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Car Sharing Services in Sweden and Spain

Market, environmental and behavioural insights

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August 2020

Sharing Cities Sweden

A NATIONAL PROGRAM FOR THE SHARING ECONOMY IN CITIES

Sharing Cities Sweden is a national program for the sharing economy in cities. The program aims to put Sweden on the map as a country that actively and critically works with the sharing economy in cities. The objectives of the program are to develop world-leading test-beds for the sharing economy in Stockholm, Gothenburg, Malmö and Umeå, and to develop a national node in order to significantly improve national and international cooperation and promote an exchange of experience on sharing cities.

Title: Car Sharing Services in Sweden and Spain: Market, environmental and behavioural insights

Authors[1]**:** Joseph Anthony L. Reyes, José M. Cansino, Rocío Román-Collado, and Luis Mundaca

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Med stöd från:

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Executive Summary

The report at hand is an outcome of the BE-USE project[2], which aims to analyse sustainable urban sharing initiatives from a behavioural economics perspective. The objective is to improve the knowledge about cognitive, motivational and contextual factors that can have impact on decision-making processes and choices in urban sharing initiatives. Experiments will be conducted to test, examine and generate policy recommendations addressing selected urban sharing initiatives.

This report is developed under Phase 1 of the BE-USE project. Its purpose is to provide an understanding of Car Sharing Services (CSS), which is one of the potential case studies for the experimental phase (i.e. Phase 2 of the project). The term CSS is herein defined as any formal initiative (private or public) that offers customers access to mobility services as opposed to (car) ownership. Consistent with the geographical scope of the project, the report addresses CSS initiatives in Sweden and Spain. We pay particular attention to market, environmental and behavioural issues. The report is guided by the following research questions: what can be said about the development of CSS initiatives in Sweden and Spain? What are the main environmental features of the CSS? What are the main factors underlying (unsustainable) consumer behaviour? And, what are the main motivating or hindering factors affecting the adoption of CSS in the analysed countries?

With due limitations, our findings confirm various aspects about CSS. First, CSS initiatives are becoming more prominent and multiple operators and business models are identified. In fact, CSS initiatives can be traced back to several decades ago (as in Sweden). Overall, market trends (and related research efforts) show a growing interest in the development of CSS initiatives. However, a number of economic, policy and environmental issues appear to hinder the ability of the CSS initiatives to materialise their potential. Second, our findings also confirm the uncertainties, debates and lack of research about the environmental performance of CSS in the countries under analysis. On the one hand, one can observe that CSS have the potential to reduce car ownership and resultant car mileage, emissions, congestion and the need for parking space. It can also increase preferences towards fuel-efficient or electric cars and complement public transportation and active mobility. On the other hand, the available information also suggests that certain car owners cannot forego car ownership so CSS may only substitute the services of a second/third car. Moreover, CSS also shows the potential to substitute active mobility or public transportation. Third, and despite the limited information, our study reveals various factors motivating but also hindering the (potential) adoption of CSS. On the positive side, economic reasons, convenience, environmental concerns, conformity towards emerging social norms, and innovative business platforms are indicated to foster the (future) adoption of CSS. On the contrary, the lack of policy action (e.g. VAT), the perceived low cost of owning a car, reliability, security and aspects preventing accessibility (e.g. parking) are often cited as factors limiting consumer uptake.

In conclusion, there is a need to further understand the motivations and barriers that affect the (non-)adoption of CSS initiatives. While much attention has been devoted to business models and market development, behavioural aspects and environmental impacts are areas that deserve much more attention. From a methodological point of view, the findings indicate various avenues supporting the research ahead. For example, we need to have a better understanding of the behaviour(s) to be changed (e.g. reactance) or encouraged (e.g. acceptance) in relation to the (non-)adoption of CSS. We are also at the beginning of understanding the potential behavioural anomalies and cognitive biases that may be applicable to CSS. Behavioural research on transport mode provide a useful platform to advance this. Current knowledge shows promising avenues for the analysis of social norms as applied to CSS and implications for sustainable mobility.

[2] For details visit [project website]

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1 Introduction

The 'Sharing Economy' (SE) has emerged as a phenomenon widely described as promoting more sustainable practices such as access over ownership (Curtis & Lehner, 2019). The SE is expected to provide economic opportunities, more sustainable forms of consumption, and a path to a decentralized, equitable and sustainable economy (Martin, 2016). A description of SE often includes relevant semantic elements such as information and communication technology (ICT) mediation, motivation for ownership, temporary access, rivalrous and tangible goods (Curtis & Lehner, 2019). As such, SE is usually defined as a peer-to-peer based sharing of access to goods and services, which is facilitated by a community-based online platform that focuses on the sharing of underutilised assets in ways that improve efficiency, sustainability and community (Mi & Coffman, 2019).

Among the ubiquitous terms associated with the SE phenomenon, 'collaborative consumption', 'peer-to-peer economy', 'product–service systems' and 'circular economy' are frequently highlighted in the literature (Cheng, 2016; Curtis & Lehner, 2019; Mont, 2002, 2019). By allowing individuals, communities, organizations and policy makers to re-think the way we live, grow, connect and sustain, it is argued that SE will start transforming many aspects of our current socio-economic system (Cheng, 2016), and that over time, it should help fostering structural change towards low-carbon economies (Mi & Coffman, 2019) in a post COVID-19 world.

Within this context, the BE-USE project aims to analyse sustainable urban sharing initiatives from a behavioural economics perspective. The objective is to improve our knowledge about cognitive, motivational and contextual factors that can have impact on decision-making processes and choices in urban sharing initiatives. Experiments will be conducted to test, examine and generate policy recommendations addressing selected urban SE initiatives in Sweden and Spain (the geographical scope of the project). Behavioural interventions (e.g. via social norms, choice settings, goal commitment) targeting the adoption of sustainable urban sharing initiatives will be tested and impacts analysed. Building upon a multidisciplinary team of researchers, the project provides policy recommendations for improvements, scaling and mainstreaming of sustainable urban sharing initiatives. To that end, under Phase I, the project seeks to identify sustainable urban sharing initiatives already implemented in Sweden and Spain with the potential for market uptake or market expansion. In turn, Phase I seeks to better understand consumer behaviour(s) that need(s) to be changed in order to advance sustainable urban sharing initiatives.

In the transport sector, car sharing has been proposed to advance sustainable modes of transportation and alternatives to private ownership of vehicles (Ferrero et al., 2018; Hartl et al., 2018). It is often defined as a mobility service, rather than car ownership *per se*, that offers consumers access to a shared fleet of vehicles in an organized and collaborative manner (Katzev, 2003; Loose et al., 2006; Rickenberg et al., 2013). The concept of car sharing is based on the distinction between access to automobiles and car ownership (Katzev, 2003). The notion of automobile use is separated from ownership by 'Car Sharing Services' (CSS), through systems and business models that allow individuals convenient access to a shared fleet of vehicles instead of a single privately owned one (Katzev, 2003). In this configuration, "individuals gain the benefits of a private automobile without the responsibilities and costs of car ownership" (Shaheen & Cohen, 2013, p. 6). Car sharing offers a flexible alternative that cater to diverse transportation needs worldwide, while, in principle, reducing the negative impacts of private automobile ownership (Shaheen & Cohen, 2013). In fact, positive aspects of CSS include its contribution towards lessening private car ownership and resultant reductions on mileage and emissions (Katzev, 2003; Lane, 2005; Meijkamp, 1998; Rabbitt & Ghosh, 2016), as well as complementarity to public transportation and active mobility (Ferrero et al., 2018; Katzev, 2003; Plepys et al., 2015).

As a value proposition, early car sharing models were often driven by cost-savings, rather than environmental concerns (Shaheen & Cohen, 2007). Over the past decades, car sharing has grown as transportation mode (Shaheen & Cohen, 2013), with a total estimated worldwide membership of 4.8 million people in 2014 and about 104,000 vehicles (Greenblatt & Shaheen, 2015). Car sharing began appearing in Europe more than seven decades ago. It has expanded to approximately "1,100 cities worldwide, in 26 nations on five continents", and with market growth observed in recent years (Shaheen & Cohen, 2013, p. 6). It is among a growing trend of business models, such as time-shares, office equipment leasing, agricultural cooperatives, and internet-based software that are moving away from private (individual) ownership towards the provision of access and services (Katzev, 2003). Technological developments have also increased the popularity of on-demand mobility services. (Greenblatt & Shaheen, 2015). Consumers enjoy benefits of car sharing such as lower cost of not owning a car, but there are new risks borne from consumers demand on car sharing configurations related to, for example service reliability (Le Vine, Zolfaghari, et al., 2014). It is estimated that between 2015 and 2018 the number of global car sharing members increased from 7 million to 27 million (Stolle et al., 2019). From the estimated 370,000 shared cars in Europe in 2018, car sharing is expected to grow up to 7.5 million shared cars by the year 2035 (Erich, 2018).

However, it needs to be acknowledged that there are concerns and uncertainties about the environmental credentials of car sharing. For example, research conducted on possible impacts due to changes in car ownership and mobility in the United States found that reduced car ownership did not correspond to a reduction in vehicle miles of travel. On the contrary, car sharing induced greater automobile travel among individuals who were formerly carless (Katzev, 2003). Increases in CO_2 emissions can also occur as individuals who do not own automobiles switch from public transit to car sharing vehicles (Jung & Koo, 2018). A study of eleven car sharing organizations in North America that examined the effects of roundtrip car sharing on public transit and non-motorized travel in 2008 found that across the entire sample, results showed an overall decline in bus use and rail use (Martin & Shaheen, 2011).[3] Studies also show that some car owners cannot forego car ownership, or that shared cars mostly substitute the services of a second or third car (Ferrero et al., 2018; Nijland & van Meerkerk, 2017). As a whole, it is argued that the expansion of car sharing fleets need be viewed with caution due to its implications on sustainable transport, such as the potential of rebound effects from increased car usage, and impacts on sustainability in the substitution of public transportation and active mobility (Firnkorn & Müller, 2011; Le Vine, Lee-Gosselin, et al., 2014; Martin et al., 2012).

Nevertheless, the substantial growth of car sharing worldwide is touted as a sustainable solution to environmental problems (Hartl et al., 2018), and potential effects to greenhouse gas (GHG) emissions and public transportation are the subject of myriad debates (Jung & Koo, 2018; Shaheen et al., 2004). In addition to observed market growth and development, car sharing "is regarded as a potential lever for change in sustainable mobility transitions" (Bocken et al., 2020, p. 1).

Within this context, this project report aims to provide a brief understanding of one of the chosen case studies under the BE-USE project: car sharing services. It presents salient issues and extant research concerning CSS in Sweden and Spain, and then followed by a discussion of insights garnered from stakeholders, barriers, uncertainties and obstacles hindering adoption, and conclusions derived. In turn, the report aims to provide important consumer-related building blocks for the design and application of behavioural economics interventions in Phase II. In this report, the term CSS is broadly defined as any formal initiative (private or public) that offers customers access to mobility services as opposed to (car) ownership[4]. Services *per se* take various forms and include, a *two-way use* (where available cars are parked in pick-up stations and trips must start and finish in the same place), *one-way use* (similar to a two-way use but "the parking lot in which the journey ends can be different from the station in which it starts"), and *free-floating* (where 'cars are freely parked within an area served by an operator so the journey can start and end in any point within this area') (Ferrero et al., 2018, p. 502). On this basis, the report is guided by the following research questions:

- What can be said about the development of CSS initiatives in Sweden and Spain?
- What are the main environmental features of the car sharing industry?
- What are the main factors underlying (unsustainable) consumer behaviour?
- What are the main motivating or hindering factors affecting the adoption of CSS in the analysed countries?

[3] As such, with consideration as well to context-specific situations and impacts, more efficient vehicles with higher fuel efficiency and longer life cycles could be allocated by providers in order to reduce the potential negative impacts of car sharing to the environment (Jung & Koo, 2018).
[4] Note that 'ridehailing' services such as Uber or Lyft are outside the scope of this report. Where possible, 'P2P ridesharing' (i.e. where passengers share a ride) initiatives are addressed (e.g. BalBlaCar in Spain).

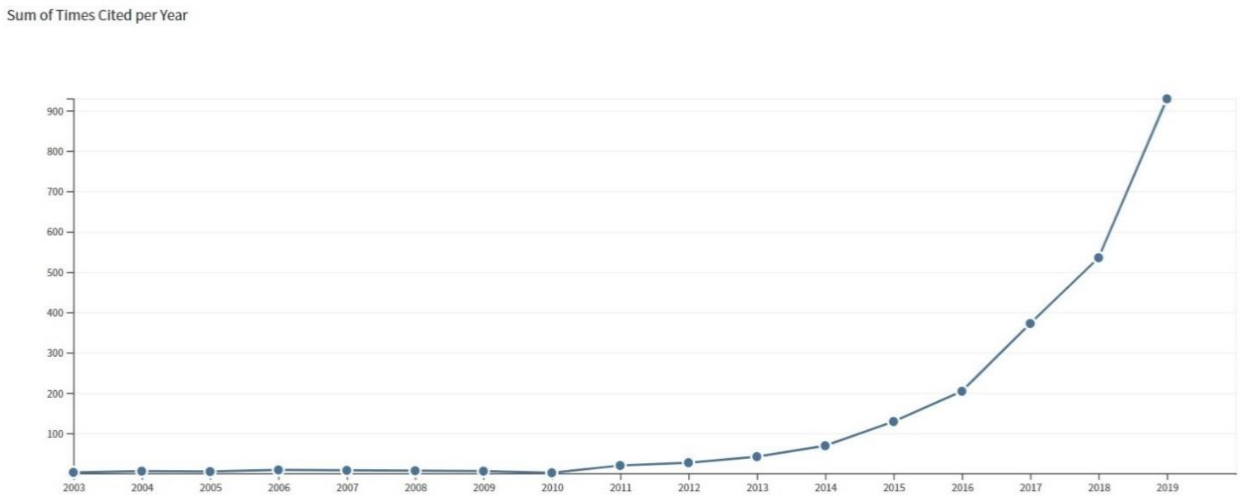
Before addressing these questions, some relevant aspects of car sharing (and related conceptual elements) need to be mentioned. First, although car sharing has been around for decades, increased interest in SE and recent advances in mobile and internet technology have facilitated the innovation of completely new business models within SE and types of car sharing (Münzel et al., 2018; Remane et al., 2016). This has led to the emergence numerous business models (and respective operators) of car sharing services under three main archetypes such as: Business-to-Consumer (B2C), peer-to-peer (P2P) and non-profit/cooperative Car sharing models (Bocken et al., 2020; Cohen & Kietzmann, 2014). For B2C models, a company acquires vehicles and supplies them at key locations in a city. There are two categories or specific market segments of B2C. Roundtrip configurations require members to return the vehicle to the same point where it was acquired, while point-to-point (one-way) models allow members to leave the vehicle parked in the vicinity of their destination (Cohen & Kietzmann, 2014). Paid relocation is a strategy for B2C companies in which users are offered specific routes for relocation in addition to a current booking, and are compensated by free minutes or a bonus. In P2P car sharing, "vehicles are lent from user to user through an online platform" (enabled by web or mobile technology) where users can select from the vehicles available in their area (Bocken et al., 2020, p. 9). It is usually up to the discretion of vehicle owners how they set the terms for price and durations of the car share (Bocken et al., 2020). P2P models are not tied to a location or pickup points as they are dependent on private owners in the area advertising their vehicles (Bocken et al., 2020). For non-profit/cooperative models of car sharing, "vehicles are either owned by one member and shared with the cooperative, or members pool together finances to maintain joint ownership of a vehicle" (Bocken et al., 2020, p. 8). With its origins in Europe in the 1960s and 1970s, "members collectively contribute resources and manage the car sharing organization usually without the expectation of financial gain" (Cohen & Kietzmann, 2014, p. 285).

Second, the above archetypes can be differentiated by: their value proposition, supply chain, customer interface, and financial model. For example, while B2C models are, in principle, in the position to offer various services (e.g. station based and free-floating), P2P and cooperatives often opt for a two-way use. Different car sharing models also offer different value propositions providing users with measureable ecological and/or social value in concert with economic value (Cohen & Kietzmann, 2014). Among several elements, the supply chain of CSS involves fleet characteristics (electric, hybrid, etc.) and suppliers taking care various operational aspects (i.e. maintenance, insurance) as well as communication with stakeholders (Cohen & Kietzmann, 2014). Customer interface deals with motivation of customers to take responsibility for their consumption, as well as shifts from vehicle acquisition to shared use (for B2C, Cooperative) and encouraging vehicle owners to share an underutilized resource. The financial model of any CSS initiative also reflects the distribution of economic costs and benefits among actors involved in the business model and accounts for the company's ecological and social impacts (Cohen & Kietzmann, 2014).

Third, with the "growth of car sharing services as a new and more sustainable way of transportation" (Ferrero et al., 2018, p. 501), some emergent car sharing configurations do not necessarily fit in the B2C, P2P, or cooperative archetypes (Abdelfaki et al., 2013; Ferrero et al., 2018). In fact, it must be noted that although an officially and universally accepted definition of car sharing and its business models remains elusive, it can be broadly defined as practices wherein multiple people in a for-profit or non-profit organisation share the use of multiple vehicles in exchange for a fee (Ampudia-Renuncio et al., 2018). This said, various taxonomies and typologies have arisen that take into account CSS business models that cater to novel market and customer segments (e.g. ride-hailing services offered by Uber and Lyft in certain countries), with their characteristics of dimensions such as value propositions (destination, duration, vehicle types, benefits), interface (vehicle booking and access), service platform (booking, parking infrastructure), organizing model (vehicle ownership, maintenance, refuelling), and revenue model (price structure, revenue, organizational ownership) (Remane et al., 2016). Other ways that car sharing models are categorized are based on their respective areas of operation and purpose, defined as: neighbourhood residential, Business, College/university, Government and institutional fleets, Public transit, One-way, Personal vehicle sharing, Vacation/resort (Shaheen & Cohen, 2013). These are then understood within their dimensions of market segments, parking, insurance, technology, vehicles and fuels used (Remane et al., 2016; Shaheen & Cohen, 2013).

Fourth, there has been growing scientific and public policy interest in CSS (Dolan et al., 2012; Ferrero et al., 2018; Hull, 2008; Shaheen & Cohen, 2013). In terms of scientific publications on the topics relevant to car sharing, results from the Web of Science (WoS) for the years 2003 to 2019 globally, indicate an overall increase in both interest in the subject and publications by year (see Figure 1).

Figure 1: Number of scientific publications about car sharing found on the Web of Science for the period of 2003 to 2019 (Source: Authors own dataset compiled from WoS citation report).



With due limitations, this report contributes toward a better understanding of CSS by presenting salient issues and extant research concerning car sharing and consumer behaviour. Section 2 briefly describes the methodology. Section 3 provides a brief overview of the transportation industry, and pays particular attention to environmental and behavioural issues. Section 4 identifies and describes CSS currently operating in Sweden and Spain. Given the orientation of our project, attention is given to consumer and environmental issues. The section also provides a discussion of insights garnered from stakeholder's interviews about barriers, uncertainties and obstacles hindering the adoption of car sharing. This provides foundations for consumer-related aspects for the design and application of behavioural economics interventions in next phase of the project.

2 Methodology

Consistent with our research on sustainable fashion consumption under the BE-USE project[5], the overall methodology of this report is simple. First, an extensive literature review on the subject of car sharing was carried out. To the possible extent, specific aspects for Sweden and Spain are explicitly highlighted whenever available data or information exist. Given the scope and orientation of our project, attention is given to environmental and behavioural aspects.

Second, in approaching behavioural aspects, the identification of (potential) behavioural anomalies and cognitive biases affecting consumers in the fashion industry is carried out guided by behavioural economics (BE). Behavioural anomalies (or 'irrationalities') are often defined as deviations that explain why individuals do not behave according to or as predicted by a rational theory model that dominates neoclassical economics (Shogren & Taylor, 2008). When behavioural anomalies (e.g. heuristics, loss aversion) produce systematic differences between decision-making utility (which is expected or intended at the time of choice) and experienced utility (which is eventually felt or experienced after the choice), they are labelled as behavioural failures (Gillingham & Palmer, 2014). In simple terms, BE draws insights from psychology and other social sciences to increase the explanatory power of economics (Camerer et al., 2003; Lehner et al., 2016; Pollitt & Shaorshadze, 2013). BE pays particular attention to the analysis of behavioural anomalies (or failures) and contextual factors affecting decision-making processes and choices (Camerer et al., 2003; Frederiks et al., 2015; Kahneman et al., 1991). This is done in order to better understand consumer decision-making, related choices and support the development of consumer policy.

Third, we identify car sharing initiatives currently operating in Sweden and Spain and provide the latest market developments. To support this exercise, stakeholder interviews were conducted with key personnel from the car sharing services operating in Sweden (see Interview Protocol in Annex 1). The interview instrument was adapted from similar research on sustainable consumption in Sweden under BE-USE with items adjusted accordingly for the scope and objectives of the present study. Adopting the approach of previous research on car sharing business models in Sweden (Bocken et al., 2020), a total of 7 car sharing organisations were approached in April 2020 for interviews, resulting in 2 positive responses. Both respondents (Snappcar, GoMore) belong to the P2P business model.

Limitations of this study are acknowledged, as cases and research being subject to availability of information and resource persons in both Sweden and Spain. It must be noted that the sample size of interviewees conducted in Sweden are limited and statistically not fully representative of all car sharing business models and users in the country. In addition, other actors (e.g. municipalities, property developers) that may also have their views and experience about CSS were not interviewed. It is also relevant to highlight that the peer

[5] The BE-USE Report on collaborative fashion consumption in Sweden and Spain is available here

reviewed literature about car sharing focusing on Sweden[6] and Spain[7] is rather limited in number, and a comprehensive study of (potential) adopters' behaviours and motivations in is yet to be done. The interviews are also limited to the case of Sweden, as in Spain interviews were not possible to carry out due to the Covid-19 pandemic. Nevertheless, and with due limitations, this report is intended to serve as a basis for subsequent phases of the BE-USE project and further studies aiming to better understand behavioural and environmental challenges related to CSS in the analysed countries.

[6] See for instance works of Noll (2017), Sprei and Ginnebaugh (2018)
[7] See also studies, for example, by Ampudia-Renuncio et al. (2018, 2020); Guirao et al.(2018); Prieto et al. (2017); Silvestri et al.(2018)

3 Transport and car usage: A snapshot

3.1 Environmental aspects

From a global perspective, the transport sector is among the major final consumers of total energy and contributors to greenhouse gas (GHG) emissions (Solaymani, 2019). More than a quarter of the world's energy use is allocated to this sector (Creutzig, 2016, p. 341), amounting to 29% of total energy consumption and 65% of world oil products consumption (Solaymani, 2019, p. 989). For mitigating GHG emissions, this sector plays an important role as it contributes with 24% of global CO_2 emissions from fuel combustion (Solaymani, 2019, p. 989) with three quarters of these emissions originate in road vehicles. In 2017, emissions from the combustion of fuel for all transport activity was at 8.04 Gt of CO_2 and specifically for emissions arising from fuel use in road vehicles, it stood at 5.96 Gt of CO_2 (IEA, 2019a).

Private cars are largely responsible for many environmental and social problems (Kahn Ribeiro et al., 2012; Katzev, 2003). Automobile usage is a major source of air and noise pollution, contributing to carbon monoxide, nitrogen oxides, and hydrocarbon emissions (Katzev, 2003). About 10% of the global population account for 80 % of total motorized passenger-kilometres (p-km) and OECD countries dominating GHG transport emissions (Bednar-Friedl et al., 2015). To accommodate vehicle usage demands, the environment had been reshaped drastically, with important portions of the urban landscape being devoted to highways, parking spaces, service facilities, highway billboards and automobile junkyards (Katzev, 2003). In many cities traffic congestion and air quality are becoming serious problems that need to be urgently addressed with low-carbon mobility policies (Gota et al., 2019).

Efforts towards the mitigation of emissions from the transportation entail reductions of carbon intensity of fuels, enhancing vehicles energy efficiency, shifting modes of transport, and reducing demand (Creutzig, 2016). Furthermore, the optimization of the electricity structure, promotion of clean and renewable energies use, increased access to public transportation, and controlling the population of private automobiles are measures also highlighted in the literature (Solaymani, 2019). In particular, and to increase the credentials of the transport sector in the context of the Climate Paris Agreement, the literature stresses a variety of ‘avoid’, ‘shift’ and ‘improve’ (ASI) strategies (Gota et al., 2019). Avoid strategies aim to reduce the need to travel and transport trips, which include improved urban planning and e-communication options, managing transport demand. Shift strategies moves towards more efficient or clean transportation, such as non-motorized, public transport, or rail freight. Improve strategies aims to increase energy and carbon efficiency of vehicles through technological developments and standards (Bakker et al., 2014; Gota et al., 2019). These strategies within the ASI approach provide an organizing framework that can fit a large range of diverse policies, regulatory instruments and best practices (Bakker et al., 2014). Among low-carbon strategies, the ‘Avoid’ strategy should be implemented first, followed by the ‘Shift’ strategy and finally an ‘Improve’ strategy (Bakker et al., 2014). Car use (petrol/diesel) and air travel are the least preferred options in the low-carbon transport hierarchy.

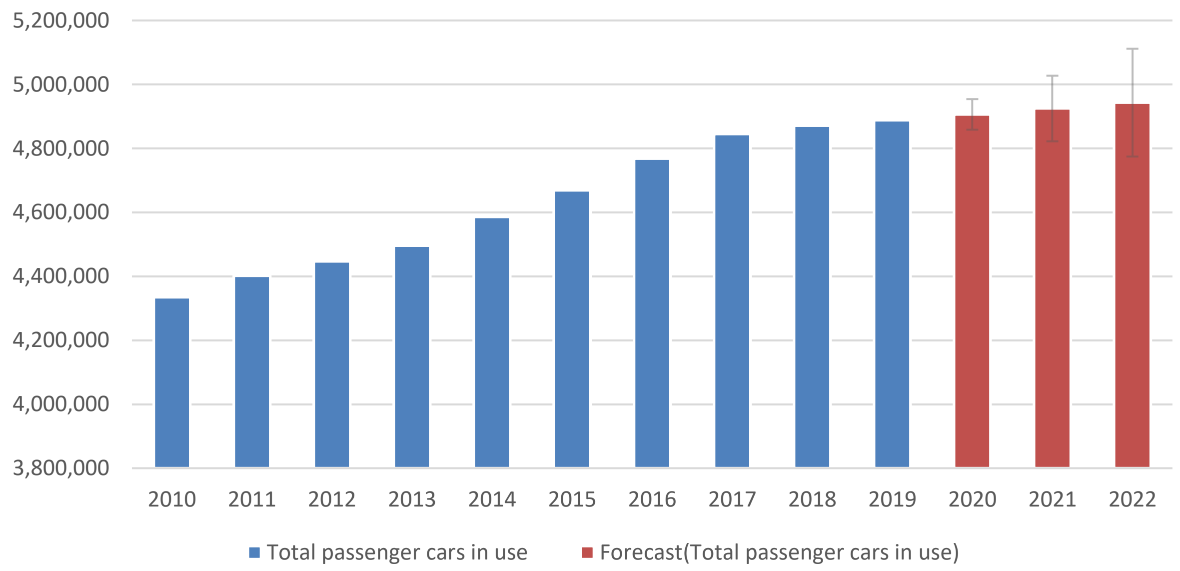
Contemporary transport research recognize problems associated with the aggregated growth of private (single occupancy) automobile usage. However, future transport systems are not necessarily conceptualized as private cars being mass replaced with public transport or active mobility (Kent, 2014). Rather, if private automobile use cannot be avoided, cars should be much less prioritised compared to other, less carbon intensive mode of transport, and positioned as part of high mitigation potential strategies among a suite of transport options, complemented by multiple and interconnected modes of mobility, and improvements in technology and standards (e.g. fuel efficiency, lifetime of electric car batteries) (Bakker et al., 2014; Bednar-Friedl et al., 2015; Gota et al., 2019). This is because alternative transport modes by themselves are unlikely to completely replace the autonomy, flexibility, speed and comfort inherent to private automobile use (Kent, 2014). In order to alleviate the situation, various efforts have been undertaken such as those towards the displacement of fossil-based transport fuels with biofuels resulting in lower carbon monoxide and hydrocarbon emissions (Bednar-Friedl et al., 2015), as well as numerous efforts have been made to encourage people to drive less, and instead try public transportation or active forms of mobility such as walking or riding their bicycles more often (Katzev, 2003).

3.2 Trends in Sweden

The transport sector accounts for half of energy-related CO_2 emissions in Sweden and plays a critical role in the decarbonisation of its energy-economy system (IEA, 2019b). As in many other countries, the sustainability of Sweden's transport system faces important challenges. Accounting for about one-third of its GHG emissions is domestic transport, of which road traffic accounts for about 90% of the emissions (Trafikverket, 2019). Further, despite a decrease in GHG from domestic transport between 2007 and 2012, emissions in recent years have remained almost unchanged. Such situation is attributed to the reduction in emissions from passenger cars and light trucks; however, improvements related to fuel efficiency and the transition to biofuels, for example, have been unable to offset the effects of increasing travel frequency and travelled distances - thus carbon dioxide emissions from new cars sold in are reduced, but not at a fast enough rate (Naturvårdsverket, 2020). Interestingly, about 50% of all new cars purchased in Sweden are reported as bought by companies and/ or organisations, and the cars they buy or lease now likely will enter the used market in a few years (Cision News, 2020). This means, for example, that more environmentally friendly cars bought, such as electric or hybrids, would in a few years' time start appearing on the second-hand car market (Jennervall, 2019). However, at the same time, it is observed that Swedish consumers purchase increasingly heavier cars, "partly offsetting energy efficiency improvements and emission reductions of new cars" (IEA, 2019b, p. 47).

In 2019, the number of passenger cars in traffic per 1,000 inhabitants in Sweden was at 473.29, or 1 car for every 2.12 persons (Miljöbarometern, 2019). Moreover, the total number of passenger cars in use in Sweden had reached 4,887,904 in 2019, and by utilizing a linear forecast function based on available historical data for the past 10 years (Trafikanalys, 2020) at 95% confidence interval, Figure 2 indicates an overall increase for the next three years.

Figure 2: Total number of passenger cars in use in Sweden 2010-2019 (Source: Trafikanalys, 2020).



Based on the challenges briefly described above, transport policy in Sweden has embraced sustainability as an important element within the overall efforts of its government to create sustainable growth, improved quality of life and welfare throughout the country (Nykvist & Whitmarsh, 2008; Regeringskansliet, 2005). In line with its Climate Policy Framework, Sweden aims to reduce its emissions from domestic transport (excluding domestic aviation) by at least 70% by 2030 as compared with 2010 levels (Government Offices of Sweden, 2017). However, it has been acknowledged that the country is not yet in the path to reach this target (IEA, 2019b).

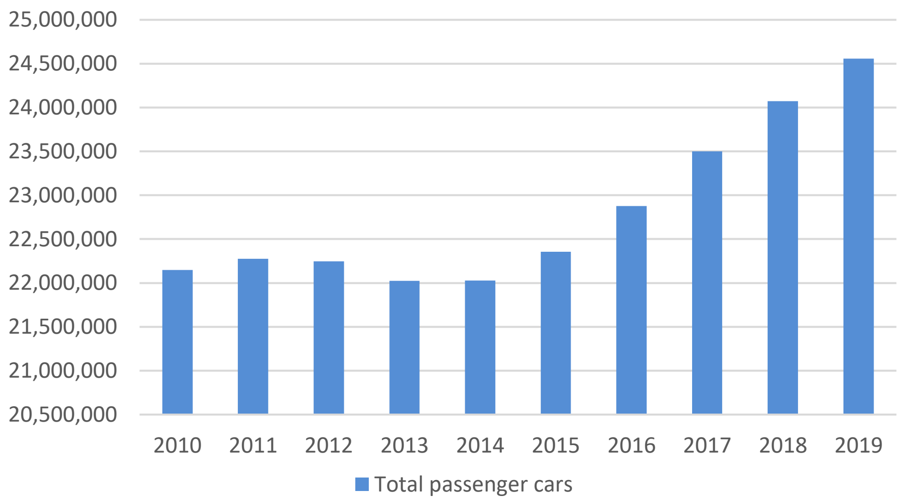
According to Sweden's National plan for the transport system 2010-2021, its policy goal is to ensure efficient and long-term sustainable transport throughout the country for people and businesses (Trafikverket, 2011). Different actors are involved in the plan (e.g. municipalities, regional authorities) and policy measures addressing personal travel include an efficient and attractive public transport (e.g. designed facilities and services, and safety aspects); coordinated public transport; taxi and ticketing systems; and opportunities for transport switching modes (Trafikverket, 2011, p. 61). Further, the plan also indicates other areas of work, including, the support towards buyers of vehicle fleets (including preferential cars, company cars, rental cars) to make energy efficient and safe car choices; and also initiatives aiming to improve the use of automobiles, for such as by supporting car pools and eco-driving (Trafikverket, 2011, p. 61).

Sharing of cars is believed to have a greater impact on sustainable travel in Sweden for the future (Trafikverket, 2013, p. 12). According to Steorn and Goldmann (2017), car sharing is an important element to reach to the 70% emission target reduction by 2030. As such, the above-mentioned elements of the national plan may be construed as multiple approaches with modalities that take into consideration the low-carbon transport hierarchy, as well as elements of the ASI strategies.

3.3 Trends in Spain

From 2010 to 2019, the number of passenger cars in Spain increased by 10.8% (Figure 3) (General Traffic Manager, 2020). Interestingly, while the fleet of vehicles for private use is 55% diesel, the fleet for commercial use is practically 100% diesel (Club Español de la Energía, 2017). The transport sector accounts for 40% of final energy consumption in the country. In comparison with other European countries, the final energy consumption per unit of GDP of the transport sector is 8 percentage points higher in Spain than the average of the sector in the European Union (Spanish Government, 2019).

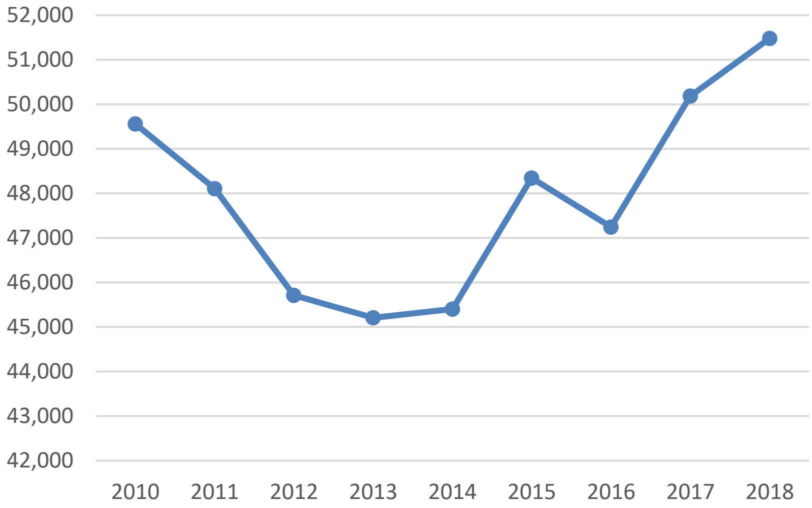
Figure 3: Total number of passenger cars in use in Spain 2010-2019 (Source: General Traffic Manager, 2020).



The transport sector contributes directly to 27% of total national $CO_{2\text{-eq}}$ emissions, with road transport being the main responsible with 25% until 2018 (Ministry for the Ecological Transition and Demographic Challenge, 2019). From 2010 to 2018, the transport and storage sector increased its total emissions to the atmosphere by 3.87% approximately (National Institute of Statistics, 2020) (see Figure 4). In 2015, the transport sector emitted a total of 83.4 $MtCO_{2\text{-eq}}$, which represented 24.8% of total emissions in Spain (Club Español de la Energía, 2017). In road transport, cars are the main emitters generating more than two thirds of total CO_2 emissions (Club Español de la Energía, 2017). The transport sector is also part of the so-called 'diffuse' sectors, that is, a sector that although it emits GHG emissions it is not (yet) subject to the emissions trading scheme that operates in the EU. In November 2017, the European Commission presented a new legislative proposal to reduce CO_2 emissions in passenger and light commercial vehicles with reductions of 15% (in 2025) and

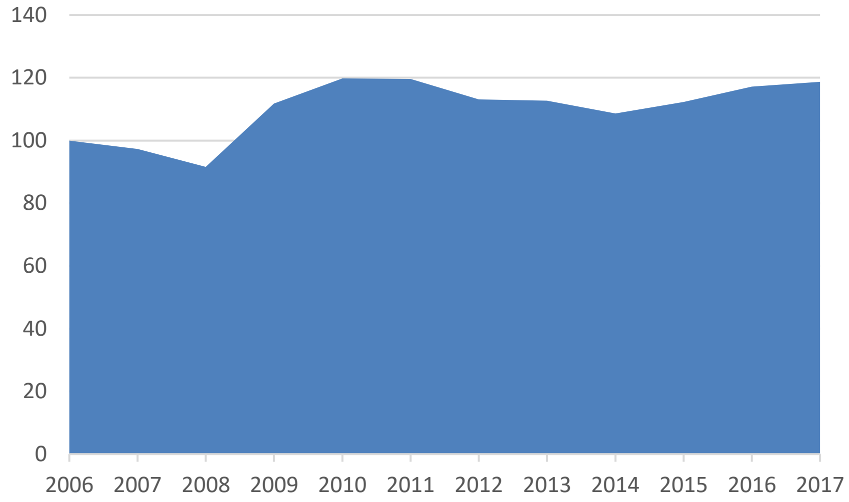
30% (in 2030), compared to 2021 levels (European Commission, 2017). Two years later, the EU Commission proposed for the European Union as a whole, a 30% reduction in emissions associated with transport for the period 2021-2030 compared to 2005 levels (European Commission, 2019). The European Union's objective means for Spain a reduction of 26% (European Commission, 2019).

Figure 4: Total emissions from the transport and storage sector 2010-2018 in $MtCO_{2\text{-}eq}$ (Source: National Institute of Statistics, 2020).



Some forecast analyses carried out for Spain, such as the report of the Observatory of Transport and Logistics of Spain (Spanish Government, 2019) show that a growing urban population combined with other trends (such as home deliveries, the aging of the population, the growth of e-commerce operations, etc.) will lead to a higher population density and a greater demand for goods and services, with the consequent increase in demand for urban transport. Figure 5 shows relative changes in the number of urban travels per year made across the six largest metropolitan areas in Spain. An increase of nearly 20% can be observed since 2006. Although there seems to be a general consensus among the Spanish authorities that the greatest potential for decarbonisation will come from electric mobility, it is recognised that projections will differ in the event that consumer preferences change, which may intensify the use of car sharing (Spanish Government, 2019).

Figure 5: Relative changes in the number of urban travel trips across the top six metropolitan areas in Spain (2006-2017). Index 2006 = 100 (Source: Ministry of Transport, 2020).



In the following sub Sections we outline the main features of consumer behaviour related to transport mode. Given the disciplinary scope of the project, attention is given to behavioural anomalies and cognitive biases potentially affecting transport mode choice.

3.4 Consumer behaviour and potential anomalies and biases

Overall, extant knowledge addressing consumer behaviour and transport draws attention to the importance of mode choice and the need for addressing (or removing) barriers for behavioural change (Avineri, 2012; Garcia-Sierra et al., 2015; Kahn Ribeiro et al., 2012). Consumer behaviour in transport is often a function of factors such as mobility service characteristics, user preferences, availability of (new) technologies/fuels, decision-making processes, infrastructure, rebound effects, context and policy interventions (Ferrero et al., 2018; Gota et al., 2019; Kent, 2014; Mattauch et al., 2016; Steg & Tertoolen, 1999; Wang, 2011).

From a general perspective, studies in the fields of behavioural economics (BE) and psychology indicate that a main factor underlying unsustainable behaviour among consumers can be attributed to various cognitive biases and behavioural anomalies (Frederiks et al., 2015; Kahneman et al., 1991; Pollitt & Shaorshadze, 2013). For example, research shows that even where cost–benefit calculations presents more materially advantageous choices, people persist in apparently making 'irrational', yet predictable tendencies – that may seem incongruous from a neoclassical economics perspective but explainable from a BE perspective (Sunstein, 2015). Within this context, it is often argued that it is critically important to understand how individuals make decisions pertaining to transportation mode choice so as to enhance the long-term sustainability of global transportation systems (Garcia-Sierra et al., 2015; Innocenti et al., 2013; Mattauch et al., 2016).

By no means exhaustive, behavioural anomalies and cognitive biases potentially affecting transport mode (or modal shifts) are elaborated below. With due limitations, we focus on behavioural explanations that pertain to mode choice decision-making processes and preferences that can potentially be applicable to the case of CSS as well.

Time-inconsistent preferences. This is when the decisions of an individual varies over time in such a way that his/her preferences become inconsistent (O'Donoghue & Rabin, 1999). It encompasses three important elements. First, inter-temporal choice, which means that choices at one point in time influence or affect the possibilities available at other points in time (Loewenstein & Thaler, 1989). Second, it also involves hyperbolic discounting (or so-called 'immediacy effect') wherein individuals value present rewards much highly than future gains, which result in outcomes that are not compatible with their best interest in the long term (Garcia-Sierra et al., 2015). Thirdly, time-inconsistent preferences may also explain self-control problems, as short-term preferences involving potentially negative consequences (e.g. health effects of car use) can overshadow an existing long-term plan involving potentially positive results (e.g. benefits of active mobility and less use of private car) (Garcia-Sierra et al., 2015; Mattauch et al., 2016).

Status quo bias. This is when individuals prefer the current state or course of action and decline a change (or decision process potentially leading to a change) from the present situation; even if the costs of change are low and the benefits may be substantial (Kahneman et al., 1991; Sunstein, 2015). This means that people continue with their original choice (or the same choices as before, e.g. use of single occupancy car) dismissing potential improvements or placing lower gains if change would occur (e.g. use of eco-friendly public transportation). This bias reveals 'choice persistence' or 'inertia' (Garcia-Sierra et al., 2015). In turn, status quo bias relates to the endowment effect, where people value more the things they own (e.g. convenience related to single occupancy car) than those they do not and the aversion of losing (i.e. loss aversion) these "owned" things kicks-in (details below) (Garcia-Sierra et al., 2015). In transport mode, this can be seen in the tendency of people to favour the status quo based on past evaluations and experiences, rather than analysing travel decisions on a trip-by-trip basis as expected in neoclassical economics (Mattauch et al., 2016). Familiarity with transport mode options can also affect or shape habits related to them (Garcia-Sierra et al., 2015; Mattauch et al., 2016).

Loss aversion. This is basically when individuals place greater value on relative losses than gains (Kahneman et al., 1991). In transport mode, for example, the disutility of giving up the comfort of using private car can be regarded as being greater than the utility associated with the benefits of public transport. Perceived gains and losses are dependent on, and relative to, a status quo or 'reference point'. For example, the existence of loss aversion can be found within the occurrence of a single, yet substantial delay in public transportation that can have long-lasting (and more salient) effect on the daily mode choice, despite time savings and the existence of other benefits in public transportation (Mattauch et al., 2016). Thus, individuals can then be averse towards the uncertainty and risk of losing travel time especially if they perceived certainty through the use of their owned cars. These past albeit unique events (e.g. important delays due to use of public transportation) can generate a reference-dependence bias that reinforces loss aversion and individuals over discounting the value of more sustainable modes of transport.

Heuristics. Known also as mental shortcuts, simplified rules, or rules-of-thumb, these are often used by individuals when making decisions and assessing related risks (Pollitt & Shaorshadze, 2013; Sunstein, 2015). When used for practical approaches to problem-solving or processing information, heuristics can lead to biased judgements among individuals (Mattauch et al., 2016). For example, the 'availability heuristic' (Folkes, 1988) relies on a mental shortcut that recalls an immediate memorable instance of a given event (e.g. like delays due to use of public transportation or related waiting times), which may not necessarily be an accurate representation of the true likelihood of its occurrence. Recent events can be more heavily weighted (saliency), while bad experiences are retained in memory for longer times (vividness heuristics) - that reduces the probability of a risky choice being repeated but impede learning about the actual value of alternatives (Garcia-Sierra et al., 2015). This means that individuals assess extraordinary evidence disproportionately against the odds, even when information about actual probabilities is available. The salient cost or experience of travelling and the end cost or experience may have a disproportionate impact on people's transport behaviours (Metcalfe & Dolan, 2012).

A heuristic approach demands less cognitive efforts, knowledge and time so when travellers are confronted with multiple travel mode options (e.g. train, car, airplane) heuristics can drive individuals to choose the easiest or first available option (e.g. single-occupancy vehicle). In this 'choice overload' scenario satisficing can unfold, often termed as a mix of 'satisfying' and 'sufficing' (as opposed to 'maximising' (Gigerenzer & Goldstein, 1996)), in which a decision making strategy aims to achieve a satisfactory or acceptable ('good enough') result, rather than finding the best or optimal choice among different options. When people's decisions are driven by heuristic reasoning, rational calculation plays a limited role in determining decisions once a travel mode is chosen (Innocenti et al., 2013). The heuristics of judgment by representativeness and by availability, along with self-serving bias (details below) have been invoked to explain habitual use of cars (Mattauch et al., 2016). As such, travellers may also use simplification heuristics and misinterpret information pertaining to travel time and money costs that points toward a systematic bias towards automobile use (Garcia-Sierra et al., 2015). The real costs of owning a car are normally unperceived, as opposed to the benefits of owning one (Young & Caisey, 2010).

Self-selection bias. Within the context of travel behaviour, self-selection bias plays a role at the interplay of choice of location and travel mode choices. This is particularly salient when individuals choose a given location based on an expected or predicted travel mode (Garcia-Sierra et al., 2015). As such, travellers choose residential locations favourable to their travel mode preferences, with people selecting car-oriented environments if they are inclined to drive, or opt for pedestrian-oriented environments if they are predisposed to walking or cycling (Garcia-Sierra et al., 2015). According to Handy and Mokhtarian (2005) self-selection bias has an important effect on individuals who have relatively strong inclinations for driving. When looking at the low-carbon transport hierarchy, one can argue that self-selection bias stresses the relevance of location choices in relation to the availability of different modal choices.

Conforming to social norms. A norm is a construct that has widespread usage as it helps describe and explain human behaviour (Cialdini & Trost, 1998). Social and cultural norms are the behavioural expectations or rules, within a society or group, that are often derived by individuals from the behaviour of others, and that can develop and spread rapidly. In transport, herding behaviour and social pressure are also related to social norms (Metcalfe & Dolan, 2012). Some social norms have a powerful automatic effect on behaviour and can influence actions in positive and negative ways – which could be due to social penalties for non-compliance, or the social benefit that comes from conforming (c.f. Garcia-Sierra et al., 2015; Mattauch et al., 2016). Social norms, contexts and perceptions on different transportation modes can have important effects on the decision-making by individuals (e.g. when cycling is the dominant travel choice in a urban context because of existing infrastructure and policies that discourage the use of car; or when car is considered as status symbol) (Mattauch et al., 2016). Norms can also encourage both pro-environmental and pro-self behaviour(s) towards travel alternatives depending on the social context; enhance the effectiveness of information by capturing the concerns of travellers; and also promote cooperation in social dilemmas through descriptive and injunctive norms (Garcia-Sierra et al., 2015). For example, research shows that perceived social support for public transportation can play an important role in the willingness or enthusiasm to use it (Murray et al., 2010; Zhang et al., 2016).

There is growing knowledge about behavioural anomalies and cognitive biases affecting transport mode choice. However, and in the context of our project, much less is known about those are specific to the case of CSS. Research is needed to address these issues and better understand the behaviour(s) that need to be changed. As CSS affects the travel decisions of individuals, careful consideration must be paid to behavioural changes resulting from utilizing this alternative mode of transportation. Analyses should consider travel activity, changes in modality and vehicle ownership, together with their resultant environmental impacts (Jung & Koo, 2018). For the specific case of car sharing, "studies have been focused on the impact of car sharing on the urban mobility" and explored the characteristics of the services and "the impact on users travel patterns" and users behaviours in order "to estimate the potential demand and main drivers of adoption of CSS" (Ferrero et al., 2018, pp. 506–507; Rabbitt & Ghosh, 2016). As CSS affects the travel decisions of individuals, careful consideration must be paid to behavioural changes resulting from utilizing this alternative mode of transportation. The reviewed literature indicates that attention must be given to travel activity, changes in modality and vehicle ownership, together with their resultant environmental impacts (Jung & Koo, 2018). Consideration must also be given to (potential) crowding out effects on more sustainable transport options such as public transportation and active mobility due to the promotion of CSS via different behavioural choice architecture techniques.

4 Car sharing services

The dominance of road transport, and demand for it, has reached alarming levels wreaking negative environmental effects and reshaping the environment to accommodate the demand and infrastructures to support it (Baptista et al., 2014; Katzev, 2003). Cars usage, though providing numerous benefits, are largely responsible for many negative environmental impacts (Katzev, 2003). Automobiles are a major source of air and noise pollution, as well as substantially contributing to global GHG emissions (Bednar-Friedl et al., 2015; Katzev, 2003). The use of private cars has indeed caused social and environmental issues in many cities (Gota et al., 2019; Rickenberg et al., 2013). Moreover, the external costs (e.g. pollution, natural areas encroachment) of automobile ownership are not directly paid for by drivers, but rather imposed on the general public - compounding the problem of accurate estimation of the cost of driving versus other modes of transport (Avineri, 2012; Loose, 2010). Even with such negative effects associated with the growth of private automobile usage, future transport systems do not necessarily envision the total phasing out of cars, but rather positions its use as part of mitigation strategies among a suite of available low-carbon transport options (Bakker et al., 2014; Kent, 2014).

Initiatives that supports the principle of sharing with service-oriented businesses utilising collaborative models are gaining increasing attention with the promise of bringing private mobility much closer to a sustainable path (Ferrero et al., 2018). Although car-based personal mobility in urban travels is lessening its share in the developed world, there are new mobility services that are now offered in the market as an alternative to the privately owned car, with CSS at the forefront and gaining ground in cities worldwide (Bocken et al., 2020; Münzel et al., 2018; Sprei & Ginnebaugh, 2018). The reviewed literature shows common trends indicating lifestyle and observed behavioural change as shifting from car travel to more sustainable forms of transport. These shifts are due to factors such as the pervasive presence of ICT and mobile technologies impacting the need and extent of travel (Bakker et al., 2014; Cattolica, 2016). Another trend is the changing perspective of people moving away from car ownership towards consumption patterns of reduced vehicle kilometres travelled by private automobiles, and uptake of car sharing and alternative forms of transport and mobility (Ferrero et al., 2018; Kent, 2014; Shaheen et al., 2012).

As elaborated in Section 1, the fundamental idea of car sharing is to offer access to a car for mobility (e.g. commuting purposes) rather than drivers owning a car themselves. Interest in car sharing has been facilitated by multiple factors. This includes the (policy) discourse on the sharing economy, advances in technology, new value propositions, and the need to improve the environmental credentials of private mobility (Bocken et al., 2020; Ferrero et al., 2018; Katzev, 2003). Setting aside the debate and uncertainties about the environmental impacts of car sharing, the growing interest in CSS can also be explained by the inefficient use of the privately owned cars *per se* (Meijkamp, 1998). Vehicles are often purchased that meet or exceed the daily (commute) and rare peak needs of their owners - with vehicles that "can meet all usage cases having higher operating cost (fuel usage) and capital costs (larger, more features such as extra seats, cargo etc.), as opposed to vehicles that only meet the daily usage cases" (Sprei & Ginnebaugh, 2018, p. 1433). The extra fuel usage and costs are directly borne by the consumers, but at the same time the extra energy used and inefficient use of resources also affects society detrimentally through air pollution, climate change, congestion, space requirements and energy security issues (Katzev, 2003; Sprei & Ginnebaugh, 2018). CSS offers a solution as shared vehicles used are smaller and (sometimes) newer vehicles as compared to the average fleet, creating fewer emissions and have lesser fuel consumption as well as reducing parking pressure (Loose, 2010).

In the following sections we briefly elaborate on a variety of market, environmental and behavioural aspects relates to CSS initiatives identified in Sweden and Spain.

4.1 CSS initiatives in Sweden

Although early notions of car sharing in Sweden can be traced back to the 1970s, the concept and business models have substantially changed over time, particularly with technological developments and emergence of internet-based platforms (Bocken et al., 2020; Nykvist & Whitmarsh, 2008). In 1970s, car sharing began with neighbours pooling resources to own cars collectively or participate in car sharing organizations as non-profit cooperatives (Bocken et al., 2020).

From the late 1990s onwards, car sharing began to proliferate with government support, and its growth further facilitated by mobile and internet technology (Bocken et al., 2020; Nykvist & Whitmarsh, 2008). Since 2010, car sharing membership has been doubling approximately every two years and more competition between car sharing businesses have emerged (Akyelken et al., 2018).

In 2009, CSS were offered in 37 Swedish towns and cities - having 14,889 eligible members with access to a fleet of approximately 500 cars, with the structure of the service described as being very heterogeneous (Loose, 2010, p. 17). First, in terms of size, "it was noted that only seven of the total 45 providers have more than 100 customers or more than 10 vehicles available" (Loose, 2010, p. 17); and second, operators were usually active within one place (Loose, 2010). At that time only Sunfleet (now 'M'), which was the largest provider and being active since 1998 until recently, had broad coverage by offering services in 15 locations in Sweden (Loose, 2010). As a whole, it is argued that car sharing is rapidly expanding in cities (Bocken et al., 2020; Noll, 2017; Nykvist & Whitmarsh, 2008). Acknowledging the lack of updated statistics in this area, Figures 6 and 7 show the evolution of CSS membership and number of vehicles across selected initiatives in Sweden, respectively.

Figure 6: Estimated total number of members in selected Swedish CSS initiatives 2011-2018 (Bilcoop, MoveAbout, Sambil and Sunfleet) (Source: Miljöbarometern, 2019).

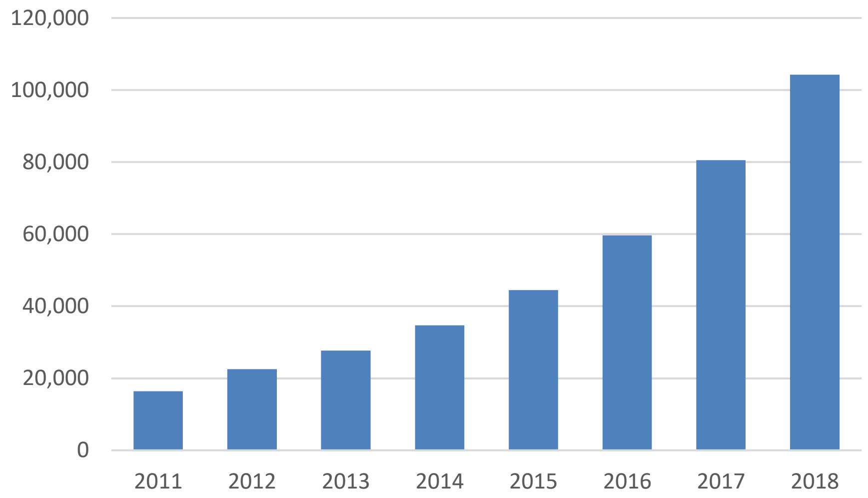
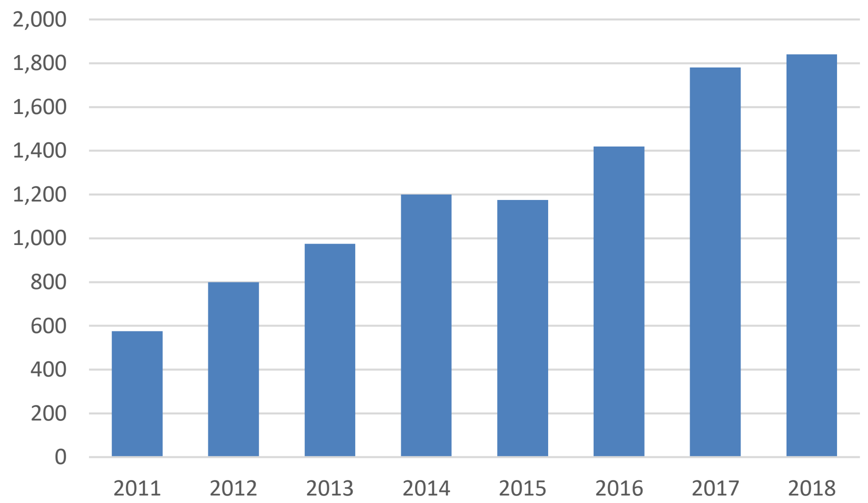


Figure 6: Estimated total number of cars in selected Swedish CSS initiatives 2011-2018 (Bilcoop, MoveAbout, Sambil and Sunfleet) (Source: Miljöbarometern, 2019).



The product-to-service shift can also be seen in the offerings of automobile manufacturers in Sweden. New models are offered exclusively for leasing service, including car models that have a markedly lower carbon emissions and targeting young consumers with urban lifestyles (Nykvist & Whitmarsh, 2008, p. 1382). There have also been developments in Sweden establishing various transport and mobility service alternatives: encompassing full-service car rentals to car sharing organisations with a high level of individual commitment for sharing cars (Noll, 2017; Nykvist & Whitmarsh, 2008; Sprei & Ginnebaugh, 2018).

Below we provide a brief description of specific CSS operators and respective business models in Sweden.[8]

[8] See Bocken et al. (2020) for a more detailed discussion about CSS and respective business models in Sweden.

SnappCar: It is a P2P car sharing platform, its business model is revenue based on commission from transactions between the owner and renter[9]. According to the interviewee, what sets it apart is that it only makes money on cars that are being shared, as compared to other car rental operators with indirect profit source most often by selling cars. Further, the decision to establish Snappcar did not come from the investors in the automobile capital side, as compared with other brands or start-ups with some of originating from car producers, car accessories, or venture capital. Owners advertise their vehicles on the SnappCar app “wherever they are located and charge a daily fee for use” (Bocken et al., 2020, p. 9). As compared to car sharing cooperatives, car owners utilizing this platform retain ownership and handle maintenance (Bocken et al., 2020). According to the company website, its mission is to have 5 million fewer cars in Europe by 2022 from the current 15 million cars, while its aim is to bring car owners and those who are looking for a car together (Snappcar, 2020).

GoMore: It is described as a P2P car rental service, where private people can rent cars from each other. It also has a leasing cooperation where one can lease a car from its commercial partner. According to the company website, its mission is to help people share cars through its platform that combines peer-to-peer rental and private leasing (GoMore, 2020). In terms of its price structure, a service fee from the transaction where owners set the price (the daily price) by themselves, and 20% is taken as the service fee/administration fee. On top of the daily price, the renter pays an insurance fee. For its more recent history, “the Danish P2P car sharing company started operating in Sweden in 2015, with vehicle leasing and P2P ridesharing for profit also offered as a value add” (Bocken et al., 2020, p. 9).

M (formerly known as *Sunfleet*): It was described as the largest commercial B2C operating with a two-way station-based system, partially owned by Volvo Cars (and Hertz). Sunfleet was “established in Gothenburg in 1998, after the announcement of Sweden's government’s support for car sharing, and marked a critical turning point in Swedish car sharing” (Bocken et al., 2020, p. 10). Members could get a car whenever they want with vehicles in the fleet that are newly serviced, tidy, and rarely more than a year and a half old - having access thousands of cars all over the country not connected to a specific city or pool, with fuel always included (Sunfleet, 2020). As of March 2020, according to its website, Volvo Car Mobility, the company behind Sunfleet, intends to create a digital and moreover sustainable car sharing service in the world. It has therefore replaced Sunfleet with the new service "M". Among the reasons stated for this change, it is claimed that technology and the platform of Sunfleet could not be further developed in order to meet the needs of the future, starting anew, and building from the ground up, in terms of brand and services[10].

[9] Looking at its history, the P2P car sharing Dutch company entered the Swedish market in 2012, with Snappcar acquiring Swedish competitor FlexiDrive in 2015. “Snappcar is present in cities across Sweden, although the unstable vehicle fleet within P2P organizations inhibits formalized partnerships, which means that P2P organizations such as have to rely on more casual users” (Bocken et al., 2020, p. 9).
[10] Sunfleet blir M i Göteborg & Malmö https://www.sunfleet.com/

MoveAbout: It has a similar B2C model, with "a niche value add; by setting up electric carpools for companies and organizations as well as offering cars for round trips to private individuals for a membership fee and rental costs" (Bocken et al., 2020, p. 10). It also uses a "station-based system, and is the second largest commercial operator" (Wimmerström, 2020, p. 5). MoveAbout "took over another Swedish electric car company, Miveo, in 2017" (Bocken et al., 2020, p. 10), and caters to a "smaller subset of the population by upholding their business model as a way for customers to become truly sustainable travellers" (Bocken et al., 2020, p. 10).

Aimo: It also operates B2C model offering free-floating CSS. It started operations in Sweden on October 2018 (Aimo, 2020). It is owned by Sumitomo Corporation, a Japanese conglomerate company, and replaced BMW's similar service, DriveNow, which was closed earlier in 2018 (Nordic 9, 2018). Described as an electric one-way service, "free-floating services like Aimo compete directly with public transportation and bikes given they are meant to be used for short trips within the city" (Bocken et al., 2020, p. 12). In contrast, "round trip models are generally used for longer trips given the lack of flexibility for pick-up and drop-off locations and need to plan ahead" (Bocken et al., 2020, p. 12). At present Aimo also offers electric scooter rentals within cities (Aimo, 2020).

Sambil and *Bilpoolen.nu* operate cooperative models. Sambil is described as the "oldest active example of a cooperative and is currently present in several Swedish cities, including Stockholm and Gothenburg" (Bocken et al., 2020, p. 8). Bilpoolen.nu was created in 2007 in Gothenburg[11], "establishing carpools for businesses or apartments and offer P2P rentals, and was successful enough to eventually take over City Car Club, an international competitor" (Bocken et al., 2020, p. 10). Cooperative models are touted to have inspired the development of car sharing over the following two decades (Shaheen & Cohen, 2007). In the cooperative configuration users retain ownership of their vehicles, while organisations "maintain contact information and ease the process of car lending to members that do not own vehicles" (Bocken et al., 2020, p. 8). It should however also be noted that Bilpoolen.nu also has a B2C presence (Bocken et al., 2020).

4.2 CSS initiatives in Spain

Together with traditional mobility options (private car, public transport), CSS initiatives coexist in Spain with bikes, scooters and electric skateboard sharing alternatives. However, these sharing options coexist only in the city of Madrid. All of them operate under local government's license. Interestingly, CSS initiatives are growing even where there is good public transport and other mobility choices. It is argued that this is partially due to population's massive use of information and communication technologies (ICTs) together with the boom of the e-economy in various activity sectors (National Institute of Statistics, 2019).

[11] Bilpoolen.nu website

B2C companies offering free-floating services only operate in Madrid. Four companies currently provide services with a fleet 100 % electric or hybrid. Total cars amount around 4,000 that operate in a service zone of 80 km^2. Together with Hamburg, the city of Madrid shows the highest use rates for free-floating car sharing (FFCS) vehicles of B2C companies, as estimated by the total time (minutes) that all cars are used each day divided by how many minutes they can potentially be driven (Habibi et al., 2016). However, caution must be exercised when listing car sharing initiatives in the country. This is because many companies that are self-promoted as “CSS” are just traditional rent-a-car companies offering two-way or one-way use CSS. B2C currently operating in Madrid are as follows: Share now, Emov, Zity and Wible. Until the end of February 2019, just one company operates in Barcelona (Avancar) but closed due to negative financial results. Avancar was a joint venture with Hyundai.[12] Briefly, details of CSS initiatives operating in Spain are given below.

Share Now: This is the first B2C company offering FFCS services in Madrid. It was originally name car2go[13] and since 2019 changed to a new brand name (‘Share Now’). Although it began to operate in 2008, it did not arrive in Madrid until November 2015. It started with 500 units of Smart's two-seater model vehicles, but has recently incorporated some four-seater vehicles and offers the lowest rate in the city. It operates over 12,000 electric journeys each day. Together with Stuttgart, Paris and Amsterdam, they are the only cities in which 100% of the fleet (600 vehicles in Madrid) is electric (Ampudia-Renuncio et al., 2020).

Emov: This B2C company was set up in December 2016 as a joint venture between the French car manufacturer PSA Group and the Spanish parking management company Eysa. Lately, all the shares have been acquired by the former. It is a company that offers FFCS services. The vehicle used is the compact four-seater BEV Citroen C-Zero, of which Emov currently has a fleet of over 600 units (Ampudia-Renuncio et al., 2020).

Zity: In December 2017, Zity was launched as a B2C company by the Spanish infrastructure developer Ferrovial Group in collaboration with the French carmaker Renault. This start-up manages a fleet of 650 Renault Zoe BEVs and has the largest service area in the capital city, which allows its users to reach the airport and some nearby municipalities. It is B2C that also offers free-floating services. In addition to the 0.26 €/min rate, users can maintain the car at a cheaper rate while it is parked (0.09 €/min) (Ampudia-Renuncio et al., 2020).

Wible: This company is part-owned by the South Korean automobile manufacturer Kia and the Spanish energy company Repsol. It was launched in June 2018. It is the first system to use plug-in hybrid electric

[12] The vehicles used in these companies include Hyundai Ionic Hybrid, Hyundai Ioniq Electric, Hyundai i10 City, Hyundai Tucson and Hyundai Santa Fe. It also operated in the cities of L’Hospitalet and Sant Cugat.

[13] Car2go has been a wholly-owned subsidiary of the Daimler AG which is one of the biggest producers of premium cars and the world's biggest manufacturer of commercial vehicles with a global reach. The BMW Group and Daimler AG are pooling their mobility services to create a new global player providing sustainable urban mobility for customers. The cooperation comprises five joint ventures: REACH NOW for multimodal services, CHARGE NOW for charging, FREE NOW for taxi ride-hailing, PARK NOW for parking and SHARE NOW for car-sharing. The previously independent services car2go and DriveNow have thus merged to form the joint car sharing service SHARE NOW.

vehicles (PHEV) instead of BEVs. It has 500 Kia Niro model cars and charges a rate of 0.28 €/min. It is B2C company offering free-floating services as well (Ampudia-Renuncio et al., 2020).

*BlaBlaCar***:** This is the most popular P2P initiative offering ride-sharing services in Spain[14]. It can be categorized as a type of non-profit car sharing cooperative. It operates since January 2010[15]. Most users are young and looking for cost savings via ride-sharing. The driver looks for reducing his/her own travel expenses and platform facilitates the process of finding passengers willing to share the costs. The driver transports passengers but can also ship parcels or pets. Users can choose to chat or not. No more than three passengers are allowed and the driver chooses the passengers through the app. More than 30 billion kilometres have been shared under this initiative. The company offers top 10 Spanish trips (Madrid-Valencia, Barcelona-Madrid, Madrid-Murcia, Madrid-Sevilla, Alicante-Madrid, Barcelona-Touluse, Barcelona-Valencia, Bilbao-Madrid, Granada-Madrid, Barcelona-Montpelier) (BlaBlaCar, n.d.).

Amovens.com: Its business model is similar to BlaBlaCar. It was founded in 2009 as a 'shared travel community' for companies and universities. In 2016, mobility solutions were added completing short, medium and long distance solutions. Actually, it employs more than 50 people. There are more than 10,000 owners who offer their car for rent/sharing. They operate in 27 provinces but mainly in Barcelona and Madrid. The company provides a '360° mobility solution' through the integration of various related services: carpooling, car rental between individuals and renting for individuals. Owners who wish to rent their car need to register and offer it. There are more than 10,000 owners who offer their rental car. They operate in 27 Spanish provinces but mainly in Barcelona and Madrid. The company offers these tops 10 Spanish trips in carpooling services (Madrid → Alicante, Alicante → Madrid, Almería → Madrid, Barcelona → Madrid, La Coruña → Madrid, Santander → Madrid, Murcia → Madrid, Valencia → Madrid, Valladolid → Madrid, Bilbao → Madrid) (Amovens, n.d.) .

4.3 General market developments

CSS, since appearing over a number of decades ago in Europe, has "expanded to about 1,100 cities worldwide, in 26 nations on five continents" (Shaheen & Cohen, 2013, p. 29). In recent decades, car sharing "has become a mainstream transportation mode for more than a million users worldwide" - with individuals generally "accessing shared vehicles by joining an organization that maintain a vehicle fleet in a network of locations" (Shaheen & Cohen, 2013, p. 6). At a rapid pace, from nearly two million subscribers of car sharing services worldwide in 2014 (Le Vine, Lee-Gosselin, et al., 2014), the global car sharing market had reached 8

[14] The company began to operate in 2006 in France. Currently, it operates in 22 countries: France, Spain, Italy, United Kingdom, Portugal, Poland, Belgium, Netherlands, Luxembourg, Germany, Ukraine, Russia, Turkey, India, Hungary, Romania, Croatia, Serbia, Mexico, Brazil, Czech Republic and Slovakia. It is the largest global social network of carpooling with more than 80 million users (5 million in Spain). It has more than 550 employees in its eight offices.

[15] BlaBlaCar has more than 80 million users in the 22 countries where it is present. Thanks to the use of carpooling, only in 2018, the emission of 1.6 million tons of CO_2 was avoided. BlaBlaCar users have managed to save more than 1.4 billion euros.

million members by 2016, and had been reported to have grown over 30% in the period of 2015-2016 (Madhavan, 2016).

Consumers have been showing interest as the global membership base of car sharing platforms had grown from 3 million members in 2013 to close to 27 million in 2018, while in terms of car-sharing fleet size it estimated that from about 71,000 cars in 2013 it has increased to 268,000 by 2018 (Stolle et al., 2019). Europe is the region with the most number of car sharing users (3.16 million) and cars (50,041) globally in 2016, as well as the highest untapped growth potential (Madhavan, 2016).

4.3.1 Sweden

There is currently only a limited number of studies dealing with CSS market development in Sweden (Akyelken et al., 2018; Bocken et al., 2020; Cattolica, 2016; Nykvist & Whitmarsh, 2008; Sprei & Ginnebaugh, 2018). Trends and figures are derived mostly from earlier studies and reports by the Swedish National Road Administration (*Trafikverket*) and Miljöbarometern (as shown in Section 4.1).

As part of their sustainable advice for car pools (Trafikverket, 2010), the administration recognised Sunfleet (now 'M') and various CSS operators throughout the country as good examples of car sharing widely operating in their respective areas. For example, in Hammarby Sjöstad, Stockholm, City Car Club has 10% of households as customers, as well as Majornas Bilkooperativ in Gothenburg having is the largest operation in the country with 36 cars (Trafikverket, 2010, p. 6).

By 2013, the market was described as being comprised mainly of one large commercial operator (Sunfleet), and a large number of smaller cooperatives - of which 27 were surveyed by Trafikverket in 2013 (Sprei & Ginnebaugh, 2018, p. 1438). At that time, total number of members was about 22,500, entailing 200,000 bookings approximately and involving 840 cars (Trafikverket, 2013, p. 11). Changes within the Swedish market should be viewed as having also been accompanied with the relatively "high adoption rate of mobile and net-based applications, as well as contextual factors such as it being a car-manufacturing country and a tradition among consumers of purchasing/using larger vehicles" (Sprei & Ginnebaugh, 2018, p. 1438).

As previously described, several CSS operators with varying configurations and platforms have emerged in the last decade. The study conducted by Bocken et al. (2020, p. 16) on "four cities—Stockholm, Gothenburg, Malmö and Umeå— followed a similar development pattern with the emergence of cooperative models, followed by an expansion into B2C and P2P models". Large B2C operators have also offered CSS to private businesses and organizations, which has created competitive relations with other business models. In turn, this has increased or further secure their market position against "smaller B2C or P2P operators pose little threat to Sunfleet given its incumbent backing and market dominance" (Bocken et al., 2020, p. 10). In fact, the largest car sharing market segment in Sweden has traditionally been business, "attracted by the proposition of temporary rentals for business trips followed by planned communities and residential neighbourhoods" (Bocken et al., 2020, p. 8). There is also substantial development in the market growth and adoption of P2P car sharing in Sweden. For example, both Snappcar and GoMore are in line with the description of Zoepf and Keith (2016), wherein users have been exposed to a growing sophistication of services, booking platforms and types of vehicles (e.g., gasoline, Hybrid, Plug-in Hybrid or Electric).

Furthermore, car sharing acts as a conduit to introduce users to new vehicles and vehicle technology, as in these cases in Sweden. Interviews conducted for this report also indicate relatively high membership for P2P car sharing (about 100,000 registered members for each) and describes promising trends for the future growth of car sharing in the country.

It must be noted also that the Swedish National Road Administration has had a multifaceted input in supporting car sharing schemes in the country. It had financed some feasibility studies, conferences and stakeholder dialogues since the 2000's in order to raise understanding about the needs and possibilities of car sharing on the national level. The Swedish National Road Administration also had a stake in direct financing of an internet booking system for the *Majorna* car sharing cooperative (Plepys et al., 2015).

4.3.2 Spain

Gaining access to CSS initiatives in Spain and get market data is not an easy issue. CSS initiatives operating in Spain –mainly B2C companies– are reluctant to share information, for example, about their business and clients' profile. There are basically two main reasons for this: for commercial and competitive aspects, and also because the results of the scientific studies (if they are focused on the environmental effects or on the decrease in the use of public transport, for example) can potentially damage the image of CSS or serve as an argument for local governments to enact regulations against them. After all, CSS generally depend on privileged access to a street space (e.g. free or cheap parking) (Ampudia-Renuncio et al., 2018).

AS previously mentioned, the B2C operators identified in the country (Share Now, Emov, Zity and Wible) currently coexist in the Spanish capital city, with a total fleet of over 2,000 cars and an average service area of 80 km^2. Fees per minute mainly depend on the car model. Companies can discriminate fees by number of kilometres driven. For example, ShareNow rises the fee up by € 0.39 /min for over 100 kms driven, while Emov applies € 0.29 /min over 50 kms. When user drop off the car with a low battery level which can make the car to be off the app map, the company can apply an additional fee. In the case of Emov this is € 30. Zity's homepage advises on this type of extra fee but without specifying it (Ampudia-Renuncio et al., 2020).

Table 1: Standard fees for car sharing companies

	Standard fees range	Fee for 24 H	Registration fee
ShareNow[16 17]	€ 0.19 - 0.31/min	€ 59	€ 9
Emov[18]	€ 0.25/min - 0.29/min	€ 49	€ 9
Zity[19]	€ 0.21 - 0.31 € 0.06 – 0.12 (when car is parked)	€ 69	€ 0
Wible[20]	€ 0.25 – 0.31	€ 65	€ 0

In the case of BlaBlaCar (a type of non-profit/cooperative car sharing company), users share travel expenses without profit but this is subject to negotiation. For this, BlaBlaCar recommends on the platform a contribution per user and trip of € 0.06 per kilometre appropriate for the sharing of expenses inherent to driving (gasoline, tolls, maintenance, insurance, taxes, etc.). The company also limits the maximum contribution that drivers can request in such a way that these expenses are not overcharged.

BlaBlaCar provides the following information about how are management costs (fees) calculated. This is important because management costs allow to establish the operating costs of BlaBlaCar. For the company, management expenses are calculated based on the minimum contribution set by the driver. The amount that appears in the search results includes both the cost for the driver and the costs for the management expenses for the company, including VAT. If, for example, a driver offers a trip between € 1 and € 6 per seat, the management costs will be € 1. If the contribution for the trip is between € 7 and € 8, the management costs will be € 1.5. For a trip between € 38 and € 40, the expenses will be € 7.50. And if the contribution for a trip exceeds € 51, the amount of the expenses would be 18% of the requested amount, with a rounding towards the nearest € 0.50 fraction (BlaBlaCar, n.d.).

Drivers do not have to pay any management fees and receive the exact amount of the contribution they establish when advertising a trip. The platform states that users belong to a "trusted community." Users have access to 70 million users with certified profiles. Services are scored or rated by users. Confidence levels are advertised in terms of "experience levels" that vary in a range of 1 to 5 (beginner, intermediate, advanced, expert, ambassador). The best levels of trust are achieved by increasing the information of the user

[16] The vehicles are charged only by the service operators, instead of offering users the possibility of charging in exchange for rate reductions.
[17] Fees vary according to vehicle model, time and location. The cheapest car (smart fortwo ED) has rates that vary between € 0.19 - 0.29 per minute. Fees for the most expensive car (smart EQ forfour) vary between € 0.21 - 0.31 per minute. The price flexibility applied by the company seeks to adjust the demand and supply of vehicles. For inactive cars to return to areas with more activity, their price per minute decreases a few cents. The price drop can reach up to 20%.
[18] https://www.emov.eco/ and https://movilidadelectrica.com/comparativa-carsharing-madrid/
[19] https://zitycar.es/
[20] https://www.wible.es/

(publishing the photo), the number of positive ratings received, percentage of positive opinions on the total opinions, and the age as a user. The main advantage of achieving better levels of experience is to fill the car faster although the scoring system does not allow the assessment of aspects such as hygiene.

In the case of Amovens, which has a business model similar to BlaBlaCar, fees are calculated as follows. Amovens deducts 10% of the amount that the passenger has paid with a maximum of € 1 if the price of the travel seat is greater than or equal to € 10 (Amovens, n.d.). The price is set by the driver. From a travellers' perspective, the valuation and messaging system allows choosing and meeting the travel companion before sharing. The mobiles are verified and only the contact information is accessible when the travel reservation is confirmed. Once the trip has been paid, the data is hidden again.

4.4 Motivating factors playing a role in the adoption of CSS

4.4.1 Sweden

Interviews with P2P CSS indicate that the most common motivation for customers to adopt CSS are economic and utilitarian reasons. In such case, CSS allows them access to automobiles when they need to, in a more financially viable and pragmatic manner as opposed to owning and maintaining them. In fact, economic reasons (e.g. capital costs, parking costs) are cited in the interviews as a main motivational driver. CSS also allows vehicle owners under P2P who infrequently use their cars to generate a source of additional income, allowing them to afford maintenance costs and/ or finance payments for the car.

The role of government in providing infrastructures as well as implementing policies to discourage private car usage is also a common theme found among factors that motivate towards the adoption of CSS. The reduction of traffic, car ownership and parking space needs are often mentioned in the literature (c.f. Akyelken et al., 2018; Anderberg, 2018; Cattolica, 2016). Policy interventions involving, for instance, fuel price increase, congestion charges, and potential bans for non-car sharing vehicles in city centres are believed to motivate people to be willing to adopt CSS or start sharing their cars. Increased taxes and removal of subsidies are seen to decrease private car ownership, and could increase other transportation modes such as car sharing and public transportation. For people in the country to accept and use car sharing, interviewees mentioned that this entails changing behaviours, establishing trust, and following the regulations and implementing rules about CSS. Higher density of urban areas and resulting scarcity of space also play a role in discussions involving policy makers and CSS operators.

Convenience is also mentioned as an important motivator. Various example can be given. For instance, and setting aside business users, motivating factors for most consumers seem to be long (weekend) trips outside the city (c.f. Akyelken et al., 2018). CSS users can get a car close to where they live, as well as CSS operators providing an easier and cheaper option as compared to a traditional rental firm. Proximity with the shared car is also a reason for renters to use CSS more often. The infrequent use of services provided by a car (e.g.

random need of a larger trunk or car) is also acknowledged to be a motivating factor affecting the adoption of CSS (c.f. Sprei & Ginnebaugh, 2018). Vehicles within the neighbourhood gives members also a feeling of convenience and security, as they are a lot closer and do not need to spend much time in getting a car for their needs. What also happens is that for renters, as long as the car meets their expectations, is clean and is as advertised – beyond the utility of going from point A to B, it becomes more about the experience and feeling of renting and using a (different) car. Other similar groups that often utilise CSS include those living in the suburbs where public transportation might not be as comprehensive or frequent, and who might feel attracted to CSS because they provide a convenient way to cope with errands, shopping or taking specific activities during weekends (see self-selection bias in section 3.4). Previous research also observed that life stage that the CSS adopters are at and relocation can be crucial factors (Cattolica, 2016). For instance, several participants in Malmö did not own cars and used CSS only when they needed it. However, once they had children or changed locations their needs changed. With higher frequency need of the car for more occasions, such as picking up and dropping off their children at school and potentially while commuting to work (Cattolica, 2016).

Interviews also revealed that the recent increase in CSS adoption can be partly explained by the COVID-19 pandemic. This is because people who used take public transportation or those who cannot walk or bike to their destinations are in need of cars. In such instance, it is believed that CSS is a more secure and pragmatic transport mode option as compared to public transportation, particularly for non-car owners.

Aspects of socialisation, relationship-building between owner and borrower, and the concept of community between members appear to be particularly common among P2P platforms. In fact, motivations were also described in the interviews as having a social element. Interviewees noted that people that engage in P2P CSS may also aim to create meaningful (professional) relationships with one another even when they do not necessarily know each other. Some people may also feel that it is efficient and environmentally friendly to rent out their unused cars to other members in the community, and thus support or enhance certain community bonding.

Environmental reasons were also among the motivations mentioned by interviewees, particularly for groups that are environmentally aware or active in sustainable practices. Owners who felt getting a car as necessity, would also feel better about themselves and for the city - as sharing allows them to make sense and justify ownership even when they are not using their vehicles. Interviewees indicate that a particular segment of CSS members are inclined towards green mobility behaviour and the perspective of utilizing resources in a better way. Some members are described as having altruistic reasons, owners also for instance rent out their electric cars (i.e. Tesla) as a means to demonstrate/ showcase new vehicle technologies and the future of transportation. Insights derived from the stakeholder interviews suggest that (emerging) norms and pro-environmental behaviour play a role in the adoption of CSS in the country. It is also found that car sharing is seen or perceived more as a complementary alternative and not a substitute to sustainable mobility (e.g. as in the city of Malmö) (Noll, 2017).

4.4.2 Spain

The main personal motivations for car sharing are economic advantages, convenience and environmental issues. Users who give up vehicle ownership usually have other reasons rather than simply joining a CSS initiative, such as a new job, an increase in the cost of car maintenance or insurance, or an old car that has broken down (Ampudia-Renuncio et al., 2020). Regarding economic advantages, Ampudia-Renuncio et al. (2020) also found that in Madrid the cost of trips in free-floating CSS vehicles can be up to 3 times more expensive than in public transport.

Focusing on convenience, short trips in FFCS services can take up to 100% more time via public transport. This reinforces the idea that the most frequent trips are between nearby neighbourhoods, since the public transport alternative doubles the trip duration. At the same time, it suggests that CSS may be substituting active mobility (i.e. walking and cycling) for short trips. Still, the substitution of traditional materialism for new forms of hedonic consumption might be leading to more responsible consumption behaviour, as members of CSS tend to have a low sense of vehicle ownership and a more utilitarian view of mobility (Alonso-Almeida, 2019).

Another, albeit not motivating but enabling factor relates to internet-based platforms. It is clear that CSS initiatives are being particularly successful among the tech-savvy millennial generation (Alonso-Almeida, 2019). It is claimed that through a combination of financial and environmental concerns, the widespread adoption of smartphones are facilitating access to products and mobility services rather than opting for individual car ownership (Alonso-Almeida, 2019).

Last but not least, feeling concerned about environmental issues when choosing a transport mode significantly increases the probability to be a frequent user of car sharing. Thus, pro-environmental behaviour is seen as an important motivating element. This aspects seems consistent (or it is supported by) the fact that all car sharing companies operating in Madrid are fully electric or hybrid, so CSS contribute to a reduction of air pollution.

4.5 Hindering factors and potential barriers in the adoption of CSS

4.5.1 Sweden

The literature in this particular area is rather limited and we rely mostly on interviews and grey literature to identify hindering factors. As for the main barriers or obstacles identified, interviews revealed that the perceived low cost of owning a car[21] and relevant regulations that do not discourage the use of a private car affect the adoption of CSS.

First, it has to be acknowledged that there is no specific legal definition of CSS in Sweden (SOU, 2020). From a policy perspective, this seems to have a number of implications for the further development of CSS initiatives in the country (SOU, 2020). For example, a differentiated VAT and further efforts to encourage procurement of CSS by public authorities is often identified in the literature (Akyelken et al., 2018; Anderberg, 2018; SOU, 2020). It has been recently argued that for CSS initiatives to be subject to a reduced VAT, they "need to be included under [the] 'transport of passengers and their accompanying luggage' in the VAT Directive" (SOU, 2020, p. 20). In addition, the presence of tax-credits for the use of private cars for the purpose of business errands is also acknowledged as a hindering factor for the uptake of CSS (Akyelken et al., 2018).

Another recurrent issue framing market development in the country relates to parking access and costs (SOU, 2020). This is because in most Swedish towns parking costs represent an increasing burden for car owners, but also a (potentially) important source of financing for small towns. The literature also acknowledges that a lack of a definition of car sharing in the legislation prevents CSS operators (mostly B2C) to deal with more effective solutions for parking issues in urban areas (Anderberg, 2018; Noll, 2017; SOU, 2020). This often acts as an important tipping point to (re-)consider car ownership and try other forms of car use, along with significant possibilities in cooperating with and gaining the support from local authorities regarding more lenient parking permits for B2C CSS vehicles (Akyelken et al., 2018). Thus, it has been already proposed that municipalities should examine parking permits and could consider the option to book exclusive parking space for CSS vehicles in municipal land (SOU, 2020). This above stresses the importance of dialogue between, for example, municipalities, CSS operators and property developers to find optimal parking solutions for CSS (e.g. via parking norms) (Cattolica, 2016).

Based on the above, a more active role on behalf of public authorities is believed to have positive spillovers on private consumers (e.g. via information awareness campaigns about CSS) (SOU, 2020). However, the priorities are mostly concentrated on public transportation and active mobility in the biggest cities in Sweden (Bocken et al., 2020). At the same time, and taking into account that CSS is perceived as complementary to public transport, the potential phase out of subsidies addressing public transportation may have a negative impact on CSS. This is because CSS becomes more dependent on affordable public transportation fees to enhance complementarities and reduce private car ownership (Akyelken et al., 2018; Noll, 2017). To deal with VAT, parking and other policy-related issues, a 'Motor Vehicle Sharing Act' has been suggested for implementation in 2021 (SOU, 2020).

[21] Setting aside negative externalities, note that depending on various factors (e.g. car usage, car model, insurance policy, fuel and parking costs) owning a car may be more expensive compared to a CSS (Burkhardt & Millard-Ball, 2006; Katzev, 2003).

Setting aside policy-related aspects, other hindering factors are also associated with (perceived) convenience. For example, issues about distance to reach the shared car, availability of cars, and booking systems can be identified. Trust and safety issues are also recognised as barriers preventing complementarities between public transportation and car sharing (Noll, 2017). In the past, charging stations for CSS electric vehicles have also been identified as a barrier (Cattolica, 2016). Interviews reveal that drivers are used to easily obtaining (informal) access to private cars whenever they want to. In addition, and when public transport services are unavailable, it can take a relatively long time for people to obtain good services within a given area due to relatively low frequency (e.g. during weekends). This motivates private car ownership in the long run, even if transportation or CSS are available or perceived to be of good quality. Furthermore, interviews revealed that car users have been brought up with social norms (or expectations) depicting a prevalent mindset that adults in Sweden should own a car.

Obtaining accurate information on real costs of car ownership together with the lack of information about CSS and its benefits are also believed to be a limiting factor. Particular attention is given to transaction costs and information barriers hindering the adoption of CSS. The former relates mostly to costs about search of information and related comparisons. Car owners in Sweden may account fuel, maintenance, parking and other automobile related expenditures discretely, as well as travellers also differentiating between travel modes, with one consequence of this is that the costs and expenses of driving are generally underestimated relative to those of using public transport, coupled with self-serving and status quo biases (Mattauch et al., 2016). It is argued that this creates a competitive disadvantage for alternatives to the private car (c.f. Garcia-Sierra et al., 2015). Travellers have also separate mental accounts for fixed and variable driving costs that may lead to (some) costs being ignored, discounted or unperceived (c.f. Garcia-Sierra et al., 2015; Metcalfe & Dolan, 2012). In fact, the pricing structure of CSS operators implies that capital costs are mostly transferred to operational costs (Sprei & Ginnebaugh, 2018), which are perceived to be relatively high by consumers that do not know or apply heuristics to keep track of the total costs related to car ownership.

4.5.2 Spain

Despite the limited available literature, a number of hindering factors are identified in Spain. They mostly related to convenience and reliability. Security in relation to gender is also possible to identify. These aspects are briefly described below.

Being a member of a CSS initiative is not synonymous with being an active car sharer, although it is the first step to using a CSS. In Spain, the charging logistics are quite important, and in the case of electric vehicles, can reduce so-called “range anxiety” for the customer. The users’ perception (and behaviour) of a CSS based only on electric vehicles is quite different from their perception of a CSS based on fuel or even hybrid vehicles. According to the data in the existing systems in Madrid, a car must be charged between once a day and once every two days (Ampudia-Renuncio et al., 2020). Considering the speed of charging and the fact that maintenance tasks can be done in the meantime, the overall time dedicated to charging is estimated to be 5% of the usage time (Ampudia-Renuncio et al., 2020). Thus, the range anxiety can thus have a negative impact on the (further) adoption of electric-based CSS.

The spatial distribution of CSS flows is closely dependent on the city's urban structure. Frequent users are more concerned about the increase in traffic of the area being served. The location of the main activities (e.g. job-related) and parking availability are key issues to understand traffic flows and potential hindering factors. Congestion, distances and devoted time are key aspects. In turn, urban structures and the location of economic activities also explain why it is difficult to make comparisons between Spanish cities about CSS initiatives, as quality, usage and related behaviour are context-dependent.

In Spain, another (potential) hindering factor that relates to convenience is the reliability of CSS. For example, waiting time for CSS use is of prime importance. If there is currently no car available within the desired distance (radius), this does not only prevent use but it also affects which transport mode CSS members choose if they finally decide not to use the CSS. Thus, reliability and quality of service depend heavily on the cars available at any given time. This means that good spatial availability is another key factor for the success of the system. Booking system can handle planned trips, but not sporadic or intermittent CSS demand. The available literature shows that 83.61% of respondents in Madrid would not accept a waiting time of over 15 minutes (Ampudia-Renuncio et al., 2020).

In addition, user's acceptance of free-floating CSS (i.e. tolerance to wait and/or walk towards an available car) also shows certain limits: users are willing to walk a maximum distance of 300 meters to reach an available car (Ampudia-Renuncio et al., 2018). In Madrid, a percentage of 31.52% would opt not to use the car sharing system if the vehicle is located at a distance of over 300 meters (Ampudia-Renuncio et al., 2020).

Security and gender are also highlighted as potential hindering factors mainly for non-profit/cooperative ride-sharing companies (BlaBlaCar and Amovens). Female users prefer to travel with people they know and prefer to be the passenger rather than the driver. Women prefer to avoid the stress associated with travelling with strangers or driving an unfamiliar car, and their use of CSS is constrained by fear about their personal security. Thus, having access to a trusted platform can reduce women's feelings of fear and insecurity (Alonso-Almeida, 2019). To confront this situation, BlaBlaCar has developed several safety features focusing on women. However, some women may prefer not to travel with men, especially on the first trip, as BlablaCar's experience indicates. The company has created the 'only women' option so that women can travel only with women. The share of female users is a little over 50%.

4.6 Environmental aspects

As introduced in Section 1, the environmental credentials of CSS have been subject to debate. To various extents, the environmental impacts of car sharing has been examined in numerous configurations and in different policy and market contexts (see e.g. Baptista et al., 2014; Becker et al., 2017a; Firnkorn & Müller, 2011; Namazu & Dowlatabadi, 2015; Nijland & van Meerkerk, 2017). Some of the approaches in assessing impact take into account life-cycle impacts, including upstream (fuel and vehicle production) and downstream (vehicle scrappage) effects, controlling for use alternative modes of transport, and its relationship to the demand for parking due to the impact of reduced car ownership brought about by car sharing (Nijland & van Meerkerk, 2017). The literature addressing environmental impacts of CSS in both Sweden and Spain appears very limited, fragmented and inconclusive, which prevents specific and elaborated insights in this area.

Acknowledging this caveat, and when it comes to (potentially) *positive* environmental aspects, research applicable to the countries under analysis indicates that CSS contribute to the reduction of car ownership, and resultant car mileage and emissions reductions (Katzev, 2003; Lane, 2005; Meijkamp, 1998; Rabbitt & Ghosh, 2016). Studies also show that CSS can complement public transport and mobility (Ferrero et al., 2018; Katzev, 2003; Plepys et al., 2015), with calls for full integration with sustainable mobility options emerging (Becker et al., 2017b; Cervero et al., 2007; Firnkorn & Müller, 2015; Kent, 2014). Further, studies have shown "complementarity between car sharing and public transport, and a strong complementarity between car sharing and bike sharing" (Ceccato & Diana, 2018, p. 1). Thus, greater use of alternative forms of mobility such as walking and bicycling can increase the environmental credentials of CSS when complementarities are further strengthened from a more integrated transport perspective (c.f. Ferrero et al., 2018; Katzev, 2003; Kopp et al., 2015). For the particular case of Sweden, the literature acknowledges that CSS is seen or perceived as complementary, and not a substitute, to public transportation (Akyelken et al., 2018; Noll, 2017). Local authorities in Sweden also seem to give priority to active mobility and public transportation (Bocken et al., 2020), which may provide a more strategic environmental niche for CSS. For the case of Spain, CSS is also seen or perceived as complementary, and not a substitute, to public transportation (Ampudia-Renuncio et al., 2018). As a consequence, possible rebound effects (e.g. CSS displacing active mobility) and corresponding traffic and environmental impacts need to be assessed.

In line with the pro-environmental behaviour narrative identified in Sweden and Spain, the reviewed literature also stresses that CSS *per se* naturally support 'access', 'product-to-service' solutions and 'sustainable lifestyles' – in addition to avoid, shift and improve policy approach (Bakker et al., 2014). Thus, it is argued that CSS has an inherent "sustainable" element that is appealing to 'green consumers' by shifting private mobility "from ownership to service use" (Ferrero et al., 2018, p. 501). Rather than reliance on private cars alone, CSS should thus be framed in terms of 'access' and the promotion of other potential benefits via active travel (Bakker et al., 2014; Kent, 2014; Young & Caisey, 2010). In Spain, the strong development of bike sharing initiatives in the past years appears to work in favour of complementarities with CSS. From an environmental point, it is argued that this is the case when both cars and scooters belonging to sharing fleets are electric.

It is also found that CSS can also introduce users to new vehicle technology (Ferrero et al., 2018; Zoepf & Keith, 2016). A positive interpretation of this is that consumers develop preferences towards cleaner or more advanced vehicles (e.g. electric cars) as opposed to conventional cars with an inferior environmental performance. With due limitations, our findings suggest that preferences towards more efficient or green vehicle attributes appear to be on the rise in Sweden and Spain.

Regarding (potentially) negative environmental issues, the reviewed literature also indicates various aspects that may be applicable to Spain and Sweden. Although there are identified positive impacts on active mobility (Kent, 2014; Khan et al., 2017) and public transport (E. Martin & Shaheen, 2011), caution must be exercised in considering the reduction of vehicle kilometres travelled and the environmental credentials or attractiveness of CSS (Bocken et al., 2020; Hartl et al., 2018; Jung & Koo, 2018; Sprei & Ginnebaugh, 2018; Wang, 2011). For example, it is found that some car owners are unable to forego car ownership, or that car sharing mostly substituted the services of a second or third car (Ferrero et al., 2018; Nijland & van Meerkerk, 2017). In Sweden, it is already claimed that car sharing is complementary, and not a substitute to existing private car usage, particularly in urban areas (Bocken et al., 2020). Some studies also reveal that CSS can substitute public transportation, particularly among non-car owners (Ferrero et al., 2018; E. Martin & Shaheen, 2011).

As mentioned above, CSS can potentially increase demand for car ownership as it introduces users to new vehicle technology (Zoepf & Keith, 2016). This also has the potential to increase car dependency and related negative impacts (e.g. congestion). Considering that many of the largest CSS platforms are backed by large car manufacturers (e.g. DriveNow – BMW, Car2Go – Daimler, Maven – GM), one car argue that the adoption of CSS via B2C models may simply promote the adoption of private car usage in the long term, particularly among young people subjected to, for example, the social norm of owning car and/ or self-selection bias when they start a family.

Finally, other concerns over the potential negative impacts of CSS were also expressed by interviewees. They include the rebound effect of cars by being used more often, or preference of car use which could crowd out other forms of transportation, particularly active mobility. Correspondingly, participants indicated the need for much more research about the environmental performance of CSS, including the role of public policies addressing the integration of transportation services' networks with CSS (c.f. Bocken et al., 2020; Cervero et al., 2007; Ferrero et al., 2018; Kent, 2014).

5 Conclusions

The objective of this report was to provide an understanding of Car Sharing Services (CSS) in Sweden and Spain. It builds upon existing knowledge on the transportation sector, travel behaviour-related issues and input obtained from interviewees. Given the orientation of the BE-USE project, particular attention was given to market, environmental and behavioural aspects that the adoption of CSS (potentially) entails. Numerous CSS initiatives were identified and to advance them, our study stresses that further analysis about transportation modality behaviour(s) is needed. This is particularly important to analyse behavioural-oriented measures that address sustainable mobility alternatives to private car ownership.

When looking at our guiding research questions, the following aspects can summarise our main findings. First, and when it comes to the development of CSS in Sweden and Spain, it is safe to say that CSS are becoming more prominent. Multiple operators and business models are identified, and the practice of CSS can be traced back to several decades ago. The number of non-business users also appears to be growing. Together with the insights from participants of P2P CSS, the outlook appears promising as the estimated total number of cars in the larger Swedish CSS initiatives for the recent decade, such as Moveabout, Sambil, and M (formerly Sunfleet), indicates an overall increase at about 14.7% per year average (Miljöbarometern, 2019). However, it must be noted that an increasing number of CSS membership does not necessarily mean active or high frequency use of CSS. High capital investment (costs of vehicle leasing and purchase), insurance rate hikes, and scarcity of cost-effective technologies appear to hinder the ability of the car sharing sector to materialise its (potential) environmental, economic, and social goals (Shaheen et al., 2003). Provided that a number of policies interventions take place (e.g. related to VAT, parking, congestion charges and procurement), it is argued that the market potential for CSS is expected to growth.

Second, the results confirm the uncertainties, debates and lack of research about the environmental performance of CSS in the countries under analysis. In line with the literature, on the one hand, there are indications that CSS have the potential to reduce car ownership and resultant car mileage, emissions, congestion and the need for parking space. It can also increase preferences towards fuel-efficient or electric cars and complement public transportation and active mobility. On the other hand, the available information also suggests that certain amount car owners cannot forego car ownership so CSS may only substitute the services of a second or third car. More research is needed to establish this particular aspect, though. However, indications that CSS can (potentially) substitute active mobility or public transportation exist[22]. This seems particularly relevant among non-car owners. The introduction to new vehicle (technology) can also foster preferences towards car ownership, which in turn can generate negative rebound effects in the long-term.

[22] For the latter, note that the COVID-19 pandemic can also be taken as an important driver having an impact on both, decreased demand for public transport and increased demand for CSS.

Third, and from a consumer point of view, this study reveals various factors motivating but also hindering the (potential) adoption of CSS. On the positive side, economic reasons (e.g. maintenance costs), convenience, and key policy enabling factors (e.g. about parking, VAT) are indicated to foster the (future) adoption of CSS. Environmental concerns, conformity towards emerging social norms, and innovative business platforms are also possible to identify in favour of CSS adoption. Moreover, socialisation aspects, relationship-building between owner and borrower, and the concept of community between members were found to be common among P2P platforms. The COVID-19 pandemic was also identified as motivating factor by the interviewees, in particular given health risks associated with public transportation. As a whole, underlying hierarchical motive structure of value-seeking, convenience, lifestyle, and sustainability aspects affecting CSS adoption is possible to identify (c.f. Schaefers, 2013). In line with the literature, one can conclude that a customer does not utilise CSS based on one motive only, but rather with a different intensity of the different motives (Schaefers, 2013). On the negative side, the lack of policy action (e.g. on VAT or tax credits for the use of private cars for business purposes), access to parking space, the low cost of owning a car, reliability, security and other aspects preventing accessibility (e.g. distance to shared cars) are often cited as factors limiting consumer uptake. The geographical concentration of certain operators in large urban areas also seem to reduce the adoption by potential customers located in other areas. In addition, and despite growing environmental awareness, pro-environmental behaviour is sometimes not considered a primary motivation to join a CSS (c.f. Böcker & Meelen, 2017; Hartl et al., 2018). From a consumer perspective the aspects listed above seem consistent with Ferrero et al. (2018, p. 507), that stress that the most critical aspects having an impact on the CSS consumer's (non-)adoption include "parking policies, technology, vehicles [fleet], fuel [pricing] and insurance [costs]". However, and for the particular case of Sweden and Spain, our study strongly indicate that there is still a need to better understand people's motivations and barriers that affect the adoption of CSS. So far, there seems to relatively higher knowledge on market and business issues than behavioural aspects of (potential) CSS customers.

In the context of our project, behavioural economics (BE) and the use of experiments provides the framework to build a better understanding of the motivations and cognitive biases that (potentially) affect individual decision-making processes and resulting choices related to CSS and other modalities (Metcalfe & Dolan, 2012; Young & Caisey, 2010). In fact, there is growing body of knowledge exploring the potential applications of BE to transport, particularly in the field of promoting alternatives to private car use, sustainable and active modes of transportation (Avineri, 2012; Garcia-Sierra et al., 2015; A. Martin et al., 2012; Metcalfe & Dolan, 2012; Namazu et al., 2018; Young & Caisey, 2010). From a methodological point of view, the findings indicate various avenues supporting the research ahead. First, we need to have a better understanding of the behaviour(s) to be changed (e.g. reactance) or encouraged (e.g. acceptance) in relation to the (non-)adoption of CSS. Second, we are beginning to understand the potential behavioural anomalies and cognitive biases that may be applicable to CSS. As shown in Section 3.4, behavioural research on transport mode provide a useful platform or departure point. Based on current knowledge, one could argue that, for example, loss aversion, heuristics and the status quo bias might be preventing the adoption of CSS. These aspects deserve more attention, certainly. Furthermore, it seems that there is an important set of external factors underlying or framing the CSS consumer behaviour (e.g. social norms and policy interventions addressing VAT and parking availability). These intrinsic and extrinsic aspects affecting the (potential) CSS adoption are significant because they provide critical grounds for the design and implementation of behavioural-oriented policy intervention(s) addressing behaviour(s); including the corresponding assessment of such interventions.

Finally, and keeping in mind the uncertainties about the environmental performance of CSS, the emerging literature shows positive avenues on the analysis of social norms to motivate sustainable mobility behaviours (Maness et al., 2015; Mattauch et al., 2016; Raux et al., 2015). The tendency of individuals to follow norms reflecting what is common / divergent (descriptive norms) and what is expected of them or socially approved / disapproved (injunctive norms) may play into trend affinity in transport mode choice, which could be influenced by herd behaviour and bandwagon effects (Avineri, 2012; Cialdini, 2007; Garcia-Sierra et al., 2015; Metcalfe & Dolan, 2012). The findings also provide indications that travellers can conform to social norms on prevalent or emergent travel behaviours and, consider the potential for available modes of sustainable transport and active mobility (i.e. walking and cycling) being crowded out by increased CSS use. Norms can also be an important element when trying to support or intensify the (potential) effectiveness of informative policy instruments (Garcia-Sierra et al., 2015). Studies prescribe the use of messages with descriptive norms (perceptions about behaviours socially-extended) to reinforce pro-environmental behaviour that are sufficiently widespread, whereas if the intention is to change an environmentally undesirable but socially-extended behaviour then messages with injunctive norms (perceptions about socially-approved behaviours) should be accordingly examined (c.f. Cialdini, 2007; Garcia-Sierra et al., 2015; Mattauch et al., 2016). Another aspect worth understanding is pro-environmentalism, which can be also be associated with conformity towards current social norms. In adopting a more sustainable mobility behaviour, analytical avenues to consider would be status seeking and caring about what nearby people do and think if CSS is or not adopted (c.f. Garcia-Sierra et al., 2015). So far, our study shows no explicit experimental application of social norms on CSS (non-)adoption. The testing and analysis of this potential behavioural-oriented policy interventions can also provide a productive room to increase our understanding of (potential) CSS adopters.

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Appendices

Annex 1 Interview Protocol

Sharing Behaviour - Behavioural Economics to advance Sustainable Urban Sharing-Economy initiatives in Sweden (BE-USE)

Stakeholder Interviews

Sharing economy initiatives are being implemented around the world with the prospects of offering sustainable solutions to cities. BE-USE is a strategic project that aims to develop behavioural economics interventions and experiments that will test, examine and generate policy recommendations to advance sustainable urban sharing economy initiatives in Sweden.

The overall goal of this interview is to collect insights and feedback from stakeholders on various issues concerning car sharing in Sweden.

Interview 2020 - April

Thank you for agreeing to participate in this interview. This conversation should take between 45 and 60 minutes.

A. About your company

1. What is your position / role at the organization and what does it entail?
2. What mode of car service (one-way, two-way, B2B carpool, free floating, MaaS, etc.) do you provide?
3. How do you describe your price structure? Would it be possible for you to explain how you set prices?

B. About your customers

4. How many customers do you have?
5. In which cities/region do you operate the most?
6. Who is your typical customer / client? (e.g. age, gender, education level, income level, environmental awareness, users of public transport/active mobility, etc.)
7. What are the main motives of your customers / clients to participate in car sharing?
8. How important (or not important at all) are the following factors among car sharing adopters: Pricing, features/age of the car fleet, parking availability, daily travelled distance, service mode (i.e. two-way use, one-way use, free-floating use), insurance policy, car sharing stations?
9. How often do your clients use the car sharing services?
10. What can be done to motivate people to adopt car sharing? Is there any role for the government or municipalities to support this?

C. About the market

11. How would you describe the car sharing business market in Sweden today?
12. What are the main barriers or obstacles for the market to growth?
13. What future do you see for the car sharing market?
14. What is your opinion about the (current and/or future) environmental performance of car sharing? What are the key environmental issues that the car sharing industry confronts?
15. How do you perceive the role of car sharing in sustainable mobility?
16. Which car sharing elements or features do you think can complement or substitute public transport and active mobility?
17. Finally, has your company been affected by the Covid-19 situation? If so, in which way? How do you foresee going about with it?