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A Novel Approach to Sustainable Urban Mobility: Systematic Review and Conceptualization of Multifunctional Commercial and Mobility Hubs

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Executive Summary

This paper explores the potential of multifunctional commercial and mobility hubs (MCMHs) as integrated solutions for sustainable urban transport. Building on a foundational study involving literature review, international practice analysis, expert interviews, and collaborative workshops, the concept of MCMHs is expanded in this study through practical use case scenarios. These hubs combine mobility services, last-mile logistics, and energy infrastructure to optimize land use, support fleet electrification, and enhance user experience. Key technical and operational challenges are identified, including high-power charging coordination, limited grid capacity, spatial competition, and the need for interoperable systems. Governance emerges as a critical success factor, requiring public-private cooperation, clear ownership models, and strategic policy support. By linking transport, logistics, and energy, multifunctional hubs can become key components of resilient, low-carbon, and user-centered urban mobility systems, provided that technical, organizational, and political barriers are systematically addressed.
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1 Introduction

Urban mobility is undergoing a profound transformation. To achieve the climate targets set by the European Green Deal-that is, a reduction of greenhouse gas emissions by 55% by 2030 [1], cities must drastically reduce car dependency, accelerate the adoption of zero-emission vehicles, and enable more sustainable multimodal transport solutions [2].
However, dense urban areas face a unique set of challenges that hinder this transformation: limited public space, competing land uses, fragmented infrastructure, and uncoordinated fleet operations across public and private actors [3]. While diverse fleets ranging from public transport buses [4] to municipal service vehicles [5], logistics providers [6], and shared mobility operators [7] increasingly switch to electric propulsion, they continue to operate in parallel and without spatial or systemic integration. This inefficiency not only wastes scarce urban space, but also complicates the implementation of shared infrastructure such as charging stations due to limited utilization and therefore high operating costs [8].
Multifunctional Commercial and Mobility Hubs (MCMHs) are an innovative approach that could represent a strategic response to these challenges [9]. By integrating mobility services, last-mile logistics, and energy supply systems into a single urban location, MCMHs hold the potential to significantly improve spatial efficiency, reduce emissions, and foster cross-sectoral collaboration.
Various types of hubs have emerged in recent years. Charging hubs [10], micro logistic depots [11] and mobility hubs ranging from decentralized micromobility stations [12] to regional interchange hubs

[13]. However, most implementations remain single-purpose and limited in functionality. The concept of multifunctionality, understood as the co-location and integration of mobility, logistics, and energy infrastructure, remains underdeveloped in both research and practice [14].
The study by Fahlbusch et. al. [14] is among the first to address this promising approach. A systematic review of 45 peer-reviewed publications and 50 global practice examples confirms the research gap. While micro-depots, public mobility stations, and charging parks are increasingly implemented in cities, only three cases were identified where all three components were combined at a single location. Among these is the “Zusammenhub” project in Hamburg, which exemplifies the potential of multifunctional integration, but also reveals the regulatory, spatial, and operational challenges that limit scalability [15].
To address these limitations, a conceptual framework for MCMHs has been developed that emphasizes shared use, adaptive design, and integrated energy management. Key features include flexible charging infrastructure, spatial adaptability (including vertical configurations), and the inclusion of shared amenities to enhance user experience. Stakeholder feedback from expert interviews highlights both the opportunities and complexities of such hubs: while cost savings, improved land use, and operational synergies are seen as major benefits, concerns remain regarding inter-fleet coordination, safety, and interoperability of infrastructure.
In addition to governance and stakeholder alignment, technical constraints such as limited grid capacity present further barriers. Multifunctional hubs with high charging demand—for instance, serving electric buses, delivery vans, and shared cars simultaneously—require intelligent energy management solutions, including battery storage, dynamic load control, and possibly bidirectional charging in the future.
To advance the discussion from concept to application, this paper expands upon the foundational research by exploring concrete use cases of multifunctional hubs and their implementation potential in real-world urban environments. It identifies practical configurations that combine different transport modes and services, discusses the benefits of shared infrastructure, and addresses core implementation challenges including spatial constraints, grid integration, and governance. The goal is to illustrate how MCMHs can move from conceptual promise to operational reality and become a cornerstone of sustainable urban mobility systems.

2 Methodology

The methodological foundation of this paper is based on a multi-step, qualitative research design that was developed and implemented in the course of the original MCMH study [14] and has been expanded in this contribution with a specific focus on application and implementation.
As part of the preceding research, a systematic literature review was conducted following the PRISMA framework. It identified 45 relevant peer-reviewed articles between 2016 and 2024 on the topics of mobility hub typologies, multifunctionality, logistics integration, and charging infrastructure. In parallel, 50 international practice examples were analyzed to assess the state of implementation of various hub formats. This dual approach highlighted the considerable gap between conceptual proposals and operational reality, particularly with regard to hubs that integrate mobility services, logistics, and energy systems at a single location.
To complement this state-of-the-art analysis, nine semi-structured expert interviews were conducted with stakeholders from different sectors, including public transport, logistics, shared mobility, and energy. These interviews provided insights into user needs, operational preferences, and the prerequisites for co-using infrastructure. The results were synthesized into a conceptual hub design, which was then reviewed and refined in a two-day collaborative workshop (”Technology Salon”) involving 16 interdisciplinary experts. The workshop applied a STEEP framework (social, technological, economic, ecological, political) to identify implementation barriers and to formulate design strategies and visions for future multifunctional hubs.
Building upon this foundation, the present paper extends the methodology in two key directions:
First, the existing qualitative data were re-evaluated. This was especially done so for the stakeholder interviews (n=8), focusing specifically on implementation requirements, operator models, and governance questions. Participants included representatives from municipal fleet operators, logistics providers, and city administrations.
Second, the paper introduces a structured set of practical use cases that translate the general multifunctional hub concept into differentiated, context-sensitive applications. These use cases were developed through a synthesis of prior findings and new inputs, and are intended to reflect real-world demands such as varying fleet types, usage patterns, charging profiles, and spatial conditions.
Furthermore, the use cases served as a basis for the deductive identification of implementation challenges, such as coordination between user groups, requirements for energy and load management, and the operationalization of shared infrastructure. In parallel, governance and business model options were examined in greater depth, including questions of ownership, public-private cooperation, and regulatory embedding.
Overall, this methodology allows for a transition from conceptual design toward application focused scenarios and provides concrete foundations for future pilot implementations of multifunctional commercial and mobility hubs in urban environments.

3 Results from the first Study

The study by Fahlbusch et. al. [14] combined a systematic literature review, a global practice analysis, qualitative expert interviews, and a collaborative design process to develop a conceptual framework for MCMHs. Together, these elements revealed both the transformative potential and the operational challenges of multifunctional hubs in urban environments.

The systematic literature review demonstrated that while the idea of mobility hubs has become increasingly prominent over the past two decades, most concepts and implementations remain sectoral and single-purpose. Early mobility hubs typically served as single-mode transfer points, focused on specific functions such as bike-sharing, park-and-ride, or multimodal commuting. Although some recent studies have expanded the scope to include neighborhood services [16], energy functions [17], or urban logistics [11], genuine multifunctionality, understood as the integrated, cooperative operation of transport, logistics, and energy systems at a shared location, remains rare. Most scholarly works continue to focus on specific transport modes or narrowly defined hub types.

Parallel to the academic review, a structured analysis of 50 international best-practice examples was conducted to understand the practical realization of hub concepts worldwide. This analysis confirmed the literature findings: despite growing attention to multimodal integration, real-world examples that combine mobility services, last-mile logistics, and energy supply infrastructure in a single site are extremely scarce. Only three cases were identified that exhibited true multifunctional integration. These projects, such as the “Zusammenhub” in Hamburg [15], highlighted the potential for synergies between shared fleet charging, urban goods distribution, and passenger mobility—but also revealed significant barriers. Chief among them were the difficulty of coordinating multiple operators, the challenges of aligning different business models and regulatory frameworks, and the constraints imposed by urban land availability and energy grid limitations. Most realized hubs continue to serve either passengers, goods, or energy separately, with minimal functional overlap.

To deepen the understanding of operational needs and opportunities, nine semi-structured expert interviews were conducted with representatives from public transport operators, logistics providers, energy companies, and municipal authorities. The interviews provided valuable insights into the specific requirements of different fleet types and user groups. Stakeholders consistently emphasized the need for flexible, high-power charging infrastructure, efficient land use, and the creation of shared service points such as maintenance zones and driver facilities. At the same time, concerns were voiced about safety risks arising from mixed fleet operations, technical incompatibilities between vehicles and charging standards, and the lack of clear mechanisms to coordinate shared hub usage. Some operators expressed preferences for spatial or temporal segregation between user groups to avoid conflicts, while others advocated for open, modular designs that could dynamically adapt to changing demand profiles.

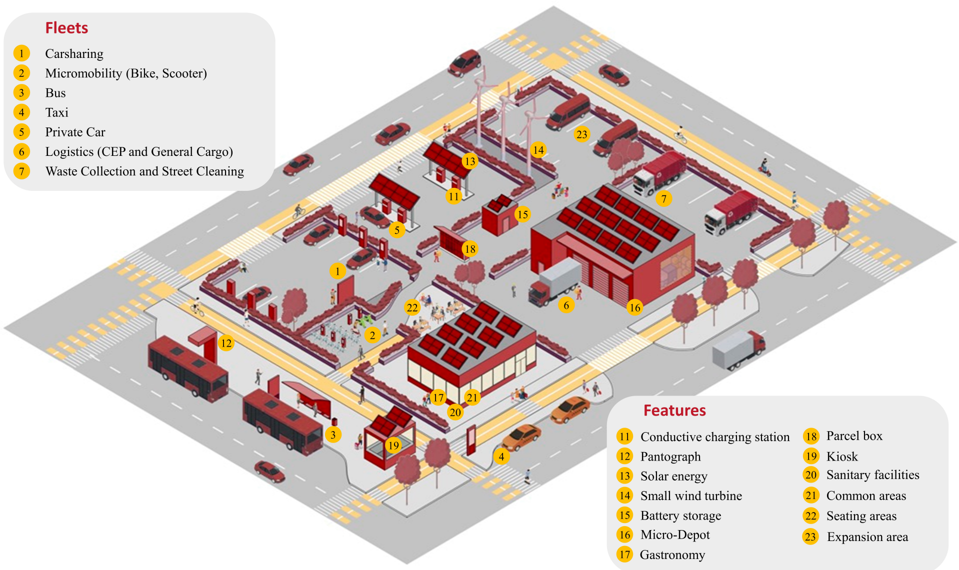

Figure 1: Schematic design of a MCMH [14]

Building on these empirical findings, a conceptual model for multifunctional hubs was developed. A schematic depiction if this model can be seen in figure 1. The proposed design envisions compact, flexible hubs that integrate multimodal mobility offerings, consolidated logistics depots, and localized renewable energy generation, supported by storage solutions to manage peak loads. Importantly, the design prioritizes user-centered features such as dining and rest facilities for drivers, micro-logistics centers for goods exchange, and flexible parking zones for shared mobility services, to maximize the

functional value of the site. Vertical integration, modular expansion capabilities, and compatibility with both fast and regular charging systems were identified as key architectural and technical elements to ensure scalability and resilience across different urban settings.
The conceptual model was tested and refined during a two-day collaborative workshop ("Technology Salon") that brought together 16 experts from various sectors. Using a STEEP (social, technological, economic, ecological, political) framework, participants critically assessed the proposed multifunctional design against real-world constraints. The workshop confirmed the strategic relevance of MCMHs as potential enablers of sustainable urban mobility and logistics systems, particularly through the more efficient use of scarce urban land and the facilitation of zero-emission fleet operations. However, several barriers to implementation were also highlighted. Participants identified the fragmentation of regulatory responsibilities, the lack of standardized technical frameworks for shared charging and fleet coordination, and the financial risks associated with upfront investments in multifunctional infrastructure as major hurdles. A consensus emerged that future MCMH projects would require strong public-sector leadership, cross-sectoral governance structures, and flexible business models capable of accommodating diverse stakeholder interests. Pilot projects, embedded in supportive policy frameworks and leveraging public-private partnerships, were seen as critical to moving multifunctional hubs from concept to reality.
Taken together, the findings from the foundational study demonstrate both the significant promise and the considerable complexity of implementing multifunctional hubs. They form the basis for the application-oriented analyses developed in this paper, where specific use cases and operational models are explored to illustrate how multifunctional hubs can be adapted to diverse urban contexts and integrated into sustainable mobility systems.

4 Potential Use Cases of Multifunctional Hubs

Building upon the foundational findings, this paper develops concrete application scenarios to illustrate how MCMHs can be adapted to diverse urban contexts. Each use case reflects real-world operational requirements and urban constraints and shows how integrated hubs can create synergies across mobility, logistics, and energy systems while addressing the technical and organizational challenges identified earlier.
A particularly promising use case addresses the combination of public transport fleets, parcel delivery services, and municipal vehicle operations within a shared urban hub. Fleet electrification creates a growing need for mid-shift charging solutions, especially as environmental and economic pressures favor the use of vehicles with smaller battery capacities. Enabling flexible opportunity charging during tours allows operators to maintain service continuity without oversizing batteries, thereby reducing vehicle weight, cost, and environmental footprint. However, for many fleet types such as municipal waste collection trucks, urban buses, or heavy trucks, delivering to micro-depots, returning to distant depots during operations is not viable. Existing depots are often located on the urban periphery, far from service areas. Installing high-power charging exclusively for individual operators at central sites would result in poor utilization and high investment costs. Therefore, multifunctional hubs that offer shared high-power charging infrastructure present an efficient solution. Operators can recharge during scheduled layovers, driver break times or low-demand periods without significant detours. Complementary services such as rest facilities, dining options, and minor vehicle maintenance (e.g. cleaning of busses) further enhance operational efficiency. Additionally, the co-location of a parcel micro-depot and public mobility access allows for the bundling of passenger and goods flows, supporting multimodal transport chains and reducing unnecessary traffic.
A second use case focuses on integrating micromobility services, carsharing, public transport connections, private electric vehicle charging, and retail activities within a multifunctional hub. Here, the hub acts as both a transition point and a destination, enabling seamless modal shifts while providing incentives for users to linger. Retail amenities such as supermarkets, cafés, or parcel lockers are co-located with mobility infrastructure, making the hub an attractive node in daily routines rather than merely a transfer point. Smart charging infrastructure plays a central role: during daytime hours, charging stations prioritize private electric vehicle users, while overnight they switch to replenishing shared micromobility and carsharing fleets. This dynamic load management maximizes infrastructure utilization, flattens energy demand peaks, and supports grid-friendly operation. The combination of convenient services, multimodal accessibility, and flexible energy management strengthens sustainable travel behavior and supports vibrant urban spaces.
A third application scenario envisions a district-level multifunctional hub as part of integrated urban development projects. In this model, the hub consolidates shared mobility options, last-mile logistics operations, neighborhood services, and decentralized renewable energy production. Solar panels and stationary battery storage help manage intermittent energy generation and charging peaks. Consolidated delivery points enable the efficient distribution of goods using small electric vehicles or cargo bikes, minimizing van traffic in residential streets. Residents gain access to diverse transport modes and local services within walking distance, reducing private car dependence and improving urban livability. For logistics operators, the hub offers optimized last-mile structures without the need for individual depot construction. Municipalities can use these hubs to support broader urban sustainability goals, creating integrated solutions that combine climate protection, mobility transformation, and efficient land use.

This type of hub has the potential to transform usage-centered locations, such as conventional mobility stations, into vibrant community hubs and livable spaces embedded in daily urban life.
A fourth use case explores the role of multifunctional hubs in institutional environments such as university campuses, hospital complexes, or business parks. These spaces often face intense transport needs, limited parking capacity, and growing pressure to decarbonize operations. By integrating institutional fleets (e.g., shuttle buses, service vehicles), visitor transport (e.g., shared mobility services), and goods logistics (e.g., cargo bike depots) within a centralized hub, campuses can significantly reduce internal traffic volumes. Flexible charging infrastructure serves both institutional and external users, optimizing asset utilization across different time windows. Complementary facilities such as parcel lockers, cafés, or coworking spaces can activate the site and enhance its multifunctional character. This approach enables institutions to align mobility management with their broader sustainability strategies, improving both operational efficiency and environmental performance.
Across all scenarios, several key design principles emerge. Strategic co-location and temporal flexibility are essential to maximize infrastructure use. Shared services must be supported by interoperable technical systems and fair governance models to manage diverse user needs. Intelligent energy management, based on load shifting and storage, is necessary to integrate hubs into constrained urban grids. Finally, successful hub implementation depends on creating tangible added value for all users—operators, service providers, and end customers alike. These use cases demonstrate that multifunctional hubs are not static, one-size-fits-all solutions, but adaptable platforms capable of addressing the complex demands of sustainable urban transport systems.

5 Technical and Operational Challenges

While multifunctional hubs offer clear strategic advantages in terms of efficiency, sustainability, and land use, their implementation in real urban contexts is technically and operationally demanding. The diverse requirements of different user groups ranging from public transport providers and logistics operators to shared mobility services and private users, must be reconciled within a shared infrastructure, often under tight spatial, temporal, and regulatory constraints.
One of the most critical challenges lies in the provision and management of charging infrastructure. High-power charging for heavy-duty vehicles such as buses, waste collection trucks, or logistics fleets creates significant demand peaks, often exceeding the available grid capacity in dense urban areas. Dedicated charging stations for individual operators are often inefficiently utilized and economically unviable, particularly in central locations where land and power access are limited. Multifunctional hubs must therefore integrate shared charging solutions supported by intelligent load management systems. Dynamic prioritization of charging slots—based on fleet schedules, vehicle types, and grid load—can help balance competing needs. In addition, the incorporation of stationary battery storage and renewable energy generation (e.g., photovoltaic systems) can buffer load peaks and reduce dependency on grid upgrades.
Closely tied to energy challenges is the issue of temporal coordination. Different fleets operate on varying schedules: municipal vehicles often start early in the morning, delivery services follow staggered routing patterns, while shared mobility fleets typically recharge overnight. Efficient use of infrastructure requires well-orchestrated timing and possibly reservation systems to avoid idle periods and conflicts. Moreover, some vehicle types such as waste trucks or buses cannot easily interrupt operations to return to distant depots for recharging. Hubs must therefore be located strategically within or near operational zones, and offer the possibility of opportunity charging during short layovers or service breaks.
The limited availability of urban space further complicates hub implementation. In high-density areas, multifunctional hubs must compete with other land uses such as housing, commerce, green space, or traditional parking. Their added value lies in the integration of services that would otherwise require separate facilities. However, this requires compact, modular, and potentially vertical infrastructure solutions that can adapt to local conditions and regulations. Designing such hubs to be multifunctional over time—i.e., through day-night or weekday-weekend usage cycles—is essential to justify their footprint and ensure political and public acceptance.
Another major challenge is operational compatibility. Vehicles, equipment, and backend systems vary across operators and use cases. Standardization of hardware (e.g., connectors, chargers) and software (e.g., booking platforms, energy management) is needed to avoid technological lock-ins and ensure interoperability. In shared environments, safety and liability must also be considered: heavy trucks, vulnerable road users, and autonomous vehicles may all interact within the same site. Clear zoning, traffic separation, and robust operational protocols are critical to ensure safe and efficient functioning.
Finally, the lack of clear ownership and management structures often hampers the practical rollout of multifunctional hubs. The shared nature of these spaces makes them difficult to assign to a single entity. Without defined roles and responsibilities, especially regarding investment, maintenance, and energy billing, conflicts can arise, and utilization may remain below potential. Therefore, technical challenges cannot be addressed in isolation; they must be embedded in robust governance models, which are discussed in the following chapter.
In summary, the technical and operational feasibility of multifunctional hubs hinges on five interconnected dimensions: scalable energy systems, temporal orchestration of users, efficient use of limited

space, technological standardization, and coordinated operation. Addressing these dimensions is essential for moving beyond conceptual design and enabling real-world, high-performing hub solutions in urban settings.

6 Governance and Business Models

While MCMHs hold significant potential for improving the efficiency and sustainability of urban transport systems, their implementation ultimately depends on the ability to organize and govern shared infrastructure across multiple actors. The diverse operational and technical requirements outlined in the previous chapters cannot be met without equally robust institutional frameworks. In practice, governance emerges as one of the most critical, yet most uncertain, dimensions of hub realization.

A central challenge lies in the definition of ownership and operational responsibility. Because multifunctional hubs serve multiple user groups including public transport operators, municipal services, logistics companies, and private mobility providers, traditional, single-operator ownership models are not suitable. Instead, new models of public-private cooperation are required. Interviewees in the foundational research widely agreed that municipal actors, such as city-owned utilities, are best positioned to coordinate the early phases of hub development. These actors often possess strategically located land, can align projects with urban development goals, and are mandated to act in the public interest. However, they typically lack the operational capacity or market incentives to serve all functions independently. As a result, hybrid operator models, for example, involving a public anchor institution that leases space and infrastructure to private operators, may offer a pragmatic pathway.

In this context, several interviewees emphasized the potential of municipal subsidiaries that combine public oversight with entrepreneurial flexibility. This model allows the city to safeguard long-term planning objectives while enabling efficient, commercially viable operations. However, the creation of new municipal entities is often time-consuming and administratively complex. An alternative pathway may involve the expansion of existing public enterprises, such as waste services or public transport companies, into the multifunctional hub domain.

Regardless of operator model, the question of energy billing and service allocation across multiple users remains a core challenge. When different vehicle types, companies, and user groups draw power from the same charging infrastructure, transparent and fair mechanisms for electricity metering, pricing, and cost-sharing are essential. This calls for interoperable backend systems that can manage access, authenticate users, and allocate consumption in real time. Standardized protocols and digital platforms are needed to avoid fragmentation and reduce transaction costs. The lack of such systems has been identified as a major barrier in existing shared charging initiatives.

In parallel, the question of who provides and controls the land is central to hub implementation. Most centrally located, multifunctional hubs depend on scarce urban land, which is often in municipal ownership. This makes cities key actors not only in terms of planning and permitting, but also in determining access and use conditions. Cities can use land allocation and planning instruments (e.g., zoning, long-term leases) to actively steer hub development and ensure alignment with broader policy objectives, such as emission reduction, traffic calming, or inclusive mobility. At the same time, a coordinated approach across administrative departments—mobility, energy, logistics, and urban development—is required to avoid siloed decisions and to unlock synergies between infrastructure systems.

Finally, funding models must reflect the cross-sectoral nature of multifunctional hubs. Because the benefits of such hubs extend beyond direct uses like reducing traffic volumes, supporting the energy transition, and improving urban quality of life, public co-investment or start-up funding could be justified. National and EU-level funding schemes could play a catalytic role, especially if hubs are framed as part of integrated climate or digital infrastructure strategies. In the long run, however, hubs must become self-sustaining through usage-based revenues, tenant contributions, and service provision.

In sum, the governance of multifunctional hubs requires institutional innovation as much as technical or spatial design. Aligning public and private interests, creating fair and transparent usage frameworks, and integrating planning and operational responsibilities are not trivial tasks. Yet without such frameworks, even well-designed hubs are unlikely to reach their full potential.

7 Conclusion and Outlook

The analysis of MCMHs across conceptual frameworks, practical case studies, use case scenarios, and governance options reveals both their substantial potential and the complex challenges associated with their realization. Multifunctional hubs emerge as a promising systemic response to the key pressures faced by urban transport systems: the need to decarbonize fleets, optimize scarce urban space, and integrate diverse mobility, logistics, and energy services into coherent, efficient infrastructures.

The use cases developed in this paper demonstrate that hubs can create tangible added value by supporting flexible fleet operations, enabling smaller and more resource-efficient vehicles, bundling goods and passenger flows, and enriching the user experience through co-located services. Smart charging management, dynamic spatial utilization, and the strategic integration of ancillary services (such as dining,

maintenance, or parcel logistics) transform hubs from mere infrastructure sites into multifunctional urban nodes that enhance efficiency, sustainability, and user convenience.
At the same time technical feasibility alone does not guarantee successful implementation. Rather, the success of multifunctional hubs hinges on the alignment of operational practices, energy management strategies, spatial integration, and above all, robust governance frameworks. Particularly critical are the challenges of coordinating heterogeneous user groups with different operational rhythms, vehicle types, and service expectations; ensuring fair and efficient access to shared resources; and embedding hub development into broader urban planning and energy transition strategies.
The need for shared, high-power charging infrastructure is especially acute in urban contexts, where grid capacity and space are limited. Innovative solutions such as intelligent load management, stationary storage, and time-based prioritization models can mitigate some of these constraints. However, technical solutions must be accompanied by institutional innovations, including interoperable billing systems, clear operational protocols, and governance models that balance public oversight with private-sector efficiency.
The discussion also underscores that political leadership and proactive urban policy are essential. Without active municipal involvement—whether through land allocation, planning instruments, funding programs, or coordination platforms—the risks of fragmented development, underutilized infrastructure, and conflicting interests are high. Multifunctional hubs challenge traditional sectoral boundaries and administrative structures, requiring integrated planning approaches that align mobility, logistics, energy, and urban development goals.
Pilot projects will play a critical role in this context. They can provide opportunities to test technical setups, operational models, and governance structures under real-world conditions. Importantly, pilot hubs must be designed not only as isolated test beds but as scalable prototypes for broader network deployment. Lessons learned from early implementations—such as the need for flexible design standards, stakeholder engagement mechanisms, and adaptive regulatory frameworks—can inform the mainstreaming of multifunctional hubs as core elements of sustainable urban transport systems.
In conclusion, multifunctional hubs represent a complex but highly impactful innovation. Their realization demands technical excellence, organizational collaboration, and political vision. If these challenges are met, hubs can become critical enablers of integrated, low-carbon, and user-centered urban mobility landscapes.

References

[1] European Commission The European Green Deal. (2019), European Commission (EC), Brussels, COM(2019) 640 final

[2] Göhlich D, Nagel K, Syré AM, Grahle A, Martins-Turner K, Ewert R, Miranda Jahn R, Jefferies D. Integrated Approach for the Assessment of Strategies for the Decarbonization of Urban Traffic. Sustainability. 2021; 13(2):839. https://doi.org/10.3390/su13020839

[3] Petzer, B.J.M., Wieczorek, A.J., Verbong, G.P.J. The legal street: a scarcity approach to urban open space in mobility transitions. Urban Transform 3, 3 (2021). https://doi.org/10.1186/s42854-021-00018-0

[4] Göhlich, D., Fay, T., Jefferies, D., Lauth, E., Kunith, A. & Zhang, X. Design of urban electric bus systems. *Design Science*. **4** pp. 15 (2018,1). https://doi.org/10.1017/dsj.2018.10

[5] R. Ewert, P. Nguyen, K. Nagel. Showing the Feasibility of Electric Waste Collection Vehicles in Rural Areas: A Case Study in the Vulkaneifel District, Germany, ABMTrans 2025. accessible online: https://svn.vsp.tu-berlin.de/repos/public-svn/publications/vspwp/2025/25-08/EwertEtAl_2025_WasteCollectionVulkaneifel_ABMTrans.pdf

[6] Martins-Turner, K., Grahle, A., Nagel, K. & Göhlich, D. Electrification of Urban Freight Transport - a Case Study of the Food Retailing Industry. *Procedia Computer Science*. **170** pp. 757-763 (2020), The 11th International Conference on Ambient Systems, Networks and Technologies (ANT) / The 3rd International Conference on Emerging Data and Industry 4.0 (EDI40) / Affiliated Workshops. https://doi.org/10.1016/j.procs.2020.03.159

[7] Calan, C., Sobrino, N. & Vassallo, J. Understanding Life-Cycle Greenhouse-Gas Emissions of Shared Electric Micro-Mobility: A Systematic Review. *Sustainability*. **16** (2024). https://doi.org/10.3390/su16135277

[8] Coppola, P. & Silvestri, F. Future mobility and land use scenarios: impact assessment with an urban case study. *Transportation Research Procedia*. **42** pp. 53-63 (2019), Modeling and Assessing Future Mobility Scenarios. Selected Proceedings of the 46th European Transport Conference 2018, ETC 2018. https://doi.org/10.1016/j.trpro.2019.12.006

[9] Krüger, A.; Altrock, U. Mobility Hubs: A Way Out of Car Dependency Through a New Multifunctional Housing Development? *Urban Planning* **2023**, *8*, 112–125. https://doi.org/10.17645/up.v8i3.6336

[10] Rongen, T.; Tillema, T.; Arts, J.; Alonso-González, M. J.; Witte, J.-J. An Analysis of the Mobility Hub Concept in the Netherlands: Historical Lessons for Its Implementation. *Journal of Transport Geography* **2022**, *104*, 103419. https://doi.org/10.1016/.jtrangeo.2022.103419.

[11] Monzón, A.; Hernández, S.; Di Ciommo, F. Efficient Urban Interchanges: The City-HUB Model. In Proceedings of the *14th World Conference on Transport Research*; Elsevier, 2016; Volume 14, pp. 1124–1133. https://doi.org/10.1016/j.trpro.2016.05.183

[12] Hachette, M. & L'Hostis, A. Mobility Hubs, an Innovative Concept for Sustainable Urban Mobility?. *Smart Cities: Social And Environmental Challenges And Opportunities For Local Authorities*. pp. 245-278 (2024), https://doi.org/10.1007/978-3-031-35664-3_14

[13] Bell, D. Intermodal Mobility Hubs and User Needs. *Social Sciences*. **8** (2019). https://doi.org/10.3390/socsci8020065

[14] Fahlbusch, J, Fischer, F, Gegner M, Grahle, A, Tasche L. Towards a Concept for a Multifunctional Mobility Hub: Combining Multimodal Services, Urban Logistics, and Energy. Logistics 2025;

[15] HOCHBAHN. Projekt ZUSAMMENHUB – Der Mobilitätshub für Hamburg. Available online: https://www.hochbahn.de/de/projekte/zusammenhub (accessed on 9 December 2024)

[16] Blad, K.; Homem de Almeida Correia, G.; van Nes, R.; Anne Annema, J. A Methodology to Determine Suitable Locations for Regional Shared Mobility Hubs. *Case Studies on Transport Policy* **2022**, *10*(3), 1904–1916. https://doi.org/10.1016/j.cstp.2022.08.005

[17] Audi AG. Audi Charging Hub – Schnellladen mit Lounge-Charakter. Available online: https://www.audi.de/de/elektromobilitaet/laden/unterwegs/audi-charging-hub/ (accessed on 9 December 2024).

Presenter Biography

Alexander Grahle is a research associate at the Department of Methods in Product Development and Mechatronics at TU Berlin. With a background in mechanical engineering, his work focuses on projects aimed at decarbonizing transportation systems, including applied research to transition Berlin's bus fleet to carbon neutrality by 2030. His expertise lies in traffic simulation, fleet design for electric commercial vehicles, and scenario planning for electrification strategies. He also serves as Deputy Managing Director of the research campus Mobility2Grid, where he provides technical leadership for the project, bridging sustainable mobility with renewable energy integration and grid stability.