For our environment

Overall concept for an inclusive and ecological transport transition for erveryone

Policy Paper

prepared as part of the Refoplan project "Distributional effects of a transport transition (Verteilungswirkungen einer Verkehrswende – VERVE): Analysis of distributional effects of environmental policy instruments in the transport sector and an overall concept for an ecological and inclusive transport transition" (FKZ 3720 58 108 0)

1 Introduction

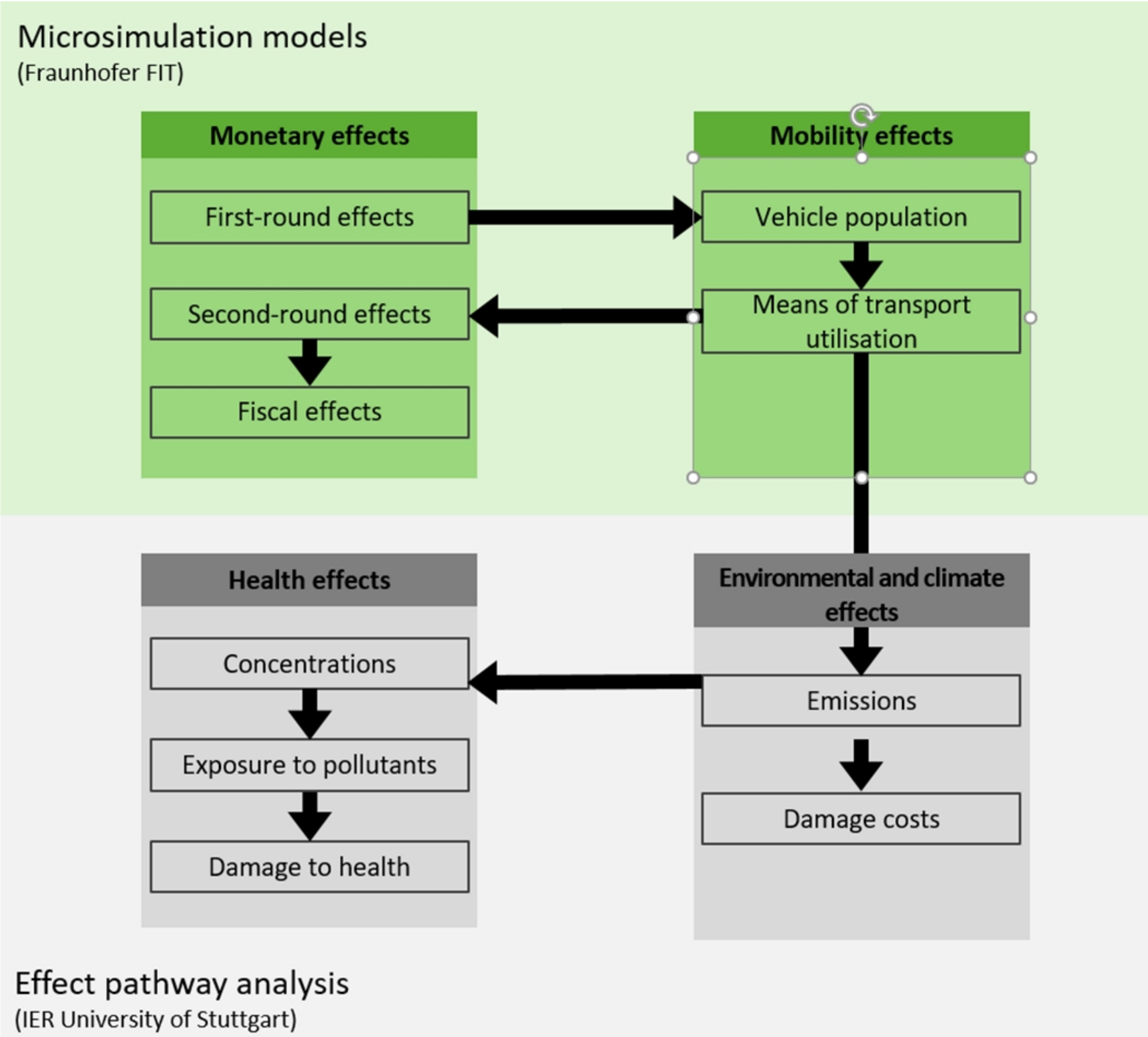
1.1 Task of the research project

The transport system in Germany has a considerable need for change in its social and ecological aspects. CO_2 emissions remain at a high level. Despite a reduction in per kilometre CO_2 emissions, total CO_2 emissions increased up to 2021 (German Environment Agency). This suggests that technically induced emission savings have been to some extent overcompensated. Other pollutants and traffic noise adversely affect the health of many people and ecosystems. Transport infrastructure contributes to land consumption and the fragmentation of natural habitats. At the same time, the existing transport system is often criticised with regard to social aspects. Key groups of people cannot access transport according to their mobility needs. The environmental impact of transport is unevenly distributed and the proposed measures for greening transport – for example by pricing CO_2 emissions – threaten to overburden those on low incomes

This is the background against which the German Environment Agency commissioned a research project as part of its departmental research. A project team consisting of employees from the Fraunhofer Institute for Applied Information Technology (FIT), the Policy Assessment Research Group at the Free University of Berlin (FU Berlin) and the Institute for Energy Economics and the Rational Use of Energy (IER) at the University of Stuttgart investigated the question of how the social and ecological goals of a transport transition can be combined. In other words, the project is tasked with analysing and designing environmental policy instruments aimed at making transport greener and taking distributional effects into account. At the centre of this analysis are distributional effects in a broad sense, i.e. the question of which social groups (defined by income, age, gender, occupational status, place of residence, mobility use and similar socio-demographic and socio-economic characteristics) are affected by the respective instrument and to what extent? The study analysed both the effects of the instrument in terms of differential costs and restrictions or the creation of mobility options (outcomes) as well as the subsequent effects of the instrument (impacts), e.g. mobility use, emission reductions and health effects.

In order to comprehensively understand and evaluate the distributional effects of an ecological transport transition, it is also necessary to consider previous distributional effects, since distributional effects are already created by the existing transport system. The project focusses on political instruments. The distributional effects arising from means of transport, mobility behaviour, infrastructure, etc. were only considered indirectly, i.e. as a result of policy instruments. However, policy instruments do not explain the transport system in its entirety. Essential components of socio-technical systems, such as the transport system, also include culture and routines, markets, technologies, etc. (Wolf et al. 2020). Moreover, key aspects are not decided at national level; the planning of transport infrastructures is largely the responsibility of the municipalities and federal states, and transport modes are largely regulated at European level, for example in the case of exhaust emission standards. However, the focus of the project was on the national level. Accordingly, there is a need for further research in order to assess the distributional effects of the transport system as a whole.

Figure 1: Schematic representation of the analysis structure



Source: Own illustration, Fraunhofer FIT

A schematic representation of the analysis structure used can be seen in Figure 1. Methodologically, mainly microsimulations were used that combine different data sources on households and their mobility behaviour. This model class is empirically robust and therefore requires comparatively few assumptions. However, especially for instruments that have not yet been introduced and for which no empirical data is available, assumptions must be made about the expected changes in behaviour. In addition, not all conceivable effects can be analysed with this family of models, rather it primarily covers those associated with income effects. Other effects, such as health effects, perception of safety, accessibility or other quality characteristics of passenger transport, were therefore quantified from supplementary modelling, e.g. from the environmental effects. If this was not possible, qualitative correlations were derived from the extensive body of research.

1.2 Objectives and conflicting goals of transport policy

The analysis describes the social effects of transport policy without evaluating them. Social objectives are strongly value-laden, e.g. when it comes to the question of whether equality should be an objective of policy. They are also a question of perspective, for example in relation to the question of whether additional labour demand is desirable; since creating more jobs may well exacerbate a shortage of skilled labour. Furthermore, how social goals can be achieved is a matter of debate, e.g. by further strengthening the performance of high earners so that tax revenue is generated or, conversely, by taxing high earners more heavily than before in order to achieve greater equality. Our basic understanding is that transport policy cannot causally address income differences. The aim is not to create equality or justice through transport policy, but to seek options for a socially acceptable transport policy. By this we mean a transport policy that is oriented towards the goals of social policy.

The primary objective of transport policy is to ensure that transport can fulfil its functions, i.e. to enable the exchange of goods and the mobility of people. This forms the basis for value creation and social participation. The flexibility of transport is an important criterion. In principle, everyone should be able to decide when and where they want to be mobile. Accordingly, the task of transport policy is to enable mobility by providing infrastructure, regulating its use and providing transport services. In addition, the externalities of transport need to be regulated, whether it is to minimise the dangers posed by traffic through traffic regulations and requirements for means of transport or, equally importantly, to limit the environmental impact.

Last but not least, the list of objectives of transport policy also includes enabling mobility for groups of people who have no access or only limited access to the use of cars, be it because of their age (children, senior citizens), their state of health or their income. Obviously, there are conflicts between these objectives. From an ecological perspective in particular, providing comprehensive and flexible mobility with the necessary infrastructure is challenging.

These conflicting goals cannot be resolved in a scientific project, as they are based on questions of values that must be negotiated in social and political discourse. However, science can reveal the extent of the conflicts between objectives and develop options to minimise them. A key finding of the project is that social and ecological conflicts of interest tend to be overestimated in public discourse. In addition, there are a large number of environmentally oriented instruments that can combine ecological and social objectives.

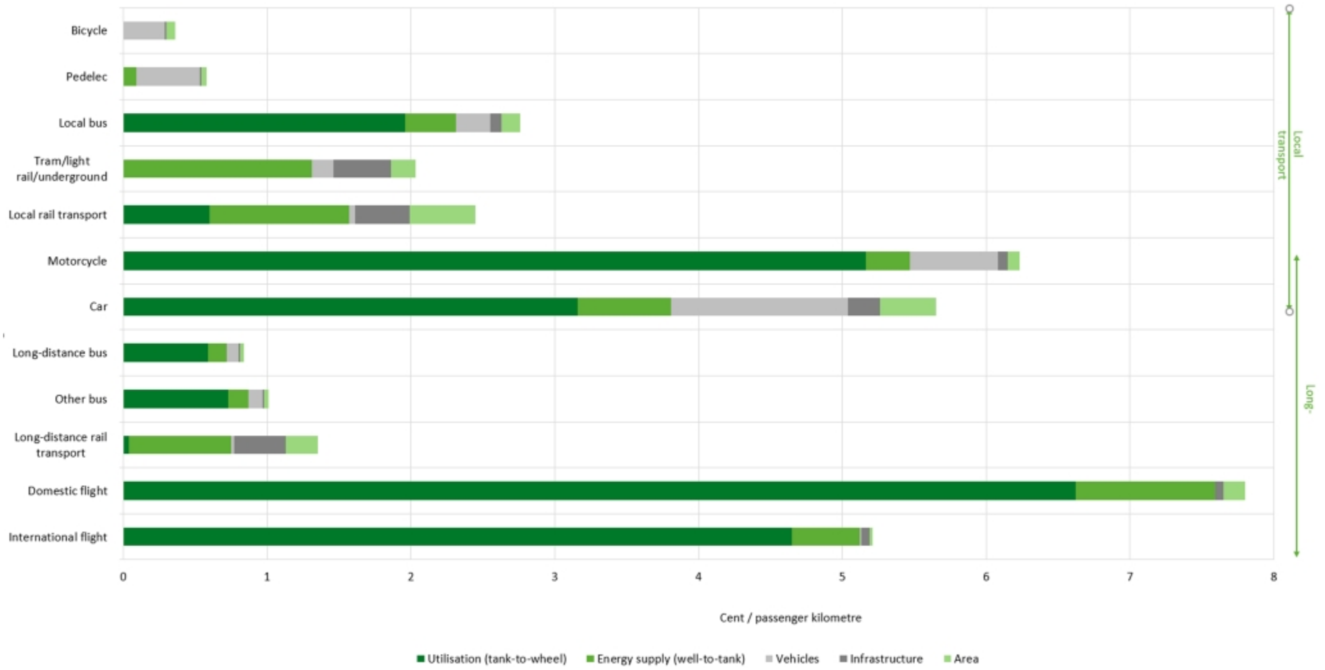
2 Effects of transport, transport systems and transport policy

Mobility is an essential part of life, whether it is travelling to work, visiting family or transporting goods. In order to fulfil the need for mobility, an appropriate means of transport must be chosen. In most cases, you can choose between different forms of transport, for example, the bike, the bus or the car. The key factors for this decision, however, are the availability of the forms of transport, the speed, the costs and the aspect of convenience (Allekotte et al. 2020a). In recent decades, the volume of traffic has increased significantly in terms of number and kilometres travelled (Allekotte et al. 2020a). The main reasons for this are the higher transport speed, increasing transport capacities and lower costs (Allekotte et al. 2020a). The social and economic benefits of this can be seen, for example, in a more flexible choice of workplace, more distant holiday destinations and a wider availability of goods at lower prices.

However, as explained at the beginning of this policy paper, transport in its current form also has significant environmental impacts. Allekotte et al. (2020b) provide a comprehensive overview of the environmental impacts of transport. Transport is associated with climate impacts and emissions of pollutants into the air, soil and water. Furthermore, transport infrastructure occupies land and fragments it. In addition, transport has an impact on health, be it through accidents, pollutants or noise. Transport services also require the use of energy and raw materials. This means that the entire life cycle of transport systems must be considered.

The environmental impacts occur spatially on all scales (local to global). Environmental impacts can be assessed in monetary terms and thus can be compared with the transport performance achieved. The different modes of transport can thus be compared in terms of the costs they incur (see Figure 2). The graph shows that domestic flights in Germany generate the highest environmental costs at almost 8 cents per passenger kilometre. This is followed by cars and motorbikes as well as international air travel at 5 to 6 cents per passenger kilometre. Rail transport, coaches, long-distance buses and local buses as well as cycling cause significantly lower environmental costs.

Figure 2: Aggregated environmental costs of transport



Source: Allekotte et al. (2020a).

This is also consistent with the comparative analysis of climate impacts in relation to transport performance (Allekotte et al. 2020b): Walking, cycling and local public transport are the most environmentally friendly modes of transport. In total, motorised individual transport (MIT) contributes to the largest share of transport performance and climate impact. In addition, MIT has a high share of local air pollution caused by nitrogen oxides and particulate matter, especially in places where there are many people, such as cities and residential areas. Furthermore, the space requirements of MIT fall into the upper mid-range of the comparison of transport modes (Allekotte et al. 2020a). The most environmentally damaging mode of transport is the aeroplane, with a disproportionately high climate impact relative to transport performance. While short-haul flights (typically flights within a country) have the highest climate impact from CO_2 emissions per passenger kilometre, the climate impact of other aircraft exhaust gases (nitrogen oxide, particulate matter and water vapour) increases proportionately over longer flight distances (Allekotte et al. 2020a). Air traffic also emits particularly high levels of nitrogen oxide, but hardly any near the ground, so the local impact is low during the actual flights (Allekotte et al. 2020a). In contrast, high levels of pollution are observed in the vicinity of airports.

Freight transport, in particular transport by air, light commercial vehicles and smaller trucks, is also associated with far-reaching environmental costs of up to 60 cents per tonne-kilometre (Allekotte et al. 2020a). The lowest environmental costs are incurred by rail freight transport at around 1 cent per tonne-kilometre and inland waterway transport at around 1.8 cents per tonne-kilometre. HGVs and light commercial vehicles account for the largest share of transport performance (71%) and therefore also have the greatest impact on the climate, accounting for around 77% of all freight transport. Rail freight transport has a clearly disproportionately low climate impact of 4 % compared to a transport performance of 19 % and a freight volume of 9 %. Air traffic has a disproportionately high impact on the climate, accounting for 0.06 % of freight traffic and a climate impact of around 16 % of total freight traffic, due to both very long transport routes and a high climate impact per tonne-kilometre. The local impact of air pollutants in freight transport is comparable to that of passenger transport.

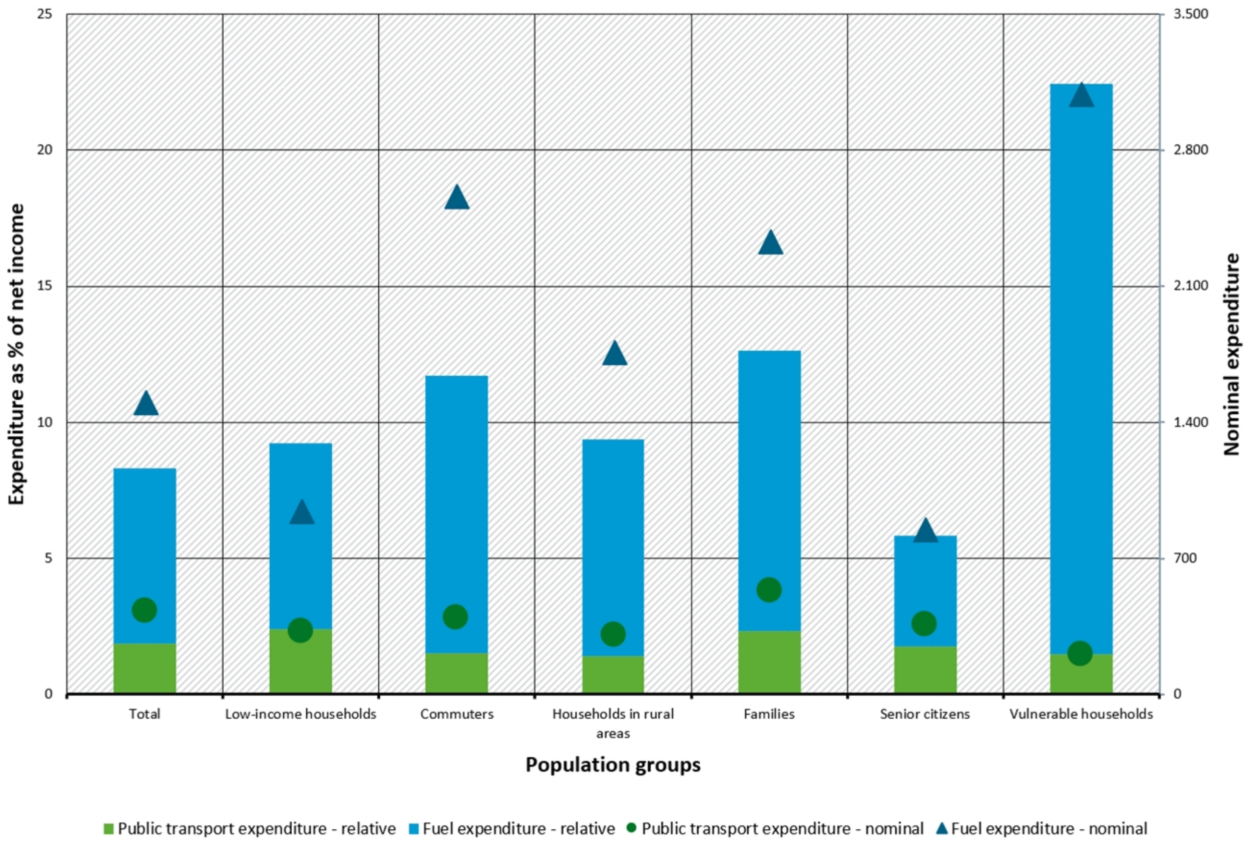
The situation described here shows that environmental policy instruments could,

- internalise previously externalised costs,
- reduce the specific environmental impacts,
- affect transport performance and
- influence the choice of means of transport.

The German transport system is in need of reform not only from an environmental point of view, but also from a social point of view.

When designing environmental policy reforms, it is important to bear in mind that costs and access to mobility are already unequally distributed. Although expenditure on mobility increases on average with income in nominal terms, it accounts for a much smaller proportion of income for wealthy households than for poorer households. As Figure 3 illustrates, there are also some clear differences between different socio-economic groups: Residents of rural areas spend around 9.4% of their income on mobility, compared to only around 7.8% for the average household.

Figure 3: Mobility costs of different population groups in 2021



Source: Own calculations with the CARMOD microsimulation model, MiD 2017, Fraunhofer FIT

Already in the status quo, the environmental impacts of transport are unevenly distributed. Transport is associated with a wide range of local environmental impacts, which in turn have an impact on health. These include noise and air pollutants in particular. People with lower incomes are more likely to live near busy and congested roads. There are also inequalities with regard to traffic-related health risks: Senior citizens and children are affected to a greater extent.

Last but not least, the effects of current transport design instruments are unequal for different groups. Transport and mobility are comprehensively regulated by statutory and fiscal law. This is done in pursuit of various goals, namely that mobility should be made available, and be as safe and as environmentally friendly as possible. However, the instruments used for this purpose have unequal effects, as shown by the following examples:

- Company cars are primarily given to higher income earners for private use. This allows them to benefit from flat-rate taxation of the associated non-cash benefit, while those on lower incomes benefit only slightly or not at all.
- In terms of income, the energy tax places a greater burden on low-income households than on households with a higher income. In addition to the unequal access to electric vehicles in the medium term, this is primarily due to the lower taxation of diesel compared to petrol.
- Diesel and electric vehicles are used to a greater extent by higher-income households.

In conclusion, there are a number of areas where action is required. In ecological terms, this means avoiding the environmental impact of (the increasing volume of) transport and the associated infrastructure and, in social terms, reducing inequalities in the costs and effects of transport and ensuring wide participation in mobility.

3 Guidelines for instruments

An environmentally oriented and socially acceptable transport policy should start in four areas:

- Establishing **true cost** pricing for transport, including the social and ecological consequential costs, in order to enable efficient mobility for society as a whole. However, this also applies to more ecologically favourable forms of transport. Although subsidies can promote the switch to more environmentally friendly modes of transport in the short term, true cost should also apply here in the long term. An example of this: *A reorganisation of the distance allowance, which reduces existing tax subsidies and provides incentives for more environmental compatibility, has positive distributional effects.*
- This change should be supported by the **expansion of infrastructures and services** for environmentally sustainable mobility. An example of this: *The development of flexible forms of public transport in rural areas can create further transport options that can help to mitigate the negative distributional effects of existing or new instruments.*
- **Protecting vulnerable households** from social hardship, i.e. households with particularly high expenditure on mobility that belong to the lower income bracket and have poor public transport connections. An *example of this: The redistribution of income from new or existing transport policy instruments to vulnerable households can alleviate their high financial burdens.*
- **Supporting vulnerable households in switching** to modes of transport with lower social and environmental costs. In the absence of good public transport connections, this is usually associated with investments that vulnerable households cannot afford and therefore require targeted support. An example of this: *The continuation of the environmental bonus (e-car purchase premium) for vulnerable households enables more environmentally friendly mobility and reduces mobility costs at the same time.*

In terms of timing, it would probably make sense to first implement instruments for true cost pricing and at the same time supplement these with measures to strengthen vulnerable groups. The expansion of infrastructures that also offer mobility alternatives for vulnerable groups will only be able to contribute to the transport transition in the medium term. Once these have been implemented, subsidies in favour of vulnerable groups can and should be gradually reduced again. In the long term, the true cost principle should also apply to ecologically favourable modes of transport. However, the need for infrastructure for environmentally beneficial modes of transport in rural areas is likely to lead to cross-subsidisation of rural areas. The extent of this subsidisation is a political decision.

In light of these considerations, the instruments we have analysed can be divided into three categories: (1.) Instruments for the expansion of ecologically favourable mobility services (2.) Instruments for creating true cost pricing in transport and (3.) Instruments to mitigate undesirable distributional effects and hardship for particularly affected groups. The distinction between the categories is not clear-cut. In particular, instruments for the expansion of mobility services may also have social components that are aimed at particularly affected groups. However, we can use the categorisation to show possible starting points for shaping a socially acceptable restructuring of the transport system.

4 Instruments for an inclusive and ecological transport transition and their effects

4.1 Expansion of ecologically favourable mobility services

Firstly, the focus of the Federal Transport Infrastructure Plan on the expansion of railways was analysed. While people with lower incomes travel more frequently by local transport, long-distance journeys are predominantly undertaken by high-earning city dwellers and people with a higher level of education. A connection to the railway increases the value of property. In the immediate vicinity of railway lines, however, noise pollution predominates, which in turn tends to affect low-income earners. Wealthy people, people living in rural areas, middle-aged people, men and working people benefit disproportionately from shorter rail journey times, while (young) men and people with a lower level of education or lower income benefit in particular from increased road safety.

The impact of a speed limit of 30 kilometres per hour in urban areas was also examined. It is true that this would increase journey times by car and thus disproportionately affect rural residents, people with above-average incomes, middle-aged people and men. At the same time, there would be benefits from lower noise and pollution levels, so there would be a reduced impact on residents living near busy roads and thus people with lower incomes, those receiving social benefits or those with a migration background, as well as residents of cities in general. Children and young people in particular would benefit from lower pollutant levels. There would also be fewer accidents and a perceived improvement in safety. Non-motorised road users, senior citizens and people with physical disabilities would benefit from this.

Another focus of the study was on measures for a more environmentally friendly car fleet. Until end of 2023, buyers of electric cars have received a subsidy from the state. The project investigated the impact of a complementary registration tax for CO_2-intensive cars (malus). The instrument would have an impact on the composition of the vehicle fleet and, not least through its effects on the used car market, facilitate access to ecologically favourable mobility services. Households with higher incomes would be more heavily burdened in relation to their income, as they are more likely to buy CO_2-intensive vehicles. Households with commuters are most affected, as are families and households in rural areas.

The European Union's car fleet targets are moving in a similar direction, but with a different approach. Two variants of a possible tightening of the target values were analysed. An 80% reduction in specific CO_2 emissions from newly registered vehicles in 2030 compared to 2021 would result in a reduction in GHG emissions of 13 to 15 million tonnes. These calculations in the projection report (German Environment Agency 2021) are based on the assumption of a massive increase in the proportion of BEVs among new registrations and thus the achievement of the target of 15 million electric cars in 2030. In contrast, only relatively small savings are to be expected when designing the car fleet targets in accordance with the Fit-for-55 package, which envisages an emissions reduction of 55% by 2030. In addition to the less ambitious target values, this is primarily due to the inhibiting effect of the flexibility measures. The literature to date suggests that the fleet targets will place a greater burden on lower-income households, as the increased development costs of BEVs will also lead to price increases for used cars in the long term.

Finally, studies on the expansion of public transport services (on-demand buses) in rural areas were analysed. Covering a rural area that is currently poorly served by public transport would require an expansion of the vehicle fleet from the current 400 vehicles to 20,000. The additional costs compared to scheduled services are estimated at 3.8 billion euros for 2030. The main beneficiaries would be people in rural areas, especially those groups who do not have a car.

4.2 Establishing true cost pricing for transport

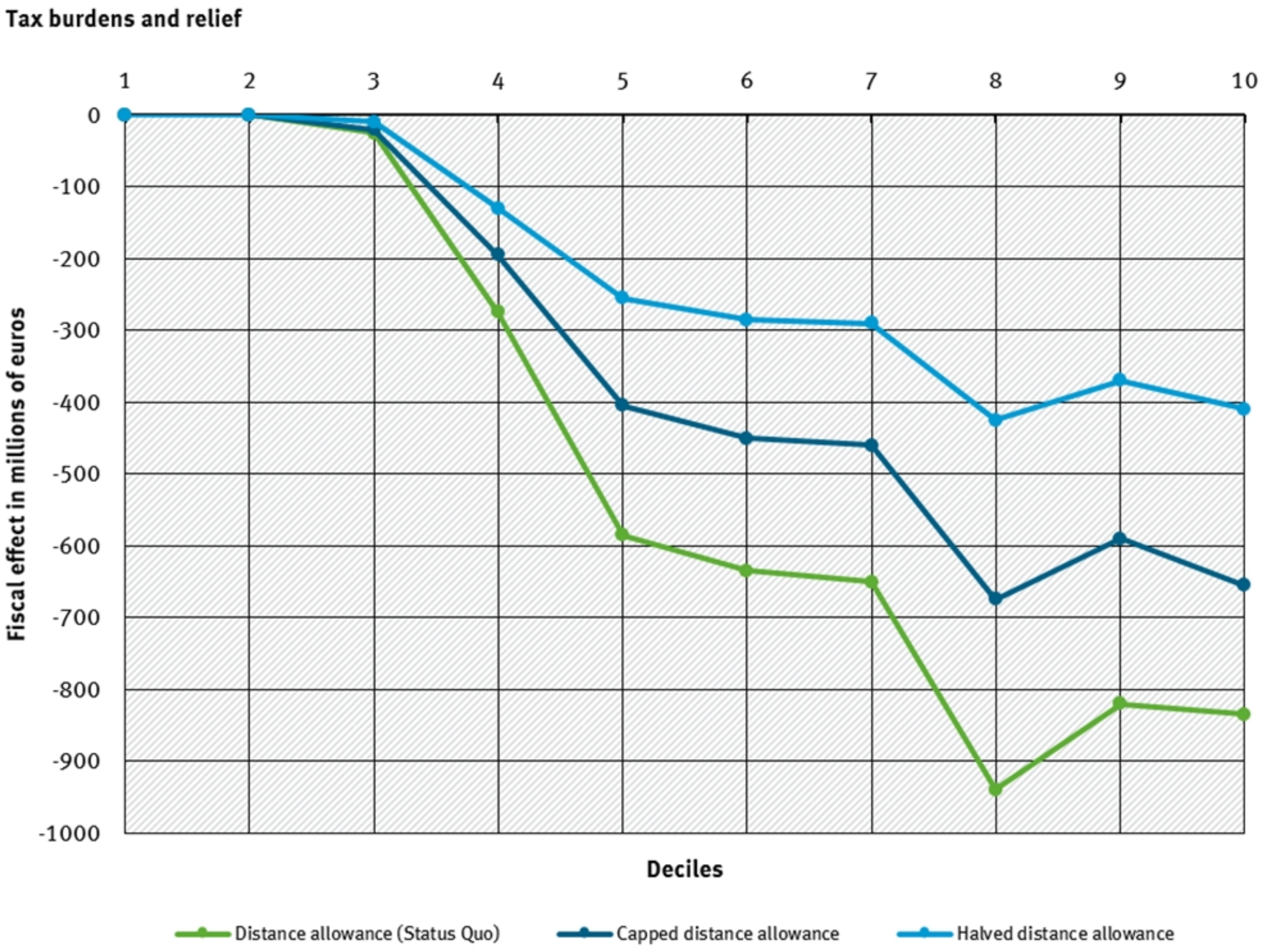
While the proposals described above are aimed at expanding mobility services and designing the necessary infrastructure, the following section presents various options aimed at ensuring true cost pricing for transport.

4.2.1 Capping the distance allowance

Up to now, employed and self-employed people have been able to claim income-related expenses for travelling between home and work as part of their income tax return, regardless of the actual costs incurred, thereby reducing their tax burden. At the same time, a mobility option was created for all citizens with the Deutschlandticket on 1 May 2023, which in many cases should make it possible to travel between home and work more cost-effectively than by car. With this in mind, the amount of the commuting allowance that can be deducted as income-related expenses will be limited to the annual cost of purchasing the Deutschlandticket or at least taken into account to a lesser extent than before. Two options were analysed: (1.) A cap on the distance allowance to a maximum of 600 euros per year and (2.) a halving of the distance allowance so that only 15 cents per kilometre can be taken into account from the eleventh kilometre. In both cases, we have provided for an exception in cases where the use of the Deutschlandticket for travelling between home and work can be considered unreasonable.

The two options for reforming the commuting allowance can help to reduce car use by employees in the medium to long term. This would result in significant reductions in air pollutant and greenhouse gas emissions. If the distance allowance is capped, and assuming prosperity remains at the same level, this would result in nominal savings of over 1.6 billion euros in climate damage costs and a marked reduction in exposure to particulate matter and nitrogen dioxide, particularly in metropolitan regions. Halving the distance-based tax allowance would have similar effects with savings of over 1.6 billion euros. Tax revenue would increase by between two and four billion euros. As Figure 4 illustrates, the existing distributional effects of the distance-based tax allowance, which previously favoured high-income households, would be weakened. The cap is particularly effective in upper income brackets, while those on lower incomes are hardly or not at all affected. There are higher burdens in rural areas compared to urban centres.

Figure 4: Distributional effects of measures to reform the distance-based tax allowance in 2030



Source: Own calculations based on wage and income tax statistics 2014, MiD 2017, Fraunhofer FIT

4.2.2 Company car taxation

An increase in taxation from the current 1 % to 2 % of the gross list price (respectively from 0.25 % and 0.5 % to 1 % for purely electric cars) was analysed. The distrubutional effects would not be critical. The top income quintile would be affected first and foremost. If individual company car users are so heavily burdened that the use of a company car is no longer financially viable, they can also give up the company car and claim a higher salary instead. For these households, there is a deterioration compared to the status quo, but no deterioration compared to people without a company car. However, it remains to be seen to what extent people would actually give up private use of the company car, as company car users may incorrectly assess whether the company car is worthwhile for them. Even under the current regulations, there may be people who use a company car privately even though it is not financially worthwhile due to low private mileage.

4.2.3 Kerosene tax

We analysed the introduction of a kerosene tax in accordance with the EU Energy Tax Directive at EU level. It should be noted that European non-EU countries (in particular Turkey and the United Kingdom) should be involved in order to prevent any possible evasion effects. A kerosene tax has the advantage over the existing aviation tax that it would incentivise airlines to use more efficient aircraft – in the medium term also with engines that are not powered by fossil kerosene. The kerosene tax also incentivises the use and expansion of long-distance rail transport. Moreover, unlike aviation tax, it includes air freight.

Our analyses show that distributional effects are generally negligible due to the very low level of the tax in relation to household income. This also applies to scenarios in which the tax is increased significantly. Although the burden increases in line with income and metropolitan regions are most heavily burdened, the average burden is too low to be able to speak of strong distributional effects.

In conclusion, it can be stated that aviation taxes can effectively contribute to CO_2 reduction and revenue generation. The crucial question appears to be how exactly the taxation should be organised. This is because the basic problem is that air traffic is often perceived as economically very relevant, e.g. for tourism.

4.2.4 Standardised energy-dependent energy tax

Up to now, the level of energy tax has been calculated differently depending on the fuel. The subject of this study is the effects of a standardised assessment based on the energy content of fuels. The standardised amount of energy tax per kWh was therefore fixed at the previous level of petrol. This results in an increase in energy tax for a litre of diesel by more than 50%, from 47.04 to 72.07 cents – around 7 cents more than for a litre of petrol. This means a price increase for consumers of 30 cents per litre of diesel, including VAT.

As high-income households are much more likely to own diesel cars, they will be much more financially burdened than low-income households. Among the households affected, however, the lowest-income households can expect a particularly high burden, even if they are comparatively rarely affected. Commuters, households with poor public transport connections and families are particularly frequently affected. While the financial burden on affected families is below average, the other two groups, as well as rural areas, are disproportionately affected. In contrast, around a third of the population, including senior citizens, are less burdened to a similar extent as households with electric cars. Figure 5 shows that the level of additional burdens is relatively low compared to a more ambitious emissions trading system or the introduction of a car toll, which also directly address the variable mobility costs and create more true cost pricing.

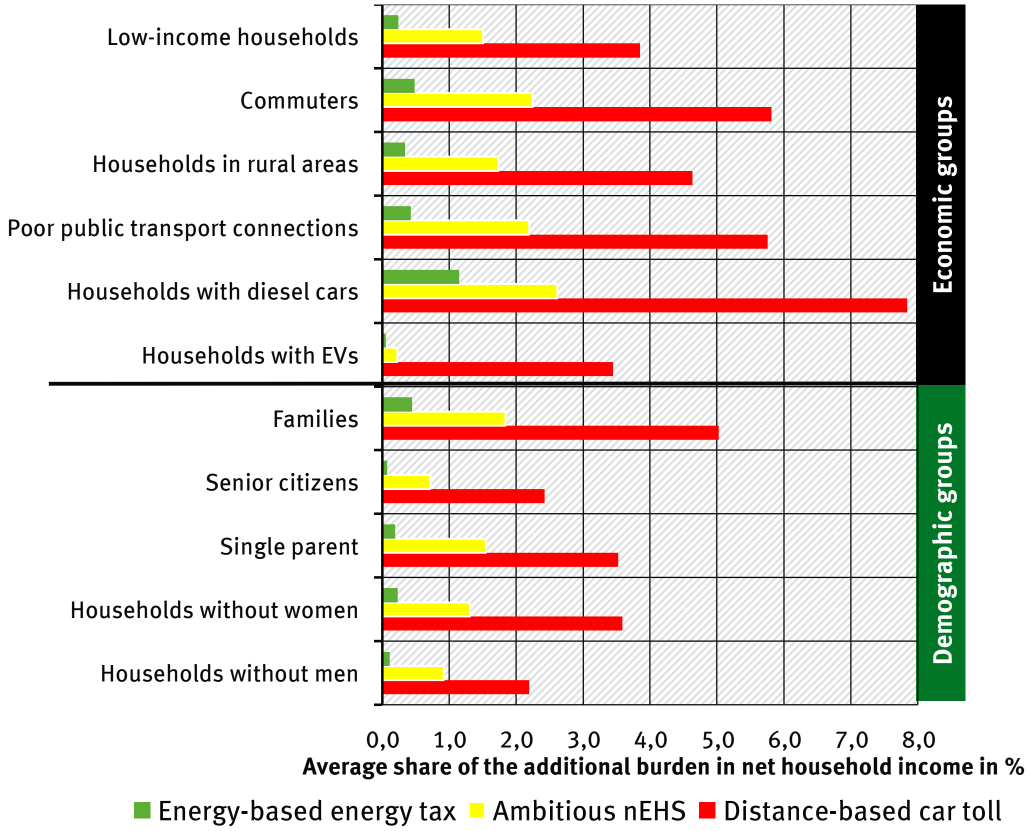
Nevertheless, the energy-based energy tax leads to a significant reduction in car mileage and specific fuel consumption. As diesel cars available on the market are on average larger than petrol cars, incentives to buy larger cars are reduced. Through its traffic and emissions-reducing incentivising effect, the reform of the energy tax contributes to reducing the impact on the climate and the environment. However, the relevance of the energy tax decreases with the increasing electrification of the car population.

4.2.5 Ambitious emissions trading system

In view of the scientific evidence that higher CO_2 prices make ecological sense, the question arises as to what distributional effects a more ambitious price path for emissions certificates in the transport sector would have. For the results, it is irrelevant which legal instrument is used to implement the higher prices. The ambitious price path analysed here starts in 2024 with a nominal certificate price of 80 euros and rises to 300 euros by 2030. This means a difference to the previous price path, based on the current legal situation, or from 2027 onwards according to the estimates of the 2023 projection report (Harthan et al. 2023), of probably EUR +45 (2024) or EUR +175 (2030).

The higher prices reinforce the effects of the existing national emissions trading system (nEHS) accordingly. With regard to the income situation, there is at best a slightly disproportionate burden on low-income households (see Figure 5). Commuters, households with poor public transport connections, families and rural areas are particularly badly affected in relation to disposable income. Households with electric cars, senior citizens and female-only households are least affected.

Figure 5: Distributional effects of measures for true cost pricing of MIT in 2030



Source: Own calculations with the CARMOD microsimulation model, MiD 2017, Fraunhofer FIT

The precise pricing of greenhouse gas emissions creates targeted incentives to mitigate them. The ambitious price path means a considerable alignment with the principle of true cost mobility, which is accompanied by significant incentivising effects, i.e. a significant reduction in car mileage and vehicle ownership and, as a result, increased use of public transport. In addition, specific fuel consumption decreases as a result of technical innovations and energy-saving driving behaviour. The considerable reduction in the impact on the environment and climate is therefore offset by the disproportionate burden on population groups dependent on MIT. As emissions trading for car fuels will provide the state with a nominal 34 billion euros in revenue from private households alone in 2030, there are sufficient resources available to socially mitigate the transformation for particularly vulnerable groups. In the long term, however, the CO_2 price – just like the energy tax – will become less important with the increasing electrification of the car population.

4.2.6 Distance-based car toll

The aim of a distance-based car toll is to reduce environmental damage caused by car use by imposing external costs on those responsible. Unlike energy tax and emissions trading, it also charges electric cars and is therefore also able to distribute infrastructure costs fairly in the future. The gradual introduction of a distance-based road user charge on all roads in Germany was analysed. The level of the charge depends on the vehicle characteristics of the car used. In addition to an infrastructure component (an average of 5.5 cents per kilometre), it is supplemented by an environmental component (an average of 2.0 cents per kilometre). The former is based primarily on vehicle weight, whereas the latter is based entirely on the environmental costs of air pollutants, land consumption and fragmentation.

After the full introduction of a distance-based car toll, commuters, households with poor public transport connections, families and rural areas – in that order – are particularly hard hit (see Figure 5). The consideration of environmental costs when setting toll rates affects diesel users in particular, while households with electric cars are relatively less burdened. Senior citizens and female-only households are charged the least in relation to their disposable income. Low-income households would also not be disproportionately burdened on average. In fact, their nominal variable mobility costs would increase slightly less than those of higher-income households. The vast majority of households with a low income do not have any noticeable burdens. However, vulnerable households, which include around 4% of all households, are burdened by the car toll with an average of more than 12% of their disposable income. It is particularly important here that the multiple burdens of a potential trio of energy tax, nEHS and car toll are anticipated and made socially acceptable by means of a gentler introduction path than can be presented in this study and accompanying measures.

The measure leads to a significant reduction in car mileage, vehicle ownership and, as a result, to increased use of public transport. The differentiation of toll rates according to local pollutant emissions and vehicle weight incentivises less harmful engines and lower greenhouse gas emissions thanks to smaller vehicles. Through its targeted traffic and emission-reducing incentivising effect, the distance-based passenger car toll contributes to a considerable reduction in the burden on the environment, climate and health. The positive health effects benefit highly exposed population groups in cities and low-income households to an above-average extent. In 2030, GHG emissions are reduced by 16 million tonnes of CO_2. At the same time, the additional state revenue amounts to 43 billion euros. The measure is therefore highly significant, particularly with regard to compensating for the prospective loss of energy tax revenue. However, the burden is particularly high for car-dependent population groups. These considerable distributional effects would suggest a combination with compensatory measures.

4.3 Mitigation of undesirable distributional effects and hardship for particularly affected groups

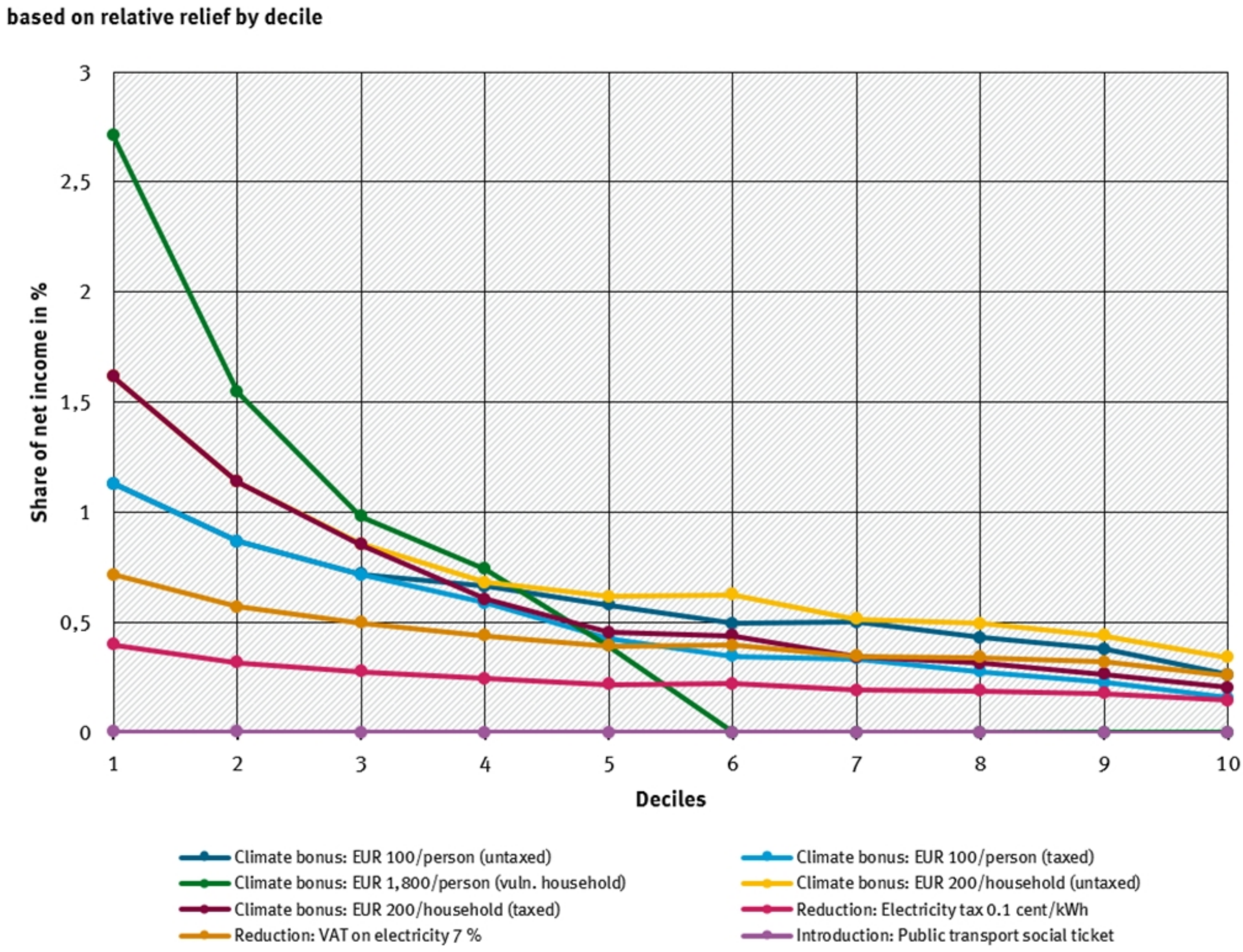
The instruments described for establishing true cost pricing for transport lead to an increase in the cost of mobility, as existing subsidies are reduced or new charges are introduced. People on low incomes or with high mobility needs may find their mobility impaired as a result. The following section presents instruments that can be used to redistribute the additional tax revenue back to private households. Various redistribution measures are discussed in order to socially balance out financially burdensome, climate-friendly measures:

- One possible instrument is direct transfer payments from the state, which are paid annually to individuals or households. In this variant, all individuals receive a direct transfer of the same amount. The relief in relative terms is higher for low-income households, but high-income households also benefit. Families, vulnerable households and low-income households benefit more in relative terms because they have more household members on average.
- Another instrument would be to reduce electricity costs. Here, the reduction of the electricity tax to 0.1 cent per kilowatt hour and alternatively a reduction in VAT from the current 19% to 7% is investigated. The relative reduction in relation to income is higher for low-income households than for high-income households. Families and commuters are less relieved in relation to their income compared to other households. Senior citizens, vulnerable households and low-income households are relieved more in relation to their income. This instrument can lead to higher electricity consumption.
- Another option is the introduction of a social tariff of 29 euros for the Deutschlandticket. Similar to the full-price Deutschlandticket, this is valid for all local and regional transport within Germany. Eligible households are need groups in which at least one person is a recipient of one or more social benefits. Due to the small number of households affected, the average relief effect on all households is extremely low (see Figure 6). However, there is a noticeable relief effect for the households concerned. As eligible benefit recipients are predominantly in the lower two income deciles, the social ticket has a clear regressive effect. Households living in urban areas with good

public transport connections benefit in particular. Rural households can derive less benefit from a social ticket.

As Figure 6 illustrates, the climate premium in particular, as a form of direct transfer, would have a stronger redistributive effect than, for example, a reduction in the electricity tax.

Figure 6: Measures to mitigate distributional effects in 2030



Source: Own calculations with the CARMOD microsimulation model, MiD 2017, Fraunhofer FIT

As part of the project, we investigated possible demarcation criteria for various income groups and analysed whether existing or proposed demarcation criteria – for example from social or tax law – can be used for repayments in the context of transport policy. Starting points arise either from demarcations that describe poverty (e.g. citizen's income) or that relate to economic performance (e.g. regulations on the receipt of student financial aid). Currently, politicians are discussing additional proposals to support people with low to medium incomes, such as the proposal to link the planned climate bonus (Klimageld) to a maximum monthly income of 4,000 euros. However, this has not yet been operationalised.

5 Conclusions

The current design of the transport system and, in particular, the political framework is primarily aimed at facilitating flexible transport, even over long distances. This places motorised individual transport (MIT) at the centre. However, the environmental impact of this mode of transport cannot be overlooked. While previous environmental problems, such as air pollutant emissions, could be addressed by modifying engines and exhaust gas treatment, a fundamental change in the transport system as a whole is required due to the climate impact of cars. Public and non-motorised transport should become more important and be supplemented in future by largely battery-electric private transport. The political instruments for this should include a reduction in existing subsidies and tax concessions in order to change the relative prices in favour of ecologically more favourable modes of transport. Furthermore, new price-effective instruments should provide additional incentives. The reorganisation of infrastructures should improve the conditions for public transport.

It is true that the existing transport system also has numerous distributional effects that mainly benefit economically more privileged households. However, changes to the status quo often provoke stubborn forces of resistance. After all, a comprehensive reorganisation of the transport system is also accompanied by distributional effects. Commuters, higher-income earners, men and people living in rural areas are more likely to use private transport than the respective comparison groups and are therefore generally more affected by such instruments. In this respect, price-based instruments aimed at increasing the costs of MIT reduce previous advantages for the groups mentioned. In other words, an ecologically oriented restructuring of the transport system has the potential to reduce the economic inequalities in the current transport system. Depending on how this reorganisation is designed, it can also contribute to the inclusion of groups that have previously been disadvantaged in their mobility. These include low-income groups, senior citizens and children.

Whilst it is true that the existing transport system has numerous distributional effects that mainly benefit economically more privileged households, changes to the status quo often provoke stubborn forces of resistance. After all, a comprehensive reorganisation of the transport system is also accompanied by distributional effects. Commuters, those on higher incomes, men and people living in rural areas are more likely to use private transport than the respective comparison groups and are therefore generally more affected by such instruments. In this respect, price-based instruments aimed at increasing the costs of MIT reduce previous advantages for the groups mentioned. In other words, an ecologically oriented restructuring of the transport system has the potential to reduce the economic inequalities in the current transport system. Depending on how this reorganisation is designed, it can also contribute to the inclusion of groups that have previously been disadvantaged in their mobility. These include low-income groups, senior citizens and children.

The environmental impact of transport is also clearly unevenly distributed; those on lower incomes, old and young people, people with pre-existing health conditions and people with a migration background are significantly more affected by the environmental and resulting health impacts than their respective comparison groups. Here too, an environmentally oriented transport policy helps to reduce previous inequalities. The expansion and (relative) reduction in the cost of public transport also enables mobility and social participation for those groups for whom a car is not available due to age, health or financial reasons.

For specific groups, however, price-effective instruments can also represent an excessive demand. This applies in particular to people in rural areas with long commutes and for whom public transport is not a foreseeable alternative. It also affects people who do not have the opportunity to switch to more environmentally friendly and therefore more cost-effective e-mobility. However, there are options here to compensate for hardship – if necessary even temporarily until alternatives can be offered or utilised. The potentially high level of additional revenue generated by the abolition of subsidies and the introduction of new levies opens up scope for mitigating hardship and undesirable distributional effects.

Overall, it appears that the distributional effects of an environmentally oriented transport policy at the expense of low-income earners tend to be overestimated in the public debate. The unequal effects of previous transport policy and the unequal effects of transport tend to, however, be underestimated

6 Summarised overview of instruments and their effects

Table 1 provides a summarised overview of a selection of the 33 design options for transport policy instruments and instruments for mitigating distributional effects that were examined. The design options relate to 16 existing or newly designed instruments. The mobility effects, monetary effects and health effects of the instruments are compared with a situation in which they do not exist. In the case of instruments for which it was not possible to quantify the effects, at least the expected qualitative effects are presented. The fiscal effects of the instruments for true cost mobility are limited to private households and the transport sector.

Table 1: Overview of the instruments analysed and their effects

Instruments and reform measures	Traffic volume (vehicle kilometres)	Climate impact (Mt CO_2, TTW)		Fiscal impact (Bn EUR)		Monetary distributional effects*						Health effects**		
	MIT	2024	2030	2024	2030	Low-income households	Commuters	Households in rural areas	Families	Senior citizens	Vulnerable households	Low-income households	Households in rural areas	Senior citizens
Ecologically favourable mobility services														
Federal transport infrastructure plan	⇧	o	⇩	-18	-18	o	o	o	o	o	o	–	+	+
Reform: Focus on rail	⇩	o	⇩	o	o	o	o	o	o	o	o	+	–	–
CO_2 fleet target value	⇧	⇩	-3.7	o	o	–	+	o	o	o	–	+	–	–
Reform: -55% in 2030	⇧	⇩	⇩	o	o	–	+	o	o	o	–	+	–	–
Reform: -80% in 2030	⇧	⬇	-14	o	o	–	+	o	o	o	–	+	–	–
Purchase premium for electric cars	⇧	⇩	o	⇩	o	o	+	+	o	o	o	+	–	–
Reform: Bonus-Malus-System	⇩	-0.3	-0.5	+10	+16	+	––	–	–	++	–	+	–	–
New: Support for public transport quality	⬇	⇩	⬇	⇩	⇩	o	o	o	o	o	o	+	–	–
New: Urban speed limit 30 km/h	⇩	⇩	⇩	o	o	o	o	o	o	o	o	+	–	–
True cost measures														
Distance allowance	⬆	+2.5	+1.8	-5.4	-4.6	––	++	++	o	–	o	–	+	+
Reform: Capped	⬇	1.9	1.4	+3.9	+3.5	++	––	––	o	+	o	+	–	–
Reform: Halved	⬇	-1.2	0.8	+2.7	+2.3	++	––	––	o	+	o	+	–	–
Energy tax	⬇	-15	-11	+31	+29	–	––	–	–	+	––	+	–	–
Reform: Energy-dependent	⬇	-3.2	-1.8	+4.3	+3.7	+	––	–	––	++	––	+	–	–
nEHS with price path of EUR 125 in 2030	⬇	-2.4	-5.4	+4.7	+16	o	––	–	–	++	––	+	–	–
Reform: EUR 300 in 2030	⬇	-3.2	-7.7	+5.7	+18	o	––	–	–	++	––	+	–	–
New: Distance-based car toll	⬇	-11	-24	+19	+43	o	––	–	–	+	––	+	–	–
Company car	⬆	+0.8	+1.1	-5.9	-6.9	–	+	o	+	––	––	–	+	+
Reform: Higher taxation	⬇	-0.6	-0.7	+4.4	+6.5	++	–	o	–	++	+	+	–	–
New: Kerosene tax Europe: 33 Cent/l	o	-0.3	-0.3	+0.6	+0.7	+	–	–	o	+	+	o	o	o
New: Kerosene tax Europe: 65.45 Cent/l	o	-0.7	-0.6	+1.0	+1.2	+	–	–	o	+	+	o	o	o
Mitigation of distributional effects														
New: Direct transfers, e.g. …														
… EUR 100/person untaxed	o	o	o	-8.4	-8.3	++	o	o	+	o	++	o	o	o
… EUR 100/person taxed	o	o	o	-6.6	-6.5	++	–	+	+	o	++	o	o	o
… vulnerable households: EUR 1,800/Person	⇧	o	o	-6.6	-6.5	++	+	+	+	–	++	o	o	o
… EUR 200/household untaxed	o	o	o	-8.4	-8.3	++	–	o	–	+	+	o	o	o
… EUR 200/household taxed	o	o	o	-6.6	-6.5	++	–	o	–	+	++	o	o	o
Reform: Electricity tax 0.1 cent/kWh	⇧	o	o	-2.8	-3.2	++	–	o	–	+	++	o	o	o
Reform: VAT on electricity 7 %	⇧	o	o	-4.5	-5.7	++	–	o	–	+	++	o	o	o
New: Public transport social ticket	o	o	o	-0.2	-0.3	++	––	––	–	–	––	o	o	o

- Low-income households
- Commuters
- Households in rural areas
- Families
- Senior citizens
- Vulnerable households:

⬆ ⬇ Significant increase/decrease
⇧ ⇩ Moderate increase/decrease
o No relevant effect

++ Significantly better off
\+ Moderately better off
– Moderately worse off
–– Significantly worse off

* compared to the average relative change in disposable household income in the total population

** compared to the average change in exposure to air pollutants in the total population

Note: In nominal prices. The full effects of instruments are shown in grey, changes to existing instruments due to reforms are shown in white. For the complete effect of a reformed instrument, the effect of the previous instrument and the reform effect must be added together. The effects are generally limited to an annual analysis. Cumulative effects due to the effects of previous years are not taken into account. This is particularly relevant for measures with an impact on the vehicle population. Source: Own calculations, Fraunhofer FIT, FU Berlin and IER Stuttgart

Legal Notice

Publisher

German Environment Agency
Wörlitzer Platz 1
06844 Dessau-Roßlau

Phone: +49 340-2103-0
Fax: +49 340-2103-2285
buergerservice@uba.de

Internet:
www.umweltbundesamt.de
/umweltbundesamt.de
/umweltbundesamt

This is not a publication of the German Environment Agency.
Responsibility for the content lies with the authors.

Authorship, Institution

Leif Jacobs, Dr Sven Stöwhase, Lara Quack, Mara Rebaudo, Marlene Scherer and Johannes Köckeis with the assistance of Dara Krolpfeifer and Laura Gergeleit

Fraunhofer Institute for Applied Information Technology FIT, Sankt Augustin

Dr. Klaus Jacob

Free University of Berlin

Dr. Ulrich Fahl and Alexander Altstadt

Institute for Energy Technology and Rational Use of Energy, Stuttgart

Published: October 2024

Bibliography

Allekotte, Michel; Bergk, Fabian; Biemann, Kirsten; Deregowski, Carolin; Knörr, Wolfram; Hans-Jörg-Althaus et al. 2020a). Ökologische Bewertung von Verkehrsarten (Ecological assessment of transport modes). Hg. v. UBA. Available online at: https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_156-2020_oekologische_bewertung_von_verkehrsarten_0.pdf, last accessed on 16.08.2023.

Allekotte, Michel; Bergk, Fabian; Biemann, Kirsten; Knörr, Wolfram; Sutter, Daniel (2020b): Umweltfreundlich mobil! (Mobile in an environmentally friendly way!) Hg. v. UBA. Available online at: https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_156-2020_oekologische_bewertung_von_verkehrsarten_0.pdf, last accessed on 16.08.2023.

Harthan, Ralph O.; Förster, Hannah; Borkowski, Kerstin; Böttcher, Hannes; Braungardt, Sibylle; Bürger, Veit et al. (2023): Projection report 2023 for Germany. Hg. v. Umweltbundesamt. German Environment Agency (CLIMATE CHANGE 39/2023). Available online at: https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_156-2020_oekologische_bewertung_von_verkehrsarten_0.pdf, last accessed on 16.11.2023.

German Environment Agency (2021): Treibhausgasminderung um 70 Prozent bis 2030: So kann es gehen! (Reducing greenhouse gases by 70 per cent by 2030: This is how it can be done!) In collaboration with Katja Purr, Kai Wehnemann, Frederike Balzer, Friederike Erxleben, Manuel Hendzlik, Andreas Kahrl, Martin Lange, Benjamin Lünenbürger, Joscha Steinbrenner, Matthias Weyland. Dessau-Roßlau. Available online at: https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_156-2020_oekologische_bewertung_von_verkehrsarten_0.pdf, last accessed on 30.07.2023.

German Environment Agency (2023): Emissionen des Verkehrs (Emissions from transport). Hg. v. UBA. Available online at https://www.umweltbundesamt.de/daten/verkehr/emissionen-des-verkehrs#verkehr-belastet-luft-und-klima-minderungsziele-der-bundesregierung, last updated on 19.07.2023, last accessed on 19.07.2023.

Wolf, Kathrin; Kraus, Ute; Dzolan, Mihovil; Bolte, Gabriele; Lakes, Tobia; Schikowski, Tamara et al. (2020): Nächtliche Verkehrslärmbelästigung in Deutschland: individuelle und regionale Unterschiede in der NAKO Gesundheitsstudie (Nocturnal traffic noise exposure in Germany: individual and regional differences in the NAKO Health Study). In:

Bundesgesundheitsblatt-Gesundheitsforschung-Gesundheitsschutz (Federal Health Gazette-Health Research-Health Protection) 63 (3), S. 332–343.