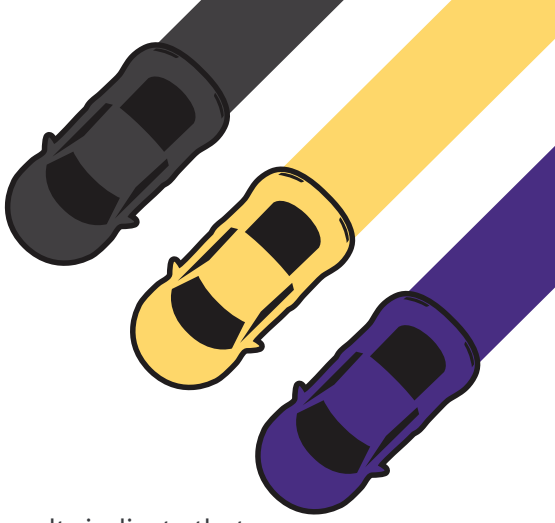
STARS
Shared mobility opporTunities And challenges foR European citieS

FACTSHEET

Traffic reduction through car sharing

Evidences from the German experience



The traffic-reducing effect of car sharing is scientifically well studied. The results indicate that car sharing leads to **the elimination of private vehicles** and to **a reduction in the demand for parking spaces.** Furthermore, car sharing alters the mobility behaviour of its users. Car sharing customers use environmental modes of transport more frequently and a private vehicle more seldom than the reference population. Car sharing contributes thereby to both a relief of the burden on space in stationary traffic and to a departure from autocentric mobility. For this reason, **the German government enacted a car sharing law (CsgG) to promote car sharing.**

More recent studies show that different car sharing variants function differently. While the traffic-reducing effect of roundtrip car sharing can be considered proven, it remains questionable for free-floating car sharing. This factsheet presents the most important results of the case studies that were carried out in some German cities within the STARS project and frames the state-of-the-art knowledge for the car sharing sector in Germany. Lastly, the document shows which conclusions can be drawn by cities and municipalities for **the promotion and the integration of car sharing in municipal mobility concepts.**

TWO KINDS OF TRAFFIC REDUCTION THROUGH CAR SHARING

Cities and municipalities suffer from the fact that **Motorised Individual Transport (MIT),** both in stationary and moving traffic, claims an all too significant share of public (street) space and leaves too little room for other, more sustainable means of transport. Car sharing contributes to a reduction of MIT in two ways:

Car sharing reduces the number of private vehicles and of parking spaces needed. Because car sharing leads to the elimination of private vehicles and bundles the usage requests by more households for fewer private vehicles. This traffic-reducing effect of car sharing can be expressed in **the "replacement rate": "one car sharing vehicle replaces X private vehicles."**

Car sharing alters mobility behaviour. Because car sharing users no longer pay for car ownership, but only for the single use of a car. In this way, they distribute their trips innovatively among diverse means of transport. Above all, bicycles and public means of transport benefit from this. This change is particularly apparent when households that had previously owned (at least) one private vehicle abandoned car ownership thanks to car sharing. The change in mobility behaviour is presented in the relevant studies in different ways – for example, with a comparison of the use of transport means with the relevant total population, with the change in number of car-free households among car sharing users, or with a "before and after" -comparison of their vehicle, bicycle and public transport use.

www.stars-h2020.eu

@StarsH2020

h2020@gmail.com

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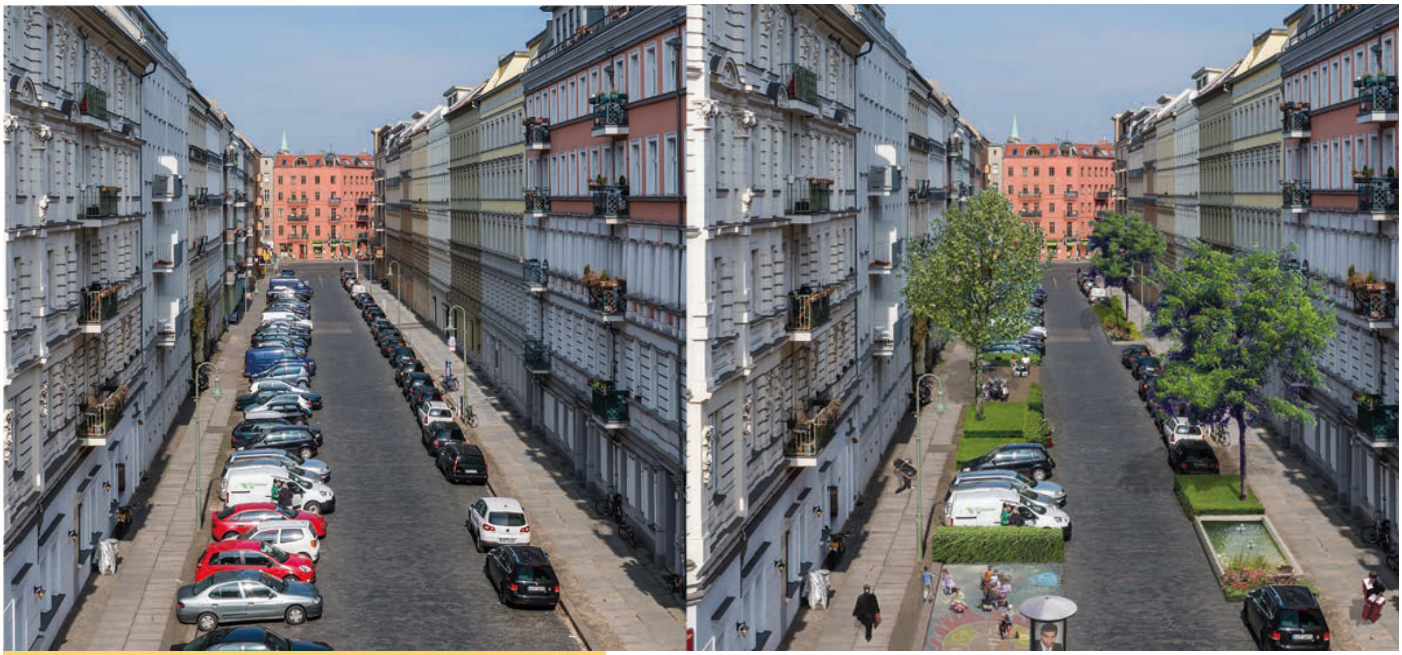
CAR SHARING REDUCES CAR POPULATION

The highest replacement rate in Germany to date is 1:20: **"one care sharing vehicle replaces 20 private vehicles"**. This ratio was determined 2016 in a study by the German Car Sharing Association, in which the roundtrip car sharing and combined roundtrip/free-floating options were examined within inner city residential areas in Cologne and Frankfurt (bcs 2016). Altogether, the study observed for residential areas adjoining the inner-city in 12 German major cities replacement ratios between 1:8 and 1:20. This means that, when converted to the parking space required by a single car, between 36 and 99 meters of street edge is relieved of parked cars by each car sharing vehicle considered in this study (calculated in curb-side parking spaces minus the parking space for the car sharing vehicle).



One car sharing vehicle replaces up to 20 private vehicles.

bcs 2016 also reveals that car sharing plays a substantial role in steadily **holding private vehicle possession in car sharing households to a low level.** If there were no more car sharing, most of those users questioned in the study would again acquire an automobile. The total number of cars owned privately would rise to 102% of the original number.

REASONS FOR VARIATIONS AMONG THE REPLACEMENT RATES

Car sharing studies of previous years show that replacement rates vary widely. The reason for that may be due for one thing to the different survey methods, and for another thing to the fluctuating replacement rates with the respective study area. The newest research makes evident, moreover, that the traffic-reducing effect depends on the examined car sharing variants (roundtrip, free-floating, combined). For roundtrip car sharing and combined roundtrip/ free-floating systems, all the studies present exclusively positive replacement rates. With free-floating car sharing, both positive as well as negative replacement rates are observable.

Car sharing variants	Replacement rate (1 cs vehicle replaces X private vehicles)	Location	Source
Roundtrip	1 : 8 to 1 : 9	Berlin	bcs 2019
Roundtrip, combined	1 : 10 to 1 : 15	Frankfurt on the Main	STARS 2019
Roundtrip	1 : 7	Bremen	Bremen 2018
Free-floating	1 : 0.3 to 1 : 0.8	Frankfurt on the Main, Cologne, Stuttgart	share, 2018
Roundtrip	1 : 8 to 1 : 20	Selected inner-city residential areas in 12 German cities	bcs 2016
Free-floating	1 : 2.0 to 1 : 3.6	Munich	EVA-CS 2015

Replacement rates in select car sharing studies, Germany 2015-2019.

CAR SHARING VARIANTS ARE DIVERSELY TRAFFIC-REDUCING

The results of different car sharing studies suggest that **the traffic-reducing effect of car sharing is variant-specific.** Especially roundtrip car sharing is recurringly attested to having a high traffic-reducing effect. By contrast, the traffic-reducing effect of free-floating car sharing remains unclear, in some cases negative results are apparent here.

The traffic-reducing effect of free-floating car sharing can, however, improve with changing background conditions. This is suggested by a study undertaken by the British Car Sharing Association comoUK (formerly carplus) (Carplus 2015). Here it is evident that the traffic-reducing effect of free-floating car sharing in London is clearly greater than the effect normally measured in other studies. The reasons for this have not been researched in great detail. However, it is probable that the influence of the city toll in effect since 2003 is having an impact here.

Explanations of car sharing variants

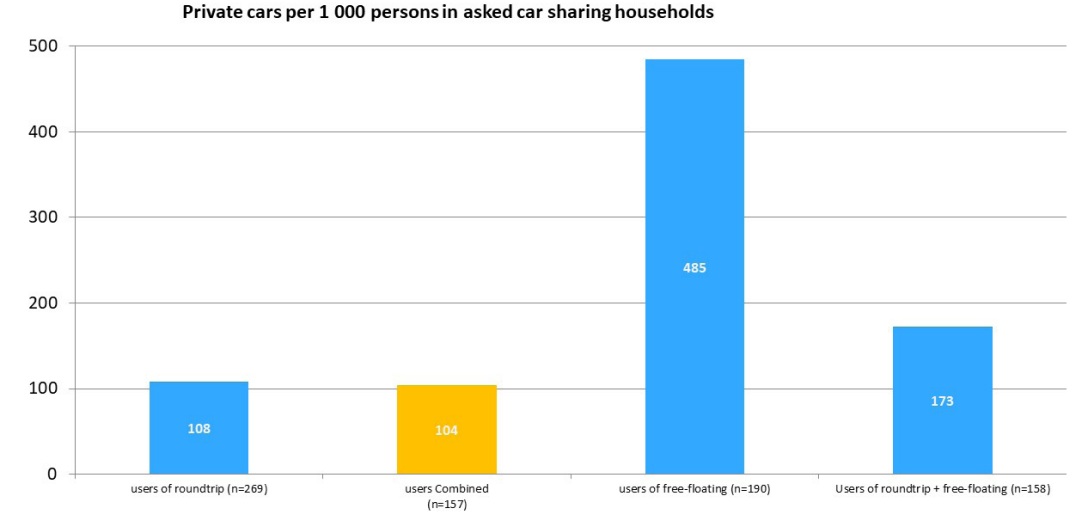
With roundtrip car sharing, autos stand close to home in a fixed parking space. Customers pick the car up there and return it there after the trip. Only with this variant are reservations for multiple days or weeks possible in advance. This insures a high predictability for vehicle availability. Roundtrip car sharing is also the least expensive car sharing variant. In Germany, the largest providers (in terms of fleet size) are stadtmobil, cambio, teilAuto and book-n-drive.

With free-floating car sharing, the cars are distributed within a defined business area randomly by the roadside. Users locate and book them with their smartphone. After the trip, they park the vehicle somewhere within the business area. With this variant, reservations in advance are not possible. Consequently, both the availability and the location of the vehicle is difficult to predict. However, free-floating makes possible one-way trips within the defined business area. The prices exceed those of roundtrip car sharing. The largest providers are ShareNow, Sixt share and We share.

Since 2011, **combined car sharing offers** have also been established, offering roundtrip and free-floating vehicles in one. There are combined offers, for example, in Hannover, Karlsruhe, Mannheim and Heidelberg (stadtmobil), in the greater Frankfurt on the Main area (book-n-drive) and in Leipzig (teilAuto). The prices are usually oriented on the lower prices of roundtrip vehicles.

Within the framework of the STARS project, the reduction benefit of different car sharing variants under comparable conditions was examined in different German cities. To this end, three study areas in Frankfurt on the Main, Cologne and Stuttgart were defined, in which all the car sharing systems (roundtrip, free-floating and combined) are equally readily available. In all three cases, the study dealt with very densely populated inner-city residential areas in which, along with car sharing, the offers for mass transport and additional mobility services are very widely available. Under these comparable conditions, it is evident that car sharing's traffic-reducing effect varies greatly.

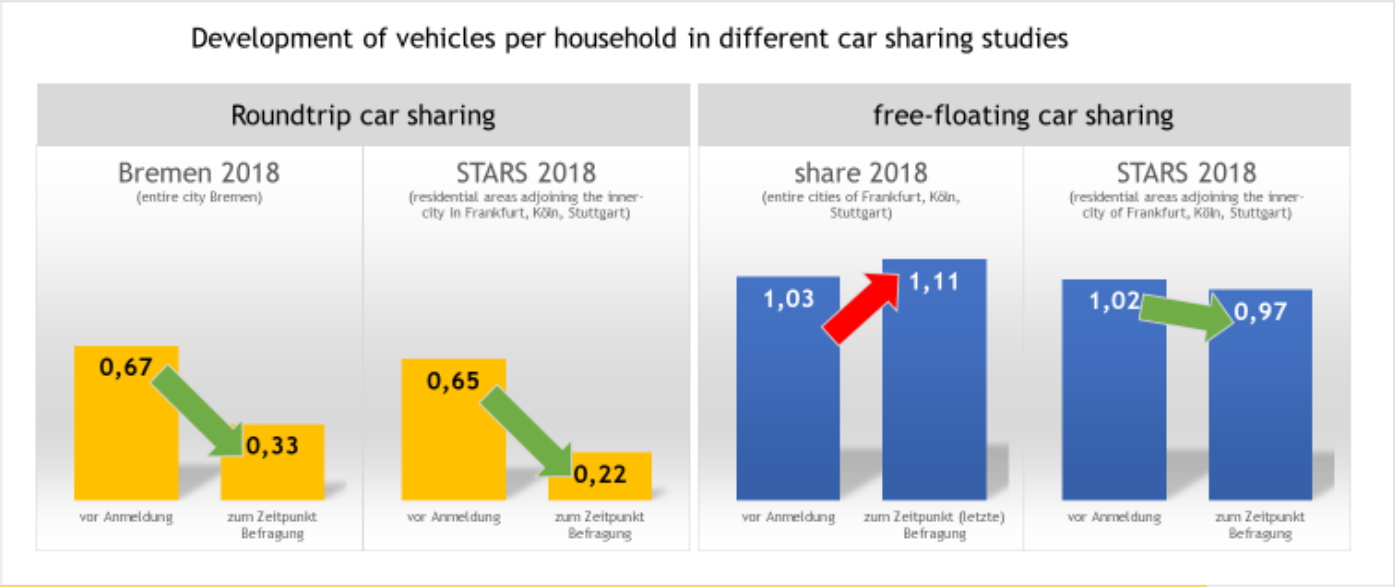
At the time of the survey, **users of roundtrip car sharing offers demonstrate a low rate of car ownership,** merely 108 vehicles per 1 000 persons in the surveyed households. This figure lies already below the target of 150 vehicles per 1 000 persons as recommended by the German Federal Environmental Agency for climate - and environment-friendly urban transport. Conversely, **free-floating users exhibit a high level of car ownership** (485 vehicles per 1 000 persons). Only free-floating users who are parallel registered with roundtrip car sharing, as well, have a lower rate of car ownership.



Car ownership rates among users of different car sharing variants (data from STARS 2018).

The development in the number of privately owned vehicles also varies strongly among the users of roundtrip and free-floating car sharing. **With the users of rountrip car sharing, the number of privately owned vehicles decreases some 66%** when compared with a time 12 months prior to the registration with car sharing. **With the users of free-floating car sharing, the number of vehicles fell in the same time period merely 5%.**

These results of the comparative study STARS 2018 are compatible with other car sharing studies carried out in Germany from the same time period.



Development of vehicles per household in different car sharing variants, as compared between different car sharing studies.

STARS 2018 provides three indications why the traffic-reducing effect of the car sharing variants is different:

Free-floating car sharing can be used parallel to car ownership as a "substitute taxi". This point also attracts auto-friendly target groups which do not at all relate the idea of eliminating private vehicles to their car sharing participation.

Free-floating car sharing is oftentimes not seen as a full-fledged car-substitute. In STARS 2018, 63% of the users of roundtrip car sharing offers agree with the statement that car sharing is a full-fledged substitute for a vehicle of one's own. Among free-floating users, only 33% are of this opinion.

Free-floating car sharing is judged worse than roundtrip and combined systems on the points of "costs of use" and "vehicle availability". In share 2018, users of free-floating car sharing likewise criticised these two points as obstacles for the user.

COMBINED CAR SHARING OFFERS PROVIDE FREE-FLOATING CAR SHARING TRAFFIC-REDUCING

In combined car sharing offers, roundtrip and free-floating vehicles are offered in one by one provider. In their tariffs and in the app, both car sharing variants in the combined system are, as a rule, closely linked. **STARS 2018 determines that combined systems have a high traffic-reducing effect, comparable to the roundtrip offers.** The motorisation level of car sharing customers who use the combined systems lies in STARS 2018 at 104 private vehicles per 1 000 persons in car sharing households. The number of vehicles in the households falls just as strongly in the reference period, as with the roundtrip variant. These values suggest that combined car sharing offers are a way by which free-floating car sharing can be offered traffic-reducing.

CHANGE IN MOBILITY BEHAVIOUR THROUGH CAR SHARING

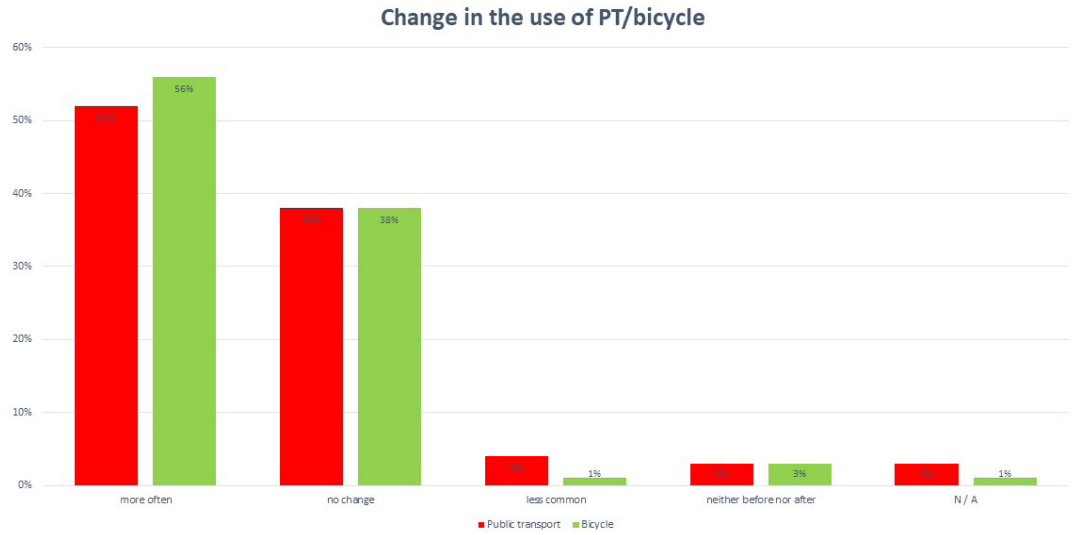
Car sharing customers travel by car more seldom than the population at large and resort more frequently to sustainable alternatives. There is ample evidence of this:

WiMobil 2016 provides evidence that car sharing customers of all variants make use of public transport significantly more often than the respective relevant reference population.

bcs 2016, WiMobil 2016, share 2018 as well as STARS 2018 and STARS 2019 show consistently that car sharing customers of all variants possess with above average frequency public transport passes. This applies most especially to customers of the roundtrip and combined systems.

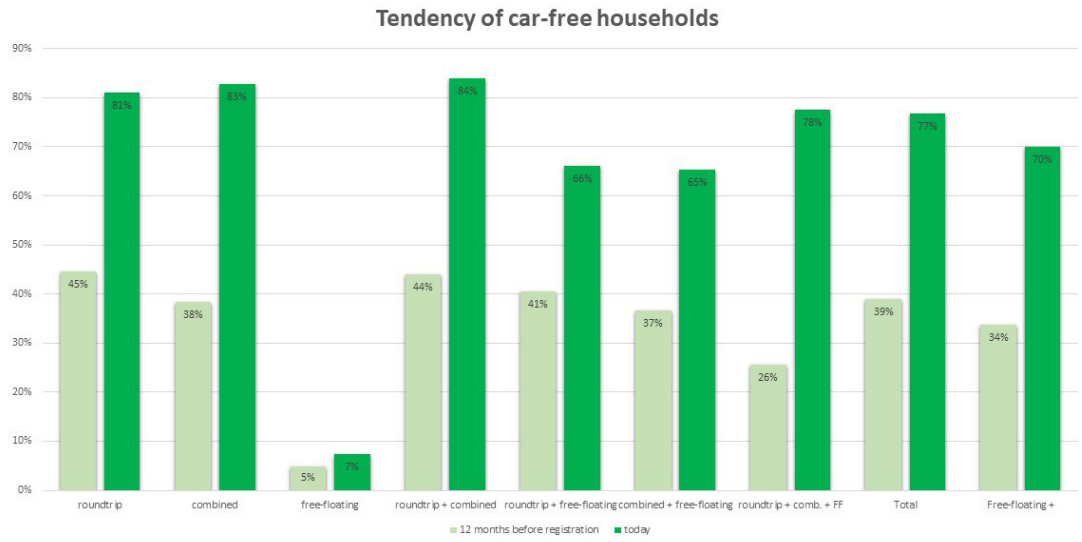
Bremen 2018 establishes that the vehicle mileage in a (roundtrip) car sharing household is 50 % lower than in an average household in Bremen.

Numerous car sharing studies concur that households alter their mobility behaviour particularly strongly when they give up a vehicle. For the routes previously traveled by car are most commonly transferred to environmentally friendly transport modes.



Change in the use of public transport bicycle in car sharing households which eliminated an auto (Bremen 2018).

The change in mobility behaviour is strongest in those households that become car-free by doing away with their own vehicle. A good indicator of the change in mobility behaviour through car sharing is, consequently, the increase in the number of car-free households in the course of the car sharing membership. STARS 2019 demonstrates that with users of roundtrip and combined car sharing offers in Frankfurt on the Main between the time twelve months prior to registration with car sharing and the time of the survey, the rate of car-free households rose some 40% to over 80%. Similar changes are evident in bcs 2016. By comparison, in metropoles like Frankfurt, 42% of households on average have no car of their own, according to MiD 2017 (Mobility in Germany from the Federal Ministry of Transport).



Tendency of car-free households in selected car sharing variants (STARS 2019, Frankfurt on the Main).

OVERVIEW: TRAFFIC-REDUCTION THROUGH CAR SHARING

For roundtrip car sharing, a high traffic-reducing effect is evident. This results for one thing from the elimination of private vehicles and thereby from the attending relief in space pressure. For another thing, the mobility behaviour of users is altered: bicycle, bus and train receive a higher proportion than before the membership with car sharing.

For plain free-floating car sharing, the traffic-reducing effect is unclear. Studies measure both slightly positive as well as negative effects.

Combined car sharing offers seem to be a way to make free-floating car sharing available in a traffic-reductive manner.

How car sharing influences the number of cars: example Frankfurt on the Main

In Frankfurt on the Main, 643 car sharing vehicles were made available at the end of 2019 by providers of roundtrip and combined car sharing. These vehicles account for 0,19% of the entire number of vehicles in Frankfurt.

The car sharing vehicles were available to 19 131 car sharing customers. That represents 2,5% of the entire population. In recent years, car sharing customers reduced the number of their privately owned vehicles by 8 906 vehicles. According to information provided by the customers, 7 748 of these vehicles would be reacquired if there were no car sharing. Consequently, the entire number of vehicles in Frankfurt at the end of 2019 would, without car sharing's offer, lie not at 336 413 vehicles, but 2,3% higher.

The sample calculation makes apparent that car sharing substantively contributes to a reduction in the number of vehicles. But the figures also show that there are still too few car sharing households in Frankfurt to stop or reverse the growth trend in the number of vehicles altogether.

CONCLUSIONS FOR MUNICIPAL MOBILITY CONCEPTS

Municipalities should actively promote the traffic-reducing effect of car sharing through measures of their own:

Municipalities should support the high traffic-reducing effect of roundtrip car sharing offers by establishing reserved car sharing parking spaces in public street space. In doing so, these offers will become more visible to current non-users. The aim should be the existence of a maximally extensive network of car sharing parking spaces close to home (in private and public space) for roundtrip car sharing. On the basis of this station network, additional offers of free-floating car sharing can raise the attractiveness of the offer in its entirety for diverse target groups. Where car sharing variants already exist parallel to one another, a networking within the framework of digital mobility as a service offer can also promote the stronger combination of the variants.

A resolute "push-and-pull" transport politics strengthens the traffic-reducing effect of car sharing and its attractiveness in comparison with private car ownership. Pull measures promote the quality offers of transport alternatives to the private vehicle, for example, expansion of bicycle traffic infrastructures, expansion of mass transport, and improvement of the information about existing alternatives. Push measures sink in parallel fashion the attractiveness of private auto use: increasing the costs for the parking of private vehicles, reducing environmentally harmful subventions for private vehicles or for privately usable company cars; stronger parking space management, resolute punishment of traffic violations, especially as regards parking, and access restrictions for private vehicles.

The variety of different mobility offers is in itself not a sensible goal for the politics of urban transport. Municipal transport politics should work toward developing a comprehensive system of climate-friendly, space-saving and traffic-reducing mobility services, with good public transport and bicycle traffic as its mainstays. In such a transport system, car sharing offers should be integrated with a higher traffic-reducing effect, as an "auto building block" of the integrated environmental modes of transport.

STARS has elaborated a more comprehensive toolbox to provide guidance on how to implement car sharing in order to maximise its benefits in European cities. It will soon be released on the project website www.stars-h2020.eu and also on CORDIS www.cordis.europa.eu/project/id/769513/results

CAR SHARING STUDIES

STARS 2018: Mobility cultures and mobility styles, Deliverable 4.2 of the STARS project. Available on www. cordis.europa.eu/project/id/769513/results

STARS 2019: Mobility scenarios of car sharing: gap analysis and impacts in the cities of tomorrow, Deliverable 5.1 of the STARS project. Available on www.cordis.europa.eu/project/id/769513/results

Bremen 2018: team red: Analyse der Auswirkungen des CarSharing in Bremen, 2018
share 2018: Öko-Institut, ISOE (Hrsg.): share – Wissenschaftliche Begleitforschung zu car2go mit batterieelektrischen und konventionellen Fahrzeugen. Forschungsvorhaben gefördert vom BMU, 2018

bcs 2016: Mehr Platz zum Leben – wie CarSharing Städte entlastet; Abschlussbericht; Bundesverband CarSharing e.V., Juni 2016

WiMobil 2016: BMW AG, DLR et al (Hrsg.): Wirkung von E-Car Sharing Systemen auf Mobilität und Umwelt in urbanen Räumen (WiMobil). Gemeinsamer Abschlussbericht. April 2016

Carplus 2015/16: Carplus Annual Survey of Car Clubs; April 2016

EVA-CS 2015: team red et al. (Hrsg.): Endbericht Evaluation CarSharing (EVA-CS) Landeshauptstadt München. Berlin 29.09.2015