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Original research article

Strong plans, weak levers: Identifying institutional limits to reducing car dependence in Finland

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ABSTRACT

Car dependence remains a persistent form of carbon lock-in, embedded in infrastructure, institutions, and everyday practices. While reducing private car use is recognized as essential for low-carbon transitions, less attention has been paid to how institutional design shapes the ability of different governance levels to pursue such goals.

This study examines how institutional design enables or constrains efforts to reduce car dependence in Finland's capital region. The analysis draws on an extensive set of policy, strategy, and regulatory documents spanning national, regional, and municipal governance levels. Using institutional grammar and institutional network analysis, the study systematically codes institutional statements and maps their interactions across governance levels. It further examines developments across two policy cycles and compares three neighboring cities to assess how institutional design evolves over time and across local contexts.

The findings reveal strong strategic alignment across governance levels, with shared commitments to densification, public transport, and active and shared mobility. However, this coherence coexists with limited authority: municipalities can innovate in land use and parking policies but lack access to key demand-management instruments, such as congestion charges. Moreover, cyclical planning and assessment rarely lead to substantive policy adjustments, limiting adaptive learning and reinforcing incremental rather than transformative change.

The study contributes to research on institutional lock-in and transition governance by showing how coherent but weakly empowered governance structures can support innovation while constraining system-wide change. Accelerating the shift away from car dependence requires strengthening national frameworks, expanding local authority over demand-management tools, and implementing more responsive assessment mechanisms.

1. Introduction

The transportation sector accounts for a significant share of energy consumption and emissions, making it a key target for global sustainability efforts. Moreover, the transportation sector has proven difficult to transform, mainly due to carbon lock-in caused by car dependence [1–3]. Widespread car use was a significant socioeconomic change in the twentieth century that fundamentally transformed society and the economy [4]. For instance, in the European Union (EU) today, passenger cars represent 75% of transportation activity [5]. Although the energy efficiency of cars has improved over the years, it has not been enough to reduce their environmental footprints and shift toward low-carbon mobility [6–8]. Such a shift requires not only reducing dependence on fossil fuels but, perhaps more importantly, reducing car dependence

[9–11].

Since the widespread adoption of the car, much effort has been devoted to understanding how society responded to the car and how different sociotechnical systems developed and became institutionalized around the car [12–16]. Lock-in describes the process whereby different technological and institutional factors become increasingly intertwined over time, effectively anchoring the economy within a particular ‘techno-institutional complex’ [2]. The car-dependent mobility system is a prime example of how the car industry and car-related policies, infrastructure, and land use have evolved in tandem, creating a car ownership culture that values freedom of mobility [12,16–19]. Although individual elements of this system may seem easy to change, collectively they create a seemingly stable system that, over time, results in policy inertia and becomes increasingly difficult to change [1].

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Lock-ins occur at and across different levels of governance (e.g., national, regional, and local), different scales of organizing (e.g., individual, collective, organizational, and sectoral), and different dimensions of path dependence (e.g., institutional and technological) [2,20]. To overcome lock-ins and create more sustainable path dependencies, efforts need to be coordinated across the system [20,21]. Although national governments are responsible for aligning policy goals with transnational emission-reduction targets and guiding climate action toward them, actual change tends to manifest more locally because regional and municipal actors, along with public and private organizations and citizens, implement changes. Overcoming infrastructural or technological lock-in typically depends on the expected viability and lifespan of existing systems, the costs of transitioning away from them, and the availability of alternatives [21]. In contrast, escaping institutional lock-in requires the institutional capacity to promote change, such as by creating structures that support more sustainable solutions and essentially destabilize carbon-intensive systems to allow low-carbon alternatives to displace them [21].

Regarding car dependence, researchers have generally identified two alternative pathways for changing the system and shifting away from private cars [22]: 1) shifting toward more collective and active mobility modes, and 2) decreasing the overall demand for mobility. The first approach involves increasing the use of public transport, shifting from private to shared vehicles, and adopting more active modes of mobility, such as walking and cycling. The second approach involves transitioning to low-mobility lifestyles and reducing the need to travel, especially for short local trips. Although many technologies (such as data infrastructures and digital platforms) and business models (including ride-hailing, shared vehicles, and delivery services) exist that could reduce the need for private cars, their impact on car dependence has so far been limited. For example, in 2020, travel that depended on passenger cars declined due to COVID-19 movement restrictions, but it recovered quickly, and steady growth has since resumed [5]. Previous research has shown that institutional factors are a key reason for this, especially the lack of institutional support for alternative pathways [23–26]. A key question, then, is how carbon lock-in caused by car dependence can be addressed within the current institutional environment and how institutional support for more sustainable pathways can be strengthened.

Addressing carbon lock-in is not only a matter of identifying policy goals or articulating shared ambitions; it also depends on whether actors at different governance levels have the authority and instruments needed to act on those ambitions [27,28]. In many mobility governance systems, including Finland's, responsibilities for land use, infrastructure, public transport, and demand-management instruments are distributed unevenly across national, regional, and municipal levels. This means that even when actors at these levels agree on the importance of a goal, their capacity to implement measures for achieving it varies considerably. Consequently, a strong commitment at the strategic level may coexist with a limited practical ability to intervene, creating tension between shared goals and uneven capacity, with direct implications for system change. It was this tension—shaped by institutional design choices—that motivated our study.

To explore this tension, we examined the institutional design of low-carbon mobility in Finland. We specifically looked at the interactions that a policy goal, in this case reducing car dependence, undergoes as it is reinterpreted through the politics of place, analyzing institutional design across the national, regional, and municipal governance levels and comparing practices in three neighboring cities (Helsinki, Vantaa, and Espoo). We defined institutions as the formal and informal rules that guide behavior [29,30], recognizing that a deeper understanding of place-based institutional dynamics is crucial for developing contributions that better reflect the political and societal realities of sustainability transitions [31,32]. In practice, we employed institutional grammar (IG) as a coding scheme to dissect statements that describe the institutional environment, after which we applied institutional network analysis (INA) to connect statements across levels. INA is particularly

useful for analyzing complex institutional environments because it offers a framework for systematically mapping and connecting formal and informal rules that govern a system, capturing unique local challenges and opportunities.

The remainder of this article is organized as follows. In Section 2, we review literature on car dependence, lock-in, and institutional governance of sustainability transitions. In Section 3, we outline the research context. In Section 4, we explain the methodology, including data collection, coding, and network construction. In Section 5, we present the results, and in Section 6, we discuss their implications for theory and practice, highlighting opportunities for future research. Section 7 concludes the paper.

2. Reducing car dependence: Sustainability transitions and the role of institutions

Sustainability transitions are typically conceptualized as complex processes of change, whereby societal systems evolve over time, transitioning from one state to another [33]. In transition research, these processes are described in terms of dynamic multilevel interactions, with the social, technological, and material aspects of society interacting and co-evolving into seemingly stable societal systems [4,33]. These systems may be resistant to change because of the many lock-ins and path dependencies that evolve over time, but they are not static; they continuously evolve and are shaped by competing solutions and practices [34]. A central objective of transition research is to explain the mechanisms underpinning stability and change [35], which is why institutions play an important role in transition research.

Institutions can be understood as the rules, norms, and strategies that govern collective behavior, resulting in observable patterns and regularities [29,36]. Institutional analysis concerns the structure and meaning of institutions and can reveal sources of stability and opportunities for change [29,37], such as voids created by the absence of rules [38]. In the context of transitions, institutions are known to influence actors' capacities to intervene and drive change [39–41]. Whether institutions facilitate or limit this capacity is vital for understanding the pace and direction of change. Adaptive capacity, defined as a system's ability to anticipate, respond, and adapt to changes in the environment, tends to be greater when institutions foster actor diversity, autonomous innovation, ongoing learning, and fair governance practices [42]. Hölscher, Frantzeskaki, and Loorbach [43] distinguish between transformative capacity (the ability to support novel ideas and practices that have the potential to bring about greater systemic change) and orchestrating capacity (the ability to mobilize and align efforts across multiple levels and domains). Especially when transitions require differing local approaches, the capacity of actors to mobilize and adapt institutional arrangements to meet local needs is a crucial enabling aspect of institutional design [39,40].

Regarding car dependence, the current mobility system has co-evolved with the institutions that maintain it, and new technologies, practices, and business models are needed to challenge it. However, not all solutions are equally viable or fair in all locations [44–46]. For instance, research on the urban-rural divide [47]–[49] has highlighted the importance of place in sustainability transitions [45]. Comparisons of potential pathways to sustainable mobility across different local contexts have shown that urban regions are more likely to benefit from multimodal mobility, where collective and active mobility modes are seamlessly integrated to promote sustainable behavior and reduce car dependence [50,51]. This might include integrating transport with land use and reallocating car space to other modes of transport [10]. In rural areas, it is more difficult to alter car-dependent mobility patterns, but measures could include, for instance, on-demand and shared car services that reduce reliance on cars without complete replacement [52]. Subsequently, cities are often recognized as having greater potential to reduce car dependence [9,10,50,53].

Concerning multilevel governance, previous research has

highlighted a common oversight in institutional efforts—higher-level initiatives sometimes overlook the specific local contexts in which change occurs, thereby reducing their effectiveness [46,49,54] and potentially increasing resistance to change [47]. For local actors to manage transitions effectively, they need sufficient independence to allow them to focus on the changes most relevant to their local contexts [55]. Consequently, a flexible but coherent institutional design requires broad stakeholder engagement, coordination, and policy support across multiple levels. National governments, the actions of which can both facilitate and constrain change, play a key role in developing policies, coordination mechanisms, and fiscal structures to guide implementation across different sectors and levels of government [56]. Ideally, this should lead to clearly understood shared goals while ensuring local capabilities for change. Local governments, on the other hand, play a key role in bridging higher-level governance voids, shaping place-based interventions, and initiating local service-level improvements and land use changes, such as those linked to infrastructure, parking, and traffic management [10,57–59]. Together, different levels of government can align collective efforts and institutionalize more sustainable options [40]. If efforts are poorly aligned, negative feedback loops or contradictory measures may prevent consistent progress toward shared goals.

As Rosenbloom and Rinscheid [60] noted, destabilizing carbon-intensive systems necessitates weakening multiple lock-ins simultaneously. Researchers investigating policies for sustainable mobility have emphasized the importance of using multiple instruments and intervention points and bundling measures together, rather than relying on a single measure [25,57,61–64]. This involves combining complementary restrictive and supportive measures, addressing interdependence, and sequencing different measures. For instance, policies that restrict car use should be paired with enhancements in alternative mobility solutions to ensure legitimacy and fairness [57]. An example would be congestion charges paired with better park-and-ride facilities and improved public transport services.

Having explained the key elements of institutional design that can help break lock-ins and overcome path dependencies, we next describe the research design that we employed in this paper.

3. Research context: Sustainable mobility in Finland

To analyze how a policy goal, in this case reducing car dependence, was addressed in the institutional environment and shaped through the politics of place, we analyzed institutional design in Finland, focusing on the capital region as the local context.

Located in northern Europe, Finland—one of the most sparsely populated countries in Europe—is characterized by low population density and high motorization rates [65,66], with a significant share of the population relying on passenger cars as their primary means of mobility. At the same time, Finnish cities are experiencing ongoing urbanization [67], which creates both opportunities and a need for them to address car dependence in order to grow sustainably. However, due to significant regional differences, uniform transition is both politically and practically unfeasible; instead, semi-conflicting transitions need to be supported to cater to diverse and often regionally specific needs. This presents an empirically interesting challenge for institutional design, as national structures need to facilitate local transitions that differ from one another.

The capital region of Finland is home to more than 20% of the population [67], making it the largest urban area in the country. It includes three of Finland's six largest cities—Helsinki, Espoo, and Vantaa—as well as smaller municipalities. It has a modern public transport system and has been recognized internationally as a thought leader in innovative mobility services [68], but it struggles to address car dependence. This tension between a progressive mindset and practical struggles made the capital region an interesting case for studying institutional design. Moreover, the location of three large cities in close proximity to each other added analytical value, enabling us to analyze

both vertical and horizontal alignment and reveal aspects of institutional coherence and flexibility.

Examining mobility patterns in the capital region more closely, Fig. 1 shows that cars overtook public transport by the late 1980s in terms of the number of trips, with demand continuing to rise in subsequent years, closely mirroring population growth. After 2018, population growth became decoupled from mobility demand; however, the proportion of car trips relative to public transport trips stayed the same, and the observed decoupling was mainly due to an increase in remote work—a change initially driven by the COVID-19 pandemic and the movement restrictions during that period.

Fig. 2 clearly shows the differences in the proportions of transport modes in Helsinki, Espoo, and Vantaa—the three neighboring cities. Although the overall modal share of passenger cars was lower in Helsinki, Espoo and Vantaa managed to decrease the modal share of cars in 2023 compared to previous years, whereas in Helsinki, the modal share of cars increased slightly. The same applied to public transport, but in the opposite direction. When considering the share of active mobility modes (i.e., walking and cycling combined), it is clear that the proportion increased steadily in all three cities over time.

Institutions that govern urban mobility in Finland's capital region exist at multiple levels. The overarching national goals concerning environmental sustainability, which directly impact mobility-related goals, are outlined in the Climate Act (423/2022). This act requires that all efforts to reduce greenhouse gas (GHG) emissions, improve carbon sinks, and implement other climate change adaptation and mitigation measures must be evaluated and recorded in a series of climate policy planning documents, including a long-term climate plan, a medium-term climate plan, a land use sector climate plan, and a national climate change plan. Additionally, an annual climate change report must be published to evaluate the effectiveness of the current measures and specify areas for further action.

Regarding mobility, the primary goal is to reduce GHG emissions from domestic transport by half compared to 2005 levels by 2030 and to eliminate these emissions entirely by 2045 [70]. Institutions that influence action toward this goal include formal rules and regulations that give structure to the mobility market, allocate power and responsibility among various actors, and organize official planning and implementation processes across different sectors and levels of governance. Examples include the Transport Services Act (320/2017) and the Municipalities Act (410/2015). In addition to regulatory frameworks, several established planning and strategy processes steer the transition efforts. They include, for example, the national transport system plan and the roadmap for fossil-free transport; agreements between the state and urban regions on land use, housing, and transport (in Finnish, MAL agreements); regional sustainable urban mobility plans (SUMPs); and municipal strategies and plans. Ultimately, these formal structures and regulations can be contrasted with practices observed at the local level, thereby aiding the assessment of adaptive capacity and coherence across multiple levels. Many of the described processes are cyclical, involving the temporal features of institutional design and facilitating the assessment of adaptive capacity over time.

4. Institutional analysis

To conduct this study, we employed an institutional analysis approach, progressing from data collection to analysis in four steps, as illustrated in Fig. 3.

4.1. Data collection

In the first step, we gathered data through desk research, reviewing regulatory, policy, and strategy documents to understand the research context and the institutions that address car dependence at different governance levels in Finland. Since the focus of the study was on understanding the role of institutional design and place-based institutional

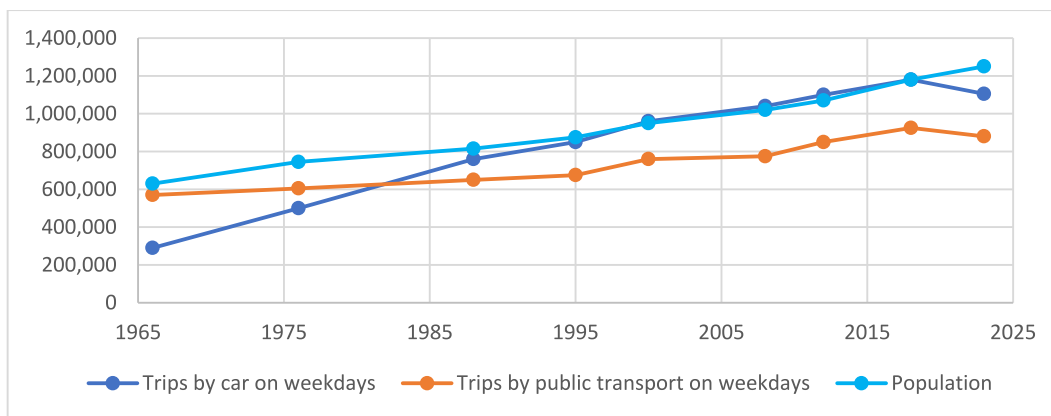


Fig. 1. Population growth and trips by car and public transport during weekdays in the capital region of Finland, 1966–2023. Based on the Helsinki Regional Transport Authority (HSL) [69].

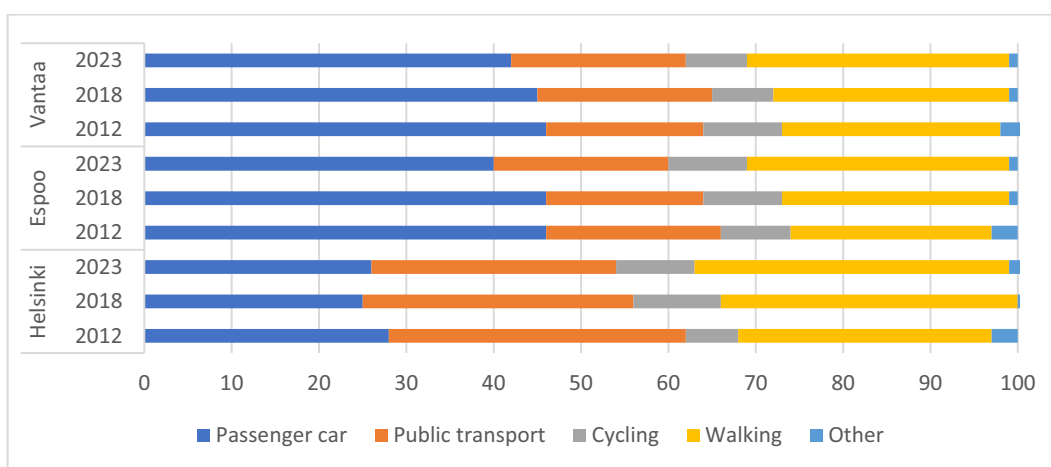


Fig. 2. Comparison of modal shares in Helsinki, Espoo, and Vantaa in 2012, 2018, and 2023. Based on HSL [69].

dynamics, we first examined regulations related to broad climate action and assessment and then moved to regulations that structured the mobility market, as well as key strategy and planning processes related to sustainable mobility. At the national level, these included the *Roadmap to Fossil-Free Transport* and the *National Transport System Plan*. At the regional level, they included MAL agreements and plans, which are negotiated every four years by major urban regions and the state. At the city level, they included various norms, programs, plans, and roadmaps that defined the local approach to tackling car dependence. Because the focus was on car dependence, we considered only policies and practices that supported alternative modes of mobility or reduced private car use. Consequently, we intentionally ignored measures related to electrification. Although electrification and other technologies that make cars cleaner are important for facilitating sustainable mobility more broadly, they do not address car dependence, which remains a core issue in cities.

Table 1 summarizes the data collection and coding outcomes, organized by level of analysis. We aimed to cover all binding frameworks and the primary strategic and planning instruments at each level relevant to car dependence in the capital region. All documents analyzed were retrieved from official repositories, including ministry, public authority, and city websites and portals, as well as from legal databases. Moreover, all data were publicly available. A detailed list of the data sources used in the analysis is provided in Appendix A. To enhance clarity, data are color-coded by level of analysis, including the regulatory landscape (blue), national level (green), regional level (yellow), and city level (pink).

4.2. Data coding

Having identified relevant documents for analysis at the national, regional, and municipal levels, the second step involved using IG to systematically extract and code institutional statements from these documents. Originally introduced by Crawford and Ostrom in 1995 [36], IG enables researchers to examine the structure, content, and performance of institutions in an organized and systematic way, making it useful for studying a wide range of governance challenges [71–75].

In this study, we employed the IG 2.0 syntax [76] to code institutional statements. IG 2.0 distinguishes between two types of institutional statements: constitutive and regulative. Constitutive statements define an institutional setting, whereas regulative statements specify the duties and discretion of actors. Although constitutive rules shape governance architecture, our analytical focus was on regulative statements because they specify actionable responsibilities and instruments that are relevant to implementation.

Each regulative statement in IG 2.0 must include at least three parts: an Attribute (A) that identifies the responsible stakeholder or entity, an Aim (I) that describes the required action or outcome, and a Context (C) that specifies when the statement applies. Additionally, the IG 2.0 syntax recognizes Direct Objects (Bdir), which refer to the receiver of an action; Indirect Objects (Bind), which refer to the object indirectly affected by an action; Deontic (D), which indicates the extent to which an action is compelled or restrained; and an Or Else (O), which states the consequence of noncompliance. At the regulatory, national, and regional levels, statements were easy to extract because the regulation, strategy,

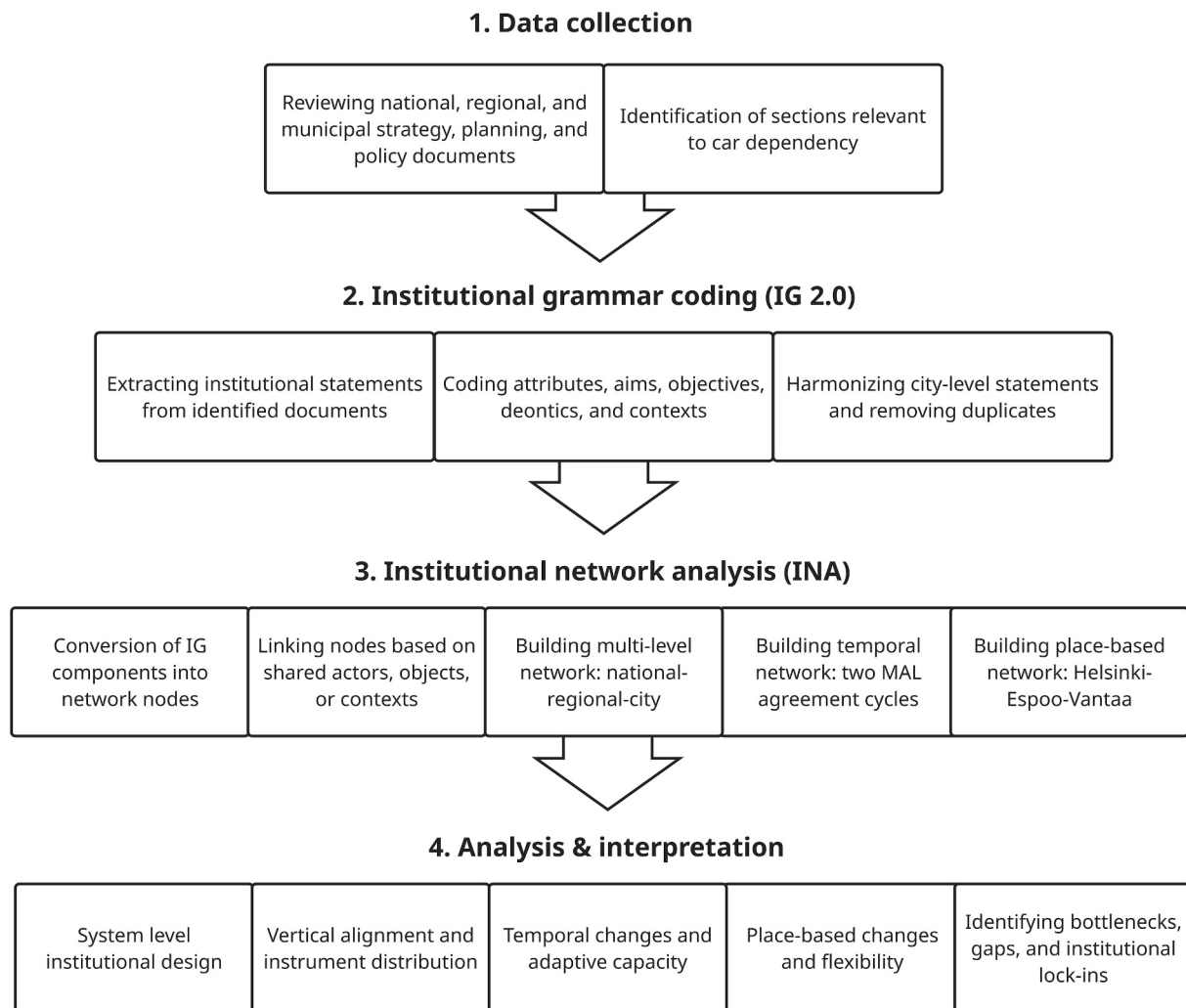


Fig. 3. Overview of the research approach, from data collection to analysis.

and planning processes were clearly organized and documented. However, at the city level, we analyzed a broader range of documents, which resulted in many overlapping statements. Consequently, we removed duplicates and performed some harmonization during the coding to make comparisons across cities more meaningful. For example, the *Helsinki Bicycle Action Plan 2020–2025* outlined several measures to improve winter maintenance, including the use of contractors, the development of new practices, and the hiring of a project manager. Instead of coding each of these measures separately, we used an aggregate statement, coded as shown below:

To improve the conditions for cycling (C) Helsinki (A) shall (D) improve (I) year-round maintenance (Bdir) on priority routes (Bind).

Appendix B lists all the extracted institutional statements, grouped by analytical level. A total of 166 statements were identified, describing the regulatory landscape (28 statements), including general roles and responsibilities in the mobility market, and institutional dynamics at the national (24 statements), regional (50 statements across two planning cycles, some repeated), and local levels (64 statements, of which 25 related to Helsinki, 24 to Vantaa, and 15 to Espoo). In addition, we assigned each institutional statement an identity number (ID) based on consecutive numbering and the level of analysis it addressed. Formal regulations describing the overall landscape were abbreviated as FR; national-level statements as N; regional-level statements as R; and city-level statements as E, H, and V for the cities of Espoo, Helsinki, and Vantaa, respectively. Moving forward, we will refer to institutional statements by their corresponding IDs.

4.3. Network construction and analysis

After coding all the statements, the third step involved visualizing them as a network structure using INA. A network structure enhances IG's analytical value by revealing connections between institutional statements that IG considers separate. For instance, it can be used to track chains of actions and dependencies within rule systems, helping to identify bottlenecks, fragmentation, and weak points in coordination across different levels. In our case, INA allowed us to compare concentrations and absences of authority and instruments by tracing shared objects and actor dependencies across statements—which were not apparent when examining statements alone.

In practice, INA involves using network diagrams to connect the syntactic components in IG, including stakeholders, objects, and contexts [77]. To create these diagrams, we assigned specific shapes to the syntactic components of IG and linked them to illustrate the relationships among the various institutional statements that made up the institutional design. Fig. 4 illustrates the structure of an institutional statement for a network diagram. A more detailed protocol for coding and connecting IG statements using INA is provided in Appendix C.

In this study, we constructed and analyzed network diagrams from multiple perspectives to capture multilevel, temporal, and place-based institutional dynamics in Finland's mobility governance system. First, we mapped the overarching institutional architecture that structured the mobility system. This network provided a system-level view of how formal rules assigned authority, defined roles for public and private

Table 1
Summary table showing data collection and coding outcomes, with color-coding by analytical level (the same color scheme is used in subsequent network illustrations).

Analytical level (color-coded)	Number of data sources	Amount of data	Number of extracted institutional statements
Regulatory landscape	6	~340 pages	28
National level	2	~190 pages	24
Regional level	6	~216 pages	50
City level	25: 8 for Helsinki, 8 for Espoo, and 9 for Vantaa	~1,408 pages: 454 for Helsinki, 320 for Espoo, and 634 for Vantaa	65: 25 for Helsinki, 15 for Espoo, and 24 for Vantaa
In total	39	~2,154 pages	166

actors, and established mechanisms for coordinating actions across the mobility market. The aim was to identify institutional foundations, including where power resided, which actors held decision-making authority, and what levers existed to influence the governance of car dependence.

Second, we examined how institutional arrangements interacted across national, regional, and municipal levels. This step involved assessing vertical coherence by identifying where mandates and responsibilities aligned or diverged across layers of government. To explore institutional evolution, we also compared two consecutive land use, housing, and transport agreements (MAL 2020–2031 and MAL 2024–2035). This temporal comparison enabled us to assess whether cyclical evaluation processes translated into meaningful adjustments in institutional priorities or instruments—an indicator of adaptive capacity.

Third, we compared the institutional networks of the three cities in the capital region (Helsinki, Espoo, and Vantaa). This analysis focused on divergence and convergence in local policy priorities, revealing the degree of place-based flexibility and how municipalities operationalized shared regional goals. Comparing the three cities provided insights into both institutional coherence across the region and the extent of local discretion that could sustain or break lock-ins.

Finally, we integrated all institutional statements into a unified network to provide a holistic view of the rules shaping mobility governance. The resulting network allowed us to identify institutional strengths, sources of adaptive and transformative capacity, and gaps or misalignments that could impede efforts to reduce car dependence. Fig. 5 provides an overview of the network structure. A more detailed network diagram is provided in Appendix C.

5. Results

5.1. Overall regulatory landscape

Finland's mobility governance system allocates responsibilities clearly across the state, regional, and municipal levels. Municipalities held primary authority over land use and local mobility systems, while public transport in the capital region was coordinated through a dedicated regional body (see, e.g., institutional statements FR1–FR4, FR9, FR13, and FR25 in Appendix B). This structure combined centralized strategic coordination with meaningful local discretion, creating space for institutional experimentation, particularly in dense areas where reallocating street space and adjusting parking norms have become important tools for tackling car dependence.

At the same time, the institutional design included ongoing efforts to manage interactions between public and private mobility actors. Recent regulatory additions, such as open-data requirements and shared ticketing interfaces (FR14–FR18), as well as local licensing rules for micromobility fleets (FR12–FR13), have responded directly to emerging business models. These measures have expanded the scope of coordination but often left operational details ambiguous. As illustrated in

Fig. 6, responsibilities partly defaulted to the regional public transport authority, which has both the capacity and the incentive to maintain system coherence, but also has institutional interests to protect (FR26–FR28).

Overall, regulatory developments reflected a reactive and adaptive, rather than an anticipatory, trend. Reforms followed market developments rather than reshaping underlying structures in advance. Municipal autonomy facilitated progressive practices, such as street-space reallocation and differentiated parking norms, but key transformative levers, particularly demand-side pricing instruments, remained underused. The regulatory landscape, therefore, appears supportive and facilitative but not yet transformative. Consequently, several institutional voids persist, especially concerning the governance of platform-based mobility integration and the ability to implement robust car-demand management.

5.2. Multilevel and temporal dynamics: National–regional–municipal alignment

Across governance levels, there was strong strategic coherence, as illustrated in Fig. 7. National strategies, regional MAL agreements, and municipal programs consistently emphasized dense land use development, high-quality public transport, and strengthened walking and cycling networks (see, e.g., institutional statements N8–N9, R6, R10, R30–31, H4, V4, and E4 in Appendix B). This alignment suggests a shared understanding of the problem and a broadly consistent approach to reducing car dependence in urban areas.

However, the distribution of the instruments revealed a structural imbalance. National policy focused largely on supportive tools, such as funding programs, guidance, and enabling frameworks, while restrictive tools remained politically constrained (R19–R26 and R44–R47). Negotiations in the MAL process have raised issues such as mobility-benefit reforms, remote-work incentives, and the need for additional demand-management tools (e.g., congestion charges), yet these proposals have not advanced. Consequently, municipalities bear the responsibility for restrictive interventions but operate with a limited range of tools. This demonstrates that national-level lock-ins shape local transition possibilities; cities may be committed to acting but cannot fully steer demand without state-level authorization.

Regional agreements played a critical coordinating role in aligning investment priorities and establishing shared targets. However, they did not impose binding implementation obligations. Consequently, the locus of transformative action remained municipal, and many municipal interventions have been reactive, responding to the growth of micromobility or car-sharing markets rather than proactively restructuring mobility systems.

Over time, MAL agreements exhibited consistency in goals and governance mechanisms, indicating institutional stability. However, despite formal monitoring cycles, policy adjustments have been limited; learning processes function procedurally rather than as engines of adaptive institutional change. Shifts in national political priorities also

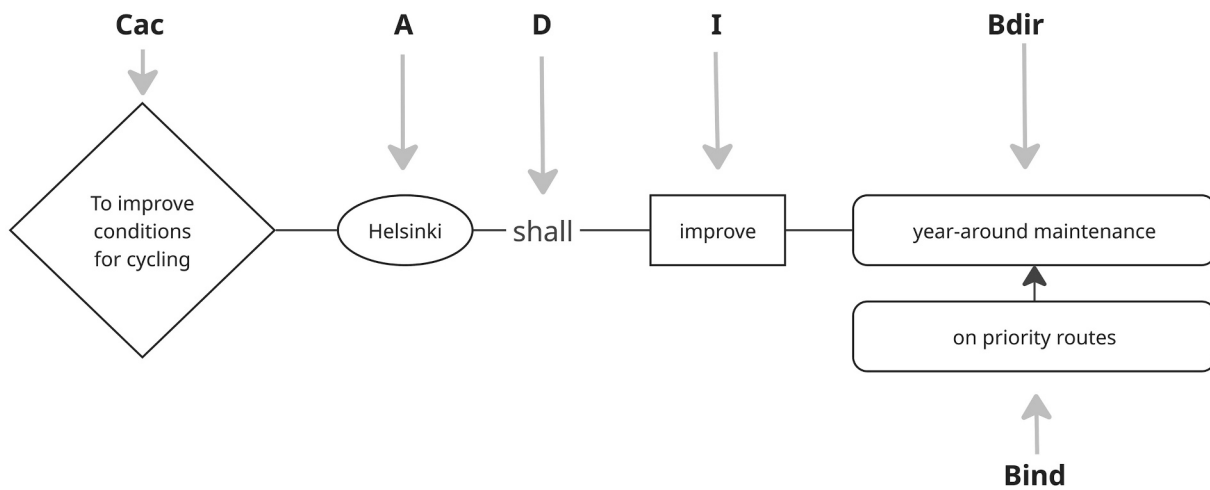


Fig. 4. Institutional statement represented in network format.

influenced funding and weakened the specificity of commitments in some periods, demonstrating that national politics shape urban transition trajectories. Although MAL agreements remain valuable as steering and coordination instruments, their adaptive capacity, linking monitoring to substantive policy shifts, appears underdeveloped.

5.3. Regional dynamics: Comparing Helsinki, Espoo, and Vantaa

Within the metropolitan region, all three cities shared a strategic direction, but they differed in the scale and pace of implementation. Regional public transport governance ensured network integration and

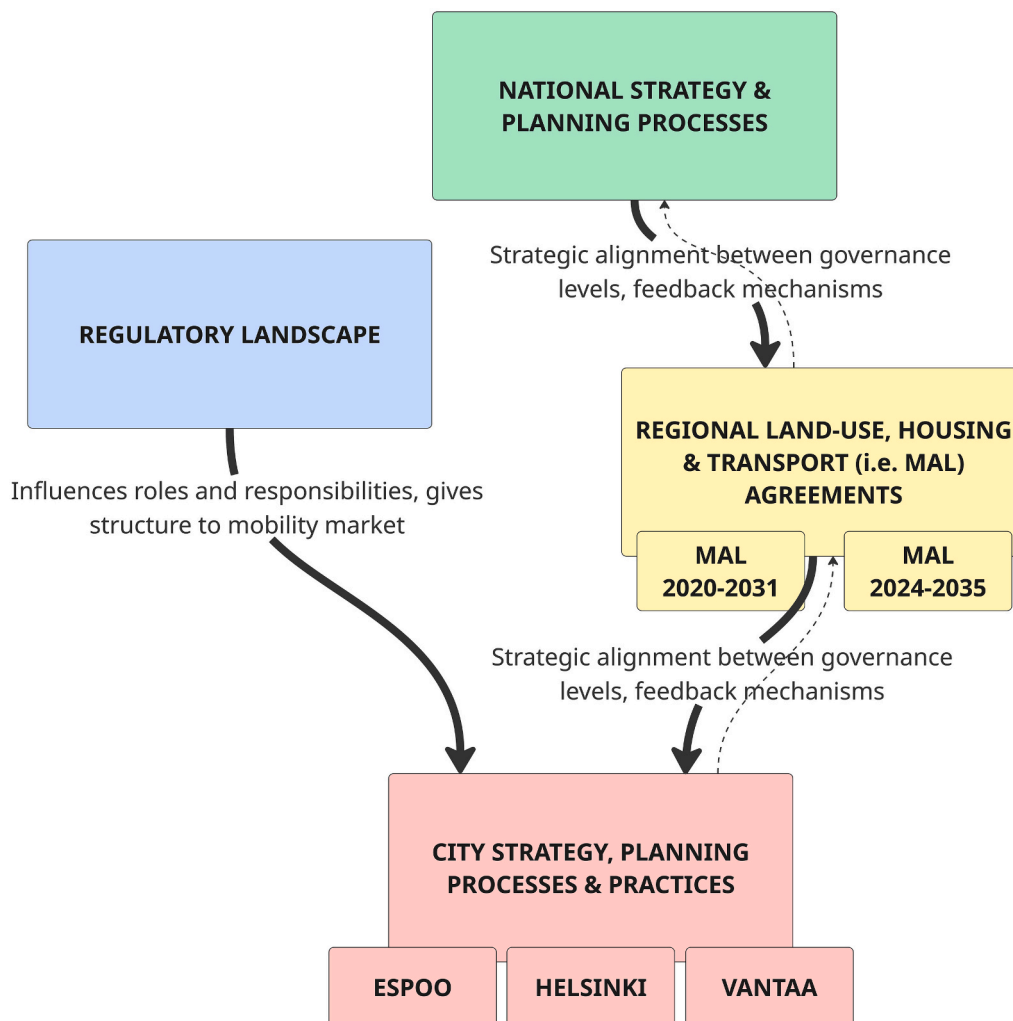


Fig. 5. Overview of the constructed network diagrams, including their analytical perspectives and relationships.

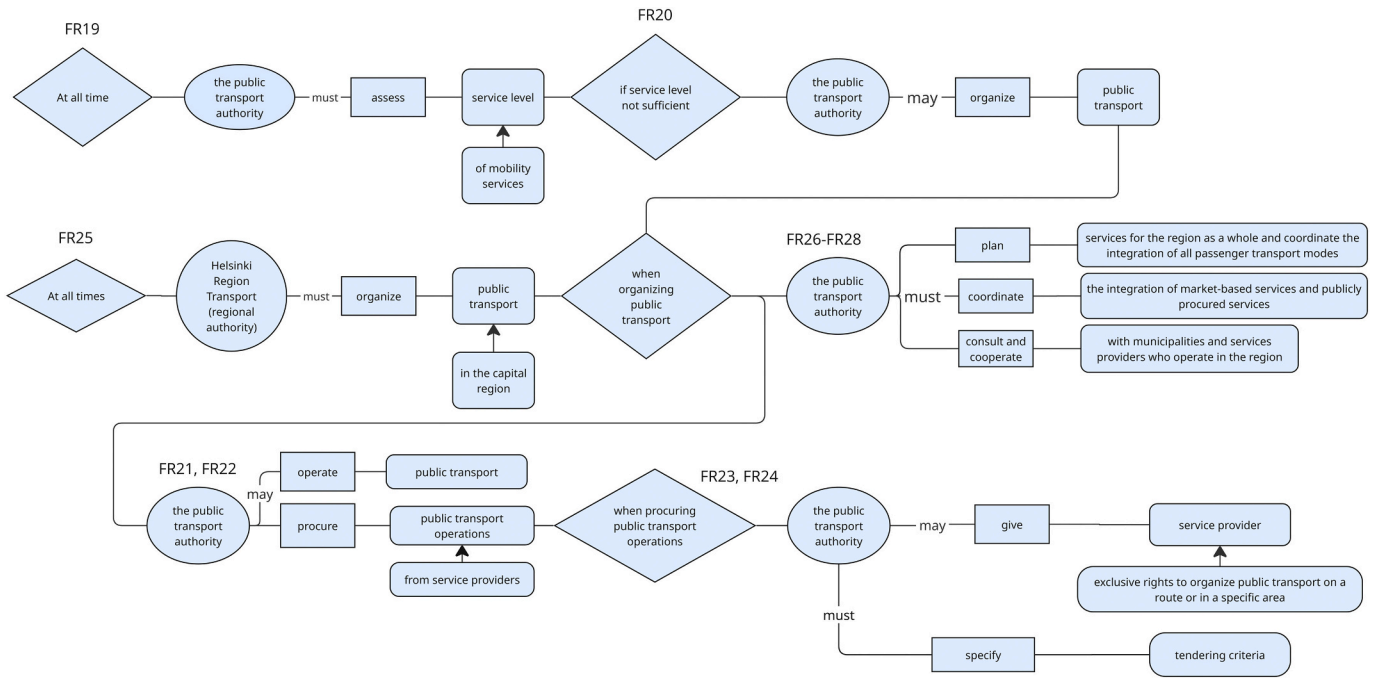


Fig. 6. Excerpt from the network diagram of the regulatory landscape, illustrating the role and responsibilities of the public transport authority.

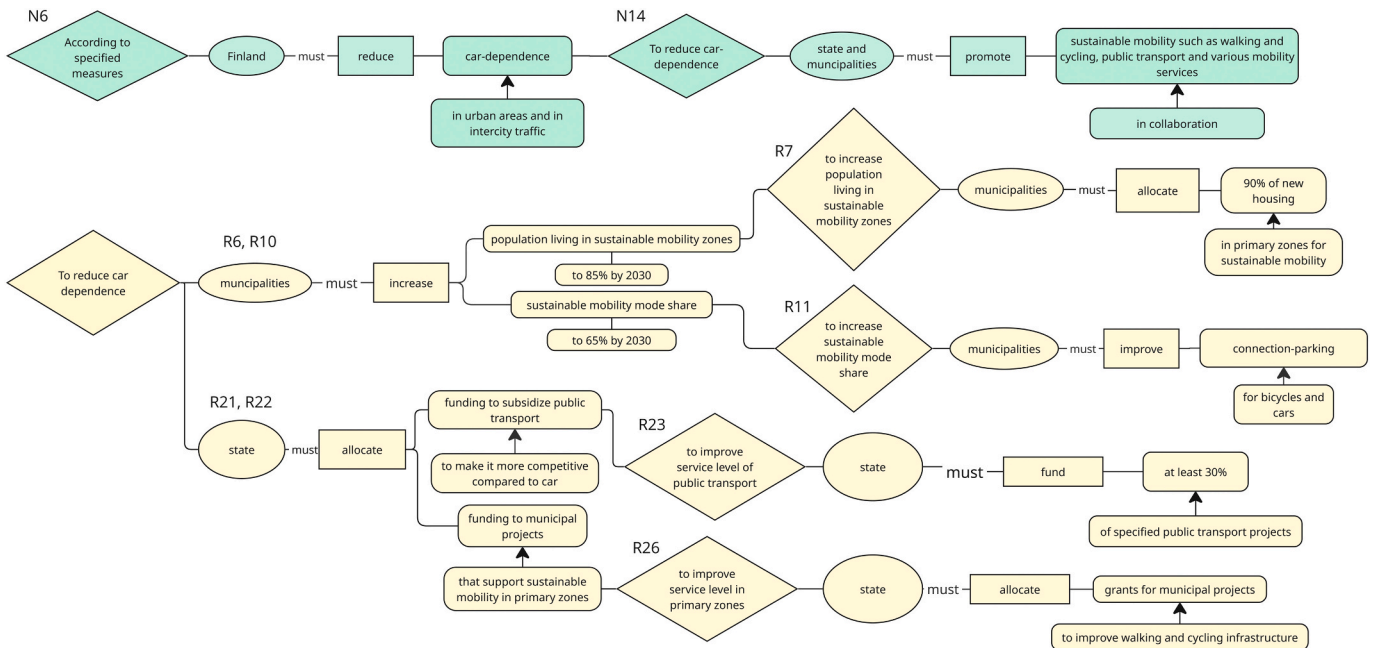


Fig. 7. Excerpt from the network diagrams at the national and regional levels, illustrating vertical alignment between strategy and planning processes.

prevented unilateral deviations by municipalities. However, this arrangement also created interdependence lock-ins. Major improvements required regional consensus and were constrained by rising operating costs and reliance on fare revenue, limiting experimentation with alternative funding mechanisms.

Land use and parking instruments displayed the most variation, as illustrated in Fig. 8. Helsinki employed the broadest set of measures to reshape mobility behavior and urban form, removing parking minimums in dense areas, reallocating curb space for non-car uses, and applying market-based pricing to reflect the value of public space (H5–H7). Espoo and Vantaa followed similar strategic directions but implemented changes more gradually, and in some cases, they

continued integrating car-oriented development patterns alongside transit-oriented growth (V7, V9, E5, and E9).

These differences revealed that place-sensitive flexibility is built into the governance system, allowing cities to tailor strategies to local conditions. However, they also highlighted the risk of flexibility leading to uneven progress and spatially uneven access to sustainable mobility options. Without stronger regional instruments to guide land use and parking standards, ambitious municipalities may advance more rapidly, while others may maintain cautious trajectories. This governance model encourages local innovation but may slow aggregate regional decarbonization and reinforce intraregional disparities.

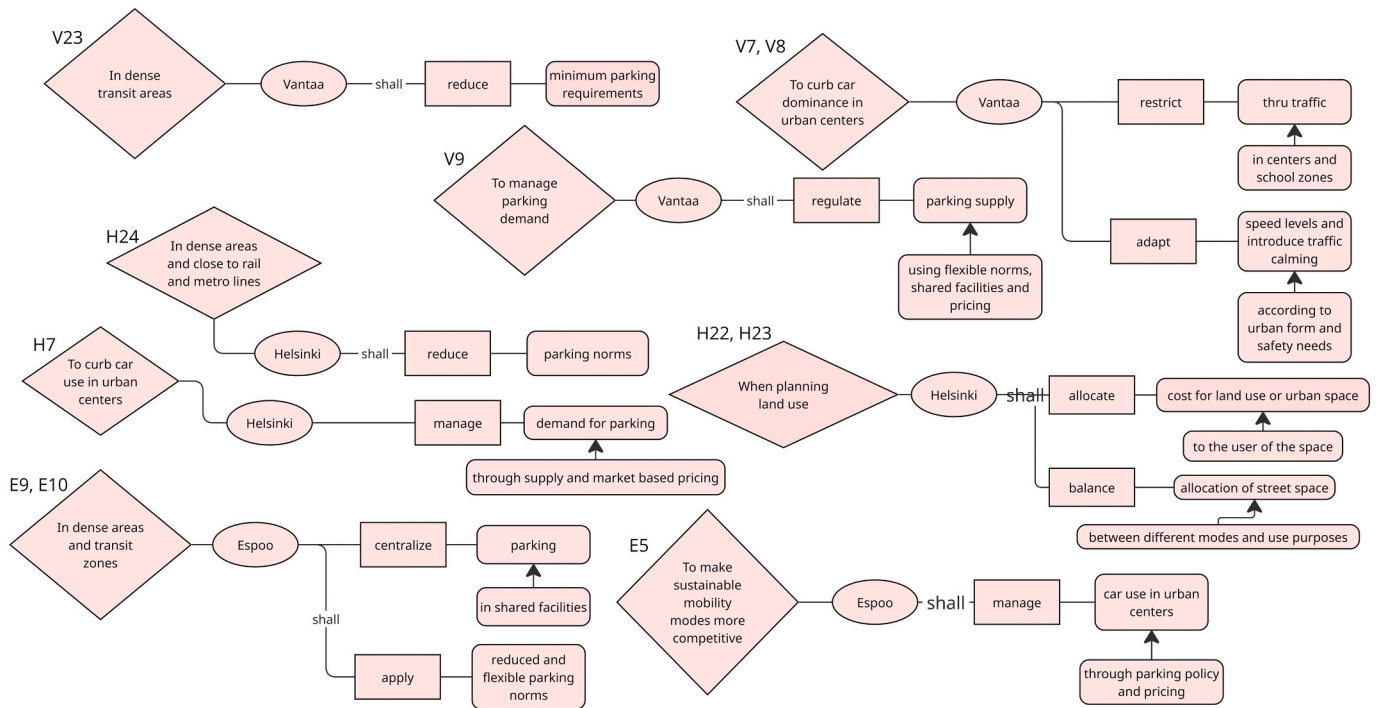


Fig. 8. Excerpt from the city-level network diagrams, illustrating measures to reduce car use through land use or parking policies across Helsinki, Espoo, and Vantaa.

6. Discussion

In this study, we set out to understand how current institutional arrangements in Finland support or constrain efforts to reduce car dependence in the capital region—a defining challenge in overcoming carbon lock-in in urban mobility systems [1,2,9]. Consistent with the literature on automobility as a deeply embedded sociotechnical and institutional system [12,16,19], the findings showed that even in a context with strong climate ambitions, high administrative capacity, and established planning traditions, institutional lock-ins continue to shape mobility pathways. The results illustrate that formal governance structures, policy instruments, and political norms co-evolve to stabilize the car-based system, in line with sociotechnical transition scholarship [4,31,32].

Finland's mobility governance displays high institutional coherence across levels, with national, regional, and municipal objectives largely aligned around dense land use, improved public transport, and active mobility. This coherence reflects a strong orchestrating capacity [40] and a shared narrative around sustainable mobility that echoes the collective and active mode-shift pathway described by Banister [9] and te Brömmelstroet et al. [11]. However, in practice, institutional support remains weighted toward enabling and supportive measures, such as infrastructure investment, coordination platforms, and procedural planning tools, rather than toward restrictive instruments designed to actively destabilize car dominance [10,22,57]. In this respect, the findings refine multilevel governance debates by showing that strategic alignment does not necessarily translate into transformative capacity when authority over key instruments remains unevenly distributed. Coherence at the goal level may coexist with limited activation at the implementation level.

The persistence of this pattern highlights one of the central insights of lock-in scholarship—alignment of goals is insufficient without mechanisms capable of displacing entrenched practices and interests [1,2]. Although municipalities have discretion in land use and street space allocation, they lack access to key demand-management tools, such as congestion charges and taxation reforms, which could challenge the attractiveness of and perceived entitlement to private car use. As Unruh

[21] suggests, institutional lock-ins are not only technical or infrastructural but also political. In Finland, political hesitancy at the national level has prevented institutional reforms that could facilitate local action, even where local support exists. The result is a form of selective flexibility; municipalities are encouraged to innovate on the supply side but are prevented from employing full toolkits on the demand side. This highlights that instrument authority and accountability can become structurally decoupled, constraining transformative potential despite apparent coordination.

This dynamic was particularly evident in regional MAL agreements. These agreements are effective instruments for policy coherence, coordination, and long-term planning—features linked to orchestrating capacity in sustainability governance [37,40]. However, they function more as planning compacts than as adaptive transition mechanisms. Although regular assessment cycles exist, they rarely trigger substantive policy adjustments. This echoes concerns in the transition governance literature about formal learning cycles potentially becoming procedural rather than genuinely adaptive [39]. Across the two MAL cycles, goals remained stable, but instruments changed little, and funding shifts even favored road maintenance, reinforcing how political context and macro-level priorities shape transition trajectories [51]. The findings thus suggest that adaptive capacity depends not only on monitoring and evaluation routines but also on institutional mechanisms that connect review processes to adjustments in instruments and responsibilities.

The comparison of cities further highlighted the importance of place-based institutional capacity [42,46]. Helsinki mobilized available institutional space more fully, advancing parking reforms, reallocating street space, and supporting higher-density development, aligning with research showing that dense urban areas hold greater potential to shift demand toward collective and active modes of transport [47,48,50]. Espoo and Vantaa shared these goals but pursued them more gradually. This variation demonstrates that flexibility in institutional design allows for differentiation, which is necessary for respecting local contexts [43,44]. However, it also creates uneven transition trajectories and risks reinforcing spatially unequal access to sustainable mobility options—a finding consistent with recent discussions on fairness and just transitions in mobility planning [41].

Taken together, the findings suggest that Finland's mobility institutions are coherent and competent but still geared toward incremental rather than transformative change. Institutional voids emerge most clearly when the responsibilities for regulating emerging mobility services and managing curb space are ambiguous, illustrating that weakly specified governance domains can slow transition momentum [29,35]. Critically, flexibility in institutional design does not automatically translate into adaptive capacity; it depends on actors' willingness and authority to activate it. As Rosenbloom and Rinscheid [57] noted, destabilizing carbon-intensive systems requires pressure across multiple lock-ins simultaneously. In the Finnish case, the system has created space for local innovation but has not yet provided the authority or political mandate necessary to challenge car privilege at scale.

Beyond the Finnish context, the observed pattern of high coherence and low-activation governance may be relevant to other settings in which municipalities are responsible for land use and local mobility systems, metropolitan public transport is coordinated regionally, and key demand-management instruments remain under national control. In such contexts, strong alignment across governance levels may coexist with structural bottlenecks that prevent escalation from supportive measures to more transformative interventions. At the same time, transferability is probably limited in contexts with fundamentally different governance arrangements, such as where cities already possess pricing authority, regional governments have stronger coercive capacity, or metropolitan coordination is weak or fragmented. Moreover, the dynamics observed in a dense metropolitan region such as Finland's capital area, may not directly translate to rural or peripheral contexts in which reliance on private cars is higher and viable alternatives are limited.

Several limitations of this study should be acknowledged. First, the analysis focused on formal policy, strategy, and regulatory documents, which captured stated responsibilities and instruments but possibly underrepresented informal practices, political negotiations, and implementation dynamics that could influence outcomes on the ground. Second, the deliberate exclusion of electrification-related measures sharpened the analytical focus on car dependence but meant that we did not assess the full transport decarbonization policy mix. Third, the aggregation of overlapping municipal measures was necessary to enable cross-city comparison, but may have obscured finer-grained differences in implementation details. Finally, although institutional network analysis reveals structural dependencies, gaps, and concentrations of authority, it does not directly measure policy effectiveness or behavioral change. Therefore, future research could triangulate document-based institutional analysis with interviews and outcome indicators to further explore how institutional design shapes mobility transitions in practice.

The Finnish case contributes to the scholarship on carbon lock-in and sustainability transitions by highlighting a nuanced form of high coherence, low-activation governance. The system is aligned, coordinated, and well-designed on paper, but its most transformative levers, particularly those that support restrictive measures and price-based interventions, remain politically inert. This suggests that governance capacity is not only a matter of institutional architecture but of political conditions and actors' commitment to using institutional space for destabilization, not just support. The findings confirm that transformative capacity hinges on both enabling structures and active governance strategies [36,40], reminding us that transitions are ultimately political processes shaped by contested ideas and power relations [14,15].

7. Conclusion

In this study, we aimed to examine how institutional design shapes efforts to reduce car dependence in a highly coordinated multilevel governance system. By analyzing national, regional, and municipal rules using IG and INA, we mapped how authority, instruments, and

coordination structures configure mobility transitions in Finland's capital region. The analysis revealed that although goals and planning processes are strongly aligned across levels, the institutional design prioritizes supportive measures over restrictive ones and lacks adaptive triggers to adjust the course when progress stalls. Consequently, Finland's mobility governance system supports incremental improvements in sustainable transport but struggles to unlock the deeper structural change required to meaningfully reduce car dependence.

This study contributes to sustainability transition research by illustrating that institutional coherence, flexibility, and voids interact to shape urban mobility trajectories. It highlights that strong alignment across governance levels is necessary but insufficient for system change unless accompanied by political willingness to deploy restrictive measures and adaptive mechanisms that translate monitoring into action. Methodologically, it advances the application of IG and INA to transport governance, demonstrating their value in uncovering the granular institutional conditions that underpin decarbonization efforts.

Going forward, accelerating low-carbon mobility transitions will necessitate strengthening the enabling environment for municipal action, clarifying responsibility for regulating shared and commercial mobility services, expanding authority to implement demand-management instruments, and embedding more robust adaptive triggers within national–regional planning cycles. Future research could compare institutional configurations across countries, investigate how informal norms and political coalitions interact with formal rules, and examine distributional effects as cities diverge in pace and ambition. As urban areas continue to pursue decarbonization, understanding how institutions simultaneously enable and constrain post-automobility futures remains essential for designing governance systems capable of transformative change.

CRedit authorship contribution statement

Natalia Lyly: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Amineh Ghorbani:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Grammarly to proofread and edit the text. After using this tool, the authors reviewed the content as needed and take full responsibility for the content of the published article.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Natalia Lyly reports that a research visit was funded by the Foundation for Economic Education. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.erss.2026.104737>.

Data availability

All data sources used for this publication are listed in Appendix A and are publicly available.

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