.

Part 2: Justice Reflections

Goal: Explore how they perceive fairness in the energy transition, especially related to V2G.

- When you think about fairness or justice in the energy transition, what comes to mind?
- In your view, what are the key equity concerns in rolling out technologies like V2G?
- **Prompt-style Questions:** *For if the dimension of justice are not directly addressed, the interviewer can use these questions to steer the conversation*

Distributive, recognition	Who do you believe can or should benefit from V2G, and who might be left out?
Distirbutive	What are your thoughts on the distribution of costs and benefits, given that V2G infrastructure is often publicly funded, or needs to be privately acquired?
Distributive	Do you see risks in decentralisation of energy systems in the future?
Recognition	How might the focus on individual ownership and energy autonomy marginalise other forms of participation, like community energy models?
	What examples (if any) have you seen of inclusive or community-based approaches to mobility and energy?
Procedural	Who should be involved in the process of a just energy transition?
	Do you think these decision-making processes are open, transparent, and inclusive?
	Are legal or institutional barriers (e.g., around energy sharing or group contracts) a challenge to more inclusive participation?

Part 3: Institutional and Practical Dimensions

Goal: Identify real-world limitations, legal or institutional challenges, and power dynamics.

Questions:

- What kinds of legal, organisational, or social barriers do you see in making V2G more inclusive?
- How do you see the role of your own organisation, or the role of a similar actor, in shaping a just V2G system?

Part 4: Future Vision and Solutions

Goal: Gather strategic or imaginative input for scenario development and justice-based system design.

Questions:

- What changes or interventions would be needed to ensure V2G systems develop in a just and inclusive way?
- What role do you think your organisation (or similar actors) can play in this process?
- If you were to describe a just V2G system for Amsterdam Southeast, what would it look like

Closing:

- Is there anything else you'd like to add that we haven’t discussed, but you feel is important?

Appendix B: Full Methodology Stakeholder Salience Model

The stakeholder analysis was done through using the 'stakeholder salience model'. This helped to understand which stakeholders should be considered and who has the power to influence the implementation of V2G. Here, the stakeholder salience model is based the main stakeholders that are involved in various variants for implementing V2G in ASE. Through this model, the stakeholder analysis will give insight into the degree of influence of each individual stakeholder. Mitchell et al. (1997) argue that stakeholders can be divided into seven groups, based on three stakeholder attributes (see Figure15). The combination of attributes determines the type of stakeholder. 'Salience', here, refers to what extent a management or project should give priority to a claim of a different stakeholder (Mitchell et al., 1997).

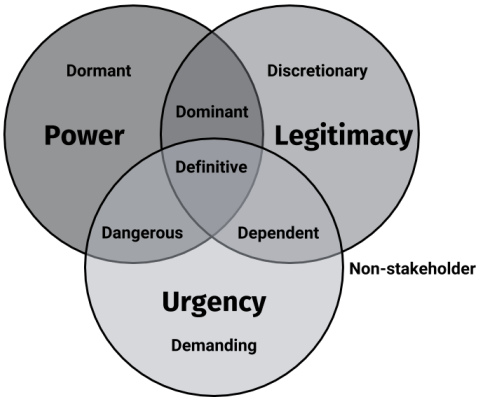


Figure 15. Stakeholder Salience model (Mitchell et al., 1997)

The three stakeholder attributes are:

- **Power:** "A relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not otherwise have done.''
- **Legitimacy:** "A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions.''
- **Urgence:** "The degree to which stakeholder claims call for immediate attention.''

In Table 8, a more elaborate explanation of the seven groups can be found, with their associated attributes and descriptions.

Category	Stakeholder Type (Salience)	Attributes	Description
Latent	Dormant	Power	Does not exert power, because the claim lacks legitimacy and urgence
	Discrete	Legitimacy	Because of lacking power not able to influence
	Demanding	Urgence	Urgent claim made, insufficient legitimacy. No power that can be exerted.
Expecting	Dominant	Power + Legitimacy	The claim is not urgent. Stakeholder expects a lot and gets attention
	Dangerous	Power + Urgence	The stakeholder can be forceful with power and urgence. Nevertheless, it is not always a legitimate claim.
	Dependent	Legitimacy + Urgence	The stakeholder lacks power but has a legitimate and urgent claim.
Definitive	Definitive	Power + Legitimacy + Urgence	Make a legitimate claim and have the power and urgence to act.

Table 8. Description of stakeholder types and attributes by Mitchell et al. (1997)

Three important comments regarding this model should be considered:

- Stakeholder attributes are variable over time.
- Stakeholder attributes are socially constructed, not factual.
- It is only considering three attributes; more attributes can influence stakeholder relationships.

After the stakeholder salience model, a power-interest diagram and stakeholder relationship map will be made. It shows the influence of the different stakeholders, and which stakeholders interact with each other in some way. Furthermore, it shows which stakeholders can be valuable to cooperate with. The definition of a stakeholder according to Mitchell et al. (1997) is as follows: “all the people and organizations that are being influenced by a project”. There is a difference between voluntary and non-voluntary stakeholders. The voluntary actors put some kind of capital into the project (social or financial). Non-voluntary actors are at risk by the activities of the project, but without the risk, there is no importance.

The stakeholder analysis is done to get insight into which actors have the most influence in the energy and mobility transition in ASE. The importance at the beginning of a project is significant, since a well-executed stakeholder analysis can enhance cooperation between parties. The stakeholder analysis is thereafter used to determine which stakeholders should be included in the interviews.

Appendix C: Grid Services of V2G and Related Variants

V2G Grid Services

To start with, V2G can be used for load shifting. This concept shift power consumption to avoid large demand peaks. The V2G technology can reduce the existing peak demands by using the batteries of EVs as a power source and then charge the EVs when demand is low. When applying this locally, this balancing technique can help prevent congestion issues on the distribution grid (Wang & Wang, 2013).

Secondly, grid balancing is a concept where the electrical grid frequency on a stable predefined level, this is done by matching energy demand and supply at every moment in time. Currently, grid operators employ the service, and function as 'Balancing Service Providers' (BSPs), in order to balance the grid. The BSPs are mainly large, centralised entities that consume or provide energy back to the grid in case it is needed. Bidirectional charging functionality allows entities that own and operate V2G charging networks, to become decentralised BPSs, consuming and providing with the aim to balance energy and power (Li et al., 2021).

Finally, local self-consumption of renewable energy can be increased by using V2G technology. To charge the EVs when production of renewables is abundant, and discharge when the production is low, renewable energy can be used more efficient on a local scale (Bartolini et al., 2020). On a macro-scale, mass adoption of V2G can help to mitigate the imbalances created by the incorporation of renewables in the grid, and therefore allow for the share of renewables to increase.

Related Variants

Vehicle-to-Anything (V2X) is an umbrella term, which explains the use of EV batteries to provide energy services during times of non-use, by utilizing the battery assets through bidirectional charging possibilities (Thompson & Perez, 2020). It can deliver benefits to the electrical grid by flattening, reducing or shifting peak energy consumption for homes and buildings, or it can provide backup power when needed. These energy services give grid operators and other stakeholders the flexibility they need to support effective technical management of the electricity grid by combining flexible charging functionalities into a type of dynamic capacity that has the potential to be traded in wholesale and ancillary service markets.

To put it more easily, a V2X ready vehicle can return energy through a (wireless) connection to an external entity. At some point earlier in time, this energy was sourced from the grid in most cases. There are various applications, or entities a vehicle can deliver its energy to. Such applications include 'Vehicle-to-home' (V2H), where the external entity is a home or building, 'Vehicle-to-Building' (V2B), where the entity is a commercial building that pays a demand charge to the utility (Pearre & Ribberink, 2019). V2G is the most well-known V2X topology, where the external entity is a grid management organisation, who's responsibility is to provide stable, reliable electricity for all customers (Kempton & Tomić, 2005; Pearre & Ribberink, 2019; Thompson & Perez, 2020).

Appendix D: Business Model Chain of V2G

Table 9 shows the business model chain of V2G by (Sovacool et al., 2020).

Actors	Description
Automotive manufacturers	Making, selling, maintaining, and developing V2G automobiles
Battery manufacturers	Designing, making, and distributing batteries and improving battery performance
Vehicle owners	Provision of energy or energy services to the grid
Energy suppliers	Electricity sales or electricity charging infrastructure
Transmission and distribution system operators	Grid management and flexibility services
Fleets	Third-party entities that consolidate benefits across multiple vehicles
Aggregators	Third-party entities that manage fleets, and handle interactions with other agents in the business model chain
Mobility as a service providers	Bundling of V2G with automation, ridesharing (carpooling), and mobility as a service
Renewable electricity independent power providers	Bundling of V2G with renewable electricity
Public transit operators	Bundling of V2G with public transit
Secondhand markets	Reselling of used vehicles or components such as batteries
Secondary markets	Peripheral software and information security, private protection, third party financing, marketing and advertising

Table 9. Business model chain V2G, from: Sovacool et al. (2020)

Appendix E: Stakeholder Identification from Literature

Table 10 gives an overview of the stakeholder identified from literature, alongside their role and potential interest in a V2G system.

Stakeholder	Role in the V2G System	Potential Interests
Direct users (EV owners)	Provide energy to the grid through their EVs; benefit from compensation and grid services.	Financial incentives, battery health, convenience, environmental contribution.
Non-direct users	Indirectly impacted by V2G systems, especially in terms of public infrastructure and energy equity.	Affordable energy, fair access to infrastructure, avoiding increased grid costs or spatial injustice.
Grid Operators	Manage electricity distribution; enable V2G integration into the grid infrastructure.	Grid reliability, peak shaving, cost savings on infrastructure investments, avoiding congestion.
Energy Suppliers	Sell electricity and interact with V2G platforms (energy in/outflow dynamics).	Dynamic pricing opportunities, energy efficiency, market competitiveness.
DSOs / TSOs (Distribution/Transmission System Operators)	Ensure technical and operational stability of the grid.	Balancing energy supply and demand, supporting decentralised energy solutions.
Charging Infrastructure Providers	Build and maintain V2G-capable charging stations.	Profitability, user uptake, compatibility with grid and vehicles.
Municipality of Amsterdam	Local policymaker and regulator; oversees urban and energy planning.	Achieving climate neutrality, reducing congestion, inclusive energy access, public acceptance of technology.
National Government	Sets regulatory frameworks, provides subsidies and incentives.	Supporting climate goals, innovation leadership, economic development, energy resilience.
NGOs	Advocate for equitable, sustainable transitions.	Promoting social justice, environmental protection, avoiding green gentrification or elitism in clean tech.

Community Organisations	Represent public interest, especially marginalized groups.	Fair participation, recognition of needs, accessibility of benefits, avoiding exclusion from infrastructure.
Mobility Providers (e.g., GVB, carsharing services)	Potential users or integrators of V2G (fleet-based services).	Operational cost savings, sustainable image, service reliability.
Real Estate Developers / Housing Associations	Integrate V2G in residential or mixed-use developments.	Value creation, energy efficiency, infrastructure cost savings.
Research Institutes	Provide knowledge and evaluate justice implications.	Insights into socio-technical transitions, policymaking support, justice frameworks application.
aggregators	Develop digital platforms to coordinate V2G services.	Data monetization, platform dominance, interoperability, regulatory compliance.
Local businesses	Use V2G to manage peak demands during operation hours; showcase innovation, possibly trade with their own energy assets	Energy cost management, sustainability branding, smart city integration.
Financial Institutions / Insurers	Provide financing for infrastructure; underwrite risk.	Risk management, investment returns, sustainable finance.
Automotive manufacturers	Provide the vehicles participating in V2G, determine which vehicles are V2G compatible	New market opportunities, engaged because of electrification of brand
Battery manufacturers	Provide the batteries that are being (dis)charged, innovation in this sector influences capacity	New market opportunities, overcome barriers such as battery degradation and capacity limits.

Table 10. Stakeholder classification for a general V2G system (Made by author, 2025)

Appendix F: Stakeholder and its Function, Overview ASE

Stakeholder with specifications for potential organisation and its function in the system for ASE are visualised in Table 11.

Stakeholder	Case study party and function
National Government	Dutch national government can assist in deploying V2G in ASE, through annual budget, EU, and national funds for mobility, energy, and climate.
Municipalities	Municipality of Amsterdam, multifunctional and strategic role. Its function spans regulatory, coordinating, and facilitating in the development of the area, and thus with the implementation of new technologies.
Direct users (EV owners)	Residents, commuters to ASE, and visitors for events and leisure activities in the area can use V2G directly when owning an EV. Hereby, receiving incentives for provided service, and enhancing grid flexibility, reliability to a certain degree, depending on their mobility behaviour.
Non-direct users	Individuals or groups in the area who do not directly participate in V2G (e.g. they do not own or operate an EV or charging infrastructure). However, they are affected by V2Gs deployment, financing or spatial presence.
Community organisations	Organisations that can serve as the point of contact, inform and engage with local communities to set up things. An example is 'Stichting Coforce', who aims to create an energy cooperation, where solar energy can be shared in the neighbourhood Venserpolder. These organisations can be public, private, or a combination of both.
Real estate developers	Responsible from planning to realising of real estate project like residential, commercial, and industrial units.
Housing associations	Housing associations (woningcorporaties) develop, own and manage a significant portion of the residential housing in ASE. They provide mostly affordable rental housing. They provide tenant support and community development, so they are an essential partner for projects/pilots regarding energy or mobility innovative development.
Association of owners (VvE)	A VvE is an association of homeowners in multi-unit residential properties in the Netherlands. The association ensures proper management, maintenance, and governance of common areas. It also facilitates communication and decision making among homeowners if needed.
Local Businesses	Operate as energy consumer, often with fluctuating energy demands. However, when local businesses possess energy assets (e.g. solar, wind, battery storage), they can also function as energy provider.
Grid operators	In ASE, Alliander (or Liander which is part of), ensures technical operation, reliability and safety of the electricity network. Tasks include managing grid stability, planning for grid development. In the Netherlands grid operation is legally separated from energy supply by focussing on infrastructure.
Energy suppliers	In ASE, electricity and gas are provided by Vattenfall. They are responsible for selling electricity to end-users. Set the contracts and rates for the service.
DSOs / TSOs	Distribution system operator (DSOs) and transmission system operators (TSOs) are together the grid operators. A TSO runs the overall grid system, its security and functionality, while the DSO operates the distribution network. In the Netherlands the only TSO is Tennet, and the DSO in ASE is Liander.

Charging infrastructure providers	Smart charging infrastructure providers like 'Groendus' (pilot JCA), and 'Wedrivesolar' (pilot Utrecht), provide charging stations that are equipped to use bidirectional charging with the necessary software and hardware to connect (and communicate) with the electricity grid.
NGOs	Non-Governmental organisations advocate for social, environmental, and ethical considerations in transitions. Often represent community interests and underrepresented voices. Can serve as critical partners/ co-designers in projects.
Research institutes	Universities, academia, and applied research centres provide independent knowledge, methods and evidence on various topics. AMS institute, TU Delft, TNO, Energielab Zuidoost provides this knowledge for the energy transition and V2G implementation in ASE.
Urban Planners	Urban planners are responsible for the spatial and strategic coordination of infrastructure, housing, and public space. The same goes for V2G infrastructure alloction, and the integration with mobility, and sustainability plans. In ASE this is mostly done by the municipality in cooperation with advisories, and contractors.
Mobility providers	Mobility providers include public transport (e.g. NS, GVB), and car-fleet operators (e.g. Mywheels, Greenwheels). Lease cars at companies can also be seen as fleets, operated by the lease firm/company form employee that leases.
Financial institutions	Banks, investors, and insurance companies can participate in financing and underwriting risk in the energy and mobility sectors. They have the role of providing capital for V2G deployment and assess the long-term investment risk.
Automotive manufacturers	Carmakers are the producers of V2G-capable EVs. They determine if a car is V2G ready, and compatible with the charging and grid infrastructure. Through their business models they influence user behaviour and adoption. Examples of V2G-compatible cars are: BMW, Volkswagen, Nissan, Renault.
Battery manufacturers	Are responsible for the design, production, and innovation of the batteries in EVs. In the context of V2G, the have a critical role in enabling and shaping the system performance. Battery manufacturers are for example, LG, BYD, Tesla

Table 11. Stakeholder overview in ASE (Made by author, 2025)

Appendix G: Full Thematic Interview Results

Distributive:

Actor group	Results
Policy and governance bodies	Policymakers are aware of the inequities embedded in infrastructure rollout and energy transition benefits. R2 critically reflects on the fairness of charging infrastructure allocation; “everyone pays taxes, also in ASE, why do they have fewer public chargers?”. There’s a structural gap in distributive planning, where lower-income neighbourhoods might fund but not benefit from public infrastructure. R1 expresses its concerns about using public funds for technologies that benefit a selected group; “if V2G remains an expensive solution, we have to ask ourselves, how many people profit from it in the end?”. R1 adds to that that non-direct participants can benefit indirectly, such as through increased grid capacity which allows for more housing. R1 adds that individual V2G implementation, together with solar, connected to a house has benefits for society, by not taking space on the grid, and using renewable energy.
Citizens and end users	Citizen-focussed actors emphasise day-to-day affordability and perceived unfairness in the distribution of benefits among residents of ASE. R3 stresses: “First thing that comes to mind are the costs”, when talking about the energy transition. Another thing that residents state according to R3 is: “if large businesses improve through the transition and we don’t, why would we cooperate?” This quote illustrates a gap between centralised innovation and local needs, where distributive justice is at stake if residents don’t see tangible improvements.
Energy system actors	R4 notes that “the four most important energy assets, solar, the EV, heat pump and home batteries, the ones that have them, are the more affluent in society”. R4 further notices from an energy perspective that these are the most important energy generators and steering mechanisms. It makes the owners able to provide in your own heat and energy, which makes it cheaper for them on the long term. Access and ownership of energy assets thus determines the ability profit from direct benefits like cheaper energy.
Advocacy, researchers and intermediaries	R5 mentions that we should assess carefully who profits from public investment. However, R5 notes that “The more V2G adopters, the less benefits for an individual adopter because the benefits are shared by more people.”. Furthermore, R5 sees difficulty ahead “These are really good questions about fairness and who should pay […] it could be that everyone pays except particular vulnerable groups who are exempted or given discounts.” In this quote the complexity of distributive justice in V2G deployment becomes clear, suggesting that vulnerable groups should be protected from bearing the same financial burdens as others, but how? Distributive justice, he argues, must be considered across all levels of the system, from infrastructure to services. R6 says “the energy transition should happen as cheap as possible according to residents”. The distributive dimension, particularly distribution of costs and benefits, is the most tangible and the most mentioned dimension of justice in practice according to R6.

Commercial and market players	From a business perspective, R7 explains that while public grid upgrades include V2G integration, their costs are socialised, while benefits go to a minority "If you do something (i.e. deploy V2G), you introduce a major advantage, but that comes with collateral damage [...] for example a raise in energy rates for people that don't receive benefits.". Without compensation or other inclusiveness enhancing mechanisms, such a setup risks reinforcing existing energy and mobility inequalities.

Recognition

Actor group	Results
Policy and governance bodies	R1 states; "If we talk about injustice, I think of mobility poverty, a topic we are busy with at the municipality". Mobility policy that changes drastically like obligated electrification, and zero emission zones are out of reach for many people in ASE. This can make them vulnerable. People feel unheard, while having different priorities, and "left-winged sustainable hobbies" that the municipality communicates about to them. R2 tells about how non-EV users are excluded in policy around charging allocation. This makes it even more elite to have and charge an EV in ASE.
Citizens and end users	R3 says; "people are not actively engaging in the energy transition at all, for sure not in Venserpolder where our project was", an important finding at a local initiative, with the aim to start an energy cooperation in Venserpolder. Furthermore, white progressive males were dominant in sessions about the energy cooperation. A particular demographic profile, that is not representative for the rest of ASE. This implies that active participation is far from inclusive now. Smart innovative development was a long way off for most citizens. A main goal became, to put people in their strengths rather than seeing them as vulnerable, which is a major pitfall. such recognition must be carefully balanced to avoid reinforcing stigmas or undermining their agency and emotional well-being.
Energy system actors	Strong advocates for the energy transition are needed to facilitate local bottom-up initiatives, says R4. An example of a well-functioning project concerning energy sharing between homes, is steered by a local energy commission. Which is a group of people who volunteer to stimulate the local energy transition, and have good connections with the municipality, know how to find the right subsidies, host information events for the community. R4 points out that this is also lacking in other projects, "yes guys, we need those local ambassadors, who will pull this carriage, and preferably volunteers". This finding clashes with the inability for some citizens and other stakeholders to engage with the energy transition for various reasons.
Advocacy, researchers and intermediaries	Most vehicles and goods rely on EVs, the system is for "whoever could own a car" as pointed out by R5. R5 also notes that recognitions justice extends to multiple levels of the system like, roads, cars, chargers, energy services and goods. The focus on car ownership can be seen as a recognition injustice, it can be other electric vehicles too. According to R5, Techno-economic research focussed on cars is most dominant in V2G literature, without recognising alternatives. R6 feels the energy transition should be seen as something owned and carried by all. From that recognition we can build on collaboration. Tokenism is also at stake, "Only inviting people for a consultation evening feels as tokenism" says R6. It is emphasised that "recognition also takes place at the institutional level",

	making it even more complex. It calls for systemic change in how institutions acknowledge and incorporate diverse voices, moving beyond performative engagement toward genuinely inclusive governance.
Commercial and market players	R7 highlights different priorities among citizens in ASE, the current generation worries more about paying the bills rather than thinking along. However, the new generation in ASE is up to date and needs to be involved. Furthermore, R7 emphasises that justice depends on how a technology is used and the people implementing it determine the degree of justice. R8 acknowledges that automotives only place V2G capabilities in their high-end models. "If we would implement more expensive V2G technology now in our cheapest model, the production costs would only increase" says R8. For this reason, automotives don't apply V2G to every model yet. Prioritisation for affluent customers can lead to exclusion of V2G technology for people who can't afford the high-end models, what has been called "Ev-elitism" in literature. However, electrification is stimulated by keeping the prices lower, while not incorporating V2G in cheaper EV models.

Procedural

Actor group	Results
Policy and governance bodies	Asking the question whether an intervention is desired by citizens, and what consequences policy might have for particular social groups is something the municipality should ask itself according to R1. R1 adds to that they are responsible to see where the costs and benefits go when a public V2G system will be deployed, and that it should be co-created with all stakeholders considered. However, R2 present a critical view on justice in policy and practice; "we talk about justice and write about it in policy, but don't act, this happens throughout the whole Netherlands". This view shows the lack of institutional mechanisms for implementation of justice principles. This gap between words and action may deepen distrust and hinder engagement, especially in communities like ASE, where inclusive engagement already needs more attention.
Citizens and end users	The relationship between governing actors and residents in ASE is marked by tension and fragility. Despite efforts to involve citizens in future planning, many residents remain wary of the sincerity behind such engagement. This reflects a deeper procedural justice concern: while participation may be formally encouraged, a lack of trust in transparent communication undermines its effectiveness. As R3 explains: *"When people have the feeling that something is sold to them nicely, but there's a catch, they quickly withdraw. They want to be taken seriously."* This quote highlights a key barrier to inclusive governance. It shows the perception that participatory efforts are tokenistic. For procedural justice to be achieved, participation must go beyond formal invitations; it requires genuine, open, and honest dialogue where resident input meaningfully

	shapes decisions. Without this, community engagement risks deepening existing distrust rather than enhancing inclusiveness. Furthermore, what R3 also points out is that full decentralisation is not wanted by all citizens, some are willing to outsource pursuing the energy transition, as long as it happens transparent Next to that, although residents are told they can start local energy cooperatives, conflicting rules and fragmented governance make real participation nearly impossible. As R3 puts it: *"On one hand the government says: go ahead, start a cooperative. But because of other rules, like around charging stations, you still need the government, and then they say, 'we don't deal with that in this department.'"* This reflects a lack of clear responsibilities and coordination between departments, which obstructs residents' ability to act. Such mixed signals create procedural injustice by offering symbolic inclusion without removing institutional barriers.
Energy system actors	While having experience with multiple V2G pilots, the lack of standardisation is a problem according to R4. "I am disappointed that it takes so long [...] that no decision has been made, we put the converter in the car or in the charger" says R4. Now the technology is implemented differently everywhere. Standardisation would make implementation, and bottom up initiatives with V2G easier, since the pool of suitable cars would increase significantly.
Advocacy, researchers and intermediaries	A car-oriented policy approach, although focussed on EVs, can reinforce procedural injustice when it fails to involve diverse mobility users in decision-making. As R5 noted down for example, *"Norwegian transport policy is still about cars [...] The tax break for a single Tesla owner was equivalent to 20,000 bus tickets."*. This highlights how policy enthusiasm for cars undermines broader, more inclusive transport planning, sidelining voices who depend on alternative forms of mobility. R6 makes a strong argument for more transparent planning in the energy transition and highlights an example of someone thinking that he/she switched from heat provider years ago, however, it was the same provider only under a different name. R6 tells: "residents want a piece of control, and want to know why things happen". When people cannot trace how decisions are made, or who is responsible, trust in governance is decreasing, which opposes an inclusive energy transition. R6 further adds that the municipality lacked a directing role in ASE in a previous project, which made the whole energy transition not a collective but fragmented. This is what R3 also experienced when pursuing a local energy initiative in ASE.
Commercial and market players	R7 points out that decision making processes in ASE are very transparent and inclusive. All stakeholders can have input on decisions. However, R7 shares that "you have to be active [..] if you don't take the opportunity in this society, then you will be skipped". This reveals a procedural justice tension as noted by R2 as well, opportunities may exist in theory, but in practice they privilege those with time, knowledge, and the confidence to engage.

	A core procedural justice issue emerges in the absence of clear standards and institutional leadership. R8 illustrates this through the disconnect between policymakers and automotives: "A car manufacturer just wants to hear: these are the standards, put this in your car and then we can make it work. But there are none." Without national or EU-level guidelines on V2G compatibility, car manufacturers are hesitant to act, waiting for clarity. Meanwhile, government actors themselves remain unsure tells R8: "Dutch government says: we don't know yet what those vehicles are capable and what we have to do" This chicken-and-egg story results in inertia. When no one defines the rules or responsibilities, development stays fragmented and slow. A lack of clear standards can limit implementation and collective action. Actors with less institutional resources or authority may be especially limited by this circumstance.

System design & Governance

Actor group	Results
Policy and governance bodies	System design and governance challenges are deeply rooted in institutional fragmentation and inconsistent policy alignment. R1 tells there's for example a department dealing with the placement of chargers, a department for carsharing, and another for justice. In this way there's no collective way forward. R2 adds to that, charging policy is not coupled yet, "there's policy for accessibility to public charging, policy for stabilisation of the network, but it is not connected". This disconnect undermines the possibility for integrated, just V2G development. This reveals a critical gap: without coordination, justice considerations risk becoming afterthoughts instead of integral design criteria. Moreover, the current design logic privileges car owners and centralized players. R1 notes that many OEMs are reluctant to support V2G: *"In the pilot at ArenA, we see that some car manufacturers and lease agencies discourage or prohibit participation."* This resistance reinforces top-down technological control, inhibiting broader stakeholder participation, slowing innovation and limiting inclusivity. Local business could already share energy with another local energy hub, or with batteries (in cars), under the condition that they share the same congestion service provider (CSP). "If that's the case, it could happen tomorrow" says R2. Local energy is way cheaper than energy from the grid supplier, due to taxes says R2. In this way sharing local energy could decrease energy prices and could have the possibility to alleviate local energy poverty. However, such prerequisites and lack of other standards hinder participation.
Citizens and end users	How do residents work together with private parties, municipalities, and community organisations? R3 addresses the difficulty in reaching people currently when trying to collaborate on the energy transition. Residents in social housing feel disempowered, with decisions resting in the hands of VVE boards or housing corporations. As R3 explains: *"Particularly people with lower incomes […] feel they have less decision power than homeowners in the same building."* Without structural recognition of this

	asymmetry, decentralised solutions risk worsening injustice by shifting responsibilities without support. Initiatives for decentralised solutions, such as an energy cooperation with VVE owned chargers are blocked by regulations, only public chargers could be placed potentially. However, in that case, the benefits, if it would be a V2G charger, would not befall the residents or VVE necessarily. R3 points out the difficulty in institutional barriers for taking initiative, which on the one hand is stimulated but also blocked by the same municipality. In this way citizen-led governance, and inclusive participation, is structurally obstructed. Local energy governance often collides with top-down frameworks. As R3 puts it: *"There is no one-size-fits-all"* But the municipality imposes uniform frameworks that do not fit the local context. This raises questions about adaptive governance capacity in V2G deployment. Moreover, R3 suggests energy pricing should be steered by grid congestion rather than market supply/demand, highlighting the need for a justice-oriented rethinking of pricing logic.
Energy system actors	Grid costs are not differentiated by actual energy usage or strain of the system but instead applied equally among all users. R4 points out, this means that low usage, often vulnerable residents, pay the same network fees as wealthy, high consuming households with energy assets, such as EVs, solar panels, and home batteries; "Aunt Sien […], who uses almost nothing, pays the same fee as a resident with a Tesla and solar panels".
Advocacy, researchers and intermediaries	At the system level, fragmentation and political inertia are identified as core barriers. R6 explains: *"It's difficult to shape the energy transition, because no party dares to take the lead."* This lacking leadership causes untransparent collaboration processes, creating confusion and slowing equitable progress. Moreover, R6 cautions against assuming uniformity in participation approaches. Some formats work for one group, but not another. A justice-based approach demands tailored engagement and dynamic, adaptive governance. R5 problematises the decentralisation ideal, pointing to a fundamental systems contradiction: *"You can't have one neighbourhood using one standard and another using another. It doesn't work."* This reveals the technical need for centralized coordination, conflicting with local energy autonomy discourses. Aggregators and intermediaries, according to R5, are essential for get a V2G system up to scale. R2 added to that, for significant grid stabilisation, 100-200 cars are needed, it could save construction of one energy substation. R5 draws attention to an overlooked dimension of current system design and governance. Namely the cosmopolitan justice dimension; global social and environmental costs embedded in technologies like V2G and EVs. R5 critiques; "When you decarbonise transport […], you buy out the conventional car with an EV, the conventional car doesn't just disappear. It goes somewhere.". Justice, therefore, must also question supply chains and end-of-life practices, not just local use.

Commercial and market players	R7 reflects on the discourse between centralized grid connection and autonomous, profit-driven microgrids. *"If you connect to the existing grid, you create many dependencies."* Yet in decentralized models, R7 articulates; *"It becomes a matter of checks and balances, profit and loss."* This underscores how system design decisions shape both justice outcomes and commercial viability. Justice here is directly linked to the system values; profit-driven or not, dependency on third parties who need their share or not. While not yet profitable, R7 sees value in pilot projects such as V2G as symbolic interventions: metaphors for what justice and sustainability could look like if scaled. This vision positions commercial actors not only as market players but as supporters of public value, if they are willing to act beyond short-term gains. R8 states that the current system makes automotives reluctant to innovate fast, this has to do with the lack of standardisation. R8 tells that: "many automotives know that their vehicles are ready for V2G, they simply don't 'turn it on' ". Furthermore, that's why some automotives start piloting with V2G anyway, to show governments what is needed to make this really work. R8 makes clear that more cooperation between actors is needed in a V2G system that will work. As an example, R8 says that automotives cannot guarantee on battery life, in case the charging operator (public or private) is not transparent about the amount of charging cycles. The same goes for fleet operators who allow for V2G, this will change the warranty that comes with the purchase of a vehicle.

Future visions

Actor group	Results
Policy and governance bodies	Public accessibility and co-ownership are central to the vision of a just V2G system shared by policy actors. One interviewee (R1) emphasizes the importance of ensuring V2G is not a top-down technological rollout, but something co-created with communities: *"It would definitely be something public. Thus, accessible for everyone in Southeast"* This reflects a distributive justice concern, ensuring access for all, especially in underserved districts like ASE. R1 continues: *"That you listen carefully to the neighbourhood's residents… is this what southeast needs at the moment ?"* This illustrates a desire to arrange planning around local needs and priorities, addressing both recognition and procedural justice. The implication is that inclusive participation is a prerequisite for a just V2G system. R2 envisions a V2G future that is rooted in neighbourhood scale, which will support both mobility justice and local energy resilience. "Then I would plan this mobility hub, with shared scooters, cargo bikes, cars, in a way that people who can't afford a car in the future, can make use of this collective shared transportation." R2 advocates for local collective ownership models of the hub, connected to public infrastructure. In this way the benefits

	befall the community. Furthermore, R2 phrases a just V2G system as a system where energy can be shared and where local businesses help the neighbourhood; “If the event centres or offices attract 100-200 people that participate in V2G, we can stabilise the net and offer cheap energy to the neighbourhood” Such a decentralised but cooperative model reduce dependency on utilities and tackle energy and mobility poverty through local loops.
Citizens and end users	R3 stresses that residents need customised solutions for distribution of burdens and benefits of V2G, the infrastructure should be standardised. For example: “In Venserpolder, if there’s an energy cooperation, it can go through the VVE’s, who are very much involved [...] in a different place people can decide for themselves locally”. This emphasises the need for place-based energy justice, avoiding pressing local needs are forgotten through one-size-fits-all policy, it fosters local empowerment. R3 argues that chargers should be owned by a cooperation or local community. In this way the potential revenue is for the community and can decrease energy costs or be reinvested. R3 also sees collaboration opportunities with event centres: “visitors often park in Venserpolder, because it is cheap and has a lot of spaces [...]. place V2G chargers, and if visitors park there, the neighbourhood gets the profit.”. R3 tackles distributive justice by arguing that V2G chargers should be owned by the local community, so the financial benefits are local. It also addresses recognition justice by building on how Venserpolder is already used, visitors already park there, so why not let the community profit from that? There’s also a procedural justice angle: if the community owns the chargers, they also get a say in how things are managed and where the money goes.
Energy system actors	R4 proposes differentiating the network tariffs by peak usage “because then you are rewarded as a small consumer, and more burden is placed on the major consumers”. This system is already implemented in Belgium and has the potential to make the energy system more just. Furthermore, R4 highlights the potential of large fleets of carsharing for V2G, since behaviour is more predictable. A large number is needed to make real impact, but R4 says that people sadly still hold on to private cars too much. Energy sharing between residents and other stakeholders with predetermined pricing agreements, is something that R4 is piloting now as well. These prices will then be fixed and don’t adjust to the market. This has potential to decrease overall energy pricing by eliminating the power of the market.
Advocacy, researchers and intermediaries	R5 provides a more critical systems-level reflection on the justice dimensions embedded within V2G’s lifecycle. He argues that justice in V2G systems requires holistic design, spanning vehicles, infrastructure, and the use phase. R5 explains: “I think for V2G, it is these very different parts of the V2G technology supply chain or lifecycle that give you the most intervention points” R5’s vision for a just V2G system also involves rethinking ownership, scale and participation.

	"if you're going to go vehicle to grid, it's not just a car. It could be a truck or a minivan, or it could even be one of the other things, fleets. Having fleets of users like rental car agencies or municipalities or police departments are a huge place of doing adoption." Whereas he argues that household to household adoption had to many barriers. R6 emphasises that a just system must be adaptive, dynamic and co-owned, proposing: *"I think how an ideal system would look like, is that it is on the one hand decentralised, but that there is some control somewhere [...] this centre moves together with its nodes.".* This centre should be composed of public and private parties. R6 believes that when all parties have a seat at the table, it enables to adapt and move faster.
Commercial and market players	R7's vision is one where revenues from V2G systems are partly reinvested into carsharing programmes, neighbourhood associations, or EV access, addressing recognition and access gaps. This business logic challenges the assumption that only private EV owners should benefit and opens doors to shared justice-driven V2G models. Next to that, R7 suggests coupling it with solar and a building. "That you essentially assign micro self-sufficiency, so micro energy management, to places where you also implement vehicle-to-grid.". This brings energy autonomy for residents. It facilitates a local energy- and mobility loop where benefits remain local. R8's vision on V2G emphasises decrease of EV- and energy prices due to obligated electrification, and standardisation of V2G in the future. This would increase flexibility in the grid for everyone, whether owning an EV or not. Maturing of the market in this case makes EV's and its benefits more accessible to everyone, in shared, rented or bought form according to the automotive's vision. R8 says to get there: "subsidy on EVs that can do V2G is a just solution in this early adopter stage", especially as it would benefit society as a whole later.

Appendix H: Personas in Detail

Bau scenario personas

Frank

58, Amsterdam

Municipal Sustainability Coordinator

Role

City official responsible for coordinating energy and mobility planning in ASE. V2G arrangements are mostly top-down or private, municipal control is limited and justice is not directly addressed. V2G is treated as a technical tool by the municipality, managed by the strongest market actors.

> We want this technology to be for everyone, but in practice we can't guarantee who benefits

Position in the system

- Working with V2G and smart charging, but faces fragmentation between departments
- Engagement efforts with stakeholders are symbolic gestures, perceived as tokenistic
- Charging allocation is done based on EV density, for the sake of technical and economic feasibility

Justice implications

- **Distributive justice**: Infrastructure rollout based on feasibility, EV-elitism can thereby be reinforced
- **Recognition justice**: Lack of tools to meaningfully engage communities and their perspectives in design
- **Procedural justice**: Governance structures are top-down, thus favouring private or centralised actors.

Julius

42, Amsterdam

Owner Co-working & Event Space, Amstel III

Role

Julius is owner of a co-working and small event space in Amstel III. With solar panels on the roof and a spacious parking that attracts EVs, the site has clear potential to support V2G charging services. Julius is willing to provide energy services to the nearby neighbourhoods, but is not involved in planning and energy transition opportunities.

> We've got people, space, and solar. We can be a great small scale example of a smart local system. No idea how though?

Position in the system

- Hosts daily visitors during small conferences, and workers commuting by car
- Has solar panels producing surplus energy occasionaly, no chargers or pathway to redistribute
- Approached by neither aggregators nor the municipality for participation

Justice implications

- **Distributive justice**: Missing out on direct public benefits, despite willingness and technical readiness
- **Recognition justice**: Local initiatives are not recognised as legitimate actors in V2G planning
- **Procedural justice**: local initiatives are stimulated, but simultaneously hindered by regulations and policy

Olivia

34, Amsterdam

Resident in Venserpolder, ASE

Role

Social housing tenant in a lower-income area. Olivia does not own an EV, and travels by train, bus, or if necessary rents a shared car, which is expensive. Olivia lacks resources and influence to participate in this V2G system. Furthermore, Olivia has to deal with energy poverty, her energy bills reach a critical height.

> They say V2G is for the future, but whose future are we really talking about?

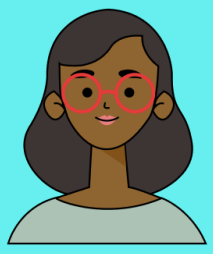
Position in the system

- Contributes through grid fees and taxes, but does not see any direct benefits
- Community priorities are not directly on EVs or V2G, e.g. energy- and transport poverty are more pressing
- Has no influence on infrastructure allocation or on decision making, various reasons for not engaging

Justice implications

- **Distributive justice**: Benefits are locked behind EV ownership, public costs are shared by all.
- **Recognition justice**: Diversity of mobility behaviour not acknowledged in system design
- **Procedural justice**: Feels engagement is inaccesible or tokenistic; not tailored to her needs or time

Just V2G scenario personas



Noor

38, Amsterdam

Urban Energy strategy, City of Amsterdam

Role

Noor is responsible for the city's integrated mobility and energy strategy in ASE. She collaborates closely with local organisations, taking a justice perspective into account that ensures V2G investments align with liveability and community-defined goals. V2G is not merely seen as a technical asset, rather as a shared resource in urban planning.

> Shifting to co-creating a just V2G system, we gained back trust. Now V2G implementation is also socially sustainable.

Position in the system

- Leads cross-department teams, linking V2G, housing, and mobility strategies and policy
- Ensures public infrastructure policy aligns with local needs, using transparent processes
- Part of a multi-stakeholder core, that centrally coordinates initiatives in the energy transition in ASE

Justice implications addressed

- **Distributive justice**: Public investments support equally shared and inclusive infrastructure
- **Recognition justice**: Public infrastructure strategy reflects diverse residential and mobility profiles
- **Procedural justice**: Decision making is collective and decentralised

Johan

51, Amsterdam

Event venue & Energy hub partner, ArenApoort

Role

Johan is director of a popular event venue in ASE. The venue is part of a cooperative energy hub, where energy is shared with surrounding offices and residential areas. The venue hosts shared e-vehicles that connect to designated public V2G chargers near the venue. Revenue is distributed fairly and energy prices, and thus rental prices remain low through keeping benefits local.

> By being a partner of the energy cooperation, we show that the energy transition is a collective effort

Position in the system

- Connects venue's energy assets as a decentralised node into the collective local energy system
- Hosts shared e-mobility, discouraging car usage and make alternatives visible to increase liveability
- Distributes surplus energy for a fixed price during low-use hours, to stabilise nearby grid demand

Justice implications addressed

- **Distributive justice**: Large institutional capacity is used for local needs, tangible benefits for everyone
- **Recognition justice**: Residents are treated as energy partners, regardless type of housing or mobility profile
- **Procedural justice**: shifts decision-making power toward collective governance rather than top-down or corporate-led rollout.

Ibrahim

46, Amsterdam

Resident & Energy cooperation member

Role

Noah lives in a rental apartment owned by a housing cooperation. Through the VVE he (and other residents) invested in solar, V2G, and shared E-vehicles in an energy cooperative. Through regular accessible meetings, priorities are reinvestment schemes are discussed. V2G helps stabilise Noah's energy bills, and supports E-mobility for the housing block without ownership.

> We are empowered to being partial owner of our own energy and mobility system. Participation is made accesible for every stakeholder

Position in the system

- Gains cheaper mobility opportunities, and lower energy bills without private EV ownership
- Participates in accessible decision making on local energy projects
- Can make use of shared e-mobility, thereby contributing to flexibility in the energy network

Justice implications addressed

- **Distributive justice**: Acces to more affordable services, regardless of income or car ownership
- **Recognition justice**: Rental housing and non-EV owners included in energy planning
- **Procedural justice**: Participation through collective governance models, bottom-up initiatives empowered