Challenges to Turn Transport Behavior into Emission-Friendly Use of Means of Transport

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Abstract

The target of emission reduction in Germany requires a turn from petrol/diesel motorized private transport toward emission-free transport solutions. Besides electrified cars, bicycles, scooters, and pedelecs become more and more common: easy to finance, easy to use, fast in town, reliable, and emission-free. Hence, many local authorities intend to force bicycle use significantly. Almost every German citizen owns a bicycle; however, roughly 50% are used less than once a month or not at all.

Bicycle traffic contributes just 11% to Germany’s modal split (amount of moves). Other countries nearby indicate that pedelec movement will become a significant player in people movement. The means of transports are just one side of the medal of the turn to future transport opportunities.

Is it necessary to own vehicles, bicycles, and scooters? There are plenty of scenarios, where private ownership of means of traffic does not solve transport problems and/or lacks of availability at a certain point of need.

How does sharing satisfy local transportation needs? How can sharing of emission-free vehicles contribute to a successful future transportation in Germany? The chapter will focus on a few hints to answer these questions, building on findings of studies and field tests and the view beyond the German horizon.
Keywords

Sustainable mobility · Modal split · Pedelec · Pedelec sharing · Mobility benchmark

4.1 Development of Modal Split for Germany

iCity’s workpackage “eBike sharing concept for Stuttgart and Tuttlingen” dealt with criteria definition for the use of pedelec sharing. It focused on the shift from motorized private transport towards emission free transport solutions and took up the question of use vs. ownership.

Looking at the use of means of transport in Germany, there is a slight increase in bicycle use within the time frame 2002–2017. However, the overall modal split distribution of means of transport has been quite stable over a long time period. Nearly 60% of traffic is performed by personal car transport, either as driver or as passenger. Regarding the modal split of kilometers, the usage of the car as driver or as passenger sums up to 75% of all moved kilometers. Public transport contributes to 19%, and transport on foot and by bicycle equals 3% of all moves (Table 4.1).

4.2 Benchmark View of Modal Split for the Netherlands

In the first instance, research circled on the benchmark question of how other people deal with bike traffic and are there significant options for change. The modal split of the Netherlands (Ministerie 2016) differs significantly from Germany. Despite differences in modal split related to means of transport by up to 30%, bicycle use differs by 245% related to amount of moves. Moreover, the difference related to passenger kilometers sums up to 300% (Figs. 4.1 and 4.2).

What makes the use of the bicycle in the Netherlands so different? There are several indicators (Schweighöfer 2019):

– Topologically, there are just a few hills in the Limburg region of the Netherlands. Most of the country is flat.
– Car drivers are to blame for accidents in any case.

Table 4.1 Modal split for Germany (Bundesministerium 2017)

<table>
<thead>
<tr>
<th>Modal split ways (%)</th>
<th>2002</th>
<th>2008</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>On foot</td>
<td>23</td>
<td>24</td>
<td>22</td>
</tr>
<tr>
<td>Bicycle</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Car—as driver</td>
<td>44</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>Cars—as passenger</td>
<td>16</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>Public transport</td>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>
Separate roundabouts, tunnels, bridges, traffic lights, and fast tracks are available for bicycles.

The worldwide biggest bicycle parking garage is located in Utrecht and offers 4500 parking lots, planned to be extended to 20,000, using electronic vacancy guiding system.

Roughly 40% of the residents use the bike on way to work.

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**Fig. 4.1** Modal split kilometers of the Netherlands/Germany (Bundesministerium für Verkehr und digitale Infrastruktur. (2017). Ergebnisbericht Mobilität in Deutschland; Ministerie van Infrastructuur en Milieu. (2026). Mobiliteitsbeeld)

**Fig. 4.2** Modal split ways of the Netherlands/Germany (Bundesministerium für Verkehr und digitale Infrastruktur. (2017). Ergebnisbericht Mobilität in Deutschland; Ministerie van Infrastructuur en Milieu. (2026). Mobiliteitsbeeld)
– Every resident owns 1.3 bikes per average.
– Investments in bicycle infrastructure are significantly higher than in Germany (investments in bicycle infrastructure/resident per year: Stuttgart, 5 €; Munich, 2.20 €; Berlin, 4.70 €; Amsterdam, 11 €; Utrecht, 132 €).
– Bicycle routes are marked in different categories (fastest routes, routes through nice areas).
– A country-wide infrastructure program ensures the extension of currently 300 km bicycle fast tracks by additional 600 km (Fietserbond.nl 2020).

The major difference in bicycle use between the Netherlands and Germany are the following pre-conditions that enable bicycle traffic:

– Convenience and safety-related conditions (i.e., it is not mandatory to wear a helmet).
– Broad bicycle routes, consequently separated from car traffic.
– The bicycle belongs to the country’s branding—people identify with bicycles.
– Road construction rules and regulations that support the extension of bicycle traffic—bicycle-focused road construction will enhance bicycle use.
– The influence of mindset related to ecological and health-wise benefits of bicycle use starts at high school.
– Priority for bicycle traffic on the road.
– Integrated design and planning of transport infrastructure taking cross finance solutions for bicycle infrastructure by cities, public transport providers, and the engagement of employers into account.
– Turn minimum amount of car park slots into maximum amount of bicycle slots for office and residential buildings.

4.3 Sharing as Opportunity to Extend Bicycle and Pedelec Use in Germany

The use of means of transport is mainly triggered by:

– Its availability and easy-to-use opportunities.
– Target and distance of the route.
– The cost of use.
– The comfort and safety it provides on the defined route.
– Ecological sense of responsibility.

Focusing on the share of means of transport with the target to reduce traffic emissions, it mainly competes with the private owned diesel or petrol engine passenger car—always available, easy to use, safe, and high travel comfort—however, expensive, space-consuming, and not environmental friendly.
Transport time to work, combined with long-term transport behavior patterns, is crucial for the choice of means of transport (Viergutz 2011). Moreover, the means of transport used for the way to work significantly influences the use of means of transport for ways outside of work. Twenty-seven percent of moves are related to way of work or at work. They significantly influence the use of means of transport in leisure time, contributing 28% to the modal mix of moves in Germany.

Moving people to multi- or intermodal use of means of transport requires attractive transport opportunities—close at the spot of use and easy to handle. This includes the reservation and usage processes as well as the transport vehicle itself. The abilities of people of different ages need to be taken into consideration. Bike, scooter, and pedelec may become an important role in supporting public transport by bridging the last mile or, in case the distance fits, to replace the passenger car at all.

Field tests with pedelecs in rural areas in the south of Germany (i.e., region of Tuttlingen) show that pedelecs mainly replace bicycles (54%); however, 30% of the test representatives state that they replaced the passenger car. At the downside, 11% of test people replaced walks by pedelec usage and 3% the public transport (Schiele et al. 2020).

Average speed of bicycle and pedelec rides differed in the field test by just 1 km/h (bicycle 11 km/h, pedelec 12 km/h); however, average distance traveled by bicycle (4 km) was significantly shorter than average distance by pedelec rides (7 km). Hence, pedelecs may support car replacement on distances longer than average bicycle rides.

Discussing the topic ownership vs. share of pedelecs, it became clear that the majority of test representatives would enjoy what pedelec sharing offers. Comparing cost of a pedelec sharing systems for small cities like Tuttlingen with the prices customers are willing to pay, it becomes obvious that a pedelec sharing systems require an immense portion of subvention by public or private authorities. Test representatives stated that they are willing to pay 8 €/average for a 1-day pedelec rental.

Pedelec sharing systems require an adequate business model containing:

- Pedelecs.
- Sharing locations and electrification for loading and parking.
- Locking system.
- Maintenance, cleaning, and repair of pedelec and sharing locations.
- Workshop.
- Redistribution services.
- Administration, marketing, and sales.
- Back-end system.
- Energy cost.

Taking actual cost and willingness to pay for share services into account, pedelec sharing systems may just become an attractive business model in case of significant raising cost of ownership for passenger cars. In addition, reduced accessibility of urban areas of interest for cars may influence bike and pedelec sharing.
Two scenarios of business models for bike/pedelec sharing solutions in the region of Tuttlingen have been calculated. Besides the one-time cost to establish the basic services, annual operation cost appears.

Scenario 1 calculates based on a mixed bicycle/pedelec park of 26 bicycles and 14 pedelecs and 80 parking lots at 10 rental stations (König et al. 2019). The ratio of annual operation cost (based on 0.64 rentals per bike and day) related to the rental revenues is 3.4:1. Rental frequency is defined based on findings of the study “Public bicycle sharing systems—innovative mobility in cities” for cities with 20,000–100,000 inhabitants (Bundesministerium 2014).

Scenario 2 calculates with 50 pedelecs at 7 rental stations. Rental price and rental frequency are based on findings of OBIS (Büttner and Mlasowsky 2011). Findings show the ratio of annual operation cost related to the rental revenues is 2.69:1.

Both scenarios don’t include one-time ramp-up efforts and installation cost. Hence, a sustainable acceptance for pedelec sharing can actually just be raised by advertising revenues, public subvention, and subvention of corporate mobility management activities.

The project “Ebike pendeln,” established by the Senate of Berlin, shows that the engagement of companies to make pedelecs and related infrastructure for parking and loading available will significantly reduce car usage and emission (Czowalla 2016). However, the change of long-term mobility behavior requires long time test phases for mobility options in order to convince people for emission-free mobility solutions.

The project “Ebike pendeln” provided 324 persons the opportunity to test pedelec use for way to work in a time frame of 8 weeks. The overall project lasted 2 years.

4.4 Necessity for Further Research

Our findings suggest that reaching transformation targets for emission-free transport in Germany starts with mindset change. How can transport behavior be significantly changed in short time frame, while it has been stable for decades? This needs to be investigated further besides providing technological and infrastructure improvements to attract emission-free means of transport. Furthermore, business models that attract the economical motivation for installation and use of emission-free means of transport need to be investigated further.

References

4 Challenges to Turn Transport Behavior into Emission-Friendly Use of Means...


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