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Potential of Cycling to Reduce Emissions in Road Transport

Executive Summary

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Potential of Cycling to Reduce Emissions in Road Transport

Executive Summary

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Responsible Mobility Means: Continual Change and Adaptation!

Results and recommendations from the study "The Potential of Cycling to Reduce Emissions in Road Transport" from the TU Dresden

Motivation for the study:

In order to put a halt to climate change and its effects, Earth's average temperature should not increase more than two degrees by 2050. This is a common goal which has been declared internationally. The European transport sector must therefore bring about reductions in greenhouse gas emissions of 20 % by 2030 and 70 % by 2050 compared to 2008 levels (EU Transport White Paper). Germany is aiming for a reduction of total greenhouse gas emissions of 40 percent by 2020 as compared to 1990 levels.

The Dresden University of Technology, Faculty of Transport and Traffic Sciences "Friedrich List", Chair of Transport and Infrastructure Planning was commissioned by the Federal Ministry for the Environment to study the potential of cycling transport in climate protection and just published the study "The Potential of Cycling to Reduce Emissions in Road Transport".

Base data and analysis:

Mobility data was evaluated from more than 175,000 persons from January to December 2008. Their daily, personal transport was analysed for workdays, including occasional business trips. Using this data, which is representative of a cross-section of the population, the model "*ProFaiR"* (prognosis of the potential for shifts in vehicle kilometres and emissions reductions through integrated cycling promotion) was developed.

It allows for variations modelling of different scenarios whilst accounting for social characteristics of persons in large cities or rural areas. The model incorporates trips to frequent destinations such as work or the supermarket. Route profiles, characterised by valleys, hills and mountains, are also accounted for. The model likewise considers modal split, network load, greenhouse gas emissions and the influence of congestion on travelled kilometres and energy consumption.

Central question:

It is becoming increasingly clear that, in order to attain climate protection goals and in light of the growing scarcity and costs of energy and other resources, we need to alter our consumption and transport behaviour. Does that mean that it will soon be necessary or even sufficient, that all of us in Germany predominantly cycle in order to be mobile?

The answer is "yes and no". Increasing walking and cycling, in particular for short, daily trips, is helpful and sends a clear signal for a shift in mentality and environmental protection. Longer trips however, which are responsible for the majority of transport-related CO_2 emissions, are not able to be substituted by cycling. In this case it is necessary to avoid or reduce traffic and to use the most efficient mode of transport. Experts are talking about the development of a multimodal transport system, since the increased use of more environmentally friendly motorised vehicles alone would not be enough to reach climate protection goals. The growth in road traffic has to be successfully stopped and reversed so that improvements in vehicle technology are not offset by an increase in vehicles.

How are Germans getting around?

According to the data analysis people in Germany travel on average 2,466 million kilometres per workday. A bus, train or car can, of course, transport multiple people at the same time. In addition, longer distances are travelled by car than on foot or with a bicycle. As a result, actual vehicle kilometres driven per work day are 1,615 million, which alone equates to 281,000 tonnes of CO_2. Around 86 percent of all vehicle kilometres driven are completed by car or motorised two-wheeler (243,000 tonnes of CO_2 emissions) (Figure 1).

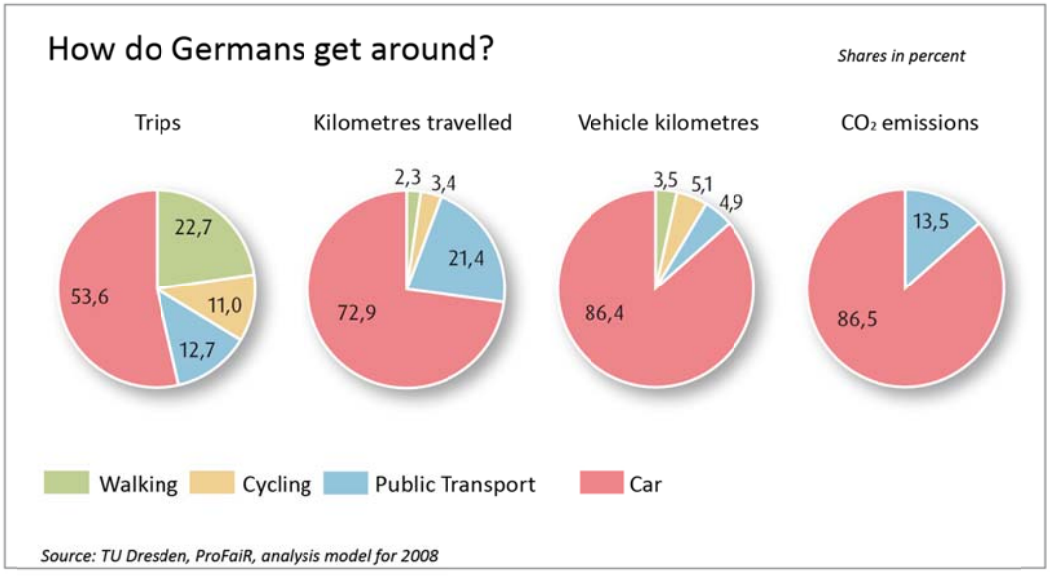

Figure 1: Selected statistics from the model results in percent (base year 2008)

Motorised vehicles are therefore the largest environmental polluters of CO_2 emissions. Accordingly, the highest potential for reducing greenhouse gas emissions lies with them. To that end vehicles must increasingly lower their emissions and we should be searching for ways to make our mobility more environmentally friendly without predominantly using an own car. Without decreases and efficiency improvements in individual, motorised transport, emissions reduction goals for the transport sector will not be reached.

Two thirds of the population lives in rural areas or small towns. They have longer journeys, a less attractive offering of public transport modes and often very individual destinations. Their use of the car is therefore clearly more intense than residents of mid-sized and large cities. As such, they are also over-proportionately responsible for CO_2 emissions (Figure 2).

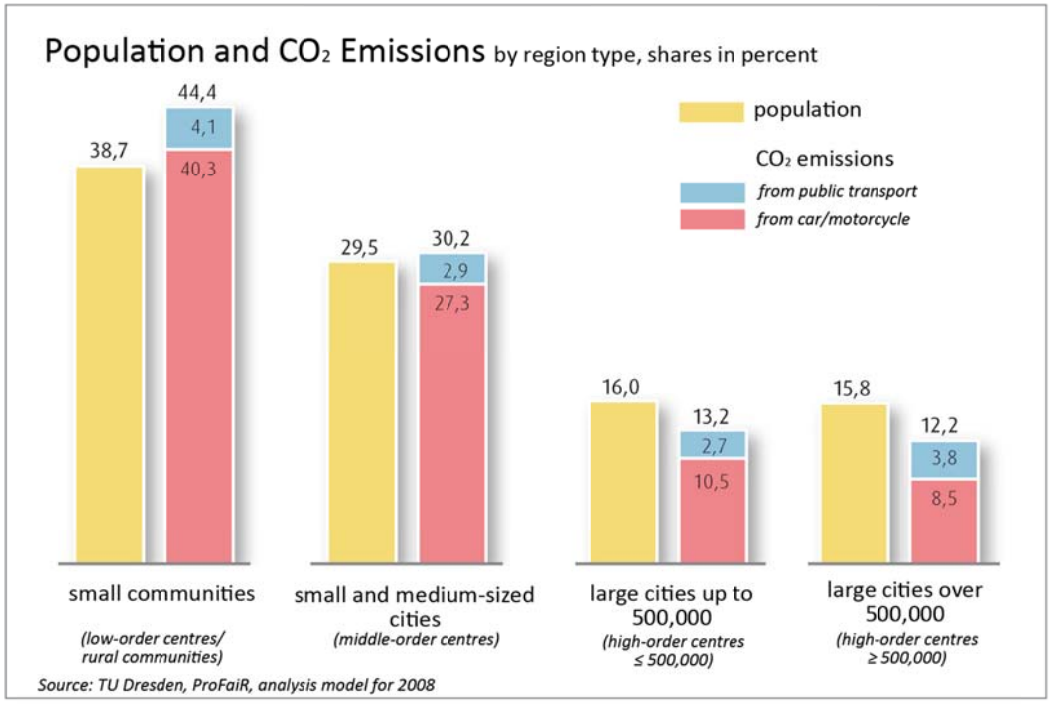

Figure 2: Share of population and CO_2 emissions according to region type (base year 2008)

Structural and demographic change (population loss, over-aging, migration, school closings, unemployment, poor supply of local shops, etc.) increases their overall mobility needs and ensures them increasingly higher mobility costs. At the same time here is the greatest potential for reducing greenhouse gas emissions. Because despite two thirds of all trips being less than five kilometres, almost three quarters of the CO_2 emissions come from the 15 percent of trips which are long trips. “With regard to overall passenger transport, the potential for CO_2 reductions by short trips is therefore rather limited“, says Professor Gerd-Axel Ahrens, head of the study at the TU Dresden. The long trips are often the trips to school or work, in other words the classic commuter trips.

How would Germans have to get around in future?

Integrated solutions are necessary for intelligent, environmentally friendly transport in future. The study looked at the effects of measures from several complementary strategic directions. Three important examples include:

(1) Modernisation of the vehicle fleet,
i.e. use of low-emitting or emissions-free vehicles
(2) Shift travel to cycling,
i.e. use the bicycle for short trips
(3) Integrated shifting and avoidance (reduction) of traffic
i.e. choose short trips to closer destinations, improve conditions for using public transport as well as car sharing (along with cycling and walking the so-called "mobility network")

(1) Modernisation of the vehicle fleet

According to the model, the increasing share of more efficient vehicles should effect reductions in CO_2 emissions of 21 percent by 2020. The consistent advancement and marketing of environmentally friendly automobiles must therefore be spurred on. The increasingly "Green Fleet" plays an important role in reaching climate goals. However this alone does not make the goals attainable and there is always the danger that any reductions could be offset by increases in vehicular transport and driven kilometres.

If a vehicle is available, then it will also be used. However cars are commonly used for short trips of less than five and often less than three kilometres, during which cold-start emissions are particularly intense due to the catalytic converter not yet being fully functional. Rarely are more than two people in the car, and in daily traffic mostly just the driver. Per capita emissions of pollutants could be noticeably reduced through better vehicle occupancy rates or the use of alternative modes of transport, as is shown in the following examples.

(2) Shift travel to cycling

Eleven percent of trips nationwide are taken by bicycle. However that is only three percent of total kilometres travelled. Cycling is not an alternative to motorised transport for mid-ranged and long distances. Its potential is in short trips, meaning distances less than five kilometres, though traffic surveys show a tendency towards longer trips. This tendency is supported by a trend towards cycles with electric motors, so called pedelecs. These can encompass an extended distance range of up to 15 kilometres. In addition, they often replace a second car as recent research shows.

Transport researchers from the TU Dresden have analysed this potential. If 25 percent of all short trips which have, to this point, been taken by car were to be taken by bicycle in future, then the share of cyclists in transport would increase to 16 percent. That would mean a one percent shift of daily vehicle kilometres to cycling (24 million kilometres). If every second short vehicular trip were to be taken by cycle, then cycling's share could even increase to 21 percent, equating to savings in

driven kilometres of three percent. In absolute numbers that means 39 million vehicle kilometres per day would be replaced by cycling. CO_2 emissions would likewise be reduced by three percent, which corresponds to almost 8,000 tonnes per day.

Clear differences in potential can be found between rural areas and cities. “Cycling is above all an option in mid-sized and large cities, where the short trips are”, says Professor Ahrens. A user survey on whether or not cycling is a realistic alternative for short trips revealed a significant relationship to topography. “If a route is flat, then a five-kilometre trip is classified by more than 80 percent of respondents as doable. If it is hilly or even mountainous, then this perception sinks dramatically.”

Were all the options classified by respondents as doable to actually be used, then the bicycle would replace almost every third journey taken by car. “That corresponds to as much as eleven percent fewer driven kilometres and up to eleven percent fewer CO_2 emissions“, says Ahrens (Figure 3). The result would not, of course, be the disappearance of the car from garages or residential streets. However the pressure in car parks in the central city or at businesses and shopping facilities would be considerably reduced. A shift to cycling would also mean that trips previously taken by walking or public transit would decrease. According to Ahrens the most optimistic assumption would see every second road user cycling. In this case almost 150 million vehicle kilometres could be saved per day.

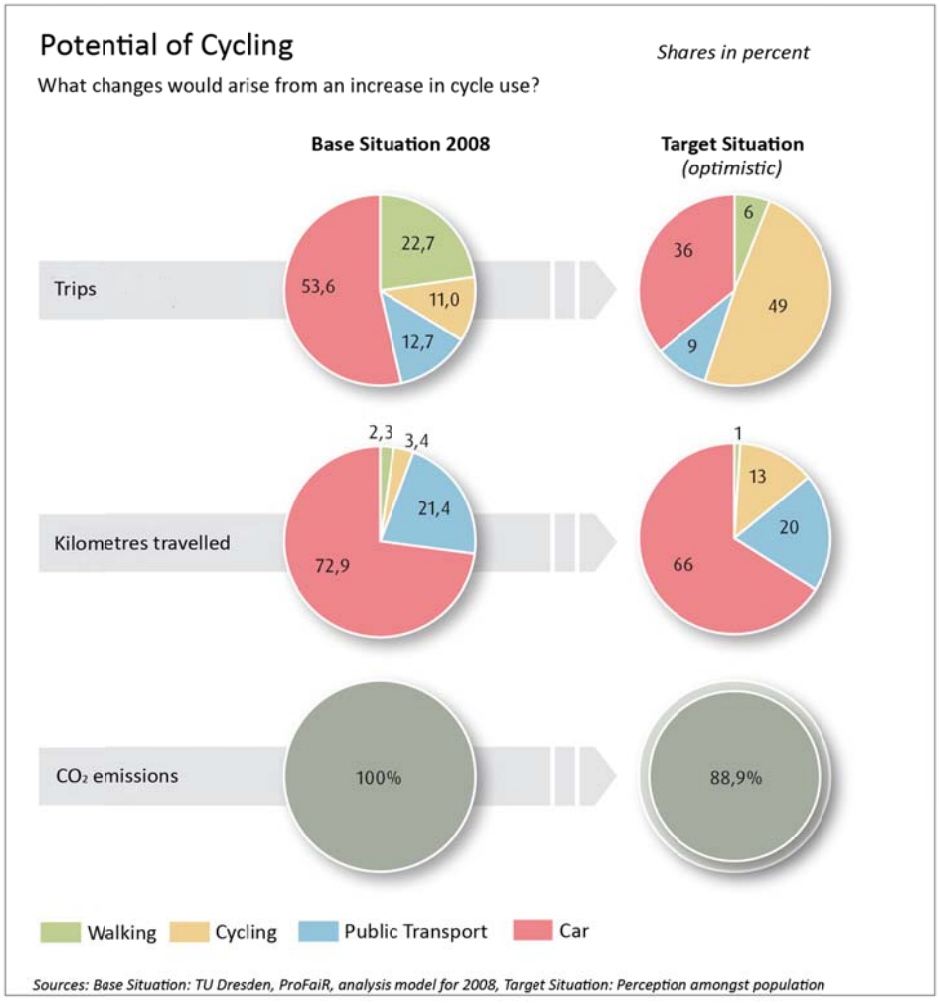

Figure 3: Potential for change due to use of cycling for all trips categorised as having good accessibility in “Perception of Cycling as an Option“

(3) Integrated shifting and avoidance (reduction) of traffic

Potential could be increased, however, were a voluntary shift in mentality among the population to be promoted. The most important aspect would be avoiding or reducing trips. The research shows that those who have a car drive it. Whether for shopping or leisure: persons with an own car undertake much longer journeys than those without car access in order to satisfy the same needs. “Therefore we asked ourselves how large the reductions would be when all persons, under reasonable conditions, refrained from having a personal car and behaved like the many people who today already live without an own car”, explained Professor Ahrens.

The approach: the trip to the bus or train station is not allowed to be longer than 500 metres. All important stores for daily necessities must be in the vicinity (max 800 metres) and easily accessible. “These conditions are, for the most part, fulfilled by large cities in Germany. Here, up to 95 percent of residents could forego an own car.” This would be even more likely under the following condition: if a car is on occasion necessary, it has to be easily accessible. “It is about shifting the mentality from car ownership to car use.“ Car sharing, carpooling and collective automobile use by several families are the alternatives. The share of public transit use and walking trips would, of course, considerably increase, as well.

The impact on attaining climate protection goals would be enormous: driven kilometres would be reduced, in the best case, by 38 percent and even by conservative estimates by at least 19 percent. The resulting decrease in CO_2 emissions would be between 13 and 27 percent (Figure 4).

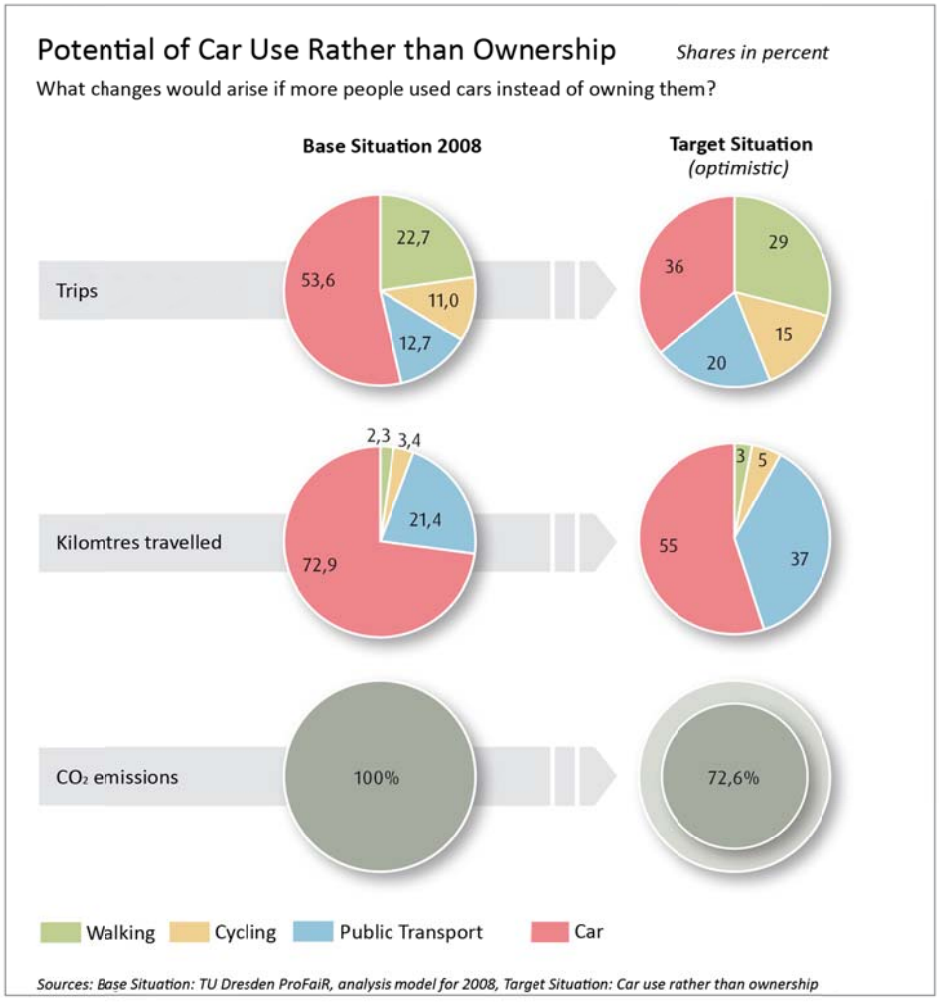

Figure 4: Potential for change through "Car use rather than ownership"

What can be done?

In order to reach the climate protection goal of reducing greenhouse gas emissions in the transport sector no single measure, alone, will be sufficient. Integrated action and changed mentality in transport behaviour is desired.

The goal: fewer and shorter journeys must be taken in an environmentally sound manner. The increasing pressure of costs and advances in technology will likely lead to a trend reversal, however this alone will not suffice. Infrastructure and mobility services can additionally be created which promote desired behaviour through better offerings amongst the mobility network. Beyond that it is necessary to have innovators, in other words model cities and regions which demonstrate that these objectives can function, as well as laws and regulations which make a change in behaviour easier. In doing so cycling plays a central role. Two exemplary scenarios from the study show how to raise the potential:

Scenario A: Promotion of cycling transport as a system

Additional potential for reducing car traffic arises when in future cyclists ride longer distances than has previously been the case. To accomplish this it has to become quicker to get around by cycling; cycling transport must be accelerated. “This is acceleration not in the sense of increasing maximum speeds but rather of a complex of measures for reducing door-to-door travel time“, says Professor Ahrens.

Those who switch to cycling should not have to spend significantly more time getting around. This can be achieved through numerous measures (see Table 1). Along with as many junction-free cycle paths as possible and more convenient traffic light control for cyclists, this includes opening up short cuts such as cul-de-sacs and counter-flow traffic on one-way streets for cyclists as well as safe and at-grade cycle racks, direct left turns, cycle lifts or public e-bike fleets for easily and quickly overcoming elevation differences.

Simultaneously it is assumed that safety for cyclists is ensured. For transport that is compatible with the city, speed limits of 30 km/h are recommended for most streets. Currently this is accomplished through the establishment of Tempo-30 zones and structural traffic calming. As a result the speeds of motorists and cyclists converge and the dangers of high speeds are reduced. “All of this makes cycling more attractive as an alternative to driving.“ A “green wave”, or phased traffic lights, could then be established locally for cars and cyclists. The study points to a success in Cologne. “The needs of cyclists for safe and direct route guidance can be met on residential streets for the most part without special cycling infrastructure by shared use of the roadway.” On main roads a few extra signs and markings are often sufficient enough. Cycle routes should not be blocked by parked cars, delivery zones or the like.

For the safety of pedestrians it is recommended that cyclists be allowed to ride in the street rather than on the sidewalk. Technical regulations and transport planning of the last few years already take this into account. At certain locations special structures for cycling transport are appropriate, such as bridges just for cyclists, which shorten trips noticeably. Therefore, combinations with public transport are important, such as Bike+Ride facilities or bicycle stations at central transfer points and

taking bicycles on public transit when train occupancy and the availability of multipurpose areas in the vehicles make this possible.

Faster journeys make cycling attractive for commuters, as well. Priority cycle routes between the city and its surroundings also provide relief to car traffic. Electric bicycles are of particular importance here since they allow trips of 10 or more kilometres to be taken in comfort. The study from the TU thus assigns potential to cycling even by longer trips, which are so important for CO_2 reductions.

Attended parking options play an important role for expensive bicycles. This is particularly relevant for cities in more hilly locations due to the support that electric bicycles, which inherently have higher purchase costs, would provide in changing behaviour in such locations. Professor Ahrens points out, however, that hilly cities often have a lot of catching up to do in the areas of transport policy and planning as regards public opinion and acceptance of cycling as an everyday means of transport.

Table 1: Overview of measures in Scenario A

Scenario A Promotion of Cycling Transport as a System	
Infrastructure	Cycling networks without gaps
	Cycling facilities according to the state-of-the-practice
	Route signage
	Cycle parking infrastructure
	Combination with PT (bike rental scheme, bicycles in trains)
	Special measures (bike stations/mobility centres, cycle tracks, promotion and consideration of pedelecs)
Information	Mobility education and mobility advising
	Mobility management
	Advertising and information campaigns
	Information and training offers for decision-makers and professionals
	Promotion of a dialogue between networks
Pricing Policy	Budgets for hard and soft measures in cycling transport
	Tax and operational incentives for cycle use
	Government promotions programmes for cycling transport
Legal	Obligatory parking racks for cyclists
	Special consideration for the safety needs of non-motorised road users, simultaneous consideration of travel comfort and standards
	Bicycle streets, removal of entrance bans, etc.
Other (e.g. Organisation and Operations)	Cyclist-friendly traffic lights
	Quality management, traffic safety audits and analyses
	Service offers
	Cycling officer and cycling transport working group
	Cycling and pedestrian guidance at construction sites
	Cleaning and winter maintenance of cycling facilities

Scenario B: Integrated promotion of cycling transport within CO_2 reduction policy at all levels

Along with the first step of promoting cycling transport the study presents a second, more advanced scenario. This presumes a foreseeable global tendency: a shortage of resources (particularly oil) combined with a worldwide increase in demand for these resources are seen as drivers of more efficient mobility, which can be capitalized upon as part of integrated urban development and sustainable mobility planning.

A central effect: private automobile use will become increasingly expensive and costs less predictable. In addition, prices are influenced by ever more demanding limits on emissions and pollution (air quality, climate and noise protection) as well as the increasing scarcity of surface area in cities for roads and above all car parks. The relative cost advantage of cycling and other transport modes within the mobility network is becoming increasingly larger. As such, a clear tendency towards reurbanisation can be seen in Germany, and thus a chance to develop less transport-demanding structures. Ever more households in cities are likewise able to do without a private car. It is not possible anymore to ensure mobility, which is necessary for everyone (public service), primarily through cars. A focused policy of support for the mobility network takes on a central role in ensuring mobility and requires measures which make possible and expedite a change in behaviour for the people.

Tax advantages for long work trips through a commuter allowance and dual residence relief need to be abolished. Subsidies, such as those for car parks which are counterproductive for climate policy, need to likewise be dismantled. From this further measures can be derived (Table 2):

Table 2: Overview of measures in Scenario B

Scenario B Integrated Promotion of Cycling Transport Within CO_2 Reduction Policy at All Levels (supplement the measures in Scenario A)	
Infrastructure	Expansion of infrastructure for the mobility network
	Broad networks of “mobile points”
Information	Expansion of information and advising offers for using the mobility network
Pricing Policy	User-financing of road transport at district and municipal level
	Indirect user or PT fees for provision of service
	Reform of the vehicle tax
	Financing reform for sustainable urban transport
	Incentives for the use of public vehicles (PT incl. car sharing and rental bikes)
	Promotion of integrated site location, where applicable fees for generating traffic
	Intensify parking space management
Legal	Speed restrictions on federal, state and city streets
	Car sharing and bike rental stations in public road space as priority uses
	Proof of bike parking
	Legally required workplace mobility management
	Intensified speed and parking space monitoring
Other (e.g. Organisation	Improved multimodal service offering

On the way towards the targeted structures the appropriate measures and conditions must be established little by little, for example through services such as car sharing or public bike rental schemes, information services such as home location consulting or mobility education in schools, mobility management at the workplace as well as pricing and regulatory policies such as car park management. All options which help reduce car traffic should – like taxis and public transit today – be given priority in public street space through the Road Traffic Act (StVO).

The easy accessibility and uncomplicated, user-specific costs play a central role in the acceptance of the mobility network. Communicating the alternatives through modern structures is likewise an important task of supportive policy. The internet and smart phones could take on a key function for both, and are already being used appreciatively and intelligently by young people today. They optimise their movement with a good understanding of the alternatives and, above all, of carpooling options or organising the collective use of group discounts.

Ultimately it is a matter of financing the changes and simultaneously providing an economic argument for a change in mentality. “It can be assumed that through supplementary, stringent and broad user financing in transport a large potential would arise for influencing behaviour“, says Professor Ahrens. He points to changes through congestion pricing in cities, like London, which faced a collapsing transport system and were forced to act. Here, car traffic was reduced by 20 percent due to the congestion charge.