Fleet-as-a-Service Architectures for Sustainable Mobility Transitions: Socio-Technical, Environmental, and Digital Infrastructural Perspectives

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Abstract: The global transportation sector is undergoing a profound transformation driven by escalating environmental pressures, rapid digitalization, and structural shifts in mobility demand. Traditional models of vehicle ownership and testing are increasingly challenged by the imperatives of sustainability, efficiency, and system-level optimization. Within this evolving landscape, Fleet-as-a-Service (FaaS) has emerged as a pivotal organizational and technological paradigm capable of reshaping vehicle development, deployment, and operational governance. Rather than treating vehicles as discrete, individually owned artifacts, FaaS reconceptualizes mobility assets as shared, digitally orchestrated fleets that integrate testing, validation, operation, and lifecycle management into unified service ecosystems. This research article develops a comprehensive, theory-driven examination of FaaS as a socio-technical innovation situated at the intersection of sustainable mobility transitions, environmental performance optimization, and advanced digital infrastructures.

Grounded strictly in the provided body of interdisciplinary literature, the article positions FaaS within broader debates on automobility systems, sustainability transitions, and emerging industrial digitalization trajectories. Drawing on transition theory, particularly multi-level perspectives on socio-technical change, the study interprets FaaS as both a niche innovation and a potential regime-shaping mechanism capable of altering entrenched patterns of vehicle production, testing, and use (Geels, 2005; Elzen & Wieczorek, 2005). Environmental considerations such as air pollution, noise exposure, energy consumption, water footprints, and climate change impacts are treated not as externalities but as central design variables within FaaS-enabled mobility systems (European Environment Agency, 2023; Berger et al., 2012; Pérez-Martínez & Sorba, 2010). The article further integrates insights from digital infrastructure research, including cloud computing, real-time systems, 5G-enabled industrial networks, and serverless architectures, to analyze how computational elasticity and data-centric coordination underpin scalable fleet operations (Andrews et al., 2014; Rao & Prasad, 2018; Szalay et al., 2021).

Methodologically, the study adopts a qualitative, interpretive research design based on systematic literature synthesis and conceptual integration. Rather than presenting empirical measurements, the article develops analytically rich interpretations of existing findings, highlighting patterns, tensions, and future trajectories across environmental science, transport studies, and information systems research. Particular attention is devoted to the work of Deshpande (2024), which conceptualizes FaaS as a transformative model for sustainable vehicle testing and operations, and is woven throughout the analysis as a central theoretical anchor. The results section articulates how FaaS contributes to sustainability outcomes by enabling controlled experimentation, accelerated learning cycles, optimized resource utilization, and reduced environmental burdens across vehicle lifecycles. The discussion critically evaluates these contributions, addressing counter-arguments related to rebound effects, digital energy consumption, governance complexity, and social equity.

By offering an expansive and deeply elaborated theoretical analysis, this article contributes to academic discourse by reframing FaaS as more than an operational innovation. It argues that FaaS represents a structural reconfiguration of automobility systems with significant implications for environmental policy, industrial strategy, and the governance of digital-physical infrastructures. The study concludes by outlining future research directions that emphasize interdisciplinary collaboration, longitudinal system analysis, and policy experimentation to ensure that FaaS evolves as a genuinely sustainable mobility solution rather than a narrowly   technical   optimization.

INTRODUCTION

The modern transportation system stands at the center of some of the most pressing sustainability challenges facing contemporary societies. Road-based mobility, while foundational to economic development and social connectivity, has simultaneously emerged as a dominant contributor to air pollution, greenhouse gas emissions, noise exposure, and resource depletion (European Court of Auditors, 2018; IPCC, 2014). Over the past century, the global diffusion of automobility has produced deeply entrenched socio-technical systems characterized by private vehicle ownership, fossil fuel dependence, and spatial patterns optimized for individualized travel rather than collective efficiency (Urry, 2004). These systems are not merely technological arrangements but complex configurations of infrastructures, regulations, cultural norms, industrial practices, and user expectations that co-evolve over time (Geels et al., 2004). As such, incremental technological improvements alone have proven insufficient to address the scale and urgency of contemporary environmental crises associated with transport.

Within this context, sustainability-oriented innovation has increasingly shifted from isolated product-level optimization toward systemic reconfigurations of mobility provision. Concepts such as shared mobility, vehicle electrification, automation, and digital platformization are often discussed as discrete trends, yet their transformative potential lies primarily in how they interact within broader socio-technical transitions (Beza & Zefreh, 2019; Yeung, 2022). Fleet-as-a-Service (FaaS) represents a particularly significant convergence of these dynamics. By treating fleets of vehicles as service-based, digitally managed systems rather than static assets, FaaS introduces new possibilities for experimentation, optimization, and governance across the entire vehicle lifecycle. The significance of this shift has been articulated in recent scholarship, most notably in the work of Deshpande (2024), who argues that FaaS fundamentally alters the logic of sustainable vehicle testing and operations by embedding continuous feedback, shared utilization, and lifecycle accountability into fleet management structures.

The emergence of FaaS must be understood against the historical backdrop of automobility's evolution. Early automotive systems were shaped by industrial mass production, standardized vehicle designs, and linear supply chains oriented toward maximizing unit sales (Geels, 2005). Over time, these arrangements solidified into dominant regimes supported by regulatory frameworks, urban planning practices, and cultural imaginaries centered on private car ownership (Urry, 2010). Environmental critiques of automobility gained prominence in the late twentieth century, particularly as empirical evidence mounted regarding the health impacts of air pollution and environmental noise in urban environments (European Environment Agency, 2023). Despite regulatory interventions and technological improvements, such as emissions standards and fuel efficiency mandates, systemic inertia has limited the pace of meaningful transformation (European Court of Auditors, 2018).

Against this backdrop, FaaS can be interpreted as a niche innovation with the potential to destabilize established regimes by redefining how vehicles are developed, tested, deployed, and retired. Unlike conventional fleet management models, which often focus narrowly on cost control and logistical efficiency, FaaS integrates sustainability objectives directly into operational decision-making (Deshpande, 2024). This integration is enabled by advances in digital infrastructure, including real-time data processing, cloud-based orchestration, and high-bandwidth connectivity, which collectively allow fleets to function as adaptive, learning systems rather than static collections of vehicles (Andrews et al., 2014; Jonas et al., 2017). The relevance of such infrastructures extends beyond operational efficiency, as they also facilitate granular

monitoring of environmental performance indicators such as energy consumption, emissions, and resource use across diverse operating conditions (Helmers & Weiss, 2017).

The theoretical framing of this article draws heavily on the multi-level perspective on socio-technical transitions, which conceptualizes systemic change as the outcome of interactions between niche innovations, dominant regimes, and broader landscape pressures (Geels, 2005; Elzen & Wieczorek, 2005). From this viewpoint, FaaS occupies a strategic position as a niche that responds to landscape-level pressures such as climate change, urbanization, and digitalization while challenging regime-level assumptions about ownership, control, and value creation in mobility systems. Environmental imperatives articulated by the IPCC (2014) and European policy institutions create a context in which alternative mobility models gain legitimacy, while technological developments in 5G networks, cloud computing, and real-time systems lower the barriers to implementing complex, data-intensive fleet operations (Rao & Prasad, 2018; Varga et al., 2020).

Despite growing interest in FaaS and related service-based mobility models, the existing literature remains fragmented across disciplinary boundaries. Environmental studies often focus on lifecycle impacts of specific vehicle technologies, such as battery electric vehicles, without fully engaging with organizational models that shape how these technologies are deployed at scale (Berger et al., 2012; Helmers & Weiss, 2017). Transport research has examined energy consumption and spatial efficiency of different modes, yet frequently treats fleet structures as exogenous rather than as variables subject to innovation (Pérez-Martínez & Sorba, 2010; Will et al., 2020). Meanwhile, research on digital infrastructures and cloud-based services has largely developed in isolation from sustainability-oriented transport studies, emphasizing performance and scalability rather than environmental outcomes (Szalay et al., 2021; Poniszewska-Maranda et al., 2020). This fragmentation has limited the development of integrative frameworks capable of capturing the full transformative potential of FaaS.

The present article addresses this gap by offering a comprehensive, interdisciplinary analysis of FaaS as a socio-technical system embedded within sustainability transitions. By synthesizing insights from environmental science, transport studies, transition theory, and digital infrastructure research, the study seeks to articulate how FaaS can function as a lever for systemic change rather than as a narrowly technical solution. Central to this analysis is the argument that FaaS enables new forms of vehicle testing and operation that are more adaptive, resource-efficient, and environmentally accountable than traditional models, an argument strongly supported by Deshpande (2024). At the same time, the article critically examines potential limitations and unintended consequences, including rebound effects, digital energy consumption, and governance challenges, which must be addressed to ensure that FaaS contributes meaningfully to sustainability goals (European Environment Agency, 2023).

The introduction thus establishes the conceptual foundation for the subsequent analysis by situating FaaS within broader debates on automobility, sustainability transitions, and digitalization. It highlights the urgency of rethinking mobility systems in light of environmental constraints and identifies FaaS as a promising yet under-theorized pathway toward more sustainable transport futures. The following sections build on this foundation by detailing the methodological approach, interpreting findings from the literature, and engaging in an extended theoretical discussion of the implications of FaaS for sustainable mobility transitions.

METHODOLOGY

The methodological approach adopted in this study is explicitly qualitative, interpretive, and theory-driven, reflecting the nature of the research objective, which is to develop a comprehensive conceptual and analytical understanding of Fleet-as-a-Service (FaaS) as a socio-technical system within sustainable mobility transitions.

Given the strict reliance on the provided reference corpus, the methodology does not involve primary data collection, experimental measurement, or quantitative modeling. Instead, it is grounded in systematic literature synthesis, conceptual integration, and critical theoretical interpretation, an approach widely recognized as appropriate for advancing knowledge in complex, interdisciplinary domains where empirical phenomena are still emerging and fragmented across fields (Geels et al., 2004; Urry, 2010).

At the core of the methodology lies an integrative review strategy, which differs fundamentally from narrative summaries or bibliometric surveys. Rather than merely cataloging existing findings, the integrative approach seeks to identify underlying theoretical assumptions, conceptual linkages, and analytical tensions across diverse bodies of literature (Elzen & Wieczorek, 2005). This is particularly relevant for FaaS, which intersects environmental science, transport studies, industrial innovation, and digital infrastructure research. Each of these domains employs distinct epistemological frameworks and evaluative criteria, making simple aggregation insufficient for capturing the systemic implications of FaaS. The methodology therefore emphasizes interpretive synthesis, where insights from different disciplines are translated and aligned within a shared analytical framework.

The first stage of the methodological process involved thematic categorization of the reference material. The provided literature was systematically examined and grouped into four broad analytical domains: environmental impacts of transport systems, socio-technical transition theory and automobility studies, vehicle lifecycle and resource efficiency research, and digital infrastructure and real-time computing systems. This categorization was not intended to rigidly compartmentalize the analysis but to ensure comprehensive coverage of the multifaceted dimensions relevant to FaaS (Pérez-Martínez & Sorba, 2010; Berger et al., 2012; Andrews et al., 2014). Within each domain, key concepts, recurring arguments, and methodological orientations were identified and mapped.

The second stage involved the identification of cross-cutting concepts that connect these domains. Concepts such as lifecycle thinking, system efficiency, shared utilization, digital orchestration, and sustainability governance emerged as central analytical anchors. These concepts were then used to structure the interpretive analysis, enabling the study to move beyond disciplinary silos and articulate how FaaS operates as an integrated system. For instance, lifecycle assessment research on battery electric vehicles highlights the importance of operational patterns and utilization rates in determining environmental outcomes (Helmers & Weiss, 2017). When interpreted through the lens of FaaS, these findings take on new significance, as service-based fleet models directly influence utilization intensity and asset longevity (Deshpande, 2024).

A third methodological step consisted of situating FaaS within established transition theory frameworks, particularly the multi-level perspective on socio-technical change. This involved interpreting FaaS as a niche innovation responding to landscape-level pressures such as climate change, urban congestion, and digitalization, while interacting with regime-level structures in the automotive and transport sectors (Geels, 2005). This theoretical positioning was not imposed a priori but emerged inductively through engagement with the literature, which repeatedly emphasizes the systemic nature of transport sustainability challenges and the limitations of incremental technological fixes (European Court of Auditors, 2018; IPCC, 2014). Transition theory thus provided a coherent interpretive lens through which disparate empirical findings could be meaningfully connected.

Throughout the methodological process, particular attention was given to the work of Deshpande (2024), which serves as a central conceptual reference for understanding FaaS as an operational and sustainability-oriented innovation. Rather than treating this source as an isolated case, its arguments were critically examined in relation to broader theoretical and empirical debates. This involved identifying points of convergence, such

as the emphasis on continuous testing and data-driven optimization, as well as potential areas of tension, including assumptions about scalability and institutional readiness. This dialogical engagement with the literature enhances analytical rigor by avoiding uncritical adoption of any single perspective.

The methodology also explicitly acknowledges its limitations. The exclusive reliance on secondary sources means that the analysis is contingent on the quality, scope, and assumptions of existing research. While the provided references span a wide range of disciplines and perspectives, gaps remain, particularly with respect to empirical evaluations of large-scale FaaS deployments and their long-term social impacts (Beza & Zefreh, 2019). Moreover, the absence of quantitative modeling limits the ability to estimate precise environmental benefits or trade-offs associated with FaaS. However, these limitations are consistent with the study's theoretical objectives and are addressed through careful triangulation of concepts and arguments across sources.

In sum, the methodology is designed to maximize analytical depth and theoretical coherence rather than empirical generalizability. By systematically synthesizing and interpreting the provided literature, the study constructs a robust conceptual framework for understanding FaaS as a transformative element within sustainable mobility systems. This methodological foundation supports the subsequent presentation of results, which are articulated as interpretive findings grounded in the literature rather than as empirical measurements.

RESULTS

The results of this study are presented as a structured, interpretive synthesis of findings derived from the examined literature, rather than as numerical outputs or statistically validated relationships. These results articulate how Fleet-as-a-Service (FaaS) reshapes key dimensions of sustainable mobility systems, including environmental performance, vehicle lifecycle management, spatial efficiency, and digital coordination. Each interpretive result emerges from the convergence of multiple strands of research and is grounded in existing empirical and theoretical work on transport systems, environmental impacts, and digital infrastructures (European Environment Agency, 2023; Geels, 2005).

One of the most salient results concerns the reconfiguration of environmental performance assessment under FaaS models. Traditional evaluations of vehicle sustainability often focus on tailpipe emissions or per-vehicle efficiency metrics, implicitly assuming stable ownership patterns and predictable usage profiles (Pérez-Martínez & Sorba, 2010). The literature reviewed in this study suggests that such assumptions are increasingly untenable in service-based mobility contexts. FaaS enables continuous monitoring and adaptive optimization of vehicle operations, allowing environmental performance to be assessed dynamically across varying conditions of load, route, and usage intensity (Deshpande, 2024). This shift from static to dynamic assessment aligns closely with lifecycle-oriented research, which emphasizes that operational phases often dominate the environmental impacts of vehicles, particularly in urban settings characterized by congestion and stop-and-go traffic (Helmers & Weiss, 2017).

A second key result relates to resource efficiency and lifecycle extension. Studies on the water footprint and material intensity of vehicle production highlight the substantial environmental burdens associated with manufacturing and end-of-life processes (Berger et al., 2012). The literature indicates that increasing vehicle utilization rates, a core feature of FaaS, can significantly dilute these embodied impacts over a greater number of service kilometers. By contrast, privately owned vehicles often remain underutilized, spending the majority of their lifespan parked and idle, which exacerbates per-kilometer resource intensity (Urry, 2004). FaaS models, as described by Deshpande (2024), facilitate centralized maintenance, predictive servicing, and optimized replacement schedules, all of which contribute to extending vehicle lifespans and reducing

premature asset turnover.

The results also point to important implications for spatial efficiency and urban form. Research on road space consumption demonstrates that different transport modes vary widely in their spatial footprints, with private cars imposing disproportionately high demands on limited urban space (Will et al., 2020). FaaS, particularly when integrated with shared mobility services, has the potential to reduce the total number of vehicles required to meet mobility demand, thereby alleviating pressure on road and parking infrastructure. While the literature does not provide definitive quantitative estimates of these effects, the conceptual alignment between shared fleet utilization and spatial efficiency is well supported (European Environment Agency, 2023). This finding reinforces the argument that sustainability gains from FaaS extend beyond emissions reduction to encompass broader urban livability outcomes, including reduced noise exposure and improved public space allocation.

Another significant result concerns the role of digital infrastructure in enabling FaaS operations. Advances in cloud computing, real-time scheduling, and high-bandwidth communication networks are repeatedly identified as critical enablers of complex, distributed fleet coordination (Andrews et al., 2014; Rao & Prasad, 2018). The literature on real-time containers, serverless architectures, and fog computing highlights how computational elasticity and low-latency processing support responsive fleet management under variable demand conditions (Abeni et al., 2019; Szalay et al., 2021). When interpreted through the lens of FaaS, these technological capabilities translate into operational flexibility, enabling fleets to adapt rapidly to changing traffic conditions, regulatory constraints, and user needs. This adaptability is central to the sustainability potential of FaaS, as it allows environmental objectives to be integrated into real-time decision-making rather than treated as after-the-fact considerations (Deshpande, 2024).

The results further indicate that FaaS alters the institutional and governance dimensions of mobility systems. Traditional regulatory frameworks are often designed around privately owned vehicles and fixed operational models, making them ill-suited to service-based, digitally orchestrated fleets (European Court of Auditors, 2018). The literature suggests that FaaS introduces new governance challenges related to data ownership, accountability, and public oversight, particularly when fleets operate across jurisdictional boundaries. At the same time, centralized fleet management can facilitate compliance with environmental regulations by enabling standardized reporting and enforcement mechanisms (European Environment Agency, 2023). This duality underscores the need for adaptive policy frameworks capable of accommodating the hybrid public–private nature of FaaS ecosystems.

Finally, the results reveal persistent uncertainties and potential trade-offs associated with FaaS. While increased utilization and digital optimization promise sustainability gains, the literature also cautions against rebound effects, where improved efficiency leads to increased demand and overall mobility volumes (Urry, 2010). Additionally, the energy consumption of digital infrastructures supporting FaaS, including data centers and communication networks, raises questions about net environmental benefits if not managed within renewable energy frameworks (Jonas et al., 2017). These findings do not negate the sustainability potential of FaaS but highlight the importance of systemic evaluation and governance.

Collectively, the results demonstrate that FaaS constitutes a multifaceted transformation of mobility systems, with implications that extend beyond vehicle technology to encompass environmental assessment practices, resource efficiency, spatial organization, and institutional arrangements. These interpretive findings provide the empirical and theoretical basis for the subsequent discussion, which engages more deeply with the implications, limitations, and future trajectories of FaaS within sustainable mobility transitions.

DISCUSSION

The interpretive results presented above invite a deeper theoretical engagement with Fleet-as-a-Service (FaaS) as a transformative construct within contemporary mobility systems. This discussion expands on those findings by situating FaaS within long-standing debates on automobility, sustainability transitions, and digital governance, while also addressing counter-arguments and unresolved tensions highlighted in the literature. Rather than treating FaaS as a discrete operational innovation, this section argues that it represents a structural reorientation of how mobility is conceived, organized, and regulated, with far-reaching implications for environmental sustainability and socio-technical change (Geels, 2005; Deshpande, 2024).

A central theoretical implication of FaaS lies in its challenge to the dominant paradigm of automobility as a privately owned, individually controlled system. Urry's conceptualization of automobility emphasizes its systemic character, describing it as a self-reinforcing assemblage of technologies, infrastructures, cultural meanings, and political interests that collectively stabilize car-centric mobility (Urry, 2004). FaaS disrupts this assemblage by decoupling mobility access from ownership, thereby weakening one of the core pillars that sustain the existing regime. From a transition theory perspective, this decoupling can be interpreted as a destabilizing force that opens space for alternative mobility configurations to emerge and scale (Elzen & Wieczorek, 2005). The literature suggests that such shifts are rarely linear or uncontested, as incumbent actors often resist changes that threaten established value chains and institutional arrangements (Geels et al., 2004).

The environmental significance of this regime-level challenge becomes particularly evident when considering lifecycle impacts. Research on battery electric vehicles has demonstrated that while operational emissions can be significantly reduced, upstream impacts associated with production and resource extraction remain substantial (Helmers & Weiss, 2017). FaaS addresses this tension not by altering vehicle technology per se, but by reshaping usage patterns in ways that improve overall lifecycle efficiency. Higher utilization rates mean that the environmental costs of production are amortized over a larger number of service kilometers, effectively reducing per-unit impact (Berger et al., 2012). This insight reinforces the argument that sustainability outcomes are as much a function of organizational models as of technological choices, a point strongly emphasized in Deshpande's analysis of sustainable vehicle testing and operations (Deshpande, 2024).

At the same time, the discussion must grapple with the possibility of rebound effects, a recurring concern in sustainability research. Improved efficiency and reduced per-kilometer costs can paradoxically lead to increased travel demand, thereby offsetting environmental gains (Urry, 2010). Within FaaS systems, this risk manifests in the potential for highly convenient, on-demand mobility services to encourage additional trips that would not otherwise occur. The literature does not provide definitive evidence on whether FaaS exacerbates or mitigates such effects, but it does suggest that governance mechanisms and pricing strategies play a crucial role in shaping outcomes (European Environment Agency, 2023). This highlights the importance of embedding sustainability objectives into the design of FaaS platforms, rather than assuming that efficiency gains will automatically translate into reduced environmental pressures.

Digital infrastructure emerges in this discussion as both an enabler and a source of new sustainability challenges. The integration of cloud computing, real-time scheduling, and high-speed communication networks is widely recognized as essential for coordinating complex fleet operations (Andrews et al., 2014; Rao & Prasad, 2018). These technologies allow FaaS systems to function as adaptive, data-driven entities capable of optimizing routes, maintenance schedules, and energy use in real time. However, the energy consumption associated with data centers, network infrastructure, and continuous data processing raises questions about the net environmental benefits of digitally intensive mobility systems (Jonas et al., 2017). The literature suggests that these concerns can be mitigated through the use of renewable energy sources and efficient computing architectures, but emphasizes that digital sustainability must be considered alongside transport sustainability rather than treated as a separate domain (Poniszewska-Maranda et al., 2020).

Another critical dimension of the discussion concerns governance and institutional adaptation. Traditional transport policies and regulatory frameworks are often ill-equipped to address service-based, digitally mediated mobility systems that blur the boundaries between public and private actors (European Court of Auditors, 2018). FaaS introduces new questions regarding data ownership, algorithmic decision-making, and accountability for environmental performance. While centralized fleet management can facilitate standardized reporting and compliance with environmental regulations, it also concentrates power in the hands of platform operators, potentially reducing transparency and democratic oversight (European Environment Agency, 2023). This tension underscores the need for governance models that balance innovation with public interest considerations, a challenge that remains underexplored in the existing literature.

From a socio-technical transition perspective, FaaS can be understood as a niche innovation whose long-term impact depends on interactions with broader landscape pressures and regime responses (Geels, 2005). Climate change, urban air quality concerns, and noise pollution constitute powerful landscape-level drivers that create political and social momentum for alternative mobility models (IPCC, 2014; European Environment Agency, 2023). At the same time, incumbent automotive manufacturers and service providers may strategically adopt FaaS elements to preserve their market positions, potentially diluting the transformative potential of the model (Yeung, 2022). This dynamic raises important questions about whether FaaS will ultimately reinforce or fundamentally reshape existing mobility regimes.

The discussion also benefits from engaging with spatial considerations highlighted in the literature. Research on road space consumption emphasizes that private car dominance imposes significant opportunity costs on urban environments, crowding out alternative uses of public space (Will et al., 2020). FaaS, particularly when integrated with shared and automated vehicle technologies, holds promise for reducing the total vehicle fleet size required to meet mobility demand. However, realizing these benefits depends on careful integration with land-use planning and public transport systems, rather than treating FaaS as a standalone solution (Beza & Zefreh, 2019). This reinforces the argument that sustainable mobility transitions require coordinated, system-wide interventions rather than isolated innovations.

Finally, the discussion highlights the role of experimentation and learning in advancing FaaS. Deshpande (2024) emphasizes that FaaS enables continuous testing and iterative improvement of vehicle technologies under real-world conditions, accelerating learning cycles and reducing uncertainty. From a transition theory standpoint, such experimentation is a hallmark of successful niche development, as it allows actors to refine technologies and practices while building legitimacy and stakeholder support (Elzen & Wieczorek, 2005). However, the literature also cautions that experimental approaches must be accompanied by mechanisms for knowledge sharing and institutional learning to avoid fragmentation and duplication of effort (Geels et al., 2004).

In synthesis, the discussion underscores that FaaS is neither a panacea nor a purely technical fix for sustainability challenges in transport. Its transformative potential lies in its capacity to reconfigure relationships between technology, organization, and governance within mobility systems. Realizing this potential requires deliberate alignment of digital infrastructures, environmental objectives, and policy frameworks, as well as ongoing critical scrutiny of unintended consequences. These insights provide a foundation for the concluding reflections on the implications of FaaS for future research and practice.

CONCLUSION

This article has developed an extensive, theory-driven analysis of Fleet-as-a-Service as an emerging paradigm within sustainable mobility transitions. Drawing exclusively on the provided literature, it has argued that FaaS

represents a significant departure from traditional models of vehicle ownership and operation, with implications that extend across environmental performance, lifecycle management, digital infrastructure, and socio-technical governance. By integrating insights from environmental science, transport studies, transition theory, and information systems research, the study has sought to overcome the fragmentation that currently characterizes scholarly engagement with service-based mobility models (Geels, 2005; Deshpande, 2024).

The analysis demonstrates that FaaS has the potential to contribute meaningfully to sustainability objectives by increasing vehicle utilization, enabling dynamic environmental performance monitoring, and supporting more efficient use of urban space. These contributions are not automatic outcomes of technological change but are contingent on organizational design, regulatory alignment, and governance choices (European Environment Agency, 2023; Helmers & Weiss, 2017). The study also highlights persistent challenges, including rebound effects, digital energy consumption, and institutional adaptation, which must be addressed to ensure that FaaS evolves as a genuinely sustainable alternative rather than a marginal optimization.

From a theoretical perspective, the article reinforces the value of socio-technical transition frameworks for understanding mobility innovation. FaaS emerges as a niche innovation shaped by landscape-level pressures such as climate change and digitalization, while interacting in complex ways with entrenched automobility regimes (Urry, 2004; Elzen & Wieczorek, 2005). This perspective underscores the importance of systemic analysis and cautions against overly narrow evaluations focused solely on technological performance.

Future research should build on this conceptual foundation by conducting empirical studies of FaaS deployments across diverse geographic and institutional contexts, with particular attention to long-term environmental and social outcomes. Policy experimentation and interdisciplinary collaboration will be essential for translating the theoretical potential of FaaS into practical sustainability gains. In conclusion, Fleet-as-a-Service should be understood not merely as a novel operational model, but as a catalyst for reimagining the governance and purpose of mobility systems in an era of environmental constraint and digital transformation.

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