

Paradigm shift in transport planning and road design for a better urban environment - achieving climate protection goals and tackling climate change

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Abstract

Climate protection is probably one of the most important tasks of this and the following decade and is of immense importance for the preservation of living conditions and for a good quality of life for present and future generations. If no decisive action is taken now, the basis of life with the fulfilment of needs of present and future generations will be extremely endangered. The "R Climate - Recommendations for the application of regulations and expertise documents in the field of transport to achieve climate protection goals" [13] published in Germany follow the need for decisive action and contain partly fundamentally new climate-relevant requirements, standards and opportunities for action to be taken into account in the planning, design and operation of transport services and facilities. They serve as a prelude to further activities to bring about necessary changes in transport planning and road design in practice in order to adequately address climate-relevant aspects and to promote new methods and measures to achieve climate protection goals in the transport sector and to establish them in planning and decision-making processes. Whereas the previous development of regulations in the transport sector, similar to the previous development of the road traffic law, had the goal of equal treatment of transport modes, prioritisation is now anchored in regulations and expertise documents. In addition, safety criteria and quality requirements, especially for vulnerable road users, are in the foreground and all possibilities are to be used to noticeably strengthen public transport. These changed approaches are initially formulated in the R Climate [13] profiles - but in the medium to long term they will lead to fundamentally different rules with changed requirements for the planning, design and traffic management of transport facilities and transport services.

1. Introduction

The "R Climate - Recommendations for the application of regulations and expertise documents in the field of transport to achieve climate protection goals" [13] published in Germany in October 2022 contain climate-relevant requirements, standards and options for action to be taken into account in the planning, design and operation of transport services and transport facilities. They were prepared in a short period of six months by an ad-hoc group of the Commission K 6 of the FGSV Road and Transportation Research Association in consultation with all bodies of the working groups 1 Transport Planning, 2 Road Design, 3 Traffic Management and with all relevant commissions.

The R Climate [13] served and still serves to initiate processes of transport planning and road design within the committees of the FGSV in order to adequately address climate-relevant aspects in future revisions or elaborations of regulations and expertise documents and to promote methods and measures for achieving climate protection goals in the transport sector. The R Climate [13] also highlights current opportunities in the fields of transport planning, road design and traffic management that can contribute to reducing greenhouse gas (GHG) emissions and final energy consumption in the transport sector. It shows how and to what extent the existing and recognised rules of technology in the transport sector can already contribute to reducing GHG emissions and final energy consumption, or how they can contribute to this with the supplementary requirements set out in

R Climate [13]. The supplementary requirements are set out in fact sheets on various regulations and expertise documents. The application of these requirements will lead to radical changes in the planning process, in the design and in the operation of transport facilities.

2. Federal Climate Change Act and Federal Constitutional Court Rule as Starting Points for Necessary Changes

Climate protection is probably one of the most important tasks of this and the following decade and is of immense importance for the preservation of living conditions and for a good quality of life for today's and future generations. Experts believe that human emissions of greenhouse gases (GHG) will cause climate change with massive ecological, economic, social and humanitarian consequences. If no decisive action is taken now, the livelihoods of present and future generations will be at extreme risk.

The United Nations (UN) has formulated socially defined sustainability goals and the European Union (EU) has concretised these in a European Climate Act. In the area of transport and mobility, the EU has also developed the "Sustainable and Intelligent Mobility" strategy and the "Fit for 55" package of measures to reduce GHG emissions by 55% by 2030.

Germany has acknowledged its responsibility in climate protection and has entered into commitments to reduce GHG emissions with quantitative climate protection targets that are anchored in law. Currently, the Federal Climate Change Act is in force as of 18 August 2021 (Federal Law Gazette I p. 3905) [6]. It defines permissible annual emission levels for the years 2020 to 2030 and annual reduction targets for the years 2031 to 2040 (Figure 1). According to this, GHG emissions in all sectors are to be reduced in total by

- by at least 65% by 2030 compared to 1990 (or 48% in the transport sector) and
- by at least 88% by 2040 compared to 1990, and
- be reduced to such an extent that net greenhouse gas neutrality is achieved by 2045, and
- become negative after 2050.

Annex 2
Permissible annual emission budgets for the years 2020 to 2030 (ad section 4)

Annual emission budgets in million tonnes of CO2 equivalent	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy	280		257								108
Industry	186	182	177	172	165	157	149	140	132	125	118
Buildings	118	113	108	102	97	92	87	82	77	72	67
Transport	150	145	139	134	128	123	117	112	105	96	85
Agriculture	70	68	67	66	65	63	62	61	59	57	56
Waste and Other	9	9	8	8	7	7	6	6	5	5	4

Annex 3
Annual mitigation targets for the years 2031 to 2040 (ad section 4)

	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Annual mitigation targets in relation to 1990	67%	70%	72%	74%	77%	79%	81%	83%	86%	88%

Figure 1: Permissible annual emission budgets for the years 2020 to 2030 and annual mitigation targets for the years 2031 to 2040 [6]

The starting point and reference value are the annual emissions in CO₂ equivalents (CO₂eq) of 1990 (1,241.9 million t CO₂eq or 1,268.9 million t CO₂eq including emissions from the land use sector, 163.4 million t CO₂eq in the transport sector, of which 154.8 million t CO₂eq in road transport). The reduction targets are to be reviewed annually. Non-compliance will lead to the need for emergency measures in each various sector, including the transport sector. In this context, it must be taken into account that in the event that the various annual target values are not met, the missed savings of the previous years must be reduced in addition to the savings actually envisaged.

The Federal Climate Change Act [6] states the following regarding non-compliance:

- If the emissions data indicate that the permissible annual emission budget for a sector has been exceeded in a reporting year, the responsible federal government ministry shall within three months present an immediate action programme for the relevant sector; the programme shall ensure compliance with the annual sectoral emission budgets in the subsequent years. (Section 8 (1) Federal Climate Change Act [6]).

Despite numerous innovations and advances in the transport sector since 1990, no reduction in GHG emissions has been achieved - with the exception of the pandemic-related decreases in 2020. In 2019, annual emissions from transport were still 164.1 million tonnes of CO₂eq. In 1990, the figure was 163.4 million t CO₂eq (Figure 2). In 2030, according to the Federal Climate Change Act [6], the figure should be only 85 million t CO₂eq, which corresponds to about half of the transport-related GHG emissions in 1990 (Figure 2). It should be noted in this context that in 2021, despite pandemic conditions, the transport sector's emission targets of 145 million t CO₂eq were exceeded by about 3 million t CO₂eq. Accordingly, the Federal Ministry of Digital Affairs and Transport (BMDV) presented an immediate programme in July 2022, which includes the development of the charging infrastructure, an expansion offensive for cycling and an expansion and quality offensive for local public transport.

Development and goal achievement of greenhouse gas emissions in Germany in the transport sector of the Climate Change Act

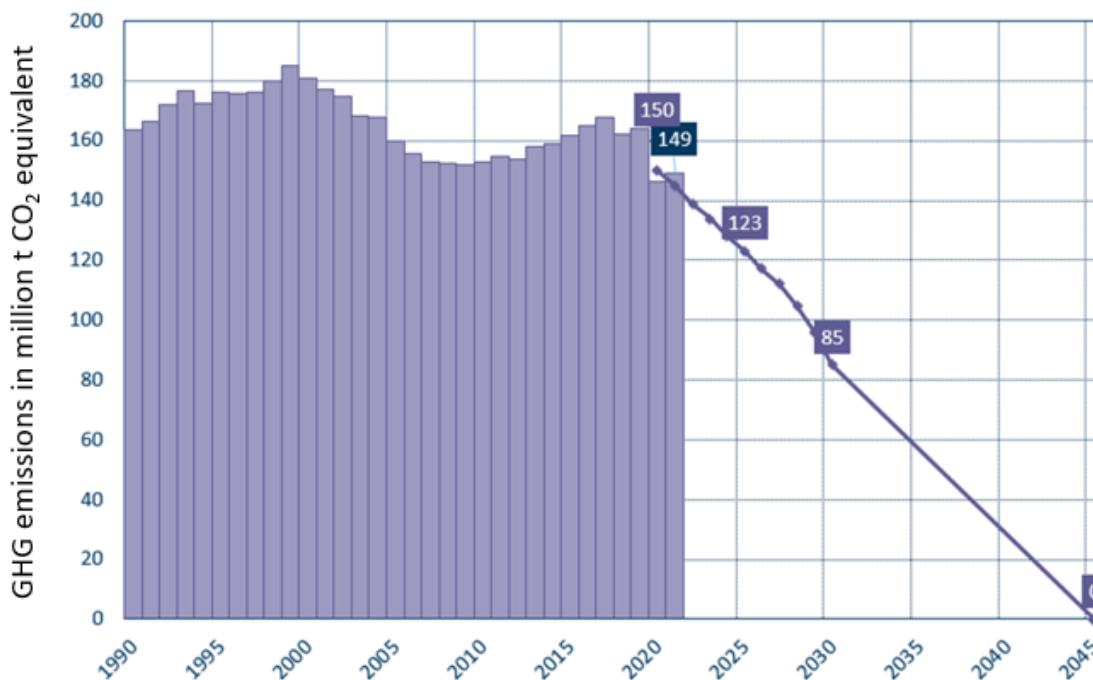


Figure 2: Trends in GHG emissions 1990 - 2020, previous year's estimate 2021 and goals according to the Federal Climate Change Act (source: [14]; data: [5])

Due to a non-emerging downward path according to the climate goals and the projected trend in the transport sector, it will require considerable efforts to meet the annual mitigation goals. It is to be expected that the consequences of non-compliance will bring unprecedented changes in the way supply and demand are managed in all transport sub-systems.

In addition, a remarkable ruling by the First Senate of the Federal Constitutional Court on 24 March 2021 [7] will lead to previous methods, decision-making processes and measures in the road and transport sector being put to the test. The ruling affirmed that everything possible must be done to keep climate change within manageable limits. The resolution states, among other things, that

- the state's duty to protect includes the obligation to protect life and health from the dangers of climate change
- the obligation to protect also applies to future generations
- the relative weight of the climate protection requirement in the balancing process increases as climate change progresses,
- the state cannot evade its responsibility by pointing to greenhouse gas emissions in other states.
- it is necessary to treat the natural foundations of life with such care and to leave them to posterity in such a state that future generations will not be able to preserve them only at the price of their own radical abstinence.

The ruling of the Federal Constitutional Court [7] has made the Federal Climate Change Act [6] and its reduction targets even more binding. At the same time, the decision addresses the principle of sustainability as a whole. The Federal Climate Change Act [6] lists the responsible Federal Ministry as the acting institution, i.e. the Federal Ministry of Digital Affairs and Transport (BMDV) for the transport sector. It is therefore obvious that nationwide measures will follow in the next few years in order not to exceed the permissible annual emission budgets in transport in the respective year or to react adequately to any exceedances. The preparation of such measures is underway, although the measures to be taken at the federal level alone will probably not be sufficient to meet the climate protection goals.

The ruling of the Federal Constitutional Court [7] does not place the responsibility entirely in the hands of the state, but rather suggests that present generations must treat the natural foundations of life with such care that future generations cannot continue to preserve them only at the price of their own radical austerity. In the transport sector, too, "everything possible must be done" [7] to encourage the current generation to treat the natural foundations of life with care.

3. State of knowledge on the allocation of GHG emissions in the transport sector

In 2020, road transport made by far the largest contribution to GHG emissions from domestic transport, accounting for around 97 %. Road freight transport accounted for about 35 % and private transport for about 60 % (Figure 3).

Transport System	GHG emissions FT & Pt [Mio. t] in the year 2020
Road Freight Transport (FT)	52,0
• Light Commercial Vehicles	11,3
• Heavy Commercial Vehicles	40,7
Road Passenger Transport (PT)	91,0
• Motorised Personal Transport (private cars, two-wheelers)	88,0
• Busses	2,9
Other (mainly rail transport, inland shipping, air transport (domestic))	4,2
Total Transport Sector	147,2

Figure 3: GHG emissions of the transport sector in CO₂eq in 2020 [14].

It should be noted that GHG emissions are accounted for according to the territorial principle. Transport-related GHG emissions from international aviation and intercontinental maritime transport are therefore neither included in the goal budgets of the German Climate Change Act nor in the accounting of GHG emissions from the transport sector. With regard to the interrelationships as well as the requirements and possibilities for changes in freight transport, reference is made here to the FGSV notes on measures for a traffic shift in freight transport [12]. The following article deals with passenger transport.

In terms of Motorised Personal Transport (MPT), the distances travelled by private cars in Germany are, according to the report Mobility in Germany - MID 2017 [3], divided up in such a way that

- around 18% of journeys are less than 2 km long
- around 42% of journeys are less than 5 km long
- around 62% of journeys less than 10 km and
- about 81 % of the trips involve distances of less than 20 km.

Due to the length of the trip, about 9 % of the private car performance is accounted for by trips of less than 5 km and about 33 % of the private car performance is accounted for by trips of less than 20 km (Figure 4). All private car journeys of less than 5 km thus cause around 9% of the GHG emissions of private car traffic, and all journeys of less than 20 km cause around 34% of the GHG emissions of private car traffic. The larger share of 66 % of GHG emissions from private car traffic is caused by 19 % of all private car journeys over 20 km.

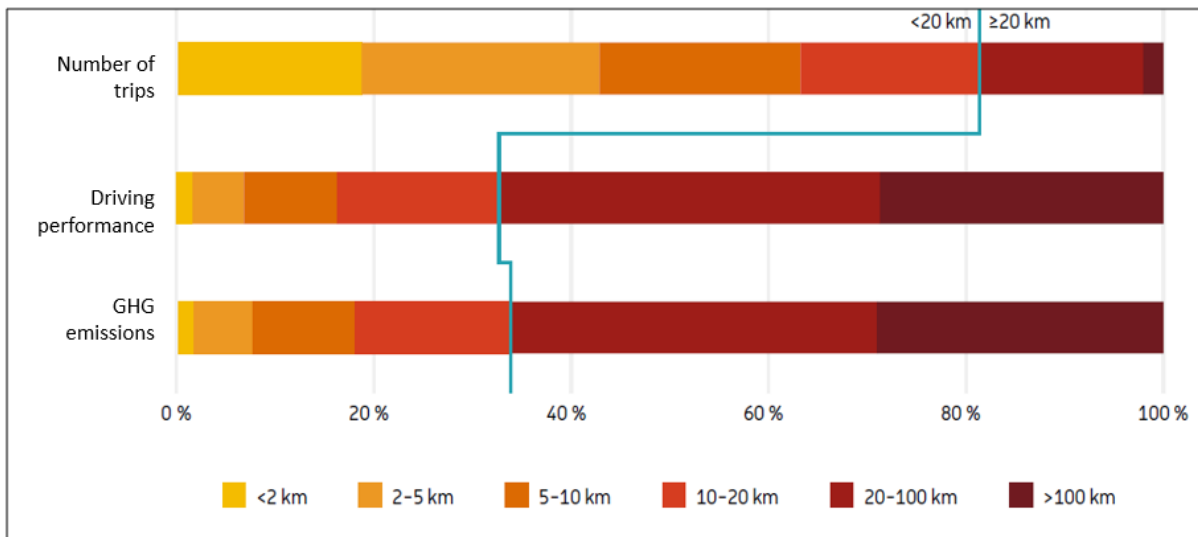


Figure 4: Allocation of private car trips, private car performance and GHG emissions of private car traffic by distance classes (Source: [6]; data according to [3])

4. Objectives, fields of action and their effects in the transport sector

The following can be considered as decisive goals:

- The reduction of transport-related GHG emissions, of which currently about 1/3 are attributable to road freight transport and about 2/3 to road passenger transport (of which about 2/3 are attributable to private car journeys of more than 20 km),
- the reduction of transport-related energy consumption, as the future energy demand of motorised mobility cannot be covered by renewable energies - based on the current framework conditions and the measures adopted so far [1], as well as
- the reduction of material and resource consumption by transport infrastructure, transport supply and means of transport in the sense of climate protection, especially since the building sector, along with the transport sector, has the greatest need to catch up with regard to the reduction of GHG emissions.

If these goals are to be achieved, it is necessary to

- the traffic performance, expressed in passenger- and tonne-kilometres,
- the specific impacts of transport demand, expressed in energy, CO₂ emissions per passenger- or tonne-kilometre,

should be reduced. In this context, motorised transport should be shifted to public transport, cycling and walking and/or the specific effects of motorised transport, expressed in energy and CO₂ emissions per passenger and tonne-kilometre, should be reduced. This requires far-reaching changes and a variety of actions in several fields of action.

The following are examples of actions that contribute to the reduction of GHG emissions and energy consumption:

- Motorised traffic should be transferred to a traffic flow that is as undisrupted as possible. GHG emissions are low if as little acceleration as possible is required and if the speed level is consistently low. In addition, a lower speed level leads to longer travel times and thus to higher resistance to overcome longer travel distances. In the medium to long term, a lower speed level can be expected to lead to a reduction in travel distances and thus to a reduction in motorised traffic. In this area of action, there are

far-reaching possibilities for influencing traffic planning, road design and traffic management.

- In general, the framework conditions are to be set in such a way that changes in the location of people and goods are associated with the lowest possible emissions. A significant influence here is the estimation of how a reduced transport demand (reduced number of trips) is distributed in space (reduced travel distances) and to the various modes, as often as possible to public transport, cycling and walking as well as to sharing/pooling systems (increase in occupancy rates, shift effects to low-emission modes). In freight transport, urban logistics concepts as well as decisions on the choice of products that can be provided with low transport services can also provide support. The influence of transport planning, road design and traffic management is also essential here.

Projects and studies on the potential effects of various fields of action on GHG emission reduction ([1], [2], [5], [13], [14]) come to the following conclusions:

- The implementation of the measures planned so far is not sufficient. On the basis of the measures planned so far, the transport sector will fail to achieve the legally anchored GHG emission mitigation goals. Further measures must therefore be planned and implemented at all levels.
- Measures that are supported by the majority of the population and find widespread acceptance only lead to minor GHG emission reductions, so that it is unlikely that the climate protection goals will be achieved without controversial measures that require communication and participation processes to increase the acceptance of the population.
- The climate protection goals can by no means be achieved through an increase in the registration of battery electric vehicles alone.
- "Push measures" that restrict the use of vehicles with combustion engines can achieve particularly high emission reductions. None of the "pull measures" that encourage the use of climate-friendly forms of mobility are expected to achieve a similarly high reduction performance as the particularly effective "push measures".
- Due to the interaction between various climate protection measures, there are uncertainties in the impact and allocation of the effects to various areas of action. Jointly effective bundles of measures in different areas of action can have great synergy and overlap effects. "For example, the reduction effect of a CO₂ price can increase through synergy effects if citizens are given the opportunity to use climate-friendly means of transport such as electric mobility or public transport, compared to a development in which there are no alternatives to fossil-fuelled modes of transport" [2].
- The path towards active, socially just, environmentally and climate-friendly forms of transport contributes to achieving the climate protection goals, reduces noise and air pollution, reduces land consumption and increases the quality of life. In order to achieve the necessary effects, a sufficient number of sufficiently qualified experts in the fields of mobility, transport, climate protection and public relations are needed.

5. Application of existing regulations and expertise documents in the task of achieving climate protection goals

Germany currently has around 200 sets of rules and expertise documents on transport planning, road design and traffic management published by the FGSV Road and Transportation Research Association. These documents are compiled in voluntary work by more than 2,000 experts on the basis of research findings and established application practice. In addition, there are numerous technical regulations and codes of practice in the building sector.

The application of regulations and expertise documents in the transport sector can help to achieve climate protection goals. They can help to justify technically sensible measures and to incorporate these justifications into political decision-making processes. Numerous regulations and expertise documents analysed by the ad hoc group can be used to act in the listed fields of action in terms of GHG emission and energy reduction.

In order to comply with climate protection goals, those regulations and expertise documents of the working groups on transport planning, road design and traffic management that are discussed in various fact sheets coordinated with all competent bodies should be applied in particular. The fact sheets are available as an annex to R Climate [13] at fgsv-verlag.de. These fact sheets provide information on the application - and, where necessary, supplementary requirements for the application - with regard to the reduction of GHG emissions and energy consumption.

The success of the application of regulations that generally can be recorded, but also the need for professionally sensible measures, can be exemplified by the development of traffic in German inner cities and on urban-rural relationships. Typical developments are those that can be deduced from the Frankfurt 2020 urban peri-urban census (Stadt Frankfurt am Main 2021). Figures 5 and 6 show the positive developments in terms of an increase in cycling by a factor of around 6 and a decrease in motor vehicle traffic by around 1/3 in the inner cordon from 1988 to 2020. On the outskirts, on the other hand, there was a 30% increase in motor vehicle traffic by 2018. Only under the influence of the pandemic situation did vehicle traffic decrease there in 2020. If the development of motor vehicle traffic on the outskirts of the city and in the inner cordon shown in Figure 6 is continued with the legally anchored target direction shown in Figure 2, it becomes clear that the approval of motor vehicle traffic, which was only recorded on the outskirts of the city under pandemic conditions, must continue. In this context, it should be borne in mind that the climate protection goals will not be achieved with a switch to e-vehicles alone, also in view of the fact that the resulting energy demand cannot be met with renewable energies. Effective measures, which are dealt with in the regulations and expertise documents listed above, are therefore indispensable.

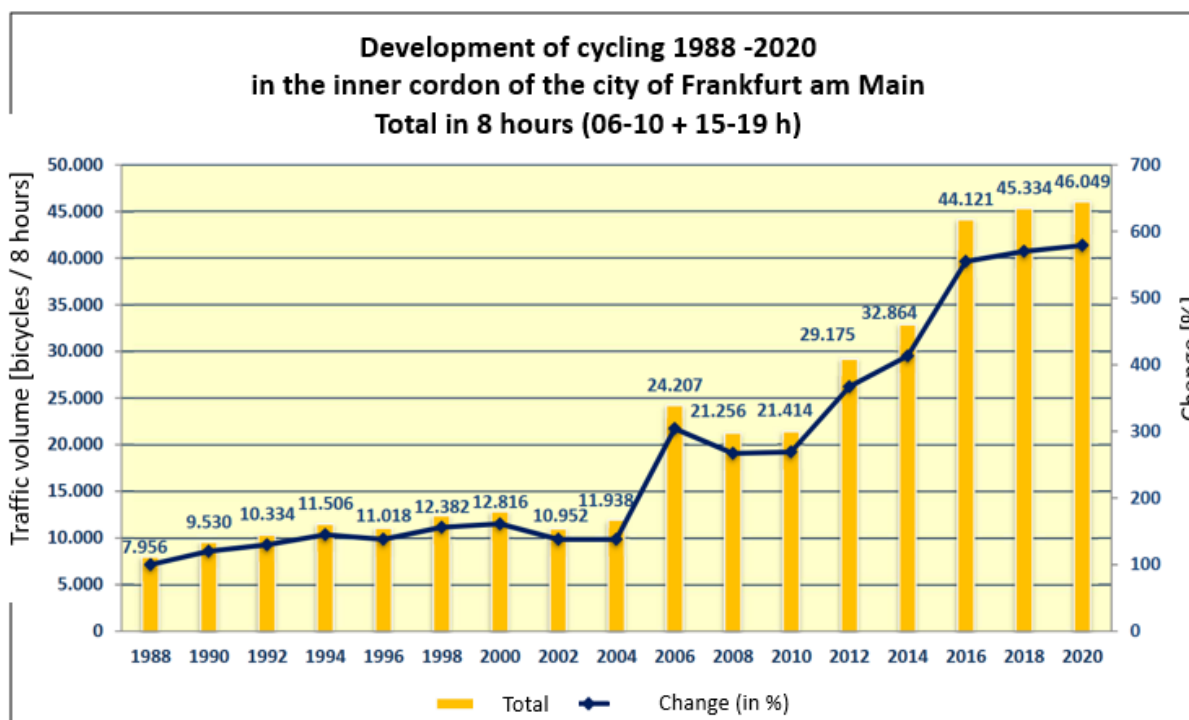


Figure 5: Development of cycling on the inner cordon of the city of Frankfurt am Main (Source: City of Frankfurt am Main 2021)

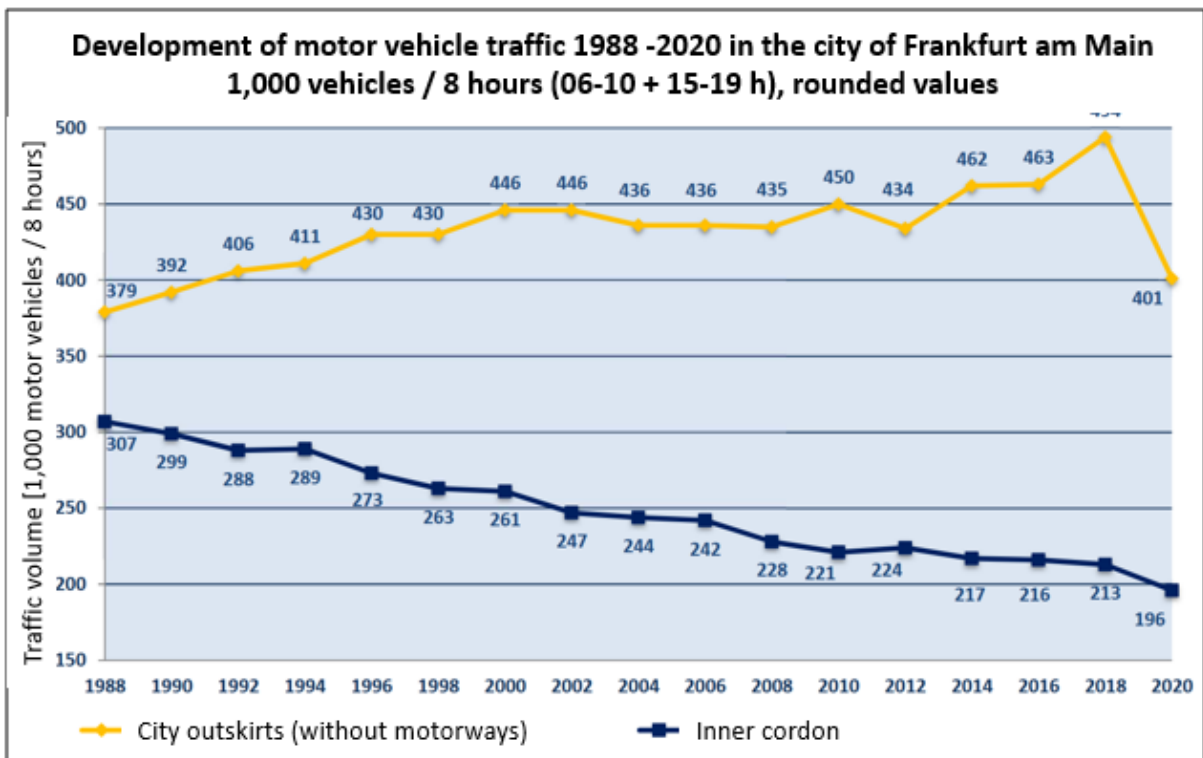


Figure 6: Development of motor vehicle traffic in the inner cordon and on the outskirts of the city of Frankfurt am Main (Source: City of Frankfurt am Main 2021)

Against the background of the GHG emissions of private car traffic, about 2/3 of which result from journeys over longer distances, such measures, which have a supra-regional and regional effect, are of particular importance.

The above-mentioned regulations and expertise documents can be of considerable assistance in the following fields of action, which are to be promoted immediately in this context

- the preparation and implementation of supra-regional and regional transport development plans and transport concepts,
- the cross-municipal coordination of transport measures, such as comprehensive parking facility management and comprehensive parking regulation and pricing management,
- the preparation and implementation of integrated municipal settlement structure development and transport development plans to promote short distances and to strengthen public transport and cycle arteries,
- drawing up and implementing integrated climate protection plans with quantitatively evaluable goals and binding measures,
- raising awareness of behavioural changes and responsibility, participation and public relations,
- acceleration and prioritisation of public transport,
- the strengthening of rail transport and the promotion of long-distance and express bus routes,
- the reliability, quality assurance and financing of public transport,
- the promotion of sharing concepts and multimodal offers,
- the development of cycling highways and cycle priority routes,

contribute to this.

One example in which the listed fields of action have been applied is the KielRegion Mobility Master Plan published in 2018 (Kiel 2018), which was developed in a comprehensive participation process with around 750 stakeholders. Regional cooperation with joint planning structures made it possible to use synergies in the field of mobility planning and to contribute to the achievement of climate protection goals. One of the challenges is the population growth in the state capital Kiel with a limited supply of residential building space. This requires an increasing designation of residential building space in the surrounding area of the metropolitan area, which will lead to a further increase in city-surrounding area interdependencies. In the analysis year 2015, 1.6 million tonnes of CO₂ per year were emitted by road and rail in the Kiel region. The goal of the Mobility Master Plan is to reduce CO₂ emissions from transport in the region by a total of 35% by 2035. Based on the analysis case in 2015 to 2035, it was expected for the CO₂ trend development without regional measures that external factors will only reduce the CO₂ emissions of transport by approx. 20% through more efficient vehicles and alternative drives. Further CO₂ reductions require a reduction in traffic performance, a change in the choice of means of transport (Figure 7) and regional measures for this, which were investigated and defined in the Mobility Master Plan.

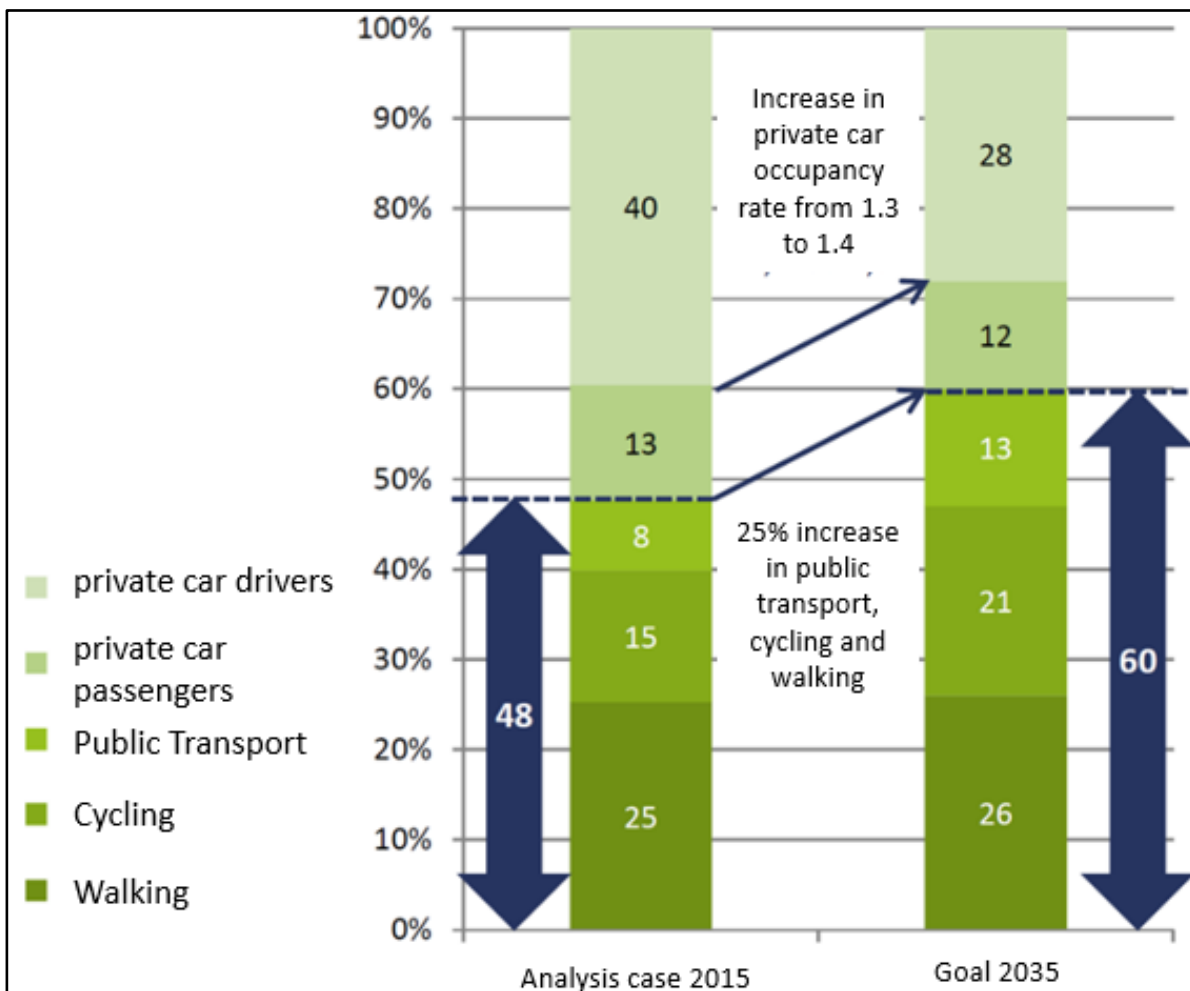


Figure 7: Goals for modal split change in the Kiel region by 2035 (Kiel 2018).

Since the publication of the Masterplan, numerous measures have been implemented over the last four years. Immediately after publication, three staff positions were created exclusively for the implementation of the measures. After three years of funding, the municipalities decided to make the positions permanent and extend them initially to five years. A large amount of money is made available each year for implementation. Based on this, e.g. mobility stations were built, a bike-sharing system was set up, many things were implemented

in the field of digital mobility and countless smaller measures and, above all, advisory services were established. With the introduction of this regional mobility management system, based among other things on the FGSV guidelines for regional settlement and transport concepts, the foundation was laid in the Kiel region for the continuous and efficient continuation of the chosen path towards climate-neutral mobility.

6. Additional requirements for the application of existing regulations and expertise documents and the need for adaptation in the task of achieving climate protection goals

Additional requirements for the application with regard to the reduction of GHG emissions and energy consumption are given in fact sheets for a large number of regulations and expertise documents. These requirements also include new requirements, standards, rules, recommendations and options for action. The FGSV recommends that these be used immediately in the application of existing regulations and expertise documents in all transport planning and in the design and operation of transport services and transport facilities to achieve climate protection goals.

The method of introducing new requirements via up-to-date fact sheets on various regulations and expertise documents, which can be accessed on the fgsv-verlag.de website, was chosen because in some cases there is an urgent need for action that cannot be reconciled with the sometimes lengthy revisions and coordination processes of existing regulations and expertise documents. The fact sheets, which are coordinated with the bodies responsible for publication, also deliberately contain expressions of new requirements and demands ("it is/it must/it must not") as well as new standards and rules ("it should/it should not"). The preliminary remarks of R Climate [13], which have been prepared in this form for many new regulations and knowledge documents across working groups, deal with the binding nature of R Climate [13] and the associated fact sheets. It is explicitly discussed that R 2 publications, such as the R Climate [13] and the associated fact sheets, are, like the R 1 publications of the FGSV, evaluated and used as recognised standards of technology or as the state of the art in the planning, approval and operation of (traffic) facilities and, in particular, in disputes. In this respect, it is recommended not to deviate from requirements and specifications, or to deviate only if absolutely necessary. In addition it is recommended to deviate from standards and rules only for good reasons, and to justify these deviations in writing. In this sense, the additional requirements listed in the profiles are to be applied in a binding manner.

The following are examples of the additional requirements for the application of the

- the HBS Highway Capacity Manual, 2015 edition [11], and
- the RASt Directives for the Design of Urban Roads, 2006 edition (last amendment 2013) [9].

The HBS 2015 fact sheet (as of 10/2022) lists the following additional requirements, among others:

- Design traffic volumes should be derived from current traffic forecasts for traffic engineering design. The forecasts should also include the demand effects of developments and measures resulting from the objectives of climate protection and the reduction of energy consumption. The Design traffic volumes should take into account the effect of all planned measures in public transport, cycling and walking (Figure 8).

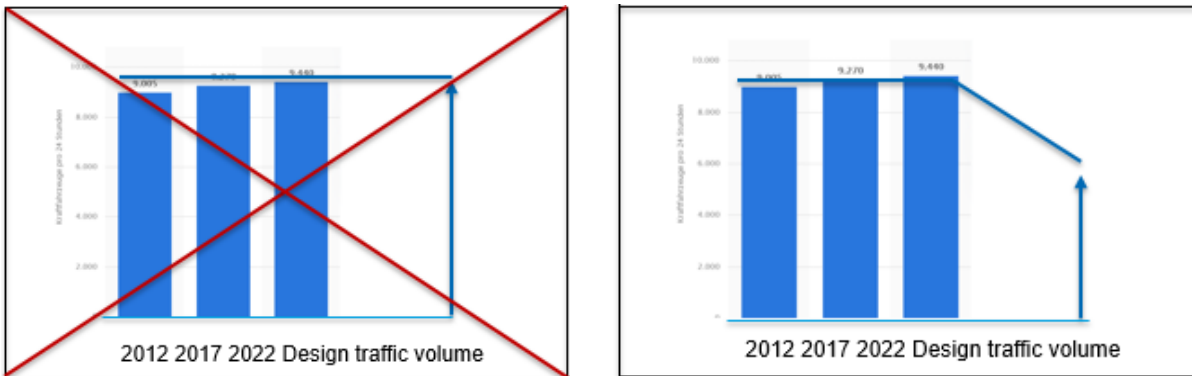


Figure 8: Modified derivation of the design traffic volumes according to the HBS fact sheet of the R Climate (exemplary, own illustration)

- Deviating from the generally accepted Level of Service (LoS) D for motor vehicle traffic, more ambitious targets for public transport, cycling and walking can increase its attractiveness and thus reduce GHG emissions and final energy consumption. For public transport, the LoS A to B should be aimed for, for cycling and walking the LoS A to C (see Figure 9). This applies both to facilities of the respective means of transport and to junctions with and without traffic signals. For this purpose, the separate designation of LoS for all relevant means of transport is recommended. When assessing the quality of traffic flow at intersections with traffic lights, this also applies to the guidance of public transport in mixed traffic with general motor vehicle traffic, irrespective of possible guidance on special bus lanes or prioritisation by means of traffic-dependent control.
- For Motorised Personal Transport facilities, LoS D reflects an efficient use of resources. If a LoS better than D is achieved for motorised traffic facilities, it should be demonstrated that no more economical variant is available for the underlying road category for which a LoS of D is achievable. A LoS of E or F can be temporarily accepted in Motorised Personal Transport as part of an overall assessment with the objective of reducing GHG emissions and final energy consumption, if a reduction in vehicle demand and thus in rated traffic volumes can be expected in the medium term, e.g. due to planned improvement measures in public transport, cycling and walking (combination of push and pull measures). A LoS of E or F is also justifiable at locations where travel time extensions are acceptable or desirable from a transport policy point of view, e.g. on access roads to city centres or when a special bus lane is installed.

LoS	Motor vehicle traffic Average waiting time [sec]	Public transport Average waiting time [sec]	Cycling and Walking Maximum waiting time [sec]
A	≤ 20	≤ 5	≤ 30
B	≤ 35	≤ 15	≤ 40
C	≤ 50	≤ 25	≤ 55
D	≤ 70	≤ 40	≤ 70
E	> 70	≤ 60	≤ 85
F	> 70	> 60	> 85 ⁴⁾

Figure 9: Desired LoS according to the HBS fact sheet of R Climate (example, source of the table: [11]).

- Within the scope of the assessment, both the Levels of Service (LoS) on single network elements as junctions or sections and the Levels of Quality (LoQ) on wider connections or in a whole network supply should be determined according to the HBS 2015 [11] (see Figure 10). When applying the procedures for a network supply, the case may arise that the Level of Quality of a wider connection (LoQC) is sufficient (Level D), although the assessment on single network elements results in a LoS of E. If a single element has a LoS of F or if other constraints of the procedures are not fulfilled, alternative procedures are required for the verification of the network supply. If the quality of network supply is sufficient, it can be accepted in an overall assessment that certain elements have a LoS E or F.
- A further integrated consideration for motor vehicle traffic and public passenger transport, but also for cycling, is made possible by comparing the levels of quality of network supply LoQN or of a wider connection LoQC according to the RIN [10] (see also Figure 10). In the case of good public transport, the requirements for the quality of network supply and wider connections (LoQC, LoQN) or the LOS of single elements can be reduced as part of an overall assessment and to influence transport demand.

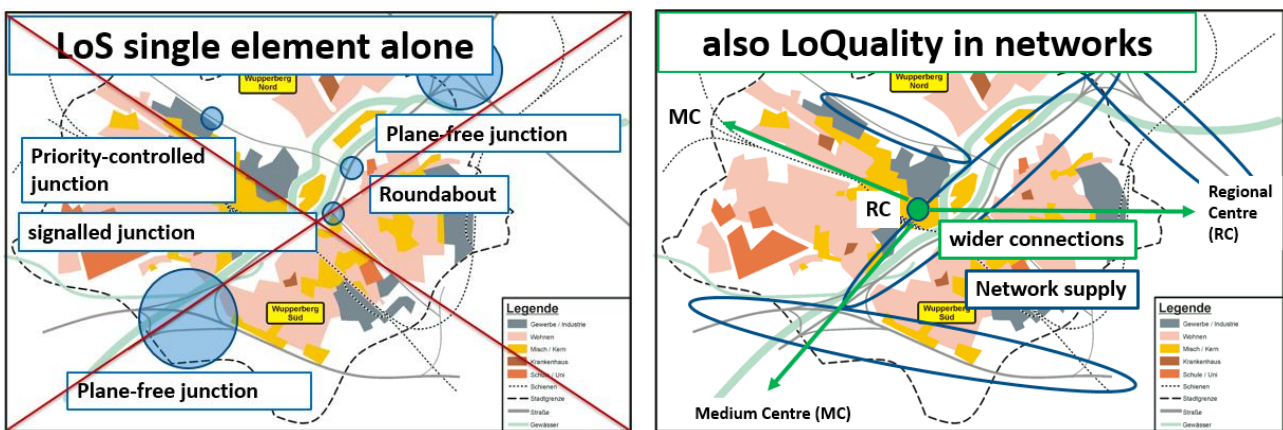


Figure 10: Necessity to consider the Levels of Quality in networks LoQ always in addition to the consideration of the LoS of single elements according to the HBS fact sheet of R Climate (exemplary, own illustrations).

The fact sheet on the Directives for the Design of Urban Roads RAST 2006 [9] (as of 10/2022) lists the following additional requirements and also new, already agreed requirements:

- The issue of "contribution to compliance with climate protection goals" is to be prioritised both in the draft objective and in the decision on consideration.
- Environmental protection concerns and the goal of sufficient greening with vegetation structures appropriate to the location are to be taken into account. As a matter of principle, possibilities for unsealing and creating retention areas are to be examined.
- The needs of public transport, cycling and walking should generally be prioritised over the needs of flowing and parking motor vehicle traffic. In addition, the demands of loading, delivery and commercial traffic must be taken into account.
- In order to achieve climate protection goals, public transport should be provided with an attractive offer that guarantees performance and competitive travel times compared to Motorised Personal Transport.
- In order to achieve climate protection goals, continuous networks for cycling and walking should be provided that are as attractive as possible and in conformity with the regulations, with the corresponding connections to infrastructure and cultural facilities, housing and commerce (Figure 11).

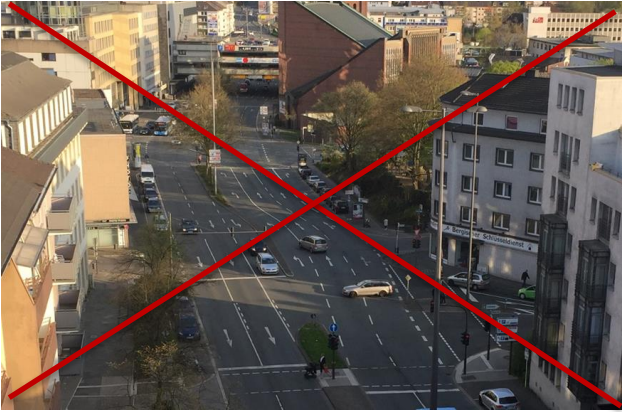


Figure 11: Standards for cycling and walking that are continuously compliant and as attractive as possible according to the RAST fact sheet of the R Climate (exemplary, own photos)

- In bottlenecks and in the case of conflicts regarding space, various sections (orientation length 50 to 150 m) with reduced lane widths are to be formed in order to offer an infrastructure for cycling and walking that is continuously compliant and as attractive as possible and to reduce speed in urban roads. These sections can have lane widths for lorry/private car or private car/private car encounters if sufficient visibility of oncoming vehicles is demonstrated, taking into account the stopping sight distances.
- In order to ensure objective and subjective safety and thus an increased use of cycling and walking facilities, sufficiently wide facilities must be provided. The standard dimensions for footpaths and cycling paths specified in RAST 06 [9] are to be regarded as minimum values and these facilities should be as wide as possible. The bracketed and limited sizes for cycle paths specified in RAST 06 [9] are no longer to be applied.
- If parking cannot be avoided, safety clearance is to be provided for all types of cycling paths. Safety clearance should also be provided for mixed traffic, especially on narrow carriageways (Figure 12).

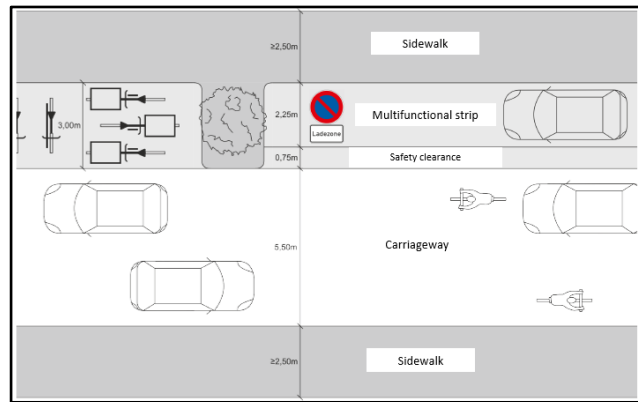


Figure 12: Requirement of safety clearance between parking and cycling in mixed traffic with and without advisory lanes according to the RAST fact sheet of R Climate (example, own photo, own illustration).

- More crossing facilities should be provided for pedestrians and cyclists.
- The provision of parking lots in the road space that are not necessary for people with severe walking disabilities and wheelchair users should be avoided as far as possible. The aim is to gain space for green areas, for retention and/or decentralised drainage with infiltration and/or for other environmentally friendly modes and to reduce the heating up of road spaces (Figure 13). The alternative accommodation of car parks

in connected parking areas or parking structures also offers itself for the efficient handling of e-charging processes, delivery and loading traffic as well as for sharing offers as a mobility hub/mobility station.

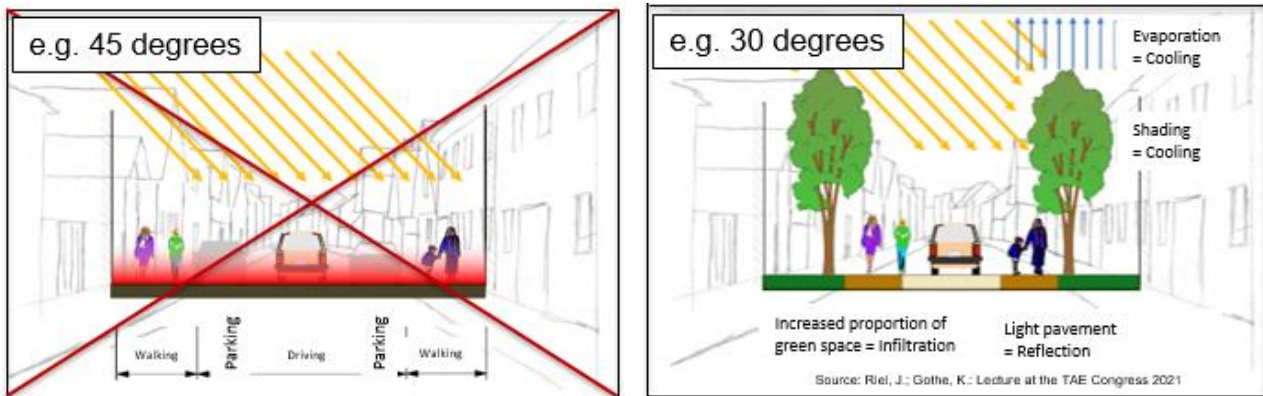


Figure 13: Standard of avoiding parking lots in road space in favour of spaces for green areas, retention and environmentally friendly transport modes according to the RAST fact sheet of R Climate (exemplary, source of illustrations: Riel, J.; Gothe, K.: presentation at the TAE Congress 2021).

If the additional requirements for the application of the HBS [11] and the RAST [9] listed here as examples and put into context are considered, it becomes clear how far-reaching the changes in the planning, design and traffic management process must and will be. While the previous development of regulations and expertise documents had the aim of equal treatment of traffic modes, similar to the previous development of road traffic regulations, prioritisation is now anchored in the regulations and expertise documents. In addition, safety criteria and quality requirements, especially for vulnerable road users, are in the foreground. In addition all possibilities are to be used to noticeably strengthen public transport. These changed approaches are initially anchored in R Climate fact sheets - but in the medium to long term they will lead to fundamentally different requirements for the planning, design and traffic management of transport facilities and transport services.

In the case of the new requirements, parallel to the publication of the R Climate [13] and the fact sheets, correction papers, e.g. to RAST 06 [9], are published, which will introduce the already agreed requirements of the revised version - in advance - as new requirements and standards.

7. Conclusion and outlook

The new R Climate [13] present the relevance of climate protection goals in the transport sector, define new requirements for the application of regulations and expertise documents, and thus support planners in the implementation of technical requirements.

The new requirements initially expressed in fact sheets will be taken into account in the future adaptation and updating of various regulations and knowledge documents. In this respect, the new generation of regulations will make its contribution to achieving climate protection goals as far as possible.

The R Climate [13] were created ad hoc and are the prelude to change processes that are far from being completed with the published work. Rather, further adjustments are planned and necessary, which relate, for example, to the preparation of GHG balancing methods and their integration into assessment procedures, to decision-making processes for suitable

measures, to structural designs or to possibilities for accelerated implementation of climate protection and climate impact adaptation measures.

Newly expressed requirements can only be effective if planning, processes and decisions on site are aligned with them. In this respect, joint responsible action is required in order to preserve adequate living conditions for us and for future generations.

Literature

- [1] Agora Energiewende / Agora Verkehrswende / Stiftung Klimaneutralität 2020: Climate Neutral Germany 2045, How Germany can achieve its climate protection goals even before 2050 (orig.: Klimaneutrales Deutschland 2045, Wie Deutschland seine Klimaziele schon vor 2050 erreichen kann), Berlin 2020.
- [2] Potsdam Institute for Climate Impact Research (PIK), Copernicus Project Ariadne 2020: Ariadne Analysis - Climate Protection and Transport: Achieving Targets Only Possible with Inconvenient Measures (orig.: Ariadne-Analyse - Klimaschutz und Verkehr: Zielerreichung nur mit unbequemen Maßnahmen möglich), Potsdam 2021
- [3] BMVI: Mobility in Germany - MID 2017, Report on the Results, Berlin 2019
- [4] Federal Government: German Sustainability Strategy, Further Development 2021, Cabinet Decision of 10 March 2021
- [5] Federal Government: Öko-Institut; Fraunhofer ISI; IREES GmbH; Thünen-Institut: Projection Report 2021 for Germany, Berlin/Karlsruhe/Braunschweig 2021
- [6] Bundestag: Federal Law Gazette Volume 2021, Part I No. 59: First Act Amending the Federal Climate Change Act of 18 August 2021, Bonn 2021
- [7] BVerfG: Federal Constitutional Court, ruling of the First Senate of 24 March 2021 - 1 BvR 2656/18 -, marginal no. 1-270, Karlsruhe 2021.
- [8] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing a framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ("European Climate Change Act")
- [9] FGSV Road and Transportation Research Association: Directives for the Design of Urban Roads (RASt) (orig.: Richtlinien für die Anlage von Stadtstraßen), 2006 edition, Cologne 2006
- [10] FGSV Road and Transportation Research Association: Directives for Integrated Network Design (RIN) (orig.: Richtlinien für integrierte Netzgestaltung), 2008 edition, Cologne 2008
- [11] FGSV Road and Transportation Research Association: Highway Capacity Manual (orig.: Handbuch für die Bemessung von Straßenverkehrsanlagen (HBS), 2015 edition, Cologne, 2015.
- [12] FGSV Road and Transportation Research Association: Guidance on measures for a modal shift in freight transport (HVwG) (orig.: Hinweise zu Maßnahmen für eine Verkehrswende im Güterverkehr), 2021 edition, Cologne, 2021
- [13] FGSV Road and Transportation Research Association: Recommendations for the application of FGSV publications in the field of transport to achieve climate protection goals (R Climate) (orig.: E Klima – Empfehlungen zur Anwendung von Regelwerken und Wissensdokumenten im Bereich Verkehr zur Erreichung von Klimaschutzziele), 2022 edition, Cologne, 2022
- [13] NPM 2021: National Platform Future of Mobility, Working Group 1 "Climate Protection in Transport": Ways for more climate protection in transport (orig.: Wege für mehr Klimaschutz im Verkehr), Berlin 2021.
- [14] UBA 2022: Federal Environment Agency: National trend tables in the delimitation of the sectors of the Climate Protection Act (orig.: Nationale Trendtabellen in der Abgrenzung der Sektoren des Klimaschutzgesetzes (KSG)); web database <https://www.umweltbundesamt.de/themen/klima-energie/treibhausgas-emissionen>; retrieved 15.08.2022