Road and Transportation Research Association
Commission Sustainability

FGSV

R Climate 2022

Recommendations

on the Application and further Development of FGSV Publications in the Field of Transportation to achieve Climate Protection Targets

Climate-relevant Specifications, Standards and Options for Action for Consideration in the Planning, Design and Operation of Transportation Services and Transportation Facilities

Edition 2022/Translation 2024

R 2

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Commission 6 “Sustainability” (K 6)
Ad-hoc group on the application and adaptation of FGSV publications in the field of transportation to achieve climate protection targets

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Preliminary remark

The “Recommendations for the Application and further Development of FGSV Publications in the field of Transportation to achieve Climate Protection Targets – Climate-relevant Specifications, Standards and Options for Action for Consideration in the Planning, Design and Operation of Transportation Services and Transportation Facilities”, edition 2022 (R Climate 2022), were prepared for the work in the committees of the FGSV and for the interested specialist public by the ad-hoc group “Application and adaptation of FGSV regulations in the field of transportation to achieve climate protection targets” of Commission 6 “Sustainability” (Chairman: Dir. and Prof. Dr.-Ing. Lutz Pinkofsky, Bergisch Gladbach).

Foreword

The FGSV would like to make its contribution to achieving the climate protection goals and to adapting the transport offer due to the already occurring and increasing climate impacts. In doing so, it is following the requirements of the Climate Protection Act, which stipulates annual greenhouse gas (GHG) emission levels, and the ruling of the Federal Constitutional Court, which stipulates the preservation of the basis of life for future generations as decisive in terms of intergenerational justice.

Our living conditions and the quality of life of today's and future generations are extremely endangered. The transportation sector in particular is called upon to act. According to the experts of the FGSV, necessary changes also include adapted procedures for planning, design, construction and operation of traffic facilities.

What is needed is immediate, decisive action with the aim of achieving the transportation-related climate protection targets. The entire FGSV community and all users of FGSV regulations and knowledge documents must take action.

In this context, an ad hoc group has worked for six months on the question of the extent to which the FGSV regulations and knowledge documents already contribute, or could contribute with additions and modifications, to achieving the reduction targets. The present "Recommendations for the Application and Further Development of FGSV Publications in the Field of Transportation for Achieving Climate Protection Goals" have already been developed in consultation with many FGSV committees and other stakeholders despite the short processing time and have been scientifically validated in this sense in the best possible way. They are the prelude to change processes that are far from being completed with the present work. Rather, further adjustments are planned and necessary, which relate, for example, to the integration of methods for GHG balancing in evaluation procedures, to decision-making processes with regard to the climate relevance of measures, to constructional designs or to possibilities for the accelerated implementation of measures for climate protection and climate impact adaptation.

The present set of rules (R 2) "Recommendations for the Application and further Development of FGSV Publications in the Field of Transportation to achieve Climate Protection Goals", edition 2022 (R Climate 2022), is an R 2 publication of the FGSV. These recommendations contain standards and rules ("it should/it should not") as well as recommendations (it should/it should not), which are usual for R 2 regulations, as well as specifications and requirements ("it is/it must/it must not") from the area of R 1 regulations (guidelines and ZTV) and options for action (it can/it could), which are usual for knowledge documents. Specifications result from safety-relevant and functional basic requirements as well as from the implementation of legal framework conditions. Standards and rule cases are derived from documented and provable knowledge and ensure appropriate quality requirements. Recommendations reflect experience that applies to most use cases.

Options for action are only appropriate in specific cases that are highlighted. Experience shows that R 2 publications, like the R 1 publications of the FGSV, are also evaluated and referred to as recognized rules of technology or 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 specifications and requirements, or to deviate only if absolutely necessary, and to deviate from standards and rules only for good reasons and to justify these deviations in writing.

The FGSV recommends that the "Recommendations for the Application and further Development of FGSV Publications in the Field of Transportation to achieve Climate Protection Goals", edition 2022 (R Climate 2022) be used in all transportation planning and in the design and operation of transportation services and transportation facilities.

The FGSV continuously adapts its regulations to sustainable development goals. In these recommendations and in the associated fact sheets (only for the German edition), available at www.fgsv.de, reference is made at numerous points to FGSV regulations. However, these are updated on an ongoing basis, content is updated and published with a new year of publication. For better readability, these recommendations refer to the references with the year of publication valid at the editorial deadline. When applying these recommendations, however, the version of the references valid at the time must be used.

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1. Introduction

1.1 Occasion and purpose

Climate protection is probably one of the most important tasks of this and the coming decade and is of immense importance for the preservation of living conditions and a good quality of life for current and future generations. Experts assume that human emissions of greenhouse gases (GHG) will cause climate change with massive ecological, economic, social and humanitarian consequences. If decisive action is not taken now, the basis of life and the fulfilment of the needs of present and future generations will be extremely jeopardised.

Climate protection measures also serve as a substantial component of the overarching goals of sustainable development, i.e. the long-term safeguarding of the basis of life for future generations. In 2015, the United Nations (UN) adopted the 2030 Agenda with 17 global goals for sustainable development (Figure 1). This sees it as our shared responsibility to decisively advance sustainable development in the coming years through transformation processes and the fundamental reorganisation of structures as well as ways of thinking and behaviour. The 17 Sustainable Development Goals are aimed at all governments, but also at society, the private sector and the scientific community. Compliance with the goals should enable a decent life and at the same time preserve the natural foundations of life in the long term.

Figure 1: The 17 global goals for sustainable development (source/symbols of the goals: www.globalgoals.org)

All countries should align their actions with the 17 Sustainable Development Goals. Germany committed to implementing these goals early on and most recently transferred the global sustainability goals to German conditions in 2021 [Bundesregierung 2021a]. The German Sustainable Development Strategy expressly draws attention to the fact that, regardless of the coronavirus pandemic and its consequences, the actions taken to date are far from sufficient to embark on a sustainable development path.

The German Sustainability Strategy contains more than 70 exemplary key indicators and essential goals in around 40 areas. These represent the status of the desired sustainable development and provide a basis for future action. Thematic clusters are summarised in six so-called transformation areas, which address several goals and for which central transformative measures with a significant impact on climate protection are defined by the Federal Government. Transport is explicitly addressed. Accordingly, mobility must be recognised as an indispensable part of social life that must continue to be accessible to all people. At the same time, mobility must increasingly take account of environmental and climate protection concerns. In detail, the following objectives were set for the transportation sector as part of the German Sustainable Development Strategy (as of 15 December 2020, now partially adapted in the Climate Protection Act):

- Reduction in land use for settlement and transport to an average of less than 30 hectares per day by 2030
- Reduce final energy consumption in passenger and freight transport by 15 to 20 % by 2030 compared to 2018

– Reducing the average journey time by public transport to improve the accessibility of medium-sized and regional centres
– Reducing greenhouse gas emissions by at least 55 % by 2030 compared to 1990; achieving greenhouse gas neutrality by 2050.

Final energy consumption in passenger and freight transport (Sustainable Development Goal SDG 11) is used as a key indicator for the transport sector, which is intended to provide an early indication of failure to achieve the desired goals (off-track indicator).

The GHG reduction target (Sustainable Development Goal SDG 13) recognises the broad consensus in climate policy to limit the global temperature rise to well below 2 °C, preferably below 1.5 °C, in order to reduce and avoid some of the most devastating impacts on our planet and people. Living conditions are increasingly out of balance due to global warming. Extreme climate events are causing the destruction of natural and cultural landscapes, resulting in great human suffering and high social costs. At the same time, society's current demand for mobility and the resulting motorised traffic is a climate problem child.

In addition to the socially defined sustainability goals, regulations have also been created in the area of legislation to concretise and comply with the climate protection goals. The European Union (EU) last amended the European Climate Law with a regulation on 30 June 2021 [EU 2021]. The legal requirements are based on the concepts of the "European Green Deal", with which the EU is taking up the UN's 2030 Agenda as a European strategy for the period 2019-2024 with the defined goal of zero net greenhouse gas emissions by 2050 and the milestone of achieving a GHG reduction of 55 % by 2030 compared to 1990. In the area of transport and mobility, the EU has developed the "Sustainable and smart mobility" strategy and the "Fit for 55" package of measures to reduce GHG emissions by 55 % by 2030 [EU 2020].

Germany has recognised its responsibility for climate protection and has made commitments to reduce GHG emissions by setting quantitative climate protection targets that are enshrined in law. At the time these recommendations were drawn up, the Federal Climate Protection Act was in force as of 18 August 2021 (Federal Law Gazette I p. 3905) [Bundestag 2021]. It defines permissible annual emission levels for the years 2020 to 2030 and annual reduction targets for the years 2031 to 2040 (Table 1). These go beyond the requirements of the first version of the Act of 12 December 2019 (Federal Law Gazette I p. 2513) and the German Sustainability Strategy as of 15 December 2020 [Federal Government 2021a]. According to this, GHG emissions in all sectors are to be reduced by a total of

by at least 65 % by 2030 compared to 1990 (or 48 % in the transport sector) and
– by at least 88 % (or 82 % in the transport sector) by 2040 compared to 1990, and
– be reduced to such an extent by 2045 that net greenhouse gas neutrality is achieved, and
– become negative after 2050.

Table 1: Permitted annual emission volumes for the years 2020 to 2030 and annual reduction targets for the years 2031 to 2040 [Bundestag 2021]

Permitted annual emission volumes for the years 2020 to 2030

Annual emissions in million tonnes of CO_2eq	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Energy industry	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 management and Other	9	9	8	8	7	7	6	6	5	5	4

Annual reduction targets for the years 2031 to 2040

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

The starting point and reference value are the annual emissions in CO_2 equivalents (CO_2eq) from 1990 (1,241.9 million tonnes CO_2eq or 1,268.9 million tonnes CO_2eq including emissions from the land use sector, 163.4 million tonnes CO_2eq in the transport sector, of which 154.8 million tonnes CO_2eq in road transport).

The reduction targets are to be reviewed annually. Non-compliance will lead to the need to introduce immediate measures in each individual sector, including the transport sector. It should be borne in mind that if the individual annual targets are not met, the missed savings from previous years will have to be reduced in addition to the savings actually planned.

The Federal Climate Protection Act [Bundestag 2021] states the following regarding non-compliance:

> *If emissions data show an exceedance for a sector in a reporting year, the Federal Ministry shall submit an immediate action programme for the respective sector within three months to ensure compliance for the following years (Section 8 (1) KSG).*

Despite numerous innovations and advances in the transport sector since 1990 - with the exception of the pandemic-related declines in 2020 - no reduction in GHG emissions has been achieved. In 2019, annual transport-related emissions still amounted to 164.1 million tonnes of CO_2eq. In 1990, the figure was 163.4 million tonnes of CO_2eq (Figure 2). According to the German Federal Climate Protection Act [Bundestag 2021], this figure should only be 85 million tonnes of CO_2eq in 2030, which corresponds to around half of the transport-related GHG emissions in 1990.

In view of the fact that there are no signs of a downward trajectory in accordance with the climate targets and the projected development in the transport sector, considerable efforts will be required to meet the annual reduction targets. It is to be expected that the consequences of non-compliance will result in unprecedented changes in the management of supply and demand in all transport subsystems.

In addition, the decision of the First Senate of the Federal Constitutional Court of 24 March 2021 [BVerfG 2021] will lead to previous methods, decision-making processes and measures as well as laws in the road and transport sector being put to the test. The resolution has reaffirmed that everything possible must be done to keep climate change within manageable limits. Among other things, the resolution states that the state's duty to protect includes the obligation to protect life and health from the dangers of climate change,

- the duty to protect also applies to future generations,
- the relative weight of the climate protection requirement continues to increase as climate change progresses,
- the state cannot evade its responsibility by referring to greenhouse gas emissions in other countries and
- it is necessary to treat the natural foundations of life with such care and leave them to posterity in such a condition that future generations cannot continue to preserve them only at the cost of radical personal abstinence.

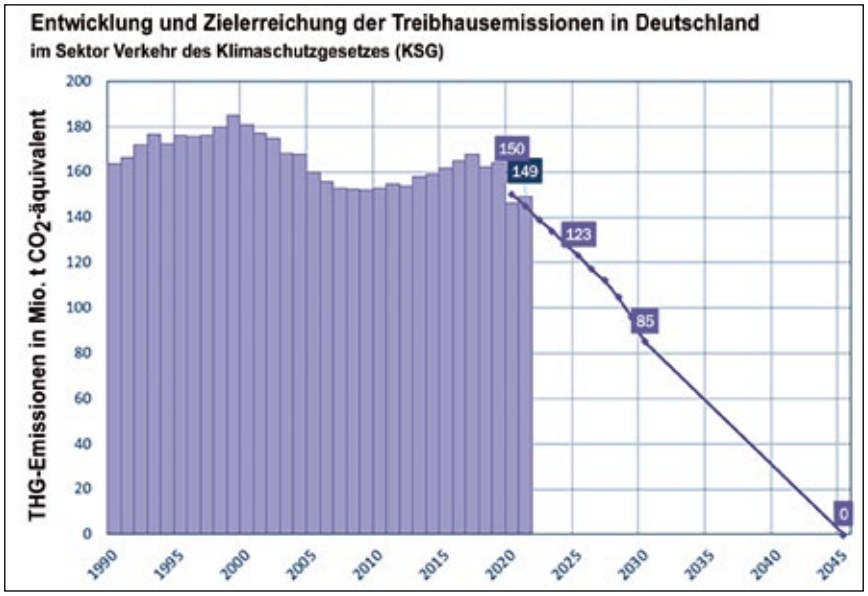

Figure 2: Development of GHG emissions 1990 - 2020, previous year's estimate 2021 and targets according to the Federal Climate Protection Act
(source: UBA 2022; figures: Federal Government 2021b)

The decision of the Federal Constitutional Court has given the Federal Climate Protection Act [Bundestag 2021] with its reduction targets an even more binding character. At the same time, the decision addresses the principle of sustainability as a whole.

The Federal Climate Protection Act [Bundestag 2021] lists the responsible federal ministry as the acting institution, i.e. the Federal Ministry of Digital and Transport (BMDV) for the transport sector. It is therefore obvious that nationwide measures must be taken in the coming years to ensure that the annual emission levels permitted for transport in a given year are not exceeded and to respond adequately to any exceedances. Preparations for such measures are underway, although the measures to be taken at federal level alone will probably not be sufficient to meet the climate protection targets.

The decision of the Federal Constitutional Court [BVerfG 2021] does not place responsibility solely in the hands of the state, but rather suggests that current generations must treat the natural foundations of life with such care that future generations cannot continue to preserve them only at the price of radical abstinence.

In the transport sector, too, "everything possible must therefore be done" at all levels [BVerfG 2021] to encourage the current generation to treat the natural foundations of life with care.

1.2 Contents of R Climate

In conjunction with the fact sheets on individual FGSV publications in the appendix, this publication contains recommendations from the fields of traffic planning, road design and traffic management that can contribute to reducing GHG emissions and final energy consumption in the transport sector.

The report shows how and to what extent the rules of technology in the transport sector - and in particular the FGSV's regulations and knowledge documents – are already

- already currently,
- with additional application notes or
- with modified specifications and standards, which are described in the fact sheets and which will take up or lead to further developments of the publication in the form of correction sheets and revisions,

can contribute to reducing GHG emissions and final energy consumption.

In this respect, R Climate contain specifications, standards and guidelines for the application of the FGSV publications, which are particularly relevant when regional or local contributions are required to meet climate protection targets in terms of sustainability. The additional application notes and the modified specifications and standards have been harmonised across the FGSV and in particular with the relevant committees responsible for the publication in question.

1.3 Scope of application and differentiation from other FGSV publications

The overarching objective of the FGSV publications is to create the basis for a transport system that enables mobility needs to be adequately managed and satisfied while at the same time fulfilling sustainability goals. The regulations and knowledge documents of the FGSV generally aim to optimise the design of all transport subsystems.

Conflicts between the individual target areas are commonplace in the application of the FGSV publications. In this context, the present recommendations represent a further development of the existing FGSV publications of working groups 1 to 3 (traffic planning, road design and traffic management) in order to establish methods, processes and measures with which climate protection goals can be successfully achieved.

These recommendations address all of the following levels:

- Federal, state and local government,
- political, legal, fiscal,
- planning, construction, operational,
- passenger transport, freight transport
- urban mobility; urban-rural relations, mobility in rural areas
- Motor vehicle traffic, public transport, cycling and walking as well as the networking of transport subsystems
- Planners, operators, users ...

In addition, the R Climate are intended to initiate processes within the FGSV committees in order to adequately address climate-relevant aspects in future revisions or elaborations of regulations and knowledge documents and to promote methods and measures for achieving climate protection goals in the transport sector, provided that these regulations and knowledge documents can contribute to achieving climate protection goals.

2. Areas of action and methodological approach to achieving climate protection targets in the transport sector

2.1 State of knowledge on the distribution of GHG emissions in the transport sector

Road transport made by far the largest contribution to GHG emissions from domestic transport in 2020 at around 97 % (Table 2). Around 36 % was attributable to road freight transport and around 64 % to private motorised transport (Table 3).

Table 2: GHG emissions from the transport sector in CO2eq 1990 – 2020
[UBA 2022. data source: data on greenhouse gas emissions for 2021 according to KSG. as at 15 March 2022]

Annual emissions in million tonnes of CO_2eq	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
Total traffic	164.5	177.5	182.4	161.3	154.2	163.0	166.0	169.2	163.6	165.3	147.2
of which road transport	*154.8*	*169.1*	*174.7*	*154.4*	*148.1*	*157.0*	*160.2*	*163.4*	*157.8*	*159.4*	*143.1*
of which rail transport	*3.1*	*2.5*	*2.0*	*1.4*	*1.1*	*1.0*	*1.1*	*0.9*	*0.7*	*0.8*	*0.8*
of which inland waterway transport	*3.0*	*2.4*	*1.6*	*1.6*	*1.4*	*1.7*	*1.5*	*1.4*	*1.5*	*1.6*	*1.4*
of which air transport (domestic)	*2.4*	*2.2*	*2.7*	*2.5*	*2.3*	*2.0*	*2.1*	*2.2*	*2.2*	*2.3*	*1.1*

Table 3: GHG emissions from freight and passenger transport in CO2eq 1990 - 2020
[UBA 2022, data source: data on greenhouse gas emissions for 2021 according to KSG, as at 15 March 2022]

Annual emissions in million tonnes of CO_2eq	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
Road freight transport	33.9	46.6	55.2	44.8	48.0	52.3	53.3	54.3	53.2	54.3	52.0
Light commercial vehicles	*4.0*	*6.4*	*8.3*	*8.5*	*8.4*	*10.1*	*10.7*	*11.4*	*11.4*	*11.7*	*11.3*
Heavy goods vehicle	*29.9*	*40.2*	*46.9*	*36.2*	*39.6*	*42.2*	*42.6*	*42.9*	*41.8*	*42.5*	*40.7*
Passenger transport by road	120.7	122.4	119.5	109.5	100.0	104.6	106.8	109.0	104.6	105.0	91.0
MIT (cars, two-wheelers)	*116.4*	*118.7*	*115.8*	*106.5*	*96.6*	*100.9*	*103.0*	*105.2*	*100.9*	*101.3*	*88.0*
Buses	*4.3*	*3.7*	*3.7*	*3.0*	*3.3*	*3.7*	*3.8*	*3.8*	*3.6*	*3.8*	*2.9*

* Heavy commercial vehicles (lorries from 3.5t, articulated lorries and road trains)

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 target values of the German Climate Protection Act nor in the balancing of GHG emissions from the transport sector.

According to the results report Mobility in Germany - MID 2017 [BMVI 2020], the distances travelled by private cars in Germany are broken down as follows

- around 18 % of journeys are distances of less than 2 km
- around 42 % of journeys are less than 5 km
- around 62 % of journeys of less than 10 km and
- around 81 % of journeys of less than 20 km

include. The average commuting distance between home and work is currently around 16 km.

Due to the length of the journey, around 9 % of car journeys are less than 5 km and around 33 % of car journeys are less than 20 km (Figure 3). All journeys made car journeys of less than 5 km thus cause around 9 % of GHG emissions from car traffic, while all journeys of less than 20 km cause around 34 % of GHG emissions from car traffic. The larger share of 66 % of GHG emissions from car traffic is caused by the 19 % of all car journeys that are longer than 20 km.

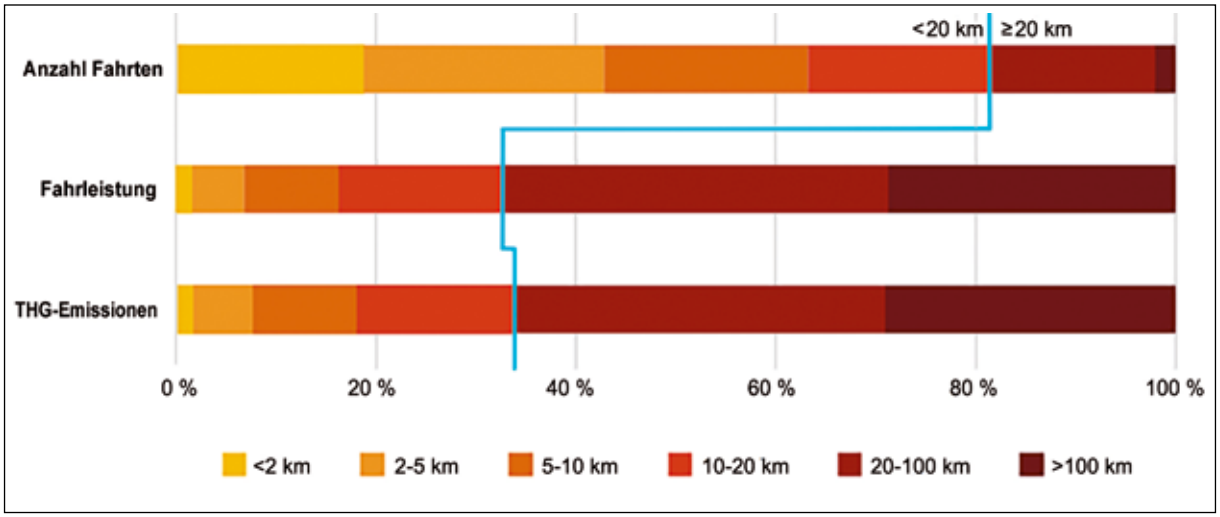

Figure 3: Distribution of car journeys, car mileage and GHG emissions from car traffic by distance class
(source: NPM 2021; figures according to BMVI 2020)

Although the energy efficiency of road freight transport has increased significantly over the last few decades, the GHG emissions resulting from road freight transport have risen considerably in recent years (see Table 3). The main reason for this is that the domestic transport performance of road freight transport has increased by over 90 % since 1991. Improvements in vehicle and drive technology and, in some cases, operational processes have made it possible to realise large specific energy saving potentials. However, the efficiency gains have been more than offset by the increase in transport demand, meaning that energy demand and GHG emissions are still growing [FGSV 2021].

It should be noted that the specific GHG emissions of a lorry currently exceed the specific GHG emissions of a car by a factor of more than 5. In this respect, comparatively high potentials can be exploited by reducing lorry mileage.

2.2 Effects on GHG emissions and energy consumption in the transport sector

The effects on GHG emissions and energy consumption in the transport sector can be illustrated in various ways. Figure 4 shows a possible illustration of the interdependencies for passenger transport, Figure 5 for freight transport.

The key objectives are

- Reduction of GHG emissions,
- Reduction of energy consumption,
- reduction of material and resource consumption in terms of climate protection.

It can currently be assumed that the future energy requirements of motorised mobility will not be covered by renewable energies under the current framework conditions and with the measures currently decided [Agora 2020].

If these goals are to be achieved, transport

- transport performance, expressed in passenger and tonne-kilometres,
- the specific effects of transport demand, expressed in energy, CO_2 emissions per passenger and tonne-kilometre,

must be reduced.

It must also be taken into account that decisions on network design and infrastructure planning have a significant influence on material consumption in the case of construction implementation, which must not be

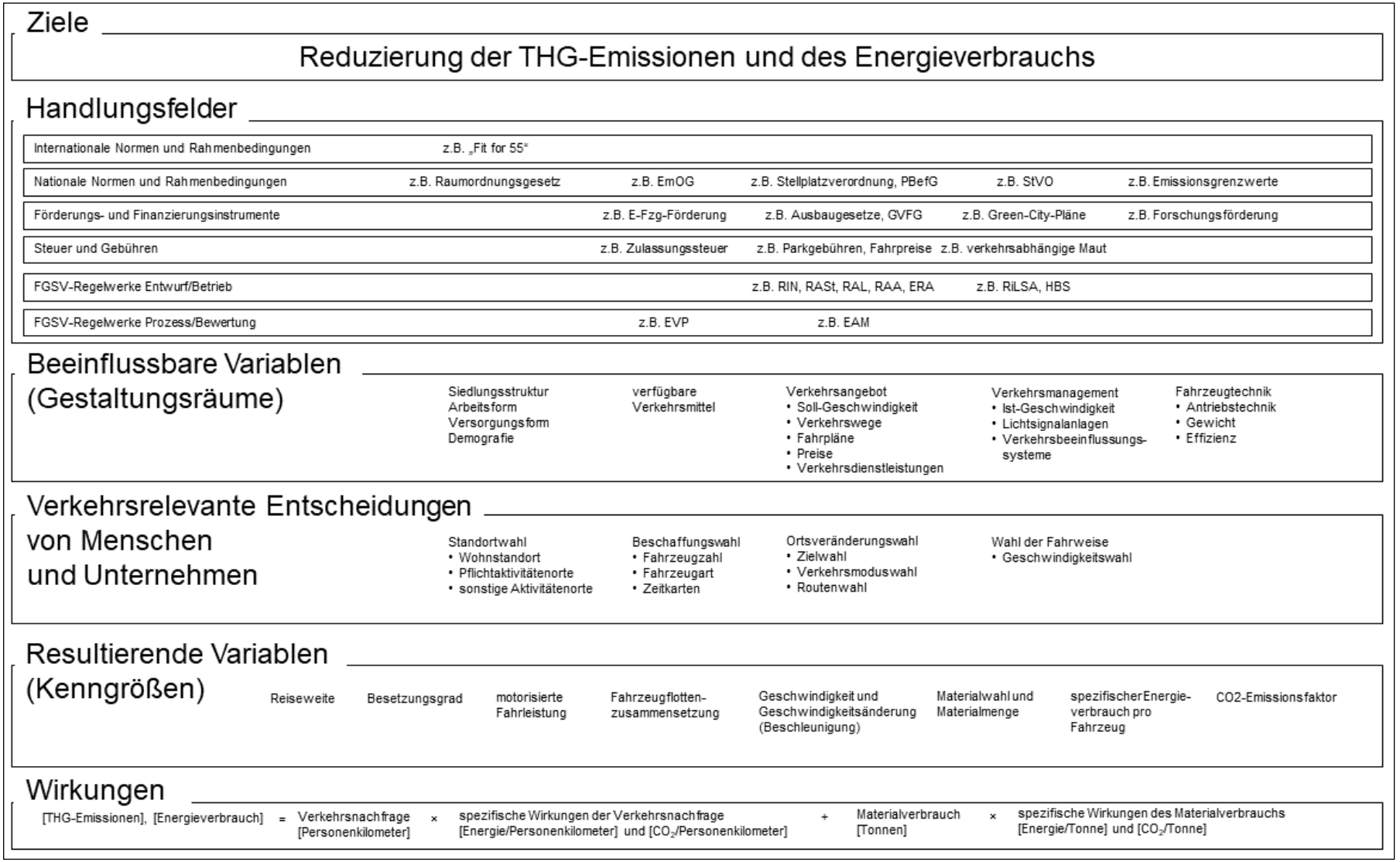

Figure 4: Impact correlations in passenger transport for the effects on GHG emissions and energy consumption

Ziele	**Goals**
Reduzierung der THG-Emissionen und des Energieverbrauchs	**Reduction of GHG emissions and energy consumption**
Handlungsfelder	**Fields of action**
Beeinflussbare Variablen (Gestaltungsräume)	**Variables that can be influenced (scope for action)**
Verkehrsrelevante Entscheidungen von Menschen und Unternehmen	**Transport-related decisions by people and companies**
Resultierende Variablen (Kenngrößen)	**Resulting variables (parameters)**
Wirkungen	**Effects**

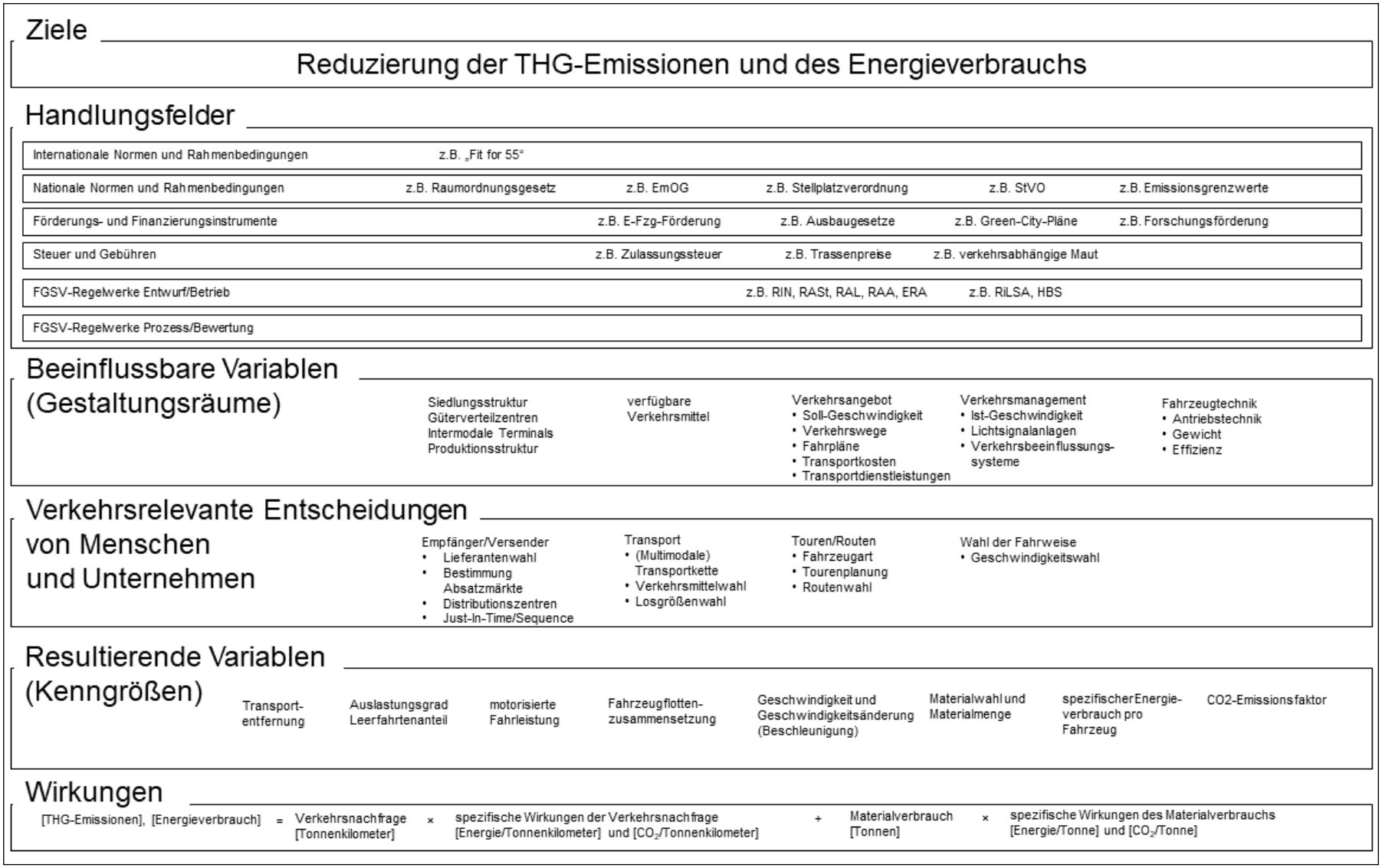

Figure 5: Impact correlations in freight transport for the effects on GHG emissions and energy consumption

Ziele	**Goals**
Reduzierung der THG-Emissionen und des Energieverbrauchs	**Reduction of GHG emissions and energy consumption**
Handlungsfelder	**Fields of action**
Beeinflussbare Variablen (Gestaltungsräume)	**Variables that can be influenced (scope for action)**
Verkehrsrelevante Entscheidungen von Menschen und Unternehmen	**Transport-related decisions by people and companies**
Resultierende Variablen (Kenngrößen)	**Resulting variables (parameters)**
Wirkungen	**Effects**

ignored, as the production of construction materials and the construction process itself cause GHG emissions to a not inconsiderable extent. When making decisions on infrastructure projects (new construction, expansion and demolition), the impact on material consumption must therefore be taken into account. In addition, construction logistics and the volume of construction site traffic must be taken into account.

Relevant parameters with regard to the stated objectives are

- Journey distance,
- occupancy rate,
- vehicle mileage,
- Vehicle fleet composition,
- Specific energy consumption per vehicle,
- speeds and speed changes,
- CO_2 emission factors,
- material consumption.

These effects on the relevant targets depend on variables and transport-related decisions that can be influenced by measures in several fields of action.

Depending on the level of consideration (e.g. international, European, federal, state, local), the respective fields of action are limited, so that some of the fields of action must then be considered as premises or prerequisites, possibly in scenarios with different characteristics of measures.

Some examples of interdependencies are shown below:

- The settlement structure, which is influenced by municipal urban land-use planning, determines possible activity locations and thus influences, among other things, the travel distance, the occupancy rate of public transport and the motorised mileage in passenger and freight transport.
- The forms of work offered (home office) and forms of supply (e-government, delivery services) influence motorised mileage, among other things.
- The supply and management of parking facilities, which are planned in accordance with the FGSV regulations, among other things, have an effect on the choice of destination and traffic mode and thus, among other things, on the distance travelled, the occupancy rate and the motorised mileage.
- A transport service and traffic management that offers short journey times makes it possible to reach more distant destinations in the same amount of time. Conversely, longer distances are more likely to be travelled at lower average speeds or longer journey times.
- The occupancy rate determines the passenger kilometres travelled by motorised means of transport. A high occupancy rate, e.g. through higher vehicle utilisation or ridepooling, reduces the specific consumption per passenger kilometre. This requires a correspondingly attractive public transport offer or incentives for ridepooling.
- Restrictions on the maximum permitted speed, road designs to support the choice of homogeneous and steady speeds, good control of traffic lights and other traffic control systems can reduce the number of stops and the amount of acceleration. This reduces energy consumption and thus GHG emissions, provided it is ensured that travelling time gains do not lead to longer journeys.
- The vehicle technology and the weight of the vehicle also have an effect on energy consumption. The drive technology in combination with the energy source determines the CO_2 emissions and the sector to which the emissions are allocated (transport or energy industry).
- The settlement structure, forms of work and supply, the transport offer including mobility costs, mobility services and traffic management form essential framework conditions for people's transport-related decisions. They can be influenced by measures in various fields of action and have an impact on the goals of reducing GHG emissions and energy consumption.

When developing measures to reduce GHG emissions and energy consumption, an iterative process is used to initially select those measures for further consideration that can be expected to have an impact in terms of the objective. Therefore, in the discussion on the effectiveness of instruments and measures, these correlations should be shown and the presumed cause-effect relationships formulated with regard to transport-related decisions made by people. Which decisions are influenced and what changes in behaviour can be expected? In passenger transport, this includes the following decisions, among others:

– Choice of location,
– Procurement of a vehicle and choice of vehicle type,
– Procurement of a season ticket,
– Choice of activities,
– destination selection,
– mode selection,
– route selection,
– departure time and
– driving style.

In freight transport, it includes the following decisions, among others:
– Choice of location,
– choice of supplier
– Choice of logistics structure (e.g. distribution centres)
– Choice of transport lot size
– Selection of a transport logistics provider
– Choice of means of transport
– Route planning
– Route selection,
– choice of departure time and
– driving style.

2.3 Possible actions to reduce GHG emissions in the transport sector

In order to achieve the specified climate targets in the transport sector, far-reaching changes and diverse actions are required in several fields of action. The question of which of these actions can be undertaken by the respective actors and which actions are to be taken as premises depends on the respective level of consideration.

The following are examples of some actions that contribute to the reduction of GHG emissions and energy consumption:
– In the energy sector, action must be taken to generate sufficient energy from renewable sources and to make the energy available to motorised vehicles using suitable energy sources (batteries, fuel cells, synthetic fuels). Transport planning can support the switch to the use of renewable energies by providing and arranging suitable charging facilities.
– As part of vehicle development, the direct emissions and energy consumption of vehicles should be reduced through new vehicle concepts, lower masses, more efficient combustion engines and alternative drive systems. In order to replace the current vehicle fleet with lighter, low-emission or emission-free vehicles, customers should be offered appropriate vehicles. On the other hand, purchasing behaviour should be changed so that these vehicles become established on the market. Lighter and smaller vehicles should be increasingly promoted and used, which can be supported by appropriate infrastructure design and allocation.
– Motorised traffic should be transferred to a traffic flow that is as smooth 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 journey times and thus to higher resistance to overcoming longer journey distances. In the medium to long term, a lower speed level can therefore be expected to lead to a reduction in journey distances and thus to a reduction in motorised transport services and a shift to public transport, provided that competitive journey times are offered. In this area of action, there are far-reaching possibilities for influencing traffic planning, road design and traffic management.
– The framework conditions must generally be set in such a way that changes in the location of people and goods are associated with the lowest possible emissions. A major influence here is the assessment of how the lowest possible transport demand (reduced number of journeys) in the area (reduced journey distances) is distributed among the individual modes, as often as possible among public transport, cycling and walking and their links as well as sharing/pooling systems (increase in occupancy rates, shifting effects to low-emission modes). In freight transport, urban logistics concepts and decisions on the choice of products

that can be provided with low transport performance can also provide support. The potential influence of transport planning, road design and traffic management is also significant here.

Further information on fields of action listed in the contents of FGSV publications of working groups 1 to 3 can be found in Section 4.

2.4 Procedure for estimating target achievement

Many climate protection measures (e.g. speed reductions in motor vehicle traffic, promotion of public transport, cycling and walking) have an impact on several areas. This multiple effect of a measure makes it difficult to determine the impact. For this reason, a simplified sequential approach can be useful. For the analysis of measures with regard to the effects on GHG emission reductions, this results in a possible procedure for the forecast with the following steps:

1 Balancing transport-related GHG emissions and transport-related energy consumption in the study area.

   Due to the high proportion of GHG emissions from long-distance car journeys, it may be appropriate to relate the study area to a larger, possibly inter-municipal, regional or supra-regional area.

2. Definition of traffic-related annual emission and energy consumption quantities in the study area that should not be exceeded.

3. Assumptions on future transport demand in passenger and freight transport:

   This step determines how transport performance in passenger transport (passenger-kilometres) and freight transport (tonne-kilometres) will change due to expected developments.

   Result: Transport performance without special measures to achieve the climate targets.

4. Forecasting or setting the vehicle fleet:

   In this step, the composition of the vehicle fleet is determined using the following variables:

   – Proportion of cars and lorries with internal combustion engines (ICE), plug-in hybrid drives (PHEV), fully electric drives (BEV) and hydrogen-based fuel cell drives (FCEV) in terms of mileage
   – Final energy consumption of these vehicles in the form of fuels (l/100 km), electricity (kWh/100 km) and hydrogen, taking into account vehicle size and weight.
   – Available quantity of biogenic fuels.

   Result: Climate contribution of changes to the vehicle fleet (mass) and drive systems (renewable energies)

   The composition of the vehicle fleet should be determined in several scenarios. If the respective reductions are not sufficient, the remaining savings target must be achieved by reducing vehicle mileage (vehicle kilometres), especially for vehicles with combustion engines. The specific fuel consumption of vehicles can also be reduced.

5. Investigation and definition of measures to reduce motorised mileage and specific consumption (push measures)

   In this step, restrictive measures for motor vehicle traffic are selected in such a way that the required reductions in GHG emissions are achieved by reducing vehicle kilometres and specific fuel consumption. This also involves measures that bring about GHG emission reductions due to changes in transport services (e.g. lane reductions), changes in driving behaviour and changes in the flow of motor vehicle traffic. The aim is to achieve a constantly slow flow of traffic with as little congestion, deceleration and acceleration as possible.

   Result: Climate contribution of the reduction of motorised mileage, the change in driving style and the stabilisation of (slow) traffic flow.

6. Investigation and definition of measures to improve the environmental network (pull measures)

   The measures to reduce the distances travelled by motor vehicles lead to modal shifts. Cycling, walking and public transport services must be expanded in such a way that the shifted demand can be met. At the same time, this expansion creates a pull effect, which brings with it additional modal shifts.

   Result: Minimum requirements for the expansion of eco-mobility.

The separation of push and pull measures may seem strange to transport planners, as transport policy favours incentives over restrictions. It should be borne in mind that “push measures” can have a rapid effect, while the effects of “pull measures” may only materialise later due to longer planning and lead times for the measures. For the purposes of scenario development, it makes sense to first define the restrictions (“push measures”)

and estimate their effects. This then results in the requirements for the transport offer of the environmental alliance (or "pull measures"). In practice, push and pull measures must be implemented as simultaneously as possible.

The individual measures must be summarised and considered interdependently with regard to their effects in terms of climate protection in order to derive the expected annual emission and energy consumption quantities or parameters that represent these. If, in comparison with the quantities defined in step 2, there is an overshoot, further measures must be investigated. The assessment of target achievement is therefore an iterative process. This should be established and carried out continuously - if possible annually - accompanied by evaluations.

Evaluations are absolutely essential in order to record the ramp-up of electrification on the one hand and the implementation and impact of the push and pull measures on the other, as well as changing framework conditions, and to be able to adjust accordingly if necessary.

The Handbook for Emission Factors (HBEFA) is currently available for balancing transport-related GHG emissions. The HBEFA was originally compiled on behalf of the Federal Environment Agencies of Germany, Switzerland and Austria and has since been supported by other countries and institutions. The HBEFA provides emission factors for the most common vehicle types, differentiated according to emission concepts (Euro 0 to Euro VI) and different traffic situations. The HBEFA provides emission factors for all regulated and a range of non-regulated pollutants, including CO_2 and fuel/energy consumption. It should be noted that HBEFA balances should be interpreted with caution, especially as individual traffic situations are taken as a basis in a generalised manner without explicitly taking into account the effects of specific stopping and acceleration processes at individual traffic facilities.

Instead of balancing traffic-related GHG emissions, in individual cases proxy parameters can be balanced as the basis for evaluations. The balance of motorised mileage, possibly differentiated according to individual vehicle types and different traffic situations, is particularly suitable here.

2.5 Results of selected forecasts on the impact of individual areas of action on GHG emission reduction

In the recent past, the potential effects of individual areas of action on the reduction of GHG emissions in transport have been analysed in several studies and projects. In order to gain an impression of the predicted effects in each case, it is worth taking a look at the following publications in particular:

- Agora Energiewende/Agora Verkehrswende/Stiftung Klimaneutralität: Klimaneutrales Deutschland 2045, Wie Deutschland seine Klimaziele schon vor 2050 erreichen kann, Berlin 2020 [Agora 2020]
- Öko-Institut; Fraunhofer ISI; IREES GmbH; Thünen-Institut: Projektionsbericht 2021 für Deutschland, Berlin/Karlsruhe/Braunschweig 2021 [Bundesregierung 2021b]
- Nationale Plattform Zukunft der Mobilität, Arbeitsgruppe 1 "Klimaschutz im Verkehr": Wege für mehr Klimaschutz im Verkehr, Berlin 2021 [NPM 2021]
- Potsdam-Institut für Klimafolgenforschung (PIK), Kopernikus-Projekt Ariadne: Ariadne-Analyse - Klimaschutz und Verkehr: Zielerreichung nur mit unbequemen Maßnahmen möglich, Potsdam 2021 [Ariadne 2021]
- Umweltbundesamt: Klimaschutzinstrumente im Verkehr, Bausteine für einen klimagerechten Verkehr, Stand 25. März 2022, Berlin 2022 [UBA 2022]
- Roland Berger/Intraplan/Florenus im Auftrag des VDV: Verkehrswende gestalten – Gutachten über die Finanzierung von Leistungskosten der öffentlichen Mobilität. Notwendige Leistungssteigerung im ÖPNV zur Erreichung des Klimaziels, Köln 2021 [VDV 2021]

The publications listed come to individual, partly comparable, partly differing reduction potentials that are to be expected quantitatively with regard to the anticipated reductions in greenhouse gas emissions when individual packages of measures are implemented. The following can be taken from all the forecasts made in the publications listed above:

- The implementation of the measures planned to date is not sufficient. Based on the measures planned to date, the transport sector will fail to meet the statutory GHG emission reduction targets. Further measures must therefore be planned and implemented at all levels.
- Measures that are supported by the majority of the population and are widely accepted will only lead to minor GHG emission reductions, meaning that it is unlikely that the climate targets will be achieved without

controversial measures that require communication and participation processes to increase public acceptance.

- The climate protection targets cannot be achieved solely by increasing the registration of battery electric vehicles.
- "Push measures" that restrict the use of vehicles with combustion engines can achieve particularly high emission reductions. None of the "pull measures" that incentivise the use of climate-friendly forms of mobility are expected to achieve a similarly high reduction rate as particularly effective "push measures".
- Due to the interaction between different climate protection measures, there are uncertainties in the impact and allocation of effects to individual areas of action. Bundles of measures that work together in different areas of action can have major synergy and overlap effects. "For example, the reduction effect of a carbon price can increase through synergy effects if citizens are given the opportunity to use climate-friendly means of transport such as electromobility or local public transport, compared to a development in which there are no alternatives to fossil-fuelled modes of transport" [Ariadne 2021].
- The move towards active, socially just, environmentally and climate-friendly forms of transport contributes to the achievement of climate protection targets, reduces noise and air pollution, minimises land consumption and improves quality of life. In order to achieve the necessary effects, a sufficient number of adequately qualified specialists are needed in the areas of mobility, transport, climate protection and public relations.

3. Recommendations for the application and further development of existing FGSV publications in the task of achieving climate protection targets

3.1 Transportation planning, road design, and traffic management measures to reduce transportation-related GHG emissions

While Section 2 addresses fields of action at all levels, the following section deals with those measures that make a significant contribution to reducing GHG emissions and energy consumption through appropriate transport planning, suitable road design and appropriate traffic management,

- reduce the volume of traffic,
- shifting motorised traffic to eco-mobility and/or
- reducing the specific effects of motorised transport, expressed in terms of energy and CO_2 emissions per passenger kilometre or tonne kilometre.

The following provides an initial overview of measures that are assigned to the design/operation and process/evaluation fields of action.

Fields of action process/evaluation

- Supra-regional/regional transport development plans and transport concepts,
- Coordination of transport measures across local authorities, such as
- Comprehensive car park management and comprehensive car park management,
- Preparation of integrated climate protection plans with quantitatively evaluable targets and binding measures to be implemented,
- Strategic network planning in freight transport in coordination with land use planning
- Preparation of integrated settlement structure development and transport development plans to promote short journeys and to strengthen public transport, cycling and walking,
- Presentation and evaluation of the climate impact and the effect with regard to the reduction of GHG emissions and the energy consumption of methods, processes, measures and transport services in the life cycle,
- Changed assessment methods with a high emphasis on the reduction of GHG emissions and energy consumption,
  - Changed assessment of travel time gains and travel time losses in motor vehicle traffic in relation to eco-mobility, possibilities here are, for exampleConsideration of journey time gains in motorised private transport only in the case of lost times due to congestion in the planned case compared to the actual case,

- Include travel time losses in MIT through optimised speed selection (goal: “steady traffic flow with reduced traffic performance or traffic volume and optimised speeds”) otherwise as positive effects in assessments,
- Gains in journey times for public transport and cycling are given a high weighting,
- Include journey time gains in pedestrian traffic (e.g. through the installation of crossing facilities) as positive effects in the assessment,

– Integrated and cross-modal assessment of the levels of service quality and
– quality levels and the quality levels of the traffic flow according to RIN/HBS,
– Raising awareness of behavioural change and responsibility, participation and public relations work,
– Integration of children’s interests in transport planning, gender aspects, barrier reduction,
– ...

Fields of action design/operation

– Establishment of an easily accessible charging infrastructure,
– Definition of target-orientated and adapted traffic volumes,
– Increasing access and departure times to and from parking bays (shifting on-street parking bays to connected areas and parking structures),
– Promotion of infrastructure for small vehicles (separate parking bay dimensions,
– separate parking zones),
– Promotion of the use of e-bikes and cargo bikes (separate bike parking facilities,
– conversion of car parks),
– Lower maximum permitted speeds and lower target journey speeds in the motorised private transport network with particular attention to public transport concerns,
– Road design to support the choice of steady and homogeneous speeds:
  - Preferential treatment of residential roads in development areas
  - (traffic-calmed areas),
  - Designs based on meeting zones, shared space on main roads,
  - Speed-reducing measures (partial pavements, offsets in close succession of 100 - 150 m,...),
  - Junctions with right-before-left regulations in development areas,
  - Mini roundabouts and small roundabouts,
  - Formation of sections with varying cross-sections,
  - Preference for narrow carriageway cross-sections,
– Proof of service and traffic quality (aim for: at best level D for motorised private transport,
– levels A to C in cycling and pedestrian traffic, consideration of lost times (not waiting times) in public transport),
– Traffic-dependent controls, network control, dynamic traffic management,
– inflow control,
– traffic flow control, liquefaction and guidance through traffic control systems,
– Promotion of eco-mobility (public transport, cycling and walking),
– Prioritisation of traffic subsystems in the following order: walking - cycling - public transport - moving motorised private transport - stationary traffic (prioritising traffic planning, prioritising road design and prioritising traffic management),
– Redistribution of space in favour of environmentally friendly modes and in favour of retention and green spaces as well as tree locations,
– Provision of sufficient and attractive spaces for environmentally friendly modes (e.g. abolition or prevention of pavement parking in favour of usable pavement widths and recreational areas)
– Reliability, quality assurance and financing of public transport,
– Acceleration and prioritisation of public transport (road organisation and traffic management measures, dynamic road space clearance or spatially protected lanes for public transport as well as traffic light priority),
– Strengthening express bus services, local rail passenger transport and long-distance public transport and linking them with inner-city networks,
– Promotion of sharing concepts and multimodal offers,

- Replacing travelling with virtual mobility (home office, video conferencing),
- Changing transport options (e.g. by reducing lanes)
- Reduction in travelling times to and from stops,
- Reduction in the number of changes and transfer times in public transport (direct connections, as well as frequency of journeys and optimisation of connections),
- Fast cycle connections and cycle priority routes,
- Number and easily accessible location of cycle parking facilities,
- Premium routes for pedestrians with good accessibility,
- Short waiting times for cyclists and pedestrians at crossings with traffic lights, installation of crossing facilities,
- Attractive urban design, recreational areas,
- Urban logistics with small-scale micro-transhipment through to rail freight transport,
- ...

In addition, other fields of action should be listed that can also make positive contributions to reducing GHG emissions or dealing with the consequences of climate change or climate adaptation.

3.2 Relevant FGSV publications and their application for achieving climate protection targets

Numerous FGSV publications contain specifications, standard cases, options for action and information on the measures listed. In order to comply with climate protection targets, those FGSV publications of the Traffic Planning, Road Design and Traffic Management working groups that are climate-relevant and are discussed in individual fact sheets (an Appendix A is available at fgsv.de only for the German edition in German language) should be used in particular.

These fact sheets - which have been agreed with the responsible bodies, among others - explain how the respective FGSV publications

- already currently,
- with additional application notes or
- with modified specifications and standards, which are described in the fact sheets and which will take up or lead to further developments of the publication in the form of correction sheets and revisions,

can contribute to reducing GHG emissions and final energy consumption.

4. Technical regulations, laws and literature

Technical regulations, laws

FGSV	BBSV	Definitions for roads and transport (FGSV 005/1)	1)
	EAM	Recommendations for the application of mobility management (FGSV 167)	1)
	EAÖ	Recommendations for local Public Transport Installations (FGSV 289)	1)
	EAR	Recommendations for resting traffic installations (FGSV 283)	1)
	ELA	Recommendations for the landscaping designs in road building with the sample cards for the standard design of landscaping execution plans in road building (sample cards LAP) (FGSV 2932)	1)
	ERA	Recommendations for Cycle Traffic Installations (FGSV 284)	1)
	ERS	Recommendations for for Service Areas on Roads (FGSV 222)	1)
	EVE	Recommendations for Traffic Surveys, 2012 (R 2), (FGSV 125)	1)
	EVP	Recommendations for transport planning processes (FGSV 116)	1)
	H BVA	Notes for barrier-free traffic systems (FGSV 212)	1)
	HBS	German Highway Capacity Manual, 2015 (R 1) (FGSV 299)	1)
	H Fahrrad-parken	Information about bicycle parking (FGSV 239)	1)
	H KRipoo	Notes on parameters for describing and evaluating ridepooling systems (FGSV 170/1)	1)
	H RS	Notes of coach parking in cities (FGSV 283/1)	1)
	H VwG	Information on measures for a turnaround in freight transport (FGSV 171)	1)
	RAA	Guidelines for the Design of Motorways, 2008 (FGSV 202)	1)
	RAL	Guidelines for the Design of Rural Roads, 2012 (FGSV 201)	1)
	RASt	Directives for the Design of Urban Roads, 2006 (FGSV 200)	1)
	RBSV	Standard vehicles and tractrix curves for checking of the traversability of traffic areas (FGSV 287)	1)
	RiLSA	Guidelines for Traffic Signals –Traffic Lights for Road Traffic (FGSV 321 S)	1)
	RIN	Guidelines for Integrated Network Design (FGSV 121)	1)
	RSAS	Guidelines for Road Safety Audits, 2019 (R 1) (FGSV 298)	1)
BMDV	MiD	Mobility in Germany, results report, Berlin 2020	2)
EU	EU-Verordnung	Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30. June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ("European Climate Law")	3)
BGBl .	EmoG	Electromobility Act - Act on the Prioritization of the Use of Electrically Powered Vehicles	4)
	GVFG	Municipal Transport Financing Act - Act on Federal Financial Aid for the Improvement of Transport Conditions in Municipalities	4)
	StVO	Federal Government to improve traffic conditions in municipalities Road Traffic Regulations	4)
	KSG	Federal Climate Protection Act of 12 . December 2019 (BGBl . I p . 2513)	4)
		First Act amending the Federal Climate Protection Act of 18 . August 2021 (BGBl . I p . 3905)	4)
Min Ba-Wü		A climate protection scenario for Baden-Württemberg, transport infrastructure 2030, Stuttgart 2017	5)
		Sustainable mobility in Baden-Württemberg: Scientific support for a climate protection scenario in transport, development of instruments and measures, Stuttgart 2017	5)
UBA		Estimation of the greenhouse gas reduction effect of the German government's 2030 climate protection program, Berlin 2020	6)

UBA		National Inventory Report on the German Greenhouse Gas Inventory 1990 - 2018, Berlin 2020	6)
		Climate protection instruments in transport, building blocks for climate-friendly transport, status 25 . March 2022, Berlin 2022	6)
		National trend tables in the definition of the sectors of the Climate Protection Act (KSG); web database https://www .umweltbundesamt.de/themen/klimaenergie/ treibhausgasemissionen; as at 15 .03 .2022; accessed on 22 .03 .2022	6)
Infras	HBEFA	Manual for Emission Factors for Road Traffic, Version 4 .1	7)

Literature

Agora 2020a: Agora Energiewende/Agora Verkehrswende/Stiftung Klimaneutralität: Klimaneutrales Deutschland 2045, Wie Deutschland seine Klimaziele schon vor 2050 erreichen kann, Berlin 2020

Agora 2020b: Agora Verkehrswende: Liefern ohne Lasten. Wie Kommunen und Logistikwirtschaft den städtischen Güterverkehr zukunftsfähig gestalten können, Berlin 2020

Ariadne 2021: Potsdam-Institut für Klimafolgenforschung (PIK), Kopernikus-Projekt Ariadne: Ariadne-Analyse – Klimaschutz und Verkehr: Zielerreichung nur mit unbequemen Maßnahmen möglich, Potsdam 2021

BMVI 2019: infas, DLR, IVT und infas 360: Mobilität in Deutschland (im Auftrag des BMVI)

Bundestag 2021: Bundes-Klimaschutzgesetz vom 12. Dezember 2019 (BGBl. I S. 2513), das durch Artikel 1 des Gesetzes vom 18. August 2021 (BGBl. I S. 3905) geändert worden ist

Bundesregierung 2021a: Deutsche Nachhaltigkeitsstrategie, Weiterentwicklung 2021, Kabinettbeschluss vom 10. März 2021

Bundesregierung 2021b: Öko-Institut; Fraunhofer ISI; IREES GmbH; Thünen-Institut: Projektionsbericht 2021 für Deutschland, Berlin/Karlsruhe/Braunschweig 2021

BVerfG 2021: Bundesverfassungsgericht, Beschluss des Ersten Senats vom 24. März 2021 – 1 BvR 2656/18 –, Rn. 1-270, Karlsruhe 2021

EU 2020: Europäische Kommission: Anhänge der Mitteilung der Kommission. Arbeitsprogramm der Kommission für 2021. Eine vitale Union in einer fragilen Welt. Brüssel 2020

NPM 2021: Nationale Plattform Zukunft der Mobilität, Arbeitsgruppe 1 „Klimaschutz im Verkehr“: Wege für mehr Klimaschutz im Verkehr, Berlin 2021

VDV 2021: Roland Berger/Intraplan/Florenus im Auftrag des VDV: Verkehrswende gestalten – Gutachten über die Finanzierung von Leistungskosten der öffentlichen Mobilität. Notwendige Leistungssteigerung im ÖPNV zur Erreichung des Klimaziels, Köln 2021

Reference sources

1) **FGSV Verlag GmbH (Publishing House of FGSV)**
Wesselinger Str. 15-17, D-50999 Köln
Tel.: +49 (0) 22 36 / 38 46 30
info@fgsv-verlag.de; www.fgsv-verlag.de

2) **www.mobilitaet-in-deutschland.de/publikationen2017**

3) **Federal Law Gazette**
www.gesetze-im-internet.de; www.bgbl.de

4) **Official Journal of the European Unionwww.eur-lex.europa.eu**

5) **Ministry of Transport Baden-Wurttemberg (Min Ba-Wü)**
vm.baden-wuerttemberg.de

6) **Federal Environment Agency (UBA)**
www.umweltbundesamt.de

7) **INFRAS**
Binzstrasse 23, CH-8045 Zürich
www.hbefa.net; www.infras.ch

Remarks on the system of technical publications of the FGSV

R stands for regulations:

These publications either specify the technical design or realization (R1) or give recommendations on the technical design or realization (R2).

W stands for information documents:

These publications represent the current state-of-the-art knowledge and define how a technical issue shall be practicably dealt with or has already been successfully dealt with.

Category R1 indicates 1st category regulations:

R1-publications contain the contractual basis (Additional Technical Conditions of Contract and Directives, Technical Delivery Forms and Technical Testing Regulations) as well as guidelines. They are always coordinated within the FGSV. R1-publications – in particular if agreed on as integral part of the contract – have a high binding force.

Category R2 indicates 2nd category regulations:

R2-publications contain information sheets and recommendations. They are always coordinated within the FGSV. Their application as state-of-the-art technology is recommended by the FGSV.

Category W1 indicates 1st category documents of knowledge:

W1-publications contain notes. They are always coordinated within the FGSV but not with external parties. They represent current state-of-the-art knowledge within the respective responsible boards of the FGSV.

Category W2 indicates 2nd category documents of knowledge:

W2-publications contain working papers. These may include preliminary results, supplementary information and guidance. They are not coordinated within the FGSV and represent the conception of an individual board of the FGSV.

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