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Understanding the dynamics and challenges of free-floating bicycle sharing systems in sustainable urban mobility transformations: Case Study Vienna

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Abstract (English)

Amidst the urgent need to address climate change and other significant societal challenges, the sustainable transformation of resource-intensive public sectors, such as the transportation sector, is crucial in urban areas worldwide. Free-floating bike sharing systems (FFBSS) have emerged as a potential contributor to sustainable urban mobility. However, there has been limited research on the dynamics and challenges surrounding these systems in transition.

In 2017, FFBSS gained prominence as a new sustainable mobility option, also in the case study Vienna. Providers from Asia introduced their services in Austria's capital, offering the advantage of flexibility without the need for docking stations. However, this perceived benefit quickly led to numerous problems, primarily stemming from misuse, such as vandalism and improper parking. Consequently, city authorities implemented strict regulations for FFBSS providers, leading to resistance from public authorities towards FFBSS.
Within less than a year, FFBSS, once seen as a sustainable and affordable transportation solution, exited the city due to these regulatory measures. Thus, the primary objective of this thesis is to gain a deeper understanding of the dynamics and challenges associated with FFBSS.

To gather comprehensive scientific insights on FFBSS, a systematic literature review encompassing 100 scholarly articles was conducted, focusing on various keywords associated with FFBSS. Additionally, 60 newspaper articles were systematically analysed to gain insights into the developments and challenges surrounding FFBSS in Vienna. Furthermore, an expert interview was conducted to gather added insights on FFBSS.

The results suggest that a collaborative approach to governance could be advantageous for city authorities and FFBSS providers. It is crucial for governance actors to integrate FFBSS into the urban mobility system, invest in adequate cycling infrastructure, and closely monitor usage data, demand and fleet sites. Factors such as weather conditions, topography, safety, traffic security, and accessibility directly influence the usage of FFBSS. Providers should focus on understanding usage patterns, peak usage hours and usage hotspots to efficiently rebalance free-floating bicycles. Implementing credit systems could engage users in dynamic rebalancing efforts. Moreover, ensuring sufficient technological quality, including geo-fencing technology, could mitigate issues related to improper parking and improve FFBSS operations. Real-time management, continuous evaluation of live usage data, and a well-equipped service team are essential for effective FFBSS operation and maintenance. Agreeing on reasonable pricing strategies and securing public and private sponsorship could further enhance the viability of FFBSS.

FFBSS offers numerous benefits, from environmental to health advantages. By learning from past mistakes and incorporating scientific insights from this thesis into policy concepts, city authorities in Vienna can potentially facilitate the successful renaissance of FFBSS. This could contribute to sustainability transitions and establish FFBSS as an integral component of the urban mobility system.

Abstract (Deutsch)

Inmitten des dringenden Bedarfs, den Klimawandel und andere bedeutende gesellschaftliche Herausforderungen zu bewältigen, ist die nachhaltige Transformation ressourcenintensiver öffentlicher Sektoren, wie die des Verkehrswesens, in städtischen Gebieten weltweit von entscheidender Bedeutung. Free-Floating-Bike-Sharing-Systeme (FFBSS) haben sich als potenzieller Beitrag zur nachhaltigen städtischen Mobilität herausgestellt. Dennoch gibt es nur begrenzte Forschung zu den Dynamiken und Herausforderungen im Zusammenhang mit diesen Systemen im Wandel.

Im Jahr 2017 gewannen FFBSS als neue nachhaltige Mobilitätsoption auch in der Fallstudie Wien an Bedeutung. Anbieter aus Asien führten ihre Dienste in der österreichischen Hauptstadt ein und boten den Vorteil der flexiblen Nutzung ohne der Notwendigkeit von Docking-Stationen. Diese vermeintlichen Vorteile führten jedoch schnell zu zahlreichen Problemen, hauptsächlich aufgrund von inadäquater Nutzung wie Vandalismus und unsachgemäßem Parken. Folglich setzten die Stadtbehörden strenge Vorschriften für FFBSS-Anbieter um, was zu Widerständen der öffentlichen Behörden gegenüber FFBSS führte. Innerhalb weniger als eines Jahres verließen FFBSS, die einst als nachhaltige und erschwingliche Transportlösung angesehen wurden, die Stadt aufgrund dieser regulatorischen Maßnahmen. Das Hauptziel dieser Arbeit ist es daher, ein tieferes Verständnis für die Dynamiken und Herausforderungen im Zusammenhang mit FFBSS zu gewinnen.

Um umfassende wissenschaftliche Erkenntnisse zu FFBSS zu sammeln, wurde eine systematische Literaturübersicht durchgeführt, die 100 wissenschaftliche Artikel umfasste und sich auf verschiedene Schlüsselwörter im Zusammenhang mit FFBSS konzentrierte. Darüber hinaus wurden 60 Zeitungsartikel systematisch analysiert, um Einblicke in die Entwicklungen und Herausforderungen im Zusammenhang mit FFBSS in Wien zu gewinnen. Zusätzlich wurde ein Experteninterview durchgeführt, um zusätzliche Erkenntnisse über FFBSS zu sammeln.

Die Ergebnisse legen nahe, dass ein kooperativer Ansatz zur Governance von Vorteil sein könnte, sowohl für Stadtbehörden als auch für FFBSS-Anbieter. Es ist entscheidend, dass Governance-Akteure FFBSS in das städtische Mobilitätssystem integrieren, in angemessene Fahrradinfrastruktur investieren und die Nutzungsdetails, Nachfrage und Standorte der Flotte genau überwachen. Faktoren wie Wetterbedingungen, Topografie, Verkehrssicherheit und Zugänglichkeit beeinflussen direkt die Nutzung von FFBSS. Anbieter sollten sich auf das Verständnis von Nutzungsmustern, Spitzennutzungszeiten und Hotspots der Nutzung konzentrieren, um die Fahrräder effizient zu verteilen. Die Implementierung von Bonussystemen könnte Nutzer in die Verteilung der Räder einbinden. Darüber hinaus könnte die Sicherstellung ausreichender technologischer Qualität, einschließlich der „geofencing-Technologie“, Probleme im Zusammenhang mit unsachgemäßem Parken mindern und die FFBSS-Operationen verbessern. Echtzeitmanagement, kontinuierliche Auswertung von Live-Nutzungsdaten und ein gut ausgestattetes Serviceteam sind entscheidend für den effektiven Betrieb und die Wartung von FFBSS. Die Vereinbarung vernünftiger Preisstrategien und die Sicherung von öffentlichen und privaten Sponsoren könnten die Tragfähigkeit von FFBSS weiter verbessern. FFBSS bietet zahlreiche Vorteile, von Umwelt- bis hin zu Gesundheitsvorteilen. Durch das Lernen aus vergangenen Fehlern und die Integration wissenschaftlicher Erkenntnisse aus dieser Arbeit in politische Konzepte könnten Stadtbehörden in Wien potenziell zur erfolgreichen Wiederbelebung von FFBSS beitragen. Dies könnte die nachhaltige Transformation des Verkehrssektors ankurbeln und FFBSS als integralen Bestandteil des städtischen Mobilitätssystems etablieren.

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1. Introduction/ Research Gap

Various grand societal challenges associated with climate change, including ecosystem degradation, insufficient access to clean water resources, socio-economic inequality (Markard et al., 2020), biodiversity loss or depletion of resources (Köhler et al., 2009), are putting modern societies under pressure, impacting crucial sectors like transportation, nutrition, and energy. While incremental technological innovations are often touted as a means to initiate sustainability transformations, they typically offer only temporary solutions to complex societal problems (Farla et al., 2012). Frequently, these niche developments even serve to reinforce existing systemic structures and institutional settings (ibid, 2012). Additionally, existing systemic structures inherit "high degrees of inertia" (Markard et al., 2020), so breaking up these entrenched structures is becoming a central focus to accelerate the process of sustainability transformations (ibid, 2020).

Addressing these locked-in structures requires engaging with various interconnected societal fields, including legal, ethical, social, biophysical, and economic sectors (Abson et al., 2016). These structures in modern societies, alongside emerging niche innovations seeking to compete and alter these existing societal structures, can either foster or hinder sustainability transformations. This dynamic has given rise to sustainability transformation as a new research field (Markard et al., 2020). Examining sustainability transformations, it becomes evident that societal structures must be reorganized, and systemic norms, like consumption and production patterns, must undergo significant change. This radical reconfiguration of systemic structures is essential for enabling the success of sustainability transformations (Farla et al., 2012; Köhler et al., 2009). Shifting the mindset of societal actors toward embracing more sustainable practices is crucial for addressing the challenges posed by grand societal issues. However, it's important that these sustainability transformations do not impede current generations from meeting their needs. Instead, they should be designed to meet the demands of both present and future generations (Markard et al., 2020).

Indeed, it's crucial to ensure that the essential functions of society continue to operate effectively while pursuing radical shifts like sustainability transformations. According to Köhler et al., these modifications need to occur at various societal levels. At the macro-level, transformations involve reshaping capitalist systems and redefining the relationship between society and nature (Köhler et al., 2009). Absolutely, at the micro-level, individual choices, social norms, and personal motivations play significant roles in influencing transitions (ibid,

2009). Scholars studying sustainability transformations acknowledge that these processes often span over a decade or more to fully unfold. However, given the urgency of current grand societal challenges, immediate action from various societal actors is imperative (Farla et al., 2012). The urgency of the situation is compounded by societal actors, companies, or politicians prioritizing short-term goals over long-term visioning, thus strategically impeding the unfolding of sustainable transformations. When these transformations do occur, they often proceed slowly, facing resistance from various actors entrenched within societal structures (ibid, 2012).

Abson et al. introduced an intriguing approach to fostering sustainability transformations by dividing the process into three distinct leverage points: re-structuring, re-connecting and re-thinking (Abson et al., 2017). Re-structuring involves assessing the stability, adaptability, and learning capacity of institutions. Often, institutional settings are established and continue to operate in outdated and unsustainable ways. Disasters can sometimes prompt structural changes by necessitating adaptation toward sustainability and breaking away from old structures. Additionally, intentional destabilization efforts aimed at locked-in systemic structures can create openings for sustainable changes in systems (ibid, 2017). If systems fail to achieve sustainability, these failures can provide valuable insights into the characteristics of institutions and guide how to structure them for the future. Beyond restructuring outdated arrangements, protecting and continuously monitoring existing well-functioning sustainable systems can also be crucial for the success of sustainability transformations (ibid, 2017).

In addition to restructuring unsustainable pathways, Abson et al. emphasized the importance of reconnecting human actors with natural systems. The perception, valuation, and interconnectedness of humans with nature are crucial for the acceptance of sustainable societal pathways. The closer the connection, the greater the reliance on and interest in protecting natural settings (ibid, 2017).

Besides fostering a better connection between human actors and natural settings, the leverage point of re-thinking is crucial for sustainability transformations. This involves the creation, use, and sharing of various forms of knowledge (ibid 2017) The reliance on path-dependent, proven knowledge and existing structures is a natural behaviour for human actors within a system. However, when producing and perceiving knowledge, it is crucial for human actors to be aware of these old-fashioned habits and actively work to change their own perceptions. This shift can facilitate the incorporation of alternative knowledge, which is essential for advancing sustainability transformations (ibid, 2017).

Looking at catalysts for sustainability transformations, effective governance and distinct policymaking are crucial for successful transitions. Kivimaa and Kern argued that system transitions require policies that not only support the emergence of niche innovations but also actively promote instability in existing institutional settings that perpetuate unsustainable behaviours (Kivimaa and Kern, 2016). Markart et al. emphasized three critical considerations for creating policies that promote sustainability transformations. Firstly, policy development must adopt a more internal approach, targeting the transformation of entire societal systems rather than isolated sectors. Secondly, the introduction of better-coordinated policy mechanisms is essential. This requires a higher degree of connection and common goals between institutions and actors to ensure the success of sustainability transformations (Markard et al., 2020). Farla et al. concur that cooperation is a key ingredient in facilitating in "making transition" (Farla et al., 2012): Effective coordination and collaboration among stakeholders, along with healthy competition, can significantly influence the success of sustainable transformations. As these transformations progress, the relationships, arrangements, and responsibilities of the involved players often evolve. This evolution can create opportunities for new and more sustainable structures within a system. Additionally, as existing structures and established settings in a socio-technical system change, actors at the regime level might begin to focus on different and more sustainable consumption patterns (ibid, 2012).

According to Markard et al., the acceptance of the sustainability transformation process among a diverse array of actors within a system directly influences the success of these transformations (Markard et al., 2020). This can involve altering industrial cooperations and potentially rewarding those who might lose out from sustainability transformations. Additionally, governance actors should coordinate a wide variety of policy instruments, such as incentives or principles. By implementing them step by step, policymakers can enhance the chances of a sustainability transformation flourishing. Ultimately, policymakers must consider the specificity of place and geographical context in the governance of sustainability transformations (ibid, 2020).

Indeed, policymakers worldwide have increasingly emphasized the need to foster sustainability transformations in response to grand societal challenges. Additionally, there is a growing trend of companies and consumers alike moving towards a more sustainable way of life (Turnheim et al., 2015). Despite significant resistance from entrenched societal systems, there are promising signs that sustainability transformations are gaining momentum, and actors are

beginning to adapt to the challenges presented by societal challenges (Markard et al., 2020). Absolutely, understanding the concerns and capabilities of actors involved in sustainability transformations is crucial for policymakers to navigate the complexities of the transition. This insight can help policymakers develop more effective strategies that address the needs and challenges of all stakeholders involved (Farla et al., 2012). Indeed, sustainability transformations present significant challenges that require coordinated efforts across various sectors and actors. Even powerful entities like governments and multinational corporations face complexities and obstacles in navigating these transitions. This underscores the need for collaborative and innovative approaches to address sustainability challenges effectively (Turnheim et al., 2015).

Understanding the dynamics of niches and their interaction with existing structures is crucial for advancing sustainability transformations. Niches often serve as incubators for innovative solutions to sustainability challenges, offering potential pathways for systemic change. However, the entrenched nature of existing structures can pose barriers to the diffusion and adoption of niche innovations. Therefore, it's essential to explore how niches can effectively navigate and interact with these established systems to facilitate broader sustainability transitions.

Geography of (urban) sustainability transformations

In the face of the arising discourse around sustainability transformations and with the geographical context set through the chosen case study city in this thesis, Fastenrath and Braun argue that the geographical and place-specific context within sustainability transformations has been insufficiently explored (Fastenrath and Braun, 2018). With this statement, the two researchers contribute to the expanding field of research, known as the "Geography of Sustainability Transition" (Hansen and Coenen, 2015). This research field focuses on understanding socio-technical changes in certain contexts as well as in different societal sectors such as energy, manufacturing, transport or food production (ibid, 2015). Fastenrath and Braun in that regards underscore the necessity of considering place-specific characteristics, including political, economic, and technological aspects, when examining sustainability transformations. This approach enables a more comprehensive understanding of the dynamics, drivers, and barriers of sustainable development (Fastenrath and Braun, 2018). They additionally highlight the significance of geographic context and place specificity in urban settings and urban

sustainability transformations: While cities are inherently interconnected with broader political, economic, and social systems at various scales, each city is a unique and distinct entity with its own individual characteristics and context (ibid, 2018).
In the case study selected for this thesis, it's crucial to account for the specific characteristics of the urban sustainable transformation under examination. The transformation observed embodies unique geographical features that are not transferrable to other geographical contexts.

As the urgency to accelerate urban sustainability transformations intensifies, a closer examination of urban transport systems becomes imperative. These systems must undergo significant improvements to enhance sustainability, especially in light of prevalent issues such as climate change, reliance on fossil fuels, air pollution, traffic congestion, safety concerns, and the underutilization of both passenger and goods vehicles (Goodman, 2005). In urban environments, where space and infrastructure are increasingly recognized as limited resources, challenges like congestion, pollution, and traffic-related accidents are compounded by inefficiencies in "last mile" logistics (ibid, 2005).
The transportation sector typically inflicts significant adverse effects on the environment and human health. Accounting for roughly a quarter of the EU's overall greenhouse gas (GHG) emissions, transport contributes substantially to climate change. Additionally, it gives rise to issues such as air and noise pollution, as well as habitat fragmentation (European Environment Agency, 2024).

As the imperative to decarbonize urban mobility systems intensifies, free-floating bike sharing systems (FFBSS) emerge as a potentially sustainable, cost-effective, and resource-efficient solution for urban areas. They play a pivotal role in endeavours aimed at effectively transforming urban mobility sustainably. Understanding the operational mechanisms and challenges of FFBSS is crucial for devising solutions to reduce emissions in the transport sector and advance sustainable urban mobility. This thesis seeks to explore how FFBSS function within sustainable urban mobility transitions, including their integration into existing mobility systems. Additionally, it aims to investigate how these sustainability niches interact with established regimes in the mobility sector, such as public institutions and policymakers, which may resist sustainable changes. By shedding light on these dynamics, this research contributes to a relatively underexplored area of study, offering valuable insights into sustainable urban mobility transformations.

The opening chapter delves into the evolving concepts of the shared economy and sharing mobility, which offer new avenues for sustainable transformations in consumerism. It introduces bicycle sharing systems (BSS) as a pivotal component of shared mobility, tracing their historical development through four generations. The chapter establishes a link between this evolving landscape and the selected case study of Vienna, setting the stage for the research question of the thesis. Emphasizing the significance of BSS as a sustainable mobility solution, the chapter outlines the various benefits they offer towards achieving transformative shifts in the mobility sector.

1.1. Sharing economy/ sharing mobility

The emergence of the sharing economy presents a viable solution to drive sustainability transformations, catalysed by social, economic, and environmental imperatives amidst escalating societal challenges. At its core, the sharing economy envisions resource sharing, cost savings, and capital generation, drawing participation from a diverse collective of consumers and entrepreneurs keen on scaling innovative sharing models. Examples like carsharing (e.g., Uber) and home-sharing (e.g., Airbnb) have propelled the sharing economy from "fringe to the mainstream" (Cohen and Shaheen, 2018). The sharing economy, as a novel paradigm, is characterized by the non-ownership utilization of publicly accessible services and goods (Machado et al., 2018). Shared mobility, as a burgeoning sector within the sharing economy, can be defined as "an innovative transportation strategy that enables users to have short term access to a mode of transportation" (Cohen and Shaheen, 2018). The rising popularity of shared transportation modes can be attributed to cultural and demographic changes, as well as evolving attitudes toward ownership in response to significant societal challenges. Shared mobility services offer an alternative to vehicle ownership in urban areas, encouraging service utilization while reducing individual ownership (Machado et al., 2018).

Within urban areas, the idea of shared mobility is particularly significant. As a cornerstone of the sharing economy, shared mobility stands out for its potential to revolutionize urban transportation systems both now and in the future. Urban mobility systems are grappling with numerous societal challenges, notably the rapid proliferation of individually owned vehicles and increasing motorization rates (Machado et al., 2018). The emergence of shared mobility systems has altered travel behaviour in urban areas. These systems have expanded in response to growing demand for environmentally friendly transportation options, as well as the desire for increased flexibility in travel choices, both in terms of spatial and temporal dimensions

(Laporte et al., 2018). It is important to understand how shared mobility concepts can be integrated into day-to-day urban mobility, how they behave and what their strengths and weaknesses are to increase their efficiency from an economic, environmental, and social point of view. The appropriate inclusion of shared mobility services can lead to a variety of benefits, as for example the promotion of multimodality, the diminishing of personal vehicle ownership and the minimization of motorized vehicle kilometres in urban areas (Machado et al., 2018). Additionally, shared mobility can have a positive impact on urban planning processes, contributing to economic progress, conservation efforts, climate activism, as well as land use and urban design. (Cohen and Shaheen, 2018).

1.2. Towards bicycle-sharing systems

Indeed, bicycle-sharing systems (BSS) play a crucial role in modern shared mobility systems, promoting the use of bicycles as a mode of urban transportation for individuals (Moon-Miklaucic et al., 2019). Bicycle sharing systems represent a robust approach to centralizing bicycle availability in urban areas while also integrating cycling into the broader mobility network within cities (ibid, 2019). The fundamental idea behind bicycle-sharing is to promote environmentally friendly transportation (Midgley, 2009). Bicycle-sharing systems differ from traditional bicycle rental services in their simplicity: they allow users to rent bicycles at various locations, providing quick and convenient access through diverse business models, often integrated into a city's overall mobility system (ibid, 2009). These schemes enable urban commuting and short-distance travel, functioning as flexible and cost-effective transportation options. Users can return bikes either to their initial rental point or to other stations within the bicycle-sharing network (Cesbron and Luckhurst, 2015).

The roots of bicycle-sharing systems can be traced back half a century ago when governance actors, entrepreneurs, and activist groups began exploring technologically advanced solutions for urban mobility that aligned with the habits of citizens and users (Ploeger and Oldenziel, 2020). The socio-technical origins of bicycle sharing systems date back to the 1960s when social movements emerged to advocate for sustainable urban mobility solutions as part of public transit. Bicycle sharing systems were among these initiatives, with their inception occurring in Amsterdam, Netherlands. The social movement Provo introduced the "White Bike Plan" in 1965, spearheaded by innovator Luud Schimmelpennink, who pioneered the world's first bicycle sharing program. Under this plan, white-painted bikes were made available to the public

through simple docking systems, featuring a coin-based payment method (ibid, 2020). Furthermore, these bicycles operated just like regular bikes, painted white and accessible to the public. Users could find a bike, ride it to their destination, and then leave it for the next user (DeMaio, 2009). Regrettably, the initiative collapsed within days due to acts of vandalism and unauthorized private use of the bikes. Nonetheless, the "white bikes" are recognized as the **first generation** of bicycle-sharing systems (ibid, 2009).

Three decades later, in 1995, the **second generation** of bicycle-sharing programs was introduced in Copenhagen, called "Bycyklen" (Macioszek et al., 2020). The second generation, also known as city bikes, introduced several advancements compared to the first generation. Initiated in Copenhagen, this new bike-sharing system featured a design focused on robust practicality, with substantial rubber tires. It offered the convenience of being picked up and returned at designated spots throughout the city centre, facilitated by a simple coin-based system (DeMaio, 2009). After completing the ride, the user would retrieve the coin, making the bicycle system free to use. Additionally, the system was accessible every day at all times, enhancing its appeal to customers (Macioszek et al., 2020).
Despite the increased formality of stations and the involvement of nonprofit organizations in running these programs, bicycle theft still remained a significant problem due to the users' privacy and anonymity (DeMaio, 2009). With 1000 bicycles and 110 bike rental stations, "Bycyclen" opened up new dimensions for bicycle-sharing systems (Macioszek et al., 2020).

In 1996, the **third generation** of bike-sharing systems began with the introduction of the "smart dock"; a new form of intelligent docking stations for BSS. The launch of this new bike-sharing system occurred in Portsmouth, England, under the name "Bikeabout". Initially intended as a bike rental option for students, the system expanded later that year and achieved full automation using magnetic cards. With comprehensive user identification, it was the first instance in the history of bike sharing that a bicycle-sharing system addressed the issues of broken or stolen bicycles (ibid, 2020). In addition, the third generation of bicycle-sharing saw a range of technological updates, including new features such as locking racks, mobile applications, and telecommunications systems (DeMaio, 2009). The third generation of BSS also marked the introduction of docked or station-based bike sharing systems, where customers were required to rent bikes from designated stations and return them after use at another station. This necessitated parking infrastructure for these systems (Hsu et al., 2018).

Partly due to the challenge of requiring parking infrastructure, the **fourth generation**, and currently the most modern form of bicycle sharing systems, emerged. Named as free-floating, station-less, or dock-less bike sharing systems, this generation was influenced by the global proliferation of smartphones and the general advancement of technology (Fishman, 2016). A distinctive feature of the fourth generation of bike sharing is the departure from "smart dock" technology, which was used in docked bike sharing systems. Fourth generation systems now utilize "smart bikes", equipped with rental, return, identification, and built-in mechanisms. These bicycles incorporate electric locks and real-time multi-system electronic supervision via GPS sensors, eliminating the need for traditional docking locations (Macioszek et al., 2020). This shift allowed governance actors to reduce subsidies for hard infrastructure such as bicycle docking stations, while providing flexibility in usage. Prospective users can utilize phone applications to locate and reserve bikes nearby, with a map guiding them to the bike's location. Accessing the bikes involves scanning a QR code on the bike itself. To end the ride, users can leave their bicycle within a designated geographical zone or at a legal parking location (Pojani et al., 2020). The increased flexibility eliminates the need for significant capital investment in docking infrastructure, potentially facilitating the expansion of bike-sharing systems and rendering subsidies for docking-station infrastructure unnecessary. However, free-floating bike sharing systems also present new challenges, such as vandalism or improperly parked bicycles, which impact urban spaces (Nieuwesteeg, 2018).

The next chapter delves into the selected case study, Vienna, to comprehend the dynamics, mechanisms, and associated challenges stemming from the emerging mobility niche of free-floating bike sharing systems. From the researcher's perspective, examining the FFBSS dynamics within Vienna's sustainable mobility transformation, exploring the interactions between the FFBSS niche and governance actors in the city, and understanding how policy regimes resist sustainable changes through the niche, make Vienna an intriguing case study for analysis.

1.3. Dynamics and mechanisms around BSS/FFBSS: Case Study Vienna

To underscore the significance of the chosen case study for this thesis, it's essential to briefly outline the history of bike sharing systems (BSS) in Vienna. "Sharing instead of owning" is a fundamental principle in Vienna's STEP 2025 plan (Vienna City Administration, 2015), reflecting the city's commitment to integrating new sharing options into its urban mobility

system. Over the years, various iterations of BSS have been introduced in Vienna, reflecting the historical evolution of this niche within the city.

The history of BSS in Vienna began with the introduction of two systems: “Veloce” in 1991 and “Wiener Stadtrad” in 1997. However, these initiatives lacked sufficient political and financial support, leading to their eventual failure (Laa and Emberger, 2020). In 2002, “Viennabike” was launched, featuring a coin deposit of 2 euros for the bicycles. Still this low deposit, functioning similarly to a supermarket trolley, led to problems arising quickly (Link et al., 2020). The low deposit resulted in bicycles being stolen, leading to the loss of 600,000 euros in subsidies (Rottenberg, 2014). Following in its predecessors’ footsteps was “Citybike Wien” in 2003, which turned out to be much more of a success story. It introduced station-based bicycle sharing into Austria’s capital city and became a pioneering program for public station-based bicycle-sharing systems. The program was exported to 60 metropolitan areas around the globe in the following years (Brandt Di-Maio, 2018). In 2018, 15 years later, “Citybike Wien” counted 1500 bicycles and 121 stations, available year-round. The program played a significant role in promoting the bicycle as a free and sustainable transport mode in Vienna.

Unlike the publicly funded and station-based “Citybike Wien”, which was a success story, private free-floating bike-sharing systems (FFBSS) didn’t fare well in the case study city. Numerous challenges, as detailed below, complicated the interaction and dynamics between the new mobility niche of FFBSS and the regime actors (public authorities in Vienna). Problems stemming from the new mobility niche, the challenging dynamics between niche and regime actors, and increasing signs of regime resistance from public authorities made Vienna a challenging environment for FFBSS to thrive. However, the various problematic trends in the case study city offer valuable insights into the dynamics of FFBSS in sustainable mobility transformations.

In mid-2017, free-floating bike sharing systems garnered significant attention as new providers entered the European market. In Vienna, the case study city, Asian providers such as “Ofo” and “oBike” launched their services to the public in August 2017. What set free-floating bicycles apart was the unlocking mechanism via smartphone. Unlike the docked “Citybikes Wien”, users could park the bicycle wherever they wished, as long as it complied with traffic regulations (Link et al., 2020). Laa and Emberger summarized the subsequent events as “uncivilized behaviour” (Laa and Emberger, 2020), the bicycles belonging to “oBike” and “Ofo” were often

found parked inappropriately on sidewalks, creating obstacles for pedestrians. Additionally, instances of vandalism and damage to bikes became increasingly prevalent, raising concerns among providers, users, and policymakers in Vienna. The escalating problem of illegally parked bicycles, along with the proliferation of abandoned bikes and the rapid expansion of free-floating bike-sharing services in Vienna, prompted the city council to take action and implement stricter regulatory measures for private free-floating bike-sharing providers (ibid, 2020). The stricter regulations introduced included a limit of 1500 bikes per provider, requirements for the timely removal of improperly parked bicycles, and the mandatory establishment of a service hotline (ORF Wien, 2018).

The specific circumstances will be further examined in detail during the analysis section of this thesis. Crucial to the research problem was the implementation of new regulatory measures, representing increased resistance from the regime towards the niche. As a result, both free-floating bike sharing providers, “Ofo” and “oBike”, exited Vienna after just one year (Link et al., 2020).

The introduction of strict regulatory measures and the subsequent withdrawal of free-floating bike sharing systems had a significant impact on the sustainable mobility niche aimed at fostering transformations in the transport sector within the case study. This sustainable mobility solution had the potential to contribute to achieving ambitious targets set by the city for transforming urban mobility and reducing individualized traffic. In addressing urban mobility in Vienna, city authorities aimed to align with broader EU ambitions concerning individualized traffic, as detailed below.

In a broader context of urban sustainable mobility concepts in Europe, the European Commission introduced the Sustainable Urban Mobility Plan (SUMP) in 2013. This plan outlined specific guidelines for European cities to transition from automotive-centric urban mobility planning to a more balanced distribution of various transportation modes. The goal was to enhance the liveability of urban areas across Europe (Vienna City Administration, 2015). Vienna aligned itself with these European goals through the introduction of the Urban Mobility Plan STEP 2025 in 2015 (ibid, 2015). The significant rise in Viennese energy consumption from 1995 to 2013, largely attributed to the surge in individualized traffic, underscored the necessity for action. The STEP 2025 Mobility plan introduced ambitious targets, notably aiming to shift the modal split to 80/20. This vision envisioned only 20% of citizen trips being made

via individualized motorization, while the remaining 80% would rely on sustainable transport alternatives like public transportation, cycling, or walking (ibid, 2015). As of 2019, Vienna, the Austrian capital, boasted a population of 1.9 million residents, with steady growth continuing. This posed a significant consideration regarding the daily commuting needs of such a substantial populace (Link et al., 2020).

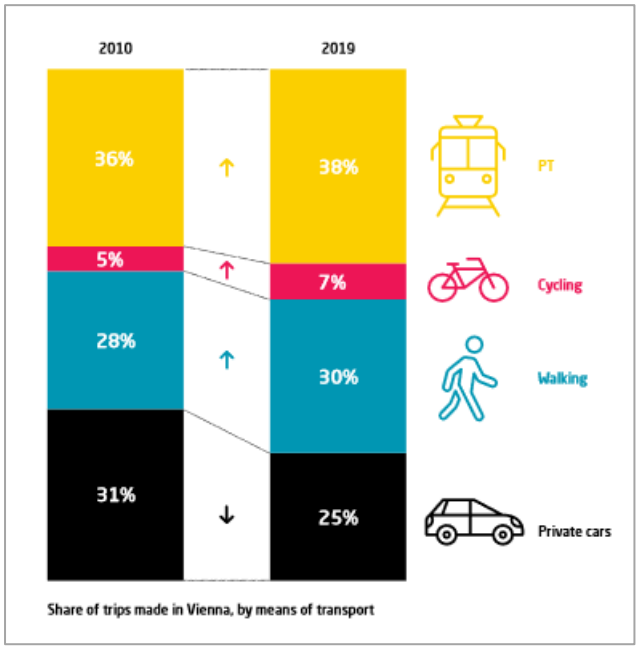

Figure 1. Modal Split Change Vienna 2010-2019

The graphic depicts the changes in modal split from 2010 to 2019 in Vienna. It's evident that there has been a steady decline in the number of private cars, while walking, cycling, and public transport usage have been on the rise, with public transport and walking emerging as the predominant modes of transportation.

However, from 2019 to 2022, there have been notable shifts. Public transport usage decreased from 38% to 30%, while walking trips increased from 28% to 35%. Additionally, cycling trips saw a growth from 7% to 9%. Despite these changes, car traffic remained relatively stable around 27% of all trips from 2012 onwards. This indicates that Vienna is experiencing challenges in meeting its modal split targets, with individual car trips showing an upward trend between 2019 and 2022 (Mobilitätsagentur Wien, 2023).

Reaching the ambitious goal of achieving an 80/20 modal split by 2025 poses a significant challenge for Vienna. Despite efforts to promote sustainable modes of transportation, such as walking, cycling, and public transport, individual motorization remains a dominant force in the city's mobility system. Niche innovations like FFBSS struggle to integrate themselves into the urban mobility landscape, partly due to resistance from existing actors in the mobility sector who are reluctant to embrace sustainability transformations.

However, sustainable mobility niches like FFBSS have the potential to contribute to these transformations. To effectively integrate them into Vienna's urban mobility system, policymakers, providers, and users of FFBSS must gain a better understanding of the dynamics

and challenges associated with these systems. This understanding will enable them to develop strategies for overcoming obstacles and maximizing the benefits of FFBSS in promoting sustainable mobility in Vienna.

1.4. Research question and objectives

Based on the identified research gap, a research question has been formulated to address several key aspects. Firstly, the thesis aims to investigate the historical context and challenges faced by FFBSS within Vienna's sustainable mobility transformation. Secondly, it seeks to explore the interactions between the FFBSS niche and various regime actors, such as public authorities, over time. This examination is particularly important given Vienna's aspirations for sustainable mobility and the need to understand any resistance from established authorities towards new sustainable mobility initiatives. Lastly, the thesis aims to propose potential strategies for the successful reintegration of FFBSS into Vienna's urban mobility system, offering pathways forward for sustainable mobility in the city.

Based on these critical considerations, the following research question has been formulated:

"How can the dynamics of free-floating bicycle sharing systems within sustainable urban mobility transformations be better understood, what were the main challenges encountered in the case study of Vienna in the past, and how can these mobility niches be more effectively integrated into urban mobility systems in the future?"

1.5. Significance: Benefits of BSS/ FFBSS

In the subsequent chapter, the importance of comprehending the dynamics of this emerging mobility niche is underscored. The significance of the research problem is elucidated by delineating numerous advantages that bicycle sharing systems, particularly free-floating bicycle sharing systems, can offer in advancing sustainability objectives and enhancing urban mobility systems.

Leister et al. commence by highlighting the advantageous nature of bike sharing systems, which offer individuals the opportunity to cycle in urban environments without the necessity of owning a bicycle. This accessibility expands the potential for cycling within cities to a broader spectrum of users (Leister et al., 2018). In addition, Polziani et al. underscore that users need

not be concerned about the risk of bicycle theft when utilizing free-floating bike sharing systems. Moreover, they can conveniently leave the bicycle behind when weather conditions change (Poliziani et al., 2022). Moreover, riding shared bicycles can alter perceptions of bicycle usage, engagement, and suitability for users. It raises awareness that bicycles are a sustainable, low-cost, and feasible mode of transportation for many societal groups (Mateo-Babiano et al., 2017). Cao and Shen agree with this perspective, suggesting that bike-sharing can serve as a reminder to civil society actors that bicycle usage is a cost-effective and straightforward means of daily commuting (Cao and Shen, 2019). With its flexible and adaptable nature, FFBSS can serve as a practical supplement to other modes of transportation, helping to address various challenges associated with multimodal transport, such as resolving the last-mile problem (Chen et al., 2020) Additionally, FFBSS, due to its affordability, can play a role in reducing social exclusion in public transport (ibid, 2020). Furthermore, Gu et al. emphasize that free-floating bicycles can be easily accessed through mobile phone applications and the parking of the bicycles is also simplified (Gu et al., 2019). The collection of trip and usage data through GPS tracking can be beneficial for providers to analyse demand and usage patterns. Moreover, if providers publicly present this data, policymakers can use it to better understand these systems (Chen et al., 2020).

Several scholars also emphasize the potential of bike-sharing schemes to environmentally benefit urban mobility systems and contribute to altering sustainability transformations. Cao and Shen mention that bike sharing can significantly contribute to lowering different forms of pollution. Additionally, it can minimize problems arising from the mobility sector such as noise levels, traffic jams, and greenhouse gas emissions (Cao and Shen, 2019). Bike sharing, as a cost-efficient and environmentally friendly way to commute, is suitable for users who pursue a sustainable lifestyle. Additionally, bike-sharing can help governance actors promote sustainable mobility transformations while simultaneously reducing greenhouse gas emissions (Si et al., 2019).

Besides that, bike-sharing systems can actively support the urban transport transition towards sustainability by increasing bike trips and minimizing car trips and their related greenhouse gas emissions by substituting them. However, if free-floating bike-sharing systems aren't run properly and have to be withdrawn shortly after introduction, the production of the bicycles for short-term use is definitely unsustainable, even more unsustainable than privately owned vehicles such as cars (Wang et al., 2019). Indeed, for shared bicycles to be environmentally friendly, they must remain in operation at a certain location for at least two years, with even

greater benefits if they are integrated into urban mobility systems for longer periods. Targeting users between the ages of 25 and 45 could significantly enhance the environmental benefits of bike sharing, as this demographic tends to exhibit the most unsustainable travel behaviour (Zheng et al., 2019). Various scholars concur that bike sharing systems can play a significant role in promoting sustainable transportation and reducing greenhouse gas emissions in the transport sector (Cesbron and Luckhurst, 2015; Lv et al., 2024; Sun and Ertz, 2021; Zhang and Mi, 2018). Cesbron and Luckhurst further suggest that reducing car usage in inner city districts through bike sharing schemes could enhance the attractiveness of urban central areas for tourists and increase accessibility for the general public (Cesbron and Luckhurst, 2015). The environmental benefits of FFBSS are particularly pronounced around public transport stations, where they directly address the "last mile" phenomenon. By replacing highly unsustainable travel options like cars in these areas, bike-sharing schemes contribute significantly to reducing environmental impact (Diao et al., 2023; Zhang and Mi, 2018). FFBSS appears to be more sustainable and environmentally friendly compared to SBSS because they do not require resource-intensive docking stations for operation. However, the greater environmental friendliness of FFBSS compared to SBSS is contingent upon efficient recycling practices for FFBSS (Sun and Ertz, 2021). Luo et al. further contribute an interesting finding: the manufacturing and redistribution of free-floating bicycles appear to be the activities within these mobility schemes that emit the most greenhouse gases (Luo et al., 2019). Bike-sharing schemes, particularly, thrive in specific geographic regions where there is a heavy reliance on individual transportation, primarily in the form of car traffic. Furthermore, these schemes have the potential to reshape citizens' travel habits, fostering greater sustainability awareness among users and guiding them towards more eco-friendly travel patterns (Lv et al., 2024).

Aside from the environmental benefits of BSS, **health benefits** associated with bike-sharing are frequently mentioned in scientific literature. Particularly, short and dynamic shared-bicycle trips appear to be most effective in enhancing the health benefits for bike-sharing users (Fuller et al., 2013). Otero et al. highlighted that the health benefits of physical activity from using bike-sharing systems significantly outweigh the potential drawbacks, such as exposure to air pollution or the risk of traffic accidents. The health benefits for users are closely linked to the extent to which car trips are replaced by bike-sharing trips, the level of traffic safety, and the air quality in the city where a BSS is implemented. Bike-sharing schemes can both improve public health through active transportation and physical activity, and mitigate certain health risks by reducing air pollution and enhancing travel safety (Otero et al., 2018).

2. Analysing the transition path of FFBSS through the help of the Multi-Level Perspective

With the introduction chapter and the given research problem outlined, this chapter aims to provide the theoretical framework used for the analysis. Generally, the Multi-Level Perspective (MLP) of socio-technical systems, developed by Frank Geels, is employed in this thesis as the theoretical framework to analyse the multi-level dynamics of free-floating bike sharing systems (FFBSS) in the context of sustainable mobility transformation and the significant actors associated with this new mobility niche. Specifically, the niche-regime dynamics and the aspects of regime resistance toward FFBSS in the sustainable urban transformation within the case study city will be examined more closely using the Multi-Level Perspective.

2.1. Socio-technical systems

Frank Geels, a prominent researcher in the field of socio-technical systems and socio-technical transitions, first introduced the term "socio-technical system" (STS) in an article he published in 2004 (Geels, 2004). Frank Geels is one of the most influential researchers in the emerging field of socio-technical systems, with numerous scholars working on interrelated topics such as socio-technical systems, their transitions, sustainability transformations, and frameworks to describe the dynamics of socio-technical systems (Abson et al., 2017; Farla et al., 2012; Geels, 2011, 2004; Geels et al., 2017; Geels and Kemp, 2007; Geels and Schot, 2010, 2007; Hansen and Coenen, 2015; Hodson et al., 2017; Markard et al., 2020; Roberts et al., 2018).

Geels distinguished between sectoral systems of innovation and socio-technical systems. Sectoral systems of innovation operate at different geographical levels, such as national or federal levels, and aim to foster cooperation between various organizational groups to drive innovation. In contrast, socio-technical systems encompass the broader context in which these innovations take place, including the interplay between technology, society, policy, and markets (Geels, 2004). Geels critiqued the sectoral systems of innovation approach, arguing that it falls short in addressing broader societal challenges. He posited that achieving comprehensive social goals within these systems is not feasible, necessitating a more holistic perspective that incorporates the complex interplay of social, technological, and policy factors (ibid, 2004).

He then proposed socio-technical systems (STS), which aim to not only foster technical innovations but also examine their social integration. STS research explores how new innovations can be seamlessly incorporated into social sectors and how users can integrate these innovations into their daily lives. By focusing on the social dimension, STS seeks to enhance the social functionality and cohesion of society (ibid, 2004). In the STS discourse, the social dimension of these systems is becoming increasingly important. Nevertheless, technological innovations remain crucial for achieving societal targets, especially in addressing the emerging challenges faced by societies globally (ibid, 2004). In general, STS emphasize fostering socio-economic growth while considering factors such as societal welfare, health, and comfort, which are integral social goals of the system. Research within STS primarily focuses on generating new knowledge, developing new political measures, and making new economic decisions to meet societal and institutional goals (Siddiqi and Collins, 2017).

The socio-technical systems approach proves valuable in addressing societal challenges like the climate crisis, system resilience, and demographic shifts. To tackle these challenges effectively, it's essential to integrate new perspectives from innovative systems into society. This enriched understanding, coupled with precise system analysis, can significantly contribute to solving the problems we face in society (Davis et al., 2014).

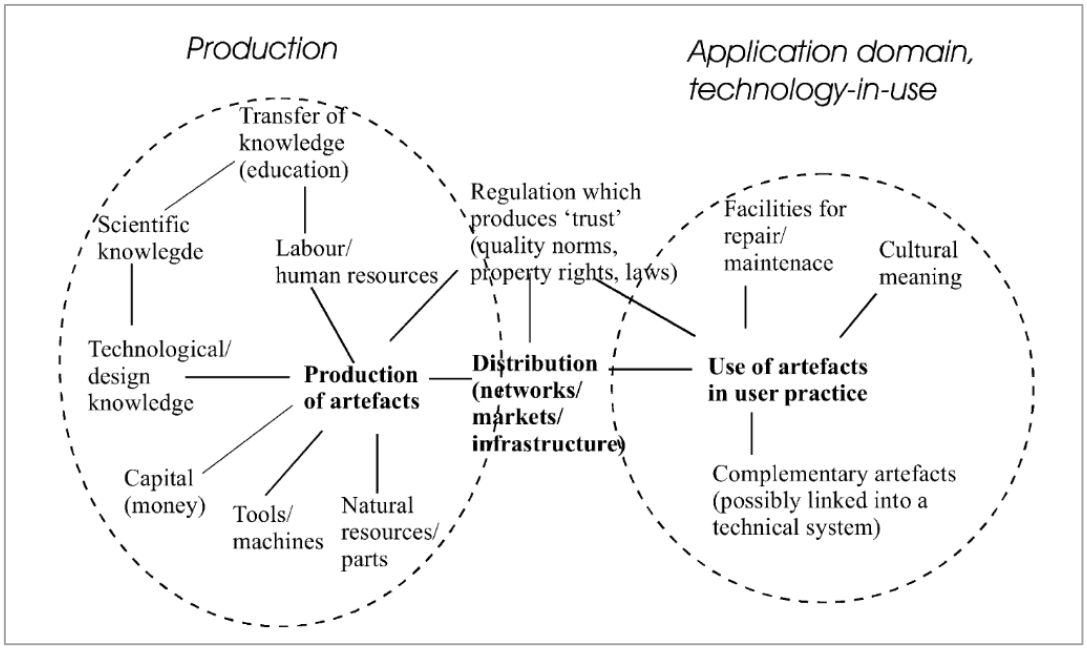

Figure 2. Social and technical side of a STS

Geels emphasizes the significant role of technology in contemporary society, delineating various sub-functions associated with innovative technologies. These include utilization (the

social aspect of socio-technical systems), distribution, and production of innovations or new technologies (the technical aspect of socio-technical systems) (ibid, 2004). The focus on the usage and distribution of technologies introduces a novel aspect into the system, involving more social groups in the integration and management of new innovative technologies (ibid, 2004). New actors on the social side of the STS include users, distributors, and various social groups. These actors play crucial roles in managing new innovations within STS. With the emergence of these new social actors in the innovation process, there is an increased demand for cooperation among them. Geels underscores this need for cooperation among actors within STS as "socio-technical regimes" (ibid, 2004), which will be presented more precisely later in this thesis.

The interactions between resources/sub-functions and social groups within STS can be described as dynamic and active (ibid, 2004). Due to this dynamism, it becomes challenging to pinpoint the exact boundaries of STS. Moreover, the constant cooperation among social alliances within STS leads to continuous changes in the formations of social groups (ibid, 2004). When considering new innovations within niches that can drive sustainability transformations, the social side, particularly users within STS, must incorporate new technologies and innovations into their daily routines. They need to adapt, learn about these new technologies, and integrate them into their habits for innovations to succeed (ibid, 2004). Constant feedback loops, cooperation, and modification of the innovation between the technological and social sides are crucial for the success of technological advancements, aiming to maximize their effectiveness (ibid, 2004).

Moreover, institutional clusters and social groups, along with rule networks, are intriguing elements within STS. They influence socio-technical system players in specific ways and restrict them from complete freedom in their actions by providing clear guidelines and rules within the socio-technical system (ibid, 2004). Geels has thus introduced an additional perspective to his socio-technical systems approach, highlighting the interconnectedness of socio-technical systems, actor groups, and how they are governed through rule networks.

The graphic from Frank Geels illustrates the interplay of the three pillars within a STS (ibid, 2004):

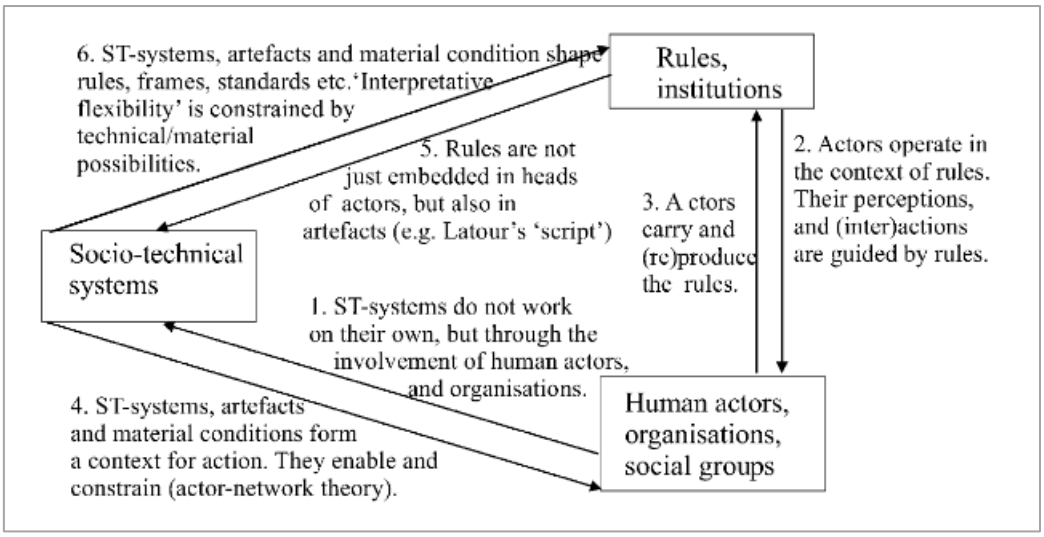

Figure 3. Interaction between STS, rules and actors

The three analytical dimensions depicted in the graphic are closely intertwined and continuously influence each other (ibid, 2004). Human activities and associations serve as the driving forces for socio-technical systems to function. Actors on the social side of the STS are directly impacted by rules and institutional settings that dictate their operations. Additionally, actors and social groups are responsible for establishing the rules and continually assessing and reproducing them (ibid, 2004).

Given the significant societal challenges and the imminent need to reassess existing structures within socio-technical systems, theories on socio-technical systems' transitions are becoming increasingly important. It is crucial to gain a better understanding of the actors involved in STS, the dynamics and mechanisms between them, and the structural settings guiding their actions. Theoretical frameworks like the Multi-Level Perspective should aid in comprehending the behaviour of socio-technical systems during transitions and how to steer them toward sustainable transformations. In the subsequent chapter, socio-technical systems in transition will be described, with the Multi-Level Perspective serving as the theoretical approach to visualize the socio-technical systems' transition in this thesis.

2.2. Socio-technical transitions

This chapter aims to provide a deeper understanding and analysis of the developments surrounding free-floating bike-sharing systems as a new niche actor in the sustainable mobility transformation in Vienna. It seeks to present socio-technical transitions and underscore the various levels interacting within these transitions. Additionally, the theoretical framework employed for analysing the FFBSS niche is introduced: the Multi-Level Perspective (MLP) of socio-technical transitions developed by Frank Geels. In the context of the analysed case study, the MLP serves as a tool to visualize FFBSS as a niche within the socio-technical mobility systems transition in Vienna. Furthermore, the phenomena of regime resistance and strategic niche management are of interest for the analysis and will also be addressed in this chapter.

In general, Geels and Schot described socio-technical transitions as a process where one socio-technical system evolves into a different one, characterized by new configurations and relationships between actors (Geels and Schot, 2010). This process occurs through a co-evolutionary procedure that necessitates new configurations in various aspects of the changing socio-technical system. Socio-technical transitions encompass progress in both technological niches and their utilization within society (ibid, 2010). Various key actors are involved in socio-technical transitions, including scientific institutions, social actor groups, policymakers, and different economic players. Transitions are most effective when they occur in a "radical" manner (ibid, 2010), meaning they bring about rapid and innovative changes that disrupt existing structures. However, innovations can also gradually alter socio-technical systems. Despite the potential for radical change, the transition of socio-technical systems often takes a considerable amount of time, sometimes up to 40-50 years (ibid, 2010). Indeed, socio-technical transitions not only take a long time to fully unfold but are also challenging to accelerate or set in motion initially. This difficulty stems from the high degree of path dependency and lock-in mechanisms characteristic of many socio-technical systems, which undermine the system's stability (Geels, 2004). Furthermore, regime structures and rulesets contribute to stability by providing guidelines on how to act within a socio-technical system (ibid, 2004). The actor groups within the system are highly interdependent due to various associations or interconnections. In general, socio-technical systems are depicted as systems with a certain degree of resistance to change. Innovations that emerge in a radical manner attempt to disrupt these structures, but the system's components often serve as formidable barriers (ibid, 2004).

2.3. The Multi-Level-Perspective of STS

The graphic below presents a simplified illustration of the Multi-Level Perspective of socio-technical systems by Frank Geels. This theoretical framework comprises three outlined levels: the niche, the regime, and the landscape level of socio-technical systems. Niches represent areas of a socio-technical system with the lowest form of structuration, followed by the regime level, and finally, the landscape level where activities are characterized by a high degree of structuration (Geels, 2004):

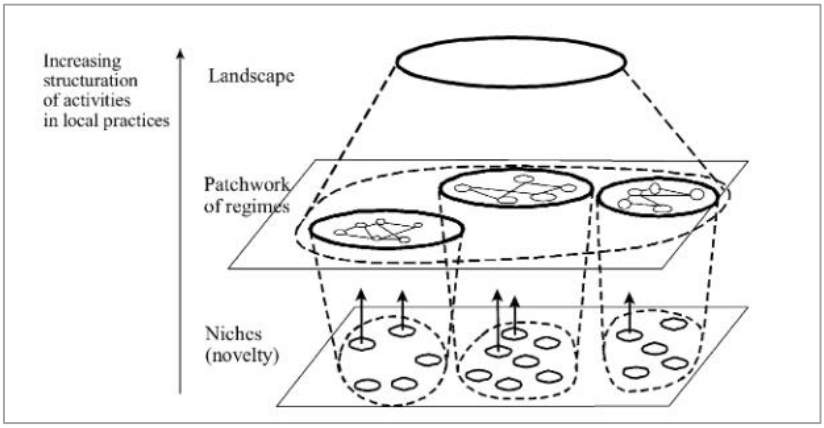

Figure 4. Multi-Level Perspective of socio-technical systems

2.3.1. Regime-Level

To begin, the regime level within the Multi-Level-Perspective of socio-technical systems is highlighted. Initially, the term "technological regimes" was prominent in the literature. These regimes focused on thinking habits, rulesets, and structures within the cooperation of technological factors, such as engineering groups. The purpose of these technological regime structures can be described as the coordination and guidance of R&D actions, with a sole focus on innovations through technological pathways (Geels and Schot, 2010). In socio-technical systems, socio-technical regimes integrate various societal actors into the equation. As regime structures evolve, they now include actors such as users, governance actors, operators, and special-interest institutions, alongside traditional technological actors (ibid, 2010). This new arrangement gives rise to numerous so-called "socio-technical sub-regimes" (Geels and Schot, 2007), which further stabilize existing pathways within STS: Now, there are even more rulesets and structures that are in constant interoperation with each other, enforcing stability and dependencies within the regime level (ibid, 2007). These socio-technical sub-regimes form a variety of different locked-in pathways and co-evolve alongside each other. Consequently, there

is not only a technological regime but also regime structures that refer to socio-cultural, political, market, and scientific aspects (Geels, 2004). The increasing institutional thickness and the growing number of structures within the socio-technical regime level support stability and lock-ins in institutional, organizational, economic, and cultural structures within a STS. Only if pressure is put on these existing institutional structures, spaces for change and transition can be created (Geels and Schot, 2010). Radical innovations can then penetrate into these broken-up structures and pathways, emerging from the niche level of socio-technical systems, where institutional structures are weaker (Geels, 2004). Additionally, rules and regulations can shape regime structures. When one rule changes, it often triggers changes in other rules as well, reinforcing the stability and strength of the regime. Distinctive social groups inherit different sets of rules within their groups, forming specific regime structures such as policy regimes, user regimes, or societal regimes. The interconnectedness within these regimes and the interplay of rules among them constitute the socio-technical regime (ibid, 2004).

2.3.2. Niche-Level

Innovations aiming to radically transform existing structures at the regime level are situated at the so-called niche level in socio-technical systems. These niches are protected environments where novelties can develop and flourish without the pressures of ordinary market forces (Geels, 2004). Niches appear at the micro-level and are characterized as the most unstable socio-technical structures, often exhibiting minimal performance rates. Niche developments are typically supported by small, entrepreneurial actor groups that differ from the ordinary actor groups within socio-technical regime structure (Geels and Schot, 2007). Innovations at the niche level can be seen as projects characterized by a high level of experimentation, aiming to create something radically new within socio-technical systems (STS). These niche innovations often receive financial support from associations looking to gain a competitive advantage by investing in emerging technologies (Geels and Schot, 2010). Moreover, niches can provide specific arenas for diverse learning processes, including new user ambitions, innovative forms of governance, novel symbols, and new specifications for technological solutions (Geels, 2004). Additionally, as niches are protected areas, they are not constrained by the thickened structures present at the regime level, allowing them to develop and operate more freely, with fewer restrictions. This protection enables innovative social associations to build momentum faster in niche spaces (ibid, 2004). However, in the context of strong existing regime structures, actor clusters need to consistently exert effort to make the niche competitive. Social structures and rulesets within the niche must be continually expressed and reevaluated (ibid, 2004). The

greatest strength of innovations at the niche level lies in their potential to initiate change, transition, and sustainability in socio-technical systems. These developments often serve as catalysts for broader transformations within the system (ibid, 2004). Once more, the penetration of niche novelties into existing market settings is not a swift process. The time span between invention and market introduction can range from twenty to thirty years (Geels and Schot, 2010).

2.3.3. Landscape-Level

The third level in STS, characterized by the highest level of structuration of activities, is the socio-technical landscape level. It can be described as the broad context in a STS that cannot be influenced by niche- or regime-level actors (Geels and Schot, 2010). The landscape level shapes the actions of all players in a STS, making landscape tendencies particularly difficult to change. Landscape developments influence all our guidelines for action, as socio-technical landscapes represent the material surroundings we inhabit, as well as the cultural values and symbols that shape our society (Geels, 2004). Geels and Schot further describe the socio-technical landscape metaphorically as a structure that surrounds us and sustains us (Geels and Schot, 2010). Landscape tendencies also change gradually, such as climatic developments or industrialization. However, short-term radical disruptions at the landscape level, such as price instabilities or conflicts, can suddenly affect the lower levels (regime and niche levels in a STS) (ibid, 2010). Typically, shifts at the landscape level occur gradually, and landscape structures are therefore not easily changed (Geels and Schot, 2007).

2.4. Socio-technical transition through the lens of the MLP

With the delineation of the three levels of a socio-technical system through the MLP, it's crucial to underscore the interrelations and dynamics between the niche, regime, and landscape levels, as well as how socio-technical transitions occur. The following graphic presented by Geels illustrates the multi-level dynamics in a STS, depicting how the three levels are interconnected and how socio-technical transitions manifest:

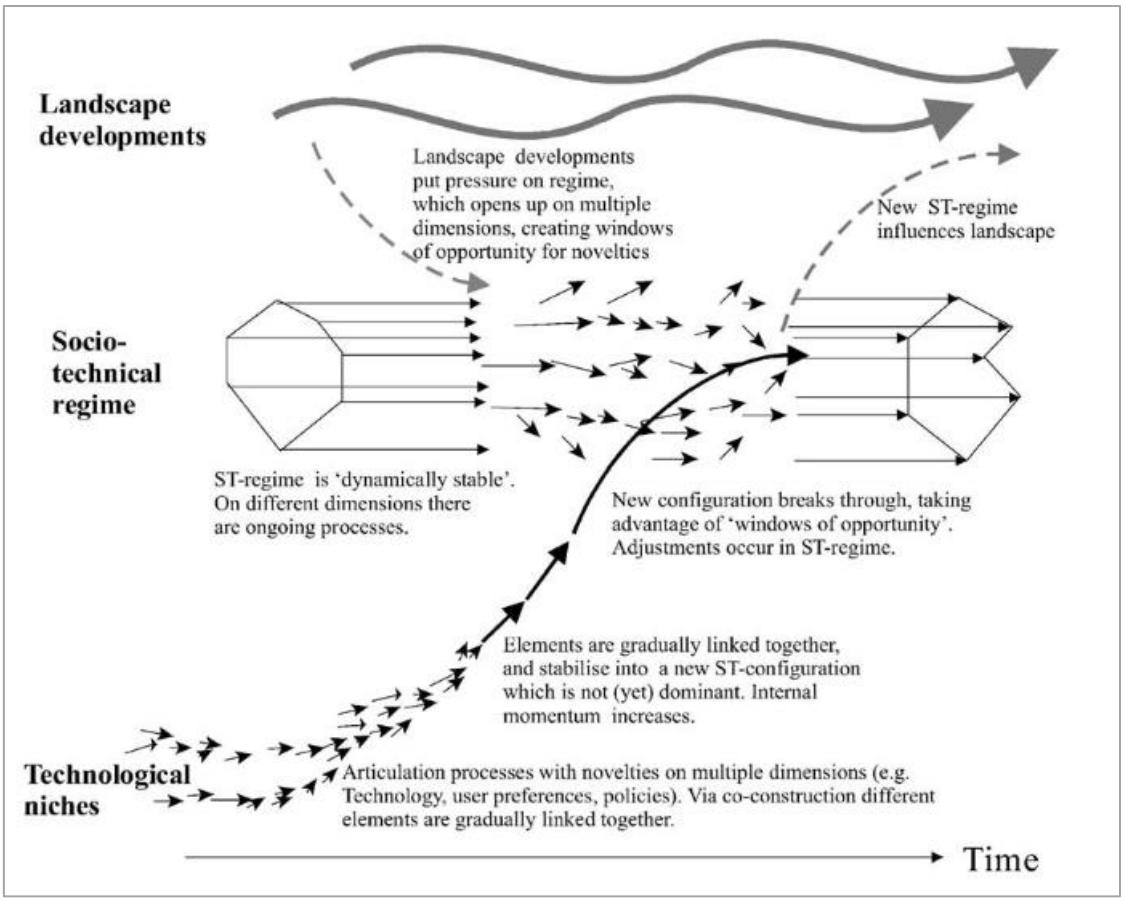

Figure 5. Multi-Level Perspective of socio-technical systems in transition

As previously noted, Geels and Schot emphasized that innovative tendencies in niches are the initiating factors for change in socio-technical systems (Geels and Schot, 2010).

However, the success of niche developments highly depends on how the regime and landscape levels respond to the emergence of new niche tendencies. It's not uncommon for innovative capacities to remain confined to niche areas for an extended period, unable to penetrate higher levels. This is often due to the prolonged processes of niche innovation development and the resistance from established regime structures (ibid, 2010). Additionally, radical newness in niches often differs significantly from existing regime settings in terms of structural characteristics, including usage patterns, governance, and infrastructural circumstances (ibid, 2010). Furthermore, players within the regime may actively oppose niche developments, as niches can challenge the status quo (ibid, 2010). This phenomenon is described as regime resistance, which will be explored in more detail in subsequent chapters.

Geels suggests that in the transition of socio-technical systems, pressures or conflicts can serve as useful initiators for change (Geels, 2004). Within regime structures, there is a high level of co-evolution and cooperation among different regime actors. This constant connection between

regime players further strengthens regime structures, yet it can also lead to conflicts in the alignment of these structures. Consequently, a loosening of existing structures may occur, creating opportunities for niche actors to make advancements and integrate into existing regime structures (ibid, 2004).

Referring to this, Geels identifies possible trigger points for conflicts occurring at the regime level of socio-technical systems, which can potentially open opportunities for change and socio-technical transition. According to Geels, this can occur through changes in landscape tendencies, such as climate change and associated societal challenges, or through niche organizations (e.g., NGOs) exerting pressure on existing regime structures and prompting a reconfiguration of these structures, thereby creating new opportunities for change (ibid, 2004). Another example of conflicts loosening regime structures can be internal complications within the regime itself, which weaken its structural cohesion (ibid, 2004). Geels and Schot concur that landscape pressure can play a crucial role in unsettling locked-in regime structures and breaking them up (Geels and Schot, 2010). Even though landscape developments do not directly impact regime structures in a mechanistic manner, their effects on the regime level can be observed in changes in players' cooperation, formation, and situational assessments (ibid, 2010).

In summary, it is crucial to exert pressure on existing regime structures to create opportunities for niche novelties to gain a competitive advantage and grow in structural size. During this growth, modifications in policy, infrastructure, and usage settings can help alter the momentum and strength of the niche novelty (Geels, 2004). Indeed, this could entail certain actors exiting while others enter regime structures to alter the regime's setting (ibid, 2004). When novelties enter conventional market structures, they begin to challenge existing regime structures, competing within regulatory and infrastructural frameworks. If the emerging niche successfully overcomes these competitive challenges, it is referred to as "technological substitution" (Geels and Schot, 2010). This leads to broader modifications within the socio-technical system (ibid, 2010).

A new regime level and a new state of the socio-technical system is formed, with the new alliance of players in the regime striving to maintain it (Geels, 2004). There is no definitive explanation of how the transition of socio-technical systems behaves and what initiates these transitions. Actors must understand that adjustments in socio-technical systems are complex, co-evolutionary developments that occur between various stages (Geels and Schot, 2010).

Transitions seem to occur when different processes connect or reinforce each other. Problems in transitions often relate to factors such as low structural reinforcement of niche innovations or the lack of cooperation between novel innovations and existing entrenched regime structures (ibid, 2010).

The Multi-Level-Perspective serves as a theoretical framework for analysing the dynamics and mechanisms surrounding free-floating bike sharing systems as a niche within the socio-technical mobility system transition in Vienna. It offers a framework to understand the niche-regime dynamics between FFBSS and city authorities in Vienna, highlighting regime structures resisting change from the niche.

2.4.1. Criticism towards the Multi-Level-Perspective

The MLP framework has faced criticism over the years from various perspectives regarding its adequacy in describing socio-technical transitions. Some scholars argue that the framework neglects the role of politics and power dynamics, lacks consideration of cultural significance, and overly concentrates on technological innovation within socio-technical systems. Critics also note that the framework tends to prioritize bottom-up disruption pathways and inaccurately portrays incumbent actors as inert, only involved in incremental innovation. Furthermore, the framework lacks attention to the concepts of destabilization, decline, and the policy-relevant dimensions and processes within STS in transition. Considering these criticisms, scholars have expanded upon the Multi-Level Perspective (MLP) in diverse ways, incorporating insights from various social sciences and refining the understanding of change processes.

Despite various criticisms of the MLP framework, it proved to be effective for the analysis undertaken in this thesis. It facilitated the examination of niche-regime dynamics between FFBSS providers and city authorities in the case study city, along with understanding public authorities' resistance to change in the mobility system and the actors involved in the transformation process. Therefore, it is crucial to define regime resistance in socio-technical systems and explore how the concept of strategic niche management can assist in better reintegrating the FFBSS niche in the future.

2.5. Regime Resistance in STT

Over the years, criticism appeared looking at the policy sub regime in socio-technical systems' transitions: critics mentioned, that in socio-technical transitions studies, the force of politicians

is often left out of the theoretical equation (Geels, 2014). This low notice of political power in socio-technical systems did not only lead to critical comments from scholars, but as well opened up a new research field on the political side of socio-technical systems as well as looking more closely towards different sub regimes at the regime level (Lockwood et al., 2019). Regarding the phenomenon of regime resistance, with the strong cooperation of politicians and companies at the regime level, they often try to maintain existing regime structures in a STS, as already mentioned (Geels, 2014). Additional to that, the interdependency between firms and political actors generates even stronger structural connections. In modern economic structures, political figures often empathise with big companies and relate to their targets and challenges. Actors, within regime structures, can besides that often use their power to actively reject deep system change, which is crucial to providing answers to grand societal challenges, such as changing global climate (ibid, 2014). This happens because actors in regimes, such as politicians or big companies, characterize through more power than niche actors, so they can dictate the decision making and the pace of change in STS (ibid, 2014). From Geels point of view, the introduction of force and political action into the Multi-Level-Perspective is possible, if the interrelation between companies and governance, which together avoid radical change, is conceptualized, and brought up in the theoretical framework (ibid, 2014). Apart from using their strength to protect existing regime structures, regime acting players can also foster resistance through so-called discursive strategies: easier said they can intentionally influence how discourses are nurtured and further stimulate public discussions, to lead them in the way they want regime structures and the overall STS to shape (ibid, 2014). Not only that regimes are most powerful within socio-technical systems, but governments can also provide additional strengthening through adequate subsidies, legislations, trading rules as well as possession privileges to strengthen already thickened regime structures (Lockwood et al., 2019). Thickened regime structures get additional support by the fact, that all societal actors are depending, in their systemic nature, to regime structures such as governments or economical structures (ibid, 2019). This dependency is further strengthening lock-ins and thickness at the regime level, as the civil society often legitimates cooperation between regime actors and supports the specific securities of regime actors (Ford and Newell, 2021).

With being relatively independent to industrial and governmental interconnections, civil society actors and niche players should function as a significant contestant against political structures (ibid, 2021).

The scientific discourse on regime resistance in later stages took a turn towards an extra lively and dynamically shaped view on the phenomena. The essence of this new view on regime resistance focuses on regime level actors, not only resisting fundamental change in regime structures, but also actively formulating policies towards intentionally shaping the modification of regime structures in their own favour (Lockwood et al., 2019). This modification of regime patterns inherits the intentional shaping of policies directly affecting regime development. Through the controlled shaping of policies, regime actors can incorporate with maintaining existing structures and manoeuvring policies towards victory or closure (ibid, 2019). How certain policies shape or how a societal discourse is formed, always depends on how different regime actors are aligned in cooperations and how networking structures characterise (Ford and Newell, 2021). They actively create policies, which work in the favour of securing regime structures and which are resistible to change (ibid, 2021). Lockwood et al. added that regime resistance can be understood in a better way, if they are looked at more closely through the interoperation between regime interest groups, the institutional settings of a STS as well as the concepts operating at the regime level (Lockwood et al., 2019). Scholars emphasize the importance of understanding how actors' interests are formed and how these interests influence policy changes. The extent to which different regime actors connect to the current structural settings of the regime depends on both material circumstances and core practices within the regimes (ibid, 2019).

Additionally interesting regarding regimes resistance are different concepts brought up by scholars, summarized by Ford and Newell. These will be shortly touched upon to further enhance the understanding of different forms of regime resistance tendencies. Also, the concept of regime resistance is embedded into the Multi-Level-Perspective (Ford and Newell, 2021). Firstly, the concept of "hegemony" is mentioned, which can be described as the continuation of existing societal or economical settings, which vantage specific groups in STS. Applying it into the MLP, the regime level inherits certain specific configurations, which empower only certain groups within a STS (ibid, 2021). Apart from that, the concept of the "historical bloc" is brought up: here, the cooperation between governance actors and firms can form a "historical bloc", which is characterized by a certain level of establishment and hegemony, through legitimation within society the "historical bloc" can further gain stableness (Geels, 2014). Within the MLP, this means that regime acting parties such as political players or different companies try to preserve existing regime structures, without trying to fundamentally change STS (Ford and Newell, 2021). Before these concepts got introduced, Gramsci earlier mentioned

the notion of the so-called “war of position” when looking on regime resistance patterns: this can be illustrated as different actors trying to organize their forms of authority to gain influence within the system (Gramsci, 1971). Gramsci highlighted the “war of position” as an “endlessly unfolding process of social contestation” (ibid, 1971). Embedding this approach into the MLP of socio-technical systems, the “war of position” would be characterized by different regime actors managing their force to prevent shifts in the system (Ford and Newell, 2021). Lastly, the concepts of passive revolution and “transformismo” were introduced. These represent two forms of regime structuring that resist change while attempting to accommodate ideas from structurally weaker societal groups, such as niche actors (ibid, 2021). Passive revolution can be seen as a pathway where dominant regime groups try to integrate pressing ideas from regime structure opponents without losing their power (ibid, 2021). “Transformismo”, on the other hand, describes a method where oppositional ideas are incorporated into the dominant regime framework. Here, actors attempt to integrate diverse ideas to maintain stability and control (ibid, 2021). Viewed through the Multi-Level Perspective, regime players aim to incorporate shifts in regime structures to satisfy other social groups’ perceptions while remaining in control of the regime dynamics (ibid, 2021).

It is crucial to better understand the phenomenon of regime resistance and the factors that strategically hinder deep system change and the sustainability transformation of STS. In this regard, Geels recommends three key points when examining STS in transition and the phenomenon of regime resistance: it is essential not only to focus on the niche level as the main driver of transition, but also to understand what happens within cooperating regime structures (Geels, 2014). Geels argues that it is crucial to understand why players within regime structures actively resist radical change, rather than merely maintaining entrenched and locked-in institutional structures (ibid, 2014). He emphasizes the importance of leveraging the Multi-Level Perspective by incorporating regime structures, power, and political will into the theoretical framework on socio-technical systems (STS) in transition. Geels contends that niche innovations are not the sole drivers of transition; he also urges actors to focus on the destabilization of existing regime structures through political pressure to accelerate sustainability transitions in STS (ibid, 2014).

2.6. Strategic Niche-Management in STT

Apart from the phenomena of regime resistance, this chapter briefly examines another phenomenon within socio-technical systems in transition, which is introduced to enhance the understanding of the analysis chapter. This section concludes the theoretical part of this thesis.

Sustainability transformations and socio-technical systems' transitions can be achieved through precise manoeuvring of technological niche pathways. These pathways provide a safe space for novel technologies and niche structures to develop and coexist without pressure from regime institutions. Schot and Geels note that, in addition to pursuing technological solutions, strategic niche management must also focus on the social aspects of STS in transition (Schot and Geels, 2008). Niches can be leveraged to generate new social settings that put existing regime structures under pressure. Strategic Niche Management involves the strategic introduction of green innovations to accelerate the transition of STS (Raven et al., 2007). In this regard, it is crucial to note that niche developments must eventually move beyond the niche and challenge existing unsustainable regime structures (ibid, 2007). Schot and Geels emphasize that Strategic Niche Management is not merely a tool for governance actions; it also involves researching general methods that ensure the successful upscaling and management of niche movements (Schot and Geels, 2008). As a governance tool, Strategic Niche Management should not rely solely on a top-down decision-making approach. Steering should come from within: not only governmental structures should decide the routes of niches, but more importantly, other players in a STS, such as social institutions or operators of radical innovations, should be involved (ibid, 2008). Through a united approach, niches can be navigated more efficiently in transitioning STS. The aim of Strategic Niche Management is not only to create a safe space for the design and experimentation of technological novelties in niches but also to support socially relevant niche innovations, which could provide solutions for emerging societal challenges (ibid, 2008). Additionally, strategic management of niches can create environments where new customer needs, technological innovations, and sustainability targets are aligned (ibid, 2008).

An important question regarding niche trajectories is: why do some niche novelties stop developing while others thrive? Raven attempted to explain this uncertainty by introducing three internal niche routes and the interplay between them. Raven suggests that properly forming expectations about niche developments is a good starting point. A fruitful approach

involves clearly articulating what is expected from niche trends, appealing to potential new actors in the process, and attracting possible investors (Raven, 2005). Schot and Geels added that having a clear vision for the niche before the trial phase begins is crucial, as it helps expand networking structures and knowledge processes (Schot and Geels, 2008). Secondly, the active creation of social associations is crucial when pushing a niche towards gaining momentum. In the initial stages of niche development, networks are often ineffective and must grow, requiring the collaboration of various actors to form new, stronger social structures (Raven, 2005). Lastly, Raven argued that successful Strategic Niche Management relies on reliable knowledge progression. This means that actors managing niche developments must constantly adjust and learn about the niche process both technologically (e.g., infrastructural settings or strategy) and socially (e.g., usage patterns, regulatory measures, or cultural settings) (ibid, 2005). Moreover, actors must be prepared to change the niche pathway if it does not align with social or technological expectations within an STS (ibid, 2005). In addition to being a policy tool, Strategic Niche Management should also be understood as a research template to better understand experiments in niches and their transition pathways (Raven et al., 2007).

The strategic management of niches also prompts discussion about the degree to which niches should be shielded from mainstream market selection and the influence of regimes. Hommels et al. criticized Strategic Niche Management for being overly protective in managing niche novelties (Hommels et al. 2007) They argue that the success of niches always involves consciously subjecting these structures to threat; being pressured by opposing factors originating from outside of the safe niche space (ibid, 2007). Schot and Geels added that niche innovations should indeed be shielded from the mainstream market, but they should also be characterized by place specificity and the instability of rule sets (Schot and Geels, 2008). Niche innovations should transition from isolated developments within a socio-technical system (STS) towards knowledge pathways, where even failing niche innovations can contribute to the learning process of STS in transition (ibid, 2008). Reviewing the literature, niche tendencies often require external support from robust structures to develop sufficiently strong foundations to compete against existing, entrenched regime levels (Raven et al., 2005; Raven et al., 2007). Schot and Geels further noted that niche tendencies, when driven by regime structures, can help resolve issues within those structures. However, conversely, niche novelties can also create problematic tendencies that put regime structures under pressure (Schot and Geels, 2008).

In summary, Strategic Niche Management serves as a valuable tool for comprehending the behaviour of niches in socio-technical sustainability transitions and identifying the mechanisms and developments surrounding niches within STS. It can offer valuable insights for governance actors aiming to facilitate radical shifts in STS and achieve sustainability transitions. (Schot and Geels, 2008).

3. Methodology

This chapter aims to outline the methodological approach of this thesis, detailing the various methods utilized to gather scientific data on free-floating bike-sharing systems. The objective is to gain a better understanding of the mechanisms and dynamics of these systems within the context of sustainable transitions of socio-technical systems. The derived data is intended to contribute to the analysis of FFBSS in the case study city of Vienna, shedding light on the niche-regime dynamics between FFBSS providers and city authorities in Vienna, as well as the overall developments surrounding FFBSS in the city. Furthermore, the data gathered should guide to outline what is crucial for urban policymakers in Vienna when reintegrating these new mobility schemes into the existing mobility system.

3.1. Mixed Methods Approach

To gather scientific data for analysis in this master's thesis, three distinct methods were utilized:

- **Systematic Literature Review**: This method involved a comprehensive examination of existing literature on free-floating bike-sharing systems (FFBSS) and traditional bike sharing. The goal was to compile sufficient scientific data to understand crucial considerations when examining FFBSS within the context of sustainable transitions of socio-technical systems.

- **Systematic Media Discourse Analysis**: In addition to the literature review, this method aimed to gather insights into the development and history of bike sharing and free-floating bike-sharing systems specifically in Vienna. By systematically reviewing newspaper articles, the analysis focused on the history of bike sharing in Vienna and the emergence and disappearance of free-floating bike-sharing systems in Austria's capital. This approach provided data for analysing FFBSS mechanisms and behaviours in the

sustainable mobility transition in Vienna, as well as for examining niche-regime dynamics and notions of regime resistance towards FFBSS in the city.

- **Expert Interview**: To supplement the data obtained from the literature review and media discourse analysis, an expert interview was conducted with the Mobility Agency Vienna. This interview aimed to gather additional qualitative empirical data regarding the agency's involvement in the transition and developments surrounding FFBSS in Vienna.

The methodological approach employed in this thesis was driven by the availability of data. Initially, a scientific literature review was conducted to gather insights into free-floating bike-sharing systems (FFBSS) and bike sharing in general, providing a foundational understanding of the mobility system. However, due to limited scientific articles specifically addressing the dynamics of FFBSS in the case study city of Vienna, a systematic media discourse analysis was undertaken to supplement this data. This analysis focused on extracting specific information on the developments and dynamics surrounding FFBSS in Vienna, which was then utilized for further analysis. Additionally, an expert interview was conducted to gather additional data not obtainable through the other two methodologies.

Overall, the thesis represents an empirical study conducted by the author. However, it can be viewed from a mixed methods approach perspective, as multiple methods were employed to derive data. Malina et al. argue that strictly segregating quantitative and qualitative research approaches is generally not advantageous for scientific research. Mixed-method approaches, which integrate both quantitative and qualitative methods, can offer a variety of benefits for conducting research and addressing research questions (Malina et al., 2011). They emphasize that a mixed methods approach can be considered a fruitful way to address designated research problems, as the connection between methods is inherently stronger than relying solely on one method (ibid, 2011).

3.2. Systematic Literature review FFBSS/ BSS

The systematic literature review aimed to provide an initial overview of the scientific discourse surrounding free-floating bike-sharing systems. To achieve this, the researcher systematically searched for scientific articles using specific keywords, which will be detailed later. These

articles were expected to establish a scientific foundation from which information on the mechanisms and dynamics of FFBSS in sustainable urban mobility transitions could be derived, as well as identifying key considerations in this regard. Furthermore, the extracted data was intended to offer insights for policymakers on how to potentially reintegrate FFBSS into the urban socio-technical mobility system to facilitate sustainable mobility transformations.

The systematic literature review conducted followed the guidelines outlined in the article "Guidance on conducting a systematic literature review" (Xiao and Watson, 2019). According to Brereton et al. and Kitchenham and Charters, fruitful systematic literature reviews can be divided into three crucial steps: planning, conducting, and reporting. (Brereton et al., 2007; Kitchenham and Charters 2007). Xiao and Watson divided these three steps into eight smaller steps (Xiao and Watson, 2019). An overview over these eight steps is presented in the graphic below, which acted as a guideline to conduct the systematic literature review of this thesis:

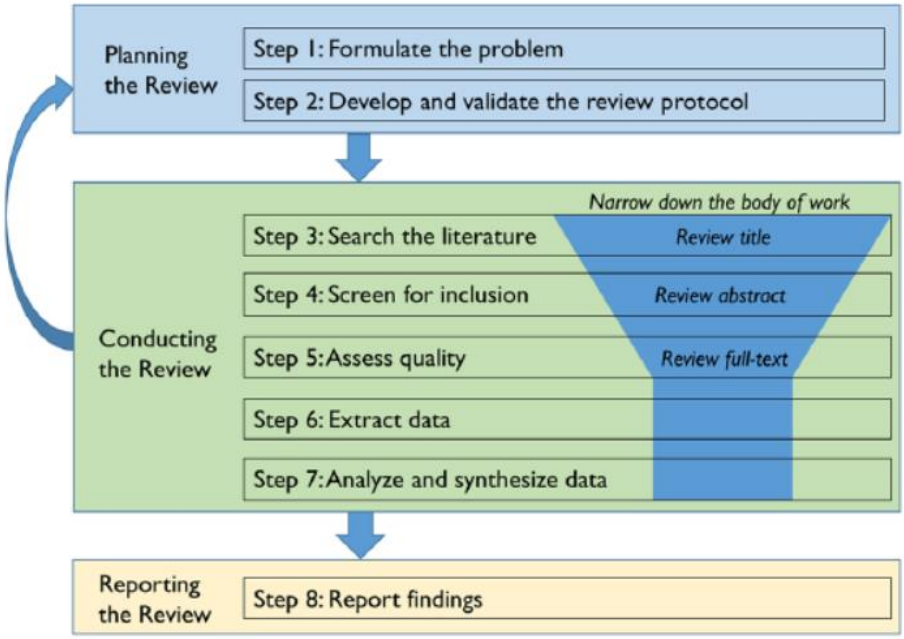

Figure 6. Steps of a systematic literature review

3.2.1. Planning the systematic literature review

Kitchenham and Charters emphasized the importance of identifying the research gap and the corresponding research question. These elements are crucial, as they guide the entire process of the literature review (Kitchenham and Charters, 2007). Absolutely, in a systematic literature review, all steps undertaken should aim to address and answer the research question at hand (Xiao and Watson, 2019).

With the emergence of regime resistance against FFBSS in the case study city and the subsequent withdrawal of FFBSS as a sustainable mobility niche in Vienna, a research gap quickly became apparent: the need for a deeper understanding of mobility niches like FFBSS within sustainable mobility contexts. In the early stages of the systematic literature review for this thesis, the research question underwent several iterations. To refine the research question further, a technique known as "preview mapping", introduced by Brereton et al., was employed. "Preview mapping" can be described as the initial scan for literature, aimed at narrowing down the focus and scope of the research question (Brereton et al., 2007). With the identification of the research gap and the formulation of an appropriate research question, the process of systematically searching for relevant scientific literature became more straightforward. However, some planning was still required to determine the precise methodology for conducting the review. The systematic literature review was designed to contribute to answering the research question, aiming to enhance understanding of the dynamics and developments of FFBSS within sustainable mobility transitions.

3.2.2. Conducting the systematic literature review

After identifying a research gap and formulating a related research question, the search for scientific literature commenced. This step, described as the third step by Xiao and Watson in conducting a systematic literature review, involved determining where to search for appropriate scientific literature (Xiao and Watson, 2019). According to Petticrew and Roberts, the contemporary approach to accessing scientific literature involves utilizing online archives (Petticrew and Roberts, 2006). For the systematic literature review in this case, online libraries were primarily utilized to gather data, with a focus on platforms such as Google Scholar, Scopus, and U-Search (University of Vienna). These online archives provided access to a wide range of scholarly articles and research papers relevant to the research question, facilitating a comprehensive literature search.

Before commencing the systematic research process, careful consideration was given to selecting appropriate keywords. Typically, keywords for scientific research are derived from the formulation of the research question (Kitchenham and Charters, 2007). Given that the research thesis focuses on understanding the dynamics surrounding free-floating bike-sharing systems (FFBSS), "free-floating bike sharing systems" was chosen as the primary keyword for the systematic literature review. Additionally, other keywords related to FFBSS were also included in the search strategy, such as "bike sharing", "shared mobility", "dockless bike sharing", "docked bike sharing" and "station-based bike sharing". These keywords were

selected by the researcher to ensure the capturing of relevant scientific literature related to FFBSS.

Creating an Excel file to organize and summarize the findings from the collected 100 scientific articles is a systematic approach to managing the data. This structured manner of recording information allows for easy reference and analysis. Readers can refer to the Appendix, specifically Appendix A (page number 106), to view the Excel table containing the list of the 100 scientific articles found.

As displayed in the excel table, the scientific articles were categorised under the following categories: One vertical column was named "source", where a distinguishing between "own research" and "snowball" has been framed: Own research related to scientific articles which have been found from searching the above-mentioned keywords, articles derived through "snowballing" have been found through referencing or citation tracking. Burns and Grove in that regard highlight "snowballing" as: *"a convenience sampling method. This method is applied when it is difficult to access subjects with the target characteristics. In this method, the existing study subjects recruit future subjects among their acquaintances. Sampling continues until data saturation"* (Burns and Grove, 1993).

In the next vertical column, the scientific articles were categorized into different keyword categories to provide a clearer overview of the research findings. The categories added to the column "Buzzword/Topic" were formulated as follows: FFBSS/ dockless bike sharing; bike sharing; bike sharing Vienna; station-based bike sharing systems (SBSS); FFBSS/SBBSS; shared mobility. Out of the total of 100 scientific articles, 42 were related to bike sharing, 38 covered the topic of free-floating bike-sharing systems (FFBSS) or dockless bike sharing, 8 focused on bike sharing in Vienna, 6 discussed the opposition between FFBSS and station-based bike-sharing systems (SBBSS), four were related to shared mobility in general, and one article specifically addressed SBBSS. In total, 63 sources were obtained through "own research", while 37 scientific articles were gathered through "snowballing". The following vertical columns within the Excel matrix contained the complete title of the scientific publication, the author or authors of the scientific article, the year of publication, the journal or institution it was published in, and the study designs used in the scientific journals. Initially, the literature search involved inserting articles into the matrix based solely on the article's title. The decision regarding the usefulness of articles and the subsequent deeper reading of abstracts and full texts occurred in later stages of the review process.

In the fourth step, as outlined by Xiao and Watson, researchers focus on screening for inclusion. During this stage, decisions are made regarding which articles to include for data extraction and which to exclude from further analysis (Xiao and Watson, 2019). First, a general screening should take place, involving the evaluation of the articles' titles and abstracts (ibid, 2019). Also, if available, the conclusion sections of the scientific articles should be further examined (Brereton et al., 2007). In the case of the systematic literature review in this thesis, initially, one hundred articles were inserted into the Excel file based on the title of each article. Subsequently, additional categories such as author, journal, and study design were included. Following this, the screening process to assess the usefulness of the articles commenced. Primarily, the abstracts and conclusion sections were thoroughly reviewed. This allowed the researcher to gain a comprehensive overview of the topics discussed in the articles related to free-floating bike-sharing systems (FFBSS) and to identify key considerations for understanding the dynamics and mechanisms surrounding FFBSS in sustainable mobility transitions.

Based on the screening of the one hundred articles and their characteristics, six different categories were evaluated. These categories represent the most discussed topics related to free-floating bike-sharing systems (FFBSS) and are considered crucial for policymakers. If an article applied to more than one of the mentioned categories, it was categorized under the "Other articles related to FFBSS/bike sharing" category. This approach ensured that each article was assigned to the most relevant category while avoiding duplication across categories. Formulated by the researcher based on the initial screening for inclusion, these categories were then color-coded to distinguish articles and their relevance. The introduced categories are as follows: governance and policy making in FFBSS (yellow), usage and user attitudes of FFBSS (light green), financing and subsidies of FFBSS (orange), infrastructure and technologies in FFBSS (blue), monitoring and operation of FFBSS (red) and other articles related to FFBSS/ bike sharing (dark green). The result of the systematic literature review and the categorization is presented in the following Excel graphic:

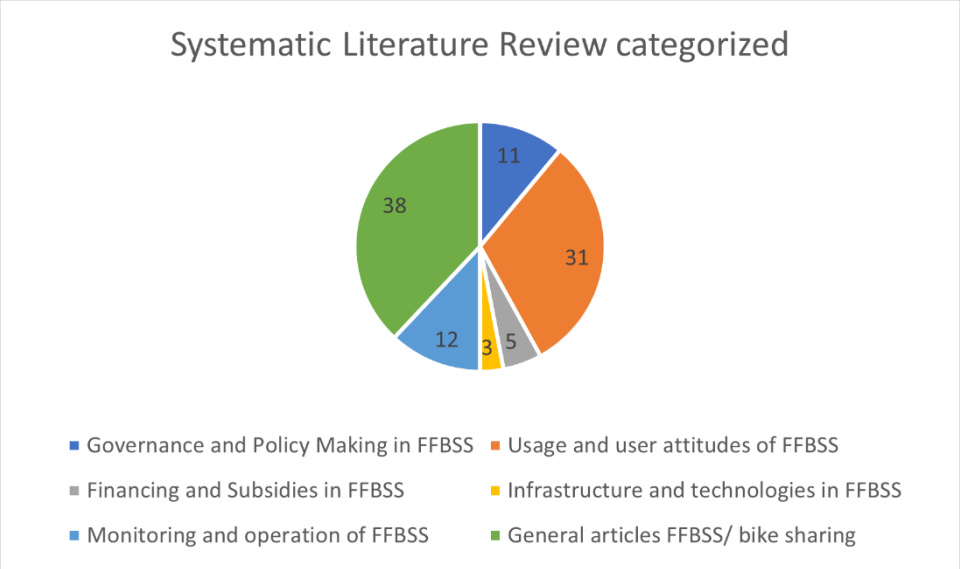

Figure 7. Categorized results of the systematic literature review

Examining the categorized results, it was found that 38 articles fell into the category of general articles on free-floating bike-sharing systems (FFBSS) and bike sharing. Additionally, 31 articles addressed the usage and user attitudes of FFBSS, while 12 focused on monitoring and operating FFBSS. Furthermore, 11 articles discussed governance and policymaking in the context of FFBSS, while five articles examined financing and subsidies related to FFBSS. Finally, three scientific articles delved into the topic of infrastructure and technologies associated with FFBSS.

After the initial assessment of the identified literature, a more in-depth analysis of the existing body of literature is conducted in Step 5 (Xiao and Watson, 2019). Here, also the full texts are evaluated, not only focusing on the abstracts and the conclusion (ibid, 2019).

In the systematic literature review of this thesis, the researcher thoroughly read the abstracts and conclusion sections of all articles. Additionally, a deeper screening of the literature was conducted where necessary. The final evaluation and filtration of scientific literature related to FFBSS were then presented in the Excel matrix (Appendix A page 106) with two additional vertical columns. One column indicated whether the article was deemed useful for the analysis, marked with a "+" sign. If there was uncertainty about the inclusion of an article, it was marked with a "~" sign, yet these articles were still included in the review. Furthermore, the articles were categorized into subcategories represented by different colours, as mentioned earlier. This process facilitated the finalization of the quality assessment. An additional vertical column was added for comments, where the researcher provided a brief description of why each article was

considered useful or not useful for further analysis. This comment section helped justify the decision-making process. The results of this final qualitative evaluation showed that 65 sources were marked with a "+" sign, indicating their usefulness for the analysis and for further research. 35 sources were marked with a "~" sign, indicating uncertainty about their inclusion. Based on this evaluation, scientific data on FFBSS was extracted from the 65 sources deemed useful for further analysis. The 35 sources, which had an uncertainty of inclusion, were subjected to a deeper screening to determine their relevance and usefulness for the thesis.

With this, the process of the systematic literature review was completed. The categorized scientific findings were extracted and will be presented in the results section in later stages of this thesis. The results of the systematic literature review serve a dual purpose: they provide scientific insights for better understanding the dynamics and mechanisms of FFBSS as new niches in mobility systems, and they offer a foundational basis for policymakers in Vienna to consider when reintroducing FFBSS into the urban mobility system.

3.3. Systematic Media discourse analysis: FFBSS/ BSS in Vienna

In addition to the systematic literature review, a systematic media discourse analysis was employed as the second method in this thesis. The literature review revealed that there were not many scientific articles specifically focused on FFBSS in the case study city of Vienna. Therefore, further research was necessary to gather detailed information about the developments of FFBSS in Vienna.

The systematic media discourse analysis aimed to achieve two main objectives: first, to obtain more specific, place-based information about the developments around FFBSS and bike sharing in Vienna; and second, to provide a data foundation for the Multi-Level Perspective analysis of FFBSS as a new sustainable mobility niche within the context of Vienna's sustainable mobility transition. This approach ensured a comprehensive understanding of the local dynamics and informed the analysis of niche-regime interactions in the city.

3.3.1. Planning the systematic media discourse analysis

The systematic media discourse analysis in this thesis was guided by the methodology outlined by Xiao and Watson (2019) for conducting a systematic literature review. This guideline proved

adaptable and effective for a systematic media discourse analysis, with necessary adjustments to account for the differences between scientific articles and newspaper articles in terms of size and structure.

For the media discourse analysis, the same excel matrix used in the systematic literature review was employed to categorize the newspaper articles, with modifications to the column names and other aspects of the matrix to suit the nature of media content. Despite these changes, the framework provided by Xiao and Watson (2019) remained central to the approach, following their three main steps: planning, conducting, and reporting the analysis (Xiao and Watson, 2019). The systematic media discourse analysis effectively complemented the systematic literature review, offering a comprehensive and place-specific understanding of FFBSS developments and their role in sustainable urban mobility transitions in Vienna.

3.3.2. Conducting the systematic media discourse analysis

After conducting the systematic literature review, the next step involved searching for newspaper articles related to FFBSS and bike sharing in Vienna. Identifying effective key search terms was crucial for finding relevant articles. To gather specific, place-based data on FFBSS and bike sharing in Vienna, the researcher primarily used search terms such as “free-floating bike sharing systems Vienna” and “bike sharing Vienna”.

A simple Google search, focusing particularly on the news column, was employed to locate relevant newspaper articles. Through a combination of direct search and snowballing, a total of 60 newspaper articles related to the developments around FFBSS and bike sharing in Vienna were collected. The collected newspaper articles primarily covered topics such as the developments of bike sharing in Vienna, the emergence and withdrawal of FFBSS providers in the city, and public bike sharing programs in Vienna. These articles were systematically categorized and inserted into an adapted excel matrix (available in Appendix B page 110), providing a structured presentation of the newspaper articles and the corresponding scientific data.

The first vertical column in the matrix was labelled “#”, indicating the sequential number of the newspaper articles, from one to sixty. The second column was titled “URL”, containing the internet link to each newspaper article. The following column was labelled “Publisher”, representing the institution that distributed the newspaper article. These institutions mostly

included various Austrian newspapers such as “Kurier”, “ORF”, “Der Standard”, and “Die Presse”.

The “date” column, which indicated the publication date of each newspaper article, was particularly valuable for the Multi-Level Analysis. This column allowed for the chronological classification of articles, enabling a systematic arrangement of the developments around bike sharing and FFBSS in Vienna. By organizing the articles in ascending order of publication dates, it became easier to track the timeline of these developments. This chronological arrangement facilitated the Multi-Level Perspective Analysis of FFBSS in Vienna.

Additionally, the “actors mentioned” column contributed significantly to the analysis. This column allowed for the identification and categorization of various actors involved in the FFBSS and bike sharing landscape in Vienna. These actors included private FFBSS providers such as “Ofo”, “oBike” and “Donkey Republic”; public bike sharing programs from the city of Vienna such as “Viennabike”, “Citybike Wien” and “Wien Mobil Rad”; and other stakeholders involved in bike sharing/FFBSS in Vienna, such as the “City of Vienna”, “MA48” and “Wiener Linien”. This classification helped in understanding the roles and interactions of different entities within the bike sharing ecosystem in Vienna, further supporting the later analysis.

When conducting the systematic media discourse analysis, the newspaper articles were searched systematically. This process involved examining each article for relevance and value, aligning with steps three, four, and five in Xiao and Watson’s guideline for conducting a systematic literature review (Xiao and Watson, 2019).

In implementing the systematic media discourse analysis, the three steps were streamlined due to the nature of newspaper articles, which are typically shorter and more concise. As the articles were searched for and structured into the Excel matrix, they were simultaneously screened for inclusion and reviewed for their value to the analysis. This approach shortened the process, ensuring it’s efficiency.

The articles were inserted into the Excel matrix with several additional vertical columns chosen by the researcher for a better overview and to ease the analysis: “Crucial Events Mentioned”, “Other Interesting Findings” and “Relevancy”. In the “Crucial Events Mentioned” column, the main events described in each article were summarized, providing an overview of the

developments related to FFBSS in Vienna's mobility systems. This facilitated the analysis of dynamics and trends. The "Other Interesting Findings" column served to document any noteworthy information from the articles that may be relevant to the analysis. This allowed for the capture of additional insights beyond the main events. The "Relevancy" column served as a critical assessment tool to determine the usefulness of each article for further analysis. Articles marked with a "+" were deemed valuable, as they provided pertinent information regarding FFBSS/BSS in Vienna that could significantly contribute to the analysis. On the other hand, articles marked with a "~" indicated a level of uncertainty regarding their usefulness. In these cases, the researcher was unsure whether the information contained in the article would be beneficial for informing the analysis. This assessment was based on the extracted data from the articles and their potential relevance to the research objectives and questions.

3.3.3. Reporting the results of the systematic media discourse analysis

Absolutely, the systematic media discourse analysis served as a foundation for comprehensively examining and organizing the newspaper articles. This methodological approach not only facilitated a thorough understanding of the niche/regime dynamics and the developments surrounding FFBSS/BSS in Vienna but also laid the groundwork for conducting a Multi-Level-Perspective analysis in later stages of the thesis. By systematically analysing and categorizing the newspaper articles, it provided a detailed and structured foundation for unravelling the complexities of the sustainable mobility transition in the case study city.

The analysis section of this thesis will present the results in detail, including a timeline highlighting the significant developments stemming from FFBSS/BSS in Vienna. This timeline will offer a clear overview of the most crucial developments related to the new mobility niche within the context of sustainable mobility transition.

3.4. Expert interview

In addition to the systematic literature review and the systematic media discourse analysis, an expert interview was conducted with an individual involved in the developments surrounding bike sharing/FFBSS. The purpose of this interview was to gather supplementary scientific information and gain new perspectives to enhance understanding of the dynamics and developments related to FFBSS in the case study city. As part of the mixed methods approach

employed in this thesis, the expert interview served as the third method used to gather data on FFBSS/bike sharing.

3.4.1. Planning the expert interview

At the stage of the expert interview, the researcher had already acquired a certain knowledge base on the developments of FFBSS/BSS in the case study city, particularly from the findings of the systematic media discourse analysis. With this analysis completed, the researcher was already familiar with various actors mentioned in the newspaper articles who were involved in the FFBSS discourse. These actors were considered potential candidates for the expert interview, as they were connected to the developments surrounding FFBSS in the case study city. They included FFBSS providers such as “Ofo”, “oBike” or “Donkey Republic”, public bike sharing concepts in Vienna such as “Citybike Wien” or “Wien Mobil Rad”, public bike sharing providers such as “Wiener Linien” or “Gewista” and governance actors/institutions and other organizations involved in the process such as the “City of Vienna”, the “Mobility Agency Vienna” or the “MA 48”.

Initially, the plan was to conduct two expert interviews to obtain differing viewpoints. However, upon reviewing the research conducted through the other two methods, it seemed that one interview would suffice for the researcher’s needs. Various actors mentioned earlier were contacted via email, with an expert interview guideline included in the email appendix (found in Appendix C1 of this thesis). The interview questions were designed to cover several key areas.

The first section focused on the interviewer introducing themselves, describing their job function, and detailing their connection to FFBSS in Vienna. The second section delved into the niche of FFBSS in the transformation of bike sharing in Vienna, exploring the dynamics, developments, and actors involved in the appearance and disappearance of FFBSS and how the interviewee perceived these developments. Additionally, the interview guide had a section dedicated to providing information for a potential reintegration of FFBSS in Vienna, outlining considerations in that regard. These questions were aligned with the subcategories from the systematic literature review, covering topics such as governance/policymaking, infrastructure, maintenance, operation, usage, and financing of FFBSS in Vienna.

The decision on the interview partner ultimately landed on the “Mobility Agency Vienna”, an institution that acts as a liaison between the public society and urban authorities, focusing on sustainable urban mobility projects. The agency plays a role in enhancing cycling and walking in the city and has been involved in various sustainable mobility projects and mobility reports in recent years (Mobilitätsagentur, 2023). The agency was directly involved in the discourse around FFBSS in Vienna, as they developed and introduced the regulatory measures on behalf of city authorities that led to the withdrawal of FFBSS providers from Vienna.

3.4.2. Conducting the expert interview

Following the arrangement of the interview partner, the interview was conducted with Gildas Le Gall, an employee in the shared-mobility department at the Mobility Agency Vienna. The interview guide was sent to the agency in advance, and the expert interview took place in person at the Mobility Agency Vienna. Prior to the interview, a consent form regarding the usage of the gathered data was signed. The interview lasted a total of 48 minutes and 10 seconds and was recorded using a smartphone voice recorder. The full transcript of the interview can be found in Appendix C2. With his background as an employee at both “Citybike Wien” and the “Mobility Agency Vienna”, Gildas Le Gall provided a variety of interesting and useful insights into the developments around FFBSS and bike sharing in Vienna.

3.4.3. Reporting the results of the expert interview

After the interview took place, it was transcribed and converted into written form. The decoding process began, focusing on how to categorize the interview statements. The categories derived from the systematic literature review, which were also used in the systematic media discourse analysis, were utilized for consistency and to facilitate further analysis. The interview statements were distributed into the following categories: “Governance and policymaking in FFBSS/bike sharing”, “usage and user attitudes in FFBSS/bike sharing”, “financing and subsidies in FFBSS/bike sharing”, “infrastructure and technologies in FFBSS/bike sharing”, “monitoring and operation in FFBSS/bike sharing”, and “general information on FFBSS/bike sharing”. Additionally, a column titled “free-floating offers nowadays in Vienna” was included to capture statements related to new mobility niches such as e-scooters in the city, which could also be relevant for analysing the dynamics of FFBSS.

In total, 56 valuable statements, phrases, or paragraphs were identified and sorted into their respective subcategories within an Excel file, available in Appendix C3 (page 126) of this thesis. The following graphic illustrates the categorization of statements extracted from the expert interview:

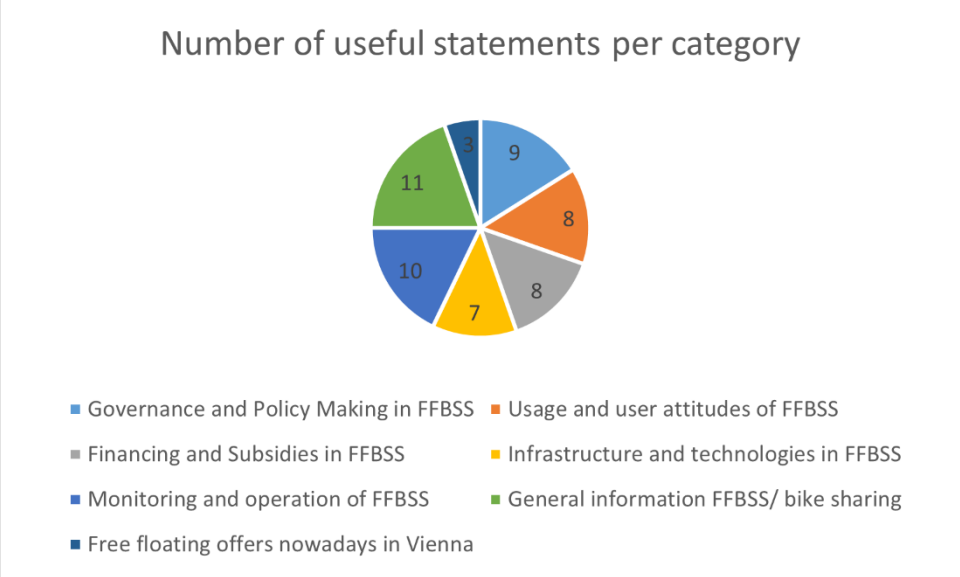

Figure 8. Categorized statements from the expert interview

Examining the categorization of the expert interview statements and reviewing the findings from the interview decoding, it's evident that there was a relatively even distribution of the number of statements across categories. While some statements were straightforward to assign to a specific category, others posed challenges, leading to some statements being allocated to multiple categories as they encompassed various topics.

The combination of the three methods employed in this thesis has provided a comprehensive data foundation for understanding the dynamics and developments surrounding FFBSS. The systematic literature review yielded general information about FFBSS and bike sharing, while the systematic media discourse analysis illuminated specific developments, dynamics, and mechanisms in the case study city of Vienna. Through the expert interview, further qualitative data on these developments and dynamics was gathered.

The systematic media discourse analysis provided geographical context and specificity to the research problem, enhancing our understanding of FFBSS in Vienna. In the subsequent analysis chapter, the results of the systematic media discourse analysis will be presented, focusing on the developments and dynamics of FFBSS in Vienna. This analysis will delve into niche-regime dynamics and notions of regime resistance through the lens of the Multi-Level-Perspective.

Additionally, the results of the systematic literature review and the expert interview will be integrated into the analysis. This synthesis of findings from the mixed methods approach will provide a comprehensive understanding of FFBSS in Vienna and offer insights for policymakers grappling with this new sustainable mobility niche.

4. Analysis: Dynamics of FFBSS/ BSS in the case study city Vienna

This chapter aims to analyse the dynamics surrounding free-floating bike sharing systems as a niche within Vienna's socio-technical mobility system. Drawing from both the theoretical framework and the insights gathered through the mixed-method approach, the analysis will primarily rely on findings from the newspaper articles found in the systematic media discourse analysis. Additionally, the developments around FFBSS will be critically examined through the lens of the Multi-Level-Perspective (MLP) on socio-technical systems.

Key questions addressed in this chapter include: What were the main actors involved at the niche- and regime levels during the emergence and disappearance of FFBSS providers in Vienna? How did these actors interact with each other during the transition process of the socio-technical mobility system? Furthermore, this chapter seeks to assess the role of policymakers in navigating new mobility niches such as FFBSS and examine how certain behaviours of these actors can either hinder or empower the development of sustainable mobility niches. This includes considerations of regime resistance and strategic niche management within socio-technical systems' transitions.

The graphic below was created by the researcher using Excel, incorporating the main events around FFBSS/BSS in Vienna, gathered from the media discourse analysis. This simplified graphic aims to highlight the most important events related to the niche of FFBSS/BSS in Vienna, presenting them on a timeline. The red dots on the graphic refer to events related to docked BSS in Vienna ("Viennabike"; "Citybike Wien"; "WienMobil Rad"), the yellow dots represent developments around FFBSS ("Ofo" and "oBike"), and the brown dots indicate significant progressions related to "Donkey Republic" as a BSS provider in Vienna:

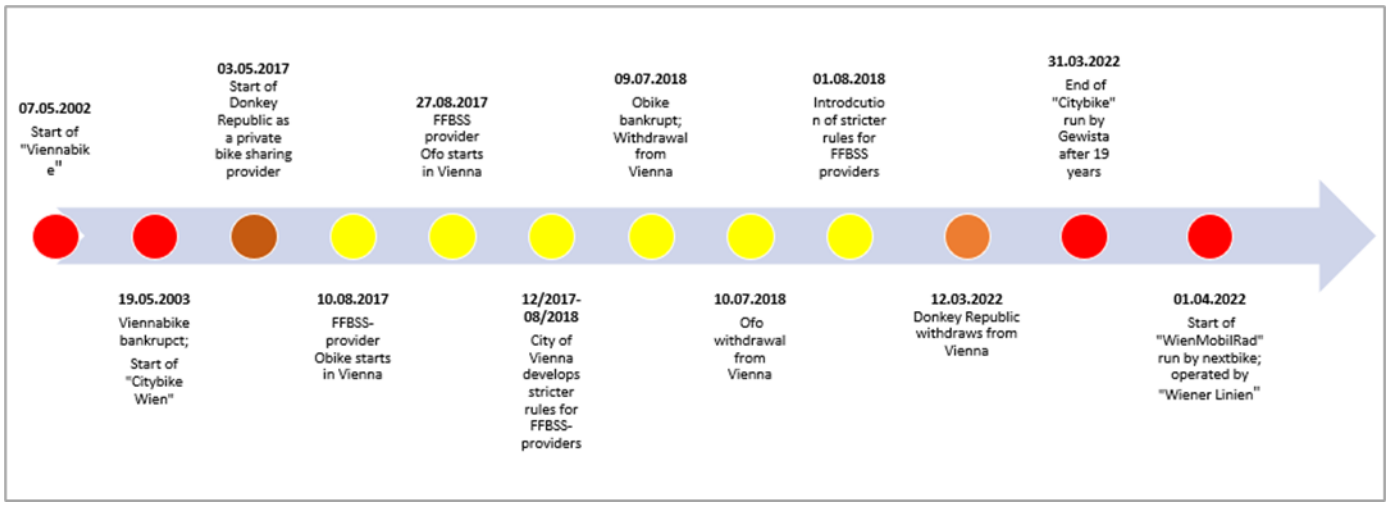

Figure 9. Developments around BSS/FFBSS in Vienna on a timeline

4.1. Initiating phase of BSS in Vienna

Before the emergence of free-floating bike sharing systems (FFBSS) in the case study city, Vienna, public bike sharing had already been successfully introduced to the city's socio-technical mobility system many years earlier, dating back to 2002. The system, known as "Viennabike", operated with a deposit of two euros, like the mechanism used for shopping trolleys. However, the low cost of the system quickly led to issues, and "Viennabike" had to cease operations shortly after its introduction (Link et al., 2020). It's intriguing to note that when "Viennabike" transitioned into "Citybike Wien", the system itself remained largely unchanged, with only the provider undergoing a shift. However, "Viennabike" faced challenges due to a lack of financial support and the abrupt termination of a three-year subsidy contract, leading to its early discontinuation (DerStandard, 2003a). Following the discontinuation of "Viennabike" a new public bike-sharing initiative, "Citybike Wien", emerged, marking a significant success compared to its predecessor. The system was operated by an advertising company called "Gewista", which funded the entire project estimated to cost between two to three million euros for its introduction. Despite funding the project independently, the company also sought potential sponsors to support it further (DerStandard, 2003b). The introduction of "Citybike Wien" brought several technological improvements to the bike-sharing system, including identity verification through credit card registration, the introduction of new bicycles, and the establishment of new stations. Initially, the plan was to have 1000 bikes at 100 stations, with operations scheduled to begin in May 2003. Among eleven applicants, "Gewista" emerged as the successful candidate to operate the new bike-sharing system (ibid, 2003b). On May 19, 2003, "Citybike Wien" commenced its operations with a trial phase involving thirty bikes and

fifty participants. By 2004, the provider aimed to expand the system to include 1000 bikes across the city (Presse Service Stadt Wien, 2003). Following its introduction, “Citybike Wien” became a success story, serving as a role model for bike-sharing systems. Its innovative approach, including registration through credit card, led to its adoption in sixty cities worldwide. It was the pioneering bike-sharing model to implement credit card registration globally (DerStandard, 2012). Initially, the first hour of bicycle lending with “Citybike Wien” was free, with subsequent hours incurring a fee. Users were also responsible for any damages or theft. The average lending duration was twelve minutes, often resulting in free rides for users, particularly for short trips complementing existing public transportation services (ibid, 2012). Hans-Erich Dechant, the head of “Gewista”, emphasized that “Citybike Wien” was not intended to compete with established bicycle rental services but aimed to serve different user demographics. Continuous user feedback prompted several system revisions, reflecting a learning process (ibid, 2012). By 2012, the system had expanded to include 92 stations and 1400 bikes, with further expansion plans (ibid, 2012). Infrastructure enhancements included the introduction of lighter bicycles in 2005 and the acceptance of credit card payments in 2006 (Brandt Di-Maio, 2018). In 2009, three-gear bicycles were introduced in response to user feedback. Subsequently, there was a continuous enhancement of station and bicycle infrastructure to accommodate the increasing number of stations, bicycles, and users (ibid, 2018). By 2012, the system had expanded to 100 stations, and by 2014, “Citybike Wien” had half a million users. In 2015, the system achieved its first one-million rides-per-year milestone, supported by the presence of 120 “Citybike Stations”. This achievement was repeated in the following two years (ibid, 2018).

4.1.1. Analysis: Initiating phase of BSS in Vienna

“Viennabike”, as the initial bike sharing system in Vienna, faced challenges and was not successful. However, its introduction marked the entry of public bike sharing as a sustainable mobility niche into the socio-technical mobility system of the case study city. The niche gained strength with the successful introduction of “Citybike Wien”, which served as a model for other cities worldwide. Financial support from “Gewista”, an advertising company, as well as the City of Vienna and other sponsors, played a crucial role in its success. Continuous improvement of the system based on user feedback, coupled with political and financial support from city authorities, led to several milestones and consistent growth of the system.

Viewed through the lens of the Multi-Level-Perspective, the introduction of "Citybike Wien" can be seen as strategically managed, financed, and protected from opposition by regime players such as public authorities in Vienna, "Gewista", and other supporting sponsors. Political will and financial backing facilitated its rapid integration into the socio-technical system, establishing it as a sustainable and cost-effective option within Vienna's urban mobility landscape.

4.2. Arrival of "Donkey Republic" as a private bike sharing provider

City authorities in Vienna have demonstrated expertise and experience in successfully managing, funding, and protecting sustainable mobility niches. A prime example in the case study city is the bike sharing system "Citybike Wien". However, the landscape changed in 2017 when private free-floating bike sharing providers entered the market in Austria's capital. Unlike the success story of "Citybike Wien", these private providers, starting with **"Donkey Republic"**, an international bike sharing company, did not achieve the same level of success. In March 2017, "Donkey Republic" introduced 200 orange bicycles into the city, marking the first entry of a private bike sharing provider into the Viennese market (DerStandard, 2017a). Typically, when "Donkey Republic" expands its service to a new city, local partner associations purchase the orange bikes and distribute them throughout the area. In Vienna, this role was fulfilled by "Pedal Power". Unlike "Citybike Wien", users of "Donkey Republic" could unlock and lock bicycles using a smartphone application. After a brief trial period of the new mobility system, "Pedal Power" decided to purchase 200 bikes and distribute them to public bicycle parking areas across the city (Marhl, 2017). This soon led to tensions with the public bike sharing provider, "Citybike Wien". They claimed that "Donkey Republic" was occupying too much public parking space, which was intended for Viennese cyclists and not for these systems (DerStandard, 2017a; Marhl, 2017). Martin Blum, as mentioned in the newspaper article by Marhl in 2017, expressed an opposing opinion. He argued that the parking of "Donkey Republic" bicycles in public spaces was legal. Furthermore, he added that the quality of urban tourism is linked to new and sufficient bike sharing offers, such as those provided by "Donkey Republic" (Marhl, 2017). Vienna is increasing its parking spots by adding an additional 2000 to 3000 bike parking spots per year. Therefore, even if 1000 new "Donkey Republic" bicycles were introduced, it wouldn't be an issue as there is sufficient bicycle parking infrastructure in the city. In this context, "Donkey Republic" was already planning in 2017 to increase the number of its bikes to 1000 by summer 2018 (ibid, 2017). If there were shortages of public bike

parking spaces in the city, additional bike parking spots could be created. In the long run, "Donkey Republic" aimed to increase the number of its bicycles to 3000, depending on the performance of the system in the city (DerStandard, 2017a).

As previously noted, concerns were raised about potential competition between "Donkey Republic" and "Citybike Wien". However, this claim was countered by the argument that "Donkey Republic" targeted tourists in the city, while "Citybike Wien" was designed primarily for local residents of Vienna (DerStandard, 2017a; Marhl, 2017).

In Mahrl's 2017 newspaper article, operators of "Donkey Republic" contended that station-based bike sharing systems were outdated. They aimed to demonstrate that bike sharing could function effectively without public financial support and without the need for costly station infrastructure. This assertion sparked further controversy, with "Donkey Republic" criticizing the approach of "Citybike Wien" (Marhl, 2017).

4.2.1. Analysis: Arrival of "Donkey Republic" as a private bike sharing provider

With the introduction of "Donkey Republic" into Vienna, the bike-sharing niche in the case study city gained another member, further solidifying its presence. However, the arrival of "Donkey Republic" brought to light an interesting dynamic from a Multi-Level-Perspective, as highlighted in the newspaper articles. It appeared that the imbalance between the technical and social aspects of the niche became evident with "Donkey Republic's" entry into the city. The discourse that ensued at the regime level primarily centred around public bicycle parking spots as an infrastructural challenge, emphasizing the technological side of the niche.

From the researcher's perspective, "Citybike Wien" had already established itself as a key component of Vienna's overall mobility system and was reluctant to cede its position. With "Donkey Republic" entering as a new bike-sharing provider, "Citybike Wien" seemed to exhibit a form of regime resistance. They appeared to criticize "Donkey Republic's" approach, possibly to maintain their dominant status as the sole bike-sharing provider in Vienna. However, it's worth considering that greater cooperation between the two providers could have potentially benefited the evolution of the bike-sharing niche in the city.

4.3. Arrival of "Ofo" and "oBike" as private FFBSS-providers

Just a few months after the introduction of "Donkey Republic", other private free-floating bike-sharing providers from Asia were poised to launch their services in Vienna. The "Radlobby

Wien", an organization dedicated to bicycle traffic in Vienna, pre-emptively outlined the advantages and disadvantages of free-floating bike-sharing providers such as "Ofo" and "oBike". They also highlighted important considerations that city authorities in Vienna needed to be mindful of before allowing these providers to operate in the city (Radlobby Wien, 2017a). They portrayed free-floating bike-sharing systems as a new mobility option for the city that could have positive contributions to the transition of the urban socio-technical mobility system. However, they also raised concerns about potential negative issues associated with FFBSS, such as the lack of clear legislative management for these new services and uncertainties regarding the financial strategies of the companies operating these systems (ibid, 2017a).

In addition to highlighting existing issues observed in other cities regarding the management of FFBSS, the "Radlobby Wien" also sought to provide guidelines to city authorities in Vienna on how to handle this new sustainable mobility option. Firstly, they emphasized the importance of ensuring an appropriate number of new bicycle parking spots. Furthermore, they suggested that governance actors should monitor the proper parking of bicycles to prevent parking disorders, such as those occurring on pedestrian walks, which could particularly impact pedestrians (ibid, 2017a) Additionally, the "Radlobby Wien" emphasized that a balanced distribution of bicycles was crucial from their point of view to enhance the success probability of the system (ibid, 2017a). The "Radlobby Wien" also stressed the importance of ensuring that FFBSS providers entering the Viennese market adhere to legislative basics and prioritize sustainability concerns in their bike sharing schemes. Additionally, they emphasized the importance of attaching information stickers on the bicycles to educate users about correct usage and minimize parking problems observed in other cities (ibid, 2017a) The "Radlobby Wien" concluded by emphasizing the importance of integrating these suggested points into the governance of these systems to ensure the successful introduction of private FFBSS providers in Vienna (ibid, 2017a).

Figure 10. An "Obike"

Firstly, **“oBike”** was introduced to Vienna, representing a FFBSS provider originating from Singapore. On the 11th of August 2017, the provider introduced 500 “oBikes” to the city, monitoring them with the assistance of two service workers. “oBike” marked the second private free-floating bike sharing provider to enter the market in Vienna, alongside “Donkey Republic”. Founded in January 2017, “oBike” steadily exported its bicycles to numerous cities worldwide (Rachbauer, 2017).

Figure 11. An "Ofo" Bike

Almost simultaneously with “oBike”, another free-floating bike sharing provider, **“Ofo”,** entered the Vienna market. “Ofo” originated from China and aimed to establish a presence in European territory through its market introduction in Vienna (Thalhammer, 2017). Founded in Beijing in 2014, “Ofo” quickly emerged as the largest free-floating bike sharing provider globally. The company operated eight million bikes across 170 metropolitan areas, boasting a user base exceeding 100 million (Kleine Zeitung, 2017). Starting on the 27th of August 2017, “Ofo” initiated a one-month testing phase featuring 200 of their distinctive yellow bikes in the district Leopoldstadt in Vienna (Diewald and Krutzler, 2017; Kleine Zeitung, 2017; Thalhammer, 2017).

The founders of “Ofo”, as per their own statement, aimed to promote sustainable transportation and encourage cycling as the primary mode of mobility in Vienna. Furthermore, they emphasized that their program was intended to serve as an additional bike-sharing option alongside existing providers, rather than competing with them (APA OTS, 2017). Initially, the city of Vienna viewed the arrival of new FFBSS providers as an opportunity to enhance

sustainable mobility within the city. There was a recognition of the importance of transitioning towards ecological modes of transportation, and FFBSS providers were seen as potential contributors to this goal (Fellnhofer, 2017).

With the introduction of "Ofo" on the 27th of August 2017, the total number of shared bicycles in Vienna reached 2300, which included 1400 "Citybikes". "Ofo" aimed to attract local residents of Vienna, potentially enticing users of "Citybike Wien" (Diewald and Krutzler, 2017).

Both "Ofo" and "oBike" utilized a smartphone application for unlocking and locking their bicycles via Bluetooth connection. The bicycles were tracked through GPS, allowing users to locate them using the app. After use, the bicycles could be returned to any legal parking spot (Thalhammer, 2017). Bicycles from both "Ofo" and "oBike" were also permitted to be parked on wide pedestrian pathways and parking lanes (Diewald and Krutzler, 2017). In Diewald and Krutzler's newspaper article, Martin Blum early on pointed out that the new FFBSS-providers could cause significant disruption to public bicycle traffic in Vienna and initiate intense competition with existing bike-sharing providers in the city (Diewald and Krutzler, 2017). "Ofo" itself emphasized that a service team would address incorrectly parked or damaged bicycles to minimize potential issues arising from misuse (ibid, 2017). Additionally, the support team would accurately monitor the demand for bicycles and, based on that information, distribute them to areas with high usage (APA OTS, 2017).

As observed in other cities worldwide, free-floating bicycles often obstructed public spaces and pedestrian walkways, causing inconvenience for pedestrians and posing safety risks (Die Presse, 2017a). The "Radlobby Wien" promptly called for the installation of new parking racks for every free-floating bicycle introduced into the city. Moreover, they proposed that FFBSS-providers should contribute to financing the construction of these new parking racks (ibid, 2017a). City authorities in Vienna remained vigilant, intending to monitor any potential issues arising from FFBSS. They aimed to observe how the dynamics around FFBSS would evolve (ibid, 2017a). Fellnhofer emphasized that if complaints were voiced by civil society and if the cityscape was being adversely affected, Vienna's city administrations could find effective ways to regulate FFBSS providers (Fellnhofer, 2017).

Following a one-month trial period, "Ofo" expanded its free-floating bicycle fleet from 200 to 700 units and extended its service to additional districts in the city (BVZ, 2017; Die Presse, 2017b). After this test phase, "Ofo" bikes did cost 50 cents per 30 minutes, "oBike" usage did

cost one euro per 30 minutes (Diewald and Krutzler, 2017; Kleine Zeitung, 2017). In October 2017, FFBSS providers, in collaboration with the "Radlobby Wien", began affixing stickers to the bicycles. These stickers provided instructions on the correct way to park and use the bicycles, aimed at minimizing blockages in areas crucial for pedestrians and other citizens. Additionally, the free-to-use period or test phase for "Ofo" bicycles was extended until the end of October (BVZ, 2017; Die Presse, 2017b). "Ofo" confirmed its intention to contribute financially to the construction of new parking racks for their bicycles (Die Presse, 2017b). This step was deemed necessary as both providers were planning to further expand their services. "Ofo" envisioned that the number of bicycles in Vienna could increase to 5000 within the city. (Die Presse, 2017a). The other FFBSS provider, "oBike", intended to increase their fleet to 7000 bikes by spring 2018 (Fellnhofer, 2017).

4.3.1. Analysis: Arrival of "Ofo and "oBike" as private FFBSS-providers

The initial phase of FFBSS providers "Ofo" and "oBike" demonstrated that the sustainable mobility niche experienced growth without encountering resistance from the city of Vienna in the first month, despite known issues with FFBSS in other cities. Initially, these providers entered Vienna with a small number of bikes, gradually increasing their fleet size while assessing user demand. This approach strengthened the socio-technical niche of FFBSS as providers engaged with users and other actors in the urban mobility system, aiming to compete with existing mobility options and contribute to Vienna's sustainable mobility transition. Although challenges arose, such as bikes being illegally parked or obstructing pedestrian pathways, policymakers observed developments closely, withholding intervention to better understand FFBSS dynamics and behaviours. This cautious approach was partly due to limited knowledge of FFBSS characteristics, but policymakers recognized the potential benefits of private financing and the opportunity to improve bicycle traffic without public funding. From a Multi-Level-Perspective, FFBSS rapidly gained structural strength with minimal resistance from authorities, who monitored developments while being mindful of challenges seen in other cities.

4.4. Increasing problems related to FFBSS in Vienna

After a series of public criticisms regarding the increasing number of wrongly parked bikes and the overcrowding of public bike parking racks by "Ofo-Bikes" and "oBikes" the city of Vienna

began working on stricter regulations for FFBSS providers just about a month after their introduction (DerStandard, 2017b; WienORF.at, 2017a).

The new regulations for FFBSS providers were to focus on expanding service possibilities, establishing parking rules, and setting a maximum number of bikes per provider (ibid, 2017b; 2017a). Martin Blum from the Mobility Agency Vienna stated in interviews with "DerStandard" and "WienORF.at" that these rules were being developed by the agency, although there wasn't a clear vision yet on their exact shape. The new regulations were also intended to include guidelines for the distribution of free-floating bikes and financial support from providers to cover any additional costs incurred by the city (ibid, 2017b; 2017a). Blum mentioned that a rule of thumb is having 30 bikes per 1000 inhabitants, although it was unclear if this applied to the new free-floating bike sharing systems. During the testing phase of "Ofo" and "oBike", some incidents of vandalism and improperly parked bicycles occurred. However, the Mobility Agency maintained close contact with the providers to ensure proper parking practices, which generally went well (ibid, 2017b; 2017a). In response to the issue of improperly parked bikes, "Ofo" committed to informing users about proper parking practices and working closely with city authorities. They suggested revoking permissions for users who park incorrectly. Additionally, "Ofo" mentioned that their monitoring team would redistribute improperly parked bikes to areas with high demand (ibid, 2017b; 2017a).

On the 9th of November 2017, "oBike" reported that they had placed 800 of their bikes in Vienna, and from the provider's perspective, this number was not expected to change in the near future (Radlobby Wien, 2017b). Until spring 2018, the number of bikes should not grow further, with "oBike" maintaining 800 bikes and "Ofo" having 700 bikes in the city (Marits, 2017). Martin Blum mentioned in a "DerStandard" newspaper article by Myriam Marits that the providers should focus on significantly improving the distribution and rebalancing of their bikes as well as their service quality, without adding more bicycles to the city until spring 2018 (ibid, 2017). As previously stated, the Mobility Agency Vienna was actively evaluating regulations for FFBSS providers at that time, working closely with magistrate departments and legislative parties in the city. Blum also noted that a cultural learning process was ongoing, where users needed to adapt to the new mobility innovation of free-floating bicycles to minimize related problems (ibid, 2017).

One of these problems was the vandalism of the bicycles, which quickly became a significant concern for FFBSS providers "Ofo" and "oBike". Soon after their introduction, more and more free-floating bikes were found in rivers, hanging in trees, or left unused in large numbers. When

a damaged free-floating bicycle was reported, it sometimes took weeks for the service teams to collect it (Imlinger, 2017). Since the quality of the bikes wasn't sufficient, FFBSS were even more vulnerable to acts of vandalism. Therefore, it was crucial for providers and governance actors to remove the damaged bikes quickly to prevent further vandalism. This necessity underscored the importance of timely maintenance and effective response strategies in managing the new mobility niche (Marits, 2017) Besides that, vandalism was named as the main reason for the bikes being damaged. This issue emphasized the need for robust strategies to address and mitigate vandalism to ensure the sustainability and effectiveness of the FFBSS in Vienna (Imlinger, 2017; Radlobby Wien, 2017b). In an interview with the "Radlobby Wien", the general manager of "oBike" in Austria, Daniel Junge, addressed the ongoing problems related to vandalism. He emphasized that the service team was committed to managing and repairing damaged or vandalized bikes promptly. Junge highlighted that "oBike" was actively working to improve their response times and ensure that damaged bikes were removed and repaired as quickly as possible to minimize disruption and discourage further vandalism. (Radlobby Wien, 2017b).

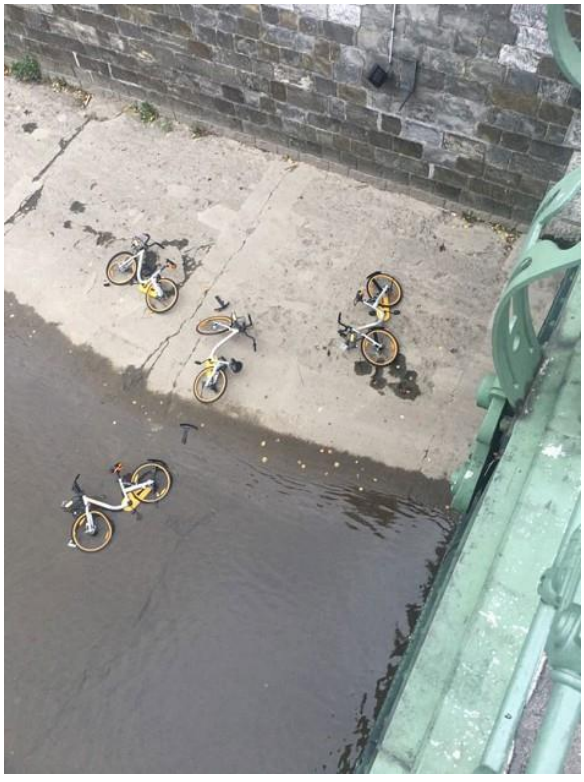

Figure 12. Vandalised free-floating bicycles in a river

Criticism arose from the "Radlobby Wien", highlighting that the service team of only two people was insufficient to maintain and rebalance the large number of bikes effectively (ibid, 2017b). Daniel Junge, the general manager of "oBike" in Austria, responded by stating that the system needed time to develop. He suggested that users should be educated on how to properly use and park the bikes, potentially through learning videos or information stickers attached to the bikes. Junge also mentioned that some car parking spots might need to be converted into additional bicycle parking racks to accommodate the growing number of bikes (ibid, 2017b). According to Imlinger, these issues were typical teething problems, and the first year of FFBSS in Vienna should be considered a pilot period to address and resolve these challenges (Imlinger, 2017). The "Radlobby Wien" proposed several

potential solutions to address the issues arising from FFBSS: Firstly, they emphasized the importance of having a robust distributional and technical support team to ensure the smooth operation of the newly introduced systems. They recommended that these teams should consist of more than two people to adequately manage the system. Additionally, they suggested that "oBike" should consider attaching information stickers to the bikes, explaining the correct way to park them (Radlobby Wien, 2017b). Martin Blum, as highlighted in the newspaper article by Marits, underscored the critical need to enhance cooperation between city authorities and FFBSS providers (Marits, 2017). These measures could involve implementing a time limit for the collection of wrongly parked bikes, such as within a maximum of two hours (ibid, 2017). Additionally, Blum emphasized that providers should contribute financially by paying a certain amount for every bicycle they introduce to the city, helping to offset the costs incurred by the city (ibid, 2017).

In December 2017, despite efforts by the Mobility Agency Vienna and political authorities, the issues regarding vandalism persisted in the city. "Viadonau", an organization responsible for cleaning the inner-city rivers in Vienna, had to retrieve 26 yellow bikes in a single day from the "Wienfluss", a river running through the inner city of Vienna (WienORF.at, 2017b). Also in December 2017, an incident occurred where a person threw an "oBike" onto the subway tracks of the U4 line in Vienna, resulting in a collision fortunately without any injuries. According to "WienORF.at", there was already a state of "chaos" in the city due to wrongly parked or vandalised free-floating bicycles (WienORF.at, 2017c). The new regulations for FFBSS providers were scheduled to be implemented in spring 2018, with political parties in the city hall still reviewing the proposals put forward by the Mobility Agency Vienna (WienORF.at, 2017b). In December 2017, "Ofo" significantly reduced their bicycle fleet due to low user numbers, removing 500 of their 700 bikes from the city over the winter period until the beginning of February (WienORF.at, 2017d).

4.4.1. Analysis: Increasing problems related to FFBSS in Vienna

The introduction of free-floating bike sharing schemes led to various problems, particularly due to misuse such as wrongly parked bicycles or acts of vandalism. Examining FFBSS as a socio-technical system, it becomes evident that both the technical aspect (e.g., broken bicycles) and the social aspect (improper usage) were not functioning properly. As highlighted in the theoretical framework of this thesis, socio-technical niches often prioritize the technological

aspects of the niche, neglecting the importance of considering users and their behaviours as part of the system (Geels, 2004).

In the case study of Vienna, both the technological and social aspects of the socio-technical niche faced challenges. The technological side suffered from insufficient maintenance services, leading to issues with bike quality and a higher likelihood of damage or vandalism. Meanwhile, users struggled to integrate the new mobility option into their daily routines, worsening the before mentioned problems. FFBSS operators attempted to address these issues by improving both the technological (e.g., better bicycles, enhanced support team, improved operations) and social (e.g., user education on proper usage) aspects of the niche. However, these efforts did not yield significant improvements, and the socio-technical mobility niche continued to experience the same problems on both fronts.

The emergence of problems with FFBSS in Vienna prompted the first instances of regime resistance, as political authorities authorized the Mobility Agency Vienna to develop regulations for FFBSS providers in response to the growing number of issues. From a theoretical standpoint, these initial months of FFBSS in Vienna can be understood through the lens of two regime resistance theories: “passive revolution” and “transformismo” (Ford and Newell, 2021). These concepts describe regime structures that aim to incorporate new socio-technical niche innovations without destabilizing the existing regime. In the case study city, these concepts can be applied to the developments surrounding FFBSS. Initially, city authorities provided a space for FFBSS to grow without actively resisting it. They observed its development and dynamics, seeking to understand its potential as a new mobility option. However, as problems arose and public dissatisfaction grew, the political approach shifted. Issues affecting society began to influence the political stance toward FFBSS, leading to a reassessment of its role and impact within the city’s mobility system.

4.5. New regulatory measures and withdrawal of FFBSS-providers

As regime resistance grew more pronounced, the city of Vienna, in collaboration with the “Mobility Agency Vienna”, introduced new, stringent regulatory measures for FFBSS providers on the 5th March 2018 (Vienna.at, 2018; WienORF.at, 2018a). As previously discussed, the increasing number of complaints regarding vandalism and improperly parked

bicycles prompted city authorities to act and assess new regulations for FFBSS providers. This was aimed at addressing and controlling the situation (Vienna.at, 2018).

The newly introduced regulatory measures mandated that FFBSS providers must promptly remove incorrectly parked or damaged bicycles. Failure to do so would result in the bicycles being removed by the towing service, with charges imposed on the providers (ibid, 2018). This requirement was made possible through the implementation of a local police regulation in the city, which obliged FFBSS providers to remove wrongly parked or damaged bicycles within specific timeframes. During weekday hours from 6:00 a.m. to 6:00 p.m., this timeframe was set at four hours, while on weekends and during nighttime, it extended to twelve hours. Failure to adhere to these timelines incurred fines of up to 700 Euros. Additionally, the regulations prohibited parking bicycles in public green areas, allowing them only to be parked on pedestrian pathways of sufficient width or at designated public bike racks. The measures also stipulated that each FFBSS provider could only operate a maximum of 1500 bikes. Newly introduced bicycles were required to be registered and display an information sticker for users, including the provider's service telephone number and a registration number visible on the bike. Furthermore, providing firms were mandated to have a company headquarters in Vienna and a service hotline for users (Vienna.at, 2018; WienORF.at, 2018a).

Maria Vassilakou, the city councillor for transport at that time, stated in a newspaper article from "Vienna.at" that the proper implementation and usage of FFBSS could be highly beneficial for Vienna (Vienna.at, 2018). She emphasized that providers of new FFBSS play a crucial role in enhancing these schemes. Improving FFBSS would help address the various challenges that emerged in 2017 (Vienna.at, 2018; WienORF.at, 2018a). According to "Vienna.at", city authorities stated that the newly presented regulations were expected to come into effect at the beginning of May 2018 (Vienna.at, 2018).

Already on the 28th of March 2018, "oBike" significantly reduced its bicycle fleet in Vienna, removing 800 of its 1800 bikes. This decision was influenced by the newly introduced regulations, which set a maximum fleet size of 1500 bikes per provider, and the increasing number of damaged bikes that led to fines for not removing them in time. The primary reason cited by "oBike" for reducing its fleet was the persistent problem of vandalism, including damage to the smart locks that sometimes made the bikes untraceable by the maintenance team. Conversely, "Ofo", the second major FFBSS provider in the city, did not plan to decrease its

fleet. Instead, they aimed to expand from 500-600 bikes to 800 bikes during the warmer summer months. Despite this reduction, “oBike” continued to operate with more bicycles than “Ofo” even after removing 800 bikes (DerStandard, 2018a; Kickinger, 2018a).

In the subsequent month, “Viadonau”, the company responsible for removing debris from Vienna’s rivers, observed a decline in the number of bicycles thrown into the rivers. Both FFBSS providers, “Ofo” and “oBike”, covered the costs for all bikes salvaged from the rivers, both past and present. Since December 2017, 26 bicycles had been removed from the “Wienfluss” river, but none needed to be removed in the months following the introduction of the new regulations. “Viadonau” suggested that this decrease might be due to both reduced usage during the winter months and the impact of the new regulations. However, two bicycles were still thrown onto subway tracks, resulting in a collision with a train (WienORF.at, 2018b). Martin Blum and the Mobility Agency Vienna were still assessing methods to control and monitor the newly introduced regulations. The goal was to ensure the complete implementation of these regulations by the beginning of June 2018 (Kickinger, 2018b).

Ultimately, the regulations for FFBSS providers became binding on the 1st of August 2018. However, prior to this, on the 9th of July 2018, “oBike” declared bankruptcy and exited the city, leaving behind 1000 bicycles. This situation led to two main problems: many users did not receive refunds for their financial deposits, and the abandoned bikes cluttered the cityscape. The City of Vienna began discussions on how to remove these bicycles, likely assigning the task to “MA48”, the municipal waste management company. City authorities aimed to collect the bicycles in August or even earlier if possible (DerStandard, 2018b). Only one day later, it was reported that the second FFBSS provider, “Ofo” from China, would also leave Vienna, marking the end of free-floating bike-sharing services in the city after just one year. “Ofo” attributed their withdrawal to the strict regulations that had been implemented. According to the provider, these new regulations made it impossible to run the system profitably (Pichler, 2018a).

4.5.1. Analysis: New regulatory measures and withdrawal of FFBSS-providers

After just one year, the free-floating bike-sharing systems (FFBSS) in Vienna withdrew, highlighting the challenges and potential of integrating such services into urban socio-technical mobility systems. Initially, FFBSS in Vienna faced minimal resistance from regime actors like

policymakers, allowing the niche to grow structurally and start competing with other mobility options. This early period of low pressure from regime resistance was partly due to FFBSS being a radical innovation, with stakeholders still learning about its behavior and impact in the transition process.

However, the emergence of problems such as vandalism and improperly parked bikes forced city authorities to act, introducing stricter regulations. These regulations increased the pressure on the FFBSS niche, making it difficult for providers to sustain their programs. The policy regime observed the process for several months, and as challenges related to FFBSS grew, city authorities had to intervene.

Ultimately, support for the socio-technical niche of FFBSS diminished. The new regulations structurally weakened the niche, making it harder for providers to scale their operations. These regulations addressed both socio-technical issues, focusing on improving the technological quality of the bikes and addressing social issues like user behaviour. This dual focus aimed to mitigate the problems generated by the niche but also made it difficult for FFBSS providers to continue operating profitably under the new constraints.

In the context of the new regulations established by the city of Vienna for FFBSS providers, it's intriguing to analyse Geels' rule network framework, which was emphasized in the theoretical section of this thesis. Geels posited that rules and institutions influence socio-technical system actors, constraining their actions and providing clear guidelines for their behaviour (Geels, 2004). Geels introduces the interplay between actors and rules, highlighting two ways in which they interact. Firstly, actors operate within the framework of rules, influencing their individual perceptions and interactions. Conversely, actors within rule networks disseminate and adapt rule sets, continually shaping the nature of rules and institutional frameworks (ibid, 2004).

Looking at the case study of Vienna, the close interaction between FFBSS providers as actors in the rule network and the regulations introduced by city authorities as rules in the rule network is evident. The behaviour and problems associated with FFBSS shaped the regulations developed by the city, while the regulations influenced the actions of FFBSS providers. Throughout the year when FFBSS providers operated in Vienna, the evaluation and evolution of regulations were consistently influenced by discourse surrounding the issues arising from FFBSS as a new socio-technical niche. Conversely, the introduced regulations decisively impacted the actions of FFBSS providers, ultimately leading to their withdrawal from Vienna.

In conclusion, the withdrawal of FFBSS as a potential niche mobility system in Vienna can be partially attributed to the interaction between rules/institutions and FFBSS providers. The problems stemming from the niche influenced the shaping of regulations, which in turn contributed to the strictness of those rules. The strict regulations, coupled with the actions of FFBSS providers, led to their withdrawal from the city. A more cooperative approach between institutions/rules and the socio-technical mobility niche of FFBSS could have potentially been beneficial for the success of the scheme. Through better communication and compromise, the needs of both parties in the transition process could have been integrated into the regulations. However, this process would have required sacrifices from both parties and more time for all actors to understand the dynamics and behaviour of FFBSS within the urban mobility system of the case study city. With more time and collaboration, FFBSS could have potentially become a successful and sustainable mobility option in Vienna.

4.6. Developments around BSS in Vienna after withdrawal of FFBSS

Following the withdrawal of private FFBSS providers in Vienna, the focus shifted to the continued presence of BSS in the city. Providers like "Donkey Republic" and "Citybike Vienna" remained active in representing the BSS niche in Vienna. The official end date for FFBSS in Vienna was declared as the 7th of August, 2018 (RTL Today, 2018). By early October 2018, over 1000 free-floating bicycles, primarily "oBikes", had been gathered from Vienna's streets. Since neither provider retrieved the bicycles, they became the possession of city authorities after two months. The authorities were then faced with the task of determining what to do with the bikes, many of which were in poor condition. Evaluation was required to ascertain whether the bicycles could be sold to private individuals or if they were too damaged for further use (Pichler, 2018b). In January 2019, approximately six months after the withdrawal of FFBSS from Vienna, the "MA48" collected 1100 free-floating bicycles. The city incurred costs for the collection and storage of these bikes. It remained uncertain whether FFBSS providers could cover the expenses associated with their removal, especially considering that "Ofo" was bankrupt and "oBike" was facing economic difficulties (Die Presse, 2019).

On the 12th of March 2020, "Donkey Republic" also ceased operations in Vienna. The decision was influenced by low user numbers and stiff competition from the public bike-sharing system, "Citybike Vienna". A misguided marketing strategy contributed to Vienna becoming an unprofitable location for the Copenhagen-based private BSS provider (WienORF.at, 2020a).

With the departure of “Donkey Republic”, only “Citybike Vienna” remained as the sole BSS provider in Vienna. However, in July 2020, the system faced challenges. Discussions between “Gewista”, the operator, and the City of Vienna centred on a subsidy of 1.1 million euros from the city to support the operation of “Citybike Wien” docking stations. Compounded by low ridership due to the COVID-19 pandemic, “Gewista” proposed closing half of the stations, particularly those in the city centre, unless financial support was provided by the city (Krutzler, 2020; WienORF.at, 2020b) With remaining subsidies, “Gewista” could potentially continue operating some stations outside the “Gürtel” street. However, politicians were already contemplating which company could take over the iconic “Citybike Vienna” scheme, the last remaining BSS in the city (WienORF.at, 2020b). In the end, the local public transport company “Wiener Linien” took over the operation from “Gewista”, with additional subsidies from the city of Vienna to run the system (WienORF.at, 2020c). This decision was reached after a political debate between the red and green political parties in Vienna. “Wiener Linien” assumed control of the system on the 29th of July 2020, and was awarded a 10-year contract to manage it (Schwarz, 2020). “Wiener Linien” aimed not only to become the new provider of the BSS but also to expand the system by adding more stations and bicycles. They were stepping into significant shoes, as “Gewista” and their “Citybike Wien” had amassed over 500,000 registered users since 2003, with over 10 million bicycle trips recorded until 2019. (Wray, 2020). In a temporary solution, city authorities again contracted “Gewista” to operate the system during the transition phase, restarting it on the 24th of August 2020. However, in 2022, a Europe-wide search for a new operator of the BSS was initiated by “Wiener Linien”. During this transition phase, “Gewista” received 1.8 million Euros per year to run the bike sharing scheme (Kurier.at, 2020). With the 10th of March 2021, the tender for a new provider of the newly named BSS “Wien Mobil Rad” officially began. According to “Wiener Linien”, the scheme was scheduled to commence operations in spring 2022 (Kurier.at, 2021; WienORF.at, 2021a). On the 8th of October 2021, an official successor to “Gewista” was announced with the internationally recognized bike-sharing company “Nextbike”: The BSS “WienMobilRad” was slated to commence operations in Vienna in April 2022, with a target of deploying 3000 bikes in the city by fall 2022, doubling the capacity of “Citybike Vienna”: “Nextbike” took charge of distribution, maintenance, and operation of the BSS. The system was designed to cover all 23 districts in Vienna, featuring 185 stations accessible round the clock. The bicycles were equipped with electronic locks and seven gears, available for rental through the “WienMobil” app by “Wiener Linien”. The service was priced at 60 cents per half-hour, with users holding a

"WienMobil" annual ticket enjoying a discounted rate of 30 cents per half-hour (Presse-Service, 2021; Puschautz, 2021; WienORF.at, 2021b).

On the 31st of March 2022, the chapter on "Citybike" officially came to a close. With 19 years of service, it stood as the most successful and enduring BSS in Austria's capital (Radlobby Wien, 2022). One day later, on the 1st of April 2022, "WienMobil Rad" was introduced, stepping into the legacy of "Citybike Wien" (Krutzler, 2022; Radlobby Wien, 2022). The BSS started with 60 stations and 1000 bicycles (Krutzler, 2022), by the end of the year, the plan was to have 200 stations and 3000 bicycles in the city (Radlobby Wien, 2022).

Unlike FFBSS like "Ofo" and "oBike", "WienMobil Rad" is a station-based or docked BSS. However, virtual stations can be utilized through the electronic locks on the bikes. Initially, the system was launched with 40 fixed stations and 20 virtual ones across the city. The project receives subsidies from the City of Vienna, which provides annual financial support of 2.3 million Euros to operate the BSS. This support is secured through a contract with "Wiener Linien" that extends until 2031 (Krutzler, 2022). "WienMobil Rad", being publicly funded, stands as the sole remaining public bike sharing scheme in the case study city.

4.7. Analysing the dynamics of FFBSS/ BSS in Vienna: Concluding remarks

With the help of media discourse analysis and a robust theoretical framework, this research has provided a comprehensive overview of the developments, mechanisms, and behaviors surrounding the niche of Free-Floating Bike Sharing Systems (FFBSS) and Bike Sharing Systems (BSS) in Vienna. The analysis has been further strengthened by examining the niche of FFBSS/BSS in the socio-technical mobility system of Vienna through the lens of the Multi-Level Perspective (MLP).

"Citybike Wien", a publicly funded docked BSS, evolved into a success story in the city over several years. In contrast, FFBSS providers from the Asian market, such as "Ofo" and "oBike", struggled to significantly impact the BSS niche within Vienna's socio-technical mobility system. The socio-technical mobility niche of FFBSS faced pressure for various reasons, including shifting regime resistance from Vienna's political authorities, which was amplified by public complaints about issues related to FFBSS. These issues pertained to both the social and technical aspects of the niche. On the social side, there was a high incidence of misuse of

the new mobility innovation. Additionally, providers failed to maintain and evaluate the behaviour of FFBSS adequately, leading to technical problems such as vandalized or broken bikes that were not repaired promptly. Due to numerous complaints from the public, Vienna's authorities imposed strict regulations on providers, intensifying the regime resistance. Ultimately, FFBSS withdrew from Austria's capital, diminishing as a potential sustainable mobility option in the city.

This analysis highlights the complex interplay between socio-technical niches and regime actors, underscoring the importance of both social and technical factors in the success or failure of innovative mobility solutions. The case of Vienna illustrates how regime resistance, driven by both public opinion and political action, can significantly impact the viability of new mobility niches, particularly when these niches face substantial operational challenges.

In the case of FFBSS in the case study city, all involved parties—providers, users, and politicians—didn't have sufficient time to fully understand how FFBSS behaves in urban mobility system transitions. The dynamics and mechanisms around these systems are new and complex, requiring more time to grasp the successful integration strategies for these schemes into urban mobility systems. This thesis' analysis presented the main developments and identified what went wrong when the city introduced the new mobility option.

The findings from this analysis can provide valuable insights for policymakers to better understand, manage, and monitor similar systems in the future. Additionally, the scientific findings from the systematic literature review, along with insights from the expert interview, offer important considerations for the successful introduction of FFBSS into urban mobility systems.

The next chapter will present the research results, combining the key findings related to FFBSS from the three methodological approaches. This comprehensive overview will further assist policymakers in Vienna in identifying the most critical factors to consider when dealing with FFBSS in the context of sustainable urban mobility transformations.

5. Results and Discussion

This section aims to synthesize the key insights gathered from the systematic literature review on Bike Sharing Systems (BSS) and Free-Floating Bike Sharing Systems (FFBSS), along with the findings from the systematic media discourse analysis. The Multi-Level-Perspective employed in analysing FFBSS developments in Vienna offers insights into the mechanisms, behaviours, and challenges inherent in integrating these systems into urban socio-technical transitions. It sheds light on how various actors interact within these systems and the challenges that arise from such integration. Drawing on additional insights from the expert interview, this chapter seeks to outline the primary outcomes derived from the three methodologies employed in this study. The findings have been categorized into six key areas deemed crucial for policymakers to consider when dealing with the implementation of FFBSS in urban mobility systems.

This serves as a comprehensive guideline for city authorities in Vienna, offering insights on how to effectively integrate FFBSS into urban mobility systems while also serving as a valuable resource for policymakers in other cities. However, it's important to note the regional specificity highlighted by the chosen case study. In the subsequent chapters, these categories will be presented, highlighting the most significant scientific findings from the three methodological approaches.

5.1. Governance/policy making of FFBSS

To begin, effective governance and policymaking are paramount when it comes to Free-Floating Bike Sharing Systems (FFBSS), particularly considering the developments observed in Vienna's mobility landscape. Governance actors played a significant role in the withdrawal of FFBSS providers from Vienna, underscoring the importance of proactive and transparent regulation. Based on insights from the systematic literature review and scientific data, it is evident that governance actors seeking to integrate FFBSS into their urban mobility systems should adopt a proactive and transparent approach to regulation. This entails maintaining flexibility in governance frameworks, allowing for agile responses to changes in the behaviour of FFBSS niches, and continuously evaluating and monitoring regulatory measures (Hauf and Douma, 2019).

Ansell and Gash emphasize the importance of close cooperation between FFBSS providers and policymakers in governing FFBSS effectively. They advocate for **"collaborative governance"** as a key approach to managing FFBSS (Ansell and Gash, 2008). In this context, collaborative governance refers to a multi-actor approach where various stakeholders, including city authorities and FFBSS providers, come together to formulate collective regulatory measures. This collaborative effort involves aggregating perspectives from different actors involved and working collectively towards a shared vision (ibid, 2008). Thus, when considering the FFBSS niche, it is crucial for city authorities to engage in close cooperation with providers to jointly and proactively govern the niche, aligning efforts towards a common goal (Laa and Emberger, 2020). To integrate FFBSS effectively into the urban mobility system, regulations need to strike a balance that satisfies all stakeholders. Collaborative governance serves as a mechanism to sustain FFBSS in the city over the long term, but it must be complemented by appropriate regulatory measures (ibid, 2020). These regulations should govern the behaviour of FFBSS providers, ensuring they do not gain a competitive advantage at the expense of public goods, such as access to public space (ibid, 2020). Cao et al. similarly advocate for collaborative governance as a crucial tool in managing FFBSS. They suggest that municipal authorities should engage not only with FFBSS providers but also with various other regulatory stakeholders within the mobility ecosystem. This includes users, academic institutions, societal actors, and related institutions involved in shaping mobility policies and practices (Cao et al., 2021). In discussions regarding collaborative governance for managing FFBSS, Ma et al. concur that the success of shared economies hinges on establishing shared motivation and a collective vision aimed at advancing urban sustainability. They emphasize the importance of collaboratively governing the mobility system to steer it in a unified direction toward sustainable urban development (Ma et al., 2018). Regarding the appropriate governance of FFBSS, a "more integrated and co-creative government business-society relationship framework, that can improve collaboration effectiveness towards urban sustainability" (ibid, 2018), must be pursued. Nikitas underscores the necessity of forging strong connections between FFBSS providers and city authorities, emphasizing the importance of collaboration to pursue shared commercial objectives (Nikitas, 2019).

In the case of Vienna, a collaborative governance approach could have potentially averted the withdrawal of FFBSS providers from the city. The regulations implemented in response to issues arising from FFBSS were perceived as one-sided, with city authorities reacting to problems without actively involving the providers in decision-making. A more cooperative

approach, allowing all stakeholders to participate in decision-making and finding compromises, could have facilitated better outcomes. Effective governance of mobility niches like FFBSS requires ongoing cooperation among stakeholders to address challenges and ensure the needs of all parties are met.

LeGall emphasized that the challenges faced by FFBSS providers in Vienna were not unique to the city. Similar issues were experienced globally, with providers facing bankruptcy and other cities grappling with the implementation of these new schemes:

"Ofo and Obike went bankrupt in the whole world, not from the regulatory measures in Vienna; they tried to occupy the whole world and they didn't get bankrupt only because of Vienna's regulations" (LeGall, 2024).

Cao et al. advocate for a comprehensive approach to regulating FFBSS, suggesting that management measures such as restrictions on problematic providers and maximum fleet size limitations be implemented. They propose that FFBSS providers should be required to publicly share bike usage data and adhere to standards for bicycle parking in urban areas (Cao et al., 2021). Access to usage data from FFBSS can serve as a regulatory tool for policymakers, offering valuable insights into the behaviour and performance of these schemes (Hauf and Douma, 2019).

In addition to collaborative governance, the effective implementation of new regulatory measures is crucial for policymakers to effectively manage FFBSS (Cao et al., 2021). Regulation of FFBSS should occur at all governmental levels, with structural settings introduced and administered in a holistic way. Local governments must remain cognizant of their responsibility in governing FFBSS effectively (ibid, 2021). Janmaat emphasizes that policymakers must prioritize qualitative and controlled management of public space when seeking to successfully integrate FFBSS into the urban mobility system (Janmaat, 2019). BSS should not have a negative impact on public spaces (ibid, 2019). Janmaat also advocates for policymakers to set maximum limits on the number of bikes per provider as part of their regulatory measures. However, providers should still retain a degree of autonomy in operating within public areas (ibid, 2019) By implementing appropriate regulations and utilizing "geofencing" technology, public areas can be effectively managed by public authorities while allowing bike-sharing systems providers to operate in a controlled yet somewhat independent manner (ibid, 2019). Laa and Emberger highlighted several additional factors that governance

actors could consider maximizing the success of bike-sharing systems. These include the cleanliness of the city, the integration of BSS into the societal culture, and the quality of the bicycles provided. Governance actors can actively influence these factors through their regulatory measures (Laa and Emberger, 2020).

In Vienna, concerns about the use of public space arose with the introduction of FFBSS, particularly due to issues such as overcrowded parking racks and blocked pedestrian pathways caused by wrongly parked bikes. In response, the city implemented strict regulations for FFBSS providers. However, this approach ultimately led to providers withdrawing from the city. A more collaborative approach to managing public space, involving compromises from all stakeholders, could have facilitated the long-term integration of FFBSS into Vienna's urban mobility system.

Nikitas also highlighted direct subsidies as a governance tool for managing FFBSS. Providers that operate responsibly and do not contribute to public space issues could be eligible for increased financial support (Nikitas, 2019). In addition, investments in cycling infrastructure by city authorities can be a way to enhance the popularity and effectiveness of bike-sharing systems in the city (ibid, 2019) Measures against vandalism and theft, along with a clear strategic approach and concept for FFBSS, are essential components for success. Cooperative measures, such as marketable partnerships, understandable terms for users, and realistic revenue prospects for providers, can further contribute to the effective governance of new bike-sharing systems (ibid, 2019). Regulative measures, such as actively integrating and connecting FFBSS/BSS with the public transport system as a valuable mobility option, can significantly contribute to the successful governance of these schemes (Cesbron and Luckhurst, 2015; Janmaat, 2019). Evaluating costs and technical needs of the system beforehand, scouting for operators to run the systems, including the operators in the planning process, and communicating with all other stakeholders involved and integrating them into the process are essential steps to successfully and sustainably integrate FFBSS into the mobility system (ibid, 2015; 2019).

Towards strategic niche management, away from regime resistance towards FFBSS:

The strategic niche management approach could have significantly improved the governance of FFBSS in Vienna. In the theoretical section of this thesis, strategic niche management is

defined as a governance method where regime structures strategically foster niche developments. Rather than solely relying on top-down governance, this approach emphasizes the inclusion of connected actors in the decision-making process, allowing them to help shape the niche's pathway.(Schot and Geels, 2008). In this context, clear expectations of the niche must be formulated in advance to attract potential partners and financial supporters (Raven, 2005). Despite this, the evolution of niches should occur by strengthening their structures to gain momentum and fostering stronger collaboration between actors involved with the niche. Through strategic niche management, policymakers can guide the behaviour of niches during transition processes (Schot and Geels, 2008). The process of niche alteration must be continuously monitored and adjusted to accommodate sudden changes within the niche. If issues arise on the technical or social side of the niche, governance actors need to incorporate these changes into the strategic management of niches (ibid, 2008).

Applying these theoretical insights to the case study of Vienna and the niche tendencies of FFBSS (Free-Floating Bike Sharing Systems) in the urban mobility system, strategic niche management could enhance collaborative governance and policymaking for FFBSS. If FFBSS providers in Vienna had initially formulated clear visions for their niche, cooperation with city authorities might have been more fruitful and enduring. Clear targets and concepts for the new mobility niche could have attracted more supporters.

Constant monitoring of the niche's behaviour and prompt adjustments for sudden changes would have been crucial. Regime actors should have focused on solving problems that FFBSS could address rather than just those it created. Collaborative and co-creative solutions could have helped FFBSS contribute to urban sustainability by addressing existing mobility issues.

Policymakers should strategically strengthen niche structures and enforce collaboration between providers, users, and policymakers. Cooperation with niche actors, continuous monitoring, and allowing time for niche growth are essential. Overall, strategic niche management, openness to niche innovations, and collaborative governance are key for successfully managing FFBSS.

5.2. Usage and user attitudes of FFBSS

Throughout the literature and the systematic media discourse analysis in this thesis, the appropriate usage of FFBSS and related user attitudes are crucial for the socio-technical niche

of FFBSS to thrive in urban mobility systems. As highlighted in the analysis, it is essential for policymakers in Vienna to focus on both the technical and social aspects of the niche, particularly how the innovation is integrated into daily mobility routines by the public. Past developments in Vienna have shown that the correct usage of FFBSS is vital for the system's success. However, the misuse of FFBSS has contributed to its decline in the city. Still, several factors mentioned in the literature can influence and improve the usage of FFBSS:

Firstly, **weather conditions** play a crucial role: favourable climatic conditions significantly increase bike-sharing usage (Lemmerer et al., 2014). Statistical data indicates that favourable weather directly correlates with higher bike-sharing usage rates (Caulfield et al., 2017). Furthermore, Campbell et al. argue that bike-sharing systems are highly sensitive to meteorological conditions. For instance, heavy rain events can lead to a significant decline in usage numbers (Campbell et al., 2016). Shen et al. do not find it surprising that factors such as rain or extreme weather events can decrease the usage of bike-sharing systems (Shen et al., 2018). Eren and Uz emphasize that other weather events, such as high temperatures, humidity, or strong winds, can also contribute to lower usage numbers (Eren and Uz, 2020). While bad weather conditions indeed decrease bike-sharing system (BSS) usage numbers, policymakers cannot directly influence this factor.

Hence, greater emphasis should be placed on factors within the control of FFBSS providers and policymakers. The **utilization of infrastructural settings** emerges as another critical consideration, as highlighted in the literature. A robust and well-developed bicycle infrastructure is imperative for the effective operation of BSS (Lemmerer et al., 2014) Fishman et al. contend that the expansion of bicycle infrastructure, particularly through the construction and modification of dedicated bike lanes, can significantly enhance the utilization of BSS (Fishman et al., 2015). The provision of cycling services and supportive infrastructure will contribute to changing BSS usage patterns (Shen et al., 2018). The density of built environments can positively impact users' perception of safety and, consequently, their usage levels (Eren and Uz, 2020).

Additionally, analysing the trip distance provides valuable insights into the intensity of BSS usage. Typically, BSS trips are short to medium in distance. Regular users often incorporate bike-sharing into their daily mobility routines (Caulfield et al., 2017). The prevalence of short-distance bike-sharing trips underscores the role of bike-sharing schemes in addressing the "first

and last mile" problem, providing a convenient solution for short-distance urban travel (Li et al., 2018). Analysing both frequent and sporadic users of bike-sharing systems, there appears to be no significant difference in trip distance and duration. Interestingly, users of both Free-Floating Bike Sharing Systems and Station-Based Bike Sharing Systems tend to become repeat users more frequently for shorter average trips (Ji et al., 2020).

Policy makers in urban mobility systems should prioritize the provision of adequate cycling infrastructure and **safety measures to address users' concerns about safety**. By ensuring safe cycling conditions, policymakers can not only boost BSS usage but also promote health benefits associated with cycling (Leister et al., 2018). Shen et al. emphasize that users' perceptions of cycling safety standards play a significant role in influencing their decision to use bike-sharing schemes (Shen et al., 2018).

Additionally, policymakers and BSS providers should monitor **usage hotspots**, which are geographic areas where bicycles are frequently utilized, such as those near public transport stations (Du et al., 2019) and MRT (Mass Rapid Transit) stations, once again emphasizing the importance of addressing "last-mile" journeys (Shen et al., 2018). Campbell et al. suggest that bike-sharing schemes, such as FFBSS, should be concentrated in densely populated areas where there is a high demand for short-distance trips (Campbell et al., 2016).
It's crucial for policymakers and FFBSS providers to not only identify where bike-sharing systems are most frequently used but also to assess when they are used. **Peak usage hours** for bike-sharing schemes typically occur during morning and evening commuting hours (Du et al., 2019). More specifically, peak usage hours for bike-sharing schemes are typically observed in the morning between 7 a.m. and 9 a.m., and in the evening from 5 p.m. to 7 p.m. (Ji et al., 2020).

Ensuring the supply of bicycles meets the demand in specific geographical areas of the city is crucial for FFBSS providers. This process, known as **rebalancing**, involves distributing bicycles to areas with higher usage density (Li et al., 2018). Providers monitor demand and usage patterns of shared bicycles, then efficiently distribute them to areas where they are in high demand, ensuring an equitable and effective allocation of resources (ibid, 2018) Ji et al. underscore the importance of **dynamic rebalancing processes** within FFBSS. They suggest equipping FFBSS users with real-time information on nearby bikes and incentivizing them to participate in rebalancing efforts by offering credit rewards (Ji et al., 2020).

The **credit system** serves as a method to reward users for their responsible behaviour within FFBSS. Users who report instances of misconduct, such as vandalism or improperly parked bikes, and actively participate in rebalancing efforts could earn credits and receive benefits as incentives. This approach aims to foster user loyalty and promote appropriate behaviour in the utilization of FFBSS (Li et al., 2018). Rewarding users who demonstrate good behaviour when using FFBSS with various benefits can incentivize positive engagement with the system. Conversely, there should be consequences for users who engage in inappropriate behaviour, such as vandalism or misuse of bikes. By implementing a system of rewards and penalties, FFBSS providers can encourage responsible usage and deter misconduct within the system. (Yin et al., 2019).
Vandalism or other misconducts in the usage of FFBSS can always "*transform successfully integrated resources into mis integrated or non-integrated resources. The misbehaviour through vandalism or appropriation usually occurs when consumers maximise their personal interests by improperly taking advantage of the firm's resources, which in turn reduces the wellbeing of other users and firms"* (ibid, 2019).

Granting rewards to well-behaving users and implementing penalties for inappropriate behaviour could have mitigated the problems caused by vandalized and wrongly parked free-floating bicycles in Vienna. Li et al. concur, emphasizing the importance of penalizing individuals who damage or vandalize free-floating bicycles. Implementing individual credit profiles, which track user behaviour and hold users accountable, could effectively mitigate these issues (Li et al., 2018).

Improving **knowledge and information on the correct usage** of FFBSS is crucial for enhancing its utilization and mitigating potential problems associated with these mobility schemes. This proactive approach can help increase awareness among users, leading to more responsible behaviour and ultimately higher usage of FFBSS (Leister et al., 2018): The lack of knowledge on how to use shared bicycles is perceived as a significant barrier for users, including both local residents and visitors in a city (ibid, 2018). Filling these knowledge gaps is therefore crucial, and leveraging social media and various forms of broadcasting can be an effective means of disseminating information to users (ibid, 2018). Increasing knowledge about the correct usage of BSS can alleviate issues related to these schemes and contribute to altering usage rates positively (ibid, 2018).

In the case study city of Vienna, FFBSS providers attempted to disseminate knowledge on the correct usage of FFBSS through methods such as information stickers on the bikes and instructional videos. However, the media discourse analysis emphasized the need for a cultural process wherein society and users continually learn about the new mobility option, gaining knowledge on appropriate usage and reducing instances of misuse (Marits, 2017). Yin et al. emphasize the significance of distinguishing between riding and post-riding practices when using free-floating bike-sharing systems. In both phases, FFBSS can either be co-destructed or co-created, indicating that positive and negative user practices during bike riding and after the completion of rides (such as locking, parking, and payment) can respectively improve or worsen BSS (Yin et al., 2019).

Moreover, the **accessibility** of shared bicycles is a crucial factor in increasing FFBSS usage. The ease of finding a bike directly correlates with the likelihood of choosing this mode of travel. If bicycles are readily available, it significantly influences usage and the propensity to make short trips (Du and Cheng, 2018). Additionally, FFBSS-providers can increase the usage of free-floating bicycles by adjusting the fleet size (Shen et al., 2018). Increasing the availability of free-floating bicycles by expanding the fleet size can lead to higher usage of FFBSS (ibid, 2018). Policymakers should regulate the fleet size to prevent the excessive presence of free-floating bikes in cities, balancing availability with avoiding overcrowding (ibid, 2018).
In the case of Vienna, the fleet size of FFBSS became problematic when providers flooded the market with an excessive number of bicycles. To address this issue, regulations were implemented to cap the fleet size at 1500 bicycles, aligning with the model of "Citybike Wien". A more collaborative approach between providers and city authorities could have facilitated finding a balanced fleet size that attracts users without overwhelming the city. However, providers may have been driven by profit motives to maximize revenue by saturating the market with bicycles.

In conclusion, the success of FFBSS hinges greatly on user behaviour, but it also relies on the guidance and regulations set forth by policymakers and FFBSS providers. Without proper guidance and support, users may engage in inappropriate behaviour, leading to negative consequences as observed in the case study city. The recommendations outlined earlier can serve as valuable guidelines for policymakers to promote correct usage of FFBSS. By fostering collaboration and addressing issues such as vandalism and improper parking, policymakers can create an environment conducive to the flourishing of FFBSS as a sustainable mobility option.

5.3. Infrastructure and technologies of FFBSS

Indeed, the findings from the various research methods underscore the critical role of infrastructure and technology in the success of FFBSS. Adequate infrastructure for bicycle traffic, including dedicated lanes and parking facilities, is essential for the smooth operation of FFBSS. Additionally, the functionality and reliability of technologies such as GPS tracking and mobile applications are crucial for ensuring the efficiency and user experience of FFBSS. Therefore, policymakers should prioritize investments in infrastructure and technology to support the sustainable integration of FFBSS into urban mobility systems.

Scholars emphasize the importance of **robust cycling infrastructure** as a cornerstone for the effective functioning of bike-sharing systems and ensuring the safety and confidence of users. This includes the provision of wide and secure cycling lanes, which are essential for facilitating smooth and safe bike journeys (Laa and Emberger, 2020). Conversely, a deficiency in adequate infrastructure for bicycle traffic can undoubtedly impede the success of bike-sharing systems (Leister et al., 2018). Furthermore, policymakers must ensure that the infrastructure settings are aligned with the actual demand of the public for shared bicycles and general bicycle traffic (Shen et al., 2018). For instance, Orvin and Fatmi highlighted that residents living in bicycle-friendly parts of a city, where safe bike lanes and cycling security are provided, are more likely to use bike-sharing systems (Orvin and Fatmi, 2021).

In addition to infrastructure such as sufficient bicycle lanes, an appropriate amount and distribution of **bicycle parking opportunities** are crucial for free-floating bike-sharing systems to function effectively (Ji et al., 2020; Laa and Emberger, 2020) Policymakers should consider building parking areas for free-floating bike-sharing bicycles around important transport nodes, such as metro stations, to meet the users' need for "last-mile" travel solutions, as mentioned earlier (Chen et al., 2019). Mindful utilization of public space when constructing new bicycle parking areas can enhance the service quality of free-floating bike-sharing systems (ibid, 2019). Vienna's commitment to adding 2000 to 3000 bicycle parking spaces annually, as per Marhl's research, suggests that accommodating additional free-floating bicycles should not pose a space issue (Marhl, 2017). In response to a shortage of bicycle parking spaces, Vienna could consider constructing new bicycle parking areas to meet the growing demand (DerStandard, 2017a). LeGall pointed out in the expert interview that repurposing car parking spaces for bicycle parking racks, including those for BSS, could alleviate the shortage. However, policymakers

must balance this approach with the need to retain support from car owners, who are influential as voters, to achieve their political objectives (LeGall, 2024).

In response to challenges such as vandalism and improper parking of free-floating bicycles, scholars suggest adopting a new approach to regulate public space: **"geo-fencing technology"**. This technology requires free-floating bicycles to be parked and returned within designated geographical areas (Yin et al., 2019). During a trial period, FFBSS providers can analyse trip data and user demand to strategically design virtual parking areas, or geo-fences. Implementing geo-fencing technologies in these areas could significantly reduce issues caused by improperly parked bicycles (Cai et al., 2023) Transitioning from completely free-floating bicycle systems to geo-fenced BSS could alleviate the challenges associated with improper parking. While this may mark a departure from the unrestricted nature of FFBSS, it offers a more controlled approach that addresses issues such as parking compliance (ibid, 2023). Laa and Emberger support the shift from FFBSS to geo-fenced BSS, seeing it as an agreement of concepts from both free-floating and station-based bike sharing systems (Laa and Emberger, 2020). In addition, geo-fenced BSS could capitalize on the advantages of both systems, while also saving costs associated with building physical docking stations and the required IT infrastructure for station-based BSS (ibid, 2020).
Gildas LeGall, from the Mobility Agency Vienna, highlighted in the expert interview the relevance of transitioning towards geo-fenced BSS. He noted that the most advanced iteration of bike-sharing in Vienna, "Wien-MobilRad", is already integrating geo-fencing technology (LeGall, 2024). In "Wien-MobilRad", physical docking stations exist, but the bicycles can already be returned in designated geo-fenced areas. This is made possible by the inclusion of electronic locks on the new bicycles, which users can operate through a smartphone application (ibid, 2024). LeGall mentioned that past issues with FFBSS providers prompted city authorities to prioritize station-based bike-sharing systems over FFBSS. This led to the implementation of docked stations as well as some geo-fenced stations in the new BSS, "WienMobil Rad" (ibid, 2024).

From the researcher's perspective, it could be crucial to gradually reduce physical docking stations in the city, allowing users to adapt to virtual parking stations while ensuring there are enough docking stations available. City authorities could closely monitor user behaviour and slowly replace physical stations with virtual geo-fencing stations, such as simple bicycle parking racks or designated parking areas. This approach could save costs for both public and

private providers, as the construction and maintenance of docked stations can be expensive. Additionally, if there is increased demand for a well-functioning geo-fencing BSS, new private bike-sharing providers could be integrated into the city's mobility system, operating under clear regulations set by city authorities in Vienna.

As emphasized by LeGall, private E-Scooter providers operating in Vienna are required to implement “geo-fencing” technology, ensuring that their scooters are returned to designated parking areas. This regulation helps manage the use of E-Scooters and prevents issues related to improper parking or obstruction of public spaces (ibid, 2024). Initially, private E-Scooter providers in Vienna operated as free-floating sharing systems, encountering similar issues as FFBSS. However, with the implementation of “geo-fencing” technology, these providers have gained convenience in rebalancing scooters. LeGall highlights the advantage for operators, as they can easily locate scooters within designated areas, saving time and resources when servicing and maintaining the system (ibid, 2024).

The presence of designated parking areas for E-Scooters in Vienna provides a valuable lesson for the management of BSS, particularly FFBSS. These marked areas serve as a practical solution for guiding users on where to park after usage, potentially mitigating issues associated with improperly parked bicycles. The concept could be extended to BSS, offering a cost-effective alternative to traditional docking stations. Furthermore, it contributes to the social aspect of the niche by educating users on proper parking etiquette, ultimately enhancing the overall experience of shared mobility in the city.

Figure 13. Parking area for E-Scooters in Vienna

LeGall suggests that FFBSS, while innovative, may not align with the current needs and challenges of urban environments. In contrast, the BSS model in Paris, with a combination of physical and virtual stations strategically placed, provides a more structured and manageable approach of bicycle sharing (ibid, 2024).

Janmaat's emphasis on **bicycle quality** underscores the importance of providing users with reliable and comfortable vehicles. Ensuring that bicycles are environmentally friendly, durable, and ergonomically designed enhances the overall experience of BSS users. This focus on quality aligns with the broader goal of promoting sustainable and enjoyable urban mobility options (Janmaat, 2019). Si et al.'s point highlights the multifaceted impact of damaged or low-quality bicycles in BSS. Not only do they represent a waste of resources, but they also contribute to user dissatisfaction (Si et al., 2019). In the case study conducted in Vienna, it was evident that the quality of bicycles directly influenced the extent of misuse, particularly in the form of vandalism (Marits, 2017). This illustrates how maintaining a high functional quality of bicycles can mitigate issues associated with the implementation of FFBSS in urban mobility systems.

Shared bicycles should not only be characterized by good quality but should also always be equipped with new technological features that make usage and operation easier. Examples of **technological advancements in FFBSS** include QR codes that explain correct usage, electronic locks, or GPS technologies that enhance the pleasure and accessibility for bike-sharing users (Yin et al., 2019). In the case study city of Vienna, the locking and unlocking of free-floating bicycles operated through a smartphone application, supported by Bluetooth connection between the bicycle and the smartphone. Free-floating bicycles were located using GPS location, which was displayed on the smartphone app (Thalhammer, 2017).

Summarizing the findings regarding infrastructural settings and technologies related to the success of FFBSS, it's evident that FFBSS, considering past challenges, may not be the optimal solution in modern urban environments. Adaptations are necessary. Implementing designated parking areas or using geo-fencing technology for bike return, without the need for physical docking stations, could significantly improve these systems. However, some form of station, whether physical, virtual, or geo-fenced, remains crucial for users to learn proper bike handling and mitigate misuse issues. A hybrid approach, combining elements of FFBSS and SBBSS, could offer the advantages of both systems while mitigating their respective drawbacks.

5.4. Operation/ maintenance of FFBSS

Ensuring the proper operation and maintenance of FFBSS is indeed critical for its success, as demonstrated by the challenges faced in Vienna. Inadequate service and maintenance teams can lead to issues such as delayed collection of vandalized or broken bicycles and inefficient

rebalancing of bikes. To improve the quality of operation and maintenance for FFBSS, several suggestions emerged from the research conducted in this thesis.

Implementing **real-time management of FFBSS** could indeed enhance its operation and effectiveness. By collecting various forms of data from FFBSS continuously and analysing this data in real-time, policymakers and operators can make informed decisions to improve the system's performance and address issues promptly (Caggiani et al., 2018). Having clear processing assessments allows operators to differentiate between well-functioning processes and emerging problems more effectively. This clarity enables them to address issues promptly and optimize the operation of BSS like FFBSS (Ricci, 2015). Evaluating data can indeed enhance transparency and visibility for BSS providers, allowing them to identify processes that either benefit or hinder bicycle-sharing systems. This information enables providers to make informed decisions and implement necessary improvements to optimize the functioning of BSS (ibid, 2015).

GPS tracking data from free-floating bicycles is indeed valuable for **monitoring trip demand** and understanding the behaviour of FFBSS within specific geographical areas. Analysing this data can provide insights into usage patterns, popular routes, and areas with high demand, allowing operators to optimize their fleet distribution and service coverage accordingly (Shen et al., 2018).

Moreover, operators should pay attention to the time-based variations in usage patterns throughout the day. This information can help them better understand peak demand periods and adjust their operations accordingly, towards efficiently **repositioning and rebalancing** bicycles to areas experiencing higher demand during specific times of the day (ibid, 2018). Redistribution and rebalancing strategies for free-floating bicycles should prioritize both the spatial and temporal demand for bicycles (Du and Cheng, 2018). FFBSS providers should integrate demand management systems based on real-time GPS data to respond promptly to current user demand (Wang et al., 2019). Monitoring live data and efficiently rebalancing free-floating bicycles should assist operators in enhancing the quality of FFBSS (ibid, 2019). Implementing such measures would not only improve the quantity of satisfied users but also enhance the attractiveness of the schemes overall (Caggiani et al., 2018).

As previously discussed, involving users in the rebalancing and repositioning of free-floating bicycles, known as **"dynamic rebalancing processes",** can simplify the operation of FFBSS for providers. This approach has been endorsed by several scholars as an effective method for addressing the challenge of rebalancing free-floating bicycles efficiently, taking into account demand and geographical context (Caggiani et al., 2018; Ji et al., 2020; Su et al., 2023).

The flexibility of **fleet size management in FFBSS**, as noted by Shen et al., contributes significantly to the success of operating such shared mobility schemes. Unlike station-based systems, FFBSS is not constrained by physical stations, allowing operators to easily expand fleet volumes without infrastructure limitations (Shen et al., 2018). Indeed, the case study in Vienna underscores the importance of regulating FFBSS fleet sizes to mitigate potential issues stemming from uncontrolled expansion. The lack of specificity regarding FFBSS in the initial regulatory framework led to problems, prompting authorities to impose a maximum limit of 1500 free-floating bicycles per provider. This measure was a response to challenges arising from misuse and highlights the necessity for tailored regulations to govern emerging mobility niches effectively.

Yin et al.'s perspective aligns with the need for governance actors to regulate fleet sizes and impose guidelines on suppliers. This proactive approach helps prevent the overcrowding of public spaces caused by an excessive number of free-floating bicycles in urban areas. By implementing such measures, policymakers can maintain a balance between promoting innovative mobility solutions and safeguarding the quality of urban environments (Yin et al., 2019).

The case study in Vienna underscores how regulatory measures, such as maximum fleet sizes, can lead to the withdrawal of FFBSS providers if compromises are not reached between policymakers and providers. In such situations, a collaborative approach is essential for controlling fleet sizes effectively. By engaging in dialogue and negotiation, policymakers and providers can find mutually agreeable solutions that address concerns about overcrowding in public spaces while still allowing for the continued operation of FFBSS. This collaborative approach ensures that the needs and interests of all stakeholders are considered, leading to more sustainable and successful implementations of FFBSS in urban environments.

Besides an appropriate fleet size management, FFBSS need to be equipped with a well-working **service, maintenance and rebalancing team**. In the context of Vienna, the FFBSS operator "oBike" had a limited service team consisting of only two workers responsible for bike

maintenance and rebalancing (Rachbauer, 2017; Radlobby Wien, 2017b). As advised by "Radlobby Wien", a service team for a FFBSS should ideally consist of more than just two workers (Radlobby Wien, 2017b). These maintenance teams should promptly collect wrongly parked free-floating bicycles and address issues such as fixing broken, damaged, or vandalized bicycles (Ma et al., 2023). Also, maintenance teams should constantly monitor trip data and rebalance bicycles in order to meet the demand of users (APA OTS, 2017). LeGall highlighted that the service team of an FFBSS should consist of 2-5 workers to handle the operation, service, and maintenance of the system (LeGall, 2024). These "operating managers", as named by LeGall, should monitor and evaluate daily the demand and travel behaviour of FFBSS users to identify possible problems and difficulties arising from the system that need to be addressed (ibid, 2024). Introducing "geo-fencing" technology simplifies the service and rebalancing of free-floating bicycles. Service teams can focus their search on designated areas for broken, vandalized, or wrongly parked bicycles, thereby saving time and effort while efficiently monitoring and rebalancing the system (ibid, 2024).

Additionally, Du and Cheng emphasize the importance of establishing **maintenance bases** where broken and vandalized free-floating bicycles can be repaired (Du and Cheng, 2018). Besides that, **mobile stations** can be established where users can report problems and provide feedback to the providers, enhancing the service quality of the schemes (ibid, 2018). Bicycles that are damaged can then be collected using GPS location data, informed by valuable user feedback (ibid, 2018). In addition to that, as seen from the regulatory measures for FFBSS providers in Vienna, establishing a maintenance hotline and a company headquarters based in Vienna can significantly improve the operation and service quality of the FFBSS (Vienna.at, 2018; WienORF.at, 2018a).

This section on the operation and maintenance of FFBSS demonstrates that operators can enhance the quality of their mobility systems through conscious and well-conceptualized operations and maintenance of free-floating bicycles. Effective operation of the system can positively influence user interaction and the general perception of FFBSS within an urban mobility system. A smooth interplay among providers, users, and policymakers, along with the ability to find compromises, can lead to a sustainable and successful future for FFBSS in Austria's capital, making it an integral part of the city's mobility network. However, it is crucial to recognize that higher maintenance and service quality will necessitate increased financial

investment in additional workers to run the system, as FFBSS is traditionally a low-budget concept.

The next and final chapter will discuss the importance of financing and subsidies for the success of FFBSS, concluding the result section of this thesis.

5.5. Financing and subsidies for FFBSS

As the final crucial pillar for the potential successful reintegration of FFBSS in Vienna, the importance of appropriate financing and subsidies for FFBSS is highlighted.

Firstly, the pricing of renting free-floating bicycles is significant. In this regard, two scholars emphasize the correlation between **bicycle trip prices** and the travel behaviour of users (Du and Cheng, 2018). If the prices for renting the bicycles are too high, this directly correlates with a significant decrease in the number of users (Politis et al., 2020). The combination of suitable cycling infrastructure along with reasonable rental prices for shared bicycles can significantly influence the success of these new systems (ibid, 2020).

To enhance the success of the scheme, governance actors and providers should collaborate on setting realistic pricing strategies, considering that affordable prices can positively impact user numbers (Du and Cheng, 2018). In that regard, the pricing strategy should always be directly linked to actual travel behaviours, demand, and the duration of trips (ibid, 2018).

As mentioned earlier, a credit system could be a win-win situation for both users and providers. This could involve offering vouchers or discount coupons to specific societal groups to encourage increased usage of FFBSS (ibid, 2018). Additionally, dynamic rebalancing challenges could be addressed by rewarding users who participate in redistributing free-floating bicycles to areas with higher demand (ibid, 2018).

Shen et al. make an interesting addition, highlighting the potential benefits of offering free bicycle rides. Providing a free trial of shared bicycles can significantly improve the perception and awareness of BSS among users and the public society. Providers offering free shared-bicycle rides could receive financial support from policymakers to ensure the success of the free trial concept (Shen et al., 2018). Fishman et al. also emphasize the importance of public subsidies in the success of BSS/FFBSS. They suggest that providers should closely monitor

which additional user groups from diverse backgrounds could be engaged to ride shared bicycles. This approach could increase user numbers, demand, and ultimately the financial revenue of the system (Fishman et al., 2015). Acquisition costs for free-floating bicycles are indeed relatively low, with each bike costing approximately 40 euros (Soriguera and Jiménez-Meroño, 2020). The low acquisition costs of free-floating bicycles allowed providers to rapidly expand their fleet size. Additionally, providers attempted to minimize expenses by employing small maintenance teams. Furthermore, FFBSS providers saved on costs by not needing to invest in expensive station infrastructure.

In the case study city, FFBSS providers attempted to maximize profits by flooding the market with cheap and low-quality bicycles while maintaining a minimal service team. However, this strategy led to problems and prompted policymakers to impose strict regulations, which ultimately proved financially burdensome for the providers. From the researcher's perspective, FFBSS providers in Vienna should receive public funding if they operate their systems responsibly and without causing significant issues. This funding could be used to enhance the quality and quantity of service teams, thereby improving the overall value of the system. Additionally, financially backed providers could offer their bicycles at lower prices or even implement a free-to-ride model for certain user groups to increase usage and public acceptance. Regulations should be developed collaboratively to avoid imposing excessive costs on providers and risking their withdrawal from the market. Geo-fencing technologies could address parking problems and reduce the burden on city authorities. The existing regulations for FFBSS should be reviewed and updated, considering the financial constraints of low-budget providers. Exploring sponsorship opportunities could also help increase the budget for FFBSS operations.

In summary, FFBSS operates on a low-budget model with affordable pricing and minimal investment in maintenance and operations. However, public financial support or private sponsorship could significantly enhance the quality and reliability of these systems. With increased funding, providers could address issues such as poor service quality, operational inefficiencies, and low-quality bicycles, leading to a more responsible and sustainable operation. City authorities in Vienna stand to benefit from a well-supported FFBSS, as it could contribute to the sustainability of the mobility system and offer cost-effective transportation options for various user groups.

6. Conclusion and Outlook

The thesis aimed to delve into the historical developments, dynamics and challenges of Free-Floating Bike Sharing Systems (FFBSS) within Vienna's sustainable mobility transformation. Additionally, it sought to elucidate the interactions between FFBSS and various regime actors, such as public authorities, over time. Given Vienna's ambitious goals for sustainable mobility, understanding regime resistance towards emerging sustainable mobility niches like FFBSS is crucial. The thesis concludes by offering potential pathways for the reintegration of FFBSS into Vienna's urban mobility system, paving the way for a successful symbiosis between innovative mobility solutions and the city's sustainability objectives.

The short-lived presence of FFBSS in Vienna was marked by significant challenges stemming from both users and operators. Issues such as vandalism, improperly parked bicycles, and inadequate maintenance plagued the system, leading to dissatisfaction among city residents and increased resistance from regulatory authorities. As a result, stringent regulations were imposed, ultimately forcing FFBSS providers to withdraw from the city. Thus, a potential sustainable niche innovation, which could have contributed to Vienna's mobility system's sustainable transformation, was diminished.

To comprehensively examine the dynamics surrounding FFBSS in sustainable mobility transformations, a mixed methods approach was employed. Firstly, a systematic literature review was conducted to synthesize existing scientific research on the topic. This provided a solid foundation of theoretical knowledge and key insights into various aspects of FFBSS. Secondly, a systematic media discourse analysis was undertaken to analyse newspaper articles categorically. This approach allowed for the gathering of real-time data and insights into the developments surrounding FFBSS in the case study city of Vienna. By examining media coverage, trends, and public perceptions, a clearer understanding of the interrelatedness between FFBSS and other actors in the mobility system was achieved. Lastly, an expert interview was conducted to gather specific and nuanced information that may not have been captured through the other methods. This qualitative approach provided valuable insights from an individual with firsthand experience and expertise connected to FFBSS, which enriching the overall analysis.

The findings from the mixed methods research approach revealed intriguing insights: amidst challenges stemming from misuse and subsequent resistance from Vienna's city authorities, leading to the withdrawal of FFBSS from the city, effective **governance and policymaking for FFBSS** are imperative: Policymakers in the case study city should prioritize collaborative governance, fostering cooperation among FFBSS providers, governance actors, and stakeholders to establish a shared vision. Regulative measures, including maximum fleet sizes, should be implemented in consultation with providers. Providers must share usage data with city authorities for better monitoring. Enhancing city cleanliness, bike quality, and promoting cycling culture can positively impact FFBSS. Policymakers should integrate FFBSS into the wider mobility system and address issues like theft and vandalism. Moving away from regime resistance, policymakers should adopt a collaborative approach, strategically managing the niche alongside providers.

Considering the case study city and the challenges arising from misuse of FFBSS, including vandalism and improper parking, promoting appropriate **usage of FFBSS** is paramount: Weather conditions, climate, and topography significantly impact the usage of FFBSS. Adequate infrastructure, including wide bike paths and sufficient parking facilities, is essential for higher usage rates. Trip distance, especially for last-mile solutions, influences usage rates. Bicycle security and safety conditions also affect usage, with inadequate safety measures hindering FFBSS uptake. Operators should focus on usage hotspots, such as public transport stations, during peak hours and incentivize users to participate in rebalancing efforts. Promoting user education on FFBSS usage through stickers or other forms of communication can enhance correct usage over time. Accessibility and availability of bikes are crucial, but fleet sizes must be regulated to match demand effectively. Overall, fostering a cultural shift towards incorporating FFBSS into daily habits takes time and effort from both operators and users.

The research results also address **infrastructure and technology improvements for FFBSS**. To enhance bike-sharing schemes, policymakers in Vienna must prioritize providing adequate bicycle parking and cycling infrastructure. Implementing geo-fencing technology can help mitigate issues with improperly parked bicycles by designating specific geographic areas for parking. Transitioning from FFBSS to geo-fenced BSS can combine the advantages of free-floating and station-based systems, reducing problems associated with bike placement while avoiding the cost of building docking stations. Geo-fencing offers benefits to operators by enabling easier identification of vandalized or damaged bicycles within designated areas,

facilitating more efficient maintenance and rebalancing efforts. Additionally, introducing bicycles with advanced technological features, such as electronic locks and GPS tracking, can enhance the overall system functionality. Policymakers should also prioritize the development of user-friendly mobile applications to improve the user experience and encourage greater adoption of bike-sharing services.

In the case study city, FFBSS providers attempted to minimize operational costs by keeping efforts for FFBSS at a minimum. However, ensuring adequate **operation and maintenance of FFBSS** is critical for the functionality of these new mobility schemes: To effectively operate and maintain FFBSS, providers should prioritize real-time management and utilize usage data for informed decision-making. By continuously monitoring usage patterns, providers can adjust bike distribution to meet demand and prevent issues like overcrowding or shortages. Implementing a maximum fleet size ensures a balance between operational efficiency and city regulations. A dedicated service and maintenance team, consisting of 2-5 members, is essential for timely repairs and rebalancing of bicycles. Additional maintenance stations can be strategically placed to address issues promptly, while mobile stations serve as user contact points for feedback and reporting. This proactive approach enhances service quality and user satisfaction, contributing to the overall success of FFBSS in Vienna.

For FFBSS to be sustainable and to enhance their service quality, **financing and subsidies for FFBSS** should be prioritized on the policy agenda of city authorities in Vienna. It is also a significant point to consider when trying to successfully reintegrate FFBSS. In that regard, the prices for bicycle trips directly connect to bike share usage, therefore providers and governance actors should discuss reasonable price strategies. With the help of a credit system, special societal groups could be motivated to use FFBSS, users which contribute to dynamic rebalancing processes could be granted through this credit system. Promoting FFBSS could be altered through free bike-share trips, which would lead to a possible raise in awareness of FFBSS-system by the local society and the users of those systems. In addition to that, FFBSS-systems could be supported by public authorities as well as private sponsors to help providers run their offer more efficiently.

The main research results outlined above contribute to understanding the dynamics surrounding FFBSS in urban sustainable mobility transformations. They also provide several potential pathways forward for policymakers in the case study city to reintegrate FFBSS into the urban

mobility system. Still, this thesis offers several **limitations**, which are crucial to recognize: Vienna's unique geography may restrict the applicability of the findings to other urban areas. Policymakers elsewhere should use caution when extrapolating these results and consider conducting additional research. Additionally, the research was conducted by a single researcher, potentially limiting the diversity of perspectives. Collaborative efforts involving multiple researchers could enhance the robustness of the findings. Furthermore, data from the literature review and other sources may have biases or limitations, such as geographic specificity. Policymakers should critically evaluate the relevance of this data to their own contexts and seek additional sources if needed.
In summary, while the research offers valuable insights into FFBSS dynamics, policymakers should be mindful of these limitations when applying the findings to other settings.

Future research endeavours in this area could emphasize the current relevance of the issue and its evolving demands and contexts. Researchers must acknowledge that these emerging mobility niches are in a state of constant evolution, necessitating ongoing assessment and monitoring. Additionally, scholars might explore the possibility of comparing studies on FFBSS in Vienna with research conducted in other cities to gain a broader understanding of the topic. However, such comparisons should be approached with caution, considering the unique characteristics and circumstances of Vienna.

This thesis has illuminated the dynamics, developments, and challenges of Free-Floating Bike-Sharing Systems (FFBSS) in sustainable urban mobility transformations. The initial implementation of this new sustainable mobility niche did not proceed as planned; misuse led to changes in the perceived regime resistance towards the niche from public authorities in the case study city. Despite these challenges, the research findings and suggested pathways for reintegrating the niche indicate that FFBSS, or adapted geo-fenced bike-sharing systems, hold significant potential to contribute to sustainable urban mobility in Vienna and to help achieve ambitious sustainability goals in the sector.

Bibliography

Abson, D.J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., Von Wehrden, H., Abernethy, P., Ives, C.D., Jager, N.W., Lang, D.J., 2017. Leverage points for sustainability transformation. Ambio 46, 30–39. https://doi.org/10.1007/s13280-016-0800-y

Ansell, C., Gash, A., 2008. Collaborative Governance in Theory and Practice. J. Public Adm. Res. Theory 18, 543–571. https://doi.org/10.1093/jopart/mum032

APA OTS, 2017. Weltweit größter stationsfreier Bike-Sharing-Anbieter „ofo“ startet in Österreich [WWW Document]. OTS.at. URL https://www.ots.at/presseaussendung/OTS_20170825_OTS0074/weltweit-groesster-stationsfreier-bike-sharing-anbieter-ofo-startet-in-oesterreich-bild (accessed 2.27.24).

Brandt Di-Maio, C., 2018. Gewista | Jubiläumsjahr 2018: Citybike Wien feiert 15-jähriges Bestehen [WWW Document]. URL https://web.archive.org/web/20180410135757/http:/gewista.at/DE/Presse/Pressemeldungen/2018/180205/Jubil%C3%A4umsjahr+2018+Citybike+Wien+feiert+15+j%C3%A4hrig.aspx (accessed 1.11.24).

Brereton, P., Kitchenham, B.A., Budgen, D., Turner, M., Khalil, M., 2007. Lessons from applying the systematic literature review process within the software engineering domain. J. Syst. Softw. 80, 571–583. https://doi.org/10.1016/j.jss.2006.07.009

Burns, N., & Grove, S. K., 1993. The practice of nursing research. Conduct Critique Util.

BVZ, 2017. Ofo stockt Flotte in Wien deutlich auf [WWW Document]. URL https://m.bvz.at/in-ausland/bike-sharing-anbieter-ofo-stockt-flotte-in-wien-deutlich-auf-china-rad-verkehrsinfo-wien-62057593 (accessed 27.2.24).

Caggiani, L., Camporeale, R., Ottomanelli, M., Szeto, W.Y., 2018. A modeling framework for the dynamic management of free-floating bike-sharing systems. Transp. Res. Part C Emerg. Technol. 87, 159–182. https://doi.org/10.1016/j.trc.2018.01.001

Cai, Y., Ong, G.P., Meng, Q., 2023. Bicycle sharing station planning: From free-floating to geo-fencing. Transp. Res. Part C Emerg. Technol. 147, 103990. https://doi.org/10.1016/j.trc.2022.103990

Campbell, A.A., Cherry, C.R., Ryerson, M.S., Yang, X., 2016. Factors influencing the choice of shared bicycles and shared electric bikes in Beijing. Transp. Res. Part C Emerg. Technol. 67, 399–414. https://doi.org/10.1016/j.trc.2016.03.004

Cao, J., Prior, J., Moutou, C., 2021. The governance of dockless bike-sharing schemes: A systemic review of peer-reviewed academic journal papers between 2016 and 2019. Clean. Eng. Technol. 4, 100140. https://doi.org/10.1016/j.clet.2021.100140

Cao, Y., Shen, D., 2019. Contribution of shared bikes to carbon dioxide emission reduction and the economy in Beijing. Sustain. Cities Soc. 51, 101749. https://doi.org/10.1016/j.scs.2019.101749

Caulfield, B., O’Mahony, M., Brazil, W., Weldon, P., 2017. Examining usage patterns of a bike-sharing scheme in a medium sized city. Transp. Res. Part Policy Pract. 100, 152–161. https://doi.org/10.1016/j.tra.2017.04.023

Cesbron, S., Luckhurst, S., 2015. Public Bike Sharing.

Chen, J., Zhang, Y., Zhang, R., Cheng, X., Yan, F., 2019. Analyzing users' attitudes and behavior of free-floating bike sharing: an investigating of Nanjing. Transp. Res. Procedia 39, 634–645. https://doi.org/10.1016/j.trpro.2019.06.065

Chen, Z., Van Lierop, D., Ettema, D., 2020. Dockless bike-sharing systems: what are the implications? Transp. Rev. 40, 333–353. https://doi.org/10.1080/01441647.2019.1710306

Cohen, A., Shaheen, S., 2018. PLANNING FOR SHARED MOBILITY. https://doi.org/10.7922/G2NV9GDD

Davis, M.C., Challenger, R., Jayewardene, D.N.W., Clegg, C.W., 2014. Advancing socio-technical systems thinking: A call for bravery. Appl. Ergon. 45, 171–180. https://doi.org/10.1016/j.apergo.2013.02.009

DeMaio, P., 2009. Bike-sharing: History, Impacts, Models of Provision, and Future. J. Public Transp. 12, 41–56. https://doi.org/10.5038/2375-0901.12.4.3

DerStandard, 2003a. Einstiger Stadtrad-Betreiber "Viennabike" geht in Konkurs [WWW Document]. Stand. URL https://www.derstandard.at/story/1255177/einstiger-stadtrad-betreiber-viennabike-geht-in-konkurs (accessed 23.2.24).

DerStandard, 2003b. "Viennabike" wird "Vienna Citybike" [WWW Document]. Stand. URL https://www.derstandard.at/story/1199078/viennabike-wird-vienna-citybike (accessed 23.2.24).

DerStandard, 2012. Das Ziel ist Verdichtung [WWW Document]. URL https://www.derstandard.at/story/1326502997045/das-citybike-wien-system-das-ziel-ist-verdichtung (accessed 24.2.24).

DerStandard, 2017a. Fahrrad-Start-up legt in Wien los: Zwist mit Platzhirsch Citybike [WWW Document]. Stand. URL https://www.derstandard.at/story/2000059832664/fahrrad-start-up-startet-in-wien-stellplatzstzwist-mit-platzhirsch-citybike (accessed 26.2.24).

DerStandard, 2017b. Bikesharing: Wien plant verbindliche Regeln für Anbieter [WWW Document]. Stand. URL https://www.derstandard.at/story/2000066743778/bike-sharing-wien-plant-verbindliche-regeln-fuer-anbieter (accessed 27.2.24).

DerStandard, 2018a. Leihfahrradanbieter O-Bike zieht 800 Räder aus Wien ab [WWW Document]. Stand. URL https://www.derstandard.at/story/2000076940817/leihfarradanbieter-obike-zieht-800-raeder-aus-wien-ab (accessed 1.3.24).

DerStandard, 2018b. Obike angeblich vor Pleite, tausend "herrenlose" Fahrräder in Wien [WWW Document]. Stand. URL https://www.derstandard.at/story/2000083096681/obike-angeblich-vor-pleite-tausend-herrenlose-fahrraeder-in-wien (accessed 1.3.24).

Diao, M., Song, K., Shi, S., Zhu, Y., Liu, B., 2023. The environmental benefits of dockless bike sharing systems for commuting trips. Transp. Res. Part Transp. Environ. 124, 103959. https://doi.org/10.1016/j.trd.2023.103959

Die Presse, 2017a. Neue Leihräder: Konflikt bei den Fahrradständern | DiePresse.com [WWW Document]. URL https://www.diepresse.com/5280611/neue-leihraeder-konflikt-bei-den-fahrradstaendern?ref=reco_a_packages (accessed 2.27.24).

Die Presse, 2017b. Bike-Sharing-Anbieter Ofo stockt Flotte in Wien deutlich auf [WWW Document]. Presse. URL https://www.diepresse.com/5293024/bike-sharing-anbieter-ofo-stockt-flotte-in-wien-deutlich-auf (accessed 27.2.24).

Die Presse, 2019. Die gelben Räder sind aus Wien verschwunden [WWW Document]. Presse. URL https://www.diepresse.com/5293030/die-gelben-raeder-sind-aus-wien-verschwunden (accessed 4.3.24).

Diewald, F., Krutzler, D., 2017. Zahl der Leihräder in Wien steigt rasant: Ofo startet mit 200 Bikes [WWW Document]. Stand. URL https://www.derstandard.at/story/2000063148266/zahl-der-leihraeder-in-wien-steigt-rasant-ofo-startet-mit (accessed 27.2.24).

Du, M., Cheng, L., 2018. Better Understanding the Characteristics and Influential Factors of Different Travel Patterns in Free-Floating Bike Sharing: Evidence from Nanjing, China. Sustainability 10, 1244. https://doi.org/10.3390/su10041244

Du, Y., Deng, F., Liao, F., 2019. A model framework for discovering the spatio-temporal usage patterns of public free-floating bike-sharing system. Transp. Res. Part C Emerg. Technol. 103, 39–55. https://doi.org/10.1016/j.trc.2019.04.006

Eren, E., Uz, V.E., 2020. A review on bike-sharing: The factors affecting bike-sharing demand. Sustain. Cities Soc. 54, 101882. https://doi.org/10.1016/j.scs.2019.101882

European Environment Agency, 2024. Transport and mobility [WWW Document]. URL https://www.eea.europa.eu/en/topics/in-depth/transport-and-mobility (accessed 9.6.24).

Farla, J., Markard, J., Raven, R., Coenen, L., 2012. Sustainability transitions in the making: A closer look at actors, strategies and resources. Technol. Forecast. Soc. Change 79, 991–998. https://doi.org/10.1016/j.techfore.2012.02.001

Fastenrath, S., Braun, B., 2018. Ambivalent urban sustainability transitions: Insights from Brisbane's building sector. J. Clean. Prod. 176, 581–589. https://doi.org/10.1016/j.jclepro.2017.12.134

Fellnhofer, B., 2017. Bikesharing: Fragen, die sich Wien zum Markteintritt der Fahrradverleiher Ofo und oBike stellen sollte [WWW Document]. URL https://www.trendingtopics.eu/bikesharing-ofo-obike-wien/ (accessed 27.2.24).

Fishman, E., 2016. Bikeshare: A Review of Recent Literature. Transp. Rev. 36, 92–113. https://doi.org/10.1080/01441647.2015.1033036

Fishman, E., Washington, S., Haworth, N., Watson, A., 2015. Factors influencing bike share membership: An analysis of Melbourne and Brisbane. Transp. Res. Part Policy Pract. 71, 17–30. https://doi.org/10.1016/j.tra.2014.10.021

Ford, A., Newell, P., 2021. Regime resistance and accommodation: Toward a neo-Gramscian perspective on energy transitions. Energy Res. Soc. Sci. 79, 102163. https://doi.org/10.1016/j.erss.2021.102163

Fuller, D., Gauvin, L., Kestens, Y., Morency, P., Drouin, L., 2013. The potential modal shift and health benefits of implementing a public bicycle share program in Montreal, Canada. Int. J. Behav. Nutr. Phys. Act. 10, 66. https://doi.org/10.1186/1479-5868-10-66

Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems. Res. Policy 33, 897–920. https://doi.org/10.1016/j.respol.2004.01.015

Geels, F.W., 2014. Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective. Theory Cult. Soc. 31, 21–40. https://doi.org/10.1177/0263276414531627

Geels, F.W., Schot, J., 2007. Typology of sociotechnical transition pathways. Res. Policy 36, 399–417. https://doi.org/10.1016/j.respol.2007.01.003

Geels, F.W., Schot, J., 2010. The Dynamics of Transitions.

Giddens, A., 1984. The Constitution of Society. Polity Press, Oxford.

Goodman, R., 2005. Whatever You Call It, Just Don't Think of Last-Mile Logistics, Last. Glob. Logist. Supply Chain Strateg. 1–6.

Gramsci, A., 1971. Selections from the prison notebooks of Antonio Gramsci. International Publishers, New York, NY.

Gu, T., Kim, I., Currie, G., 2019. To be or not to be dockless: Empirical analysis of dockless bikeshare development in China. Transp. Res. Part Policy Pract. 119, 122–147. https://doi.org/10.1016/j.tra.2018.11.007

Hansen, T., Coenen, L., 2015. The geography of sustainability transitions: Review, synthesis and reflections on an emergent research field. Environ. Innov. Soc. Transit. 17, 92–109. https://doi.org/10.1016/j.eist.2014.11.001

Hauf, A., Douma, F., 2019. Governing Dockless Bike Share: Early Lessons for Nice Ride Minnesota. Transp. Res. Rec. J. Transp. Res. Board 2673, 419–429. https://doi.org/10.1177/0361198119845651

Hommels, A., Peters, P., & Bijker, W. E., 2007. Techno therapy or nurtured niches? Technology studies and the evaluation of radical innovations. Research Policy, 36(7), 1088–1099.

Hsu, C.-C., Liou, J.J.H., Lo, H.-W., Wang, Y.-C., 2018. Using a hybrid method for evaluating and improving the service quality of public bike-sharing systems. J. Clean. Prod. 202, 1131–1144. https://doi.org/10.1016/j.jclepro.2018.08.193

Imlinger, C., 2017. "Billig-Leihräder in Wien": Invasionsstopp und... [WWW Document]. Presse. URL https://www.diepresse.com/5317602/billig-leihraeder-in-wien-invasionsstopp-und-charmeoffensive (accessed 28.2.24).

Janmaat, Y., 2019. Governance of Dockless Bicycle Sharing.

Ji, Y., Ma, X., He, M., Jin, Y., Yuan, Y., 2020. Comparison of usage regularity and its determinants between docked and dockless bike-sharing systems: A case study in Nanjing, China. J. Clean. Prod. 255, 120110. https://doi.org/10.1016/j.jclepro.2020.120110

Kickinger, H., 2018a. OBike zieht 800 Leihräder ab [WWW Document]. URL https://wien.orf.at/v2/news/stories/2903570/ (accessed 1.3.24).

Kickinger, H., 2018b. Fixe Regeln für Leihräder „ab Juni" [WWW Document]. URL https://wien.orf.at/v2/news/stories/2911845/ (accessed 1.3.24).

Kitchenham, B., & Charters, S., 2007. Guidelines for Performing Systematic Literature Reviews in Software Engineering. EBSE Technical Report, Software Engineering Group, School of Computer Science and Mathematics, Keele University, Department of Computer Science, University of Durham.

Kivimaa, P., Kern, F., 2016. Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. Res. Policy 45, 205–217. https://doi.org/10.1016/j.respol.2015.09.008

Kleine Zeitung, 2017. Kosten- und Stationslos: Chinesischer Bike-Sharing-Anbieter Ofo in Wien gelandet [WWW Document]. URL https://www.kleinezeitung.at/oesterreich/5274748/Kosten-und-Stationslos_Chinesischer-BikeSharingAnbieter-Ofo-in (accessed 27.2.24).

Köhler, J., Whitmarsh, L., Nykvist, B., Schilperoord, M., Bergman, N., Haxeltine, A., 2009. A transitions model for sustainable mobility. Ecol. Econ. 68, 2985–2995. https://doi.org/10.1016/j.ecolecon.2009.06.027

Krutzler, D., 2020. Wiens Citybike-System vor dem Aus: Hälfte der Stationen wird abgebaut [WWW Document]. Stand. URL https://www.derstandard.at/story/2000118624425/wiens-citybike-system-vor-dem-aus-haelfte-der-stationen-wird (accessed 4.3.24).

Krutzler, D., 2022. Citybikes werden ab Freitag von Wien-Mobil-Rad abgelöst [WWW Document]. Stand. URL https://www.derstandard.at/story/2000134574110/citybikes-werden-ab-freitag-von-wien-mobil-rad-abgeloest (accessed 5.3.24).

Kurier.at, 2020. Die Wiener Citybikes gehen wieder in Betrieb [WWW Document]. URL https://kurier.at/chronik/wien/die-wiener-citybikes-gehen-wieder-in-betrieb/401009582 (accessed 4.3.24).

Kurier.at, 2021. Betreiber von Bikesharing-Netz WienMobil Rad ausgeschrieben [WWW Document]. URL https://kurier.at/chronik/wien/betreiber-von-bikesharing-netz-wienmobil-rad-ausgeschrieben/401213481 (accessed 5.3.24).

Laa, B., Emberger, G., 2020. Bike sharing: Regulatory options for conflicting interests – Case study Vienna. Transp. Policy 98, 148–157. https://doi.org/10.1016/j.tranpol.2020.03.009

Laporte, G., Meunier, F., Wolfler Calvo, R., 2018. Shared mobility systems: an updated survey. Ann. Oper. Res. 271, 105–126. https://doi.org/10.1007/s10479-018-3076-8

Leister, E.H., Vairo, N., Sims, D., Bopp, M., 2018. Understanding bike share reach, use, access and function: An exploratory study. Sustain. Cities Soc. 43, 191–196. https://doi.org/10.1016/j.scs.2018.08.031

Lemmerer, H., Shibayama, T., Brezina, T., 2014. Ten years of bike-sharing in Vienna - An exploration into subjective user choices. https://doi.org/10.13140/2.1.2360.7045

Li, X., Zhang, Y., Sun, L., Liu, Q., 2018. Free-Floating Bike Sharing in Jiangsu: Users' Behaviors and Influencing Factors. Energies 11, 1664. https://doi.org/10.3390/en11071664

Lie, M., & Sørensen, K. H. (Eds.)., 1996. Making Technology Our Own: Domesticating Technology into Everyday Life. Scandinavian University Press, Oslo.

Link, C., Strasser, C., Hinterreiter, M., 2020. Free-floating bikesharing in Vienna – A user behaviour analysis. Transp. Res. Part Policy Pract. 135, 168–182. https://doi.org/10.1016/j.tra.2020.02.020

Lockwood, M., Mitchell, C., Hoggett, R., 2019. Unpacking 'regime resistance' in low-carbon transitions: The case of the British Capacity Market. Energy Res. Soc. Sci. 58, 101278. https://doi.org/10.1016/j.erss.2019.101278

Luo, H., Kou, Z., Zhao, F., Cai, H., 2019. Comparative life cycle assessment of station-based and dock-less bike sharing systems. Resour. Conserv. Recycl. 146, 180–189. https://doi.org/10.1016/j.resconrec.2019.03.003

Lv, G., Zheng, S., Chen, H., 2024. Spatiotemporal assessment of carbon emission reduction by shared bikes in Shenzhen, China. Sustain. Cities Soc. 100, 105011. https://doi.org/10.1016/j.scs.2023.105011

Lynn, G. S., Morone, J. G., & Paulson, A. S., 1996. Marketing and discontinuous innovation: the probe and learn process. California Management Review, 38, 8-37.

Ma, X., Zhang, S., Wu, T., Yang, Y., Yu, J., 2023. Can dockless and docked bike-sharing substitute each other? Evidence from Nanjing, China. Renew. Sustain. Energy Rev. 188, 113780. https://doi.org/10.1016/j.rser.2023.113780

Ma, Y., Lan, J., Thornton, T., Mangalagiu, D., Zhu, D., 2018. Challenges of collaborative governance in the sharing economy: The case of free-floating bike sharing in Shanghai. J. Clean. Prod. 197, 356–365. https://doi.org/10.1016/j.jclepro.2018.06.213

Machado, C., De Salles Hue, N., Berssaneti, F., Quintanilha, J., 2018. An Overview of Shared Mobility. Sustainability 10, 4342. https://doi.org/10.3390/su10124342

Macioszek, E., Świerk, P., Kurek, A., 2020. The Bike-Sharing System as an Element of Enhancing Sustainable Mobility—A Case Study based on a City in Poland. Sustainability 12, 3285. https://doi.org/10.3390/su12083285

Malina, M.A., Nørreklit, H.S.O., Selto, F.H., 2011. Lessons learned: advantages and disadvantages of mixed method research. Qual. Res. Account. Manag. 8, 59–71. https://doi.org/10.1108/11766091111124702

Marhl, J., 2017. Fahrrad-Start-up breitet sich in Wien aus [WWW Document]. URL https://wien.orf.at/v2/news/stories/2839577/ (accessed 26.2.24).

Marits, M., 2017. Wie viele Leihräder verträgt Wien? [WWW Document]. Presse. URL https://www.diepresse.com/5320881/wie-viele-leihraeder-vertraegt-wien (accessed 28.2.24).

Markard, J., Geels, F.W., Raven, R., 2020. Challenges in the acceleration of sustainability transitions. Environ. Res. Lett. 15, 081001. https://doi.org/10.1088/1748-9326/ab9468

Mateo-Babiano, I., Kumar, S., Mejia, A., 2017. Bicycle sharing in Asia: a stakeholder perception and possible futures. Transp. Res. Procedia 25, 4966–4978. https://doi.org/10.1016/j.trpro.2017.05.375

McGregor, D., 1960. The Human Side of Enterprise. McGraw-Hill.

Midgley, P., 2009. The Role of Smart Bike-sharing Systems in Urban Mobility.

Mobilitätsagentur Wien, F., 2023. Drei Viertel der Wiener:innen klimafreundlich unterwegs [WWW Document]. Fahrrad Wien. URL https://www.fahrradwien.at/2023/03/24/klimafreundlich-unterwegs/ (accessed 11.1.24).

Mobilitätsagentur Wien., 2023. Über uns. Available at: https://www.mobilitaetsagentur.at/ueber-uns/ (Accessed: 21.2.2024).

Moon-Miklaucic, C., Bray-Sharpin, A., Maassen, A., 2019. THE EVOLUTION OF BIKE SHARING: 10 QUESTIONS ON THE EMERGENCE OF NEW TECHNOLOGIES, OPPORTUNITIES, AND RISKS.

Nieuwesteeg, T., 2018. Dockless bikes promise the future of transportation, but litter the city of Dallas.

Nikitas, A., 2019. How to Save Bike-Sharing: An Evidence-Based Survival Toolkit for Policy-Makers and Mobility Providers. Sustainability 11, 3206. https://doi.org/10.3390/su11113206

Okoli, C., & Schabram, K., 2010. A Guide to Conducting a Systematic Literature Review of Information Systems Research. Sprouts: Working Papers on Information Systems, 10(26).

ORF Wien, 2018. Strenge Regeln für Leihräder fix [WWW Document]. URL https://wien.orf.at/v2/news/stories/2899096/ (accessed 11.1.24).

Orvin, M.M., Fatmi, M.R., 2021. Why individuals choose dockless bike sharing services? Travel Behav. Soc. 22, 199–206. https://doi.org/10.1016/j.tbs.2020.10.001

Otero, I., Nieuwenhuijsen, M.J., Rojas-Rueda, D., 2018. Health impacts of bike sharing systems in Europe. Environ. Int. 115, 387–394. https://doi.org/10.1016/j.envint.2018.04.014

Petticrew, M., & Roberts, H., 2006. Systematic Reviews in the Social Sciences: A Practical Guide. Oxford: Blackwell.

Pichler, G., 2018a. Nach Obike zieht sich auch Fahrrad-Start-up Ofo aus Wien zurück [WWW Document]. Stand. URL https://www.derstandard.at/story/2000083194335/nach-obike-fahrrad-start-up-ofo-verlaesst-wien (accessed 1.3.24).

Pichler, G., 2018b. Obike-Fiasko: 1.000 Räder in Wien eingesammelt, Schicksal unklar [WWW Document]. Stand. URL https://www.derstandard.at/story/2000088574349/obike-fiasko-1-000-raeder-in-wien-eingesammelt-schicksal-unklar (accessed 4.3.24).

Ploeger, J., Oldenziel, R., 2020. The sociotechnical roots of smart mobility: Bike sharing since 1965. J. Transp. Hist. 41, 134–159. https://doi.org/10.1177/0022526620908264

Pojani, D., Chen, J., Mateo-Babiano, I., Bean, R., Corcoran, J., 2020. Docked and dockless public bike-sharing schemes: research, practice and discourse, in: Curtis, C. (Ed.), Handbook of Sustainable Transport. Edward Elgar Publishing. https://doi.org/10.4337/9781789900477.00025

Politis, I., Fyrogenis, I., Papadopoulos, E., Nikolaidou, A., Verani, E., 2020. Shifting to Shared Wheels: Factors Affecting Dockless Bike-Sharing Choice for Short and Long Trips. Sustainability 12, 8205. https://doi.org/10.3390/su12198205

Poliziani, C., Schweizer, J., Rupi, F., 2022. Supply and Demand Analysis of a Free Floating Bike Sharing System. Commun. - Sci. Lett. Univ. Zilina 24, A53–A65. https://doi.org/10.26552/com.C.2022.2.A53-A65

Presse Service Stadt Wien, 2003. Archivmeldung: Montag, 19. Mai: Startschuss für Probebetrieb der City Bikes Wien [WWW Document]. Press. Stadt Wien. URL https://presse.wien.gv.at/presse/2003/05/15/montag-19-mai-startschuss-fuer-probebetrieb-der-city-bikes-wien (accessed 23.2.24).

Presse-Service, 2021. Archivmeldung: Ab 2022 3.000 WienMobil Räder in der ganzen Stadt [WWW Document]. Press. Stadt Wien. URL https://presse.wien.gv.at/presse/2021/10/08/ab-2022-3-000-wienmobil-raeder-in-der-ganzen-stadt (accessed 5.3.24).

Puschautz, A., 2021. Citybike wird zu WienMobil Rad und expandiert mit neuem Betreiber [WWW Document]. URL https://kurier.at/chronik/wien/citybike-wird-zu-wienmobil-rad-und-expandiert-mit-neuem-betreiber/401763060 (accessed 5.3.24).

Rachbauer, S., 2017. oBike-Start in Wien: Private Konkurrenz für Citybike rollt an [WWW Document]. URL https://kurier.at/chronik/wien/obike-start-in-wien-private-konkurrenz-fuer-citybike-rollt-an/279.873.061 (accessed 27.2.24).

Radlobby Wien, 2017a. Neue Leihradsysteme kommen: Flut oder Segen? [WWW Document]. Radlobby. URL https://www.radlobby.at/wien/neue-leihradsysteme-kommen-flut-oder-segen (accessed 26.2.24).

Radlobby Wien, 2017b. Leihradsysteme: Verbesserungen und Ausweitungen von oBike [WWW Document]. Radlobby. URL https://www.radlobby.at/oesterreich/leihradsysteme-verbesserungen-und-ausweitungen-von-obike (accessed 28.2.24).

Radlobby Wien, 2022. WienMobil Rad ersetzt Citybike [WWW Document]. Radlobby. URL https://www.radlobby.at/wien-mobil-rad (accessed 5.3.24).

Raven, R. P. J. M., 2005. Strategic Niche Management for Biomass. A Comparative Study on the Experimental Introduction of Bioenergy Technologies in the Netherlands and Denmark. Ph.D. Thesis, Eindhoven University of Technology, Eindhoven, The Netherlands.

Raven, R., Weterings, R., Van den Boesch, S., 2007. Strategic Niche Management and Transition Experiments: From analytical tool to a competence kit for practitioners.

Ricci, M., 2015. Bike sharing: A review of evidence on impacts and processes of implementation and operation. Res. Transp. Bus. Manag. 15, 28–38. https://doi.org/10.1016/j.rtbm.2015.03.003

Rip, A., & Kemp, R., 1998. Technological change. In S. Rayner & E. L. Malone (Eds.), Human Choice and Climate Change (Vol. 2, pp. 327–399). Battelle Press, Columbus, OH.

Rottenberg, T., 2014. Citybike: Lernen Sie Geschichte ... [WWW Document]. Stand. URL https://www.derstandard.at/story/1389858742502/lernen-sie-geschichte- (accessed 11.1.24).

RTL Today, 2018. Vienna declares victory in war on dockless bikes [WWW Document]. URL https://today.rtl.lu/news/business-and-tech/a/1220692.html (accessed 4.3.24).

Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technol. Anal. Strateg. Manag. 20, 537–554. https://doi.org/10.1080/09537320802292651

Schwarz, C., 2020. Wiener Linien retten die Citybikes [WWW Document]. URL https://kurier.at/chronik/wien/wiener-linien-uebernehmen-citybikes/400985459 (accessed 4.3.24).

Shen, Y., Zhang, X., Zhao, J., 2018. Understanding the usage of dockless bike sharing in Singapore. Int. J. Sustain. Transp. 12, 686–700. https://doi.org/10.1080/15568318.2018.1429696

Si, H., Shi, J., Wu, G., Chen, J., Zhao, X., 2019. Mapping the bike sharing research published from 2010 to 2018: A scientometric review. J. Clean. Prod. 213, 415–427. https://doi.org/10.1016/j.jclepro.2018.12.157

Siddiqi, A., Collins, R.D., 2017. Sociotechnical systems and sustainability: current and future perspectives for inclusive development. Curr. Opin. Environ. Sustain. 24, 7–13. https://doi.org/10.1016/j.cosust.2017.01.006

Soriguera, F., Jiménez-Meroño, E., 2020. A continuous approximation model for the optimal design of public bike-sharing systems. Sustain. Cities Soc. 52, 101826. https://doi.org/10.1016/j.scs.2019.101826

Su, S., Yu, H., Xiong, D., Dong, X., 2023. A multiobjective dynamic rebalancing evolutionary algorithm for free-floating bike sharing. Appl. Soft Comput. 147, 110696. https://doi.org/10.1016/j.asoc.2023.110696

Sun, S., Ertz, M., 2021. Contribution of bike-sharing to urban resource conservation: The case of free-floating bike-sharing. J. Clean. Prod. 280, 124416. https://doi.org/10.1016/j.jclepro.2020.124416

Thalhammer, A., 2017. Bike-Sharing: Chinesische Leihräder für Wien [WWW Document]. Presse. URL https://www.diepresse.com/5258280/bike-sharing-chinesische-leihraeder-fuer-wien (accessed 27.2.24).

Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B., Van Vuuren, D., 2015. Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. Glob. Environ. Change 35, 239–253. https://doi.org/10.1016/j.gloenvcha.2015.08.010

Vienna City Administration, 2015. STEP 2025 Urban Mobility Plan Vienna; Short Report.

Vienna.at, 2018. Stadt Wien führt strengere Regelungen für stationslose Leihräder ein [WWW Document]. vienna.at. URL https://www.vienna.at/stadt-wien-fuehrt-strengere-regelungen-fuer-stationslose-leihraeder-ein/5693949 (accessed 29.2.24).

Wang, J., Huang, J., Dunford, M., 2019. Rethinking the Utility of Public Bicycles: The Development and Challenges of Station-Less Bike Sharing in China. Sustainability 11, 1539. https://doi.org/10.3390/su11061539

WienORF.at, 2017a. Fixe Regeln für Leihräder kommen [WWW Document]. URL https://wien.orf.at/v2/news/stories/2874603/ (accessed 27.2.24).

WienORF.at, 2017b. Stadt Wien überlegt Gebühr für Radverleiher [WWW Document]. URL https://wien.orf.at/v2/news/stories/2881883/ (accessed 29.2.24).

WienORF.at, 2017c. O-Bike auf U-Bahn-Gleise geworfen: Kollision [WWW Document]. URL https://wien.orf.at/v2/news/stories/2883463/ (accessed 29.2.24).

WienORF.at, 2017d. Ofo reduziert „Winterflotte“ massiv [WWW Document]. URL https://wien.orf.at/v2/news/stories/2885243/ (accessed 29.2.24).

WienORF.at, 2018a. Strenge Regeln für Leihräder fix [WWW Document]. URL https://wien.orf.at/v2/news/stories/2899096/ (accessed 29.2.24).

WienORF.at, 2018b. Weniger Leihräder landen im Wienfluss [WWW Document]. URL https://wien.orf.at/v2/news/stories/2909237/ (accessed 1.3.24).

WienORF.at, 2020a. Leihrad-Anbieter Donkey Republic verlässt Wien [WWW Document]. wien.ORF.at. URL https://wien.orf.at/stories/3038604/ (accessed 4.3.24).

WienORF.at, 2020b. Hälfte der Citybike-Stationen fällt weg [WWW Document]. wien.ORF.at. URL https://wien.orf.at/stories/3057416/ (accessed 4.3.24).

WienORF.at, 2020c. Wiener Linien übernehmen Citybikes [WWW Document]. wien.ORF.at. URL https://wien.orf.at/stories/3059852/ (accessed 4.3.24).

WienORF.at, 2021a. Ausschreibung für neues Leihrad-System [WWW Document]. wien.ORF.at. URL https://wien.orf.at/stories/3094129/ (accessed 5.3.24).

WienORF.at, 2021b. Neue Leihräder ersetzen Citybike [WWW Document]. wien.ORF.at. URL https://wien.orf.at/stories/3124891/ (accessed 5.3.24).

Wray, S., 2020. Vienna takes over bike rental scheme from private operator. Cities Today. URL https://cities-today.com/vienna-takes-over-bike-rental-scheme-from-private-operator/ (accessed 4.3.24).

Xiao, Y., Watson, M., 2019. Guidance on Conducting a Systematic Literature Review. J. Plan. Educ. Res. 39, 93–112. https://doi.org/10.1177/0739456X17723971

Yin, J., Qian, L., Shen, J., 2019. From value co-creation to value co-destruction? The case of dockless bike sharing in China. Transp. Res. Part Transp. Environ. 71, 169–185. https://doi.org/10.1016/j.trd.2018.12.004

Zhang, Y., Mi, Z., 2018. Environmental benefits of bike sharing: A big data-based analysis. Appl. Energy 220, 296–301. https://doi.org/10.1016/j.apenergy.2018.03.101

Zheng, F., Gu, F., Zhang, W., Guo, J., 2019. Is Bicycle Sharing an Environmental Practice? Evidence from a Life Cycle Assessment Based on Behavioral Surveys. Sustainability 11, 1550. https://doi.org/10.3390/su11061550

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Statutory declaration

Deutsche Version:

Hiermit versichere ich,

• dass die ich die vorliegende Masterarbeit selbstständig verfasst, andere als die angegebenen Quellen und Hilfsmittel nicht benutzt und mich auch sonst keiner unerlaubter Hilfe bedient habe,

• dass ich dieses Masterarbeitsthema bisher weder im In- noch im Ausland in irgendeiner Form als Prüfungsarbeit vorgelegt habe

• und dass diese Arbeit mit der vom Begutachter beurteilten Arbeit vollständig übereinstimmt.

English Version:

I hereby declare,

• that I have authored the present master thesis independently, did not use any sources other than those indicated, and did not receive any unauthorized assistance,

• that I have not previously submitted this master thesis topic in any form, in this country or any other, for academic credit,

• and that this work is identical to the one assessed by the registered supervisor.

Wien / Vienna / Datum / Date: 14.06.2024

Name (Nachname, Vorname) / Name (Last name, First name): Rauchmann Anton BSc

Unterschrift / Signature: 

Appendix A: Systematic Literature Review Excel Table

Categories for evaluation of the systematic literature review:

Governance and Policy Making in FFBSS
Usage and user attitudes of FFBSS
Financing and Subsidies in FFBSS
Infrastructure and technologies in FFBSS
Monitoring and operation of FFBSS
General information FFBSS/ bike sharing

#	Source	Buzzword/ Topic	Title	Author	Year	Journal/ Institution	Study design	Research focus	Relevant?	Comment
1	Own Research	FFBSS/dockless BS	The governance of dockless bike-sharing schemes	Cao et al.	2021	Journal of Transport (	Lit Review	Governance of DBSS	+	Useful to describe governance of FFBSS/DBSS
2	Own Research	FFBSS/dockless BS	Analyzing users' attitudes and behavior of free-fl	Chen et al.	2019	Transport Research P	Questionaire Analysis	User Attitudes of FFBSS	+	Useful for analysing usage of FFBSS
3	Own Research	FFBSS/dockless BS	Dockless bike-sharing systems: what are the impl	Chen et al.	2020	Transport Reviews	Lit Review on implications of d	Implications of dockless bike sharing	+	General information about FFBSS; definetely useful for the analysis
4	Own Research	FFBSS/SBBSS	How could the station-based bike sharing system	Cheng et al.	2020	Journal of Transport (	Predictive Model with Data Col	Strategy for coordination of FFBSS and SBBSS	+	Coordination of FFBSS and SBBSS can be crucial to Vienna
5	Own Research	FFBSS/dockless BS	A model framework for discovering the spatio-te	Du et al.	2019	Transportation Resear	Model framework of spatio-temp	usage patterns of FFBSS	+	Useful for analysing usage of FFBSS
6	Own Research	FFBSS/dockless BS	To be or not to be dockless: Empirical analysis o	Gu et al.	2019	Transportation Resear	Empircial Analysis	Empricial Analysis of dockless bikeshare developmer	+	General information about FFBSS; definetely useful for the analysis
7	Own Research	FFBSS/SBBSS	Comparison of usage regularity and its determina	Ji et al.	2020	Journal of Greener Pr	Case Study; logistic model; regr	Comparisoon of usage regularity between FFBSS and	+	Useful for comparison of Usage of FFBSS and SBBSS
8	Own Research	FFBSS/dockless BS	An empirical analysis of dockless bike-sharing ut	Li et al.	2020	Journal of Transport (	Empirical Analysis	Analysis of dockless bike sharing utilization	+	Useful for analysing usage of FFBSS
9	Own Research	FFBSS/dockless BS	Free-Floating Bike Sharing in Jiangsu: Users' Bel	Li et al.	2018	Energies	Binary Logistic Model	Empirical Evidence of User Behaviours and Influenci	+	Useful for analysing usage of FFBSS
10	Own Research	FFBSS/SBBSS	Comparative life cycle assessment of station-base	Luo et al.	2019	Resources, Conservat	Comparative life cycle assessme	Comparison of life cycle of FFBSS and SBBSS	+	Useful to analyse the comparison between SBBSS and FFBSS
11	Own Research	FFBSS/dockless BS	Impacts of free-floating bikesharing system on pul	Ma et al.	2018	Transportation Resear	difference in difference method	impact of BSS on bus ridership in Chengdu. China	~	Not really sure if the impact of BSS on bus ridership is crucial to the thesis
12	Own Research	bike sharing	Bike-sharing systems' impact on modal shift: A ca	Ma et al.	2020	Journal of Cleaner Pr	Case Study; binary logit model;	Bike sharings impact on modal shift	+	General information useful to see hwich impact bike sharing has on travel behaviour
13	Own Research	FFBSS/SBBSS	Can dockless and docked bike-sharing substitute	Ma et al.	2023	Renewable and Sustai	Hybrid Choice Model	Substitution of dockless and docked bike sharing?	+	Interesting study, if FFBSS is replacing SBBSS; useful for the thesis
14	Own Research	FFBSS/dockless BS	Challenges of collaborative governance in the sha	Ma et al.	2018	Journal of Cleaner Pr	FFBSS Case Study Evaluation	Challenges of Collaborative Governance in sharing ec	+	Could be a useful approach to govern FFBSS in Vienna
15	Own Research	FFBSS/dockless BS	Freedom from the station: Spatial equity in access	Mooney et al.	2019	Journal of Transport (	American Community Survey	Spatial equity in access to dockless bike share	+	access for FFBSS can be useful for the thesis
16	Own Research	shared mobility	Customer-Centric Dynamic Pricing for Free-Floa	Müller et al.	2023	Transportation Scienc	profit-maximizing dynamic prici	Dynamic pricing for free-floating Vehicel Sharing Sys	~	lets see if it is useful for the subsidies part of the policy recommendation; dynamic pr
17	Own Research	FFBSS/dockless BS	Free-floating bike sharing: Solving real-life large	Pal and Zhang	2017	Transportation Resear	Novel Mixed Integer Linear Pro	Solving real life large-scale static rebalancing proble	+	rebalancing of FFBSS bike important for operation of successful FFBSS
18	Own Research	FFBSS/dockless BS	A Deep Reinforcement Learning Framework for F	Pan et al.	2019	Proceedings of the AA	Markov decision process; Hiera	Develop a Deep Reinforcement Learning Framework	+	rebalancing seems to be really important so also a crucial article to the thesis
19	Own Research	FFBSS/dockless BS	Docked and dockless public bike-sharing scheme	Pojani et al.	2020	Handbook of Sustainable Travel		Comparing docked and dockless public bike sharing s	+	interesting , as FFBSS and SBBSS are compared; useful
20	Own Research	FFBSS/dockless BS	Shifting to Shared Wheels: Factors Affecting Doc	Politis et al.	2020	Journal Sustainability	stated preference survey among	users' intentions to use bike-sharing systems (BSS) co	+	propably useful, bike sharing systems replacing classical transport modes
21	Own Research	FFBSS/dockless BS	Supply and Demand Analysis of a Free Floating E	Poliziani et al.	2022	Communications - Sci	Supply and Demand Analysis	article presents an analysis of the supply and demand	~	specific case study on supply and demand of FFBSS; maybe useful
22	Own Research	FFBSS/dockless BS	A multiobjective dynamic rebalancing evolutiona	Su et al.	2023	Apllied Soft Commuti	multiobjective dynamic rebalanc	ig challenge of free-floating bike sharing system is to r	+	rebalacing algorithm for FFBSS; useful for operation of FFBSS
23	Own Research	FFBSS/dockless BS	Does large scale free-floating bike sharing really	Wang et al.	2022	Sustainable Cities and	sing life cycle assessment (LCA	Large scale free floating bike sharing and how it impr	+	definetely useful, as FFBSS is analysed how it can improve sustainable transportatio
24	Snowball	Governance	Collaborative Governance in Theory and Practice	Ansell et al.	2008	Journal of Public Adm	Lit Review	Lit Review of collaborative governance examples	~	Propably not to useful for the thesis
25	Snowball	bike sharing	Are Bikeshare Users Different from Regular Cycl	Buck et al.	2013	Transportation Resear	profile of user dynamics	Comparison of users: bike sharing and regular cyclists	~	user comparison normal cyclers/ bike sharing users
26	Snowball	FFBSS/dockless BS	A modeling framework for the dynamic managem	Caggiani et al.	2018	Transportation Resear	propose a new comprehensive d	Proposal of a new modeling framework for the dynam	+	management of FFBSS useful for Governance
27	Snowball	bike sharing	Factors influencing the choice of shared bicycles	Campbell et al.	2016	Journal of Transport (	stated preference survey and mu	Factors influencing the choice of shared bycicles and	~	propably useful for the thesis
28	Snowball	bike sharing	Contribution of shared bikes to carbon dioxide en	Cao and Shen	2019	Sustainable Cities and	quantitative model; response sur	Which affect fo shared bikes have on the carbon dioxi	~	maybe useful, could be interesting to know to what extend bycicle can force carbon d
29	Snowball	FFBSS/SBBSS	A comparison of users' characteristics between s	Chen et al.	2020	Transportation	Survey	user characteristics of FFBSS/SBBSS in Hangzhou Cl	+	Useful for analysing usage of FFBSS
30	Snowball	FFBSS/dockless BS	Better Understanding the Characteristics and Influ	Du und Cheng	2019	Sustainability	Survey through questionaires; m	Characteristics and Influential Factors of Different Tra	+	definetely useful travel patterns/ usage of FFBSS
31	Snowball	bike sharing	Bike Share: A Synthesis of the Literature	Fishman et al.	2013	Transport Reviews	Litearture Review	Literature review bike sharing	~	literature review on bike sharing; maybe usefull data for the policy recommendation/
32	Snowball	bike sharing	Bike share's impact on car use: Evidence from th	Fishman et al.	2014	Transportation Resear	examining survey and trip data fr	Bike shares impact on car use (Evidence from USA, C	~	probably could be useful; bike sharing vs. car use
33	Snowball	bike sharing	Factors influencing bike share membership: An an	Fishman et al.	2015	Transportation Resear	online survey; logiustic regressi	Factors influencing bike share membership	~	not sure if this topic is useful to analysing FFBSS in Vienna

34	Snowball	bike sharing	The potential modal shift and health benefits of in	Fuller et al.	2013	International Journal c	cross sectional telephone survey	potential of a modal split and health benefits of impler	~	bike sharing impact on health benefits and modal split with case study; maybe useful c
35	Snowball	FFBSS/dockless BS	Governing Dockless Bike Share: Early Lessons fc	Hauf et al.	2019	Transportation Resear	case studies and wider smart mo	Recommendations for regualting dockless bike sharing	+	Recommendation for the regulation of dockless bike sharing
36	Snowball	bike sharing	Characterizing the speed and paths of shared bicy	Jensen et al.	2010	Transportation Resear	Data analysis of shared bycicle s	Characterizing speed and paths of shared bycicle use i	~	maybe useful to learn something for Vienna ccoming from this on speed and paths of s
37	Snowball	bike sharing	Enabling Value Co-Creation in the Sharing Econo	Lan et al.	2017	Sustainability	mixed methods case study	main enabling factors which is transforming people fr	~	value co creation in the sharing economy; propably to really useful to the thesis
38	Snowball	FFBSS/SBBSS	Micromobility evolution and expansion: Understa	Lazarus et al.	2020	Journal of Transport (	travel behavior analysis, 2) disc	Understanding how docked and dockless bikesharing i	+	interesting data on competition/ complementation of FFBSS and SBBSS
39	Snowball	bike sharing	Understanding bike share reach, use, access and f	Leister et al.	2018	Sustainable Cities and	online surcey	Understanding bike share reach, use, access and functi	+	general understanding of bike sharing prob useful for the thesis
40	Snowball	FFBSS/dockless BS	Considering user behavior in free-floating bike sh	Lu et al.	2019	Sustainable Cities and	big data/ spatial agent-based mo	user behaviour in free-floating bike sharing system de	+	Useful for analysing usage of FFBSS
41	Snowball	bike sharing	How can bicycle-sharing have a sustainable futur	Mao et al.	2021	Journal of Cleaner Pr	life cycle assesement (LCA)	assesement of environmental impact of bycicle sharing	~	maybe useful but rather not; waste discussion of bike sharing propably not really usef
42	Snowball	shared mobility	The sharing economy: A pathway to sustainability	Martin	2016	Ecological Economies	analysis of sharing economy disc	Sharing Economy: Sustainability or nightmarish form c	+	Sharing economy: really sustainable? Maybe some interesting facts for the analysis
43	Snowball	bike sharing	Bicycle sharing in Asia: a stakeholder perception	Mateo-Babiano et al.	2017	Transportation Resear	survey based research design ap	on towards achieving sustainable urban mobility outc	~	bycicle sharing towards sustainable futures; maybe some interesting facts for the anal
44	Snowball	bike sharing	The contradictions of bike-share benefits, purpos	Médard de Chardon	2019	Transportation Resear	smart-city critique framework	contradictions of bike-share benefits, purposes and ou	+	bike sharing benefits, purposes and outcomes; could be useful to adapt some things to
45	Snowball	bike sharing	The Role of Bicycle-sharing in the City: Analysis	Murphy and Usher	2015	International Journal c	questionaires	Irish experience of the role of bycicle sharing in the ci	+	the role of bycicle sharing systems in the city; could be adapted to FFBSS in Vienna
46	Snowball	bike sharing	How to Save Bike-Sharing: An Evidence-Based S	Nikitas	2019	Sustainability	survey based studies	Evidence based Survival Toolkit for Policy-Makers a	+	Could be beneficial, more general on bike sharing
47	Snowball	bike sharing	Understanding the diffusion of public bikesharing	Parkes et al.	2013	Journal of Transport g	analysis of data, survey of 19 sy	Understand the diffussion of public bike sharing syster	~	diffusion of bike sharing systems; propably some useful information form this article f
48	Snowball	bike sharing	The sociotechnical roots of smart mobility: Bike s	Ploeger et al.	2020	The Journal of Transp	research paper	history of bike sharing and the initiating events	~	Already used in the introduction; probably not so useful for the analysis
49	Snowball	bike sharing	Bike sharing: A review of evidence on impacts ar	Ricci	2015	Research in Transport	dentifying and critically interpre	Review of Evidence on impacts and process of impler	+	useful information for the implementation and operation of FFBSS; even though the ar
50	Snowball	FFBSS/dockless BS	Understanding the usage of dockless bike sharing	Shen et al.	2018	International Journal c	analysis through spatial autoregr	Understanding the usage of dockless bike sharing in Si	+	Useful for analysing usage of FFBSS
51	Snowball	FFBSS/dockless BS	Critical Factors to Achieve Dockless Bike-Sharir	Shi et al.	2018	Sustainability	literature analysis; interviews; s	Critical factors to achieve dockless bike-sharing Susta	+	how to acielve FFBSS; applying it to Vienna
52	Snowball	bike sharing	Mapping the bike sharing research published fron	Si et al.	2019	Journal of Cleaner Pr	scientometric analysis; lit reviev	Lit review of bike sharing articles published from 201	~	maybe interesting learnings for bike sharing which can be applied to FFBSS
53	Snowball	FFBSS/dockless BS	Contribution of bike-sharing to urban resource co	Sun and Ertz	2021	Journal of Cleaner Pr	quantitative analysis	Contribution of bike-sharing to urban resource conserv	+	how FFBSS can contribute to resource conservation; benefits of FFBSS
54	Snowball	FFBSS/dockless BS	Rethinking the Utility of Public Bicycles: The De	Wang et al.	2019	Sustainability	survey of users and non-users	Rethinking the Utility of Public Bicycles: The Develo	+	Challenges of FFBSS in China; could be applied to FFBSS in Viennna so useful
55	Snowball	SBBSS	Diffusion behavior in a docked bike-sharing syste	Wei et al.	2019	Transportation Resear	analysis of bike trip data	paper examines bike diffusion behaviour in a docked b	~	diffusion behaviour in docked bike sharing; maybe useful for the analysis
56	Snowball	bike sharing	Health effects of the London bicycle sharing syste	Woodock et al.	2014	BMJ	health impact modelling and eva	Health effects of bicycle sharing system: health impac	~	health effects of public bike sharing; could be interesting to include which effects PBS
57	Snowball	FFBSS/dockless BS	Customer Incentive Rebalancing Plan in Free-Flo	Wu et al.	2019	Sustainability	numerical studies; incentive plar	Customer Incentive Rebalancing Plan in Free-Floating	+	rebalancing important for the success of FFBSS
58	Snowball	FFBSS/dockless BS	The station-free sharing bike demand forecasting	Xu et al.	2018	Transportation Resear	dynamic forecasting model with	station free bike sharing demand with a deep learning	+	FFBSS demand and usage; useful to the thesis
59	Snowball	FFBSS/dockless BS	Unravel the landscape and pulses of cycling activ	Xu et al.	2019	Computers, Environm	analytical framework; GPS datas	landscape and pulses of cycling activities from a FFB	+	cycling activities/ usage of FFBSS; useful for the thesis
60	Snowball	FFBSS/dockless BS	From value co-creation to value co-destruction? '	Yin et al.	2019	Transportation Resear	thematic analysis of social media	how do users participate in value co-creation and co-c	+	value co-creation of users for FFBSS can be interesting for the thesis
61	Own Research	bike sharing	Inventory Routing for Bike Sharing Systems	Brinkmann et al.	2016	Transportation Resear	two dimensional decomposition	Inventory Routing for bike sharing systems: Case Stud	~	inventory routing of bike sharing; not really sure if it is beneficial to the thesis but it is
62	Own Research	bike sharing	The economic contribution of public bike-share to	Bullock et al.	2017	Sustainable Cities and	survey data	economic contribution of PBS to sustainable and effic	+	can be useful to understand also the economic benefits FFBSS can aggregate in Vienn
63	Own Research	FFBSS/dockless BS	Niche innovation dynamics and the urban mobility	Cannon	2019	Malmö University	master thesis	Niche innovation dynamics in the urban mobility: Cas	+	really similiar to the case study this master thesis is aiming for; FFBSS as a niche inn
64	Own Research	bike sharing	Going a long way? On your bike! Comparing the c	Castillo-Manzano et al	2016	Applied Geography	propensity score matching-based	Comparison of the distance PBSS and private bicycles	~	maybe useful to the analysis; analysis of the distance of BS and private bycicles may
65	Own Research	bike sharing	Examining usage patterns of a bike-sharing schem	Caulfield et al.	2017	Transportation Resear	Case Study	Usage patterns of bike sharing in medium sized city	~	Usage of bike sharing; maybe useful to usage of FFBSS
66	Own Research	bike sharing	Public Bike Sharing	Cesbron et al.	2015	European Cyclist Fed	Report	Public Bike Sharing- Final Guidance Note for Policy I	+	Governance of bike sharing

67	Own Research	bike sharing	Bike-sharing: History, Impacts, Models of Provis	DeMaio et al.	2009	Journal of Public Trar	exmanation of models of provis	discussion of bike sharing from the 1st generation of b	~	already used in the introduction; some useful data maybe for the policy recommendati
68	Own Research	bike sharing	A review on bike-sharing: The factors affecting b	Eren et al.	2020	Sustainable Cities and	review of recent studies	Factors affecting bike sharing demand	+	general information about bike sharing demand/ usage
69	Own Research	bike sharing	Using a hybrid method for evaluating and improvi	Hsu et al.	2018	Journal of Cleaner Pr	decision-Making Trial and Evalu	improving the service quality of piblic bike-sharing sy	+	service quality of bike sharing; useful for operation of also FFBSS
70	Own Research	bike sharing	The Bike-Sharing System as an Element of Enhan	Maciosiak et al.	2020	Sustainability	analysisi of a case study city	Bike sharing and the possible enhancing of sustainable	+	how can bike sharing enhance sustainable mobility; useful to adapt results to FFBSS i
71	Own Research	bike sharing	The Economic Impact of Bike Sharing in Europea	Martínez et al.	2019	Buisness School of Ne	analysis that estimates a single a	report aims to analyze the impact of bike-sharing syste	+	public authorities governing bike sharing impact
72	Own Research	bike sharing	Bicycle sharing system 'success' determinants	Médard de Chardon	2017	Transportation Resear	analysis of public data	Sucess determinants of bicycle sharing systems	+	
73	Own Research	bike sharing	The Role of Smart Bike-sharing Systems in Urbar	Midgley	2009	Journeys	analysisi of state of art of bycicl	The role of BSS in Urban Mobility- State of Art 2009	~	Role of bike sharing in urban Mobility; propably some useful data for the reintegratio
74	Own Research	bike sharing	THE EVOLUTION OF BIKE SHARING: 10 QUI	Moon-Miklaucic et al.	2019	World Resource Instit	working paper	10 questions on the emergence of new technologies, o	~	evolution of bike sharing; already in theintroduction so maybe not so useful anymore f
75	Own Research	bike sharing	Health impacts of bike sharing systems in Europe	Otero et al.	2018	Environmental Interna	healt impact assesement study to	Healt impacts of bike sharing sytems in Europe	+	Health benefits of bike shraing; some useful learnings can be included in the policy re
76	Own Research	bike sharing	A Public Value-Based, Multilevel Evaluation Fra	Podgórniak-Krzykacz e	2022	Transport and Telecor	public value based multilevel ev	Public bike sharing- implications for cities sustainable	+	bike sharing useful for sustainable transport policies
77	Own Research	shared mobility	Reassessing the Role of Shared Mobility Service	Ruhrort	2020	Sustainability	Theoretical framework from soc	Can shared mobility rise as an alternative socio-techn	+	interesting for the MLP analysis; shared mobilities rise twoards a socio-technical reg
78	Own Research	FFBSS/dockless BS	Platform innovation in urban mobility transitions/	Van Waes	2021	University of Utrecht	PHD Thesis	Platform Innovation in urban mobility transitions: The	~	maybe useful information through platform innovation but maybe not
79	Own Research	bike sharing	Business model innovation and socio-technical tr	Van Waes	2018	Journal of Cleaner Pr	prospective transition framewor	Buisness Model Innovation and socio-technical transit	~	maybe useful for subsidies or fiancing of FFBSS in Vienna
80	Own Research	bike sharing	Environmental benefits of bike sharing: A big dat	Zhang and Mi	2018	Applied Energy	big data analysis	Environmental benefits of bike sharing	+	useful topic for explanation why bike sharing is useful for sustainability transformatio
81	Own Research	bike sharing Vienna	A dynamic bike sharing module for agent-based tr	Hebenestreit et al.	2018	Procedia Computer Sc	dynamic bike sharing model	dynamic bike sharing model for agent-based transport	~	not sure if useful to the policy recommendation; to specific topic
82	Own Research	bike sharing Vienna	Bike sharing: Regulatory options for conflicting i	Laa et al.	2020	Transport Policy	expert interviews and literature r	bike sharing in vienna and options for conflicting inter	+	can be really useful to anaylse regulatory options in the case study
83	Own Research	bike sharing Vienna	Ten years of bike-sharing in Vienna - An explorat	Lemmerer et al.	2014	Research Gate	survey on user responses	Exploration of subjective user choices of bike sharing	+	useful because user choices in the case study city Vienna are desribed
84	Own Research	bike sharing Vienna	Competition or Supplement? Tracing the Relation	Leth et al.	2017	GI_Forum	survey on bike sharing data from	Evaluation of the relationship of public transport and b	+	could be useful for the polic recommendation; bike sharing as a opposition to public t
85	Own Research	bike sharing Vienna	Who, how and why? First insights into the new st	Link	2019	Transportation Resear	mixed method approach	First insights into new stationless bikesharing schmem	+	useful to analyse especially the case study
86	Own Research	bike sharing Vienna	Free-floating bikesharing in Vienna – A user beha	Link	2020	Transportation Resear	series of discrete choice models	User behaviour analysis of free-floating bike sharing u	+	user behaviour analysis of case study city so really useful towards usage of FFBSS
87	Own Research	bike sharing Vienna	Assessment of the demand for bycicle parking inf	Pfafenbichler et al.	2014	Urban Transport	mixed method approach	Assesement of the demand of bycicle parking infrastru	+	bycicle parking infrastructure in the case study city Vienna
88	Own Research	bike sharing Vienna	Wheels when you need them	Wald	2014	Sciencemag.org	article	Can special algorithms keep shared bycicles rolling in	~	propably useful for the analysis; case study city Vienna is part of the article
89	Own Research	bike sharing	A statistical analysis of bike sharing usage and its	Barbour et al.	2019	Journal of Transport &	survey and parameters logit mod	Statistical analysis of bike sharing usage and ist poten	~	again bike sharing usage vs. Car usage; possibly useful for the analysis
90	Own Research	FFBSS/dockless BS	Identifying the nonlinear relationship between fre	Chen und Ye	2021	Journal of Cleaner Pr	modelling framework and case s	analysing the nonlinear relationship between FFBS us	+	FFBSS usage realted to built environment; useful for the thesis
91	Own Research	FFBSS/dockless BS	The environmental benefits of dockless bike shari	Diao et al.	2023	Transportation Resear	GPS-based big dataset on DLBS	Environmental benefits of dockless bike sharing syster	+	environmental benefits of dockless bike sharing can be useful to push FFBSS
92	Own Research	FFBSS/dockless BS	Quantifying economic benefits from free-floating	Gao et al.	2021	Transportation Resear	mixed method approach	economic benefits from free-floating bike-sharing syst	+	economic benefits from free-flaoting bike sharing; useful for thesis
93	Own Research	FFBSS/dockless BS	High-resolution assessment of environmental ben	Li et al.	2021	Journal of Cleaner Pr	distinctive framework and transa	assesement of dockless bike sharing systems based on	~	interesting approach pn how to assess FFBSS; maybe some useful information for the
94	Own Research	bike sharing	Spatiotemporal assessment of carbon emission re	Lv et al.	2024	Sustainable Cities and	spatiotemporal pattern analysis,	carbon emission reduction by shared bike in Shenzhen	~	quite specific; interesting results about carbon emission savings coming from bike sha
95	Own Research	FFBSS/dockless BS	Why individuals choose dockless bike sharing ser	Orvin and Fatmi	2021	Travel Behaviour and	egmentation-based logit (LSL) m	Why do individuals choose dockless bike sharing serv	+	Useful for analysing usage of FFBSS
96	Own Research	shared mobility	Mode choice, substitution patterns and environme	Reck et al.	2022	Transportation Resear	evaluation of data from survey; b	Mode choice, substitution patterns and environmental	~	maybe useful for the thesis; really general on shared mobility
97	Own Research	bike sharing	A continuous approximation model for the optima	Soriguera an Jimenez	2020	Sustainable Cities and	a parsimonious model from whic	continuous approximation model for the optimal desig	+	article about the optimal design of PBS; also probably useful for FFBSS in Vienna
98	Own Research	bike sharing	Is Bicycle Sharing an Environmental Practice? Ev	Zheng et al.	2019	Sustainability	survey; life cycle assessement(L	is bycicle sharing an environmental practise?	~	maybe useful information about the connection between bike sharing and environment
99	Own Research	FFBSS/dockless BS	Bicycle sharing station planning: From free-floati	Cai et al.	2023	Transportation Resear	multi-objective integer non-linea	Bicycle sharing station planning: From free-floating to	+	definetely usefulf for infrastructural part especially comparison between FFBSS and
100	Own Research	FFBSS/dockless BS	Governance of Dockless Bicycle Sharing	Janmaat	2019	University of technolo	interviews with municipalities	Governance of Dockless Bicycle Sharing	+	surely useful; basic paper about the governance of FFBSS

Appendix B: Systematic Media Discourse Analysis Excel Table

#	URL	Publisher	Title	date	Actors mentioned	Crucial Events mentioned	Other interesting data	Relevancy
11	https://www.derstandard.at/story/1199	derstandard.at	"Viennabike" wird "Vienna Citybike"	31.01.2003	Viennabike; Gewista; City of Vienna;	Mai 2003: First bike of Gewista; 2004: Final build up phase of Gewista with 100 Terminals and 1000 Vienna City		~
10	https://www.derstandard.at/story/1255	derstandard.at	Einstiger Stadtrad-Betreiber "Viennabike" geht	28.03.2003	Viennabike; Gewista;	Viennabike in 2003 in Konkurs; Gewista folgt also Anbieter; Projekt lebt weiter; 230 Station nicht in Zwischenzietr		~
15	https://presse.wien.gv.at/2003/05/15/n	presse.wien.gv.at	Startschuss für Probebetrieb der City Bikes Wie	15.05.2003	Citybike; Gewista; Sponsors	19.05.2003: Startschuss für die Citybikes Wien, 30 bikes with test	Anfangsphase war Testphase über mehrere Woc	~
17	https://www.derstandard.at/story/1326	der standard.at	"Das Ziel ist Verdichtung"	22.01.2012	Citybike; Gewista	2002: Wien war bereits for Citybike eine Leihradstadt; Angebot der Citybike konnte durch Kundenfeedback und kor		~
8	https://www.derstandard.at/story/1389	derstandard.at	Citybike: Lernen Sie Geschichte …	31.01.2014	Citybike; Viennabike; JC Decaux	2002: Viennabike Initiation; 2003 Gewista "Citybikes"; 2013 more than 750000 bike rides; Viennese concept of bik		~
60	https://wien.orf.at/v2/news/stories/283	Wien ORF.at	Fahrrad-Start-up breitet sich in Wien aus	03.05.2017	Donkey Republic; Citybike; Pedalpower	Seit März rollen die Donkey-Republic Räder in Wien; Wien für 1000 Donkey Republic Räder geeignet-bis Sommer		+
59	https://www.derstandard.at/story/2000	derstandard.at	Fahrrad-Start-up legt in Wien los: Zwist mit Pla	27.06.2017	Doneky Republic; Citybike; Pedalpower;	2012: Donkey Republic Kooperation mit Pedalpower; Twirst mit Citybike Wien wegen Abstellplätzen die eigentlic		+
58	https://www.radlobby.at/wien/neue-lei	radlobby wien	Neue Leihradsysteme kommen: Flut oder Segen?	26.07.2017	Obike; Ofo; MA48; City of Vienna	Suggestions of the Radlobby Vienna towards the City of Vienna before the FFBSS were introduced in the city: what		+
57	https://wien.orf.at/v2/news/stories/285	Wien ORF.at	Chinesischer Radverleiher startet in Wien	30.07.2017	Ofo	Ofo startet in Wien; 200 bikes in Testphase; eine Stunde fahren kostet einen Euro; Ofo größtes bike sharing Unternel		+
51	https://www.ots.at/presseaussendung/(	OTS	Weltweit größter Stationsfreier bike-sharing An	25.08.2017	Ofo; Stadt Wien	200 Ofo bikes ab 27.08. in Wien im zweiten Bezirk in Testphase; Ofo, der größter bike sharing Konzern der Welt, s		+
52	https://futurezone.at/digital-life/chinesi	futurezone.at	Chinesischer Bike-Sharing-Anbieter Ofo startet	25.08.2017	Ofo	Start von Testphase mit 200 Leihrädern in Leopoldstadt; Testphase fahren gratis, dann 50 cent pro halber Stunde		+
54	https://www.kleinezeitung.at/oesterreic	Kleine Zeitung	Chinesischer Bike-Sharing-Anbieter Ofo in Wie	25.08.2017	Ofo	200 bikes Testphase Ende August 2017; nach Evaluierung geplante Expansion; 100 Millionen Nutzer weltweit von (		+
56	https://www.derstandard.at/story/2000	derstandard.at	Zahl der Leihräder in Wien steigt rasant: Ofo sta	25.08.2017	Ofo; Donkey Republic; Obike; Gewista; Citybike; Stadt Wien			+
48	https://www.diepresse.com/5280611/n	Die Presse	Neue Leihräder: Konflikt bei den Fahrradstände	06.09.2017	Ofo; Obike; Radlobby; Stadt Wien	700 Leihräder in Wien von Obike und Ofo; sollen mehr werden; bis zu 5000 bikes sollen kommen; Radlobby forder		+
45	https://m.bvz.at/in-ausland/bike-sharing	BVZ	Ofo stockt Flotte in Wien deutlich auf	27.09.2017	Ofo; Stadt Wien; Radlobby	Nach einmonatiger Testphase Aufstockung von 200 auf 700 bikes in Flächenbezirken und nicht nur im zweiten Bezir		+
46	https://www.diepresse.com/5293024/bi	Die Presse	Bike-Sharing-Anbieter Ofo stockt Flotte in Wie	27.09.2017	Ofo; Radlobby	Ein Monat nach Startphase Aufstockung von 200 auf 700 Ofo bikes (3 Gang Leihräder); Aufstockung in Außenbezirk		+
41	https://www.trendingtopics.eu/bikeshar	Trending Topics	Bikesharing: Fragen, die sich Wien zum Marktei	28.09.2017	Obike: Ofo: Citybike; Mobilitätsagentur	"Rainbow Wars": Konkurrenz unterschiedlich farbiger Leihrradanbieter in China; Eroberung neuer Märkte in Europ		+
38	https://www.derstandard.at/story/2000	der standard.at	Bikesharing: Wien plant verbindliche Regeln fü	27.10.2017	Stadt Wien; Ofo, Obike; Donkey Republic;	neue Vereinbarung/ Regularien soll Flottenobergrenze, Abstellregel und Kostenfragen beinhalten; 10 bis 30 Fahrräd		+
39	https://wien.orf.at/v2/news/stories/287	Wien ORF.at	Fixe Regeln für Leihräder kommen	27.10.2017	Ofo; Obike;Stadt Wien; Donkey Republic	Verbindliche Regeln für Anbieter was Serivce und Abstellregeln betrifft; weniger Erfgarung in Wien mit FFBSS; Si		+
40	https://www.vienna.at/nach-kritik-an-ne	vienna.at	Nach Kritik an neuen "Bike Sharing"-Angeboten	27.10.2017	Stadt Wien; Ofo; Obike; Citybike; Donkey Republic;	30 Leihräder für 1000 Einwohner passend; Wegen Beschwerden über überfüllte Fahrradständer Einführung von Re		+
36	https://www.radlobby.at/oesterreich/le	radlobby wien	Leihradsysteme: Verbesserungen und Ausweitur	09.11.2017	oBike; Ofo;	Seit August 2017 gibt es die Räder von Obike; 800 Räder in Wien davon 100 defekt; Bonusvideos für richtiges Parl		+
35	https://www.diepresse.com/5317602/bi	Die Presse	"Billig-Leihräder in Wien": Invasionsstopp und	10.11.2017	Obike; Ofo	Hoher Verschleiß an bikes: 100 von 800 oBikes mussten bereits ersetzt werden; Vandalismus, in Flüsse geworfen; s		+
33	https://www.diepresse.com/5320881/w	Die Presse	Wie viele Leihräder verträgt Wien?	15.11.2017	Ofo; Obike; Mobilitätsagentur	FFBSS Vandalismusanfälliger als docked bike sharing; FFBSS haben Vorteile (schnell für kurze Fahrten verfügbar;		+
29	https://kurier.at/chronik/wien/leihraede	Kurier	Leihräder in Wien: Virtuelle Flotte größer als di	18.11.2017	Obike; ofo	Weniger Fahrräder von ofo und Obike in der Stadt Wien also virtuell in der App angezeigt; Vorgaukeln höherer Ver		+
28	https://wien.orf.at/v2/news/stories/288	Wien ORF.at	Stadt Wien überlegt Gebühr für Radverleiher	04.12.2017	Ofo; Obike; Citybike	Gebühr pro Fahrrad um Kosten die für die Stadt entstehen zu decken; auch Abschleppfirst für Bikes; auch Datenschr		+
12	https://wien.orf.at/v2/news/stories/288	Wien ORF.at	O-Bike auf U-Bahn-Gleise geworfen: Kollision	12.12.2017	Stadt Wien	Jugendlicher warf Leihrad auf U4 Gleise-Kollison einer U4 Garnitur mit dem Fahrrad und eine folgende Betriebsstö		+
9	https://wien.orf.at/v2/news/stories/288	Wien ORF.at	Obike reduziert „Winterflotte" massiv	21.12.2017	Ofo; Obike; Mobilitätsagentur	Ofo zieht 500 der 700 Bikes bis Februar 2018 zurück aufgrund zu geringer Nutzerzahlen. 200 bikes bleiben im Wint		+
32	https://www.diepresse.com/5310058/bi	Die Presse	Bikesharing: Wien will Verhaltenskodex für asi	24.01.2018	Obike; Ofo; Stadt Wien	Einführung von Strafen für falscha bgestellte Räder; Ofo stockt Flotte auf 700 Räder auf; Flut an gelben bikes soll di		+
4	https://web.archive.org/web/20180410	Gewista urban media	Jubiläumsjahr 2018: Citybike Wien feiert 15-jäl	05.02.2018	Citybike; Gewista; Stadt Wien	Chronologie einer Erfolgsgeschichte des Citybikes Wien von 2003 bis 2018 und die wichtigsten Updates und Innova		+
5	https://www.vienna.at/stadt-wien-fueh	vienna.at	Stadt Wien führt strengere Regelungen für statio	05.03.2018	Stadt Wien; Ofo; Obike; Citybike	Mai 2018: Neue Verordnung soll in Kraft treten, um rasche Entfernung von widrig abgestellten und kaputten bikes zu		+

6	https://wien.orf.at/v2/news/stories/290	Wien ORF.at	Strenge Regeln für Leihräder fix	05.03.2018	Obike; Ofo; Citybike; Stadt Wien	Neue Verordnung soll ab Mai 2018 kommen: Abtransport mit vierstündiger Frist; max 1500 Räder pro Anbieter; Pr		+
47	https://wien.orf.at/v2/news/stories/289	Wien ORF.at	Wiener Leihradanbieter stoppt Projekt	06.03.2018	Ofo; Obike; Greenbike; Stadt Wien	Greenbike zieht sich aus Betrieb zurück; vor allem wegen 700 Euro Strafe wenn Fahrrad nicht innerhalb von vier St		+
7	https://wien.orf.at/v2/news/stories/290	Wien ORF.at	OBike zieht 800 Leihräder ab	28.03.2018	Obike; Ofo; Stadt Wien	End of March 2018: Obike removing 800 bikes because of vandali	Obike removes bikes also becuase of the 1500 b	+
13	https://www.derstandard.at/story/2000	der standard.at	Leihfahrradanbieter O-Bike zieht 800 Räder aus	28.03.2018	Obike; Ofo; City of Vienna	Obike in the city since May 2017; End of March 2018: Obike remo	Obike removes bikes also becuase of the 1500 b	+
16	https://wien.orf.at/v2/news/stories/290	Wien ORF.at	Weniger Leihräder landen im Wienfluss	29.04.2018	Ofo; Obike; Viadonau; Statd Wien;	Ende Dezmeber 2017: 26 Leihräder werden in Wienfluss gefunden; nach Regulierungen Reduzierung des Kontingen		+
34	https://wien.orf.at/v2/news/stories/291	Wien ORF.at	Fixe Regeln für Leihräder „ab Juni“	14.05.2018	Stadt Wien; Mobilitätsagentur; ofo; oBike; Citybike	03.2018: First insights into stricter regualtions for FFBSS in Vien	Regulations will include: 1500 bikes per provid	+
49	https://www.derstandard.at/story/2000	der standard.at	Obike angeblich vor Pleite, tausend "herrenlose	09.07.2018	Obike; Ofo; MA48; Stadt Wien	01.08.2018: Regelungen für FFBSS Anbeiter werden in Wien schlagend; 1000 Herrenlose Räder von Obike in Wie		+
37	https://www.derstandard.at/story/2000	derstandard.at	Nach Obike zieht sich auch Fahrrad-Start-up Of	10.07.2018	Obike; Ofo; Donkey Republic;	01.08.2018: new regulations staring in Vienna; both Obike and ofo	Ofo also had withdrawals from other countries i	+
55	https://futurezone.at/digital-life/auch-le	futurezone.at	Auch Leihrad-Anbieter Ofo kehrt Wien den Rüc	10.07.2018	Ofo; Obike	Regularien bringen Ofo nach Obike dazu, Wien mit ihrem Service den Rücken zu kehren; Ofo ist pleite und hohe Re		+
43	https://today.rtl.lu/news/business-and-t	RTL Today	Vienna declares victory in war on dockless bike	07.08.2018	Ofo; Stadt Wien	Anfang August 2018: Regelungen treten in Kraft; Ofo removed from the city in July; huge growth of dockless bikes i		+
44	https://www.derstandard.at/story/2000	derstandard.at	Obike-Fiasko: 1.000 Räder in Wien eingesamm	03.10.2018	MA48; Obike; Ofo; Stadt Wien	08.2018: stricter regulations in Vienna for FFBSS; direct withdraw	resale of bike needs evaluation of bikes over the	+
53	https://www.diepresse.com/5293030/d	Die Presse	Die gelben Räder sind aus Wien verschwunden	24.01.2019	Ofo; Obike; MA48; Stadt Wien	1100 Fahrräder von Ofo und Obike in Wien eingesammelt; Anbieter fast vollständig aus dem Stadtbild verschwund		+
26	https://wien.orf.at/stories/3038604/	Wien ORF.at	Leihrad Anbieter Donkey Republic verlässt Wie	12.03.2020	Donkey Republic; Citybike	Letzter privater FFBS Anbieter zieht sich aus Wien zurück; zu geringe Nutzerzahlen und große Konkurrenz von City		+
23	https://www.derstandard.at/story/2000	der standard.at	Wiens Citybike-System vor dem Aus: Hälfte de	10.07.2020	Citybike; Gewista, Stadt Wien	Streit um 1,1 Millionen Euro Förderung der Statdt Wien für Gewista zum Betreiben der Stationen; Corona Pandemi		~
31	https://wien.orf.at/stories/3057416/	Wien ORF.at	Hälfte der Citybike-Stationen fällt weg	10.07.2020	Citybike; Gewista; Stadt Wien; Wiener Linien	Mai 2020 Drohung von Gewista Stationen zuzudrehen, wenn keine finanzielle Unterstützung der Stadt Wien kommt;		~
22	https://wien.orf.at/stories/3059852/	Wien ORF.at	Wiener Linien übernehmen Citybikes	29.07.2020	Citybike Wien; Wiener Linien; Gewista	Übernahme Leihradsystem Citybike durch Wiener Linien; finanziel	politischer Diskurs kurz vor Wienwahl über die	~
25	https://kurier.at/chronik/wien/wiener-li	Kurier	Wiener Linien retten Citybikes	29.07.2020	Gewista; Wiener Linien; Wien Mobil Rad; Stadt Wie	Politische Debatte um Weiterführung der Citybikes Wien; Grüne haben Wiener Linien als Nachfolger vorgeschlage		~
2	https://cities-today.com/vienna-takes-o	Cities Today	Vienna takes over bike rental scheme from priva	10.08.2020	Wiener Linien; Gewista; City of Vienna; Citybike	Citybike launch 2003; 10 million rides in 2019;	"shared bikes are now a crucial part of the transp	~
27	https://kurier.at/chronik/wien/die-wien	Kurier	Wiener Citybikes gehen wieder in Betrieb	24.08.2020	Citybikes; Gewista; Wiener Linien; Stadt Wien	Gewista für Übergangslösung angestellt tortz Polit Geplänkel und Streit um Finanzierung mit Grünenchefin Hebein;		~
30	https://wien.orf.at/stories/3072368/	Wien ORF.at	Neue Leihräder für die Stadt	21.10.2020	Lime; Citybike; Donkey Republic; Wheels	Neuansiedlung von FFBSS durch Lime- E-Bikes; neben Citybike nach aus von Ofo und Obike wieder zweite Kraft i		~
24	https://kurier.at/chronik/wien/betreiber	Kurier	Betreiber von Bikesharing-Netz Wien Mobil Rad	10.03.2021	Wiener Linien; Citybike; Wien Mobil Rad	10.03.2021: Start der europaweiten Suche nach Nachfolger für cit	Wien Mobil Rad soll in Wien Mobil App integri	~
50	https://wien.orf.at/stories/3094129/	Wien ORF.at	Ausschreibung für neues Leihrad-System	10.03.2021	WienMobilRad; Citybike; Wiener Linien	Ausschreibung für neuen Betreiber von WienMobilRad (10.03.2021); Citybike war internationales Vorbild wenn m		~
1	https://www.vindobona.org/article/wie	Vindobona	Wiener Linien: 3,000 New WienMobil Bikes in	08.10.2021	Wien Mobil Rad; Wiener Linien; Citybike	opening of Wien Mobil Rad April 2022; by Fall 2022 3000 share	new locations in all 23 districts; previous statior	~
19	https://wien.orf.at/stories/3124891/	Wien ORF.at	Neue Leihräder ersetzen Citybike	08.10.2021	Citybike Wien; Wien Mobil Rad; nextbike; Wiener Li	April 2022: Einführung des Wien Mobil Rads; Ende des Citybike	Betreibskosten 2,5 Mio Euro pro Jahr (Wiener L	~
20	https://kurier.at/chronik/wien/citybike-	Kurier	Citybike wird zu WienMobil Rad und expandier	08.10.2021	Citybike Wien; Wien Mobil Rad; nextbike; Wiener Li	April 2022: Einführung des Wien Mobil Rads; Ende des Citybike	Darstellung der neuen Räder, der neuen Tarife u	~
21	https://presse.wien.gv.at/2021/10/08/a	Stadt Wien Presse	Ab 2022 3.000 WienMobil Räder in der ganzen	08.10.2021	Citybike Wien; Wien Mobil Rad; nextbike; Wiener Li	Ab 2022: 3000 bike also doppelt so viele wie bei Citybike; 185 fixe Stationen und 50 digitale Stationen (FFBSS)		~
3	https://www.themayor.eu/en/a/view/b	The Mayor.EU	Bike-sharing as public transport. Vienna covers	31.10.2021	Wiener Linien; Gewista; City of Vienna; Citybike	31.10.2022: public bike sharing sytsme Wien Mobil Covers the wi	renting a bike is cheaper for transport card owne	~
14	https://www.derstandard.at/story/2000	der standard.at	Citybikes werden ab Freitag von Wien-Mobil-R	31.03.2022	Citybike; Wien-Mobil Rad; Wiener Linien; Nextbike	01.04.2022: 60 Stations with 1000 Wien Mobil Rädern, resplacing	city of Vienna provides 2,3 Million Euros; contr	~
18	https://www.radlobby.at/wien-mobil-ra	radlobby wien	Wien Mobil Rad ersetzt citybike Wien	22.05.2022	Wien Mobil Rad; Wiener Linien; Citybike	01.04.2022: Wien Mobil Rad in Betrieb; 31.03.2022 Ende von Citybike Wien nach 19 Jahren; Test der neuen Bikes		~
42	https://www.vienna.at/ein-jahr-wienmo	vienna.at	Ein Jahr WienMobil Rad: Bikesharing zieht pos	30.03.2023	Wien Mobil Rad; Wiener Linien;	Einjähriges Bestehen von Wien Mobil Rad mit positiver Bilanz; 93000 Menschen registriert; 300000 Mal genutzt; 4		~

Appendix C1: Interview Guideline

Interview-Leitfaden: Free-Floating Bike Sharing in Wien

Einleitung:

Herzlich Willkommen und zuallererst vielen Dank, dass Sie sich Zeit für dieses Interview genommen haben. Dieses Interview über 30-45 Minuten dient zur Aufklärung über die Entwicklungen von free-floating bicycle -sharing Systemen (FFBSS) in Wien, die Abwanderung der privaten Anbieter aus der Stadt sowie die Akteure, die in den Prozess involviert waren. Das Ziel dieser Masterarbeit ist, einen Vorschlag (innovation policy) an die Stadt Wien zu präsentieren, wie eine erfolgreiche Reintegrierung von privaten free-floating bike sharing Anbietern in Wien möglich sein kann und welche Punkte dabei in (auch in Ansicht vergangener Entwicklungen) in Betracht gezogen werden müssen.
Es gibt keine richtigen oder falschen Fragen, ich freue mich über jede Information, die Sie mir geben können. Um die Daten leichter zu analysieren, werde ich dieses Interview aufzeichnen und transkribieren, daher frage ich Sie um Ihre Zustimmung. Die Daten aus diesem Interview werden vertraulich behandelt und anonym analysiert. Die Daten dienen ausschließlich wissenschaftlichen Zwecken. Haben Sie bereits Fragen?

Thema der Masterarbeit:

Originaltitel Englisch:
„Generating an innovation policy towards the successful reintegration of free-floating bike sharing systems (FFBSS) as a niche innovator in sustainable urban mobility transitions in Vienna: A multi-level analysis of FFBSS in Vienna in the past and an innovation policy for the future."
Titel Deutsch:
"Entwicklung einer Innovationsstrategie zur erfolgreichen Wiedereingliederung von Free-Floating-Bike-Sharing-Systemen (FFBSS) als Nischeninnovation in der nachhaltigen Mobilitätstransformation in Wien: Eine Multi-Level-Analyse von FFBSS in der Vergangenheit in Wien und eine Innovationsstrategie für die Zukunft"

Fragenkatalog Interview:

Einleitung:

- Können Sie sich bitte kurz vorstellen und mir sagen, was Ihre berufliche Position ist?

Verbindung des Interviewpartners zu FFBSS in Wien

- Wie würden Sie Ihre Verbindung zur FFBSS Debatte in Wien beschreiben und welche Rolle nehmen Sie dabei ein/ haben Sie dabei eingenommen?

Transformation/ Vergangenheit: Beschreibung von privaten FFBSS als Nischeninnovation in der nachhaltigen Mobilitätstransformation in Wien (Ereignisse, Wendepunkte, Akteure)

- Generell: Wie würden Sie bike-sharing/ die Transformation von bike-sharing in Wien beschreiben/ können Sie mir von der Entwicklung von FFBSS in Wien aus Ihrer Sicht erzählen?
- Wie würden Sie die entscheidenden Wendepunkte in der Transformation von FFBSS in Wien beschreiben?
- Können Sie mir positive/negative Aspekte von privaten FFBSS- Angeboten/ Anbietern in Wien nennen bzw. wie haben sie diese mitbekommen?
- Wie würden sie die politische Herangehensweise im Diskurs um FFBSS beschreiben? Was würden Sie als positiv/ was als negativ herausstreichen? (Governance; Regularien; politische Einflüsse auf FFBSS in Wien)

Ausblick/ Leitfaden für Reintegrierung von FFBSS in Wien:

- Bezüglich der Abwanderung von privaten FFBSS-Anbietern in Wien, was hätte Wien im Nachhinein in der politischen Herangehensweise eventuell anders machen müssen?
- Was müssen Politiker beachten, um Wien wieder attraktiv für FFBSS-Anbieter zu machen und was sollen politische Regularien dafür unbedingt beinhalten?
- Was sind die größten Herausforderungen der Reintegrierung von FFBSS in Wien (zum Beispiel Stellplätze, Regularien, Vandalismus, Aufteilung der Räder, …) und wie kann man vor allem den Problemen von FFBSS entgegenwirken?
- Was würden Sie als positiv/negativ an Wien als Standort für FFBSS/ bike sharing herausstreichen?
- Wie könnte eine Kooperation zwischen privaten FFBSS-Anbietern und öffentlichen Akteuren aussehen? (zum Beispiel Wiener Linien; WienMobilRad; Stadt Wien)
- Ist eine langanhaltende Koexistenz von unterschiedlichen bike-sharing Anbietern in Wien (privat/ öffentlich) grundsätzlich möglich und wenn ja wie?
- Bei FFBSS Modellen: welche Punkte sind Ihrer Meinung nach wichtig, um FFBSS attraktiv für Kunden zu gestalten?
- Thema Subventionierung/ Finanzierung: Wie sieht für Sie das perfekte FFBSS in Wien aus, an dem alle involvierten Akteure (Investoren, Betreiber, Kunden) profitieren und ist das überhaupt möglich?
- Allgemein: Finden Sie docked bike sharing oder FFBSS für Wien geeigneter oder ein Mix aus beiden Modellen?

- Allgemein: Was sind Ihrer Meinung nach die Vor- bzw. Nachteile von FFBSS für urbane Mobilität?
- Allgemein: Inwiefern können Ihrer Meinung nach gut funktionierende FFBSS zur nachhaltigen Mobilitätstransformation in Wien beitragen?

Schlussteil:

- Haben Sie noch ergänzende Fragen/ Anmerkungen?

Appendix C2: Interview Transcript

Interviewtranskription Interview Mobilitätsagentur 12.1.2024

AR: Anton Rauchmann (Interviewer)

GL: Gildas LeGal (Interviewte Person / Interviewed Person)

Interview Sprache/ Interview Language: German

Interview Dauer/ Interview Duration: 48:10 Minuten

AR: Ja okay Hallo, danke, dass Sie sich die Zeit genommen haben und erste Frage von mir wäre, dass Sie sich kurz vorstellen und mir sagen könnten, wie Ihre berufliche Position ist hier bei der Mobilitätsagentur aussieht.

GL: ja klar. Also ich mach vielleicht auch einen kurzen Rückblick, weil ich habe auch Geographie studiert, allerdings in Frankreich, Humangeographie: mein Interessenspunkt war mehr Tourismus. Immerhin, es ist immer noch Humangeographie. Und irgendwann habe ich doch angefangen, andere Sachen zu machen. Und ein Beruf, ja, man macht nicht unbedingt das, was man studiert hat, aber ist doch ok. Auf jeden Fall, 2015 habe ich mich bei Citybike Wien beworben, das war das ehemalige Bike-Sharing-System hier in Wien und ich habe die Stelle bekommen. Ich war dort im Büro für vieles zuständig. Also wir waren wirklich ein kleines Büro, wir waren vier Personen danach fünf danach sechs. Wie ich angefangen habe, waren sie vorher drei und ich war wirklich der vierte Mitarbeiter, feste Mitarbeiter dort. Und wirklich alles Mögliche von Kunden-Support bis Rechnungen und so.

AR: Wann haben sich dort beworben?

GL: 2015 war das.

AR: Also hat es dann Citybike eben glaube ich seit 13 Jahren schon gegeben, also seit 2003: Und wie haben Sie das, damit wir zu meinem Masterarbeitsthema über Free-Floating Bike Sharing, also über diese vierte Generation von Bike-Sharing, mitbekommen und das war ja in Wien nicht so erfolgreich, ist ja nach einem Jahr durch diese Regularien, ich glaube da war die Mobilitätsagentur eh beteiligt auch. Waren Sie da schon bei der Mobilitätsagentur?

GL: Nein, ich war, ich war immer noch bei Citybike, vielleicht beende ich die erste Antwort zu. Zu antworten die dann habe ich dort gearbeitet okay und wie das System dann umgetauscht wurde, da gab es ein paar politische Streits im Jahr 2021 und 2022 da wurde dann Nextbike statt uns also statt Citybike übernommen, wurde ausgeschrieben und dann haben wir mit 31. März 2022 die letzte Fahrt gehabt und mit 1. April, sofort also ein einen Tag später, hat eigentlich Nextbike angefangen. Äh, das heißt in den nächsten Monaten haben wir viel geschreddert und dann im Juli habe ich hier angefangen, weil sie hier auch jemand als Unterstützung für die Frau Reichert gesucht haben, für ihn die ganze Sharing Mobility, wie das so schön auf Deutsch heißt. Ähm, ja, für die ganzen regulativen oder organisationalen Sachen in der Stadt. Also es geht, es ging oder es geht mittlerweile besonders um Scooter, aber immerhin haben wir ein bisschen die Schnittstelle auch mit den Wiener Linien, dass wir auch

über WienMobil Auto oder WienMobil Rad, also die verschiedenen Sharing Angebote, die es in Wien gibt, ja da arbeiten wir zusammen. Ja genau, dann also jetzt, wie das Free-Floating also Ofo und Obike wie die angefangen haben das heißt Obike hat eigentlich als erstes begonnen im August 2017

AR: Genau ich habe eben glaube, dass würde ich nur gerne kurz einwerfen, dass ich kenn mich mit der Transformation gut schon aus, weil ich eben so eine systematische Medienanalyse schon gemacht ich habe 60 Zeitungsartikeln analysiert, um eben zu wissen, was so passiert ist. Mich interessiert an dem ganzen halt eben diese politischen Herangehensweisen. Das am Anfang kommt free-floating nach Wien und ist voll erfolgreich und es gibt wenig Regularien, aber es gibt eben auch diese Probleme mit Vandalismus und so und wie das dann so drastisch durch Regularien, die Anbieter sagen okay ja ich zieh mich zurück, ist ja nicht nachhaltig.

GL: Also der Artikel haben wir auch damals, ähh ich glaub alle oder so viel wie möglich gelesen, weil es sowas auch uns interessant oder auch mit der Umwandlung danach von Citybike auf Nextbike haben wir auch alles gelesen was da veröffentlicht wurde. Ich finde oft, dass es nicht nicht richtig immer zusammengefasst wurde von den Journalisten also es gab vieles, wo wir müssen sie manchmal. Sie übernehmen einfach die OTS einer Firma, ohne sich Fragen zu stellen, die sagen ja so, also nicht um die Wiener Linien zu kritisieren, aber ich weiß noch wie bei der bei der Umstellung auf Nextbike haben sie gesagt, ja wir werden verdichten und auch, also wir verdoppeln die Anzahl der Stationen und werden noch verdichten in der ganzen Stadt. Es ist nicht möglich sind. Also die Stadt Wien ist so, Citybike hatte ungefähr so ein Netzwerk von 120 Stationen. Wenn sie sagen wir verdoppeln. Und wir verdichten. Es ist nicht möglich, ja, also kann man verdoppeln, aber dann ist nicht verdichtet oder kann man verdichten, aber dann ist nicht verdoppelt, einmal also ist eine Verdopplung nicht genug, man muss auf solche Sachen achten und solche Sache. Ja ich glaub die Journalisten, ich würde fast sagen der österreichische Journalismus ist oft einfach abschreiben was gesagt wurde und das ist ja, so viel zu. Aber wie wir das erlebt haben, also ich muss noch einen kurzem Rückblick machen, davor ist es im April 2017 hat es Donkey gegeben. Die haben erst mal 30 bis 40 Räder gehabt.

AR: Die waren aber nicht ganz auf diesem free-floating Prinzip?

GL: Sie waren nicht free-floating, aber Sie waren stationslos und das ist auch wieder oft haben wir hinterfragt die Begriffe, weil zum Beispiel Ofo und Obike sind stationslos, Citybike war nicht stationslos, aber beide waren free-floating. Weil beide kann man irgendwo nehmen oder überall, wo es erlaubt ist, nehmen und da, wo es erlaubt ist zurück geben. Und Donkey war stationslos aber nicht free-floating, weil man immer wieder am selben Bügel oder an derselben Radabstellanlage, wo man das bike gefunden hat, wieder zurückgegeben hat. Und da gab es auch ein paar Artikel, wo auch mein Chef da zitiert wurde am Anfang und er hat sich ein bisschen verbrannt gefühlt.

AR: Ah also der Herr Blum?

GL: Nein der Herr Blum ist hier mein Chef. Damals war mein Chef der Herr Dechant.

AR: Aja von dem habe ich auch gehört.

GL: Genau und ganz am Anfang wie Donkey Republic angefangen hat, dann wurden wir oder Citybike gefragt, was wir davon halten. Da hat mein Chef dann gesagt so von mir aus also, wenn eine Firma versuchen will, ist es möglich aber nur das Problem ist wenn Sie größer werden sie die Radbügel belegen, also die die für die Allgemeinheit stehen. Der Betreiber von Donkey Republic ursprünglich war pedal power. Sie haben sich bei Donkey Republic beworben und gesagt was sie für Donkey Republic machen können aber nach sechs Monaten bis einem Jahr haben sie das abgegeben und dann hat es jemand anderes gemacht, also Sie haben es als

getrennte Firma gemacht und der Mensch bei pedal power hat da sich ein bisschen angegriffen gefühlt also es war sicher auch ein bisschen so wie die Presse jetzt da diese Sachen aufgespitzt hat weil also mein Chef hat nie gemeint so böse zu sein gegen Donkey oder pedal power es war mehr ein, also es kommt drauf man wenn sie damit 30 bis 40 Rädern in der Stadt sind ist es ok, wenn sie auf einmal 5000 versuchen dann haben wir vielleicht ein Problem. Und danach jedes Mal, als es eine Anfrage gab, eben über Ofo und Obike und Scooter undso haben wir nie wirklich geantwortet oder auch danach über unseren Abgang, weil er nicht mehr falsch verstanden werden wollte und daher gab es manchmal nur eine Seite weil unsere Seite die Gewista hat nicht antworten wollen also ja wir machen was was die Politik von uns will und mehr nicht.

AR: Also ihr wart eigentlich so, dass ihr gesagt habt ein paar Räder sind ok aber wenn es zu viel wird ist es auch eine Konkurrent für euch?

GL: Nein das haben wir nie behauptet und wir haben es wirklich nie so gesehen. Wie Obike und Ofo angefangen haben, haben wir wirklich beobachtet also ich weiß noch wie ich hinter dem Hauptbahnhof die ersten Ofos- Obike pardon fotografiert haben und wir das Rad begutachtet haben. Dann haben wir auch ab und zu Fahrten gemeinsam gemacht und auch genau geschaut was kann das Rad und was kann es nicht. Wirklich sachlich aber wir haben kein einziges Rad demoliert.

AR: Haha, da waren sie einer der wenigen.

GL: Genau, nein nein aber die Sache ist wir haben eigentlich mehr die Schwäche von dem System gesehen als die Kräfte also zuerst musste man erstmal 20 oder 80 Euro hochladen, dass man überhaupt damit fahren darf es gab nicht so gute Möglichkeiten zum Zahlen wie heutzutage.

AR: Viele haben sich ja dann auch aufgeregt, dass sie diese Kaution nicht zurück bekommen haben von Ofo oder Obike?

GL: Naja zu Recht auch. Und auch diese GPS-Steuerung ist eigentlich ursprünglich durch das Handy gegangen also es hat wahrscheinlich mit Bluetooth kommuniziert aber das Rad an sich hatte keine GPS-Daten, keinen Sensor oder so. Daher, wenn ein Rad verschwunden ist, dann konnte Obike oder Ofo nicht wirklich sagen, wo das Rad ist eigentlich. Und ja wie sie die Stadt bisschen überrollt haben mit den Rädern dann haben wir als Citybike auch gesehen wie sich die Stadt eben auch sehr gefreut hat. Der Herr Blum oder die Politik damals also die Frau Vassilakou, also viele haben gesagt oh es geht auch bike-sharing ohne, dass die Stadt einen einzigen Cent zahlen muss, und dann haben wir vielleicht uns ein bisschen gefährdet gefühlt ok gebe ich zu. Andererseits, dadurch dass ursprünglich alle diese Schnittstellen waren, sehr offen wir konnten auch sehr gut beobachten, wo die Räder sind und wie Sie benutzt werden, also wir haben ein bisschen einen Schadow-Dashboard geführt wo wir die Räder so alle paar Stunden abgefragt haben und verfolgt haben.

AR: Also bei Ofo und Obike jetzt? Weil das habe ich in einem Zeitungsartikel gelesen, dass sie auf der Karte mehr Räder angezeigt haben als wirklich da waren, um vorzugaukeln, dass ein hohes Angebot an Rädern da war.

GL: Weil eben auch diese Beobachtungskarte- ok ja das ist wahrscheinlich ein bisschen off the record- wir haben das Programm auch bisschen gegeben für die Kurier Journalisten, dass sie das auch ein bisschen so probieren und eine Karte erstellen aber muss nicht unbedingt das geschrieben werden. Wir haben dann alles beobachtet und es hat uns nicht unbedingt glücklich gemacht ursprünglich natürlich aber wir haben auch wirklich dann beobachtet, dass es nicht so benutzt wurde wie man denken könnte. Glaube auch dass die Räder nicht wirklich gut waren, also Obike war deutlich schlechter als Ofo- also Ofo waren schon fahrbar finde ich also ab und

zu habe ich ein Rad entsperrt gefunden und dann bin ich damit gefahren und mehrere Strecken und auch längere Strecken und es hat sich ganz gut angefühlt beim Fahren daher habe ich keine Kritik, technisch keine Kritik, diese Drehklingel am Lenkergriff war auch relativ eine Innovation auch damals wo wir dann auch geschaut haben ok ja könnte man auch machen. Mittlerweile haben auch die WienMobilRäder das.

AR: Ja, die Fahrräder muss ich eh auch noch probieren. Aber die sind ja jetzt auch in gewisser Weiße free-floating und docked in einem, weil es gibt auch Stationen die virtuell sind?

GL: Also eigentlich ist Nextbike stationslos, auch wenn man sieht in Niederösterreich zum Beispiel es ist oft es sind ganz normale Rad Bügel und da gibt es ein Schloss, die Schlossnummer per Handy oder so und das wars. In Wien funktioniert es auch stationslos, in Wien war der Wunsch der Stadt- wir springen jetzt ein bisschen von einem Thema zum anderen aber ist ok- also ich beende das kurz: Wien war es ein Anliegen, dass es überhaupt stationsbezogen ist aus Ofo und Obike Erfahrung und Nextbike hat gesagt ok wir können Stationen machen und manchmal gibt es diese Boxen, manchmal sind es auch nur normale Radbügel aber es ist ein bisschen nur „Scheinstationen". Im Endeffekt ob das Rad wirklich in der Box ist oder daneben oder sogar 10 Meter weiter es ist egal, denn es ist stationslos gemacht.

AR: Ich glaube es muss eben fixe geographische Orte geben, wo man die Räder hinstellt? Was ich immer ganz witzig finde, ist dass das Problem war, dass auch den Gehwegen dann eben diese Fahrräder gestanden sind und alles verstellt haben aber man könnte ja dann theoretisch fixe Abstellzonen machen für FFBSS wo man nur die Räder abstellen dürfte.

GL: Ja eh aber dann also wir haben oft auch das beobachtet wie die ersten, also es gab Ofo und Obike auch in anderen Städten und andere Marken, das haben wir auch sehr streng beobachtet, dann kommen Sie zuerst alle mit haha wir brauchen keinen Strom wir brauchen keine Stationen kein Startgeld usw. Und dann nach drei, sechs oder neun Monaten je nachdem nach dem Anbieter gibt es diese: naja, vielleicht könnten wir auch ein bisschen Startgeld kriegen also Finanzierung, weil wir auch etwas für die Allgemeinheit machen, dann gibt es die die sagen aha also vielleicht könnten wir ein paar Stellen kriegen, wo wir die Räder hingeben können, also damit wir sie nicht überall einsammeln müssen. Und was war noch einmal das Dritte achso ja Strom. Ja es hat auch Innovationen gegeben bei irgendwelchen Messen dann haben sie angefangen: Hey wir haben so ein Ding gemacht und darin kann man das Rad tun und es kann sich laden- ja es ist eine Station, das gibt es seit 20 Jahren also sie haben Innovationen verkauft, die überhaupt keine waren und da kommen wir zurück eigentlich auf dieses Stationsbasierte. Und die Scooter in Wien laufen ein bisschen ähnlich, weil es seit letztem Jahr diese Abstellflächen haben und viele Scooter Betreiber sagen uns jetzt also das ist ideal so müssen wir auch nicht die ganze Gegend absuchen, denn es gibt 100 Meter Abstellverbot in dieser Station das heißt das Rad oder der Scooter darf nicht an gewissen Orten stehen sondern nur in der Mitte zum Beispiel. Das heißt wenn wir die einsammeln oder hinbringen dann ist es sehr leicht wir müssen nur zu einem Ort gehen, statt überall jede Straße zu prüfen.

AR: Also das würde mit FFBSS dann auch funktionieren, oder?

GL: Naja, wenn man will das ist was WienMobil ist. Also das sind stationslose Fahrräder, die trotzdem manche Scheinstationen haben, sodass die Leute verstehen, wohin man das Rad bringen muss oder wo man es finden kann, wo die Techniker auch wissen wo die Räder einzusammeln sind und zu reparieren, wenn es nötig ist. Also es immer noch wegen der Scheinstationen stationsbasiert. Und die Scooterfirmen sagen uns auch dass sie gerne mehr Abstellflächen und Stationen hätten, sodass sie sehr dicht also die Scooter haben könnten. Alle wünschen sich stationsbasiert, und stationslos ist weder für die Nutzer, die nicht unbedingt wissen wo bin ich sicher, dass ich ein Gerät finde mittels einer App noch für die Firmen selbst die dann viel mehr leere Kilometer machen, um die eigenen Räder zu suchen, wenn sie kaputt

oder verschwunden sind. Ich glaube eine gute Dichte wie zum Beispiel das bikesharing System in Paris mittlerweile hat- also alle 200 bis 300 Meter ist gut und wichtig aber free-floating oder stationslos finde ich mittlerweile einen Fehler.

AR: Also man müsste da Free-Floating Konzept wahrscheinlich ein bisschen um konzipieren und sagen, dass man zum Beispiel fiktive Stationen hat. In Paris ist es ja auch so dass sie dort bewusst Parkplätze von Autos wegnehmen, um dort eben neue Abstellzonen zu errichten, das würde in Wien ja eigentlich auch recht gut funktionieren? Weil ja eigentlich so viel Platz in Wien eigentlich verloren geht durch parkende Autos.

GL: Also es gibt schon eine Anzahl an Wienmobilrad Stationen bzw. Scooter-Abstellflächen, die manchmal auf der Parkspur sind, also die einen Parkplatz belegen, also nicht so viele, weil die ja von der Politik fürchten sich ein bisschen von dem Aufschrei, wenn man sagt ab morgen gibt es 3000 Abstellflächen und alle kommen auf der Parkspur. Alle so was 3000 Parkplätze weg und so.

AR: Also ist wahrscheinlich dann auch sehr viel politische Strategie dahinter, oder?

GL: Es würde wahrscheinlich eine grüne Politikerin sich mehr trauen so etwas zu machen also ich glaube die SPÖ bleibt ein bisschen also will schon relativ grün agieren auch das Fahrrad fördern aber ohne, dass da Auto schlechter zu machen.

AR: Sie haben ja irgendwie im Mobilitätsplan in Wien haben sie sich vorgenommen im Jahr 2025 eben 80% nachhaltige Wege und nur 20% mit dem Auto und diese Zahl verändert sich aber irgendwie kaum und das habe ich mir eben gestern angeschaut, es bleibt immer irgendwie bei 27% und ich glaub es liegt eben dann auch an der Politik.

GL: Nicht 40%. Ich dachte es ist viel mehr ok das ist eine gute Nachricht.

AR: Ja genau, das habe ich mir eben auch wegen free-floating bike sharing oder generell auch Scooter gedacht, in Wien sind die Öffis halt so gut, dass das wahrscheinlich ein Grund ist, dass sich Fahrradleihsysteme nicht durchsetzen. Jetzt ist es so kalt, da fahren alle lieber mit den Öffis, denn die funktionieren auch gut. Das könnte auch ein Grund sein, dass sich das nicht so durchgesetzt hat. Mich interessiert dabei auch, ich weiß nicht, wie Sie das mitbekommen haben mit der politischen Herangehensweise, da haben sie dann so Regularien aufgesetzt, für Ofo und Obike? Ich wollte noch kurz was dazu sagen, weil es ja vor einer so einer Wien-Wahl war das es ja zwischen der Hebein also der Grünen Chefin und dem SPÖ Chef Ludwig hat es eben dann einen politischen Streit gegeben. Das war eben genau als die Free-Floating Bike Sharing Systeme in Wien waren.

GL: Nein würde ich nicht so sagen. Ich glaube die Hebein hat offiziell Anfang 2019 angefangen. Die Vassilakou war bis Ende 2019 noch da.

AR: Aja, es ging dabei um die Citybike Übernahme.

GL: Ja genau, wobei das das reine Fiasko war. Wien-Wahl hat es 2015 und 2020 gegeben. Die Ofo und Obike haben dann im August 2017 angefangen und da sind wir im Stadtdiskurs von ein bisschen einer Begeisterung von allem, was möglich ist ohne Steuergeld zu schon kurz vor Weihnachten Chaos in der Stadt und Rädern, die in Bäumen hängen. Es hat 1000 Fotos gegeben davon

AR: Und Bikes im Wienfluss.

GL: Ja genau noch ohne Strom, aber wenn es die Scooter waren war das auch ein Problem wegen Fluss und Umwelt. Ja genau und die ersten Regularien wurden Anfang 2018 eingeführt wo dann gesagt wurde: maximal 1500 Räder pro Firma, was basierend auf unserer Zahl von

1500 Rädern also von Citybike. Die Firmen mussten auch einen Sitz in Wien haben und Ansprechpartner, der Deutsch spricht und das war schon eine deutliche Verbesserung. Vorher gabs es Leute also oft haben die Firmen eine Lieferfirma beauftragt, ok am Flughafen kommen jetzt 500 neue Räder, ihr nehmt die und tut sie irgendwo auf die Straßen und gut ist es danke.

AR: Es waren ja 3-4 Mitarbeiter pro Firma also es waren ja wenige.

GL: Ja genau und wir haben eben auch zufällig Menschen auf der Straße anscheinend für Ofo gearbeitet haben und die hatten mehrere Handys und haben geschaut wo ist ein Ofo überhaupt zu finden, wie gesagt, wenn die Position nicht mehr gestimmt hat, dann mussten man nur noch suchen. Ich glaube das war nicht so gut durchgesetzt, wie man das heutzutage machen würde. Es hat ein paar Regeln gegeben.

AR: Und waren diese Regularien dann zu streng für FFBSS Anbieter?

GL: Nein da war auf jeden Fall nicht zu streng, weil danach als die Scooter gekommen sind da haben sie es geschafft. Das Problem ist erst dass die Räder nicht viel Geld gebracht haben, also es war generell also es war immer noch ein billiges Dings und sie sind auch weltweit pleite gegangen. Das fand ich interessant, denn so viele Zeitungen in Wien haben gesagt, ja wegen Wien und den Regularien müssen Firmen und Mitarbeiter jetzt arbeitslos werden undso also die Firmen sind weltweit pleite gegangen also im Juni 2018 war es das mit Obike und Ofo. MoBike hat sich ein bisschen länger gehalten und ein paar kleinere Firmen. In Frankreich gab es dieses Indigo, es gab das Pony, das hat bei denen noch ein paar Monate länger gedauert, bis sie pleite gegangen sind. Aber Obike und Ofo haben wirklich versucht die ganze Welt zu erobern und nicht wegen den Regularien in Wien sind sie eingegangen. Also es ist auch ein bisschen komische Pressearbeit gewesen.

AR: Also in den Zeitungsartikeln habe ich mir eben auch durchgelesen, dass sie probiert haben den Markt zu fluten und wahrscheinlich mit wenig Konzept dahinter. Schauen was passiert, wenn ich da unser Studium hernehme, wir bezeichnen das auch immer auf die Region fokussieren muss und schauen was funktioniert in der Stadt und was nicht, denn in Paris wird es jetzt auch wieder ganz anders sein als in Wien. Man muss sich wahrscheinlich auch auf die Stadt einstellen und die politischen Maßnahmen und die Voraussetzungen. Kann auch ein Grund sein, warum es nicht funktioniert hat.

GL: Was interessant ist 2017 ist damals das absolut beste Jahr an seinen Fahrten, dass wir bei Citybike erlebt haben. Paradoxal, aber das hat trotzdem einen Grund, wie die Konkurrenz da war haben wir am meisten Fahrten gehabt und ich glaube, dass die anderen Bikes ungewollt als Werbung für Citybike gewirkt haben. Wo ein Obike vielleicht hier halb gefaltet oder gelegen oder kaputt war, dann haben sich die Leute gedacht: schade ich wäre vielleicht gerne mit dem Fahrrad gefahren und dieses Fahrrad da sagt mir nichts oder wie geht das- zum Beispiel 3 Obikes stehen nebeneinander nagelneu- Kreditkarte habe ich nicht, Smartphone habe ich nicht- das waren andere Zeiten vor 5 bis 6 Jahren.

AR: Ich glaube auch das die Wiener so sind, voll wir wollen die heimische Marke unterstützen.

GL: Das weiß ich nicht. Für Touristen war es auf jeden Fall einfacher über Citybike zu gehen. Ich weiß nicht wie sehr die Einheimischen das Citybike als ihre Marke angesehen haben.

AR: Im Nachhinein gesehen, wie hätte das Projekt mit Ofo und Obike besser funktioniert? Was hätte man da verändern müssen, dass es wirklich funktioniert, hätte auch?

GL: Ich glaube also sowohl der Erfolg oder solange Citybike war der Erfolg von Citybike und danach das Problem von Ofo und von Obike war ein relatives Problem von Nextbike dass sie ein paar Menschen haben die wirklich sich dafür zuständig fühlen und für das Operative in

Wien zuständig sind weil das man einfach ein paar Leute hat die das Rad oder den Scooter reparieren und aufteilen ist nicht genug es muss auch gedacht werden wo sind die Geräte gerade und wie werden sie benutzt wo kann ich die Nutzung unterstützen.

AR: Also das ganze Monitoring und so?

GL: Ja genau also eine Art Operations-Manager oder so also so 2-5 Leute, das ist ja das was wir bei Citybike gemacht haben und bei den Scooters wurde das zum Beispiel wurde das auch verlangt dass Sie einen Operations-manager wirklich vor Ort haben. Und da sieht man auch den Unterschied also es läuft nicht alles perfekt, aber wenn es mit den Scootern so wäre wie es damals mit Ofo und Obike war dann wäre es schon eine deutlich größere Katastrophe. Und ich glaube je nach den Märkten also je nach den Städten und Ländern in Europa oder in der Welt gibt es immer noch Scooter Firmen die ein bisschen egal wie das machen und daher schlechter als Wien oder noch schlechter als Wien das Problem haben von kaputten Scootern oder blockierten Gehsteigen. Ich glaube wirklich essentiell sind ein paar Leute, die wirklich täglich analysieren also systematisch wirklich den Markt analysieren und die Stadt analysieren also dort, wo sie sind, und verstehen was falsch läuft.

AR: Und halt wahrscheinlich in Kombination mit den fixen Abstellflächen.

GL: Ja das ist wahrscheinlich Teil der ganzen Sache. Bei den Scootern hat es bisher auch ohne Abstellflächen gemacht also im Prinzip free-floating.

AR: Denken Sie auch dass es funktionieren könnte, dass das nebeneinander funktioniert, also WienMobilRad und ebenso ein privater FFBSS Anbieter, dass das beides auch in Wien angenommen werden kann.

GL: Nein ich glaube so viel Konkurrenz kann es auch nicht geben. Ich glaube ein Teil der Probleme, die wir mit den Scootern haben im Moment ist, dass wir vier Anbieter haben. Ich glaube das ist zu viel für so einen Markt ich glaube zwei bis drei und bei den Fahrrädern würde ich auch sagen zwei bis maximal drei.

AR: Deswegen wurde es ja auch von der Mobilitätsagentur ausgeschrieben, oder? Dass es nicht zu viele Anbieter sind?

GL: Bei den Scootern?

AR: Ja genau und die Kollegin hat gesagt, dass es halt eben auch für bike-sharing ausgeschrieben war. Dass sich da dann anscheinend niemand gemeldet hat.

GL: Ich würde sagen es war eher eine Absicherung als eine echte Ausschreibung. Die Ausschreibung hat gesagt, wenn es nicht genug Scooter gibt, dann kann man statt dem oder zusätzlich E-Bikes anbieten. Also das war die Idee, wenn es wirklich nur zwei Anbieter gegeben hätte, die sich für die Ausschreibung melden und ein dritter sagt ich mache Ebikes oder ich mache teilweise Scooter und teilweise Ebikes dann würden wir sagen why not. Aber es war eine Absicherung im Endeffekt hatten wir fünf Plätze und alle wollten grundsätzlich Scooter anbieten und daher ist alles nur in Scooter gegangen. Also es wäre möglich gewesen, dass die Firmen Ebikes anbieten.

AR: Also die Tendenz ist eher hin zu den Scootern, oder?

GL: Ja genau.

AR: Ok ja interessant. Ich überlege grade, was wir jetzt noch nicht angesprochen haben. Also was mich auch interessiert ist eben, wie man bikesharing eben auch attraktiv für den Kunden macht- also wie das auch gut funktioniert dass es von den Kunden angenommen wird weil sie auch gesagt haben dass es meistens kompliziert ist und es schwierig ist zum Anmelden und man

kenn sich nicht aus. Was wären da so wichtige Punkte?

GL: Also ich kann sagen, was WienMobil Grade nicht ganz richtig macht. Es ist zum Beispiel, dass Nextbike gerade nicht in der WienMobil App also nicht so drinnen programmiert oder so. Das heißt es gibt schon die Werbung auf Wienmobil App aber eigentlich, wenn ich mich wirklich anmelden muss ich das über Nextbike machen und dann schickt mich Nextbike zu einer Website und für viele ist es dann mehr eine Hürde als wie, wenn es direkt in der App wäre. Also bei Citybike war es wieder anders, weil wir da gar keine App hatten, sondern musste man mit Kreditkarte sich anmelden, das hatte natürlich auch seine Hürde. Ich glaube der andere Punkt ist auch die freien Minuten da denke ich auch das WienMobil sich irrt da. Das heißt es kostet 60 Cent pro halbe Stunde im Moment also 65 Cent ab ersten März.

AR: Stimmt, für Menschen mit der WienMobil Karte ist es die Hälfte glaub ich also 30 Cent.

GL: Also, wenn ich eine WienMobil Karte hätte, dann würde ich auch nicht radfahren. Ich glaube sie verstehen nicht, wer die Zielgruppe ist, also wir haben auch bei Citybike Pendler gehabt also Leute die wirklich jeden oder fast jeden Tag zweimal gefahren sind mit dem Citybike zur Arbeit und zurück und die hatten in der Mehrheit kein Smartphone zum Beispiel. Ihr kannst du ohne Smartphone nichts anfangen also es gibt eine Hotline, aber wer macht das. Letztens haben und die Wiener Linien auch die Statistik gezeigt und gesagt, niemand ruft die Hotline an also es funktioniert alle nutzen nur die App. Das heißt nein ihr erwischt diese Gruppe nicht aber das sehen sie nicht so. Ich weiß nicht, wer die Marktanalyse macht, aber es ist jemand der sich nicht auskennt. Und wo waren wir?

AR: Ich glaube halt auch dass die FFBSS sich eher auf so Tourismusgruppen fokussiert haben, die in Wien sind und dann damit fahren und die Citybikes dann eben eher für die Wiener da waren?

GL: Will ich nicht unbedingt kritisieren also jeder versucht so ein bisschen seinen eigenen Weg zu gehen mit den Tarifen und so. Aber Citybike hat ab der vierten Stunde vier Euro pro Stunde gekostet. Das Ziel für die Nutzer war so viel zu haben ohne viel Geld auszugeben. Also unter 3 Stunden hat es noch drei Euro gekostet also eine Stunde hat genau nichts gekostet und dann wurde das Rad zurückgegeben und dann konnte jemand anderes das Rad wieder nutzen. Und das ist auch ein Ding 2003 muss man bedenken als Citybike angefangen hat gab es deutlich mehr Radverleihe in der Stadt, weil das war auch eine Sache ich komme als Tourist ok ja Wien ist angenehm ich will am Donaukanal oder entlang der Donau einfach fahren okay was mache ich und da gab es unheimlich viele Radverleihe in Wien und das war auch wichtig in dem Moment nicht ihren Markt zu klauen eigentlich also in einem Radverleih wird die erste Stunde nie kostenlos sein. Aber wenn man es für zehn Stunden nimmt das Rad dann kostet es wahrscheinlich 20 bis 30 Euro, ist Citybike wahrscheinlich teurer für 10 Stunden und daher haben sich die Radverleihe und Citybike nicht aneinander kannibalisiert. Niemand hätte auch das Rad zur Arbeit von einem Radverleih genommen und am Abend wieder zurück gegeben also das macht auch wieder keinen Sinn also daher war es sehr schön wieder getrennt. Mit Nextbike ist dieser Preis eigentlich fest aber pro halbe Stunde, wenn ich 10 Stunden fahre, ist das viel billiger als ein Radverleih das Anbieten kann und da frisst Nextbike ein bisschen das Brot von den Radverleih Geschäften.

AR: Okay, die Verleihgeschäfte haben dann aber wahrscheinlich bessere Räder, aber das ist eine andere Sache. Ich wollte nur erwähnen was ich interessant gefunden habe ich war in Turku letztes Semester in Finnland auf Auslandssemester. Und dort machen sie es so, dass wenn du eine Öffi Karte hast, dann kannst du die privaten FFBSS Anbieter, also dort ist Donkey Republic eben, kannst du dann gratis nutzen. Und das ist so cool, weil du hast, dann halt deine

Öffi Karte und scannst sie eigentlich nur am Rad ein und das System erkennt ja du hast eine Karte und sowas könnte ich mir für Wien auch extrem gut vorstellen.

GL: Und das ist nicht was es einbringt im Einkommen also als Einnahmen. Also wenn man bedenkt sie haben wahrscheinlich um die 800000 Fahrten gehabt also WienMobil Rad also die übliche Fahrt ist bei um die 10 Minuten. Aber sagen wir ok die Leute fahren mehr als eine halbe Stunde also machen wir einen Durschnitt von einem Euro zum Beispiel also das heißt sie kriegen weniger als eine Million Euro Einnahmen dafür es ist, dann nicht das, was es kostet. Ich finde auch eigentlich bei WienMobil wenn man zusätzlich 25 Euro im Jahr zahlt dann ist die erste halbe Stunde kostenlos für jede Fahrt. Und ohne WienMobil Karte kann man auch um 25 Euro das gleiche eigentlich kriegen, aber trotzdem muss man es kaufen es ist nicht gegeben also die Möglichkeit ist nicht sofort da und es ist trotzdem ich glaube, dass die Öffi Nutzer und die bike sharing Pendler, also die die das Angebot jeden Tag nutzen, die sind ein bisschen eine andere Zielgruppe und wenn das eine nicht bei dem anderen besser integriert ist was macht das dann für einen Sinn.

AR: Also ich habe mir das auch durchgelesen, die durchschnittliche Fahrt sind nur 11 Minuten. Also die 25 Euro sind dann für das Jahr auch nicht so viel und in den schönen Monaten also im Frühling oder Sommer.

GL: Ja aber 25 Euro durch 30 Cent so viel wie es kostet, wenn man die Jahreskarte hat oder 25 Euro durch 60 Cent, wenn man nicht die Jahreskarte hat. Das heißt 80 Fahrten. Das heißt damals haben wir uns die Statistik angeschaut, wie ich noch bei Citybike war das war zwar das Ende aber wir haben die Tarife erfahren. Und dann haben wir geschaut welcher Anteil an Citybike Fahrten oder Nutzer fahren mehr als 80-mal pro Jahr und das ist ungefähr um die 4% gewesen. Das heißt sie haben so ein super Angebot 25 Euro aber sie haben gar nicht geschaut wen es interessieren kann. Weil wenn man nur 4% der Zielgruppe damit erreicht ist es das überhaupt wert etwas dafür zu machen.

AR: Ja es ist generell in Wien auch so dass Fahrradverkehr jetzt nicht so große Prozentanteile hat von den Leuten, die sich fortbewegen. Ich frage mich dann halt auch immer woran das liegt das liegt wsl schon zu einem großen Teil daran, dass die Öffis so gut ausgebaut sind und weil viele Leute auch noch mit dem Auto fahren. Das habe ich in vielen wissenschaftlichen Artikeln gelesen, dass diese bike sharing Modelle eben genau in dieser „last-mile“ funktioniert, das heißt man fährt mit dem Zug irgendwie zur Station und dann noch so 3-4 Minuten zu seiner Arbeit. Und für diese letzten Meter würde, das halt ganz gut das Auto ersetzen, zum Beispiel Leute die außerhalb von Wien wohnen müssen mit dem Auto zur Zugstation und dann mit dem Zug, das würde zb etwas sein wo Bike-sharing Wege mit dem Auto ersetzen würde um diesen Modal-Split von 80/20 zu erreichen aber das ist wahrscheinlich sehr schwierig weil das auch ein bisschen in der Gesellschaft verankert ist.

GL: Bei aller Liebe für bike sharing, bike sharing allein wird nicht die Welt retten. Es ist schön, dass zu haben und es ist schön ein funktionierendes System zu haben, wenn es geht aber so oder so ich glaube der Modal-Split hängt nicht an bike sharing. Ja in Paris sagt man immer sie haben 40 Millionen Fahrten im Jahr, dort glaube ich sind die Distanzen auch viel kleiner, der Modal Split hängt aber wirklich nicht daran. Es ist schön, wenn es mehr Fahrten gibt, auch die Infrastruktur könnte verbessert werden.

AR: Was könnte man grundsätzlich machen, um mehr Leute zum Fahrradfahren zu bewegen? Viele Leute sagen auch dass sie gerne so Fahrradwege haben, wo das Auto nicht direkt vorbei fahrt also so freistehende Fahrradwege.

GL: Ja also so Infrastruktur ist wichtig und es, wenn es wirklich um den Modal Split geht, muss das Auto verhindert werden. Autofahren muss viel mehr verhindert werden. Es muss viel weniger Parkplätze geben oder eine Art Steuer, wenn man nach Wien fährt.

AR: Sowas wie eine City-Maut?

GL: Naja City-Maut ist eigentlich für die nicht Wiener gemacht und das finde ich eben genau unfair, weil die haben, nicht immer die Möglichkeit einen Zug zu nehmen also in Gablitz ist es wahrscheinlich komplizierter einen Zug zu nehmen als in Perchtoldsdorf. Warum gibt es SUVs die vom 19. Bezirk in den 2. Fahren oder alle Porsche die im ersten Bezirk mit 30 km/h fahren, ich glaube nicht, dass der Herr Porsche sich das gewünscht hat. Allgemein weiß ich nicht, ob das bike sharing eine Maßnahme ist die Fahrradverkehr erhöht. Andersherum es muss an der Verhinderung an Autofahrten gearbeitet werden und das darf ich wirklich als Mobilitätsagentur gar nicht sagen, denn wir sind nicht gegen Autos, wir sind nicht gegen Autofahrer. Ich glaube es gibt keinen Weg, wenn wir den Modal Split noch verbessern wollen also ja weniger Autos in Wien.

AR: Okay danke dann für das Interview. Haben sie noch Fragen oder Anmerkungen?

GL: Ich freue mich, dass das Thema immer noch lebendig ist und wünsche Ihnen viel Glück für die Masterarbeit

AR: Danke Ihnen vielmals für das Gespräch.

Appendix C3: Interview Decoding

Category	Interview Statement
Governance and Policy Making in FFBSS	System dann umgetauscht wurde, da gab es ein paar politische Streits im Jahr 2021 und 2022 da wurde dann Nextbike statt uns also statt Citybike übernommen, wurde ausgeschrieben und dann haben wir mit 31. März 2022 die letzte Fahrt geha
	mein Chef hat nie gemeint so böse zu sein gegen Donkey oder pedal power es war mehr ein, also es kommt drauf man wenn sie damit 30 bis 40 Rädern in der Stadt sind ist es ok, wenn sie auf einmal 5000 versuchen dann haben wir vielleicht e
	Und ja wie sie die Stadt bisschen überrollt haben mit den Rädern dann haben wir als Citybike auch gesehen wie sich die Stadt eben auch sehr gefreut hat. Der Herr Blum oder die Politik damals also die Frau Vassilakou, also viele haben gesag
	Also es gibt schon eine Anzahl an Wienmobilrad Stationen bzw. Scooter-Abstellflächen, die manchmal auf der Parkspur sind, also die einen Parkplatz belegen, also nicht so viele, weil die ja von der Politik fürchten sich ein bisschen von dem
	Es würde wahrscheinlich eine grüne Politikerin sich mehr trauen so etwas zu machen also ich glaube die SPÖ bleibt ein bisschen also will schon relativ grün agieren auch das Fahrrad fördern aber ohne, dass da Auto schlechter zu machen.
	ersten Regularien wurden Anfang 2018 eingeführt wo dann gesagt wurde: maximal 1500 Räder pro Firma, was basierend auf unserer Zahl von 1500 Rädern also von Citybike. Die Firmen mussten auch einen Sitz in Wien haben und Ansprechpa
	Ich glaube das war nicht so gut durchgesetzt, wie man das heutzutage machen würde. Es hat ein paar Regeln gegeben.
	, ja wegen Wien und den Regularien müssen Firmen und Mitarbeiter jetzt arbeitslos werden undso also die Firmen sind weltweit pleite gegangen also im Juni 2018 war es das mit Obike und Ofo
	Aber Obike und Ofo haben wirklich versucht die ganze Welt zu erobern und nicht wegen den Regularien in Wien sind sie eingegangen.
Usage and user attitudes of FFBSS	Alle wünschen sich stationsbasiert, und stationslos ist weder für die Nutzer, die nicht unbedingt wissen wo bin ich sicher, dass ich ein Gerät finde mittels einer App
	Wo ein Obike vielleicht hier halb gefaltet oder gelegen oder kaputt war, dann haben sich die Leute gedacht: schade ich wäre vielleicht gerne mit dem Fahrrad gefahren und dieses Fahrrad da sagt mir nichts oder wie geht das- zum Beispiel 3 O
	Für Touristen war es auf jeden Fall einfacher über Citybike zu gehen. Ich weiß nicht wie sehr die Einheimischen das Citybike als ihre Marke angesehen haben.
	Ich glaube der andere Punkt ist auch die freien Minuten da denke ich auch das WienMobil sich irrt da. Das heißt es kostet 60 Cent pro halbe Stunde im Moment also 65 Cent ab ersten März.
	musste man erstmal 20 oder 80 Euro hochladen, dass man überhaupt damit fahren darf es gab nicht so gute Möglichkeiten zum Zahlen wie heutzutage.
	Ich glaube sie verstehen nicht, wer die Zielgruppe ist, also wir haben auch bei Citybike Pendler gehabt also Leute die wirklich jeden oder fast jeden Tag zweimal gefahren sind mit dem Citybike zur Arbeit und zurück und die hatten in der Mehr
	Ich finde auch eigentlich bei WienMobil wenn man zusätzlich 25 Euro im Jahr zahlt dann ist die erste halbe Stunde kostenlos für jede Fahrt. Und ohne WienMobil Karte kann man auch um 25 Euro das gleiche eigentlich kriegen, aber trotzdem n
	Ja aber 25 Euro durch 30 Cent so viel wie es kostet, wenn man die Jahreskarte hat oder 25 Euro durch 60 Cent, wenn man nicht die Jahreskarte hat. Das heißt 80 Fahrten. Das heißt damals haben wir uns die Statistik angeschaut, wie ich noch b
Financing and Subsidies in FFBSS	kommen Sie zuerst alle mit haha wir brauchen keinen Strom wir brauchen keine Stationen kein Startgeld usw. Und dann nach drei, sechs oder neun Monaten je nachdem nach dem Anbieter gibt es diese: naja, vielleicht könnten wir auch ein biss
	Nein da war auf jeden Fall nicht zu streng, weil danach als die Scooter gekommen sind da haben sie es geschafft. Das Problem ist erst dass die Räder nicht viel Geld gebracht haben, also es war generell also es war immer noch ein billiges Di
	, ja wegen Wien und den Regularien müssen Firmen und Mitarbeiter jetzt arbeitslos werden undso also die Firmen sind weltweit pleite gegangen also im Juni 2018 war es das mit Obike und Ofo
	Will ich nicht unbedingt kritisieren also jeder versucht so ein bisschen seinen eigenen Weg zu gehen mit den Tarifen und so. Aber Citybike hat ab der vierten Stunde vier Euro pro Stunde gekostet. Das Ziel für die Nutzer war so viel zu haben o
	Aber wenn man es für zehn Stunden nimmt das Rad dann kostet es wahrscheinlich 20 bis 30 Euro, ist Citybike wahrscheinlich teurer für 10 Stunden und daher haben sich die Radverleihe und Citybike nicht aneinander kannibalisiert. Niemand
	Aber sagen wir ok die Leute fahren mehr als eine halbe Stunde also machen wir einen Durschnitt von einem Euro zum Beispiel also das heißt sie kriegen weniger als eine Million Euro Einnahmen dafür es ist, dann nicht das, was es kostet
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Infrastructure and technologies in FFBSS	Und auch diese GPS-Steuerung ist eigentlich ursprünglich durch das Handy gegangen also es hat wahrscheinlich mit Bluetooth kommuniziert aber das Rad an sich hatte keine GPS-Daten, keinen Sensor oder so. Daher, wenn ein Rad verschwun
	und es hat sich ganz gut angefühlt beim Fahren daher habe ich keine Kritik, technisch keine Kritik, diese Drehklingel am Lenkergriff war auch relativ eine Innovation auch damals wo wir dann auch geschaut haben ok ja könnte man auch mache
	Also eigentlich ist Nextbike stationslos, auch wenn man sieht in Niederösterreich zum Beispiel es ist oft es sind ganz normale Rad Bügel und da gibt es ein Schloss, die Schlossnummer per Handy oder so und das wars. In Wien funktioniert es a
	Und die Scooter in Wien laufen ein bisschen ähnlich, weil es seit letztem Jahr diese Abstellflächen haben und viele Scooter Betreiber sagen uns jetzt also das ist ideal so müssen wir auch nicht die ganze Gegend absuchen, denn es gibt 100 Me
	Also es gibt schon eine Anzahl an Wienmobilrad Stationen bzw. Scooter-Abstellflächen, die manchmal auf der Parkspur sind, also die einen Parkplatz belegen, also nicht so viele, weil die ja von der Politik fürchten sich ein bisschen von dem
	Fixe Abstellflächen: Ja das ist wahrscheinlich Teil der ganzen Sache. Bei den Scootern hat es bisher auch ohne Abstellflächen gemacht also im Prinzip free-floating.
	Es ist zum Beispiel, dass Nextbike gerade nicht in der WienMobil App also nicht so drinnen programmiert oder so. Das heißt es gibt schon die Werbung auf Wienmobil App aber eigentlich, wenn ich mich wirklich anmelden muss ich das über
Monitoring and operation of FFBSS	Wiener Linien zu kritisieren, aber ich weiß noch wie bei der bei der Umstellung auf Nextbike haben sie gesagt, ja wir werden verdichten und auch, also wir verdoppeln die Anzahl der Stationen und werden noch verdichten in der ganzen Stadt.
	Und die Scooter in Wien laufen ein bisschen ähnlich, weil es seit letztem Jahr diese Abstellflächen haben und viele Scooter Betreiber sagen uns jetzt also das ist ideal so müssen wir auch nicht die ganze Gegend absuchen, denn es gibt 100 Me
	Naja, wenn man will das ist was WienMobil ist. Also das sind stationslose Fahrräder, die trotzdem manche Scheinstationen haben, sodass die Leute verstehen, wohin man das Rad bringen muss oder wo man es finden kann, wo die Techniker a
	noch für die Firmen selbst die dann viel mehr leere Kilometer machen, um die eigenen Räder zu suchen, wenn sie kaputt oder verschwunden sind. Ich glaube eine gute Dichte wie zum Beispiel das bikesharing System in Paris mittlerweile hat-
	Also es gibt schon eine Anzahl an Wienmobilrad Stationen bzw. Scooter-Abstellflächen, die manchmal auf der Parkspur sind, also die einen Parkplatz belegen, also nicht so viele, weil die ja von der Politik fürchten sich ein bisschen von dem
	Ja genau und wir haben eben auch zufällig Menschen auf der Straße anscheinend für Ofo gearbeitet haben und die hatten mehrere Handys und haben geschaut wo ist ein Ofo überhaupt zu finden, wie gesagt, wenn die Position nicht mehr gestimm
	Ich glaube das war nicht so gut durchgesetzt, wie man das heutzutage machen würde. Es hat ein paar Regeln gegeben.
	Aber Obike und Ofo haben wirklich versucht die ganze Welt zu erobern und nicht wegen den Regularien in Wien sind sie eingegangen.
	Ich glaube also sowohl der Erfolg oder solange Citybike war der Erfolg von Citybike und danach das Problem von Ofo und von Obike war ein relatives Problem von Nextbike dass sie ein paar Menschen haben die wirklich sich dafür zuständi
	Ja genau also eine Art Operations-Manager oder so also so 2-5 Leute, das ist ja das was wir bei Citybike gemacht haben und bei den Scooters wurde das zum Beispiel wurde das auch verlangt dass Sie einen Operations-manager wirklich vor
General information FFBSS/ bike sharing	Also es geht, es ging oder es geht mittlerweile besonders um Scooter, aber immerhin haben wir ein bisschen die Schnittstelle auch mit den Wiener Linien, dass wir auch über WienMobil Auto oder WienMobil Rad
	Sie waren nicht free-floating, aber Sie waren stationslos und das ist auch wieder oft haben wir hinterfragt die Begriffe, weil zum Beispiel Ofo und Obike sind stationslos, Citybike war nicht stationslos, aber beide waren free-floating. Weil bei
	Genau, nein nein aber die Sache ist wir haben eigentlich mehr die Schwäche von dem System gesehen als die Kräfte
	Wir haben dann alles beobachtet und es hat uns nicht unbedingt glücklich gemacht ursprünglich natürlich aber wir haben auch wirklich dann beobachtet, dass es nicht so benutzt wurde wie man denken könnte. Glaube auch dass die Räder nicht
	Also eigentlich ist Nextbike stationslos, auch wenn man sieht in Niederösterreich zum Beispiel es ist oft es sind ganz normale Rad Bügel und da gibt es ein Schloss, die Schlossnummer per Handy oder so und das wars. In Wien funktioniert es a
	Was interessant ist 2017 ist damals das absolut beste Jahr an seinen Fahrten, dass wir bei Citybike erlebt haben. Paradoxal, aber das hat trotzdem einen Grund, wie die Konkurrenz da war haben wir am meisten Fahrten gehabt und ich glaube, d
	Nein ich glaube so viel Konkurrenz kann es auch nicht geben. Ich glaube ein Teil der Probleme, die wir mit den Scootern haben im Moment ist, dass wir vier Anbieter haben. Ich glaube das ist zu viel für so einen Markt ich glaube zwei bis drei
	Ich würde sagen es war eher eine Absicherung als eine echte Ausschreibung. Die Ausschreibung hat gesagt, wenn es nicht genug Scooter gibt, dann kann man statt dem oder zusätzlich E-Bikes anbieten. Also das war die Idee, wenn es wirklich
	Bei aller Liebe für bike sharing, bike sharing allein wird nicht die Welt retten. Es ist schön, dass zu haben und es ist schön ein funktionierendes System zu haben, wenn es geht aber so oder so ich glaube der Modal-Split hängt nicht an bike shar
	Ja also so Infrastruktur ist wichtig und es, wenn es wirklich um den Modal Split geht, muss das Auto verhindert werden. Autofahren muss viel mehr verhindert werden. Es muss viel weniger Parkplätze geben oder eine Art Steuer, wenn man na
	Naja City-Maut ist eigentlich für die nicht Wiener gemacht und das finde ich eben genau unfair, weil die haben, nicht immer die Möglichkeit einen Zug zu nehmen also in Gablitz ist es wahrscheinlich komplizierter einen Zug zu nehmen als in P
Free floating offers nowadays in Vienna	Und die Scooter in Wien laufen ein bisschen ähnlich, weil es seit letztem Jahr diese Abstellflächen haben und viele Scooter Betreiber sagen uns jetzt also das ist ideal so müssen wir auch nicht die ganze Gegend absuchen, denn es gibt 100 Me
	Und die Scooterfirmen sagen uns auch dass sie gerne mehr Abstellflächen und Stationen hätten, sodass sie sehr dicht also die Scooter haben könnten
	Ich würde sagen es war eher eine Absicherung als eine echte Ausschreibung. Die Ausschreibung hat gesagt, wenn es nicht genug Scooter gibt, dann kann man statt dem oder zusätzlich E-Bikes anbieten. Also das war die Idee, wenn es wirklich