ifmo
Institute for
Mobility Research

The Future of Mobility

Scenarios for the Year 2025

First Update

BMW Group

Die Bahn DB

Lufthansa

MAN

Bundesministerium
für Bildung
und Forschung

Contents

Preface

Mobility is timeless. It is as indispensable for human society as it is for the ability of national economies to function. In the beginning, the issue mobility faced was how people and freight could at all overcome distances, but it soon had to meet new demands: it had to extend further and it had to be faster, safer, more flexible, more cost effective, friendlier to the environment. And for these requirements new solutions were continually developed, solutions that meant, in turn, that expectations could be raised even further.

Today, we are on the move on land, in the air, across the water at hitherto unprecedented levels of speed, security and comfort. These technical advances have made the world become smaller. They entail numerous benefits and advantages for people, but occasionally also nuisances.

What will the future of mobility, one of the most important foundations on which our society is based, look like in twenty years? Focusing on Germany, the Institut für Mobilitätsforschung (ifmo, Institute for Mobility Research) has prepared the first update of the scenarios first presented in 2002. While this first study analyzed the future of passenger traffic, it has been supplemented in the meantime with an independent study on freight transportation. The result is what you are holding in hand.

The fact that these scenarios could be compiled so comprehensively and in such depth is owed to a great degree to the Bundesministerium für Bildung und Forschung (German Federal Ministry of Education and Research), which contributed funds to this project from the very beginning. The project was supported by further funding from the BMW Group and by Deutsche Bahn AG, Deutsche Lufthansa AG and MAN Nutzfahrzeuge AG, all of whom also made members of their staff available for the project. We would like to especially give our thanks to those four company representatives who also belong to the Board of Trustees of the Institut für Mobilitätsforschung (ifmo, Institute for Mobility Research).

We would also like to thank all of the experts who were involved in the study. By their contributions, they created the foundations on which the scenarios are based. Special thanks to Professor Dr. Horst Geschka and his team, who gave their guidance to the project in terms of methodology. We would also like to thank the mentors, from whom the project team received many valuable inspirations.

A warm word of thanks also goes to the ifmo-Team, Ms. Sylvia Giesel, Mr. Frank Hansen, Ms. Gundi Metzner-Dinse and to Mr. Martin Lenz, who was delegated from Deutsche Lufthansa to ifmo, who were responsible for the smooth administration of the project and the preparation of the results in the present finalized form.

We hope that this study will be met with the same high degree of interest at the political level, in the economic sector and in academe as the basic study was in the year 2002.

Detlef Frank
Chairman of the Board of Trustees
of the Institute for Mobility Research

Dr. Walter Hell
Director of the Institute for Mobility Research

Summary

Why Take a Look into the Future of Mobility?

Mobility is a part of our lives – not only today, it will continue to be so in the future as well. Whether it is about going to work or taking business trips and vacations, enjoying leisurely travel or transporting freight, all of these types of mobility form the basic substrate of our society and shape our lifestyle as characteristic elements. Mobility opens up new opportunities. Nonetheless, it also entails strains, for individuals as well as for society as a whole. This means that we are constantly challenged to design mobility such that we can enjoy its benefits, while at the same time minimizing its disadvantages and burdens.

This gives rise to the question of what our concept for the mobility of the future actually is? And secondly, what do we need to do to get there? The present study focuses on scenarios developed by a group of around 80 experts working in scientific research, the economy and various professional and special-interest associations. They describe what passenger and freight transportation may be like in the year 2025. The study was initiated by the BMW Group, Deutsche Bahn AG, Deutsche Lufthansa AG, and MAN Nutzfahrzeuge AG.

The above four companies have joined forces with the Bundesministerium für Bildung und Forschung (Federal Ministry of Education and Research) as sponsors of this project. Its intention was to have independent experts discuss what mobility could look like in the future, independent of the various modes of traffic. The results of this project do not reflect the wishes of the project participants, but deliver expert-supported knowledge about a possible future of mobility in the year 2025.

On the basis of the study's results, a regular dialogue is to take place between the various entities enabling or providing mobility, in order to bring the discussion of how to design our mobility in the future back to the facts.

What will our World Look Like in the Year 2025?

Mobility is dependent on numerous framework conditions. It is influenced by factors such as income, division of work, consumer preferences and even energy prices. That is why this project initially analyzed how all of those factors might develop that could have a particularly significant impact on mobility.

From the experts' perspective, the environment in which our scenario "Mobility Requires Action" has been set might be determined by the following framework conditions in the year 2025:

One basis for such considerations is formed by the demographic development: The population in Germany will remain constant because of immigration. The age structure will continue to shift further, so that an increasing share of society will be made up of older people. Where the spatial distribution of the population is concerned, the experts forecast a concentration process: while people will be moving to economically powerful metropolises and making them grow, those areas that are weak in economic terms will be losing their populace.

The economic framework conditions in the scenario will be marked by challenges. The development of the gross domestic product in Germany will be rather flat; the average growth rate will amount to a mere 1.8 percent per annum. As a consequence, the rate at which peoples' incomes will grow will also be relatively low for the majority of the population. At the same time, the price of energy will increase. As a result of the pending reforms of the social security systems, many people will have less money at their disposal.

Globalization will continue to move forward and with it, the division of labor in industrial production. In addition, the developments leading Germany towards becoming a service society will be dynamic. This structural change will continue to mark the development in Germany, demanding a high level of flexibility from people in gainful employment. The distances between homes and workplaces will increase. Traffic infrastructure systems of all kinds will be facing the impacts caused by the integration process within Europe. The transportation of freight will increase dramatically. At the same time, however, there will be very few resources available in public budgets that could be invested into the traffic sector.

What Does this Mean for our Mobility?

The scenario describes a world in which we can continue to be mobile, just as before, albeit at significantly higher prices. German automobile drivers will have to pay a toll for using the Autobahns (highways) and some of the Bundesstrassen (regional expressways). The revenue will go to private operator companies, who will have the task of maintaining and upgrading the streets. The greatest part of the traffic budget will be spent on rail traffic and will make using the railway system attractive on long distance stretches and in metropolitan areas. Next to the railway systems, only selected roads, airports and harbors can be further upgraded or constructed, and those tasks will require additional private funds.

It will be freight transportation in particular that will dramatically increase traffic volume. This development cannot be accommodated simply by upgrading the infrastructure; traffic must also be organized more efficiently. Some examples of such organizational means are individual dynamic traffic guidance systems on the road, the removal of impediments on Europe's rails by increasing the systems' interoperability, and the harmonization of flight security systems in Europe. Because ship traffic will become more efficient, greatly increased numbers of containers can be transported by ever larger ships. German seaports will be appropriately upgraded. Furthermore, the hinterland connections, which are just as important in this context, will be realized in due time. This is a segment in which rail traffic will be well on a par with its competitors.

Only if the metropolitan public transportation networks are continuously improved and expanded will it be possible to deal with the traffic in growing metropolises. The public transportation services will be tendered out to privatized carriers or to newly formed private service providers, and that in an environment characterized by competition. While the services offered will be more attractive, they will also be more expensive. The tariff systems will be more transparent and easier to understand, and discounts for specific groups of citizens will not be granted by the transport services operators, but will rather be paid out, in some instances, to the people affected in the form of "mobility money".

How Mobile will We be in the Year 2025?

The scenario "Mobility Requires Action" shows the path towards the mobile future of 2025, assuming some very basic decisions are taken and consistently implemented: this includes a significant reorganization of budgetary funds, the use of new models for financing projects, and a significantly greater involvement of the users as compared to today. All of the traffic carriers will place a greater focus on their strengths. Every one of these measures must be taken in order to, in the end, be as mobile as we are today. The increasingly growing amounts of freight will reach their destinations with a speed and punctuality comparable to that given today. Passenger traffic will run much as it does today.

In addition, people's attitudes towards mobility will become more pragmatic. The choice of the modes of transport will be less self-evident than in the past. We will more frequently encounter what is called "multiple-option users", i. e. people who choose between railway, automobile or airplane, basing their decision on their needs. However, this basic flexibility is fraught with restrictions for many people who have a limited household budget. There will be a large market for low cost offers: the already familiar low cost, no frills flights are just the first part of a development that will give us extremely affordable long-distance bus lines and an increasing distribution of low cost automobiles.

The scenario provides a consistent idea of what mobility could look like in the future. In order to enable this to become a reality, considerable challenges must be overcome and policy-makers will need to take decisions defining the direction that this aspect of public life will take. All of these measures will, however, only prevent the situation on the roads, on the rails, in the air and on the water from becoming worse. Against the backdrop of the predicted traffic growth, that is essentially a quite satisfactory situation. How the situation will develop if the necessary decisions cannot be taken, or if they are not taken in due time, is briefly illustrated in an alternative vision of the future.

A Summary of the Study

The present study is intended to provide a basis for dealing with the long-term issues of mobility in a targeted way. This is, on the one hand, in the interests of the project partners, who initiated the scenarios for exactly this reason. On the other hand, the objective pursued by the study is to raise the interests of many political and economic decision makers as well as all other people who want to be mobile in the future, or who must be.

After the methodology used in this project is introduced in Chapter 2, Chapter 3 will outline the experiences that were made with the first scenario study, which was published in December of 2002. Chapter 4 presents a different scenario: “What Happens When Nothing Happens” describes future mobility should the decisions that need to be taken in the area of traffic not be implemented. In Chapter 5, the main scenario of “Mobility Requires Action” is described in detail. Which decisions will have to be made by which stakeholder in order to have this scenario become reality is set out in Chapter 6. The further procedure within the scenario project is gone into in Chapter 7.

What happens when extraordinary events occur and disturb the consistent world of the scenario? Events that break with trends are an important part of the technique of creating scenarios. For this reason, two possible breaks in trend and their effect on the mobility of the future have been described in the annex.

1. Scenarios for Traffic in 2025 – a Foreword

It was in December of 2002 that the Institute for Mobility Research presented its first scenario study on the subject of "The Future of Mobility".[1] Nearly 50 experts from various disciplines investigated how we will be moving from place to place in the year 2020. This group of experts included economists, sociologists, demographic experts, engineers, and traffic experts; while a majority was from the academic world, there were also representatives from companies, associations and business consultancy firms. The study showcased the factors that, in the experts' opinions, were likely to influence the future situation of mobility in Germany, and systematically linked these opinions to form coherent scenarios.[2] The main idea behind this first study was to investigate passenger traffic, on the road, on rails and in the air.

The advantage of the scenario technique is that the individual scenarios are not investigated in isolation from one another, as is normally done in prognoses. Rather, the various links and reciprocal dependencies and the ways in which they impact mobility are presented, as is the effect they have on the actions taken by the various stakeholders. Along with the general economic and political framework conditions, technical innovations and societal developments are considered.

From the beginning, this study was devised so as to be continuously updated. Since today, the framework conditions of our lives change at a greater speed than ever before, it is not possible to simply leave our assumptions about the development of mobility and ideas we have for its future uninvestigated for longer than two or three years, in particular when they are to serve as the basis for decisions that are to have long-term effects.

If the objective is to ensure that any dialogue on the future of mobility is given a meaningful foundation, it is not enough to focus on passenger traffic – this was realized early on in the process of the project. After all, passenger traffic and freight transportation rely on the same infrastructure and, in environmental terms, it is irrelevant whether emissions come from a passenger vehicle, a truck, a diesel locomotive or the jet engines of an airplane.

For this reason, the passenger traffic scenarios presented in 2002 are not only being updated and extended into the year 2025 by the present report, but also supplemented with further scenarios on freight transportation. The partial scenarios were linked to create overall traffic scenarios. Because of their complex content, the two partial scenarios will be described separately. However, the individual developments were each prepared against the background of identical framework conditions, taking into consideration their reciprocal dependencies.

The present scenario carries special weight in the dialogue about the future of mobility in Germany because of its systematic update and due to the fact that passenger and freight transportation are considered. We will continue to discuss the updated statements with groups of stakeholders from politics and from the economic sector, as well as with special interest associations. We believe that this will contribute towards ensuring that in future, the discussion will be based on the facts of what options exist for action and what are absolute necessities in obtaining sustainable mobility.

The initiators of the study are the BMW Group, Deutsche Bahn AG and Deutsche Lufthansa AG. MAN Nutzfahrzeuge AG was a further contributor to the project in the context of preparing the first freight transportation scenarios. The Bundesministerium für Bildung und Forschung (Federal Ministry for Education and Research) has financially sponsored this project. ifmo was responsible for the overall project management.

In order to avoid misunderstandings, please be advised that the developments described in this work are based on the opinions of the experts involved (cf. the following list of names in the annex). The contents of the positions taken and opinions stated are therefore not necessarily those of the companies listed above.

[1] "Zukunft der Mobilität – Szenarien für das Jahr 2020" (The Future of Mobility – Scenarios for the Year 2020), Ed.: Institut für Mobilitätsforschung (ifmo, Institute for Mobility Research), Berlin 2002.

[2] For more information about the methods of the scenario technique developed by Geschka, cf. page 13 et seq. below.

2. The Approach Used in Preparing the Scenarios
2.1 The Method Selected – Scenario Technique[3]

The present study was prepared using the scenario technique according to Geschka. The basis for this method was developed in the 1970s by Professor Dr. Horst Geschka and members of the staff at the Battelle-Institut in Frankfurt am Main; since then, the method has constantly been developed further. The philosophy of the scenario technique, briefly described, is the following.

While many visions of the future that are prepared for planning or research purposes are in fact conceivable, they cannot always be followed in terms of the logic of their design and their development. Scenarios, by contrast, are systematically extracted from the present situation. They are visions of the future that are logical and consistent.

A scenario includes both the description of a possible future situation and the developments which lead up to this situation. Of course there is not only one imaginable and plausible path that will lead into the future, rather many different routes can be conceived and underpinned with reasoning. In this way, alternative scenarios can be constructed.

As a matter of principle in preparing a scenario, the basic assumption is proceeded from that any given topic will be very strongly influenced by outside forces. If, then, the intent is to understand what development such a topic may take, one has to assess first how the relevant factors influencing the topic will develop themselves. On the basis of this prediction, therefore, visions of the future can be worked out that for the most part will be consistent.

These perspectives are enhanced by a further important element of the scenario technique: the inclusion and analysis of what is termed “events breaking with trends”. These refer to events whose occurrence initially is not discernible in the trend analysis. They occur suddenly and unexpectedly and may direct the development process of the scenarios into an entirely different direction. Such events could include technological innovations, unexpected political or economic developments, natural disasters, terrorist attacks or wars.

[3] There is only a short description of the method and procedure of the project at this point. For a detailed description, please contact the Institute for Mobility Research in Berlin.

2.2 Updating Passenger Traffic Scenarios

In the year 2004, it was begun to update the study "The Future of Mobility", as regards passenger traffic in 2025, with expert workshops, of two days each, dealing with one of the following influential environments:

- Society,
- National economy,
- Public order and traffic policy,
- People and work,
- Technology and organization,
- Traffic carriers and services provided by traffic carriers.

Nearly all of the experts who contributed to the first study also attended these workshops. It was thus possible to guarantee the continuity of the project and to continue where the discussions held in preparing the first scenario study had left off. All in all, 40 experts were involved in updating the scenarios (cf. the list of names in the Annex).

Every single influencing factor was checked against the developments of the past years and, if necessary, updated in the expert workshops. Suggestions and critical remarks that had been voiced in discussion rounds held in 2003/2004 with representatives from politics, the economic sector and academe were also included in the updates. In this way, the influential factors were revised and updated to the year 2025. In two further workshops, selected experts worked at comparing the influential factors across their respective environments and at comparing the passenger traffic scenarios with those prepared for freight transportation.

The following events could be named as examples for developments that took place from 2001 until 2004 and resulted in the individual projections for the future being modified: the terrorist attacks of September 11th, 2001, the war in Iraq, and the low growth rates of the German gross domestic product in the years 2001, 2002 and 2003. These developments either had not been considered at all in the 2002 scenario or had been viewed in terms of their ability to break with trends. Subjects like unemployment and the crisis of the German social security system, as well as climate change and CO_2 emissions, were some of the topics that had not stood in the center of attention before, but now dominated the public debate. For the factors defined as being influential in the first study, this meant that:

- The content statements made for 7 influential factors were changed significantly.
- 4 influential factors were restructured.
- 2 influential factors were added.
- 8 influential factors were deleted because they had proven to be less relevant, or because they had been transferred to the freight transportation study.
- 38 influential factors (approximately 70 percent) remained largely unchanged regarding their content; however, the projections and reasoning with which they were underpinned were put in more precise terms and were updated.

Among the more than 54 influential factors, the following were identified as main catalysts for the development of passenger traffic in the coming twenty years:

- Development of the population in terms of geographical criteria and regional structures,
- Gross domestic product in Germany,
- Framework conditions in terms of regulatory policy for road traffic,
- Significance of traffic policy within general policy,
- Total investments made into the traffic infrastructure system,
- Framework conditions in terms of regulatory policy for rail traffic.

Four of these influential factors had also been defined as catalysts in the basic study in 2002.

The scenarios were not further selected or detailed in this phase since the passenger and freight transportation scenarios were to be combined first.

2.3 The Freight Transportation Scenarios

In the second half of the year 2003, work on a scenario study with the title "Freight Transportation in the Year 2025" was begun.

For the scenario, the subject was limited as follows:

- Freight transportation is defined as the transport of goods
  - On the road,
  - On rails,
  - Across bodies of water,
  - In the air.
- The long and short distance freight transportation within, from, to and across Germany is analyzed; this also includes the traffic corridors leading to neighboring countries.
- Non-motorized transportation of goods (for example on bicycle), pipeline transport, and internal transportation within factories were not included.

The following influential environments were determined under these framework conditions:

- Society,
- National economy,
- Traffic policy,
- Technology,
- Freight transportation supply,
- Demand for freight transportation.

Seven noted personalities whose competence in these fields is generally acknowledged were brought in as mentors, who acted as consultants when the study was worked on (cf. the list of names in the Annex).

45 qualified experts from the most varied institutions were called in to compile the influential factors (cf. the list of names in the Annex). Two two-day workshops were held for every influencing environment. The size of the expert group varied from between five and nine participants.

As early as in the course of these workshops, care was taken that the freight traffic scenarios' content did not overlap with the passenger traffic scenario and that links were established to it. Two further workshops with selected experts worked at comparing the influential factors across their respective environments and at comparing the passenger traffic scenarios with those prepared for freight transportation.

Meetings of the core project team[4] took place regularly, during which the interim results were discussed and the next work steps were planned. The objectives pursued by the project, the procedure to be followed and key issues of content were discussed with the mentors at the project's beginning. For example, it was discussed how the subject being investigated and the content of the influential environments could be defined. Once all expert workshops had been concluded, extensive discussions of the interim results obtained were held with the mentors and their suggestions were included. Finally, the draft version of the present study underwent a further critical discussion during another meeting.

Among the total of 44 influential factors, the following catalysts were identified for the development of freight transportation:

- Gross domestic product in Germany,
- German foreign trade (of goods),
- Freight structure of traffic (bulk commodities versus general cargo),
- Integration of the new member nations of Europe.

Both scenarios (passenger traffic and freight transportation) proceed from the assumption that the gross domestic product will have a marked influence on the future development of traffic.

Here as well, because the freight transportation scenario was to be linked with the updated passenger traffic scenarios, the scenarios were not worked on in any greater detail at this point.

[4] The project team supported the work of the project in all of its phases. This included preparing for the workshops and then following up after them, working on individual methodical steps taken outside of the workshops, and contributing to writing the reports.

2.4 Merging the Scenarios to Form General Traffic Scenarios

In a next step, the updated passenger traffic scenarios and the freight transportation scenarios were merged. This presented a new challenge, since both of the scenarios each evidenced a high level of complexity. Illustration 1 provides an overview of the procedure.

First, the descriptors used in both scenarios were aligned with one another, since, while being similar in content, they had been worded somewhat differently. Alternative scenario structures that are consistent within themselves were developed with the help of the software program INKA 3.

The scenario with the highest level of consistency, in other words the scenario having the greatest internal logical coherence, was chosen as the main scenario to describe visions of the future. This scenario, entitled "Mobility Requires Action", will be described in Chapter 5. An alternative vision of the future entitled "What Happens When Nothing Happens" is the basis for Chapter 4 and contrasts with the first one.[5]

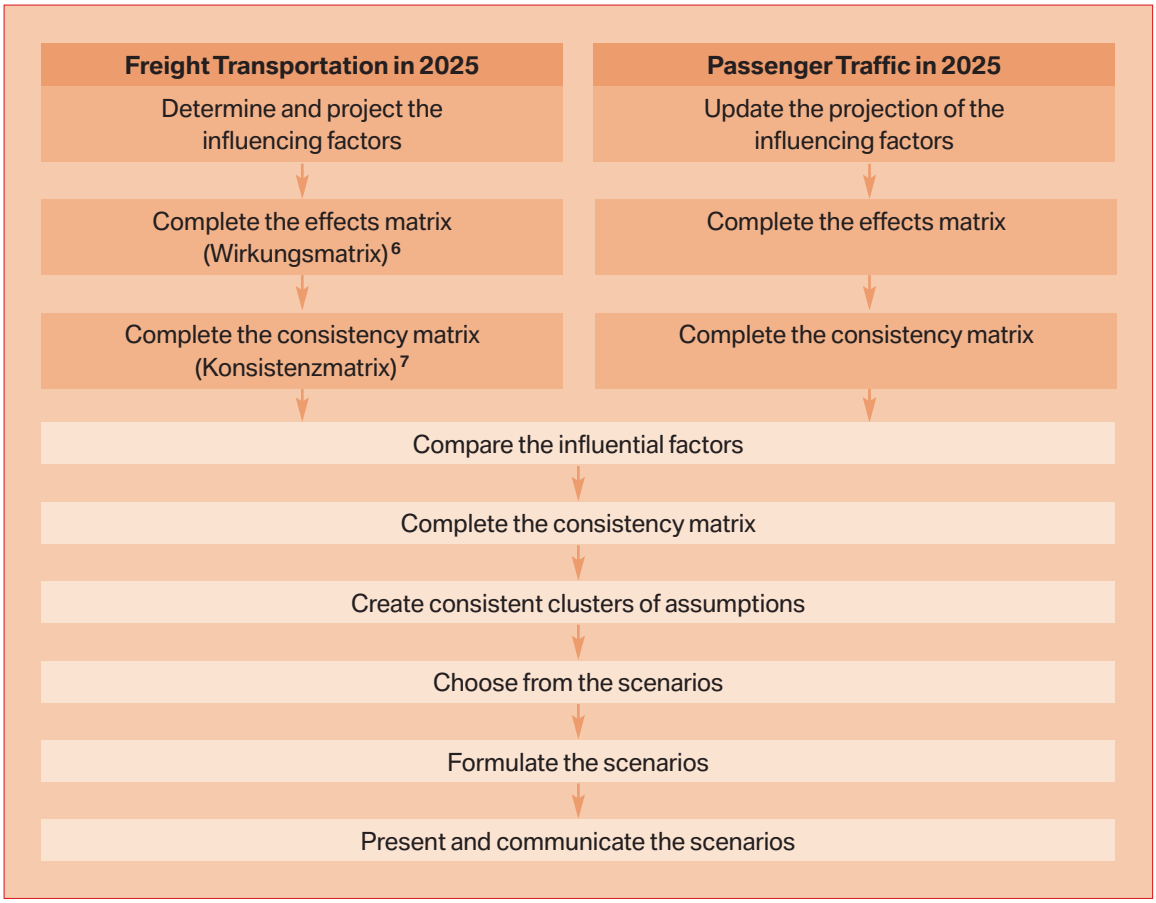


Illustration 1: Procedure in the Project

[5] A detailed description of the procedure as well as a presentation of both scenarios in table format may be ordered from the Institute for Mobility Research, Berlin.

[6] Translator's Note: "Wirkungsmatrix" is a feature of the scenario software INKA 3. The term seems to refer to the interconnectivity of effects in and on possible scenarios.

2.5 Events that Break with Trends

In the introduction of this Chapter (cf. 2.1) it was mentioned that one step of the scenario technique involves the identification of unexpected events, and the subsequent analysis of their impacts on how the scenario was developing. The probability that such trend-breaking events will occur is low, but when they do occur, they change the situation significantly.

A list of over 50 possible events had already been compiled in the basic study of 2002, which had been identified by the experts in the course of the workshops (cf. Annex A on the following issues).

This list had then been reduced step-by-step using the following criteria:

- No events whose probability of occurring is extremely low,
- No events that cannot be expected to happen within the time frame covered by the scenario,
- No events that have the same effects,
- Only events with considerable impacts on transportation.

In selecting the events, it had been taken care to have them originate in different sectors, such as economic development, energy and raw materials supply, technology, international relations.

The following nine events that break with trends had remained, and had then been analyzed in depth:

- Long period of economic growth,
- Deep economic depression as a result of a so-called Big Bang,
- Deep economic depression resulting from a creeping recession,
- Wars in oil supply regions,
- Shortages in oil supply,
- New energy technology for passenger vehicles,
- New traffic infrastructure,
- Chinese economic miracle,
- Continental strongholds.

In updating the scenarios, the relevance of these assumed events was investigated. It was concluded that to a certain degree the events "wars in oil supply regions" and "Chinese economic miracle" had already taken place. It was furthermore concluded that most likely we were already in the middle of the assumed event "creeping recession". The event "new transportation infrastructure" was rejected by the experts. The other events that break with trends still remain up for discussion.

In the course of this updating work, two events were again taken up and analyzed:

- Dramatic increase of climatic extremes,
- Escalation of international terrorism.

A complete summary can be found in Annex A.

The events that break with trends were analyzed in accordance with a specific scheme:

1. Presentation of the relevant history leading up to the event,
2. Determination of the point at which the situation peaks or at which indicative events occur more and more frequently,
3. Description of the event itself,
4. Delineation of the event's impacts in selected societal environments and business sectors,
5. Analysis of the event's specific effects on mobility and transportation.

Steps 1 and 2 were based on literature research and focused discussions with experts. Steps 3 through 5 were developed and worked out in the core project teams; individual scientific literature was also consulted for this step.

[7] Translator's Note: "Konsistenzmatrix" is a feature of the scenario software INKA 3. This process involves entering data values into a special table and the data is then calculated and analyzed based on its consistency or inconsistency.

2.6 Innovation Road Maps

The future development of traffic conditions in general will be marked by constant changes, such as the shift in the principles guiding mobility. But technical or organizational innovations as well will influence the further development of transportation and its framework conditions. However, the concepts and technological developments, the introduction and expansion of transportation innovations all do not follow a fixed pattern. And it is often underestimated how long it takes for an innovation to have an effect in the overall system. The question of when specific innovations are actually put to use and how they spread is of great significance for other influential factors, for the impacts on traffic, and also for the stakeholders in traffic sector and their behavior.

In order to make this clear, ifmo selected four important traffic innovations as examples and compiled road maps for their development processes from 2005 to 2025. This concerns the following innovations:

- Electronic fare management (electronic ticketing),
- Individual traffic control system,
- 12,500 TEU (Twenty Foot Equivalent Unit) container ships with freight reloading facilities and infrastructure in the inland area,
- Interoperable rail traffic networks in the EU.

The compilation of the road maps relied considerably on the expertise of the scenario experts. The following specific steps were taken:

- The technology/innovation was labeled based on research and the study of literature; experts then checked and amended the results.
- Up to five experts were questioned beforehand for each innovation as to the factors that could influence the various technological developments and the technology's spread.
- The core project team members compiled interim scenarios for the years 2010, 2015, and 2020.
- The various experts in the workshops estimated how the selected innovations could develop by the year 2025 within the framework conditions of the interim scenarios.

The results of these four road maps are compiled in a separate report.[8] They are compatible with the scenario described in Chapter 5, "Mobility Requires Action".

[8] The study "Szenario-Roadmaps für ausgewählte Verkehrsinnovationen" ("Scenario Roadmaps for Selected Traffic Innovations") may be ordered in German from Institut für Mobilitätsforschung (ifmo), Berlin.

3. The Scenario Process – Looking Back and Looking Forward

3.1 Is Predicting the Future like Taking a Walk on a Tightrope?

The objective that the ifmo scenarios pursue is in fact to compile illustrative and realistic concepts of mobility in the next twenty years on the basis of expert statements. But because like all statements made about the future, no statement on the developments of the influential factors relevant to transportation can ever be made with absolute certainty, it seemed important to us that those developments that were considered plausible be substantiated by the experts, and that they then be linked to form a consistent overall vision by means of the scenario method selected. In this way it is safeguarded in methodological terms that any ideas that deviate too much from what the world of the future is, or that are too eccentric, can be identified and discarded.

From the start of our project, there was great interest as to how strongly the assessments made by the experts would change in the course of regular updates, and what their justification for such changes would be. To put it in different terms: How long will the scenarios be a valid basis for long-term planning? In which intervals must the data and assumptions be updated? How precise are the predictions about the future after a few years?

Answers to these questions will take shape step-by-step, from one update to the next. This is why this first update may provide insights, but surely not any final results. Nonetheless, we wish to point out this interest already at this point in time, and we intend to begin commenting on the scenario process under this aspect.

Because expert prognoses are not developed without the general societal situation taking an influence, some key economic and political aspects are described below that made up the framework conditions for the first mobility scenarios in 2001/2002, and that were given when the update was prepared in 2003/2004.

3.2 The Economic and Political Framework Conditions on which the Basic Scenario and the First Update are Based

During the first half year of 2001, when we asked six groups of experts in workshops lasting several days how they imagined their specific area of expertise would develop in the fields relevant to mobility in the coming twenty years, the Federal Republic of Germany was looking back on three years with an average economic growth rate of 2 percent. Despite this fact, the mood of the population was more or less reserved. The upcoming introduction of the Euro and the expansion of the EU made many people skeptical. Topics such as the party donations scandal and the resignation of the entire EU Commission because of irregularities in awarding EU contracts contributed to increasing the political sullenness felt in Germany, much lamented as this was. Immigration was a frequent topic in the media and more or less presented as a problem. The BSE scandal was growing ever larger, causing great insecurity with consumers, and led to reciprocal political accusations among various European countries. Even in the year 2000, when the gross domestic product grew by 2.9 percent, there were only very few news stories that were able to generate a feeling of optimism and a sense that things were taking a turn for the better in Germany.

In the face of this generally negative mood prevailing in the country, the view the experts took into the future was surprisingly positive. For example, they felt that an average economic growth rate of just over 2 percent in the coming twenty years was entirely realistic.

In the two and a half years that passed until the scenarios were updated, in the spring of 2004, the negative reports increased and drove the mood in Germany further down. General public opinion held that the introduction of the Euro was being used to increase prices on the sly, which had negative effects on the purchases made. The insecurity of the public pension fund dominated public discussion; the concept of the state-subsidized "Riesterrente" private retirement arrangement more or less turned out to be a flop, and the percentage of income being put into savings increased.
The G8 Summit in July of 2001 in Genoa was accompanied by massive demonstrations protesting against economic globalization. When Vodafone took over the Mannesmann corporation, reports of unjustifiably high salaries and severance payments made to executives in the industrial sector caused outrage in the population over what was felt to be a "self-service mentality".

In September of 2001, there was a stock market crash that affected the so called "new economy" in particular.[9] The terror attacks on September 11th, 2001, and increasingly frequent attacks world wide, contributed to people becoming even more insecure. The Iraq War began and continues to be referred to in the German media as an "unsolved problem" even today.

And, finally, the economic situation in Germany underwent a negative development. The growth rate of the gross domestic product sank from 0.8 percent in 2001 to just over 0.2 percent in 2002 and ended up in the year 2003 at a negative growth of 0.1 percent.

Following the parliamentary elections in September of 2002, the re-elected coalition of the Social Democratic Party with the Green Party (referred to as the "red-green coalition") for the first time presented a comprehensive reform package in the form of the Agenda 2010. However, it was not possible to promptly implement the necessary reform measures due to massive criticism from the unions and the continued discussion of which cuts in the social welfare system it could be expected of people to tolerate. All of this resulted in the uncertainty and pessimism about the future becoming more firmly entrenched as the nation's basic mood.

Under these circumstances, it was not easy to gain an objective view of the situation and the general sentiment in Germany. On the one hand, it was claimed that by their constant criticism, politics and the media were actually creating the negative situation in Germany, since, in fact, when compared with those given world-wide, our living conditions were above average and we were "complaining on a high comfort level". On the other hand, there were voices which announced the end of an era: for the first time since the end of World War II, the continuous growth of prosperity had ended and the coming generations would have to survive on less than the generation of their parents currently had available.

Against this backdrop, it is not surprising that most of the experts from economic research institutes corrected the estimates they had proposed in the year 2001 downward in the scenario workshops in 2004. If the pessimistic projection for the development of the gross domestic product was just under 2 percent per annum in 2001, it has sunk to 0.8 percent per annum in the meantime.

[9] $12 billion were nominally destroyed world wide.

3.3 The "ifmo Scenario Dialogues" with Politics and the Economy

A further objective the present scenario project had set itself was to use the results obtained as a basis for a regular dialogue with representatives from politics, the economic sector, academe and special interest associations. The future demands on mobility must be analyzed from different angles, while taking into consideration their reciprocal dependencies. Because it is precisely such interconnected, multifunctional analyses that, for various yet understandable reasons, the individual expert departments of politics, the economy and science all lack.

Thus, interdisciplinary expertise is still the exception in academe because academic careers continue to require highly specialized and detailed expert knowledge such that individual researchers can best distinguish themselves. For this reason it is rare that an engineer, to use this profession as an example, would examine issues of social sciences, economics or politics alongside those of his or her actual field of expertise. True, highly specialized knowledge in a specific area is the necessary prerequisite for advancements in research, but it is nonetheless unfortunate that this often means that there is no connection to other disciplines.

The same applies to the business sector, where companies will almost always, in analyzing which decisional options have the best chances of success, focus exclusively on those changes that are impending in their own sector. After all, taking the decision would soon be very confusing if the factors influencing all relevant environments were considered at the same time. In the end, the resulting complexity would no doubt have to be reduced again in order to draw conclusions regarding the individual areas of responsibility.

Nor is an interconnected, integral manner of thinking and acting established practice in politics and the administration. Here as well, the principle of the division of work applies. In political parties as well as in the Federal Ministries and Authorities, the need to possess expert knowledge results in clearly differentiated areas of responsibility for economic issues, finances, traffic or similar areas of expertise. Even within the traffic departments themselves, there will be individual experts for road, rail, and air traffic.

Alongside this division of work based on expertise, tactics also play a large role in the decision-making process of politics. The acceptance of political decisions is very often dependent either on the general mood prevailing in the population or on whether or not the point in time at which they were taken was suitable, for example at an important election. And finally, there are those subjects that a politician best need not bring up at all.

Certainly, these various forms of dividing up work are not entirely indispensable, in view of the range and variety of existing knowledge. Nonetheless, there are decisions that require close cooperation, open dialogue and a comprehensive view across all boundaries. This applies in particular to all decisions that are relevant for many disciplines, sectors or political areas – in other words, and particularly so, to all decisions impacting the transportation sector.

After all, passenger vehicles and trucks compete for the same infrastructure; rails and roads are competing for the same, and limited, public funds. As regards freight transportation, politics has been propagating its objective for years now that "freight should be transferred from the roads to the railways", but has never bothered to taken the interests of the reloading industry into consideration. It is as a matter of course that politics demands that the economy grow – while failing to take into account the effects this will have on traffic demand. Everyone is an advocate of having the Eastern European nations accede to the European Union, but no-one remembers that this will entail upgrading the traffic infrastructure.

Based on these few examples it becomes clear that decisions in the field of traffic policy can only be taken in an informed way, and situations can only adequately be assessed, where the general situation is perceived as a whole and the interplay of many factors is taken into consideration.

For this reason we are striving for a regular dialogue with all of the relevant traffic stakeholders and decision makers. We want to make the public more aware of the varied reciprocal dependencies that decisions about traffic policy involve, and we want to ensure that the discussion about the future of mobility more adequately addresses the problems while orienting itself to the future.

3.4 First Experiences Gained in the Dialogue Process

For all of the reasons cited above, the Institute for Mobility Research initiated this discussion in the years 2003 and 2004 in its "ifmo Scenario Dialogues" with the transportation experts of the four political parties represented in the Bundestag (German Parliament), with representatives from the Verkehrsministerium (German Ministry for Transportation) as well as with discussion partners from transportation suppliers and special-interest associations.

The Institute also presented the results of the scenario study in panel discussions and at lecture events. We view this to be the beginning of a long-term, facts-oriented dialogue about the most important influential factors for mobility in the future, and their reciprocal dependencies.

In preparing the first scenarios in 2001, we forwent extracting any recommendations from the results we had obtained, for example on how to ensure that a positive vision of the future becomes reality, or on how to avoid a negative development, which is normal practice for scenario methods. This was due to our concern that the discussion rounds would focus only on the recommended actions and not the scenarios themselves. It was important for us to emphasize that we had not compiled desired visions of the future, but realistic, scientifically founded paths of development that were based on current evaluations. We wanted to make very clear that we do not understand our role to be that of political consultants who have a personal agenda. Instead, we wanted to contribute methodologically secured results to the mobility discussion we need so urgently, which must take place across all fields of expertise and administrative departments.

What became apparent in the dialogue rounds, however, was that the discussion partners viewed the more optimistic scenario to be absolutely something worth striving for. It was in particular the representatives of the political sphere who asked us over and over again which preconditions we felt needed to be created in order to realize the vision of the future as set out in the "Action Scenario". Recommendations for action were thus often in fact requested in these discussions about the future of mobility.

In the first dialogue rounds, we also noted that the participants who represented companies were very often open and farsighted in discussing the long-term connections, dependencies and necessary actions to be taken. Politicians, in contrast, think in the short and medium term and are very interested in being provided with options for action. This applies even for facts that can be influenced only in the long term, such as the demographic development of the German populace and immigration; the maintenance, extension and upgrade of the infrastructural system; the diffusion of technological innovation; or the change in settlement structures and forms of living. Because politicians often orient themselves by the resolutions taken at party conventions and basic ideological convictions, they were often very reserved when they were asked to evaluate the developments in politics, the economy and society of the coming twenty years that our experts had assessed as realistic.

For these reasons, we have highlighted the decisions that will need to be implemented in order to fully realize the described scenario in the present update. We will be including these options for taking action in the dialogues in the future.

Otherwise, the discussions in which the participants came from very different institutions proved to be particularly constructive. In them, mobility was viewed from contrary points of view, for example when the groups were comprised of experts from environmental organizations, industrial firms and political parties. While subjects such as environmental aspects and the upgrade of the infrastructural system; economic growth and traffic growth; demographic developments and the demand for labor are often discussed in public with ideological overtones and irreconcilable positions are taken by the various groups, the scenario dialogues saw an extremely productive exchange of opinions happen. As the representatives of these groups were involved in a dialogue in the context of a comprehensive traffic policy, they exhibited a surprising degree of mutual understanding regarding the same topics where normally, the conflicting objectives of the various groups lead to great friction.

This reaffirmed our conviction that our scenarios provide a solid foundation for a productive discussion about the factual needs and options for action, also between stakeholders – and particularly between stakeholders – who otherwise, because of their contrary opinions and differing ideological orientation, rarely start a conversation with one another.

The following Chapters 4 and 5 will describe the current estimations about mobility in the year 2025, as compiled by the experts whose number has in the meantime grown to 90. Based on these results, we will continue the dialogue process starting at the end of 2005, following on from the ifmo scenario dialogues of 2003 and 2004.

4. What Happens When Nothing Happens – A Critical Look into the Future

4.1 Preliminary Statement

We would like to begin by describing how the situation in Germany could develop in the coming years if we allow the future to happen to us without influencing it in any decisive way

We will not present a full and complete scenario in the following text. Rather, we have taken some framework conditions from an opposing scenario[10] we feel are particularly important and have linked them with one another.

This description of the situation is to make clear that the (traffic) world could considerably deteriorate, based only on the development of some framework conditions up to the year 2025, in particular if we do not take action now.

Seen against this backdrop, the options for action are more clearly outlined that are either available or must be taken in order to ensure we have a future like the one that is presented in greater detail in Chapter 5.

[10] The opposing scenario will be briefly presented in the following text. A complete tabular summary of this scenario may be ordered from the Institute for Mobility Research, Berlin.

4.2 The Direction Things Could also Take ...

It is entirely possible that the volume of passenger traffic will enter into a permanent phase of decline, for the first time, over the next twenty years. Many people might consider this to be an attractive perspective, considering the already high strain that the traffic infrastructure in Germany is under, and furthermore considering the frequent delays in air and rail traffic as well as the environmental pollution related to traffic. Whether this decrease in traffic volume is in fact desirable or whether it could actually be an indicator for an entirely different, undesirable development can only be judged when it is viewed in connection with other framework conditions.

Disposable Household Incomes on the Decline

With an assumed economic growth rate of 0.8 percent per annum for the next twenty years,[11] the average gross income of those gainfully employed will only slightly increase also in nominal terms, reducing the real disposable income for the majority of the population.

This coincides with a further consequence of the assumed economic development: it will no longer be possible to fund the currently existing social security systems, which of necessity will lead to a higher compulsory own contribution of citizens to their pension benefits and preventive health care measures. This development will further reduce the disposable income.

The demographic development forecast for the coming twenty years will witness a constant increase in the number of retired people and pensioners while the number of younger people will decline. This trend will be reinforced by the sinking number of immigrants; the number of people living in Germany will decrease on the whole. As a result, the number of people capable of gainful employment decreases, while the number of older people strongly increases. Furthermore, life expectancy constantly increases, which means people are becoming older and are receiving pension benefits for a longer period of time. This means that the pension fund payments for that share of the population that is gainfully employed will almost inevitably continue to increase.

Compensating the strain on the German national pension fund by raising the legal retirement age is a measure that is often discussed and hotly disputed. Factually, the real retirement age today is already approximately 5 years below that of the legal age of retirement. This means many people use the opportunity to retire earlier than at the age of 65, as is provided for by law.[12] The desired effect of relieving the national pension fund could already be achieved today if it were possible to keep the majority of employees working until they reach the valid age limit for retirement. So in view of the fact that no success has been achieved up to now at relieving the strain on the pension fund with the current lower age, it still needs to be proved that this compensation can be reached by establishing a higher retirement age by law.

At the same time an increasing polarization of income is expected, which means a small part of the population will enjoy higher incomes, while a larger portion will have to cope with having a smaller (real) income. The middle income group will successively shrink, according to the experts.

To a certain extent, the increasing financial strain will surely be compensated by consumers switching to low cost products, as is often the case today. This is applicable for consumer consumption in general, not only for mobility.

[11] The experts considered an average economic growth rate of 0.8 percent per annum to be as probable as an economic growth rate of 1.8 percent per annum.

[12] The average factual age for entering retirement in the year 2001 was 60.2 years in Germany. In the states that existed in the Federal Republic of Germany before the fall of the Berlin Wall, this was 60.5; in the states acceding to the Federal Republic of Germany after the fall of the Berlin Wall, this age was 58.7 years.

Many People have to Limit Themselves in their Mobility

In the coming years, mobility will become more expensive. In view of the financial situation of public budgets, many experts assume that sooner or later passenger vehicles as well will have to pay tolls for using the Autobahns (highway), without this being compensated for by other charges on participants in traffic being reduced in any meaningful way, such as passenger vehicle tax, petroleum tax, and ecological tax. This topic was already discussed even prior to the technical prerequisites being created for the collection of the toll to be paid by trucks. The regular denials of the Bundesverkehrsministerium (Federal Ministry) are considered by most of the expert public to be nothing but political tactics.

As early as today, the German state annually earns approximately Euro 50 billion in duties levied on motorized road traffic. Although the condition of our traffic infrastructure has been deteriorating over the last years, the state reinvests approximately only one-third of the overall duties collected into road infrastructure. It has been shown in the past in many instances that the rising costs of mobility caused by the increase in petroleum tax or ecological tax have not achieved a reduction of traffic volume. The majority of people either would not like to, or cannot afford to, do without their individual mobility, even in the face of rising costs. It can thus be expected that road traffic will be viewed, also in the future, as being especially suited for being charged with higher or new duties.

In addition, it can be assumed that in the coming years, the basic price for fuel will rise.[13] The expectation that the "depletion mid point" will be reached in the next 10 to 15 years is viewed to be an indicator for the price of crude oil increasing world-wide.

Continuing armed conflicts in the area of the OPEC countries could reduce the world-wide supply of petroleum or additionally increase the pressure on the crude oil price.

Likewise, the increasing demand for energy in countries like China and India will presumably drive the barrel price of crude oil higher.[14]

But it is not only road traffic that will be affected by these price increases. The introduction of a kerosene tax for air traffic is constantly being discussed. As a result, traveling by plane would become more expensive in general.

And even public transportation is constantly threatened because it cannot be expected that the regionalized funds, which the federal government currently pays out to the Länder (states) for the purpose of financing public transportation, will continue to be granted at the same level in the long term. Should these funds be reduced, the public transportation systems would inevitably have to either reduce the number of the lines they operate, or raise their prices.

[13] At the time this study was written, the price for a barrel of crude oil was around $60.

[14] In an article in the business section of the newspaper "Tagesspiegel" dated June 30th, 2005, it was stated that a constant increase in the crude oil price to over $70 per barrel within one year would result in the economic growth decreasing by 0.3 percent.

The Importance of Individual Mobility Increases

Many people will be forced to adjust their mobility as a result of the contrary developments that the costs of mobility (higher) and disposable income (lower) take. This means doing without a passenger vehicle, driving and owning passenger vehicles for a longer time, while buying smaller, less expensive vehicles, taking shorter vacations, and booking more low-cost, no-frills flights. In general, it is expected that people will develop a "bargain-hunting mentality", and that this will also extend to mobility. In many cases, people will not be able to avoid limiting themselves as regards their mobility.

However, such a reduction of mobility ends where job-related and private day-to-day requirements exist that the individual either cannot influence, or that are difficult to influence. For example, mobility can be a requirement of the labor market (weekend commuters, people in several employment relationships, providing services to customers, and the like). Likewise, the increasing number of single-parent families and single-person households reflect lifestyles that normally require greater mobility, for example in order to maintain friendships or long-distance love relationships, or simply to get everyday life organized. For this reason, it can even be assumed that mobility spending, despite people's readiness to restrict their mobility, will increase slightly in many cases.

Based on the polarization of income referred to above, the demand for exclusive mobility will increase (for luxury passenger cars, exclusive flights and train trips, expensive vacations), however in a limited scope.

Under these conditions, individual mobility styles could once again serve as indicators for luxury and prestige. A smaller portion of the population is once again to flaunt what it's got, for example its passenger vehicle, the airline it travels on, or the vacation destinations it selects. Concurrently, a larger share of the population must deal with the issue of covering its respective mobility needs or meeting its mobility demands despite having fewer financial resources.

Freight Transportation in Germany Increases even without Economic Growth

The previous statements are valid in particular for passenger traffic; for the most part, the developments in freight traffic remain unaffected by the influences described above.

As regards the freight transportation volume, a growth rate is to be assumed that that is only partly influenced by domestic demand. The essential causes underlying the increase of freight transportation do not have their origins in the country, but are rather driven by global developments – in this context, the key words are the increasing international division of work or the relocation of German production plants into Eastern European countries.

In view of the German economic sector's strong orientation towards foreign trade, it is to be expected that the freight traffic going into Germany and leaving the country will further increase. Furthermore, the central location of Germany within an expanded Europe means that there will be a strong increase in transiting traffic.

In other words: freight transportation in Germany will grow no matter what, even when there is a weak domestic economic trend. The more the German economy will grow in the coming years, the more traffic volume will increase.

The argument frequently heard that because of the foreseeable demographic decrease of the German population from 2020 onwards, traffic demand will also decrease and that therefore, further improvements of our traffic infrastructure conditions are no longer necessary, thus misses the point. In fact, this stance, were it to be made reality, even jeopardizes the qualities that characterize Germany as a country where economic enterprises locate.

Poor Road Infrastructure Prohibits Mobility and Traffic

In view of the weak economic development and the strain that the public budgets are under (unemployment benefits, pension payments, and similar expenditures), it cannot be assumed that it will be possible to maintain or even upgrade and expand the traffic infrastructure on the scale that would be adequate for the growth of freight transportation that is being forecast. It is improbable that the low level of importance that traffic policy is given, as opposed to other political departments, will be raised, and that more funds will be made available than previously in order to perform the tasks required, and it is all the more unlikely in times when budgets are tight.

This means that on many routes, traffic jams will be a regular occurrence, in particular in the heavily frequented freight transportation corridors. The average speed on German roads will be reduced almost on a nationwide basis. The results for freight transportation would be comparable with that of strikes: economic development would be slowed down, which would entail disadvantages for individuals and society alike.

Railway Traffic Profits from Growth on the Roads, but cannot Substantially Relieve Them

In this type of situation, the obvious political move is to once again focus on railway freight transportation in order to solve, or at least to reduce, the problems faced by the overloaded road traffic network. However, the objective of the past years to increase the share of railway freight transportation was never realized in the past years. For this reason it can hardly be assumed that – in times when financial resources are tight – the railway infrastructure would be expanded in order to accommodate freight traffic, or that it would be upgraded to ensure interoperability within Europe. Even less likely is that in economically difficult times, the road infrastructure will be substantially relieved by traffic moving to railway transportation.

Environmental Pollution Increases Further

In an economically weak environment, it can hardly be expected that companies will either want to, or will at all be able to, regularly upgrade their vehicle fleets to the latest technological standards. For many defects of the road infrastructure, it will not be possible to provide technical compensation, for example by means of having traffic information systems issue recommendations on how to avoid traffic jams in real time. Nonetheless, it can still be assumed that because of initiatives launched by Brussels, official environmental requirements will be made stricter in the coming years. This is all the more so the case because the population is reacting more sensitively to the climatic disasters world-wide that are occurring more and more frequently, and will take an increasingly critical stance despite the difficult economic situation.

As a consequence, the overall ecological situation will deteriorate, despite stricter official environmental requirements. To cite a few examples, there will be greater noise pollution from badly maintained roads, additional emissions of gases because of outdated technology, regular traffic jams and the acceptance of de-tours, and similar problems. It is to be expected that this will be a difficult area of conflict, both nationally and internationally.

More and More Companies Relocate

Seen against the backdrop of such developments, there is a risk that even more companies will relocate or move parts of their operations abroad. Even just by increasing the cooperation with foreign suppliers, many companies feel economic relief since for many years to come, the labor costs in Eastern Europe will remain below those in Germany. This will inevitably result in the number of jobs in Germany decreasing.

The tendency of companies to move abroad, or to relocate certain of their activities abroad, will be further intensified by the fact that the number of qualified persons gainfully employed will continuously decline at the latest from 2020 onwards.

This is further aggravated, at least in the automotive sector, by affordable imports from Asia, which have already reached a remarkable scope at the present time. These developments will put considerable pressure on prices in Germany and will force auto manufacturers and other firms in the sector to take further rationalization measures. As a result, there is the risk that further jobs could be lost to Germany.

It should be noted that the future developments presented here are not a break with trends. They are based on projections that even today are indicated by an entire range of factors. If one orients oneself by the political and societal trends of the past and the present, then it is recognizable that many of the developments discussed are nothing more than the present conditions carried forward.

Furthermore, there are (as yet) no indications that a basic change in the attitudes held by the population is taking place where dealing with limitations and doing without certain luxuries is concerned, on the one hand, and as regards the courage it needs to make some changes, on the other hand. But such a change in awareness is not really supported by politics or other societal groups, anyway. If we take the tenet "If things are to remain the way they are, a lot will have to be changed" as our guideline, then such a change in awareness is in fact one of the most basic requirements for permanently maintaining the standard of living that Germany has achieved. However, it seems that there are still too many people concentrated on preventing any form of change whose impacts they are unable to clearly evaluate. There does not seem to be a shift in trend, neither in society nor at the political level.

What Happens When Nothing Happens: Developments 2005–2025

Assumptions

- The average gross domestic product growth is 0.8 percent.
- Disposable household income declines.
- Mobility is more expensive.
- Mobility remains important in order to organize work requirements and private lives.
- The public budget does not have the funds needed to create adequate pre-requisites for an efficient infrastructure.
- Freight transportation on German roads increases without the economy experiencing any considerable growth; should the economy grow, freight traffic will increase to a greater degree.
- More companies leave the country because of bad conditions.

Effects on Traffic

- People do without mobility where it is easiest to cope with; passenger traffic volume declines.
- Freight transportation continues to increase.
- The number of traffic jams increases and the average speed at which people drive on the Autobahns (highways) is reduced all across Germany.
- The strains on the environment caused by traffic increase.

It does not take a pessimist to regard the development described as quite realistic: Failing a change of essential framework conditions in Germany in the years to come, the problems we will be facing in the year 2025 will be far greater than the problems we already have today. Considering that over the past years in Germany, any implementation of political concepts has taken an increasingly long period of time; that many decisions are no longer being taken in Berlin, but rather in Brussels; and that the population, already feeling insecure, is not exactly open to a process of change, nothing would appear to be more difficult than to introduce a genuine change of such framework conditions.

Without such a fundamental change, however, the problems encountered by society in the next 20 years will not be limited to mobility alone, but will rather have repercussions on the whole of Germany.

Is it really true – as some believe – that the situation must become even worse for politicians and the population in general to accept the need for more drastic change?

The following chapter sets out that the perspectives for the future described on the preceding pages are by no means inevitable, and details how matters might develop if we influence their development and take the right steps. However, it is important to remember that this calls for significant efforts and (upfront) commitments on the part of politicians, the economic sector, associations, the media, society and, not least, of each individual in order to let the scenario become reality that we have entitled “Mobility Requires Action”.

5. Scenario "Mobility Requires Action" – A Look Back from the Year 2025[15]
5.1 Passenger Traffic in the Year 2025
5.1.1 Moderate Economic Growth as the Population Grows Older

The German Economy Experiences an Average Annual Growth Rate of 1.8 Percent

Promoting economic development and keeping the standard of living in Germany at roughly the same level that it had been at in 2005 required considerable efforts to be made in the years from 2005 to 2025. During this period, the fast growth of foreign trade, in particular with China and India, had a very positive effect on the German economy (cf. also Freight Transportation in the Year 2025, Chapter 5.2.1 "Freight Transportation is the Basis of a Global Economy", page 58).

Comprehensive reforms were required to mitigate, at least somewhat, the aberrant developments that educational policy and the social security system had been taken in the preceding years. Because of the pressure exerted by the high rate of unemployment in the early years of the century, the labor market was made more and more flexible in a step-by-step process. Weekly working hours were increased in nearly all of the economic sectors, while the minimum wage was reduced.

The legal retirement age was set at a greater age and options for taking early retirement were cut back. As a result of these changes, the unit labor costs decreased significantly. Nonetheless, the gross domestic product grew by more than 2 percent only in exceptional cases, the average rate of GDP growth in the last 20 years amounting to approximately 1.8 percent[16] (cf. Illustration 2).

The Income Gap has Grown Further

Because of the weak development of the overall economy, the share of disposable income that private households had increased only slightly as compared to the share given in 2005. Furthermore, this growth was not spread evenly across all income brackets. The gap between poor and rich widened and the middle class grew smaller.

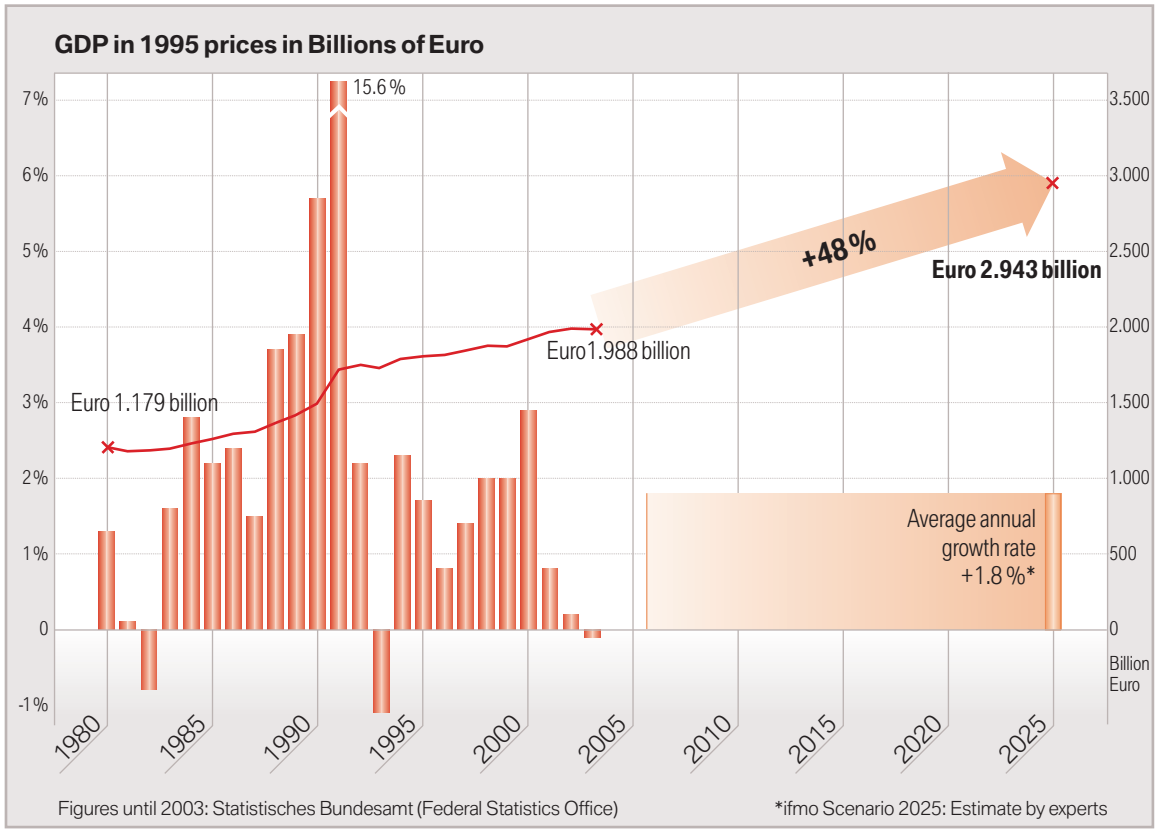


Illustration 2: GDP Development

[15] The Scenario takes a retrospective view from the year 2025

[16] In compiling the first Scenario Study "Zukunft der Mobilität 2020" ("The Future of Mobility 2020") in 2001, the experts assumed that, in the optimistic case, Germany's gross domestic product would grow at a rate of slightly over 2.0 percent, their pessimistic assumption at the time was 1.8 percent. Both estimates were lowered when the study was updated in 2004: Now the experts assume average annual GDP growth of only about 1.8 % up to the year 2025 to be realistic and justifiable, their pessimistic assessment being just 0.8 % per annum.

While the relatively small group of high-income earners has grown, the number of economically weak people has increased far more significantly.

People have Changed their Consumer Habits

Despite the slight increase in disposable household income, consumption has largely stagnated. By contrast, expenditure on private retirement arrangements and preventive health care measures has increased significantly. But there has also been a change in spending habits for consumer goods: Spending has shifted away from classic consumer products such as clothes, shoes, furniture and household appliances towards telecommunication and mobility products (cf. also Freight Transportation in the Year 2025, "Consumer Behavior Reflects Individualization and Globalization", page 67).

Mobility Spending has Increased Considerably

Mobility spending has increased in both relative and absolute terms vis-à-vis the 2005 levels. On the one hand, this is attributable to the specific prices for participating in traffic being increased, while on the other hand, the fact that mobility continues to have high priority in the design that people give their everyday lives is another factor.

The unequal development of incomes has had a polarizing effect on the demand for transport: While, on the one hand, demand for low-cost (mass) transport and no-frill offers grows, people are also willing to pay greater amounts of money for expensive, comfortable and lifestyle-oriented mobility (expensive passenger vehicles, first class flights, etc). In other words, while certain segments of the population can no longer afford many kinds of mobility, a small group of approximately 15 percent is highly mobile and accounts for nearly half of all long-distance passenger traffic (including long-distance commuters).

In all, the volume of passenger traffic is up by only 10 percent (cf. Illustration 3) – a very small increase compared with former periods. This means that the volume of passenger traffic has continued to grow apart from the development of the economy as a whole, a trend that had already been becoming noticeable at the turn of the century.

Role of Service Sector Continued to Increase

The service sector has experienced particularly high growth rates over the last 15-20 years. Since the turn of the century, the high-income groups in the population have exhibited growing private demand in particular for personal services and services that refer to leisure time and consumption. The options available in this sector were consistently expanded and varied to an increasing extent. Whoever can afford it avails himself or herself of the services of private caterers as well as style consultants and personal trainers.

Compared to the rates at which the gross domestic product grew, the turnover for company-related services has also increased over-proportionally, albeit at a slightly less dynamic growth rate than at the beginning of the millennium. Apart from demand for logistics services (cf. also Freight Transportation in the Year 2025, "Boom in the Logistics Sector", page 59), demand has increased in particular for knowledge-intensive services of the type rendered by research institutes, development offices and marketing agencies, to name but a few.

Relating all this to traffic, it is apparent that these developments entail an increase of short-distance travel (for example by a service provider to the customer or vice versa) and an increase in mileage covered in business and commercial traffic.

Demand for Labor Force still Covered

In absolute figures, the demand for labor has remained largely unchanged as compared to 2005. This is attributable to the fact that developments went in opposite directions: First, rationalization measures and the relocation of many companies abroad destroyed numerous jobs in Germany. On the other hand, it was possible to implement comprehensive reforms in the labor market in recent decades which served to create new jobs even with the gross domestic product exhibiting only relatively low growth rates.

As a result of these reforms, demand for labor has increased on all levels of qualification. Up until the point in time at which we are now looking back, up until the year 2025, this demand has been met largely by the growing share of female employees, by a longer working life (people are entering employment at an earlier age and retiring later), and by the growing number of immigrants, and this trend is likely to continue in the next years. However, the average age of persons in gainful employment has increased significantly.

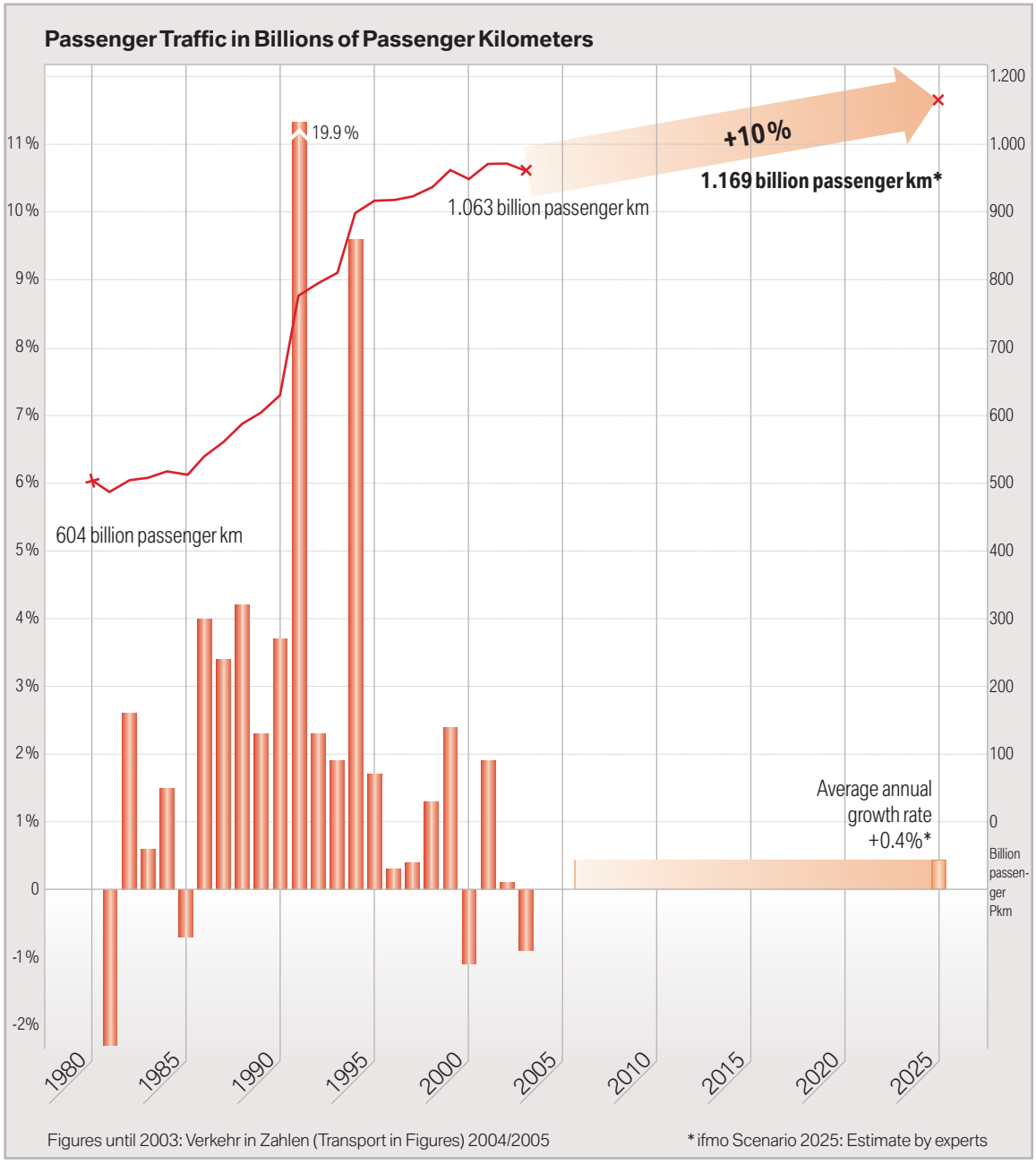


Illustration 3: Development in Volume of Passenger Traffic

Most likely, however, the demand for a labor force will no longer be covered after the year 2030.

Population Remained Stable only due to Influx of Immigrants

At approximately 82 million in 2025, the population of Germany has remained at roughly the same level as in 2005. However, this is exclusively attributable to the political intervention that led to a (net) balance of 200,000 immigrants per annum. In order to meet the demand for highly qualified employees, the Green Card Scheme introduced at the beginning of the millennium that never met with the desired success, was revised: Although the new scheme facilitates the immigration of highly qualified citizens and their families, which also resulted in increased immigration, the demand for labor, particularly in highly specialized industries, remains unfulfilled. Among other factors, the reasons are to be seen in the economic situation as well as in language barriers. Both factors contributed to many highly qualified potential immigrants choosing another country as their new home.

Furthermore, fewer highly qualified immigrants from the new EU member states have come to Germany to work here than anticipated – while concurrently, a significant number of highly qualified Germans have moved abroad, where they have better opportunities to pursue their studies and careers.

Ultimately, therefore, even the revision of the Green Card Scheme has not changed the fact that most immigrants come from crisis areas or are illegal immigrants, or people seeking asylum to whom Germany is obligated to grant such asylum. These immigrants account for the largest share in the overall volume of immigrants.

Death Rate in Germany Remained Higher than Birth Rate

Another factor which has remained unchanged since 2005 is the birth rate, still remaining at approximately 1.4 children per woman. The threat of a declining population constantly growing older, a familiar specter since decades, thus still prevails. At the political level, the reaction for many years was to allocate to women a particularly significant role within society and in the labor market, while at the same time seeking to improve the compatibility of family and professional life. Schemes such as a greater number of day schools and child care virtually from birth have been available for this purpose ever since 2003/2004, while women who are re-entering their profession are given targeted support and family allowances are paid to parents as a function of their income. While these measures succeeded in increasing the number of women gainfully employed and saw them returning to their professions at an earlier time than they did in 2005, the average number of children per family has not increased. Even families immigrating to Germany from countries with a far higher birth rate adjust to the typical birth rate in Germany as of the next generation. The urgent societal and political issue of which conditions must be met in order for women/couples to decide to have children – and in that case, more than one child – thus still remains unanswered.

German Population increasingly Growing Older

The German population has continued to grow older in the course of the last 20 years: While in 2003 20.5 percent of the population were under 20 years of age, the share this group has in the population in 2025 has dropped to just 17 percent. In absolute terms, this represents a decrease from 16.9 to 14.3 million. By contrast, the share of 60- to 80-year-olds has increased in the years from 2003 to 2025 from 20.4 percent (= 16.9 million) to 25 percent (= 20.6 million). The age group of people over 80 has even grown by 80 percent, up from 3.4 million to 6 million (from 4.1 to 7.3 percent of the total population) (cf. Illustration 4).

The number of single-person households has increased at the same rate as the number of over 60-year-olds: While in 2003, 14.4 million people lived alone, this figure has now increased to 19.4 million in 2025. By contrast, the number of multi-person households is down from 24.5 to 23.1 million.

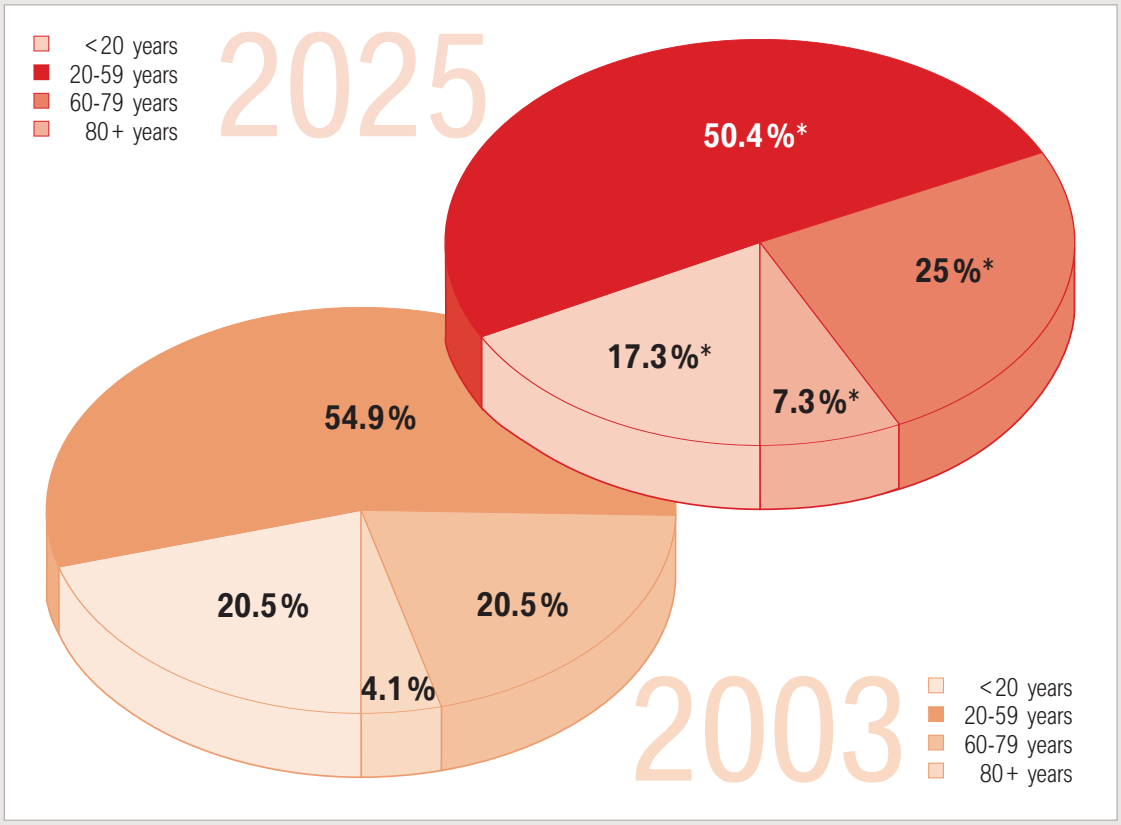
Demand for Traffic has Changed in Quantitative and Qualitative Terms

Demographic developments in the last 20 years have affected the demand for passenger traffic in both quantitative and qualitative terms. Although the population has remained at the same level – with the number of participants in traffic also remaining unchanged as compared to the numbers given in 2005 – the increase in single-person households has resulted in the number of trips increasing and more complex trip chains because the need for social contacts continued unabated.

Looking at the individual groups of participants in traffic, it becomes apparent that the use of transportation by school-children, students and apprentices, in many cases the very backbone of public transportation, has significantly lost its potential.

By contrast, the traffic volume generated by senior citizens has increased significantly, resulting in different demands being placed on the modes of transport: On the one hand, there is the group of affluent "young and active senior citizens" who enjoy traveling and look for high-quality modes of transport; while on the other, there are those senior citizens who have to live on a smaller budget and require inexpensive mobility options.

Age Structure of the Population in Percent



Figures 2003: Statistisches Bundesamt (Federal Statistics Office)

*ifmo Scenario 2025: Estimate by experts

Illustration 4: Development of Age Structure

These two groups are contrasted with a growing number of the participants in traffic who are limited in their mobility for reasons of age. Whether or not appropriate modes of transport suitable for use by senior citizens exist will be a pre-requisite for them to participate in traffic.

The group of immigrants also shows two quite opposing types of behavior in their traffic behavior: While economically weak immigrants mostly live in densely populated areas and use public means of transportation, immigrants with a higher income demand fast and high-quality traffic modes, both in everyday transport and when traveling on vacation to attractive destinations and to their home countries.

In view of the fact that the number of persons gainfully employed and, accordingly, the age groups of highly mobile citizens remain unchanged due to longer lifetime working periods and earlier entry into professional life than in 2005, the quantitative figures alone do not reflect any change in travel volume. It is to be expected only from 2030 onwards that, when the number of persons gainfully employed is likely to decline, the traffic volume will most likely also decrease.

Economic and Demographic Developments 2005-2025

Assumptions

- The average GDP growth is around 1.8 percent.
- The population remains unchanged at 82.4 million due to immigration.
- The share of under-20-year-olds decreases as opposed to 2005, while share of over-60-year-olds increases.
- The number of gainfully employed persons remains virtually unchanged as opposed to 2005.
- The demand for labor can still be met.
- Mobility spending will increase significantly.

Effects on Traffic

- Decrease in the use of transportation by school-children, students and apprentices.
- Increase in the use of leisure travel transportation by affluent "young senior citizens".
- Increase in cross-border traffic by immigrants traveling to their home countries.
- Increased traffic volume for the growing group of over-60-year-olds.
- Increase in the number of trips due to the growing share of services and the growing number of single-person households.
- Further polarization of demand for mobility options due to economic and demographic developments.

5.1.2 Germans Now More Mobile and Flexible

Individual Regions in Germany Devoid of Population

In the last twenty years leading up to 2025, a process of concentration in the distribution of the population has taken place in Germany nationwide: While the regions around conurbations[17] with high economic growth rates such as Munich, Hamburg, Leipzig, and Berlin have seen an increase in population with people moving to these areas (positive migration balance), the population has dwindled in economically weak, largely rural regions of Mecklenburg-Western Pomerania, Saxony-Anhalt, parts of Thuringia, and also in North-Hesse as well as in parts of the Ruhr District, this decrease in population numbers rapidly spreading in the course of time (cf. Illustration 5). Some parts of Germany have been literally abandoned. The state subsidies for economically weak regions as part of the Joint Task: Improvement of the Regional Economic Structure program, which for a long time had no effect, were finally discontinued due to the lack of funds. However, even had the promotion of these regions been subsidized without limits and for an unlimited period, this would not have resulted in the revitalizing effect desired, quite simply because the potential of labor, qualifications, purchasing power, and infrastructure was insufficient in the long run.

In the "winner regions", on the other hand, the trend towards suburbanization has continued. This development was sustainably fostered by the high prices of real estate in inner city areas, in conjunction with many people's unbroken desire to live in an area approximating the countryside. The only exception to this trend is the growing share of senior citizens moving back into the city: They no longer need as much residential space as before, and the shorter distances, good public transportation connections (cf. also Passenger Traffic in the Year 2025, Chapter 5.1.7 "Competition has Made Public Transportation a More Attractive Alternative", page 53), good medical services, as well as the wide range of nursing and general care services all make life in the city an attractive option.

These trends have also left their stamp on transport: Demand for transportation between metropolises has increased, while in more remote and economically weak regions the traffic volume has consistently declined. Hence, railway public transportation has been discontinued wherever it was no longer possible to justify its costs. Only in some individual cases are on-demand bus services still being operated in sparsely populated regions. Otherwise, transport is organized in these regions by passenger vehicles and local (self-) help schemes.

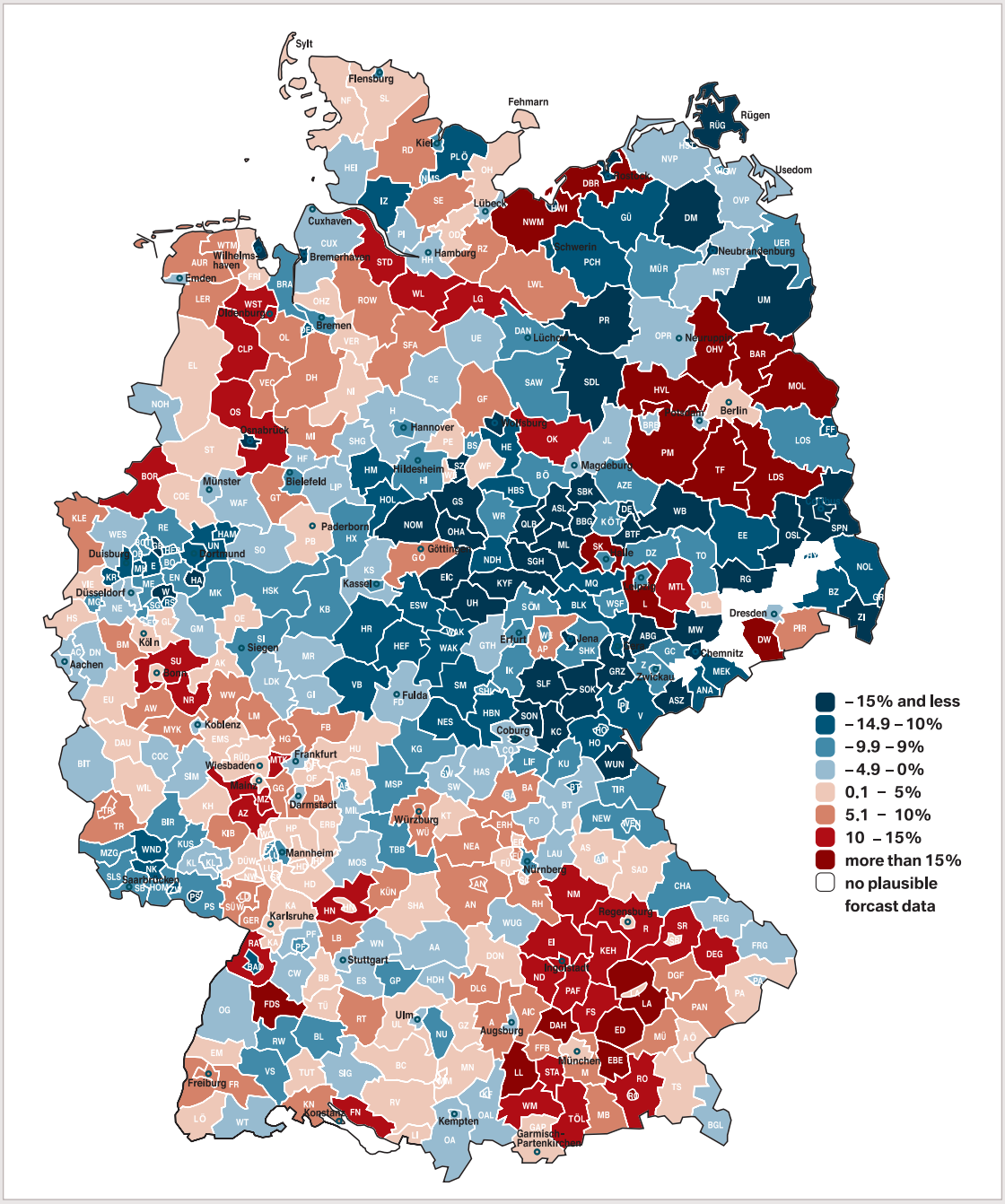
Social Relationship Cover Larger Area

This geographical spread of the population also has repercussions on social relationships and, accordingly, on the distances people cover in their everyday lives. An increasing number of people are prepared to travel longer distances between their place of residence and employment or in order to maintain their social contacts. Some of the most important reasons for this trend are:

- Husbands and wives are both gainfully employed.
- Employers and the place of employment change more frequently, while the place of residence remains the same.
- The number of weekend commuters increases due to significant regional differences in the cost of living.
- Private relationships take new forms, such as living together/living apart or in "patchwork" families.
- Infrastructure and transport options are the foundation for mobility.

[17] Cf the study "Germany 2020 – Demographic Future of the Nation", published by the Berlin Institut für Bevölkerung und Entwicklung (Berlin Institute for Population and Development) (www.berlin-institut.org).

Regional Migration of the Population in Percent
(Forecast by the Berlin Institute for Population and Development for 2000-2020)



Source: Berlin Institut für Bevölkerung und Entwicklung (Berlin Institute for Population and Development), Bundesamt für Bauwesen und Raumordnung (BBR, Federal Authority for Construction and Regional Planning), 2003

Illustration 5: Development of the geographical population distribution

Orientation towards Work Needs Balanced out with Recreation

People have learned that while their work must be performance-oriented, they can enjoy their leisure time in a way they have determined themselves. This balance of dedicated work and active leisure time is promoted and fostered by innovative employment contracts. They were introduced in the interest of ensuring company operations are more flexible while taking account of employees' wishes regarding their working hours. In the meantime, sabbaticals, annual work time accounts or even lifetime work time accounts as well as diverse schemes for part-time employment have become standard features in employment relations.

It was almost inevitable that this development led to leisure traffic increasing, both in terms of short trips and cross-border tourism, where in recent years the traffic volume has once again increased.

The extension of weekly working hours and, likewise, of lifetime working hours has slowed down the general pace of growth. Since people now work more hours a week than in the past, and since continued work and employment is now a matter of course for the 60-plus age group, growth rates in leisure traffic have dwindled in the last twenty years to values that are lower than those given in the 1990s.

Flexible working hours have served to slightly spread out the peak traffic loads previously experienced in commuter traffic.

Daily Schedules have Become More Complicated

With an increasing number of women entering gainful employment, the daily routines of many families has become significantly more complex. This means people must carefully plan their schedules and manage their time efficiently.[18] People run several errands at a time, and their car is particularly suited for such complex trip chains. Despite the very customer-oriented options public transportation has been offering, it still suffers from inherent drawbacks in this respect.

Traffic Behavior Becoming More Flexible – Passenger Vehicles Continue to be Highly Important Mode

With working hours and employment concepts becoming more flexible in terms of times and locations, and with traditional family and household structures increasingly dissolving, not to mention the increasing complexity of everyday life, the share of regular trips (people traveling at the same time to the same destination) has decreased. This means that selecting the mode of trans-port has become less of a routine matter.

This has two effects on the behavior of people when they select their transport mode: First, the automobile has become even more significant, since it can be used flexibly and at any time for virtually every purpose of a trip. Second, this development has significantly fuelled demand for individualized mobility, as has the higher cost of mobility, the greater focus many people are placing on prices in general, as well as fundamental changes in mobility behavior (cf. also Passenger Traffic in the Year 2025, "Pragmatism Prevails in Use of the Automobile", page 44).

[18] For the effects of this development on consumer behavior, see also Freight Transportation in the Year 2025, "Consumer Behavior Reflects Individualization and Globalization", page 67.

Good opportunities have opened up in the market for innovative providers of mobility services such as mobility consultants. The pre-requisite for their success is that they are able to provide clear information promptly on travel connections and transport options in inter- and intra-modal trip chains. Demand has increased as a function of the differences in the services offered and fares charged for various types of transport, making alternative options more attractive. An increasing number of people no longer have a passenger vehicle of their own, since because they are able to access the corresponding information at any time, they are able to choose the most appropriate mode of transport, or a combination of various transport options, depending on the purpose of their trip.

In other words, modern participants in traffic have become more flexible in selecting their traffic mode, provided they benefit in terms of the time required for travel (overall length of the trip, but reliability and punctuality also play a role) and the fares charged, and/or they enjoy comfort-related or lifestyle-specific benefits. However, whenever the process of changing from one mode of transportation to another becomes too complicated, people still prefer to own a passenger vehicle, as in the past.

Societal Developments 2005-2025

Assumptions

- The distribution of the population changes nationwide, with people concentrating in densely populated areas.
- Longer distances for commuters.
- More women in gainful employment.
- Longer weekly and lifetime working hours.
- Many people are required to rigidly plan their activities and ensure they make efficient use of time in their everyday lives.

Effects on Traffic

- Traffic concentrates on main routes between conurbations that have grown over the years.
- Social networks of relationships cover greater distances.
- Decrease in traffic volume in emigration regions.
- Slight increase in volume for commuter traffic and leisure traffic.
- Slight increase in the number of trips.
- Traffic behavior more flexible, with growing demand for personalized mobility options.
- Readily available and highly flexible in use, the passenger vehicle remains significant to many people, mainly because of its functional benefits.

5.1.3 Active Traffic Policy Establishes Important Framework Conditions

Traffic Policy gains Significance in Germany

While in the early years of the century, national policy focused mainly on implementing reforms in education, the labor market, and the social security system, the significance allocated to traffic policy started to increase substantially from 2010 onwards. It was understood to be a tool essential for promoting the economic development of Germany. Both the political level and society re-discovered that a high-quality traffic infrastructure was a significant factor for making Germany attractive to companies wishing to locate in the country. At this point, traffic was allocated a type of cross-sectional function in that it was considered in all areas of politics. While previously, public debate had generally linked traffic with negative attributes such as emissions, accidents or traffic jams, it has been accepted and communicated increasingly in recent years, also by politicians, as a necessary factor on which economic growth is based.

Harmonization and Liberalization in the EU Concluded

The countries of Europe have steadily and consistently met the uniform requirements in terms of traffic policy. Throughout the EU, general regulatory policy and traffic policy have been largely harmonized to meet the needs of the market and to ensure far-reaching liberalization. In some aspects, this has had far-reaching consequences for the various member nations.

The most important changes impacting Germany include:

- Introduction of a passenger vehicle toll geared to actual road use and emissions on the Autobahns (highways) and on certain regional expressways, with the truck toll scheme being expanded by introducing criteria geared to actual road use for all weight categories (cf. also Freight Transportation in the Year 2025, "Charging Toll in Order to Efficiently Manage Traffic", page 70).
- Privatization of many Autobahns (highways) and regional expressways.
- Introduction of a uniform railway traffic market in the EU, with the same rules applying to all rail transportation companies offering their services on European networks. These refer to non-discriminatory access to the rail network for all railway companies, necessary staff qualification measures, homologation of rolling stock, and handling of cross-border traffic.
- Consistent practice of tendering traffic services in passenger rail transportation and public transportation.
- Conclusion of the EU/USA Open Sky Accord.
- Harmonization of European air traffic control.

In Germany, because of the lack of funds in public budgets, the market-oriented re-alignment of traffic policy was powered in particular by the need to reduce public spending. The objective of enhancing the efficiency of the overall traffic system was only a secondary issue.

Increased Investment into Infrastructure

By basing road traffic on a system of user-based financing and by privatizing most of the road infrastructure, as already mentioned, it was possible to increase the over-all volume invested into improving the infrastructure, although state spending on traffic has been further reduced in the twenty years leading up to the year 2025 in both absolute and relative terms.

Now most of the – reduced – public funds go into rail traffic, even though some years ago the state gave up its involvement in rail traffic as such. The public sector nevertheless considers itself to primarily be an investor in traffic infrastructure and as the party ordering regional traffic services.

The funds required for investments in road traffic are mostly generated by toll.

Environmental Policy once again in the Focus of Public Interest

Also where environmental policy is concerned, a lot has changed in the last two decades. Although people are still concerned about their jobs being secure, their retirement arrangements and national security as a whole, environmental policy has regained significance. This is attributable to the increasing occurrence of natural disasters such as severe storms and flooding. This resulted in environmental policy once again becoming the subject of political and public debates.

The population accepts the introduction of stricter standards and environmental charges, just as they expect technical solutions. Environmental policy no longer means that people must orient their lives by austerity principles. Instead, it entails the use of innovative technologies that serve to maintain the standard of living, and pricing policies based on the cause-and-effect principle.

While in some instances, participating in traffic has become a lot more expensive, traffic is cleaner, quieter, and consumes fewer resources, despite its increased volume.[19]

Developments in Traffic Policy 2005-2025

Assumptions

- Traffic policy takes on a higher priority within the overall world of politics.
- General administrative conditions and policies for traffic deregulated further and harmonized throughout the EU.
- Growing orientation by the market determines traffic policy in Germany.
- The population advocates consistent environmental policy focusing on innovations.

Effects on Traffic

- Despite the increase in traffic volume, the overall consumption of energy in transportation, as well as noise and air pollution, decrease slightly.

[19] The chapters specifically dealing with traffic carriers (5.1.4, 5.1.5, and 5.1.6) describe the implications that such stricter environmental policies have.

5.1.4 Driving has Become More Expensive – But Traffic Keeps Flowing

User Financing and Privatization of Road Traffic now a Reality

The condition of the roads in Germany has deteriorated considerably in the course of the last twenty years, since the infrastructure was only inadequately upgraded and expanded and since truck traffic increased. The only reason why the road system still functions as a traffic carrier in spite of the depletion of public funds – albeit at the price of decreasing quality in some regions – is that the political level has continued its first steps, taken in 2005, to introduce a user financing scheme, in which the revenue generated will be spent on the road system as such (and not on other purposes) and to privatize the infrastructure.

While in 2005 only about 60 percent of the revenue generated by the toll on trucks was invested into traffic routes – including railway and waterway transportation as traffic carriers – the revenue now earned is re-invested nearly 100 percent and exclusively into improving the road infrastructure, simply because this is what needs to be done. The same applies to the "A-model" solutions, as they are called in Germany:[20] While in 2005 only a few sections of the Autobahn were offered to the first private operators in order to finance the necessary increase in capacity and ensure appropriate maintenance, there are now large, private operating companies responsible for large sections of the network of Autobahns (highways) and regional expressways.

This means that today, in 2025, the government limits itself largely to acting as the principal issuing tenders for infrastructural services or ordering same. Only in those instances in which private investors are unable to obtain an adequate return on investment does the government get involved in funding the project, either fully or by providing partial financing. Beyond this, the state has retained its constitutional responsibility for all matters of urban and spaces planning, zoning, and approval.

Toll for Passenger Vehicles Introduced

Following the example of toll on trucks, use-related toll for the Autobahn and certain regional expressways is also charged in 2025 for passenger vehicles. The revenue generated in this way is re-invested almost entirely into the road infrastructure. The use of smaller and subordinate roads remains toll-free, with the exception of those located in a few inner cities (cf. also Freight Transportation in the Year 2025, "Charging Toll in Order to Efficiently Manage Traffic", page 70).

This toll charged on passenger vehicles results in passenger traffic taking secondary roads (state-operated and municipal roads) that remain toll-free. This has not entailed a greater nuisance of local residents, but also meant that the number of accidents increased.

Technical Innovations Improve Traffic Flow

Not only pricing mechanisms such as tolls on passenger vehicles and trucks geared to actual road use are deployed in order to influence the volume of traffic, but also a wide range of innovations in technology: Driver assistance systems, for example, enable drivers to follow another vehicle at a shorter distance while reducing the risk of an accident at the same time. Telematics systems guide the driver past bottlenecks on the road, taking account of the individual driver's needs and time strictures, thus preventing any greater traffic jams from forming. These systems are networked with telematics control systems for road freight traffic as well as with the respective municipalities' traffic management centers. Furthermore, they are able to provide route recommendations because they have nearly fully captured the existing traffic conditions (cf. also Freight Transportation in the Year 2025 "Road Traffic Optimized as a Result of Individual Traffic Information Systems", page 69).

[20] The term A-model relates to the activities of private investors in developing and improving a small number of sections of the Autobahn already in existence today (widening up these Autobahn sections from two to three lanes in each direction) as well as their operation. This expenditure is financed using the toll imposed on trucks, as generated on the respective section of the highway. The cost share actually accruing to passenger vehicles is financed by government funds as a "start-up financing".

Driving into the inner city, drivers are informed early on which parking garages are still available or where and when there will be the next opportunity to change to public transportation. This has reduced the number of drivers looking for parking space in the inner city.

In addition, there are the collective traffic guidance systems that serve to re-direct the flow of traffic or to determine the appropriate maximum speed. As a result, traffic continues flowing despite a volume of traffic which, twenty years ago, would have caused major congestion.

Pragmatism Prevails in Use of the Automobile

The general attitude towards the passenger vehicle has changed. While the car used to be "the German's favorite baby" that was literally pampered by its owner and regarded to be a way of expressing its owner's personality, people have now become more pragmatic in the way they see their automobiles. Many use their car mainly for functional reasons and switch over to other modes of transport whenever they are more suited for the respective purpose of the trip. It is difficult to state in hindsight how this came about in all its details. A significant factor for this change in mentality certainly lies within society as a whole, since material values no longer are held in the high regard they were previously held in. Now, it is the actual activities pursued by people in life that are important. Where an advertising slogan in the past read, "My House, My Car, My Boat…," it would now sound more like, "Me out Gardening, Me out Cruising, Me out Sailing…". A further point is that the lack of time, money and sheer stamina also calls for greater awareness in organizing the tasks of everyday life. For a trip downtown, people no longer simply hop into their car just because it is parked outside, but plan their route in advance, with mobile terminals enabling them to retrieve traffic information quickly and easily. So if a nerve-racking search for a parking spot is to be expected, expensive parking fees, or a traffic jam, they will choose another mode of transport. In other words, many people have become more pragmatic in choosing which mode of transport they will use for a specific purpose.

It goes without saying that auto manufacturers have responded to this more pragmatic viewpoint: the vehicles are now more differentiated according to customer needs and are optimized for various purposes, low-cost vehicles being a common sight at international motor shows. There is also a good supply of passenger vehicles with comprehensive electronic equipment such as driver assistance systems for active safety, infotainment facilities, and Internet access.

New Market Potentials for Providers of Automotive Mobility

The winners most strongly benefiting from this new pragmatic attitude are specialist companies providing mobility services for drivers. What used to be the small, fragmented niche market of car sharing has developed in recent years into a professional, nationwide-segment comprising various offers: Whether it is car rental, car sharing or short-term leasing, a mobility card or mobile phone is all it takes to book a vehicle within a matter of minutes. The user is then able to pick up the vehicle near his or her residence or current location, or the vehicle can even be delivered to his or her doorstep. In other words, an increasing number of people use such automobile services when and where they need them, without tying themselves to property or having to bear the appurtenant fixed costs. Accounts are then settled conveniently via intelligent systems. Electronic detection systems within the vehicle can adjust specific features such as the seats, mirrors, and radio, even vehicle's interior design and layout, to the personal wishes and requirements of the respective driver.

Alternative Fuels now have a Market Share of 20 Percent

Alternative fuels are the ones finally benefiting from the growing environmental awareness of the public and significant hikes in the price of oil. After the industry and the political sector made considerable efforts to establish them, they have become a substantial segment in the market: Hydrogen and bio fuels, etc., now have a market share of approximately 20 percent. However, they are still not available all across Germany at all gas stations. A further drawback is that vehicles running on such fuels and the fuels themselves still come at a significant premium, in spite of having been granted special tax benefits. Innovations of this kind are nevertheless already part of "normal" life in big cities at least, where the new style of mobility is to "drive clean", which appeals not just to people who want to protect the environment, but also

to the modern, more exclusive and fun-oriented individual. Politicians have supported the introduction of such vehicles and fuels by granting special prerogatives under traffic management system, granting tax benefits and preferred access to many inner cities.

Average Fleet Consumption Down Significantly

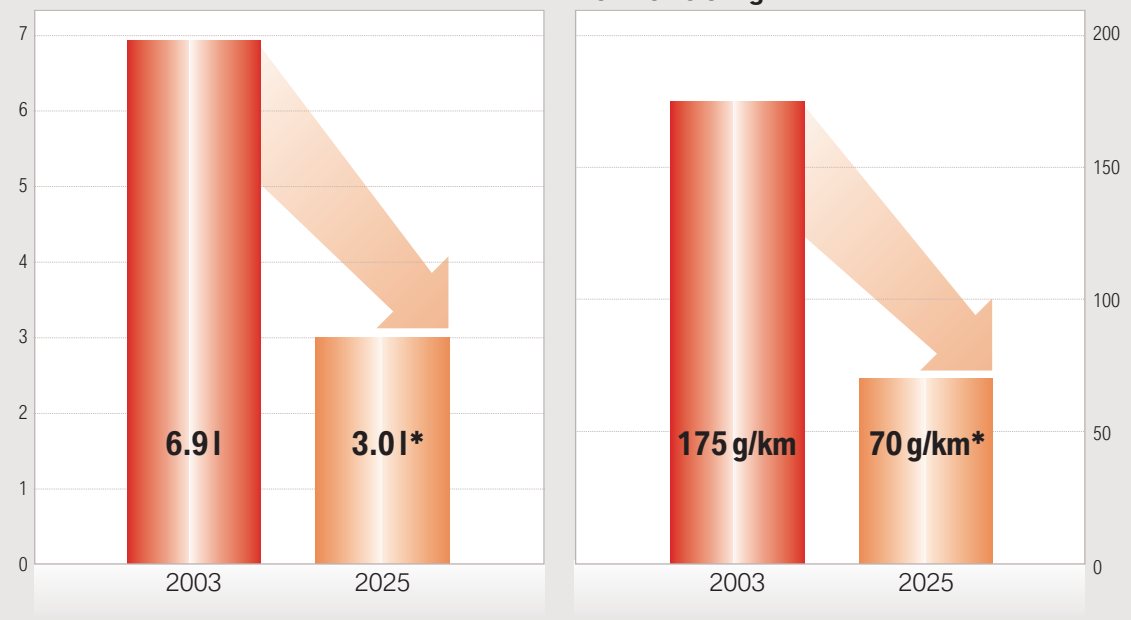
In the last twenty years, the automotive industry has focused in particular on reducing fuel consumption. As a result, the average CO_2 emissions of newly registered passenger vehicles built in Germany has dropped in the last twenty years to approximately 70 g/km (it should be noted that the CO_2 emissions of vehicles using alternative drive systems have been included in this calculation at zero) (cf. Illustration 6). The main reasons behind this decrease, apart from the large share of alternative fuels, are the introduction of hybrid propulsion and energy management systems, further optimization of engine technology, fuels tailored to new, highly efficient power units, the use of driver profile assistants, lightweight construction, and the increased sales of small passenger vehicles. Other harmful emissions such as carbon monoxide, nitric oxide, chlorinated hydrocarbons, and particulates are far below the limits relevant to human health and therefore no longer play any significant role in the environmental debate.

Noise Emissions Reduced

The situation is quite different in the case of noise emissions, which have gained growing significance in public debate in the last ten years. That is why this issue was given particular attention at the political level when the infrastructure was recently upgraded and expanded. Because tires and road surfaces were optimized, it was possible to reduce specific noise emissions by 20-30 percent.

Base Price of Fuel Doubled

Compared with 2004, the base price of fuel[21] has doubled from 0.35 €/ltr to 0.70 €/ltr (calculated in 2004 prices).[22] Added to this, there have been price hikes resulting from inflation, taxes, and other charges.



Figures 2003: Verband der Automobilindustrie (VDA, German Association of the Automotive Industry)

* ifmo Scenario 2025: Estimate by experts; consumption and emission of alternative fuels shown as zero.

Illustration 6: Development of Average Fleet Consumption per New Passenger vehicle

[21] Base price of fuel = product purchase price + cost of marketing + profit.

[22] Upon the completion of the present report in June/July of 2005, the price of crude oil had almost doubled since 2004 to more than US $60.- per barrel. We nevertheless decided not to adjust the projections of our experts to such short-term trends.

The fact that the base price of fuel has doubled is attributable in particular to the greater demand for crude oil existing in China and India. The peak moment in oil extraction was already passed approximately ten years ago. Given this trend, therefore, the relative cost status of renewable fuels has improved significantly.

Driving has Become More Environmentally Friendly, but a Lot More Expensive

Progress in technology with conventional vehicles, the optimization of tires and road surfaces, the use of alternative fuels as well as the reduction of traffic jams by introducing road tolls, as well as other innovative technical solutions, have all added up in recent years to make automobile traffic a lot more environmentally friendly.

However, driving a car has also become a lot more expensive. This applies both to fixed and variable costs: Toll charged on passenger vehicles, the high cost of production based on technological reasons alone which is reflected by higher purchase prices, as well as the higher price of fuel have resulted in prices being hiked up considerable. The only alternative when buying a new passenger vehicle is to opt for the low-comfort products making up the low-cost, no-frills segment of the market.

Individual Motorized Traffic Volume Increased only Slowly

Now that the costs that driving a car entails have increased significantly, the overall traffic volume of individual motorized traffic has not increased at the same rate in the last twenty years as the volume of all modes of transport combined did. This has flattened the decade-long trend of ongoing growth in individual motorized traffic.

The modal split of transport systems has shifted, albeit only slightly, towards rail and air traffic.

Developments in Road Traffic 2005-2025

Assumptions

- Private investors reduce the maintenance backlog, eliminate bottlenecks, and expand the road network.
- Passenger vehicle toll geared to actual road use is introduced.
- Individual traffic management is introduced, based on linking private telematics systems with public traffic management centers.
- The share of alternative fuels is increased. Average fleet consumption is significantly reduced.
- Noise emissions are reduced substantially.
- Fuel becomes much more expensive for consumers.

Effects on Traffic

- With people becoming more pragmatic in choosing their mode of transport, providers of "automobility" services have new opportunities and potentials in the market.
- Technical measures for traffic control and management, as well as road tolls based on actual road use, serve to significantly reduce traffic jams.
- Driving is more expensive, but also more environmentally friendly, quieter, and makes sparing use of natural resources.
- The volume of individual motorized traffic increases, albeit not at the same rate as overall passenger traffic volume does.
- The modal split shifts slightly in favor of railway and air traffic.

5.1.5 Major Investments and Competition Strengthen Rail Traffic

Rail Traffic Continues to be Promoted by Policy

Even though the debate on rail traffic has been more strongly oriented by facts and the polarizations are a thing of the past, rail traffic still receives particular support from the government. As in the past, rail traffic is regarded to be synonymous with environmental friendliness, the reduction of CO_2 emissions and, in particular, as the best way to reduce road traffic. It is the government's declared objective to increase rail traffic both in Germany and in Europe as a whole. The lion's share of public investments made in transport systems therefore goes towards subsidizing this particular traffic carrier.

Encompassing and, in some cases, extremely expensive action has been taken in the last twenty years to make rail transport more appealing and competitive as compared to other modes of transport. The most important steps were:

- To increasingly separate fast (passenger) traffic from the slow (goods and railway public transportation).
- To ensure trains could cross borders freely and without delays.
- To provide non-discriminatory access to the railway networks throughout the European Union.

Increase in Rail Traffic Capacities

As a result of organizational and technical improvements, the railway network capacities have been significantly improved. A particular highlight was the separation of fast (passenger) traffic from slow (goods and railway public transportation) traffic, which now no longer impede each other. Electronic guidance and control systems serve furthermore to reduce the gaps between trains, thus allowing more trains per unit of time to use a specific section of the rail network. The use of long-distance rail connections has been increased significantly because higher average speeds were enabled, inter alia, by upgrading those parts of the network requiring slow passage and by overcoming bottlenecks.

Passengers benefit from greater punctuality and reliability, while travel times are reduced (cf. also Freight Transportation in the Year 2025, Chapter 5.2.5 "Concentration Promotes Rail Freight Traffic", page 72).

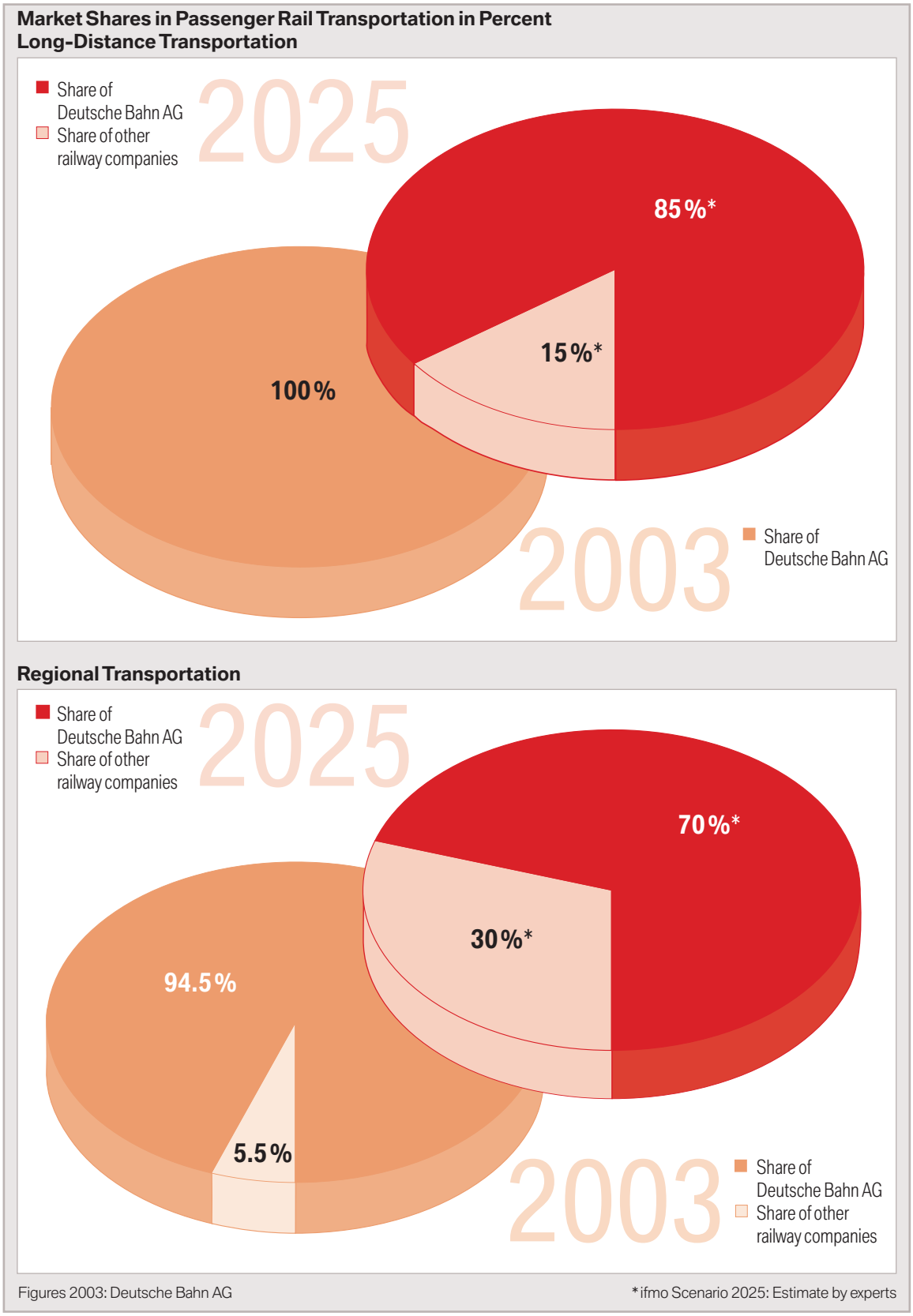


Illustration 7: Development of Market Shares in Rail Passenger Transportation

Non-Discriminatory Access to Railway Networks and Unrestricted Cross-Border Traffic Guaranteed in the Entire EU

Benefiting from a rail traffic policy harmonized throughout the European Union, all rail transportation companies are now able to offer their services throughout Europe at nearly comparable conditions, while using the same rail systems, train stations, etc. The rain transportation companies have mostly been privatized and are focusing their activities on the market. Competition has increased accordingly, also on the main lines. It is in particular the former large state-owned railways that are now competing with one another in their respective former "territories". While in Germany, it is Deutsche Bahn AG that offers 85 percent of the total volume in long-distance passenger rail transportation, the share that Deutsche Bahn has in regional public transportation has already decreased to 65 percent (cf. Illustration 7).

The harmonization of general administrative and technical conditions, achieved after considerable effort, has now enabled largely unrestricted rail traffic without delays from the North Cape of Europe all the way to Sicily. While certain technical barriers such as different signaling and control systems, power systems and track widths have still not been overcome in all instances, these obstructions can now be dealt with to large extent by technical and organizational improvements such as the widespread use of multi-system vehicles (cf. also Freight Transportation in the Year 2025,"Railway Companies Focusing on Single-Load Train Traffic", page 72).

Rail Traffic Concentrates More on Main Railway Lines

While at least some of the main railway lines have become much more attractive all over Europe thanks to substantial investments being made, railway companies have withdrawn their operations from routes that are economically no longer viable. In particular the concentration of the population in a handful of conurbations, and the fact that entire regions have lost their populace has forced operators to close down many of their routes and services (cf. also Freight Transportation in the Year 2025, "Further Decline of Small-Scale Distribution Traffic in Rural Areas", page 73). Almost all public transportation in these "empty" regions is provided by bus lines.

Regular Service Bus Lines Competing with Rail Traffic

Competition is keen in long-distance traffic not only between various providers of passenger rail transportation, but also between bus travel services and bus line operators. The market for long-distance bus travel has become a significant sector in the meantime and is no longer restricted by strict statutory regulations, as was still the case in Germany in 2005. Various bus line operators have established lines connecting many of the large cities in Europe. In part, traveling by bus is not only less expensive than taking a train, but also just as comfortable thanks to improved bus technologies. Central bus stations have developed into modern travel centers.

The Customer is the Winner

The customer benefits most from this inter- and intra-modal competition. Features such as electronic information and communication systems, a higher standard of travel comfort and – in some instances – outstanding service on board have become aspects that travelers expect just as naturally as punctuality, reliability as well as fares tailored to specific target groups and levels of capacity.

Competition is Tough, also in Regional Traffic

Regional traffic has developed more or less in the same direction: Various providers of regional traffic services compete with one another, seeking to win over customers with the help of attractive offers. The German Länder (states) use their funds more efficiently, tendering out most of the transportation services. While in the past most tenders were for railway services, the tenders issued today cover all kinds of functions including bus transportation services wherever rail transport is no longer economically feasible.

Rail Traffic has Become Much Quieter

By investing substantial funds, it was possible to reduce noise emissions by taking noise reducing measures at the vehicles and at many stretches of the existing railway lines.

Traffic Volume on the Main Railway Lines has Increased

All of these developments have strengthened the position held by rail traffic in inter-modal competition against road traffic and air traffic. The volume of passenger rail transportation on the main railway lines was increased over-proportionally as compared to the overall volume of traffic, inter alia on account of

- Longer commuter distances (in particular weekend commuters) and the more widespread distribution of social networks,
- Concentration of the population within just a few densely populated areas,
- Increased business travel,
- Increased (short) vacations, and
- Attractive offers resulting from the competition among various modes of transport.

All in all, however, the shift since 2005 in the modal split of transport systems away from road traffic and domestic flights has not been so dramatic because the railway companies have been discontinuing their service to sparsely populated areas.

Developments in Rail Traffic 2005-2025

Assumptions

- Slow and high-speed rail traffic separate more and more.
- Passenger rail transportation concentrates on main railway lines.
- Passenger rail transportation withdraws from sparsely populated regions wherever such services are not economically vaible.
- Deregulation leads to competition in rail traffic.
- Demand for regular service bus lines increases.

Effects on Transportation

- Significant increase in long-distance passenger rail transportation on main railway lines.
- Significant decrease of rail traffic volume in sparsely populated regions.
- On the whole, there is a slight shift in the modal split towards passenger rail transportation.

5.1.6 From Cheap Flights All the Way to First Class

Rapid Liberalization of Air Traffic

Since the air traffic market had already been largely deregulated in 2005, developments in this area have continued at a rapid pace. Following an initiative by the European Union, the EU/USA Open Sky Accord was concluded already in 2010, allowing complete deregulation of the European and American air traffic markets. Entry restrictions in and between the major markets in America, Europe, and Asia have also been cut back increasingly. Subject to slots being available, all airlines are now able to offer regular services between any airports of their choice.

The process of concentration in the airline market has continued. Only a few of the small traditional passenger carriers have survived, and most of the small companies were bought up by the large airline groups. A very few have concentrated on lucrative niche markets and have managed to survive over the years.

EU-Wide Harmonization of Air Traffic Control Completed

Air traffic control, which for years was a bottleneck in Europe, has also improved significantly. After substantial political efforts, it was finally possible to harmonize air traffic control throughout Europe, which had positive effects in terms of punctuality, safety, and on the environment.

Air Traffic Capacities Expanded

Following long debates in Germany during the last twenty years, the airline hubs in Frankfurt and Munich have at long last been enlarged and upgraded. Network airlines offer passengers a worldwide network of flight connections out of Frankfurt and Munich.

On short access routes, airlines cooperate closely with railway companies in order to reduce the flights that are economically not viable on these short distances.

Greater use of wide-bodied aircraft has helped to boost capacities even further.

No-Frills Carriers Now Firmly Established

Airline hubs have also been established in Germany for no-frills carriers who now represent a firm segment of the market. A number of regional airports have been either expanded, or new regional airports have been built from the ground up. This enables no-frills airlines to now offer point-to-point transport service between almost all cities. In this context, they are also increasingly making efforts at offering offer network services and appropriate connecting flights.

With airline networks and no-frills companies competing hard to win them as clients, customers are able to benefit from a wide range of offers. Whether it is luxury flights and very comfortable amenities or "super saver" and minimalist offers, there is something for every passenger.

Taking the Plane has Become More Efficient

When the capacity of airline hubs was increased and air traffic control was harmonized, another positive effect resulted: The many delays in domestic German air travel that, at the beginning of the millennium, gave rise to growing criticism have largely become a thing of the past. This also applies to other aggravating problems such as long trips to the airport, sometimes in congested traffic, and tedious security and check-in procedures which wasted nearly the entire time, on short distances, that was to be saved by taking the plane. Today the time required for flight security has become much shorter on account of biometric testing procedures and the acknowledgement of frequent flyers as so-called Trusted Passengers.

Air traffic today, in 2025, is not only punctual in most cases, but also saves time even on shorter distances. And although the target times for check-in procedures on short flights (15 minutes) and long-distance flights (30 minutes) have not yet been reached, the use of new technologies and organizational concepts has expedited most procedures quite substantially and overcome security problems. Many newly constructed inter-modal connections to public transportation or regional traffic make travel to and from the airport more efficient and smoother than in the past.

No Increase in Noise Pollution

Air traffic has always been criticized for its effects on the environment, particularly on account of its noise emissions. Regulatory procedures (introduction of additional noise categories, bans on night-time flying) and major investments into the improvement of aircraft have helped to keep the overall level of noise at the same point as in 2005, despite the further increase in air traffic volume.

Air Traffic Volume has Risen Over-Proportionally as Compared to Overall Traffic Volume

Air traffic, benefiting from the measures and developments described above, has become far more efficient in recent years. Despite the over-proportional increase in air traffic as compared with traffic as a whole, delays are now more the exception than the rule. Apart from the strongly segmented range of flight options, the growth of international tourism and an increasing volume of business travel are the main factors responsible for the increase in air traffic as a whole.

Developments in Air Traffic 2005-2025

Assumptions

- Deregulation of the air traffic market.
- Harmonization of European air traffic control.
- Enlargement of capacities by expanding the hubs in Frankfurt and Munich.
- The no-frills segment grows.

Effects on Traffic

- Punctuality and thus time efficiency increase, also for short trips.
- Network airlines and no-frills airlines provide parallel flights, which leads to further segmentation of offers.
- The air traffic volume increases, albeit not at the same rate as overall traffic volume does.

5.1.7 Competition has Made Public Transportation a More Attractive Alternative

Public Transportation Deregulated and Privatized

A lot has also changed for public transportation: Suffering from a lack of funds, many municipalities have been forced to with draw from operating their public transportation systems. To make up for this change, the public transportation markets have been largely deregulated in the last twenty years, with many transportation services being privatized. What used to be a matter for lawyers in the past has now been cleared up, and the public sector now merely coordinates and solicits bids for transportation services.

As the parties responsible for the task to be performed, the municipalities define the transportation service that is desired by policy, coordinate the fare system within the regional or local traffic mode network, and tender the transportation services. This means public transportation is now subject to an entirely different market order, with keen competition in this new market. Financially powerful European transportation companies are pushing into the market, buying up local enterprises and submitting bids in public tenders that are met with success. The tenders are designed such that buses can replace rail traffic wherever the latter is no longer economically feasible.

Mobility Money Replaces Discount Fares

While in the past there were special fares for certain groups of customers (such as school-children, the disabled, and senior citizens), one and the same fare now applies to all passengers. Subsidies previously paid to transportation companies offering such "social" fares have been reduced. They have been replaced by "mobility money" for low-income groups within the population. In addition to the – reduced – subsidies granted for promoting specific services, certain groups of users receive direct financial support. Holding a "mobility card" credited with a certain amount of "mobility money", these users can now decide themselves how to travel most conveniently and economically from A to B. Hence, they are no longer required to take public transportation.

Public Transportation Capacity Expanded

Public transportation is used by municipalities as a "tool" in their efforts at getting business to locate in their community and in their economic policy. Those municipalities that are growing in terms of inhabitants invest into the expansion of public transportation capacities; with the federal government continuing to subsidize them. Decision-makers in politics have come under growing pressure by the threat of traffic chaos within town, the daily traffic jams on roads to settlements and service companies in the suburbs, as well as by the risk of soon exceeding the limits imposed by the EU Environmental Directives.

Depending on local requirements and demand, various steps have been taken to increase the capacity of public transportation. These include the growing deployment of telematic systems, ongoing replacement of cars in the vehicle fleets, inter-connection of transport networks by means of inter-system concepts based on the Karlsruhe Model,[23] the construction of inner-city train lines, and even the enlargement or new construction of underground railways.

Attractive Offers have Reduced Barriers against Using Public Transportation

Reflecting this development, the options available in public transportation covering conurbations are far more customer-oriented than they were twenty years ago. Consistent deregulation and far-reaching privatization of transportation services have created a fiercely contested public transportation market with all kinds of providers competing for tenders. To be successful in this market, a provider must offer innovative concepts tailored to the customers' needs. The myriad of different fares, the annoyance of having to constantly look for coins and wait long times between trains or buses, are largely a thing of the past. Stations that are accessible to disabled people or to persons with prams, with user-friendly transit options to other traffic carriers, are now standard. Wherever there is high demand, attractive options are available to customers.

[23] Karlsruhe Model: In the German city of Karlsruhe, the railways are already interconnected with the complete network of tram services and a special generation of inner-city trains has been developed.

Because of the widespread use of information technologies and mobile terminals, as well as electronic information services offered by public transportation providers, real time information on timetables is now available everywhere both collectively (at stations and bus stops) and individually (to be called down the user's mobile phone, PDA, etc). Electronic tickets are standard. Passengers are automatically registered when entering and leaving public transport systems, the route covered is recorded and the appropriate fare calculated. Such monitoring systems are in use almost throughout Germany in the year 2025.Various fare schemes for calculating the fares as well as different payment modes are available. Mobile telephones, PDAs or special chip cards are used as ticket media. In addition to the monitoring systems described, cash payment systems are still in use in some instances; however, this is mostly the case at highly frequented junctions such as airports and central stations.

One side-effect of privatization is that unprofitable bus lines and services are being shut down increasingly often, particularly in the areas on the outskirts of town. People living in the countryside in the year 2025, or further away from a conurbation, are almost exclusively dependent on their passenger vehicle. On-demand taxi pools and buses are able to reduce this dependence on the automobile only to a limited extent.

This liberalization also means greater individualization of taxi fares and more flexible structures than in the past. Today taxis are available that offer various fare categories and quality segments, and have been clearly marked so that this is recognizable.

The bicycle is used more often than in the past as a mode of transport for short distances and represents an important link within the inter-modal trip chain. Safe bicycle parking lots and rent-a-bicycle companies are now quite common at terminal stations and other important stops within the public transportation system.

A Wide Variety of Traffic Regulation Systems in Use

Traffic control systems serving to streamline motorized traffic in conurbations are just as varied and flexible as the options available in public transportation. While some cities have restricted motorized traffic in the inner city by building large pedestrian areas, other cities charge a toll from cars driving into town, or have instituted a parking space management system that increases the costs for drivers. Speed limits imposed across large areas and the availability of larger park-and-ride facilities in the outskirts of town have prompted many people not to use their passenger vehicle when making a trip downtown, but to use public transportation instead.

Volume of Public Transportation in Conurbations has Increased

Public transportation has seen a genuine renaissance in many high-demand conurbations – the improvement of options available, greater network density, and more frequent services have made public transport more attractive. Another reason are the restrictive traffic-control regulations imposed on the use of the automobile in the inner city, as is the more pragmatic attitude now prevalent in selecting the appropriate mode of transport. For these reasons, the number of passengers has been increasing slightly but steadily over the years. In some conurbations, therefore, the modal split has shifted in favor of public transportation. Taking Germany as a whole, the share of public transportation services has remained the same as in 2005, since fewer services of this kind are offered in smaller communities where the population is shrinking.

Developments in Public Transportation 2005-2025

Assumptions

- Neither the government nor municipalities act as service providers any more in providing public transportation.
- Instead, many transportation operators are private companies.
- As a general rule, publicly funded transportation services are tendered.
- Constructional, technical and organizational measures serve to increase capacity on routes in high demand.
- Access to many inner cities is made more difficult or expensive.
- The options provided by public transportation are more attractive.
- While the subsidization of transport services is reduced, more funds are paid out to individual users ("mobility money").

Effects on Traffic

- The number of passengers increased significantly.
- In many conurbations, the modal split shifts towards public transportation.
- The volume of public transportation services increased at the same rate as overall volume of passenger traffic.

5.1.8 Progress in Networking

Intermodality – an Often-Quoted Buzzword Slowly Became Reality

The term "intermodality" – the linkage of various modes of transport – has been at the focus of traffic planning since the 1990s. In particular politicians have for a long time regarded this to be a concept that is better able to implement traffic as a whole while also enhancing public modes of transport, providing a shift away from individual motorized transport.

Looking at air and rail traffic as well as public transportation, intermodality primarily entails the coordination of timetables, reliable connections even in the event of a delay, inter-system information as well as short distances between stations operated by the various transport providers involved.

For a long time the individual traffic services merely optimized their own systems and paid no great attention to improving connections with other traffic carriers. A particular obstacle was the unclear responsibility for interfaces leading from one traffic carrier to another.

Only the growing regional concentration of the flows of traffic has caused traffic carriers to feel the need to coordinate with one another. Supported by public funds, transport providers have created and/or improved transport infrastructures step-by-step. The public sector actively monitors and controls the development of traffic systems, particularly in its role as the party ordering specific transportation services. This means the public sector coordinates and makes appropriate investments with the objective of optimizing the use of the overall system. Vertically organized mobility providers act within networks extending across traffic carrier boundaries. Inter-modal information geared to specific locations and trip chains are supplied individually to the customers on an as-needed basis.

In conjunction with the users' more pragmatic approach to selecting modes of transport, these changes have significantly increased the number of inter-modal trip chains.

Developments in Inter-Modal Trip Chains 2005-2025

Assumptions

- Efficient connections and reliable transit to other modes of transport are important factors in tenders for public transportation services.
- As the party ordering transportation services, the public sector pursues an active transportation management and control policy.

Effects on Traffic

- Increase in the number of inter-modal trip chains, particularly in conurbations.

5.2 Freight Transportation in the Year 2025

The “Freight Transportation in the Year 2025” Scenario is subject to the same political conditions and considerations as the “Passenger Traffic in the Year 2025” Scenario (cf. Chapter 5.1.3, page 41 et seq.).

5.2.1 Freight Transportation – the Basis of a Global Economy

The worldwide exchange of goods has increased significantly in the last twenty years. At an average annual growth of 6 to 7 percent, the value of goods traded has more than tripled versus 2005.

The globalization of the economy has likewise continued unabated. The world's major economic regions – the EU, NAFTA,[24] and ASEAN[25] – have continued to strengthen their mutual relations. On the other hand, the World Trade Organization, now comprising many additional countries including Russia, has succeeded in largely abolishing trade barriers in several Ministerial Conferences.

Large Companies have Located Production Abroad

Ongoing globalization is attributable in particular to the economic development of former threshold countries such as India, China, Malaysia, or Thailand. The new markets that developed in these nations have become home not only to rapidly growing local companies, but also to nearly all international corporations. These large corporations not only sell their products in these new markets, but have also established many new production plants there. One reason for international corporations, most of whom are involved in global production networks, to move their production facilities abroad is that they wish to capitalize on worldwide differences in costs. Another factor is the local content requirement existing in many countries that must be met in order to gain access to the market. But it is not only global players, but also a number of small and medium-sized suppliers who have established plants in the new markets, on the one hand because they are pursuing their own international marketing and production strategies, in other cases they are following in the wake of large global players.

Division of Labor has Increased Further

A particularly important feature of growing globalization is the ongoing international division of labor in industrial production. While there are many reasons for this trend, the three most significant and stable factors have been evident ever since the 1990s:

- With Western societies becoming increasingly "individualized", consumer behavior has become increasingly diverse. The demand for products in consumer goods markets is more widespread and individual than ever before.
- Product lifecycles, reflecting this trend, have become shorter. New products and generations are entering the market at an ever-increasing pace.
- Product complexity has continued to increase at the same time. The network of driver assistance systems in a luxury passenger vehicle, for example, is now as complex as the entire electronic network of the entire automobile was twenty years ago.

The only way to cope with such an increasing diversity of products and their shorter lifecycles was for the industry to make production processes even more flexible. To respond quickly to changes in the market, companies are forced to focus and slim down their production to an ever-increasing extent. This in turn, has helped to promote the process of outsourcing – required to take "make-or-buy" decisions, more and more companies have opted for "buy". Likewise, the industry has only been able to deal with the complexity of products by concentrating on their own special skills and, accordingly, cooperating with other companies. In global terms, therefore, the creation of value by the industry in the year 2025 is part of highly differentiated global networks.

[24] NAFTA: North American Free Trade Agreement

[25] ASEAN: Association of Southeast Asian Nations

Value-Added Chains Extend Across Company Borders to an Increasing Extent

With value creation networks having become increasingly differentiated, it is now common practice to think and operate in chains of value creation that extend across company borders. Supply chains are usually planned and monitored throughout all links making up the value chain, ranging from the loading industry through suppliers all the way to providers of logistics services. This development is supported technologically by the widespread use of high-performance IT systems linking the production and logistic processes of companies with one another in real time within one common supply chain. Such technologies ensure far-reaching transparency concerning the physical flow of goods along the entire value chain from beginning to end.

Boom in the Logistics Sector

A complex, efficient and highly flexible logistics network forms the foundation and backbone for worldwide production and value creation networks. As a result, demand for freight transport by the loading industry has increased significantly.

Because the demands placed on logistics have increased and industrial enterprises are concentrating more and more on their core competences, logistic functions have been outsourced to an increasing extent. In particular the operative management and physical transport are being implemented by the providers of logistic services, who now specialize on managing and controlling global supply chains. Solely the Purchasing and the Strategic Logistical Planning Departments remain within (large) companies.

Distances have Increased

The relocation of production facilities, the high degree of division of labor in industrial production, and the resulting network-like flow of goods also have an effect on traffic because the distances to be covered have become much longer. More and more components and preliminary products must be transported to production facilities spread out over an increasing area. The global increase in the volume of freight transportation is largely attributable to this over-proportional increase in distances covered.

Global Economic Framework Conditions 2005-2025

Assumptions

- Globalization of the economy cannot be stopped, the volume of world trade grows substantially.
- Production facilities are moved abroad in increasing numbers.
- The division of labor in industrial production increases.

Effects on Traffic

- Significant increase in freight transportation volume (ton kilometer) the world over on account of
  - the growing increase in freight volume (tons) and
  - the over-proportional increase in distances (kilometers).

5.2.2 Germany is Europe's Freight Turntable

The volume of freight transportation has increased by another 80 percent in the last twenty years (cf. Illustration 8).

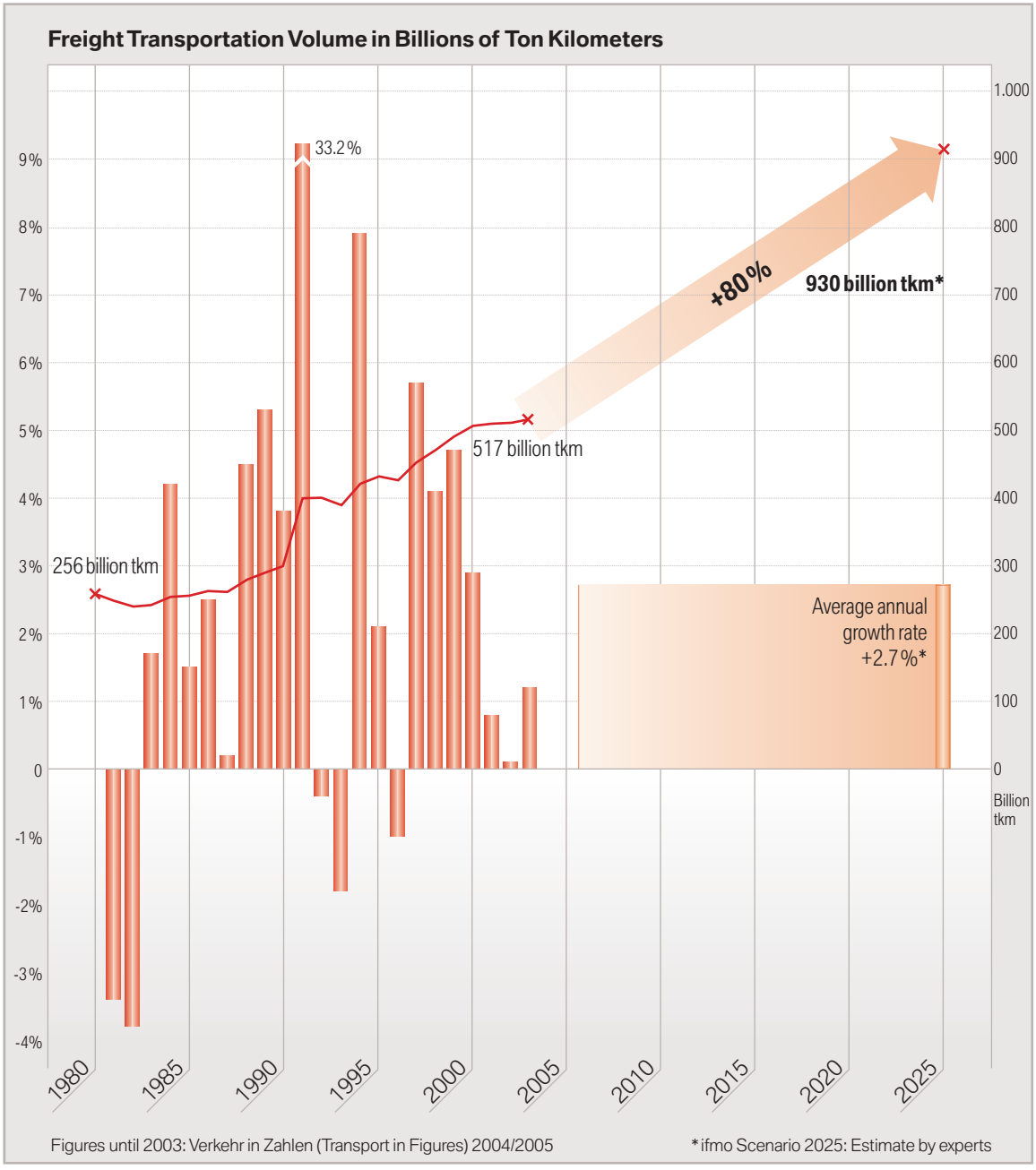


Illustration 8: Development of Freight Transportation Volume

Freight Volume in Foreign Trade has nearly Doubled

Being an exporting nation, Germany has benefited significantly from the growth of world trade, the volume of German foreign trade having almost doubled in the last two decades, with annual growth of 2.5 percent. Overall, German foreign trade[26] has nearly doubled from 777 million tons in 2002 to almost 1.37 billion tons in 2025. It is in particular exports, which increased overproportionally by an average annual volume of 3.6 percent, that have driven this development. In addition, imports have also increased significantly at an average annual growth of 1.8 percent. The growth of German foreign trade is described even more clearly in monetary terms: Starting at approximately Euro 1.170 billion in 2002, German foreign trade is now up in real terms to almost Euro 4.800 billion, meaning that it has more than quadrupled within this period (cf. Illustration 9).

This impressive growth is not just attributable to general changes in the world market, in other words to the growth momentum generated by Asia and Africa, nor can it be attributed to further WTO Free Trade Agreements. Rather, there have also been substantial developments in Europe in the last twenty years that significantly influenced the volume of foreign trade. These are described below.

Flow of East-West Freight Transportation up Significantly

The first and foremost factor for the relevant European development is the accession of new members to the European Union, which has grown to thirty member states. The new members are largely so-called cohesion countries with a per capita GDP that is lower than 90 percent of the EU average. This means that the countries concerned receive subsidies from the EU Cohesion Fund above all for financing traffic infrastructure and environmental projects. Furthermore, many regions in these countries are so-called Target 1 Regions: With a per capita GDP that is lower than 75 percent of the average within the EU, they receive support from the EU Structural Fund to finance projects promoting their industry.

As a result of these structural changes in Europe, the EU has concentrated its subsidies in recent years on Eastern Europe and Turkey. Public investments have acted as a kind of catalyst, attracting substantial private investments by Western companies: more production was relocated to Eastern Europe. Corporate ties between Germany and the countries of Eastern Europe have become more intense, and the production networks have resulted in cross-border trade with advance performance.

The political enlargement of Europe is reflected by German foreign trade relations, in which East-West freight transportation has significantly increased. The greatest increase in the volume of trade has occurred in the corridors leading into Eastern Europe, showing the following growth rates in the last twenty years:

- Freight transportation in the River Oder Corridor up almost four-fold, from approximately 31 million tons to 115 million tons.
- Freight transportation tripled at various border crossings to and across the Czech Republic from 27 million to 82 million tons.
- And, finally, freight transportation more than doubled in the Balkans Corridor from 43 million to 107 million tons (cf. Illustration10).

Enormous growth rates of this kind have led to bottlenecks and obstructions in traffic between Germany and Eastern Europe, despite significant investments having been made into the traffic infrastructure. The transport times on the main connections from East to West have become longer, with the cost of transportation going up accordingly. These developments will continue also in the years to come, both in transports to Eastern Europe and through the Balkans Corridor.

As in the past, however, a major share of the German foreign trade volume (40 percent) is not being transported from and to Germany over land, but rather via seaports:

- Goods traded in an overall volume of approximately 290 million tons are shipped through German ports on the North Sea.
- Another 310 million tons go through the goods transport corridor leading to the Netherlands, that is largely via Dutch ports also on the North Sea.

[26] The foreign trade volume is the sum total of all imports and exports.

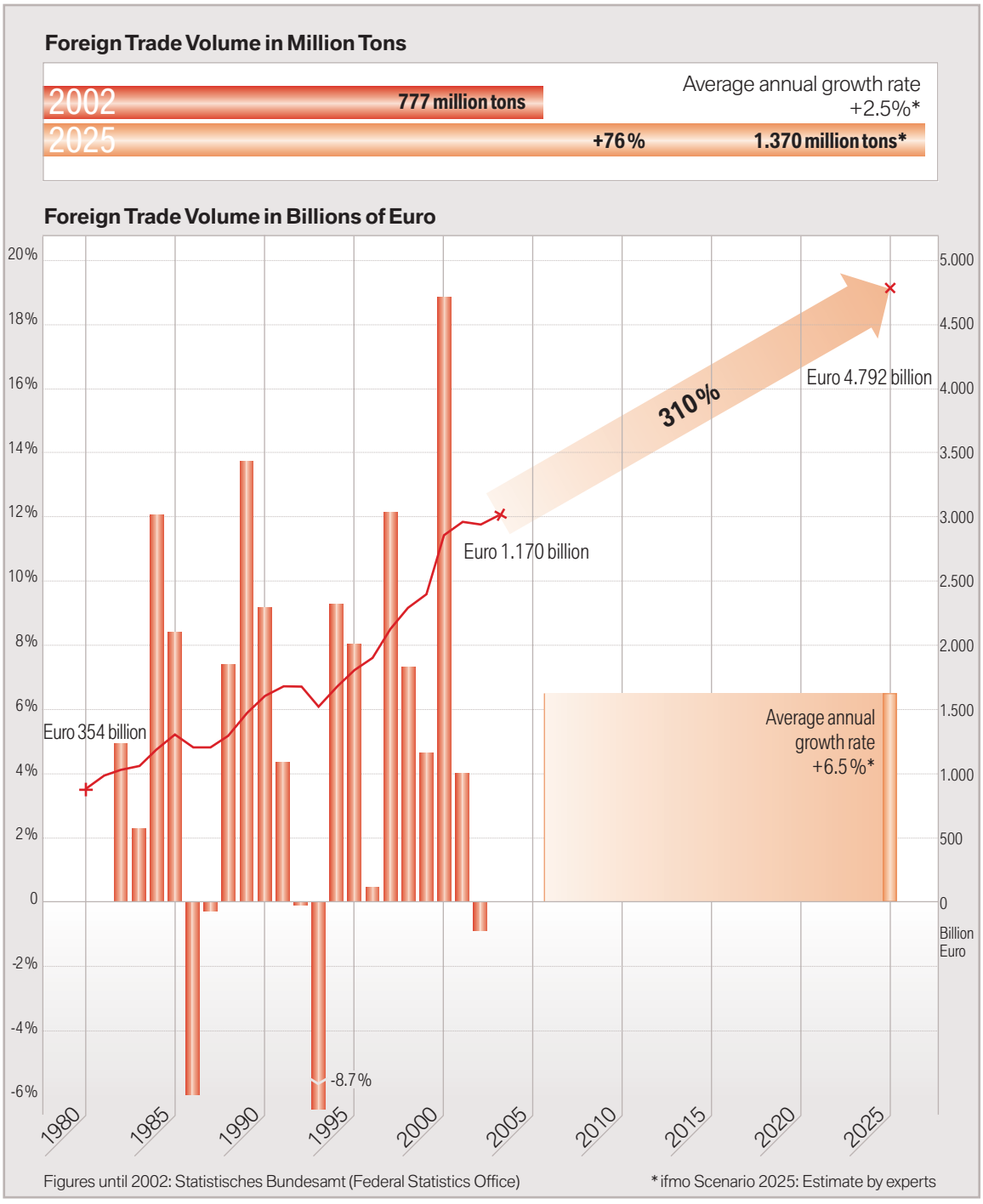
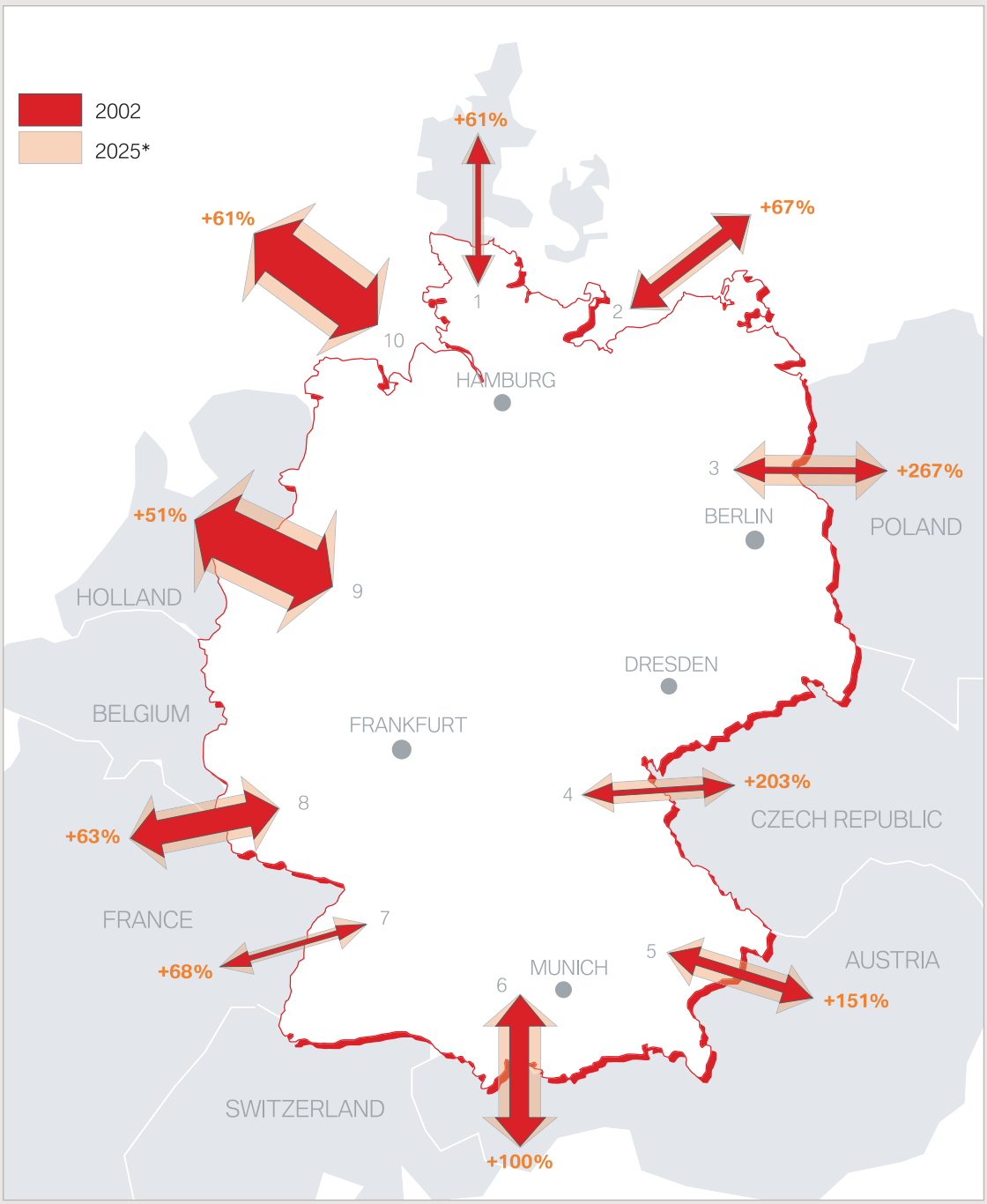


Illustration 9: Development of Foreign Trade Volume



Figures for 2002: Deutsche Bahn AG, internal calculation

* ifmo Scenario 2025: Estimate by experts

(Figures in 1,000 tons)

1	Northern corridor	25.656	41.353
2	Baltic Sea ports	55.396	92.463
3	Oder River corridor	31.244	114.630
4	Czech border crossings	26.902	81.569
5	Balkan border crossings	42.774	107.335

6	Alpine border crossing	80.883	161.456
7	Burgundy Gate	24.859	41.833
8	Western corridor	99.851	162.998
9	Netherlands	205.567	310.065
10	North Sea ports	182.868	293.830

Illustration 10: Development of Foreign Trade Volume by Corridor

Transiting Freight Traffic has More than Doubled

However, the strong economic growth experienced by the Eastern European member states has not only fuelled the growth of German foreign trade, but has also led to a significant increase in the volume of traffic transiting through Germany. Due to Germany's central location within the now larger EU and the economic conditions described, the volume of transiting traffic in the last two decades

- Has increased steadily at an average growth rate of 4 percent a year, and
- Has more than doubled from approximately 103 million tons to some 250 million tons (cf. Illustration 11).

Traffic Volume in Germany has Increased Significantly

A further result of the economic growth in Western and Eastern Europe is that there has been an ongoing shift of sectoral structures in the individual economies. The share of bulk commodities such as steel and coal in the German traffic volume has decreased from approximately 40 percent to roughly 27 percent in the last two decades.

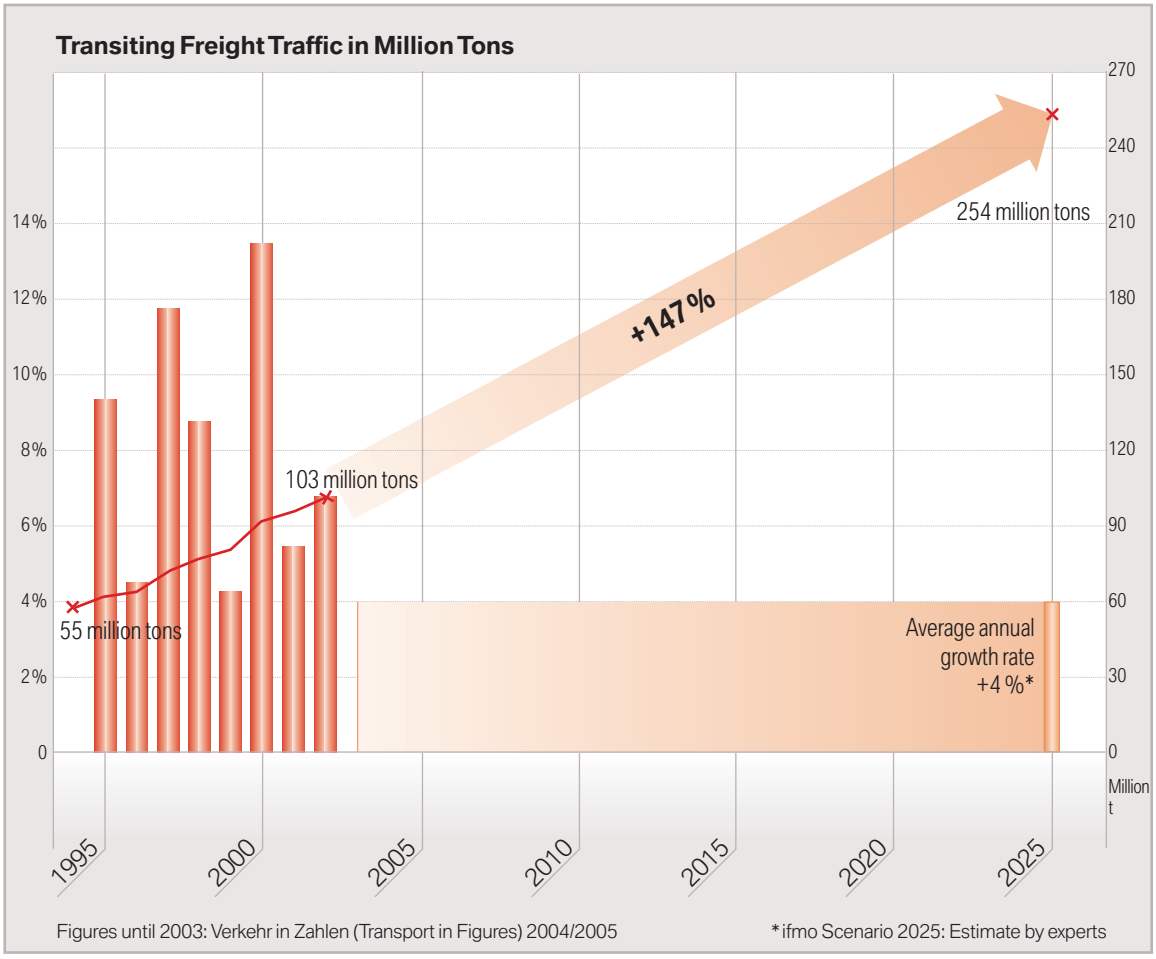


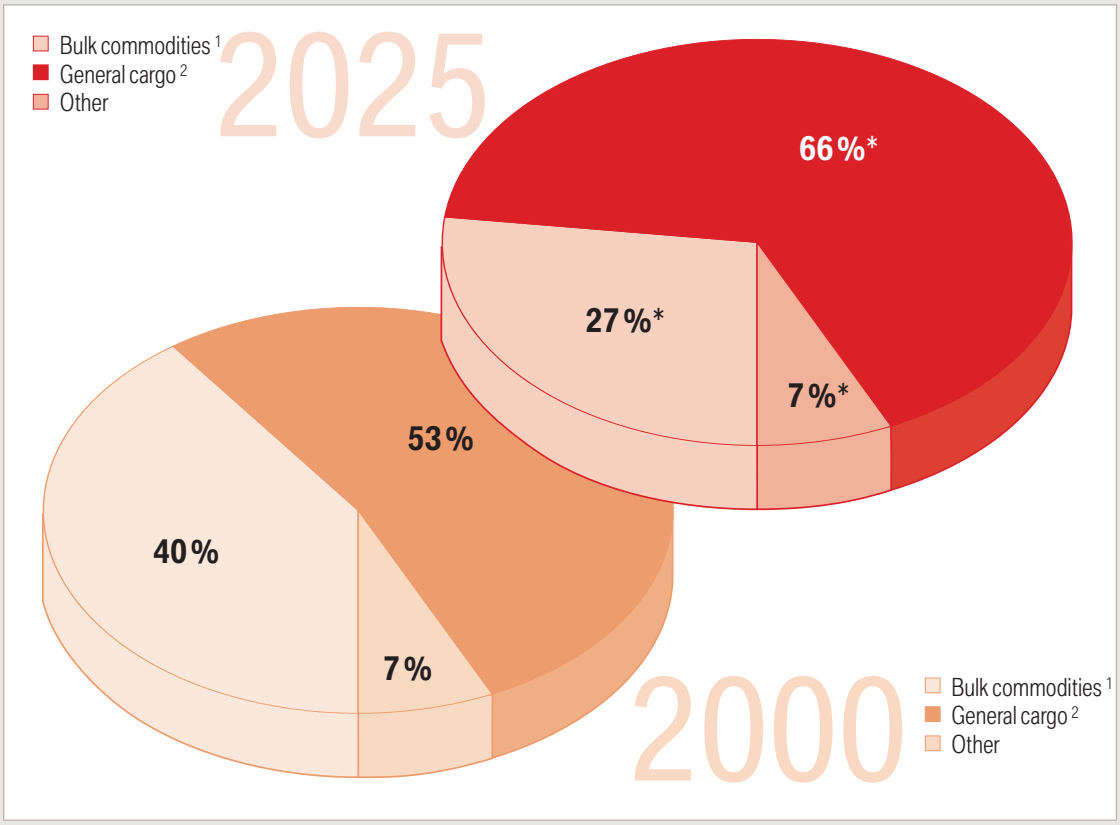
Illustration 11: Development of Transiting Freight Traffic

By contrast, there has been a significant increase in the volume of high-value cargo transported, such as machinery or vehicles. The share of such freight transportation in the overall volume of traffic is now up from approximately 53 to roughly 66 percent (cf. Illustration 12). However, such high-value products take up much more space in transport than bulk commodities, since they are larger in volume and require more packaging as a result of their higher value. Simply put, this shift in sectoral structures means that one ton of freight transported in 2025 is far more voluminous than it was in 2005. Thus, more containers and, accordingly, more vehicles are required in order to transport the goods.

This volume effect alone has led to a significant increase in the volume of freight traffic.

In the same period we see an even greater increase in volume in cross-border traffic between Western and Eastern Europe on account of unmatched freight traffic: While most products transported from Western to Eastern Europe are high-value, light and voluminous cargo, the goods transported from Eastern to Western Europe are mainly simple, heavier goods such as bulk commodities or preliminary products.

Structure of Freight Transported in Percent



[1] Iron/steel; construction raw materials; crude oil; petroleum products; solid fuels; agricultural and forestry products
[2] Vehicles; machinery; other semi-finished and finished products; chemical products; food and animal feed

Figures 2000: Deutsche Bahn AG

* ifmo Scenario 2025: Estimate by experts

Illustration 12: Development of Structure of Freight Transported

The transport containers required for voluminous, high-value products (such as vehicles or machinery) going from West to East can only rarely be used for transporting goods and commodities in the opposite direction, since the products involved either take up a far smaller volume or, because of their characteristics (as in the case of a liquid bulk product), have to be transported in special containers. Hence, the share of empty runs is relatively large.

General Economic Conditions in Germany and Europe 2005-2025

Assumptions

- Volume of German foreign trade doubles (in tons).
- Substantial growth experienced by Eastern European economies.
- Freight transported shifts from bulk commodities to higher-value products.

Effects on Traffic

- Overall increase in freight transportation volume by 80 percent.
- Significant increase in freight volume from, to and across Germany:
  - Volume of German foreign trade quadruples in some instances on corridors to Eastern Europe – and while this increase begins at a relatively low level, the traffic infrastructure used was already overburdened in 2005.
  - Volume of traffic transiting through Germany more than doubles, particularly on the East-to-West axis.
  - North Sea ports in Germany and the Netherlands still handle a major share of German foreign trade volume.
- Additional increase in traffic volume
  - due to changes in the structure of freight and
  - due to traffic between Germany and Eastern Europe not matching.

5.2.3 General Social Conditions in Germany Lead to Less, but More Differentiated Consumption

The growth of the German economy in the last twenty years – at an average annual growth rate of the German GDP of 1.8 percent – is attributable above all to the steady and consistent increase in the volume of German foreign trade. While domestic trade has also increased, growth in this sector has been under-proportional compared with overall economic production: In the same period, the growth of domestic trade averaged "only" 0.8 percent a year.

However, this growth of the gross domestic product is not reflected by a corresponding increase in domestic consumption, at least not regarding goods and commodities that need to be transported. This is because the need to save money for private retirement arrangements as well as increased spending on health care, communication and mobility has reduced, for a large group of people, the share in income that they used to spend on traditional consumer products (cf. also Passenger Traffic in the Year 2025, "People Have Changed Their Consumer Habits", page 32).

Another reason for the significant change in consumer behavior as compared to the year 2005 is the very different age structure of the German population. With the group of over-80-year-olds being far larger than in the past, the average consumption of goods and commodities relevant to transport is far lower than that of younger age groups (cf. also Passenger Traffic in the Year 2025, "People Have Changed Their Consumer Habits", page 32).

The fact that domestic trade volume has slightly increased in spite of stagnating consumption is primarily attributable to changes in industrial production. In Germany, like in other countries, the division of labor in industry and, accordingly, the trade in goods and services has continued to increase over the years.

Consumer Behavior Reflects Individualization and Globalization

There have also been structural changes in the demand for goods relevant to transport. On the one hand, there is an unbroken trend towards globalization also in consumer habits, because the ongoing intercultural exchange has transcended borders and broadened people's scope and experience, resulting, in other words, in globalization of the minds. Under theinfluence of global media such as the World Wide Web, MTV, and the cinema, the public tastes, fashions and lifestyles have become uniform and standardized the world over. This has also left its stamp on consumer behavior, with great demand in particular for global brands.

On the other hand, consumer behavior has also become more individual. While demand for classic consumer goods has grown only moderately, consumption as a whole has retained its great significance as an expression of individual lifestyle. The industry has responded to this development by continuing to differentiate its product portfolio. These individualized products continue the trend towards small batches in transportation. However, such smaller consignments are combined by logistics providers to form larger shipments, meaning that the overall volume of freight traffic is up only slightly.

The complexity of consumer behavior is further driven by consumers becoming increasingly multi-facetted, looking to acquire either low-priced or expensive and prestigious products, depending on the product group involved. This trend towards "hybrid" consumption, in addition to the increasing significance of private retirement arrangements, has given many consumers a clear focus on prices. Low-priced products are manufactured largely in low-wage countries and imported into Germany. This has not only increased the volume of foreign trade, but also means that longer distances are covered on the trade routes.

However, such longer distances have resulted in only a minor increase in freight traffic volume in Germany, since they are set off by smaller overall demand for goods relevant to transport.

Time Saved is an Important Purchasing Criterion

Developments in the world of labor have had a noticeable influence on consumer behavior. With markets being highly dynamic, the demands made on the individual's professional flexibility have grown consistently. The share of gainfully employed women (cf. also Passenger Traffic in the Year 2025, "Demand for Labor Force Still Covered ", page 32) has continued to grow, and many people in gainful employment have only limited time available. The time factor also plays an increasingly significant role in consumer decisions, with

products being purchased which allow the consumer to save time. Hence, demand for convenience, semi-finished and finished foods has further increased. Supplementary services such as home delivery have also taken on greater significance. In the course of these trends, the mail order business has grown substantially and now accounts for some 12 percent of total turnover in retail. Today, the distinction is no longer between B2C, C2C, and e-commerce or traditional mail order purchasing, since these various channels ultimately only differ in terms of the type of communication used for placing orders.

New Distribution Concepts Developed for the "Last Mile"

The substantial growth of the mail order business can no longer be met by high-cost deliveries directly to the households. Messenger, express and parcel delivery services have established new distribution concepts in addition to making direct deliveries, in most cases making the transport on the "last mile" the responsibility of the consumer. This means the service providers deliver the product ordered to a central, often automated, delivery center. The customer, after having been informed that the shipment has arrived, is able to pick up the goods at any time.

Contrary to what was feared, shifting the last mile to the customer has not led to an increase in passenger traffic, since such pickup stations are located on highly frequented transport routes people use regularly, anyway, in commuting. In other words, such new distribution concepts hardly require the customer to cover additional distances. On the contrary, by making joint deliveries to recipients at such pickup stations, the frequency of parcel and home delivery traffic in residential areas was noticeably reduced, also saving multiple deliveries to households where nobody was at home the first time to take delivery of a shipment.

General Societal Conditions in Germany 2005–2025

Assumptions

- Minor increase in the volume of domestic trade:
  - Domestic consumption of goods relevant to transport stagnates, spending shifts towards private retirement arrangements and preventive health care measures.
  - Continued, slight increase in the division of labor in the German industry (proceeding from a very high level).
- Ongoing individualization of consumer behavior, further differentiation of products.
- Internationalization and globalization of lifestyles. Demand for foreign products continues to grow.
- Continued, growing demand for low-priced products from low-wage countries, reflecting consumers' strong orientation by prices.
- Increase in mail order business and integration of e-commerce.

Effects on Traffic

- Batch sizes in transport continue to become smaller.
- Hardly any changes in traffic volume due to the low level of domestic demand.
- New distribution and delivery concepts become established practice on the "last mile".

5.2.4 Massive Increase in Freight Transportation on the Road

The volume of freight traffic on the road has increased substantially in the course of the last two decades. The main reasons for the growth of freight traffic as a whole lie in the general economic conditions in the year 2025 described above, such as the high division of labor in industrial production, smaller batches in the deliveries made, as well as the general shift in the structure of freight transported.

Although these general conditions have in each case affected different transport-related factors – the volume of freight, the distances covered, as well as traffic volume – they all act in the same direction in influencing the modal split: Freight traffic has increased mainly on the road.

Freight Transportation on the Road Characterized by High Flexibility and Low Fixed Costs

Of all traffic carriers, the road offers the highest network density and allows enables capacities to be adjusted easily. This makes the road system most suited to meet the requirements of growing freight traffic, where, given the far-reaching division of labor in industrial production, a high degree of flexibility is an absolute must. A further advantage offered by the road system in transportation is the cost structure, because in view of the relatively low level of fixed costs the road is more attractive than other traffic carriers for conveying small parcels and shipments. Particularly on short and medium distances, high-value products made in relatively small batch sizes can be transported more cost-effectively on the road.

Another reason for the increase in road freight traffic is that the new EU member states, after joining the European Union, have invested primarily into their road networks. This is why particularly high growth rates are evidenced on the main lines within the Eastern European countries and connecting them with Western countries, and thus also in transiting traffic along the East/West axis.

Traffic Collapse Deferred

It would have been impossible to cope with this enormous growth in road traffic simply by expanding and upgrading the existing infrastructure in the same way as before. Whatever financial resources were available had to be invested in the maintenance of roads and bridges. But while this was just sufficient to overcome particularly acute bottlenecks, funds were far too low to expand and upgrade the road network to the degree actually required in view of growing freight traffic. To understand why this is the case, one just has to consider the growth rates some corridors experienced in the last twenty years, with freight traffic increasing no less than four-fold.

Considering furthermore that growth rates have been particularly high in the corridors to Eastern Europe, which were already overburdened in 2005, it becomes apparent that maintaining a functioning, efficient system of road freight traffic required huge efforts. It is therefore anything but normal that road freight traffic, with the exception of a few new bottlenecks, is operating at almost the same level of performance as it did twenty years ago. The only way to prevent a significant increase in traffic jams was by the political stakeholders taking tough decisions and consistently following up on them, and by the automotive industry introducing numerous innovations. The most important of the decisions taken and innovations introduced, together with their respective consequences, are therefore described below.

Road Traffic Optimized as a Result of Individual Traffic Information Systems

One of the most significant innovations in technology successfully introduced in recent years is individual traffic management. Many trucks are now equipped with navigation systems communicating both with one another and with a system of computer and database centers that is financed by toll revenue. This system monitors general traffic conditions, evaluates the data obtained in real time, and provides valid, short-term traffic forecasts. These are transmitted permanently to the navigation systems in trucks, giving drivers personalized recommendations for the route to be taken, in each case geared dynamically to the overall traffic scenario. The prerequisite for this development

was the widespread availability of low-cost, wireless sensor networks and the installation of on-board units in trucks serving to collect the toll. As a result, the traffic volume is distributed better, covering a larger area in peak hours, and the road network is more uniformly used in 2025 than had been the case back in 2005.

Sensor networks used in trucks also provide the technological basis for new, inter-vehicle driver assistance systems. A good example is the now common Stop-and-Go Assistant automatically and very efficiently guiding truck drivers through bottlenecks and ensuring a smooth flow of traffic. This new technology also makes an important contribution to active safety in road freight traffic, with driver surveillance, lane control and outer contour monitoring systems now being standard equipment on a modern truck. Despite the higher volume of traffic, there are therefore much fewer accident-induced traffic jams than was the case just twenty years ago.

Charging Toll in Order to Efficiently Manage Traffic

Toll charged on trucks and passenger vehicles has proven to be a valuable system of controlling and managing traffic (cf. also Passenger Traffic in the Year 2025, "Toll on Passenger Vehicles Introduced", page 43). With toll being charged on the Autobahn and also on some regional expressways as a function of the time of day and traffic volume, there is now a better balance of traffic density between what used to be peak hours and times with less traffic. By spreading out the flow of traffic on Autobahn highways and regional expressways, the toll system has provided a better time-spread of the traffic load, traffic flowing much more smoothly and consistently than before.

The expansion of truck toll to cover larger areas has also had positive effects, toll now also being charged in some cases on smaller, secondary roads (in some cases toll is even charged in cities). And at the same time toll is now obligatory for all trucks driving on the road in Germany.

One drawback, however, is that a large number of different, largely incompatible technologies are used for collecting toll. This requires trucks traveling on cross-border main roads in Europe to take along several terminals for the purpose of properly being monitored and toll subsequently collected.

No German Haulage Contractors Any More

The poor implementation of EU-wide harmonization efforts, which fact is attributable to the continued dominance of regional and national interests in politics and business, has increased the overall net burden on road freight traffic. The main reason for this increased demand placed on roads, however, is that the road toll was compensated for only to a very slight degree by other taxes and charges on traffic being reduced.

The logistics industry was able to compensate the higher net burden now imposed on their business by ongoing rationalization measures and by deploying haulage contractors from low-wage countries. As a result, very few German haulage contractors are now to be found in road freight traffic.

Trucks are Bigger and Heavier than Before

Harmonization has been implemented far more successfully in another area, in the Europe-wide standardization of vehicle dimensions and weight in road freight traffic. During the last twenty years, truck dimensions and the maximum weight allowed have been increased step-by-step. In this way, the stakeholders involved in traffic policy responded to the shift in the structure of freight transported towards more voluminous goods (as described hereinabove) and provided another option on how to handle the significant increase in road freight traffic.

Such measures, which in the past had been difficult to implement for political reasons, are now based on the agreed objective pursued by traffic policy to separate the increase in the traffic volume on the road, on the one hand, from the increase in mileage covered by trucks, on the other. At the end of the day, traffic jams are attributable not only to the larger volume of goods transported or to growing distances, but above all to the number of trucks on our roads. Increasing the transport capacity of each truck meant that the growing density of traffic could be countered, so that the traffic volume no longer increased at the same fast pace as in the past. Apart from the time- and space-related capacity effects already described, this has also served to expand capacities in road freight traffic.

Emissions Down, but CO_2 Remains a Problem

Surprisingly, emissions in road freight traffic have decreased significantly despite growing traffic volume. This is attributable to the introduction of new European emissions standards and new technologies serving to reduce gaseous emissions. In this way, harmful emissions such as NO_X, HC, CO and soot were reduced in a step-by-step process. Widespread use of sulphur-free fuel, in turn, has also helped to minimize SO_2 emissions. However, these improvements have not been sufficient to completely compensate the CO_2 emissions resulting from the higher volume of traffic, despite the greater efficiency of freight traffic in general and in spite of fuel-saving technologies such as lightweight construction and low-emission engines. CO_2 emissions therefore remain a problem.

Noise emissions have also been reduced in the course of the last twenty years. On the one hand, trucks themselves now run at a lower noise level, lower by about 3 dB(A) from the former level, reducing the noise level actually perceived by 20 - 30 percent. On the other hand, new road surfaces and tarmac, as well as the ongoing improvement of the tire/road system, have also helped to reduce the noise level given in road transport.

Developments in Road Freight Transportation 2005-2025

Assumptions

- Most of the growth experienced by freight transportation is on the road.
- Constructing new roads alone is not sufficient.
- Innovations and political decisions are implemented in order to ensure that road freight transportation can function:
  - Individual, dynamic traffic management.
  - IT-supported capture of traffic conditions in real time.
  - Enhancement of the toll system by introducing criteria relating to road use.
  - Permissible dimensions and weights of trucks are increased.

Effects on Traffic

- Congestion on some bottleneck routes, particularly from and to Eastern Europe.
- Larger geographical spread of traffic flow, smoother and more consistent use of the infrastructure available.
- Fewer accidents and fewer traffic jams caused by accidents.
- Timed distribution of the flows of traffic, achieving a continuous traffic flow.
- By introducing larger trucks, the traffic volume's disproportionate increase is cushioned.

5.2.5 Concentration Promotes Rail Freight Traffic

Rail traffic has also benefited from the general increase in freight transportation: The traffic volume of rail freight transportation has increased steadily in the last twenty years, albeit at a significantly slower pace than road freight transportation did. So in fact, freight transportation has not shifted massively from road to rail – even though such a changeover was urgently demanded by many stakeholders twenty years ago and was often predicted. This is largely attributable to the fact that the demands concerning the transportation of freight ever since 2005 are quite simply fulfilled better by road transport. These demands result from very stable trends given in several areas relevant to freight transportation as a whole and described in detail hereinabove. The basic events causing them, once again, are the shift in the structure of goods, greater demands in terms of flexibility in the loading industry, as well as smaller batch sizes in transportation.

A number of fundamental decisions had to be taken by railway companies and traffic policy in the last twenty years in order to ensure an increase, at least in absolute terms, and not a decrease in the volume of freight traffic on the rail in 2025 as compared with 2005. These decisions are described hereinbelow.

Growing Distances and Container Traffic Make Rail Transport a Sensible Selection

Providers of rail freight transportation have benefited from two trends in the last twenty years: First, longer distances than before; second, the significant increase in container transports.

Longer distances have put the higher fixed costs of freight transportation on the rail into a different perspective, making rail traffic an attractive price option on long distances. However, the prerequisite for becoming competitive versus road freight traffic was the interoperability of European freight traffic on rails. At the EU level, such interoperability was promoted by the European Railways Agency (ERA) established in 2006. An essential factor in this process was the technical interoperability of signaling, communication and power systems in the enlarged EU. Just as important was the abolition of institutional constraints, in particular national egotistical interests on the part of railway companies as well as the heterogeneous homologation regulations for rolling stock. In the meantime rail freight transportation has been "Europeanized" on all levels, extending all the way to an internationally valid driver's license for railway locomotives.

As a result of these improvements, and in combination with the gradual separation from passenger rail transportation, average speeds of rail freight traffic within Europe have increased over the years. Quicker processing at border crossings and the option to now use the same locomotive driver on both sides of a border – without having to change drivers – have contributed to increasing the average speed, which meant that the transportation costs of border-crossing traffic were also reduced. Privatized, market-oriented railway companies put these market opportunities to full use, offering competitive options to their customers. At the same time, these companies concentrated on economically viable routes, significantly increasing the productivity and efficiency of rail freight transportation. The downside is that this concentration has significantly cut back the overall density of the rail traffic network, with many shorter and unprofitable routes being closed down for operational reasons.

Railway Companies Focusing on Single-Load Train Traffic

Based on similar operational and business considerations, the focus in freight traffic is on single-load trains, which nearly all providers of rail traffic opt for. Single-load trains[27] are far more economical than shipping in individual freight cars, since the operator is not faced with the high cost of collecting and distributing individual goods. Rail freight transportation using individual freight cars is therefore to be found only very rarely on long international routes, since this is the only instance in which, on account of the distances involved, the high cost of shunting the train can be set off.

[27] A "single-load train" means that one whole train is dedicated exclusively to one complete shipment. The entire train is filled completely by the loading company and is driven directly from the loading to the unloading station.

An essential prerequisite for the economic operation of individual freight cars, the future of which was still queried by experts just twenty years ago, was the successive replacement and technological modernization of freight cars. Today such freight cars feature a kind of "intelligent", automatic testing and communication system, enabling them to independently determine their load status, compare information with other freight cars that are a part of the same train, and feed data consistently to the locomotive itself as well as the forwarding agent and network operator.

Further Decline of Small-Scale Distribution Traffic in Rural Areas

This focus on profitable single-load train traffic has effects similar to the concentration of transportation providers on long routes: Rail freight transportation is now virtually non-existent in rural and secondary areas. Just a few main routs have remained on which single-load trains can be driven at a profit. However, the volume of freight transported is much higher in 2025 than just twenty years ago.

A major reason for this development is the significant increase in container shipping, above all in sea shipping. This significant increase in container shipping has led to the goods being bundled in a manner appropriate for rain transportation in areas around sea ports. The providers of rail freight transportation services made use of this potential for single-load train traffic to offer profitable and competitive transport options.

Developments in Rail Freight Transportation 2005-2025

Assumptions

- The volume of rail freight transportation grows, albeit not at the same rate as overall traffic volume does.
- Growth in container shipping and longer distances offer opportunities to rail freight transportation which, in other respects, is at a disadvantage vis-à-vis road traffic.
- Innovative measures are implemented and political decisions taken in order to keep rail freight transportation competitive:
  - European rail traffic continues to become more and more interoperable.
  - Freight transportation and passenger traffic on main railway routes are separated.
  - Consistent continuation of market deregulation at the European level.
  - Step-by-step replacement of old freight cars and technical upgrading of freight cars.

Effects on Traffic

- Focus on single-load train traffic.
- Substantial decrease of shipping in individual freight cars.
- Offers concentrate on economically profitable routes.
- Rail freight transportation no longer distributes shipments in secondary, more remote regions.

5.2.6 Sea Shipping Characterized by Ongoing Containerization of Overseas Shipping

In the course of the last twenty years, the container shipping volume worldwide has increased by an annual average of 10 percent, growing to more than six times its original size in the process. Shipping companies have responded to this significant increase in container shipping volume by ordering the construction of container ships constantly increasing in size, thus using economies of scale to cope with the larger volume. In the year 2025, container ships have a capacity of 12,000 TEU[28] or more. This means that the capacity of larger container ships, which had already become much bigger around the turn of the millennium, is up once again by approximately 50 percent.

Ships with a capacity of 12,000 TEU are now the standard size on routes to the Far East. Due to their draft, however, they are able to enter only sea ports with appropriately deep access routes, which, only twenty years ago, were not to be found anywhere in Germany.

When such 12,000 TEU vessels were introduced, many large shipping companies have opted for economic reasons for the one-port concept. This means that they sail to only one port on each trip and unload their entire shipment of containers in that port. This, in turn, means even keener competition among ports. In the meantime, it is becoming apparent that only one port for such large 12,000 TEU container vessels can be operated economically for the whole of Germany.

The Jade-Weser-Port – a Genuine European Container Hub

The Jade-Weser-Port was built in 2010 as a result of a State Agreement between the Länder of Bremen and Lower Saxony. In the meantime the third expansion stage has been concluded in the year 2025, tripling the Port's reloading capacity. Being a deep water port, Jade Weser is easily able to handle 12,000 TEU ships. The infrastructure of the Port's terminals allows one terminal to handle several large container vessels and feeder ships[29] all at the same time.

In the year 2025, the Jade-Weser-Port acts as a major hub for Central European container shipping. A large amount of the cargo reaching the port from overseas is re-loaded at Jade-Weser into smaller feeder ships continuing on to Russia, the new member states of the EU, and Scandinavia as the final destinations of the containers involved. In particular, short sea shipping in the North Sea and Baltic Sea benefits from this trend.

[28] TEU: Twenty Feet Equivalent Unit, a 20-foot-long standard container.

[29] Feeder ships are ocean-going supply ships transporting containers from large vessels to other sea ports.

Germany's other sea ports, particularly Hamburg and Bremerhaven, have also benefited from the increase in sea container volume. However, they have specialized on handling smaller container ships with up to 9.000 TEU. Following the expansion of facilities in Bremerhaven with Container Terminal IV and the completion of further expansion projects at the Altenwerder and Steinwerder Terminals in Hamburg, there are no further options to enlarge these sea ports.

Transportation of containers further inland has required very substantial enlargement and upgrading of the road and railway infrastructure. Reloading and forwarding cargo of this volume to inland destinations represented a complex logistics problem which would have been quite impossible to solve with the existing infrastructure. Very major enlargements were therefore required to cope with the enormous increase in volume.

Developments in Sea Shipping 2005-2025

Assumptions

- Six-fold increase in container shipping volume worldwide.
- One-port concept is pursued by shipping companies in overseas transportation.
- Completion of the Jade-Weser-Port as a European container hub.
- Substantial enhancement of infrastructure around sea ports in the hinterland.

Effects on Traffic

- Container ships increase in size to more than 12,000 TEU (Twenty-foot Equivalent Unit).
- Further concentration of container shipping.
- Concentration of overseas container shipping among just a few hubs in Europe.
- Increase in short sea shipping.
- Significant growth of traffic volume in the hinterland around sea ports.

5.2.7 Inland Shipping Holding Its Own

The trend towards containers is also reflected by inland shipping. Particularly the Rhine River has seen a significant increase in container volume in the last twenty years, because this major waterway leads directly to West European sea ports that continue to play a significant role in overseas transport.

Primary Inland Shipping Routes Upgraded

This upgrade was only possible because in the last twenty years, the limited funds available for inland shipping have been invested specifically into routes offering significant growth potentials in freight traffic while exhibiting a high ability to perform and furthermore being operable at relatively effective costs. These measures were further promoted by the transport policy of the EU seeking to further reduce the traffic load on the road.

The Danube River has also been further upgraded and expanded for inland shipping as a major route to Eastern Europe, the main challenge being to eliminate bottlenecks, for example in the region of Straubing and Vilshofen, two towns in Lower Bavaria. The construction and ongoing development of low-draft barges has also been subsidized. Deploying ships of this new type, which have a far lower draft than conventional ships, helped limit the investments required in the expensive operation of dredging waterways, while enabling operations to continue even in the event of the more and more frequently occurring low water levels.

Concentration Process in Inland Shipping Continues

In the course of time, inland shipping haulage contractors have joined forces to form a small number of big cooperatives. This development in German inland shipping was preceded in the 1990s by the deregulation of freight rates and the process of large shipping companies splitting up. The current form of organization now allows specific functions to be combined, provided this is economically sensible, such as financing ships, loading freight, and maintenance. As a result, fleets have been renewed step-by-step. This means that in 2025, the majority of inland vessels operates with lower emissions, are safer and run faster, all the while having fewer impacts on the river banks than the ships operated only twenty years ago.

Inland Shipping Participates in Overall Growth

Despite these improvements, inland shipping has benefited only proportionally from the general increase in freight transportation. Compared to road traffic, therefore, the growth rates are much smaller, meaning that inland shipping was merely able to keep its share in the modal split of freight transportation in 2025.

The reasons why there has not been any significant growth are similar to the factors determining rail traffic: It is the extremely low density of the waterways network, the relatively long time required to adjust capacities, and the lack of reliability caused by constant changes in water level. Here as well, these factors all speak in favor of road transport, at least when it comes to freight transportation and its specific requirements. Macro-trends such as smaller batch sizes or the change in freight structures resulted in the road freight transportation benefiting, so that inland shipping, like rail traffic, thus missed out on most of the growth experienced in freight transportation.

Developments in Inland Shipping 2005-2025

Assumptions

- Benefits from the growth of overseas container shipping.
- Existing main inland waterways are improved and new ones are constructed to meet demand.
- Inland shipping haulage contractors join forces to form a small number of cooperatives.

Effects on Traffic

- Growth of inland shipping in line with overall growth.
- Capacities are expanded to deal with rapidly growing freight transportation on the Danube Corridor to and from Eastern Europe.
- Gradual renewal of the fleet, introduction of low draft barges.

5.2.8 Air Freight Moving Up Rapidly

Growth rates in air freight have been substantial. Compared with the overall volume of freight transportation, however, the share of freight shipped by air to, from and within Germany is still very small – despite annual growth rates averaging 6 percent and an increase in volume from almost 2.5 million tons in 2003 to more than 9 million tons in 2025, in other words, more than 3.5 times the original volume.

In monetary terms, the growth rates are even more impressive, with the largest growth being recorded in the case of express freight, in other words where extremely valuable computer and machine parts require rapid transportation.

The reasons for this enormous growth of air freight are the significant increase in world trade as well as the stable macro-trends already described in detail in the context of other traffic carriers – in particular the division of labor in industry and changes in the structure of freight transported. Growing consistently, the highly developed industrial production in Germany is largely destined for exports to other countries, and is therefore integrated in a worldwide, extremely differentiated network of value creation. At the same time, the share of high-tech products manufactured for exports has also increased – and with these products having to be fed into production processes over long distances and without delay, the high cost of air freight is certainly justified, also in the light of such products' high value.

There is now no longer any denying in the policy sphere that air freight has become even more significant to Germany's export-oriented economy. German airports have received the necessary support from the political level and the economic sector, and have been further upgraded and expanded. And as in the past, Germany has an air freight hub of global significance that is not subject to an absolute ban on night-time flying.

Developments in Air Shipping 2005-2025

Assumptions

- Growth, above all, in the transportation of very high-value cargo.
- Germany has an air shipping hub of global significance that is not restricted by an absolute ban on night-time flying.

Effects on Traffic

- The volume of air shipping increases three and a half.

5.2.9 Combined Traffic Works Better

The fact remains, despite all the considerations presented hereinabove, that most of the growth in freight traffic took place on the road. Still, the freight volume handled by other traffic carriers has increased significantly in the last twenty years, albeit at far lower growth rates in rail traffic and inland shipping, despite their significance within Germany. Particularly inland shipping and rail traffic have benefited from the growth of container shipping volume.

The growth of rail traffic has also benefited from the general increase in distances in rail traffic. Particularly when looking at long, cross-border European lines for freight transportation, forwarding and haulage companies focus on low-priced offers made by private providers of rail freight transportation.

However, this is a relatively recent development, since for a long time providers of logistic services did not consider combined transport options, despite growing distances and cost benefits in switching over freight transportation from the road to the rail on long distances. This was also because such potential cost benefits were outweighed by significant quality restrictions in transport. Only because trains are now operating at a higher frequency and at a higher average speed has the quality improved and, accordingly, the appeal of rail freight transportation on major railway lines.

Furthermore, the consistent promotion of innovations for reloading freight by EU and Federal German funds has allowed technical progress to overcome what was once the bottleneck in combined transport. Whereas previously there were only a few terminals, mostly at sea ports and in conurbations, for reloading freight from the road to the rail system, in a very time-consuming and expensive process, such operations can now be performed much faster, more cost-effectively and at many places along the major railway lines in 2025.

Despite their absolute growth, rail traffic and inland shipping have not increased their share in the modal split. Indeed, because its services are restricted to economically viable routes, rail traffic has even suffered slight losses in the overall modal split pattern. Nonetheless, the main reason for this development of the modal split is the significant growth of transport on the road.

The further development of freight transportation in 2025 is driven, as before, by factors generally in favor of the road as a traffic carrier. Just to mention one example once again, trucks operating on the road remain the best solution if demand is for a high level of flexibility in freight traffic. So it is not foreseeable that the modal split will shift towards rail traffic and inland shipping in the year 2025.

6. Conclusion – The World of the Scenario "Mobility Requires Action" as Seen from the Perspective of the Various Stakeholders

It seems there is no simple recipe for utilizing the advantages of mobility while keeping the disadvantages to a minimum. The system is too multi-layered; it is driven too strongly by historical structures, individual objectives and political influence. Road traffic, rail traffic as well as air and ship traffic are on different developmental levels, both organizationally and legally. In terms of structure, the spectrum ranges from state-owned to private companies, from public planning to corporate action.

There are, however, some basic developments in all this variety that equally affect all parts of the overall system: the demand for mobility increases, traffic volume expands. And this in the face of a concurrent shortage of public funds, which will continue for the foreseeable future. Even today the budget just barely covers the costs of maintaining and upgrading the infrastructure. In view of this situation, there is only one sensible solution: to increase the efficiency of the traffic system while networking the individual partial systems with one another.

However, it is not only economic aspects that are relevant for designing a stable and sustainable traffic system. Ecological and social aspects must also be taken into consideration, which present their own particular challenges within the framework of traffic policy.

The approaches that could make the world in our scenario become reality range from the development of infrastructure in individual instances to specific organizational measures to general regulative policy decisions.

Below, we will describe what needs to happen, in the perspective taken by political decision makers, by the economic sector and the participants in traffic, in order to make the scenario "Mobility Requires Action" become reality. Our focus is on changes yet to come, we do not describe any already existing developments.

We have purposely not assigned any value to any given factor. The scenario is a possible, consistent model depicting the future. It has been created as a result of the discussions between the experts involved in the project. The developments described within the scenario, however, do not, as a matter of principle, reflect the interests of the initiators of this study.

The following sections are intended to make very clear once again that the mobility world described in the scenario "Mobility Requires Action" will not be handed to us on a silver platter. Instead, it will require considerable effort, advance investments, but also concessions that will need to be made by various stakeholders – and, of course, they are not acting independently from one another.

The World of the Scenario as seen from the Perspective of Political Decision Makers

- A large share of the Bundesfernstrassennetz (network of Autobahns (highways) and regional expressways) has been transferred to private companies, who bear the costs of constructing or upgrading, maintaining and operating the roads essentially using the income generated from the tolls paid by passenger vehicles and trucks.
- The investment funds of the traffic budget are being used, for the most part, for the railway infrastructure.
- Toll has become a traffic control instrument through an expansion of criteria geared to actual road use.
- The expansion of traffic hubs and important transit routes is supported by way of accelerated decision and planning procedures.
- Public traffic management systems are linked to private navigation services in order to completely capture and reflect the traffic situation.
- The dimensions and permissible maximum weights of trucks are increased.
- Rail traffic in Europe has been harmonized: the conditions for competition have been brought in line with each other, access to rail networks is non-discriminatory, and the technical systems are all compatible with each other.
- Innovations in reloading freight road/railway were consistently promoted.
- Air traffic control was harmonized in Europe.
- There was political support for the expansion of at least one air traffic hub with the possibility of a 24 hour service.

- The countries and city states on the North Sea have expanded their harbors and inland connections.
- Public transportation services are consistently tendered.
- Public transportation was converted from services financed by public budgets to services provided by private companies. A portion of the public funds is paid, in the form of "mobility money", directly to the group of persons whose active participation in mobility might otherwise be jeopardized.
- Taxi traffic is less strictly regulated and is able to differentiate its offers.
- The regulations for long distance traffic with regular service buses have been cancelled.

The World of the Scenario as seen from the Perspective of Corporate Enterprises

- The automobile industry continues to develop vehicles with reduced emissions and reduced fuel consumption; fleet consumption was greatly reduced.
- The share of alternative fuels was raised to 20 percent.
- Technologies for individual traffic management in road traffic were introduced on the market and serve to optimize the traffic flow; in this regard, networked navigation systems, real time communication of the traffic situation, and dynamic route recommendations all have a decisive role to play.
- Safety in road freight traffic continued to improve with driver assistance systems being developed that are independent of vehicle types, as were sensor networks.
- Rail traffic service companies concentrated their offers in freight and passenger traffic on main railway lines and, in passenger traffic, on metropolitan areas and their connection to the surrounding regions.
- Rail traffic in Europe is a single market. Suppliers compete with one another across national borders.

The World of the Scenario as seen from the Perspective of Participants in Traffic

- The variable costs of mobility have risen.
- The share that mobility spending has in household budgets has increased, at the expense of other consumer spending.
- In planning their driving routes, drivers take the toll geared to actual road use into account.
- Employees increasingly use flexible working hours to avoid the rush hour during commuter traffic times.
- In addition to the demand for high-quality vehicles, demand for low-cost automobiles continues. Low cost vehicles are the only possibility for an increasing number of households to maintain their "automobility".
- Alternative offers of mobility by car are in greater demand, such as car rental and car sharing schemes.
- For an increasing share of the population, using different traffic carriers in a flexible and pragmatic manner will develop into natural behavior.
- Travelers find differentiated offers for rail and air traffic, based on price and comfort.
- Public transportation in metropolitan areas is attractive; the offers outside of the metropolitan areas have dramatically decreased.

7. Outlook

An important part of our project is to communicate our results. The great interest with which our dialogue events were received by the public in the past encourages us to use this forum once again in order to publicize the present scenario update. We are looking forward to discussing our results with representatives from politics, special interest associations and the economic sector.

Some of the developments described in the scenarios were investigated in greater detail in what are called roadmaps. These roadmaps not only set out the conditions prevailing in the year 2025 as described in the scenarios, but also how those conditions have come about; they show the individual developmental steps from today until the year 2025 (cf. also Chapter 2.6, page 18). This means that indications can be gained from these roadmaps on what actions need to be taken. This is how we followed up on the requests for concrete decision-making aids that were repeatedly expressed by our conversation partners in the dialogue events. Furthermore, the roadmaps offer an opportunity to gain a better impression of the amount of time that it will take from a decision being taken up to the point of implementation of specific processes.

From the beginning, the intention was to continuously update the scenario project. The dialogues with all stakeholders enable us to get a sharper image of the future and to obtain an understanding of which aspects of the study should be included in the next phase. We welcome suggestions and additional information from our readers at any time.

Annex A: Wild Card Events Breaking the Trend – What Happens When the Unexpected Happens

1. Count on the Unexpected to Happen

What happens when the developments predicted in the scenario "Mobility Requires Action" are suddenly disrupted by unexpected events? Introducing and analyzing such events that break with trends (also called "wild card events") while also considering their possible effects are part of the seven-step scenario technique on which this project is based.

Events that break with trends obviously are not in line with the trend; at best, they represent an unusually steep rise of a trend and its peaking impact. Wild card events have a low probability of occurrence but a high intensity or range of effect(s). The terrorist attacks of September 11th, 2001, are a typical event that breaks with trends. Or the tsunami flood disaster in the Indian Ocean at the end of 2004 and beginning of 2005 with its catastrophic consequences is another.

By contrast with the other steps of the scenario technique, the investigation of wild card events is characterized by two basic features: on the one hand the analysis of events that break with trends is not mandatory, but optional. Such an investigation can be made, but does not necessarily have to be implemented. On the other hand, any investigations of events that break with trends and their effects will of necessity be speculative. It is not possible to comprehend these events such that any precise statements can be made – this applies for the event itself as well as for its effects. Moreover, not all conceivable events can be possibly analyzed.

Still, it is sensible to develop events that break with trends and to outline their impacts. Though we may not always be successful in predicting such wild card events exactly, risks and critical areas or changes in trend will at least be registered.

2. Experiences Gained in Analyzing the Trend-Breaking Events described in our Previous Study

In order to avoid drifting off into utopian and irrelevant speculations, the trend-breaking events had to be carefully selected. In the basic study we had chosen nine possible wild card events from a list of over 50.[30] We used the following criteria in making our choice:

- Events whose probability of occurring is extremely low were not considered.
- Events that it is not expected will happen within the time frame covered by the scenario were also excluded.
- If events were assumed to have similar effects or to occur in the same environment, only one was selected.
- Only events with considerable impacts on transportation were selected.

The following nine events that break with trends remained and were analyzed in depth:

- Long period of economic growth,
- Deep economic depression as a result of a so-called Big Bang,
- Deep economic depression resulting from a creeping recession,
- Wars in oil supply regions,
- Shortages in oil supply,
- New energy technology for passenger vehicles,
- New traffic infrastructure,
- Chinese economic miracle,
- Continental strongholds.

Some of the analyses prepared in 2002 of these events that break with trends can be commented on as early as now (2005):

- The economic development since 2001 is suspiciously similar to the pattern typical of a "Creeping Recession". A characteristic of this drawn-out event is that "new hope of a final economic reversal and upswing springs time and again." Many factors indicate that we are currently in the middle of such a long, drawn out recession.
- A "War in Oil Supply Regions" took place in 2003, this was the War in Iraq. Since it only had direct impacts on the oil supply of Iraq, the effect was essentially weaker than the analysis had predicted at the time. Still, the War in Iraq surely had effects on the oil price increase in the following years. The essential basic statements of the study published in the year 2002 have thus become reality in a somewhat weaker form.
- The "Chinese Economic Miracle" came about earlier than expected. The impacts set out in the study are to be observed at present. However, the positive effects of the business done with China by the German industry will be offset for the most part by stagnating domestic demand.
- In the meantime the scenario study also includes freight traffic. In this context, innovative transportation technologies were more intensively examined than in the basic study. However, the various transportation technologies and transportation infrastructures presented to the expert groups were either dismissed unanimously as unrealistic, or were not thought to be implementable in the next twenty years. Thus, the event "new transportation infrastructure" has not been pursued further.

The analysis of the remaining events that break with trends set out in the basic study and not commented on in the present report (long period of economic growth, deep depression as a result of a Big Bang, new energy technologies in passenger vehicles, continental strongholds) continue to be valid, as seen from today's perspective. For this reason, describing them once again in the present report is forgone.

[30] These trend-breaking events and their effects have been described in detail in the report "Zukunft der Mobilität – Szenarien für das Jahr 2020" ("The Future of Mobility – Scenarios for the Year 2020") in Chapter 7, pp. 48 et seq., edited by the Institute for Mobility Research, Berlin 2002.

3. Selection of Two Additional Trend-Breaking Events

In the course of updating the study and expanding it to include freight traffic, new possible wild card events were compiled. Two events were selected for closer analysis from more than 20 suggestions, using the same procedure as in the basic study, in order to estimate their effects on mobility:

- Dramatic increase of extreme weather situations,
- Escalation of international terrorism.

Other events that were perhaps interesting at first glance, were not selected, such as, for example, "A two-speed Europe", "Permafrost relationship between the United States and the European Union," or "Concerted action is taken to increase the birth rate to 2.1 percent." These possible events were not analyzed in depth because the probability of their occurrence, and, above all, their impacts on traffic, were considered to be too low.
In the following two sections the two events selected are more closely analyzed. Against this backdrop, and based on our present situation, we will then describe the possible events in the future and their effects.

4. Dramatic Increase of Extreme Weather Situations

4.1 The Starting Point: Natural Disasters caused by Climate Change are on the Rise

"Natural disasters cause increasingly greater damages world-wide. Since the 1960s, the frequency of great natural disasters has almost tripled, while the damage to the national economy, already adjusted to reflect inflation, has increased to seven times the amount given in the 60s, and insured damages have even increased to fourteen times that amount." (Berz, Münchener Rückversicherungs-Gesellschaft, 2005). If one looks at the weather related natural disasters of the last decades that have cost insurance companies more than a billion dollars, there is only one prior to the year 1987, Hurricane "Alicia" from 1983. Since the year 1987, however, there have been a total of 41 events of this magnitude, 27 of which in the 1990s and 12 since the year 2000.

What is particularly striking is the fact that in the last years weather disasters have occurred more often in regions that to date did not belong to the areas usually hit by such catastrophes, like North America or the Caribbean. Even Germany was afflicted by severel weather disasters: Hurricane Lothar in 1999, the 2002 flood or the Elbe River, and in 2003 an extreme heat wave. Climate researchers are proceeding from the assumption that an increase of extreme precipitation events, including drought and flooding, must be expected.

The climate researchers' calculations furthermore show that climate change is not only leading to a general increase in average temperatures, but also to greater weather fluctuations, such as episodes of heavy winds, heavy rains or droughts. The heat wave in Germany of 2003 could thus be a preview of what awaits Europe in the future.

It is presumed that the main causes for the increase of weather disasters are the man-made emissions (mostly CO_2 emissions) and the resulting global warming of the atmosphere (the greenhouse effect), the growing urban sprawl, (resulting in soil sealing) by structural facilities and traffic areas being built, as well as the deforestation of the tropical rain forests in South America.

4.2 The Trend Breaker: Extreme Heat and Floods Occur on a Regular Basis

The developments set out above will now be presented as seen from the perspective taken in the year 2025. In this context, it is assumed that because of the frequent and increasingly intense extreme weather situations, it is general consensus among experts starting in 2010, and in the general public in 2015, that an irreversible climate change is taking place in Central Europe.

Climatic fluctuations in Central Europe intensified: hurricanes, flooding resembling the biblical Great Flood, and long periods of drought all happened at increasingly shorter intervals. Hurricanes laid individual regions in Southern Germany as well as in Northern Germany to waste within a short time. Also, periods of heavy rainfall became more frequent, although the south was affected more often than the northern regions. At the same time, heat waves in the summers claimed many lives in Europe.

The topic was hugely dramatized by the media: they painted dreadful pictures of the damages that could occur and how it will affect peoples' lives. CO_2 emissions were named as a main cause, in particular emissions by motor vehicles. The media reports, as well as recurring extreme weather events, caused increasing uncertainty among the population. Public anger was increasingly directed against CO_2 emitters.

After a few years, however, a new level of normalcy set in. People accepted climate change as a given and developed a certain routine in dealing with it.

4.3 General Impacts: Measures serving to Mitigate the Damage and to Reduce CO_2 Emissions were Taken

Measures Taken to Prevent and Mitigate Damages

It was attempted to construct buildings that were as hurricane resistant as possible. Likewise, numerous measures were taken to avert the damages caused by flooding: larger catchment areas were developed the protective facilities for buildings were upgraded, stream renaturalization, reconversion of soil-sealing structures.

As a result of the long heat waves, demand for air conditioning spaces came up even in Germany. This meant that technological solutions serving to heat buildings in the winter and cool them in the summer enjoyed great market success.

The agricultural production throughout Europe became extremely difficult and was altered by the extreme climate fluctuations and the increasingly frequent periods of drought. In Germany, there were large crop shortfalls, and fewer agricultural products were produced, which resulted in considerable price increases.

The drought also had drastic impacts on potable water supply, in particular in metropolitan areas. Disputes arose between communities, counties, regions and states. New "water alliances" were formed in order to provide the citizens with enough water. In Germany a promotional program was launched for the use of dual water systems (separate water pipe systems for potable water and service water), which resulted in potable water consumption being decreased to half of what it was previously.

The drainage of rainwater into the canal systems and surface water was noticeably decreased as a result of a new waste water removal system being deployed. In this way, it was possible to reduce the rate at which the ground water table was sinking. Other measures were also taken serving to curb flooding, which on the whole mitigated the intensity of the flood waves along the rivers. The Rhine River was available as a source for potable water and run-of-river power plants only to a limited extent.

The demand for air conditioning in the summer, the conversion to dual water systems as well as the measures taken to protect the country against flooding resulted in the construction industry temporarily booming, particularly the installation trade. Other sectors also profited: manufacturers of stationary and mobile air conditioning units, of water pumps and drying and dehumidifying equipment, of emergency power supply units, and roofing and facade materials experienced a temporary upswing.

The insurance industry suffered high losses for a short period of time, but experienced a long-term volume growth. Many operations in the agricultural sector had to give up, those remaining were able to ensure their survival by using new cultivation methods and developing new products (niches).

Changes in Attitude towards Climate Protection

The realization that the disasters can be traced back to anthropogenic emissions also made the topic of environmental protection a highly popular one in the general public. Huge numbers of people engaged in protesting against old trucks, diesel locomotives, airplanes and ships running on heavy oil. As a result, traffic carriers reinforced the development of low-emissions motor vehicles, in particular with low fuel consumption and lower CO_2 emissions. The efforts concentrated on reducing fuel consumption, particularly in road traffic: on the one hand motor vehicles were developed that had improved propulsion systems technology and were constructed using light-weight design technology, on the other hand traffic flow was optimized and fleet management improved by installing telematics systems. The demand for small passenger vehicles with low motor capacity and low fuel consumption noticeably increased.

Ecological issues became essential selection criteria for many large shipping companies deciding on modes of transport, since they oriented themselves increasingly by the fundamental environmentally-friendly attitude of their customers.

4.4 Effects on Traffic: Recurrent Damages to Traffic Infrastructure

Road Traffic Impaired by the Weather

The frequent hurricanes and heavy precipitation affected road traffic: not only fallen trees and flooding on the roads limited the roads' capacity, but also the road blocks for clean-up and maintenance work. Private and commercial users alike avoid using the roads whenever possible.

However, because buildings and traffic infrastructure needed to be repaired in the aftermath of the catastrophes, additional traffic was generated by material transportation and construction vehicles. Frequent clean-up and repair work make the maintenance of the traffic infrastructure more expensive; as a result the taxes and duties on road traffic were raised.

Rail Traffic also Suffered because of Natural Disasters

Fallen trees that block the rail routes, torn-down railway overhead lines, rails that have been flooded or whose foundations have been washed away, as well as damages to buildings and infrastructural facilities caused by storms all created difficulties for railway companies. The companies changed their operations to ensure 24/7 stand-by service to remedy service disruptions, and developed a special device to promptly clear and reconstruct the railway tracks and railway overhead lines. Particularly dangerous stretches were partially covered, for example, avalanche protection facilities were constructed in the mountains. In the case of newly constructed routes, diesel drive trains were considered to be put into service instead of the usual electric drive trains, because their overhead lines are so susceptible to damages by heavy storms.

The heat waves also forced the railroad companies to react: public transportation vehicles and the working areas of the train personnel (driver's cab, control area, offices) were equipped with air conditioning. This meant train transportation became generally more expensive due to the increasing operating expenses and investments into "unproductive" infrastructural facilities, such as more protective constructions instead of more rails). In this way, the railway lost part of its competitive edge that it had been able to gain over road or waterways traffic.

Floods and Low Water Tables in Rivers Reduced the Transportation Volume of Inland Water Transportation

The efficiency of the inland waterways was diminished by the frequent floods and low water tables. The transportation capacity of the Rhine River as Europe's most important waterway was reduced almost to half of what it had been previously; as a result of the low cargo capacities, transportation costs increased. Barges benefited from the low water table in that they were more frequently deployed.

Airplanes Back in the Air Pretty Soon

Hurricanes and heavy precipitation often kept planes on the ground and led to many airplanes being diverted to airports that were not affected. However, following the storms and floods that damaged the infrastructure used by motor vehicles, trains and ships, air traffic was the fastest of all modes of transport to return to operation.

Shifts in the Modal Split

Bulk commodities were transferred from waterways to rail systems, because due to the measures taken, the railway was less susceptible to storm related problems. Passenger traffic tended to move from the rails to the roads; still motorized passenger traffic saw a slight decline. As opposed to rail and road traffic, air traffic was able to increase its share of high quality freight traffic and of long-distance passenger traffic.
Owing to the considerable impediments to traffic and the limited usage possibilities of the infrastructure, transportation costs on the whole increased significantly, across all modes of traffic. The public funds designated for investment in traffic were no longer generally allocated "per rail" or "per road" but spent where they were most urgently needed.

5. Escalation of International Terrorism

5.1 The Starting Point: International Terrorism has Changed

International terrorism can be defined as

- The pursuit of political, economic or religious objectives.
- The threat and use of violence; targets are mainly governments, prominent institutions or buildings of symbolic importance. The fact that innocent people are killed or injured as a consequence of the attacks is tolerated or even intended, for example the attacks on commuter trains in Madrid.
- Terrorism can take many different forms of action, ranging from individual attacks ("single issues") to guerilla warfare. Open confrontation is avoided, in particular direct war.
- A world-wide networking of cadre cells, small groups, and "sleepers".
- The greed for publicity and media attention. Whether or not an attack is successful has less to do with its actual results than with the ensuing publicity. In the case of the attacks against the World Trade Center, the attacks had been "staged" as regards their timing.
- The readiness given in many groups to implement suicide attacks. This factor makes combating terrorism more difficult because any threat of a penalty here on earth has no effect on a suicide bomber.

The ideological enemies of the terrorist organizations oriented by their Islamic beliefs are, along with Israel, the western industrial countries, in particular the United States. The goal of Islamist terrorists is primarily to overturn the government systems in the Muslim countries and establish an Islamic "God's state" that strictly follows the Sunni Sharia law. The United States are seen as the greatest barrier for establishing these political systems. However, the consistent actions taken by the United States, but also by Israel and Russia, against terror suspects have unintentionally resulted in a revolutionary mobilization of the Islamic population.

Islamic Terrorists are Active all over the World

The world was shocked by the most severe terrorist attacks ever experienced at the beginning of this century: the attacks on the World Trade Center in New York and on the Pentagon Building in Washington D.C. on September 11th, 2001 and those on three train stations in Madrid on March 11th, 2004. The perpetrators were identified as the terror network Al-Qaeda and its leader Osama bin Laden. Sheer terror and immense fear prevailed in the media and in the population that further terrorist attacks might take place. While the military operations of the international Anti-Terror Coalition in Afghanistan and in Iraq led to the infrastructure and communication networks used by the terrorist groupings being destroyed, they did not incapacitate them. Islamic terrorist still remain active world-wide.

The western governments reacted to the attacks with diverse political measures. These included preventive measures, such as, for example, the improvement and further development of international collaboration between secret service organizations, the establishment of anti-terror units, the capture of biometric data, and improved training within security authorities. At the same time, repressive measures were taken, such as the stricter application and consistent enforcement of the rule of law, while greater pressure was placed on the search for terrorists using special means of screening. Military operations for self-defense were used as well as, ultimately, retaliation attacks.

There are Several Reasons for Why Terrorism has Escalated

Intelligence agencies observed an increase in terrorist activities in the ensuing years, which then led to further preventive strikes by the United States and other countries. The United States favored an extreme form of deterrence policy. However, this policy, combined with the increase of poverty in certain regions of the world, resulted in terrorist organizations becoming ever larger and more popular.
There was a creation of an increasing number of smaller, but nonetheless effective organizations that had access to high-tech weapons. They are networked world-wide and operate on a global scale. The risk that weapons of mass destruction could be deployed was already real. As a consequence of proliferation the number of owners of such weapons increased, and with it the risk of their being deployed.

[31] Proliferation describes the distribution of nuclear, biological and chemical weapons as well as the passing on of the means and knowledge of how to manufacture such weapons to countries of which it is feared that they could use these weapons in armed conflict or could threaten to use the weapons to achieve a political objective. (Brochure "Proliferation – das geht uns an!" (Proliferation – It Matters to Us!) published by the Bundesamt für Verfassungsschutz (Federal Office for the Protection of the Constitution), Cologne 2004).

5.2 The Trend Breaker: Devastating Terrorist Attacks One Right after the Other

As a result of these developments, the years following 2006 saw an escalation of terrorist attacks throughout the world that reached war-like proportions. Within periods of only a few months, symbolic civilian targets in the United States and Europe were subjected to attacks with biological and chemical weapons. Thousands died or were injured.
The media focused on nearly nothing else during this time. Because of the frequency and scope of the attacks, the feeling arose of being at war with an invisible enemy. This had decisive impacts on the everyday life of many people – they avoided large assemblies of people and voluntarily limited their freedom of movement. In particular in metropolitan areas, this fear was widely felt. No large events took place anymore.

5.3 General Impacts: Insecurity and Strain Widely Felt – Measures Taken to Combat Terrorism Begin to have an Effect after a few Years

Global Economy was Seriously Affected

The terrorist attacks had negative impacts on the development of the world economy, and this in many ways: the higher expenditures by the states for internal and external security burdened the national economy and restricted economic growth. The increased security regulations also limited world trade. Fears that oil supply facilities could be attacked by terrorists drove up the price of oil and resulted in energy prices increasing significantly.

All of this meant that the already high insecurity that enterprises felt about their future economic development became even greater. In view of the critical situation, their willingness to take risks was rather low. Companies accordingly attempted to compensate for the rising costs by economizing further. Global sourcing and the relocation of production sites to low-wage countries experienced a downward trend because the costs of transactions had increased noticeably. Suppliers locating near the system suppliers benefited from the significantly shorter trip chains.

International tourism experienced a sharp drop in volume, which had corresponding impacts on international air traffic. Particularly in metropolitan areas, where the fear of attacks is highest, services are increasingly being demanded within the home. Likewise, mail order companies registered a clear increase of turnover since many consumers avoided shopping centers.

Drastic Political Measures Taken to Improve Security

After the attacks, the main focus of the overall policy shifted in the direction of security policy. All political areas had to face this threat, traffic policy included.

In Germany, parliament quickly passed a resolution enabling the Bundeswehr (Federal Armed Forces) to be deployed also for internal matters. Measures serving the protection of the populace and reconnaissance in previously unknown dimensions were initiated: strong police presence in public, controls, building and property protection, police raids, searches, and criminalistic analyses were all executed at high-risk locations with the highest intensity. The population was involved in prevention and reconnaissance activities. Immigration was more strictly controlled, which meant that the European Union became less attractive for immigrants. Within Germany there were less people taking up residence in metropolitan areas since the risk of attacks was viewed to be particularly high there.

On the whole, the options for international cooperation (for example, The United Nations) were put to better use. There was a general consensus that one of the most important tasks now was to provide economic, structural and political aid to the Near East and Middle East regions in order to deprive terrorism of its breeding ground. The international cooperation of secret service agencies will be intensified.

Political and police actions proved to be successful after only a few years; the acute risk of terrorist attacks for the population was reduced without, however, the danger being excluded completely. It took many years until normalcy returned. The security measures and directives introduced after the attacks were not abolished, despite the risk of terrorist attacks lessening, but rather remained in place as a standard.

5.4 Impacts on Traffic: Costs of Transportation and Mobility on the Rise; Road Traffic Proved to be the most Flexible Mode

Freight and Passenger Traffic Declined

The series of terror attacks led to passenger traffic as well as freight traffic declining. There were many different reasons for this: first, the more extensive security measures and security institutions, as well as the stricter controls, increased transportation costs as well as mobility spending by private households. Second, the costs for new vehicles rose and taxes were increased. Third, the rise in oil prices caused a further jump in fuel prices and energy costs. And fourth, the security requirements of all participants in traffic were so high that all other criteria such as punctuality, travel time and comfort were secondary, making a participation in traffic significantly less attractive.

Road Traffic Continued to be the more Flexible and Attractive Mode

While the road infrastructure was in fact affected by the terrorist attacks, it proved to be more flexible as compared to rail and air traffic. Investment funds were mainly used to further expand and develop the security institutions. Road use tolls and other charges levied on road traffic had to be raised in order to cover the rising costs for security and to ensure that roads were given surveillance. In addition, access to city centers was restricted in order to have better surveillance in metropolitan areas and to obtain a contribution to cover the rising costs.

This favored the pervasive use of technology. The increasing need for information and the demands of security surveillance and flexible reaction in emergencies resulted in increased distribution and networking of telecommunications systems, telematics systems and individual traffic management systems. At the same time automobile manufacturers will introduce innovative safety concepts for their vehicles, for example camera surveillance systems, oxygen supply in the vehicle's interior, automatic fire-extinguishing systems.

Despite the rising costs, individual motorized traffic became increasingly attractive. When compared to means of mass transportation, individual motorized traffic fulfills the need for security better, since it is more flexible in critical situations and is less suited as a target for attack. The roads also became more attractive for freight traffic because of the higher network density of the infrastructure.

Rail Travel was Avoided

The attacks caused serious disruptions at important railway hubs; for a time, the capacity of the infrastructure decreased. In addition, the high expenditures for security facilities resulted in investments in railway infrastructure being lower than they had been previously. As a result of the stagnation in metropolitan area traffic, the infrastructure of the railway public transportation was not expanded and upgraded in any major way.

Likewise where rail freight traffic was concerned, technology was used more pervasively in order to improve security surveillance. The project of equipping freight cars such that they are "intelligent" benefited from this status quo.

On the whole, the appeal of railway traffic and railway public transportation lessened. This, as well as the lack of flexibility given in rail traffic, meant that the interest in an intermodal network with individual motorized traffic also fell.

Safe Harbors were Competing

Investment shifted from expanding and upgrading the waterways to providing harbors with security facilities. Because of high security requirements that were placed on harbors as well as on loaders, shipping companies and freight carriers, processing times for the freight increased dramatically, resulting in considerable disruptions. Additional border controls were put in place, while further controls were implemented inland; as a result, transportation costs rose considerably. "Glass containers" were introduced to provide additional security. The increased handling of trade via particularly safe harbors occurred at the expense of those harbors that were considered less safe. This often led to road and rail networks in the inland area of the safe harbors being overloaded.

Air Traffic was Hit Especially Hard

Air traffic was hit especially hard because international tourism took a dive. Because of its high security requirements, stricter controls and the resulting increase in cost, it clearly lost much of its appeal. The application of these security standards resulted in very long clearance times (like flying to Israel today), which will make air travel on short stretches much less attractive.

Shifts in the Modal Split

The road suffered the least from the results of terrorist attacks. Attacks on a road are not a particularly interesting modus operandi for terrorists; the symbolic effect as well as the mass effect (number of victims killed) are rather small. Roads damaged by terrorist attacks are relatively easy to drive around. Rail traffic, in contrast, is more sensitive to the destruction of hubs; repairs take longer and the possibilities to solve the problem by taking a detour are limited. Rail traffic's share of the modal split decreased during the phase of intensive attacks, and the modal split shifted in favor of road traffic.

Freight transportation by ships, in particular container ships, decreased slightly both in absolute and relative terms, in which context a concentration especially on the safe harbors emerged.

Air traffic was hit particularly hard by this escalation of terrorism, since airplanes are still considered to be high-risk and their appeal sank because of high costs and lengthy security checks. Air traffic's share of the modal split decreased.

6. Conclusion: In the Long Term, Traffic Situations will not Change Fundamentally

The events that break with trends described here deal with conceivable disasters. When they occur, they will seriously dampen down passenger and freight traffic for a short while and will cause a shift within the modal split. In both cases, a new normalcy will set in, in which the basic developmental lines of the scenario presented in this report will once again take hold (cf. Chapter 4).

However, both wild card events differ fundamentally from one another. While climate change will remain a permanent condition, the escalation of terrorism will abate after a few years. The changing climate will lastingly alter the situation, but people will adjust to it. The threat of international terrorism will decrease so much that it will have no further influence on daily life; what will remain as a "legacy", however, is a certain sensitivity to risks as well as stricter security regulations and enhanced security institutions.

Both of the events that break with trends introduced will strongly impact people's daily lives and will place a strain on the economy, while also triggering technological developments and societal changes.

Thus, the "Climatic Extremes" wild card will mean that air conditioning and ventilation technology in Germany will develop further, that water usage and water treatment as well as the waste water management and sewage treatment follow new paths; that concepts for low-emissions engines and heating systems are pushed ahead. As a whole, the ecological awareness in society will increase and will be expressed in massive demands and individual ecological actions.

The wild card "Escalation of International Terrorism" will lead to an improvement in detection and information systems, and this will mean that among others, traffic management systems will benefit from the newly gained knowledge. New security institutions and improved infrastructure may also be used for other situations relevant to security and may be transferred to other areas of daily life. The increased collaboration of the various security institutions will also optimize the process in other critical situations.

This means that a whole series of developmental lines within the scenario presented will be reinforced or stimulated as a result of events occurring that break with trends. Consequently, along with the effects that will restrain traffic, there are impacts that will improve traffic efficiency in the middle and long term.

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