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Climate Protection in Transport: Need for Action in the Wake of the Paris Climate Agreement

Report as part of the project „Klimaschutzbeitrag des Verkehrs 2050“ (Climate Change Mitigation in Transport until 2050)

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CO_2	Carbon dioxide
COP	Conference of the Parties
EU-ETS	EU Emissions Trading Scheme
F-gases	Fluorinated greenhouse gases
FTIP	Federal Transport Infrastructure Plan
GHG	Greenhouse gas
HGV	Heavy goods vehicle
ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
KSBV	UBA-study ***K**lima**s**chutz**b**eitrag des **V**erkehrs bis 2050* [UBA, 2016a]
NDC	Nationally Determined Contributions (in Paris-Agreement)
NEDC	New European Driving Cycle
N_2O	Nitrous oxide (laughing gas)
PJ	Petajoule (energy measuring unit)
PtG	Power-to-Gas (any power-based gaseous fuels)
PtL	Power-to-Liquid (any power-based liquid fuels)
RDE	Real Driving Emissions
TWh	Terawatt hours (measuring units for energy)
UNFCCC	United Nations Framework Convention on Climate Change
WLTP	Worldwide Harmonized Light-Duty Vehicles Test Procedure

1 Summary

Transport is not only an indispensable part of our daily lives, but also one of the major sources of greenhouse gases in Germany. What can be done to reduce greenhouse gas emissions from transport in the short- and mid-term? How can transport become greenhouse gas-neutral in the long term? Are Germany's climate targets in the transport sector sufficiently ambitious?

This paper answers these questions. **It describes what needs to be done in the coming years to reconcile developments in the transport sector with the commitments of the Paris Climate Agreement and the German government's Climate Action Plan 2050.** It suggests measures that can help to achieve a quick and significant reduction in greenhouse gas emissions, ensuring that the climate targets agreed upon in Paris could be met by Germany's transport sector.

The Paris Agreement aims at limiting the rise of the earth's average temperature to well below 2°C. In the long term, only net zero emissions will be permitted. The implementation of the agreement poses enormous challenges for all signatory states, as the global carbon budget is extremely limited if the temperature target of 2°C is to be reached. Germany must reduce a major proportion of its emissions even before 2030. However, the immediate need for action is not adequately reflected in the targets set in the German Climate Action Plan or in the European framework for climate and energy policy. In other words – **Germany and the EU must significantly increase their efforts, and transport plays a part in it**.

When assessing the scenarios in the UBA-study *Klimaschutzbeitrag des Verkehrs bis 2050* (German abbr. KSBV; Climate Change Mitigation in Transport until 2050) [UBA, 2016a] it becomes clear that the most ambitious Climate Protection Scenario “E+” contains a broad array of policy measures that would come close to the transport target for 2030. However, looking at a realistic carbon budget that would meet the 2°C target, transport would still be responsible for almost 40% of all emissions across sectors. This would not leave enough leeway for other sectors to introduce realistic mitigation policies. Without rapid action in the transport sector, it will be almost impossible to adhere to the Paris Climate Agreement. This means that existing instruments must be enforced more strictly and new instruments must be introduced. To meet the temperature target of the Paris Agreement, more ambitious policies must be implemented in the transport sector, such as:

- **Stricter efficiency requirements for internal combustion engines,** introduced by significantly stricter fleet target values for 2025 and 2030 as well as realistic test cycles;
- **Electrification of road vehicles** by introducing a quota for electric vehicles in order to reach between 6 and 12 million electric vehicles on German roads;
- **Developing a sustainable transport infrastructure with clear price signals for all users:** Flexible distance-based road charging creates incentives for a climate-friendly use of transport, while an ecomobility system that attracts more users depends on an effective infrastructure, especially for railways and bicycles.
- **Phasing out of environmentally harmful subsidies**: This would free money that could be used for funding a transformation in the transport and energy sectors.

It is paramount when implementing the policy measures to focus on a rapid and comprehensive mitigation effect. We would like to emphasize that although the climate targets of the Paris Agreement are very ambitious, the instruments to achieve them are available, but they must be implemented immediately and consistently.

2 Introduction

The **Paris Agreement** of December 12th 2015 is considered to be a milestone in international climate protection. It is an agreement of the 195 member states of the United Nations Framework Convention on Climate Change (UNFCCC) and replaces the Kyoto Protocol. In the agreement, the signatory states declare for the first time that their common concrete target is to limit the increase of the mean global temperature **well below 2°C** compared to the pre-industrial age and if possible to 1.5°C. By the second half of the century, global greenhouse gas emissions should not be higher than the amount taken up and sequestered by biological and artificial sinks. Emissions would thus become **net zero emissions** [UNFCCC, 2015a].

The targets of the Paris Agreement were adopted by the German government and became part of their Climate Action Plan 2050. The Climate Action Plan also prescribes a **mitigation target for the transport sector**. According to the plan, the sector must reduce its emissions by 40 to 42% by 2030 compared to 1990 [Bundesregierung, 2016].

This paper is investigating whether the climate policy targets for 2050 and 2030 respectively are achievable and what conditions must be met. The evaluation is based on the Paris Agreement, the climate protection targets of the EU and insights from the UBA-study *Klimaschutzbeitrag des Verkehrs bis 2050* [UBA, 2016a]. The authors conclude from their review that action is needed and describe the options. The paper focuses on three key points:

- the current climate policy framework and targets set by the Paris Agreement and the German government's Climate Action Plan 2050.
- an evaluation of the climate protection scenarios in the UBA-study *Klimaschutzbeitrag des Verkehrs bis 2050* within this context, including the development of an action plan,
- pointing out necessary options for action that could be implemented in the short or mid-term.

3 The climate policy framework

Climate protection requirements and climate targets exist at various levels: in the United Nations Framework Convention on Climate Change (UNFCCC), the policy frameworks of the European Union and several plans and concepts by the German government. They all have in common that they want to achieve a significant reduction in greenhouse gases (GHG) to slow down global warming.

3.1 The Paris Agreement

In the Paris Agreement [UNFCCC, 2015a] of December 2015, all signatory states that ratified it recognised "the need for an effective and progressive response to the urgent threat of climate change" [UNFCCC, 2015b]. As climate change is a long-term and complex phenomenon that cannot simply be stopped, policy measures within the framework of the agreement include not only emission mitigation, but also steps towards adaptation to inevitable consequences of global warming. A special focus is on the needs of the least developed countries.

National or sectoral targets can be derived from the following:

- a global temperature target
- an invitation to the agreement parties to introduce self-imposed **nationally determined contributions** (NDCs)
- a procedure for reconciling the targets set in the NDCs with the global temperature goal and tightening them if necessary (**ratchet or ambition mechanism**)

Figure 1: Determining the global temperature goal and supporting sub-targets in the Paris Agreement

"... Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change ..." ([UNFCCC, 2015b], Artcle 2)

"... aim to reach global peaking of greenhouse gas emissions as soon as possible..." ([UNFCCC, 2015b], Article 4)

"... to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century..." ([UNFCCC, 2015b], Article 4)

Source: [UNFCCC, 2015a]

The Paris Agreement demands the redirection of finance flows towards climate-compatible investments and explicitly addresses non-governmental players. **Investments** should benefit the climate, facilitate adaptations to the consequences of climate change and protect the least developed countries. Climate protection cannot be delivered without governmental funding. It was therefore decided that from 2020, industrial countries will make $100 billion per annum available to developing countries for emission mitigation measures.

At the COP 22 Climate Conference in Marrakesh in November 2016, the agreement parties confirmed the Paris decisions and initiated steps towards the concrete implementation of the agreement. The centre piece for the implementation is the 'rule book', which lays down the implementation rules up to 2018 and makes targets and plans of participating nations more transparent and comparable.[1] In addition, 48 countries that have been particularly affected by climate change announced that they would abandon fossil energy and switch their energy supply to 100% renewables as soon as possible.

The NDCs – in particular the national emission mitigation plans – play an important role in achieving the climate goals in the Paris Agreement. They include two essential points – the temperature goal well below 2°C and a trend reversal (peaking of emissions) in the near future. Their time horizon is usually between 2025 and 2030. Germany is committed to the common NDC of the EU, which includes a GHG reduction by at least 40% compared to 1990 by 2030.

It depends on the individual countries how ambitious their NDCs are. **A ratchet or ambition mechanism has therefore been agreed between the countries and the UN Climate Secretariat, which scrutinises the NDCs at regular five-year intervals and tightens them if necessary.** National targets cannot be softened or loosened. It is hoped that this will help to close ambition gaps step by step. The mid-term goals laid down in the NDCs will be complemented by long-term strategies developed by the agreement parties, which aim at net zero emissions.

[1] http://www.wri.org/news/2016/11/statement-cop22-marrakech-climate-negotiators-agree-roadmap-2018 (last accessed on 24.04.2017)

It is now becoming clear that it is easy to call for ambitious climate policies, but difficult to implement them. According to the current UNFCCC report evaluating the effect of NDCs, global GHG emissions will not decrease with the current NDCs, but rise by 8 to 23% by 2030 compared to 2010. Compared with the roadmaps for a maximum temperature rise by 2°C, emissions would exceed the acceptable maximum by 26 to 59% in 2030. [UNFCCC, 2016].

3.2 EU climate targets for 2030

The climate targets of the EU are reflected in the common NDC with a time horizon until 2030. The NDC takes on board the three core targets of the European Climate and Energy Framework of 2014 – reduction of greenhouse gas emissions by 40% compared to 1990, an increase of the proportion of renewables in energy consumption to 27% and an increase in energy efficiency by 27% compared with projected data.

The emission mitigation target is further subdivided. Sectors that are part of the EU Emissions Trading System (EU-ETS) must lower their emissions by 43% compared to 2005. **Other sectors – including the transport sector – must reduce their emissions by 30% compared to 2005.** These commitments are divided into national contributions from member states as part of the 'Effort Sharing Regulation.' **The Effort Sharing Regulation proposal of July 2016 obliges Germany to reduce its greenhouse gas emissions in these sectors by 38% compared to 2005[2] levels by 2030. The transport sector in Germany will have to deliver reductions of a similar order.**

3.3 The German government's Climate Action Plan 2050

The Paris Agreement is the first to set the goal that in the second half of the century, nations should only generate net zero emissions. This would mean that the emission of greenhouse gases must be balanced by a corresponding amount sequestered in biological and artificial sinks. The countries are expected to work out long-term strategies. Germany was one of the first countries to present such a concept – its Climate Action Plan 2050 – at the COP 22 in Marrakesh.

The targets in the Climate Action Plan are based on the German government's energy concept of 2010. **By 2030, an overall GHG mitigation target of 55% and 80 to 95% by 2050** (compared to 1990) **have been set.** In addition, Germany intends to become largely greenhouse gas- neutral by 2050. The Climate Action Plan means progress in two aspects: mid-term targets for 2030 are set that seem to be achievable from today's perspective, thus putting pressure on policy makers and industry. The second important aspect of the Climate Action Plan is that requirements are sector-specific. **The transport sector, for instance, must lower its emissions by 40 to 42% (compared to 1990) by 2030.** In numerical terms, this means that the entire sector will only be allowed to emit 95 to 98 million tonnes of CO_2 equivalents per annum.

Similar to the Paris Agreement, the Climate Action Plan is also conceived as a process that involves regular evaluations and continued revisions of the mitigation targets. What has so far been missing is a catalogue of concrete measures, which will be worked out and submitted by 2018.

3.4 Reconciling the national mitigation targets with the temperature target

CO_2 is a long-lived greenhouse gas that has long-term effects. To achieve net zero emissions, **aggregated CO_2 emissions from today to the target horizon must be significantly reduced** [IPCC, 2014a]. The size of the global carbon budget depends on two factors – parameters related to the target temperature, i.e. the target figure and the likelihood to achieve the goal on the one hand, and the development and use of technology and methods that can stop excess greenhouse gases from being

[2] http://ec.europa.eu/clima/policies/effort/proposal_en (last accessed on 24/04/2017)

released into the atmosphere or extract them. These include the use of bioenergy in connection with carbon capture and storage.[3]

In contrast to earlier climate conferences, the Paris Agreement sets ambitious climate standards, but does not impose actual reduction obligations for individual countries. It is left to the partners of the agreement to set their NDCs and thus decide what contribution to emission mitigation they are willing to make or regard as adequate.

However, the question will remain relevant – how to evaluate individual NDCs in their scope and effectiveness. This paper uses the **budget approach** suggested by the German Advisory Council on Global Change (German abbr. WBGU). Although at the climate conference in Paris the budget approach did not play a part, it is considered to be a useful tool for distributing global emission shares to nation states.

The WBGU budget approach

How can global greenhouse gas emissions be measured, controlled and monitored over a long period? How are permissible emissions distributed among nation states? The German Advisory Council on Global Change (WBGU) suggested a budget approach in 2009. It is based on the idea that the maximum permitted amount of climate gases will be evenly distributed per capita of the world population. This results in national emission budgets that countries can manage autonomously (e.g. timetable flexibility or trading with emission certificates). The budget approach explicitly refers to long-lived greenhouse gases such as CO_2, N_2O and fluorinated greenhouse gases because they have a cumulative effect on the climate. Other substances that damage the climate, but are more rapidly degradable, such as methane, soot, nitrous oxide and steam should be considered separately.

The following parameters must be set to determine the budget:

- the global budget of still permissible emissions
- the demographic reference year for which the national share of permissible emissions is calculated (for instance, for Germany the middle of 2015, with 1.1% of the world population
- the start year that must be before the reference year. By setting the start year, climate gases emitted in the past can be taken into account.
- the maximum number of certificates a country can acquire. Because the overall goal of net zero emissions, there is only a limited number of certificates available.

Calculating the national budget on this basis, Germany would be allowed to emit between 3.9 and 12.2bn tonnes of CO_2 for the entire period between 2010 and 2050. The large bandwidth is the result of different assumptions (see Table 1). These calculations do not take into account large-scale use of technology for capturing and storing greenhouse gases.

[3] Extracting greenhouse gases from the atmosphere is required in many scenarios for achieving the temperature goals and particularly in those scenarios that want to limit global warming to 1.5°C. (see [Rogelj, et al., 2015], [IPCC, 2014b], [Climate Analytics, 2015], [UBA, 2014d]). However, a strategy that relies on the availability of large-scale technology to achieve negative emissions is a high-risk strategy (see [Germanwatch, 2016], [UBA, 2014d], [UBA, 2013b]).

Table 1: Emission budgets for Germany 2010-2050, based on the WBGU budget approach and the global budget

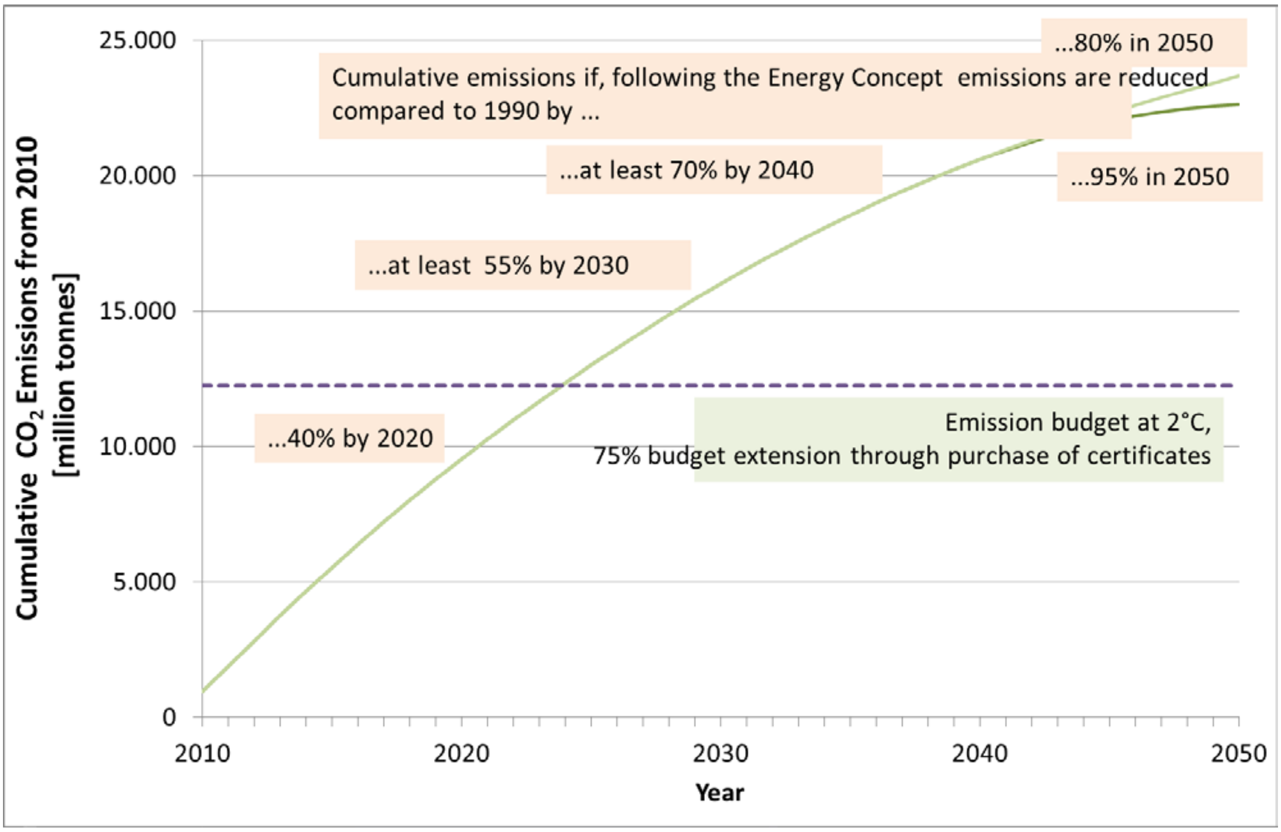
Use of emissions trading	0% Sales of certificates	75% Purchase of certificates (in analogy to assumption in [WBGU, 2009])
Maximum warming of 1.5°C, 50% probability of achievement	3.9bn t CO_2	6.8bn t CO_2
Maximum warming of 2°C, 66% probability of achievement	7.0bn t CO_2	12.2bn t CO_2

Source: [Rogelj, et al., 2015]

By comparison, in 2016, Germany emitted 796bn tonnes of CO_2[4]. Using the upper limit of permissible 12.2bn t CO_2 within 40 years, we calculate average annual emissions of 307bn t CO_2, which is 39% of current emissions. How ambitious it is to remain within the emission budget calculated using the WBGU approach is also illustrated in Figure 2. The budget is compared with Germany's cumulative emissions under the assumption that the targets of the Climate Action Plan 2050 will be met. The emissions are calculated under the assumption that the mid- to long-term mitigation targets of the Climate Action Plan 2050 will be met. The cumulative emissions are then compared with a budget that has been expanded by 75% through the purchase of certificates under the assumption that the global temperature rises by 2°C.

[4] https://www.umweltbundesamt.de/themen/klima-energie/treibhausgas-emissionen (last accessed on 24/04/2017)

Figure 2: Comparison of accumulated CO_2 emissions with the WBGU emissions budget under the assumption that the Climate Action Plan 2050 targets will be met.



Source: own calculations

In spite of the above assumption for the emissions budget, the CO_2 emissions exceed the budget by 77%. In other words: **If the objectives and statements of the Paris Agreement are to be taken seriously, Germany must contribute significantly more to climate protection.** Against this background, the suggested ratchet mechanism with regular tightening of national mitigation commitments is becoming ever more important for German and European climate policy.

It becomes clear that climate protection has become a matter of urgency that can no longer be postponed. If emissions are to be reduced significantly and effectively by 2050, policy makers and industry must focus more on mid-term goals. **Existing goals for 2030 and 2040 must be ratcheted up considerably if Germany is to make a meaningful contribution to climate protection.** Emissions should be reduced by 95% by 2050. This is an ambitious goal. Since some sectors of the economy are unable to avoid a proportion of their greenhouse gas emissions, other sectors – including transport – must become greenhouse gas-neutral by 2050 and reduce their emissions to zero (see box Residual emissions).

Residual emissions

Agriculture and some industrial sectors cannot reduce their emissions to zero because there is no technology available that would be economically viable and proportional to the benefit. Thus, in agriculture, methane and laughing gas will continue to be emitted. The study Germany in 2050 – a greenhouse gas-neutral country [UBA, 2014a] states that – **not including the transport sector** – such unavoidable emissions amount to an annual 60 million tonnes of CO_2- equivalents. This is roughly equivalent to 5% of GHG emissions of 1990. Therefore, if emissions were to be reduced by 95%, all other emissions would have to decrease to near zero.

Other difficult-to-avoid emissions in the **transport sector** include aviation emissions, which are not directly fuel-related, but nonetheless climate-relevant. They include nitrous oxides and steam. Their effect on the climate will persist as long as aircraft use hydrocarbon-based fuel. This additional climate effect from Germany's aviation was 29 million tonnes of CO_2-equivalents, trending upwards in recent years.

4 A roadmap towards greenhouse gas-neutral transport

The UBA-study *Klimaschutzbeitrag des Verkehrs bis 2050* sets out an ambitious, but realistic roadmap that would make transport in Germany almost greenhouse gas-neutral. The study pictures three scenarios that reflect different technological and traffic control developments, determining their effects on emissions and energy consumption (results see Table 2):

- The **Reference Scenario** is a continuation of current policies, focusing on efficiency-enhancing measures and the use of electromobility in cars and light commercial vehicles.
- The **climate protection scenario introduces additional measures for transport avoidance and modal shift.** This transformation of the transport sector (German *Verkehrswende*) is complemented by an energy transformation in the transport sector, i.e. complete switch to electromobility using renewable electricity and electricity-based power-to-liquid and power-to-gas fuels. Biofuels, however, will no longer be relevant in 2050.
- The **E+ scenario** is similar to the climate protection scenario, but introduces more energy-efficient hybrid trolley trucks alongside HGVs using PtL/PtG fuels. In addition, the proportion of electromobility and light commercial vehicles is higher.

A comparison of the three scenarios shows that ecological transport policy must be able to change direction at short notice and even E+, the most ambitious scenario to date, is no guarantee that all targets will be met. Climate protection in the transport sector poses new challenges for stakeholders, for instance by creating an increasing demand for renewable electricity.

Table 2: Summary of the most important results on GHG emission and final energy consumption in the transport's contribution to climate protection 2050 scenarios

	Reference	Climate Protection	Climate Protection E+
Direct greenhouse gas emissions in 2050 (million t CO_2-equivalents)			
- national transport (land transport following the territorial principle, aviation between German airports)	86.4	1.1	0.9
- total transport (incl. international aviation and fuel storage for marine transport)	130.9	1.4	1.3
Changes in greenhouse gas emissions from 1990 to 2050			
- national transport	-42%	-99%	-99%
- total transport	-22%	-99%	-99%
Cumulative direct CO_2 emissions 2010 to 2050 (billion t CO_2)			
- national transport	5.1	3.7	3.6
- total transport	6.8	4.8	4.7
Changes in final energy consumption 2005 to 2050			
absolute			
- national transport	-852PJ	-1,243 PJ	-1,311PJ
- total transport	-656PJ	-1,094PJ	-1,162PJ
relative			
- national transport	-36%	-53%	-55%
- total transport	-24%	-40%	-42%
Renewable electricity demand in transport in 2050 (PJ)			
direct use			
- national transport	216	179	284
- total transport	216	179	284
via electricity-derived fuel			
- national transport	54	2,654	2,202
- total transport	54	4,201	3,749
Total			
- national transport	270	2,833	2,486
- total transport	270	4,380	4,033

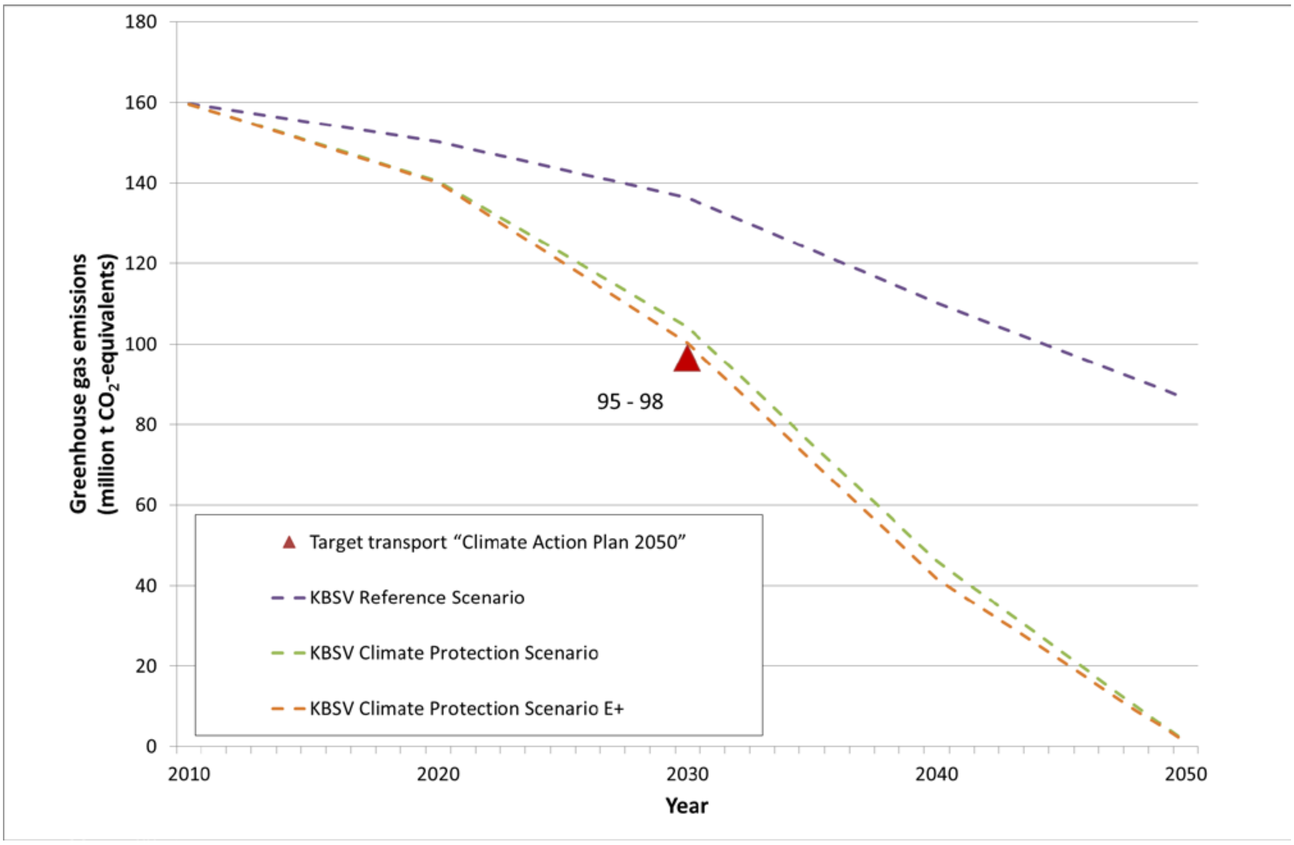
Source: [UBA, 2016a]

4.1 The greenhouse gas effect of the transport scenarios

The UBA-study *Klimaschutzbeitrag des Verkehrs bis 2050* comes to the conclusion that an almost **greenhouse gas-neutral national transport system would be feasible after 2050.** However, what matters for the contribution the transport sector can make is the speed of development and ambitious intermediary targets by 2030. The German government's Climate Action Plan 2050 calls for an annual reduction of 95 to 98 million tonnes of CO_2 maximum by 2030. A closer look at the three scenarios reveals that[5]:

- The Reference Scenario misses the 2030 target corridor of the German government's Climate Action Plan by a wide margin.
- The climate protection scenario misses the 2030 target corridor of the Climate Action Plan by 5 to 8 million t CO_2-equivalents.
- In spite of ambitious electrification, the climate protection scenario E+ still misses the 2030 target of the Climate Action Plan by 2 to 5 million t CO_2-equivalents

Figure 3: Target values for national transport and the trajectory of direct THG-emissions in the UBA-scenarios (national transport) from 2010 to 2050



Source: own calculations, based on [UBA, 2016a]

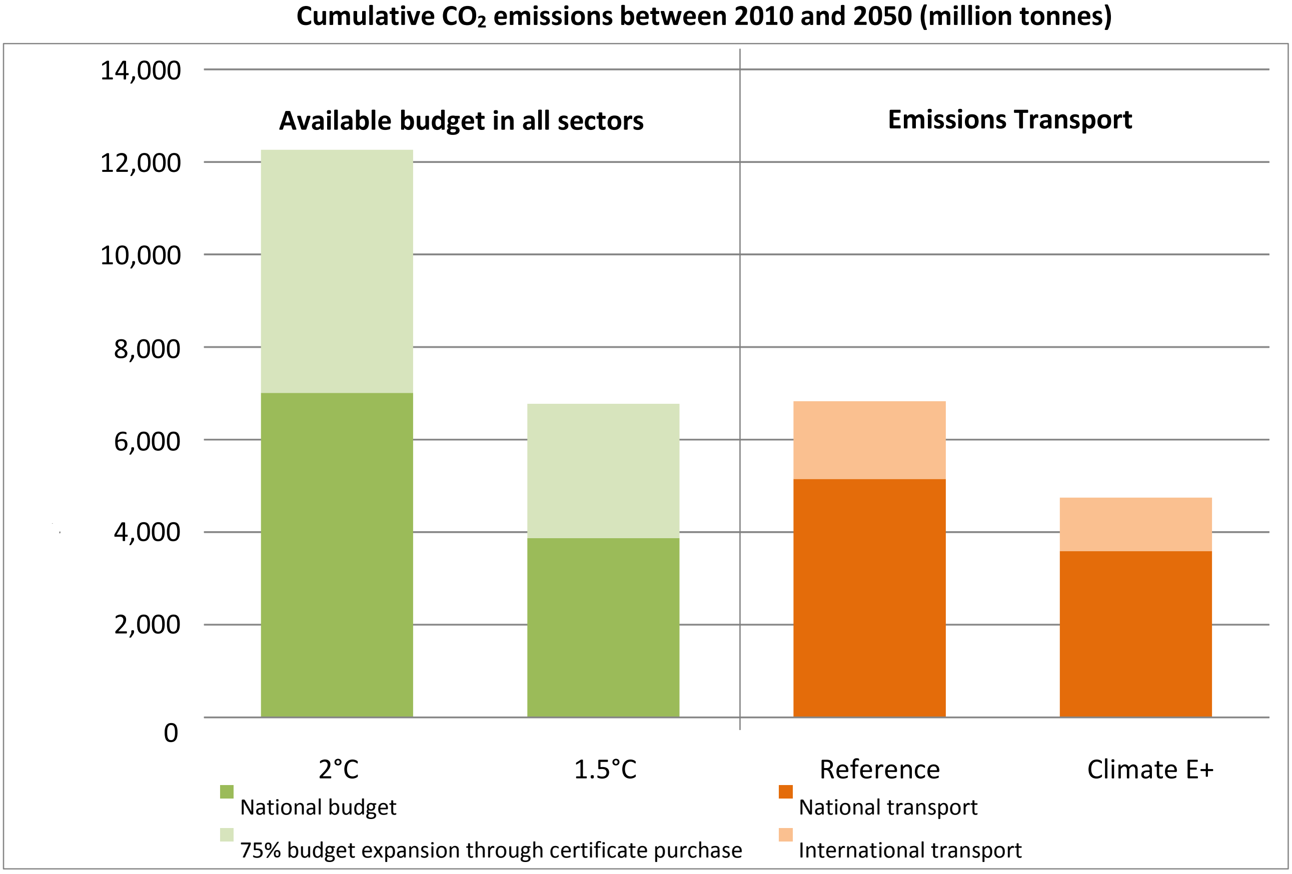
The results are even more striking if compared against the emission budgets based on WBGU. As the entire budget of globally still permissible emissions has been distributed over national emission

[5] Due to different definitions of transport in the Climate Action Plan 2050 and in the UBA-study Klimaschutzbeitrag des Verkehrs bis 2050, results are not entirely comparable.

budgets, proportional emissions from international transport must be added to national emissions. In this study, emissions from international transport are attributed via outgoing flights in aviation and the amount of fuel supplied by German sea ports for marine transport. If international transport is included in the evaluation, the results are even stronger.

- In the Reference Scenario, cumulative CO_2 emissions from all transport will reach 6.8bn tonnes, which is 56% of the overall permissible national budget for all sectors (and a temperature target of 2°C and 75% redeemed by certificate purchases).
- Climate Protection Scenario E+ will undercut the Reference Scenario by 2.1bn tonnes of CO_2 by 2050. However, this still leaves the transport sector spending almost 40% of the overall available budget. Of overall emissions to be spent between 2010 and 2050, 75% will have been emitted by 2030.

Figure 4: Side-by-side representation of the available national emission budgets for 2°C and 1.5°C temperature rises and calculated transport emissions for the 2010 to 2050 period.



Source: own calculations

We can clearly see that the **CO_2 emissions of the first two decades are the most significant**. Greenhouse gas emissions in transport must therefore be cut before 2030 to have an effect on the overall budget. The ambitious Climate Protection Scenario E+ is the best available roadmap for achieving the transport target laid out in the Climate Action Plan 2050. The key to success lies in a major decrease in final energy consumption in the transport sector and a switch to electromobility. Where direct use of electricity is not possible, power-based fuels should be used in the long term.

4.2 Energy consumption in the transport scenarios

The transformation of the energy supply in transport and the transformation of the transport sectors are closely linked. Both are ambitious long-term approaches that must be underpinned by concrete steps. There is also an obvious connection: **The more energy is used by the transport sector, the more expensive the transformation of the energy sector will become. One cannot be pursued without the other** [UBA, 2016a]. In its Energy Concept, the German government set the target of reducing final energy consumption by 10% by 2020 and by 40% by 2050 compared to 2005 [Bundesregierung, 2010].

In the scenarios of the UBA-study *Klimaschutzbeitrag des Verkehrs bis 2050,* mitigation will be achieved by a reduction of final energy consumption through enhanced efficiency, shifting transport from roads to ecomobility, rail or ships, better exploitation of capacities and comprehensive electromobility. Alongside a reduction in final energy consumption, switching to electromobility and the use of power-based fuels are decisive tools to achieve long-term greenhouse gas neutrality in the transport sector (see box 'Where next for biofuels?').

Where next for biofuels?

Scientists, policy makers and society have come to see biofuels in a very critical light. In coming decades, the legal framework must be reformed, not least because current EU Directives (2009/28/EC and 98/70/EC) will expire by 2020. The EU Commission has the political will to terminate the scheme for generating biofuels from biomass crops (1st-generation biofuel crops). The schedule has not yet been decided upon. Biofuels of the 2nd and 3rd generation will become more important in the future. These include biodiesel from plant residues, ethanol from lignocellulose or synthetic fuels produced using the Fischer-Tropsch method.
Biofuels of the 2nd and 3rd generation can help to reduce emissions by 2030. However, their contribution will only be small, as there is only a limited quantity of advanced biofuels and the raw materials required for their production. Incentives in the EU Directive on petrol and diesel quality are not sufficient to encourage further investment and development.

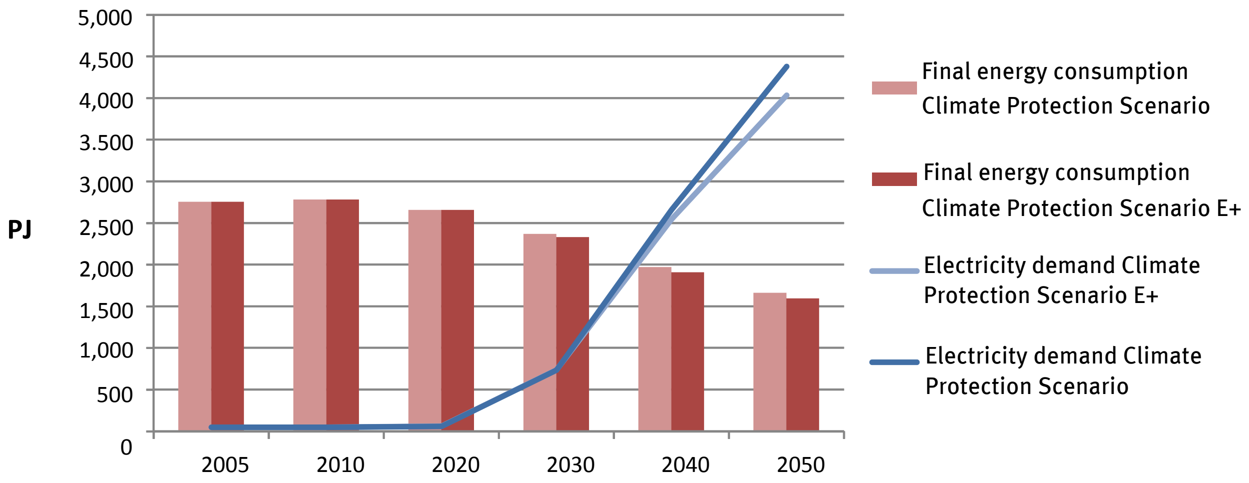
Power-based fuels are chemical energy vectors generated with the help of electricity. Any primary energy source, whether renewable or not, can be used for power generation, and, depending on the mix of these sources, the fuels can be climate-effective or not. They can only be climate-compatible if produced using exclusively renewable electricity.

The use of climate-neutral, power-based fuel requires two and a half to eight times the amount of electricity per vehicle-kilometre, compared to direct electricity use in electric vehicles, for instance. In aviation, however, as well as in marine transport and other areas, liquid or gaseous fuels cannot be replaced by battery storage in the foreseeable future because of their energy density. **There is no alternative to power-based fuels in achieving greenhouse gas-neutral transport,** leading to two main challenges: The required quantity of renewable electricity must be made available and production facilities for power-based fuels must be built.

The domestic potential for the generation of solar, wind and water power is limited and cannot meet the demand for fuel production. This is a matter of social acceptability as well as the economic viability of production sites. In the future, power-based liquid fuels could be produced more cost-effectively in other countries and imported into Germany. High sustainability standards must be set, for instance within an international framework of regulations that guarantees that power-based fuels are produced from 100% renewable energy and are ecologically sustainable and socially compatible.

The Climate Protection Scenario suggests that in 2050, demand for renewable electricity for the entire transport sector will be around 4,400 PJ (1,220 TWh), of which 1,550 PJ (430 TWh) will be for international transport. The E+ scenario with its advanced electrification further reduces demand for renewable electricity by 8% by 2050, compared to the Climate Protection Scenario (see Figure 5). Nevertheless, the transport transition is associated with huge challenges for the electricity sector, as demand from the transport sector will significantly increase Germany's demand for electricity and require major investment.

Figure 5: Development of final energy consumption and electricity demand for the entire transport sector in the Climate Protection and Climate Protection Scenarios E+



Source: [UBA, 2016a]

With regard to the **Climate Action Plan targets for 2030,** results for **national transport** reveal the following:

- In the Climate Protection Scenario E+, greenhouse gas emissions of the transport sector will fall to 100 million tonnes by 2030 – supposing that by then, six million electric cars and light commercial vehicles are part of the fleet and an additional 10% of fuels are power-derived.
- A 10% proportion of power-based fuels by 2030 reduces greenhouse gas emissions from national transport by approximately 11 million tonnes, but also increases demand for renewable electricity by 400 PJ, which is hardly achievable by 2030 from today's perspective [UBA, 2016b]. Alternative strategies are called for.
- In order to achieve the same reduction in greenhouse gas emissions, the electric vehicle fleet would have to be doubled from 6 to 12 million vehicles by 2030. This would also reduce demand for renewable electricity significantly by approximately 50 PJ.

It becomes clear that the mitigation targets of the Climate Action Plan require enormous efforts before 2030. As power-based fuels from renewable electricity will not be available in the quantities required, alternative strategies must be pursued. One promising strategy would be to encourage the electrification of the vehicle fleet with the aim of doubling the fleet from 6 to 12 million by 2030.

4.3 Transport and energy transition go hand in hand

The ambitious Climate Protection Scenario E+ provides a good template for more climate protection in the transport sector for the period until 2050. However, in view of the current targets, strategies must be revised to achieve a significant reduction of greenhouse gas emissions before 2030.

As has been demonstrated, GHG emissions from national transport can be reduced to 95 to 98 million tonnes by 2030, as the German government's Climate Action Plan stipulates if the following conditions are fulfilled:

- immediate measures are taken to shift and avoid traffic, which could reduce final energy consumption and greenhouse gas emissions by 15% compared to the Reference Scenario (cf. [UBA, 2016a], p. 162 et seq.),
- at least 12 million electric cars and light commercial vehicles are part of the fleet by 2030 and
- all measures suggested in the scenario to enhance energy efficiency are implemented.

Even these goals can only be achieved if efforts exceed existing planning considerably. And yet the targets set out in the German Climate Action Plan 2050 are just first steps towards effective climate protection. **More substantial efforts are needed if the global temperature goal of well below 2°C – as stated in the Paris Agreement – is to be achieved. In order to remain within the emissions budget, it will be necessary to take additional steps, while also implementing already planned measures more rapidly and vigorously.** Possible options for action are suggested in Chapter 5.

5 Options for action to mitigate transport emissions

The previous chapters showed that the temperature goal of the Paris Agreement requires a more rapid and drastic reduction of greenhouse gas emissions in Germany. This applies to all sectors, including the transport sector. All major transport policy decisions for the upcoming years must therefore be scrutinised for compatibility with the permissible emissions budget.

The most important action options for the reduction of GHG and final energy consumption in the coming years are[6]:

- further development of efficiency regulation in new vehicles,
- encouraging electromobility on the roads,
- further development of a sustainable infrastructure to enable shifting of transport to climate-friendly modes of transport and
- phasing out of environmentally damaging subsidies and
- introducing a distance-based road charge for all road vehicles.

These instruments are already part of the UBA-study *Klimaschutzbeitrag des Verkehrs bis 2050*[7]. In order to achieve the targets of the Climate Action Plan 2050 and the Paris Agreement requirements, these instruments must be implemented sooner and with more intensity. We will show in the following which parameters and instruments are suitable for ambitious climate protection within Germany (and the EU).

5.1 More efficiency for road vehicles

Enhancing energy efficiency in road vehicles reduces greenhouse gas emissions and energy consumption. Efficiency enhancement is very important in vehicles with internal combustion engines, as these will remain the dominant energy users in the transport sector in the short- to mid-term (at least until 2030). In the long term, vehicles with alternative engines will benefit from ambitious efficiency

[6] Developing the infrastructure for power-derived fuels is a matter for the energy sector and will not be discussed here.

[7] The scenarios in *Klimaschutzbeitrag des Verkehrs 2050* are not quantified using the effectiveness of measures, but rather the potential of certain technologies or best-practice implementations. In a second step, possible measures to exploit these potentials are shown, but no concrete steps for implementation, timeline and intensity of the measures are fed back into the scenario.

management because many measures that increase efficiency work for any engine type. The main body that will shape the regulatory framework for the energy efficiency of new vehicles is the European Union (EU).

5.1.1 Cars and light commercial vehicles

The mandatory EU fleet target values for cars and light commercial vehicles are a crucial instrument for efficiency regulation. A target value of 130 g CO_2/km for new cars came into force in 2015. From 2020, a new target value of 95 g CO_2/km will be introduced that will be valid for all new registrations from 2021. Battery-only electric vehicles are allocated 0 g CO_2/km and (until 2022) multiple weighted [EU, 2014]. The target value for light commercial vehicles is 175 g CO_2/km from 2017 and 147 g CO_2/km from 2020.

At the moment, the fleet target values are there to help to reduce CO_2 emissions from vehicles with internal combustion engines. However, their practical effectiveness is limited, as the requirements refer to CO_2 emissions measured during the type approval procedure. **Real consumption and actual emissions on the road are on average much higher than in the test setting.** In 2015, the discrepancy between standard fuel consumption (measured using the current New European Driving Cycle (NEDC) test system) and real consumption was about 42% [ICCT, 2016a]. **We can therefore conclude that CO_2 emissions from new cars were not reduced at all and regulatory efforts to enhance efficiency were largely ineffective.**

From September 2017 at the latest, new models are tested with the more realistic WLTP (Worldwide Harmonized Light Duty Test Procedure). To comply with the CO_2 fleet target values the new values must still converted into NEDC values, and only from 2020 will fleet target values be exclusively determined using WTLP. Until then, a conversion factor must be decided upon.[8] In its analytic report on the EU's policy options, the ICCT (International Council on Clean Transportation) [ICCT, 2016b] uses a conversion factor of 1.15, resulting in a target value of 109 g CO_2/km for 2021. As the new test cycle reduces the gap between virtual and real energy consumption, but does not close it, the ICCT projection gives 134g CO_2/km as actual emissions [ICCT, 2016b]. This may be above the 2015 threshold, but according to ICCT, this is the best-case scenario for what can be achieved by 2021.

As a result of recent experience, **highly ambitious fleet target values should be set on the basis of realistic test cycles.** Switching to the WLTP cycle is a first step. In addition, the maximum discrepancy between test stand and road emission results must be defined. **In the long term, tests must be developed further and markets monitored to ensure that regulated emissions correspond to real emissions on the road.**

Within the current regulation framework, including electric vehicles in the fleet target value calculations leaves leeway for cars with higher emissions from internal combustion engine. This is an incentive for manufacturers to include as many electric vehicles as possible in their fleet. At this stage where the market is just beginning to take off, this is a politically desired effect. However, registration figures reveal that the incentive has so far had very little effect. It is also true that rising numbers of electric vehicles will soften efficiency regulations for vehicles with internal combustion engines. The ICCT suggests therefore to speed up the current slow efficiency development by introducing car target values of 78 g CO_2/km by 2025 and 48 g CO_2/km by 2030 [ICCT, 2016b] within the WLTP system.

If the Climate Action Plan 2050 target is to be reached without the large-scale use of power-based fuels, more than half of new car registrations must be electric vehicles by 2030. The suggested target

[8] https://www.vda.de/de/themen/umwelt-und-klima/abgasemissionen/wltp-weltweit-harmonisierter-zyklus-fuer-leichte-fahrzeuge.html (last accessed on 19/04/17).

values would have to be made much more stringent to have an effect on combustion vehicles. Vehicles with combustion engines could be far more economical than they are today. The potential for reducing specific energy consumption in conventional vehicles, including hybrids, is close to 50% [JEC, 2013]. **Ambitious CO_2 target values must therefore separate regulations for electrification from those for efficiency enhancement to fully exploit the available potential.**

Tightening up standards only makes sense if there is sufficient notice given for manufacturers to develop and adapt engines and vehicles (e.g. a model generation period of seven years). Such an ambitious regulation framework must therefore be defined immediately for 2025. A further tightening of regulations for 2030 should follow within five years.

Energy efficiency regulations – i.e. electricity consumption in electric vehicles – will be required once electric and hydrogen-powered vehicles have reached a significant market share. In the midterm, this would create a foundation for efficiency increases in alternative drive systems (e.g. see UBA-study *Konzept zur zukünftigen Beurteilung der Effizienz von Kraftfahrzeugen* (Concept for the future evaluation of efficiency in cars) [Jöhrens/Helms, 2013]).

5.1.2 Heavy goods vehicles (HGVs)

The technical potential for reducing the greenhouse gas emissions of HGVs is currently not nearly fully exploited. Many technologies for increasing efficiency have hardly been used so far, although they are available on the market and offer comparatively cost-effective mitigation options [ifeu/TU Graz, 2015].

At the heart of measures to reduce GHG emissions in heavy goods traffic is the introduction of EU-wide, legally binding standards for efficiency or CO_2 emissions. Such legislation already exists in countries such as the USA, China, Japan and Canada, while the EU only took first steps in the summer of 2016. Many unanswered questions remain about the practicalities of the regulation. Within the context of the current debate, encouraging alternative drive systems in the heavy goods sector is hardly on the agenda.

The introduction of CO_2 monitoring is now being planned at EU level, which could become the basis for the introduction of CO_2 target values. As HGVs consist of modular units, monitoring uses a combination of tests of consumption-relevant components and HGV simulation. Monitoring is expected to start in 2018 [Savvidis, 2015], while first CO_2 target values could be in force by 2020 at the earliest.

The following unanswered questions should be clarified:

- what kind of regulation should be used, e.g. regulatory parameters and reference values, fleet average values or maximum limit values,
- how high should the limit values be set,
- how vehicles and their uses should be classified,
- how vehicle components should be assessed (e.g. semi-trailers, trailers and truck bodies, auxiliary units, tyres) and
- how alternative drive systems should be handled.

These questions are discussed in more detail within the UBA project *Entwicklung und Bewertung von Maßnahmen zur Verminderung von CO_2 emissionen von schweren Nutzfahrzeugen* (Development and evaluation of measures to reduce CO_2 emissions in HGVs). The objective is to find a compromise that accommodates ambitious limit values, wide acceptability and low-admin and low-cost solutions.

The regulation may use final energy consumption or CO_2 emissions as monitoring parameter. Transport performance is recommended as reference value. Assumptions for typical loads for different vehicle classes must be agreed upon. In analogy to the suggestion for cars and light commercial vehicles, electrification and efficiency enhancement should be regulated separately. Setting a CO_2

fleet target value for HGVs with internal combustion engines or similar energy efficiency requirements could increase efficiency by 30% by 2030 (compared to new vehicles in 2015) [UBA, 2016c].

5.2 Encouraging electromobility

Direct use of electricity has major efficiency benefits and is therefore the preferred technology option. This would apply in particular to cars and light commercial vehicles, which were responsible for over 70% of direct CO_2 emissions in road traffic. Technical hurdles are higher for HGVs, but electrification is the way forward here, too.

5.2.1 Cars and light commercial vehicles

The share of electrical vehicles in the fleet is still low, and to reach the transport target set in the Climate Action Plan 2050 without large-scale use of power-based fuels, this share must be raised to 12 million electric vehicles by 2030. **Current instruments for encouraging electromobility have so far not been effective enough. In order to speed up market take-up, a quota could be introduced as an additional instrument.**

The basic idea is to set a fixed minimum share of newly registered cars every year, which must be CO_2 emission-free cars or externally chargeable hybrids (plug-in hybrids and electric vehicles with range extenders). The quota applies to all manufacturers. To achieve a share of 12 million electrical vehicles, the minimum shares of new registrations should be set as shown in.

Table 3: New registration quotas for electrical vehicles that would achieve a fleet enlargement to 12 million electrical vehicles by 2030

	2020	2025	2030
Minimum share electrical vehicles	3%	30%	70%

Source: own calculations

Manufacturers who do not meet the electric vehicle quota must pay a penalty. Flexibility could be added to the quota by introducing a system of tradeable certificates that could be exchanged between manufacturers. Such a system is used in California. Exemptions could be introduced for small manufacturers, similar to EU fleet target values.

An electric vehicle quota would have several advantages. If penalties are high enough, it would be highly probable that millions of electric vehicles would become part of the fleet in foreseeable future. However, it must be ensured that the low-emission vehicles will become part of the German fleet and not, for instance, sold on abroad under a traders' license. This could – as far as legally possible – be prevented by introducing a minimum registration period for newly acquired electrical vehicles. Generally, the quota is revenue-neutral for the state sector. It can also be combined with the existing subsidy for the purchase of electric cars to lighten the cost burden caused by the quota for manufacturers and buyers.

The implementation must ensure that despite the electric vehicle quota, efficiency requirements for combustion vehicles are not weakened.

5.2.2 Heavy goods vehicles

The electrification of the fast-growing road freight transport sector is not easy. Batteries for large HGVs would be too large and expensive, so electrification would only be possible using hybrid trolley trucks or other line systems. Hybrid trolley trucks are economical and efficient, but require an extensive national or, ideally, international overhead line infrastructure to operate [UBA, 2015b]. Further power-related options are fuel cell drives and the use of power-based fuels in internal combustion engines. For both electrification with overhead lines and power-based fuels, action must be taken quickly because without a contribution from the long-distance traffic sector to emission reduction, the reduction targets laid out in the scenarios cannot be reached.

In smaller commercial vehicles (up to 12t total permissible weight), the same technology as in cars and light commercial vehicles can be used. Buses, too, can be electrified with today's technology, which is highly recommended. These are transport niches where the climate protection potential could be safely achieved by introducing a registration quota combined with a subsidy for buyers – as for cars.

5.3 Building a sustainable transport infrastructure

The attractiveness and choice of transport largely depends on the available infrastructure. Adapting transport infrastructure is a prerequisite for a switch from the road to low-emission options.

There is usually a large time lag between planning and using infrastructure. Once tracks and roads have been built, they have a long-lasting effect on use and services. Building and extending transport infrastructure is cost-intensive and binds funding that is then no longer available for climate protection measures. Extending infrastructure can also lead to an increase in journeys and transport. The options for short-term responses to higher climate protection standards by building, expanding and modifying infrastructure are limited, and changes towards a greenhouse gas-neutral transport system must be made early.

The most important instrument the German government has is the Federal Transport Infrastructure Plan (FTIP), the basis for government investment into building new and expanding existing infrastructure, as well as maintenance and renewal for next 10 to 15 years. The current FTIP has a total volume of €270bn until 2030 (details in table 4).

Table 4: Investment according to FTIP 2030, divided into modes of transport and use

	Road	Rail	Waterways
FTIP 2030 investment			
Share total (absolute, in bn €)	132.8	112.3	24.5
Share total (relative)	*49.3%*	*41.6%*	*9.1%*
- of which new build and expansion (absolute, in bn €)	53.7	41.3	6.2
- of which new build and expansion (relative)	*40.4%*	*36.8%*	*25%*

Source: [BMVI, 2016a]

The FTIP 2030 [BMVI, 2016b] environmental audit reveals an emission abatement of 0.5 million tonnes of greenhouse gases per annum. The alternative scenario *Strengthening Rail and Waterways* suggested a significantly higher investment share of 70% for the development of rail and waterways, while a substantially lower share would go into motorways and trunk roads (30% instead of 59%). Had the FTIP 2030 investments been allocated according to this scenario, greenhouse gas emissions could have been reduced by 1 million tonnes, which would have been twice the actual reductions. A comparison with the analyses of the KSBV-study [UBA, 2016a] shows that **the greenhouse gas emission reduction to be achieved by FTIP 2030 is not sufficient to warranty sustainable infrastructure development in the transport sector.**

For the transport system to comply with climate policy target, the Federal Transport Infrastructure Plan must be underpinned by economic, governance and organisational measures that will have a steering effect on transport development. **The need for an integrated federal mobility plan is more urgent than ever. Such a plan would bring together all modes of transport** (road, rail, waterways and aviation) and the various infrastructure plans such as the Federal Transport Infrastructure Plan, the Aviation Concept, the National Port Concept or the Logistics Concept [UBA, 2014b]. It should contain long-term goals for the development of infrastructure and be compatible with the climate targets of the Paris Agreement. Citizens must become sufficiently involved in the planning. Strategic environmental assessment should be mandatory when developing a federal mobility plan for Germany.

While waiting for a fundamental realignment, the following guidelines for infrastructure planning should be observed:

- Existing transport routes should be maintained and modernised,
- the further development of rail network capacities must be prioritised and
- the motorway and trunk road network should not be developed much further.

Passenger rail transport should be expanded in compliance with *Deutschland-Takt* projects. In freight transport, measures are needed that will enhance the rail network's capacity, such as adapting the network to 740 metre-trains. In addition, the handling capacity for combined road-rail transport must be expanded and regional distribution centres supported [UBA, 2016e].

5.4 Phasing out environmentally damaging subsidies

Environmentally damaging subsidies are gifts of public money to companies and household that achieve very little in return and encourage environmentally damaging behaviour [UBA, 2017]. About half of all environmentally damaging subsidies – €28.6bn – went into the transport sector. The most expensive subsidies were the following:

- Nationally: an energy tax break for diesel fuel and the commuters‘ tax allowance in domestic transport,
- Internationally: exemption from energy tax for aviation fuel and exemption from VAT for international flights.

Environmentally damaging subsidies are counter-productive and must be phased out. At national level, this could happen almost immediately. Phasing out could be managed in a socially compatible manner and would create urgently needed financial scope to go ahead with the transformation of the energy and transport sector. A controlling system for the reform and removal of environmentally damaging subsidies must be established to ensure a systematic approach.

Two cases of environmentally damaging subsidies in the domestic transport sector will be looked at in more detail below – the **tax break for diesel fuel** and the **commuters‘ tax allowance.**

Diesel is currently taxed lower than petrol, although it has a higher energy content per litre and causes higher CO_2 emissions. The tax break was initially introduced to help road freight transport against international competition. This subsidy costs the taxpayer now approximately eight billion euros per annum, of which more than three and a half billion are paid for private cars [Deutscher Bundestag, 2017]. Even after subtracting the higher vehicle tax on diesel cars, there remains a subsidy of €1.5bn for diesel technology every year. From a climate protection perspective, it is not so much the high proportion of diesel vehicles, but the fact that vehicle tax does not depend on the actual consumption and mileage. Combined with low fuel costs, it tends to reward drivers that cause the highest greenhouse gas emissions due to their high mileage or their high fuel consumption.

Uniform taxation of fuels, based on their energy content and the resulting CO_2 emissions, would be by far the better solution (see Table 5). So as not to disadvantage diesel vehicles, vehicle tax must be reformed or abolished when an energy tax based on specific CO_2 is introduced. Focussing on a CO_2 tax would be a positive, targeted incentive to encourage more climate-friendly behaviour in motorists.

Table 5: Taxes for petrol and diesel, showing volume, energy and CO_2 emissions as well as lost revenue through diesel tax breaks

	Volume	Energy content	CO_2 emissions
Petrol	65.45€-Cent/l	2.03€-Cent/MJ	277.4€/t
Diesel	47.04€-Cent/l	1.32€-Cent/MJ	178.3€/t
Diesel in relation to petrol (petrol =100)	*72*	*65*	*64*
Lost revenue through tax breaks on diesel, 2015	€8bn	€11bn	€11bn

Source: [Deutscher Bundestag, 2017], own calculations

The **commuters‘ tax allowance** favours high-mileage drivers, as it lowers pre-tax income by 30 eurocents per kilometre of the distance between home and workplace (per working day), thus increasing commuters‘ traffic volume and promoting urban sprawl. Subsidies of €5.1bn [UBA, 2017] will result in an annual increase in emissions of 2.5 million tonnes of CO_2 by 2030 [UBA, 2008]. Furthermore, commuters‘ tax allowances are not a very efficient tool of social policy, as the tax break mostly benefits higher-income households [UBA, 2014c]. **The commuters‘ tax allowance should therefore be abolished.** Employees who have very high travel costs compared to their income could be helped by social hardship regulations and claim their travel costs as extraordinary expenses for their income tax.

Removing subsidies in international transport is much more difficult and needs a consensus between countries. Germany should therefore use its weight in international bodies such as the International Civil Aviation Organization (ICAO) or the International Maritime Organization (IMO) to remove subsidies (see Box Options for Action in International Transport).

Options for action in international transport

The **effect of aviation on the climate is not only determined by the carbon contained in aviation fuels, but also by nitrous oxides and steam arising from combustion**. When emitted at cruising altitude, they have a greenhouse gas-reinforcing effect, e.g. by causing additional cloud to form. From today’s perspective, aviation can therefore not be completely greenhouse gas-neutral and the net zero emissions target for the second half of this century is a major challenge for the industry. However, by optimising flight routes, switching to power-based fuels and shifting and avoiding flights, its damaging effect on the climate can be significantly reduced. Against this background, calls for a transformation of the transport sector are becoming more meaningful.

The International Civil Aviation Organisation (ICAO) targets and regulations are crucial for **international aviation**. In its Resolution A38-18, the ICAO set the target „CO_2-neutral growth from 2020“. In addition, a catalogue of measures was agreed upon, which includes technical efficiency improvements, operation improvements, sustainable alternative fuels and market-based measures such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) from 2021. However, if international aviation is to contribute commensurably to the achievement of the Paris Agreement targets, the ICAO targets must be tightened, and Germany should champion such tightening as much as possible.

The central international institution that sets environmental targets for **maritime transport** is the International Maritime Organization (IMO). So far, the IMO has not delivered a schedule for the achievement of climate targets or suggested measures to fulfil the Paris Agreement. Again, Germany should use its influence in maritime transport to speed up transformation in transport and energy. A large proportion of maritime transport – in particular large container ships – could contribute to the energy transformation by using power-based fuel. This could be encouraged, for instance, by the introduction of a quota system.

5.5 Distance-based road charging

Increased road funding by users not only helps finance transport infrastructure, but also contributes to climate protection. If users are charged according to the polluter-pays principle, diminishing revenue from the taxation of fossil fuels can be balanced out in the long term. **After all, more user-funded road pricing is an important impulse to achieve a lower-emission vehicle fleet and more climate-friendly user behaviour.**

Distance-based road charging would meet these requirements. Currently, Germany has road pricing for HGVs of over 7.5 tonnes of total permissible weight on motorways and trunk roads similar to motorways. Including cars, commercial vehicles under 7.5 tonnes of total permissible weight and long-distance coaches in the road pricing scheme and extending it to all roads would be a considerable contribution to emission abatement. This has been discussed in the UBA position paper *Maut für Deutschland: Jeder Kilometer zählt* (A road toll for Germany: Every kilometre counts) [UBA, 2015c]. Distance-based road charging would also be an ideal instrument for responding to the further development of climate targets.

5.5.1 Cars and light commercial vehicles

In order to make foreign road users share the burden of funding our roads, the German Ministry for Transport has decided to introduce a time-based road charge (vignette). However, this will not allocate costs to the actual polluters and not exploit the full potential of an effective mitigation measure.

To achieve more effective GHG abatement, the vignette must be developed further into distance-based road charging. Not only would the financial burden passed on to polluters, but it would also be a fairer system because frequent drivers pay more than occasional drivers. Further differentiation according to CO_2 emissions or energy consumption would encourage the switch to more energy-efficient vehicles or vehicles with alternative drives.

Several types of distance-based road charging are currently discussed. There are still questions to be answered on the parameters and cost of measuring and compatibility with data protection requirements. If travel and environmental costs were both fully included in the equation, road pricing for 2017 would cost between 6.5 eurocents/km (motorway/petrol cars) and 10.8 eurocents/km (diesel, federal trunk roads) [UBA, 2015c].

A political decision on the introduction of distance-based road charging should be taken immediately and implemented as soon as possible. It would provide policy makers with an instrument that would let them respond rapidly and flexibly to any tightened climate protection requirements in the transport sector.

5.5.2 Heavy goods vehicles and buses

Germany currently applies a road toll for all HGVs over 7.5 tonnes of total permissible weight on 12,900 km of motorway as well as 2,500 km heavily used federal trunk roads. The German government has decided to extend road pricing to all federal roads from 2018. Revenue from road pricing or 2016 is expected to amount to €4.63bn, while costs of raising the tax are approximately €1.09bn.[9] Road charge tariffs per km vary depending on types of axle and pollutant class.

In order to strengthen its contribution to greenhouse gas mitigation, road tolls for heavy goods vehicles must be reformed. Possible approaches include:

- Extending road pricing to long-distance buses and coaches as well as heavy goods vehicles from 3.5 tonnes of total permissible weight.
- Amending the EU Directive on Road Charging with the purpose of including GHG in the calculation of road toll tariffs.
- Staggering road pricing according to efficiency criteria to set incentive for increasing the efficiency of vehicles [BMUB, 2014].

At the moment, a proportion of the state's revenue is reimbursed to German haulage companies. These are subsidies for the purchase of new, low-emission HGVs, and, alongside pollutant-dependent road pricing, these could drive dynamic rejuvenation of the fleet. In future, the payment of such subsidies should be linked to particularly low CO_2 emissions in vehicles.

5.6 Weighing up the options

Consistent action is needed to achieve a comprehensive transformation of the transport and energy sector. As a first step, the true cost of transport must be established and environmentally friendly transport services must be created by increasing efficiency, electrification and encouraging ecomobility. This can only be achieved by leaving behind the status quo, where the purchase of electric vehicles is subsidised with €1bn until 2020, while diesel cars receive a tax break of one and a half billion euros per year (see Chapter 5.4).

Other countries demonstrate that it is possible to have a much more environmentally friendly transport system. Norway leads the way for electric cars, the Netherlands for cycling and Switzerland for the use of trains. These examples also clearly show that consistent action is needed over a long time. The measures discussed – in particular the electric car quota and the ambitious tightening of fleet target values – must be implemented as fast as possible if the 2030 target of the Climate Action Plan 2050 is to be reached. (see Table 6).

[9] http://www.vifg.de/de/kompetenzen/maut-finanzsteuerung/Mauteinnahmen-und-Mautverwendung.php (last accessed on 20.04.2017)

Table 6: Summary of main options for action and suggested Implementation Intensity by 2030

Measure	Regulatory Parameter	Implementation Intensity by 2030
CO_2 Fleet target value (cars)	Average CO_2 emissions of newly registered cars in operation, for conventional vehicles only; WLTP measurement with check under real driving conditions	Real consumption reduction of 20 to 30% compared to 2015
CO_2 Fleet target value– (heavy goods vehicles)	Average CO_2 emissions of newly registered HGVs in operation; mileage-related	Real consumption reduction of 20% compared to 2015
Electric car quota	Minimum share of vehicles with no direct CO_2 emissions and externally chargeable hybrids in annual registrations	Moving towards 12 million electric vehicles in the fleet by 2030: 2020: 3% 2025: 30% 2030: 70%
Federal mobility plan	Adapting the transport infrastructure to climate protection targets; further development of ecomobility	Implementation of Deutschland-Takt, 740-metre freight trains; doubling combined transport capacity
Phasing out environmentally damaging subsidies in transport	Linking diesel tax to CO_2 emissions, abolishing commuters' tax allowance	National environmentally damaging subsidies will be removed altogether
Distance-based road charging for cars, HGVs, long-distance buses and coaches	Introducing a fee per km for all users. Switching the transport system to a more user-funded system with internalisation of external costs	Including all users as well as all road costs and external costs

When current NDCs in the EU will be tightened in connection with the ratchet mechanism enshrined in the Paris Agreement (see Chapter 3.1), the suggested instruments must be adapted. When adapting these instruments, these may also need to be ratcheted up beyond the implementation intensities suggested here.

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