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OptiTrans

Baseline Study Thuringia

Version 1.0

14.03.2018

Contents

1 Introduction

The purpose of this baseline study is to provide an information basis in the context of the Interreg Central Europe Project „OptiTrans: Optimisation of Public Transport Policies for Green Mobility". Therefore, this baseline study has to be understand as an analysis of the mobility and public transport situation in the project region Thuringia. The study offers key figures as well as policy approaches and it provides a comprehensive overview of the current conditions to promote a modal shift from motorised private car towards eco-mobility.

The baseline study mainly examined existing statistics, reports and development plans, and if necessary combined them to produce indicators and conclusions. The study followed a multi-step approach: The statistics and literature have been analysed and the results converted into a structure able to provide a comprehensive overview of key elements on the mobility and transportation sector in Thuringia.

In order to fulfil the purpose of a baseline study this report is organised in the following four parts, each of them covers a specific topic and deals with the analysis of questions and statements concerning the current situation in Thuringia:

- *Population and Territorial Characteristics* – an overview of the structural characteristics which determine the specific conditions in the Federal state, like the settlement structure, demographic development and transport infrastructure,
- *Mobility and Public Transport* – key figures and statistics on mobility behaviour, modal split and public transport use for Thuringia as well as in comparison to Germany,
- *Public Transport Organisation* – information about the status of the organisational conditions and financial aspects of the public transport system in Thuringia,
- *Challenges and Opportunities* – summarises the measures of the Thuringian climate action plan towards greenhouse gas reduction in the transport sector, it includes a brief SWOT-analysis, which also serves as a brief summary and conclusion of the overall report.

2 Thuringia: Population and Territorial Characteristics

The free state of Thuringia is predominantly rural, there is no metropolitan area and the only city with more than 200.000 inhabitants is the state capital Erfurt. Even so, Thuringia does not lack diversity and variation in its settlement structure, landscape and industry. Its variety of landscapes and settlement patterns is unique in Germany: From prosperous cities and lively villages to spacious forests and natural heritages.

The demographic situation within Thuringia is a challenging issue, especially the population decrease thru emigration, a drop in the birth rate and low figures of immigration after the reunification. The forecast until 2035 identifies no significant change so that the rural areas facing a persistent declining population. Nevertheless, the countryside forms one of the backbones of the Thuringian economy. Its forestry and agriculture, its small manufacturing companies are one supporting pillar of Thuringia's job market. Larger industrial sites are usually close to the big cities like Erfurt, Jena and Eisenach.

The settlement patterns, the population development and economic welfare are the main parameter of traffic trends and mobility patterns at the macro level – because of this, the following part will provide an insight into the current situation of Thuringia.

2.1 Settlement Structure and Urban Development

The settlement structure in Thuringia is predominantly rural and is characterised by villages and small or medium-sized cities. The main urban regions are settled along the so-called „Thuringian string of cities", where the cities of Eisenach and Gotha, Erfurt and Weimar, Jena and Altenburg are located right in the centre of the state. Those cities form a corridor where most of the industrial and manufacturing sites are located. The areas beyond this corridor are mostly rural – with small and mediums sized towns as there regional centres. These towns can be seen as rural development cores.

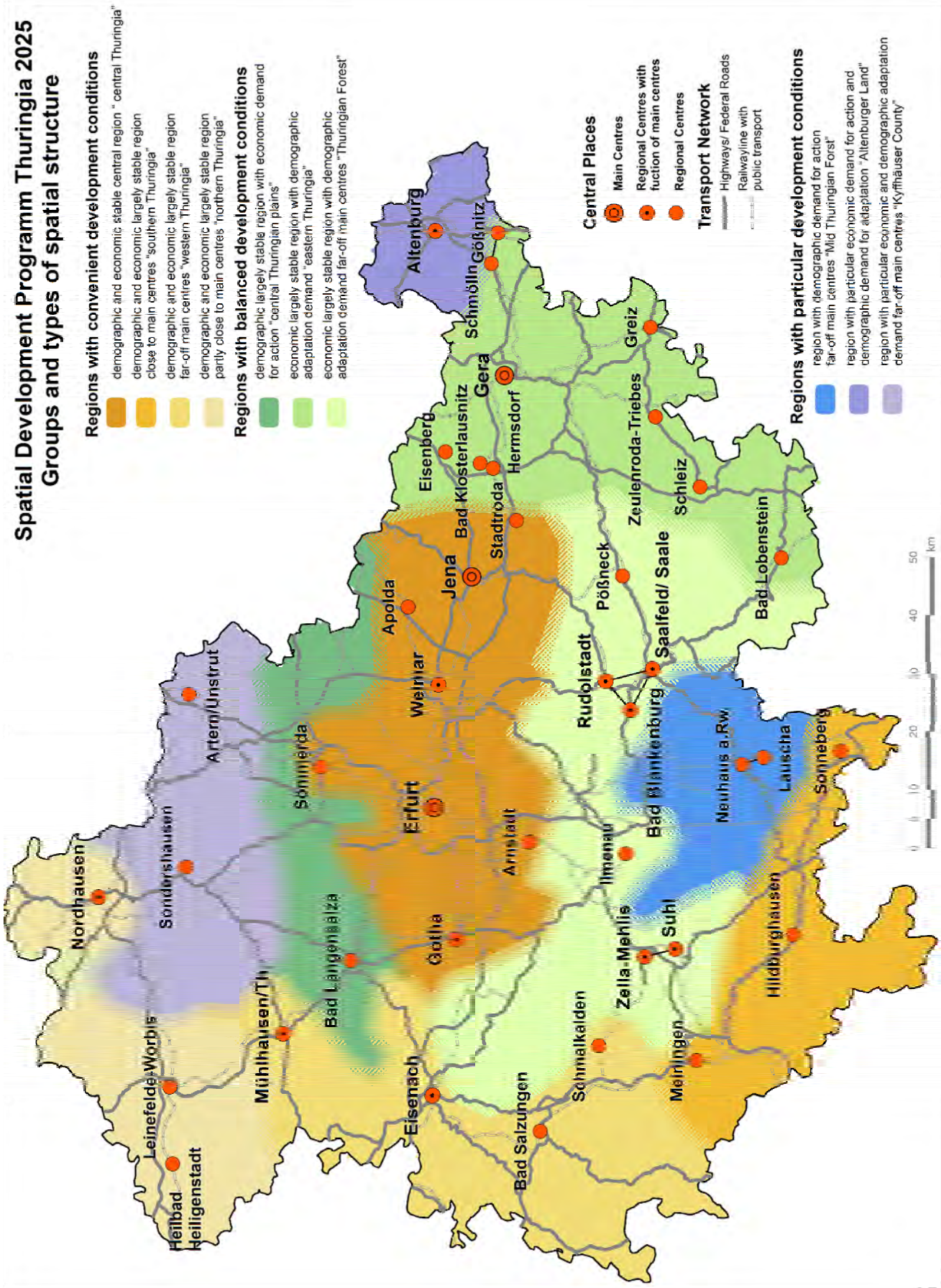
Central places concept and accessibility standards

Like every regional development approach in the states of Germany, the Thuringian approach is orientated at the concept of *central places*. The definition of central places follows functional indicators, a specific set of purposes, infrastructure and facilities. The Thuringian regional development program 2025 [1] determines a hierarchical scheme with three categories of central places: main centres, regional centres and *local centres* – see Map 1. Main centres are the cities of Erfurt, Jena and Gera – those are the cities with more than 100.000 inhabitants. There are eight regional centres with functions partly of main centres and 24 regional centres all over Thuringia. Beyond that, the regional development plan defines 76 local centres. Every central place serves as a regional node for a predefined catchment area. At this point, spatial planning overlaps with transport planning:

The access to central places must be assured for the people living in a specific catchment area – transport is, therefore, a service of public interest.

The regional development programme defines accessibility standards in terms of travel times from an origin within a catchment area to the central places as the destination that shall not be exceeded. According to this approach, the travel time should be:

- for main centres within 90 minutes by public transport and 60 minutes by private car,
- for regional centres within 45 minutes by public transport and 30 minutes by private car and
- for local centres within 30 minutes by public transport and 20 minutes by private car. [1]



Map 1: Spatial structure and central places [1]

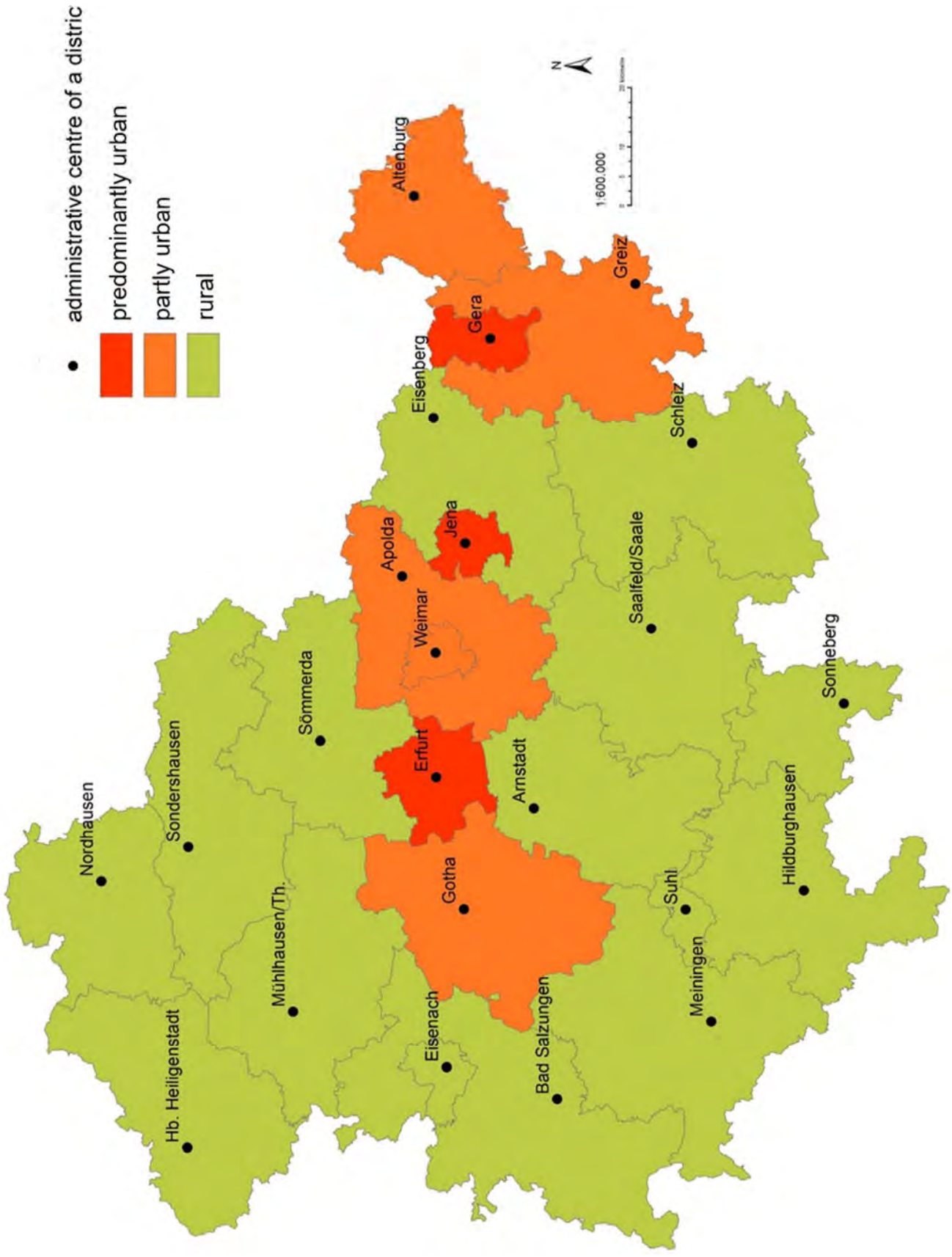
Settlement pattern – rural countryside and the string of cities

On the national scale, the Federal Institute for Building, Urban Affairs and Spatial Research (BBSR) is responsible for the spatial monitoring programme and defines indicators of urban and regional development structure. It uses a system to categorise each region into one of three types: a) *predominantly urban*, b) *partly urban* and c) *rural*. A second category-system uses an additional positional attribute in terms of accessibility, this range from d) *very central* and e) *central* to f) *peripheral* and g) *very peripheral*.

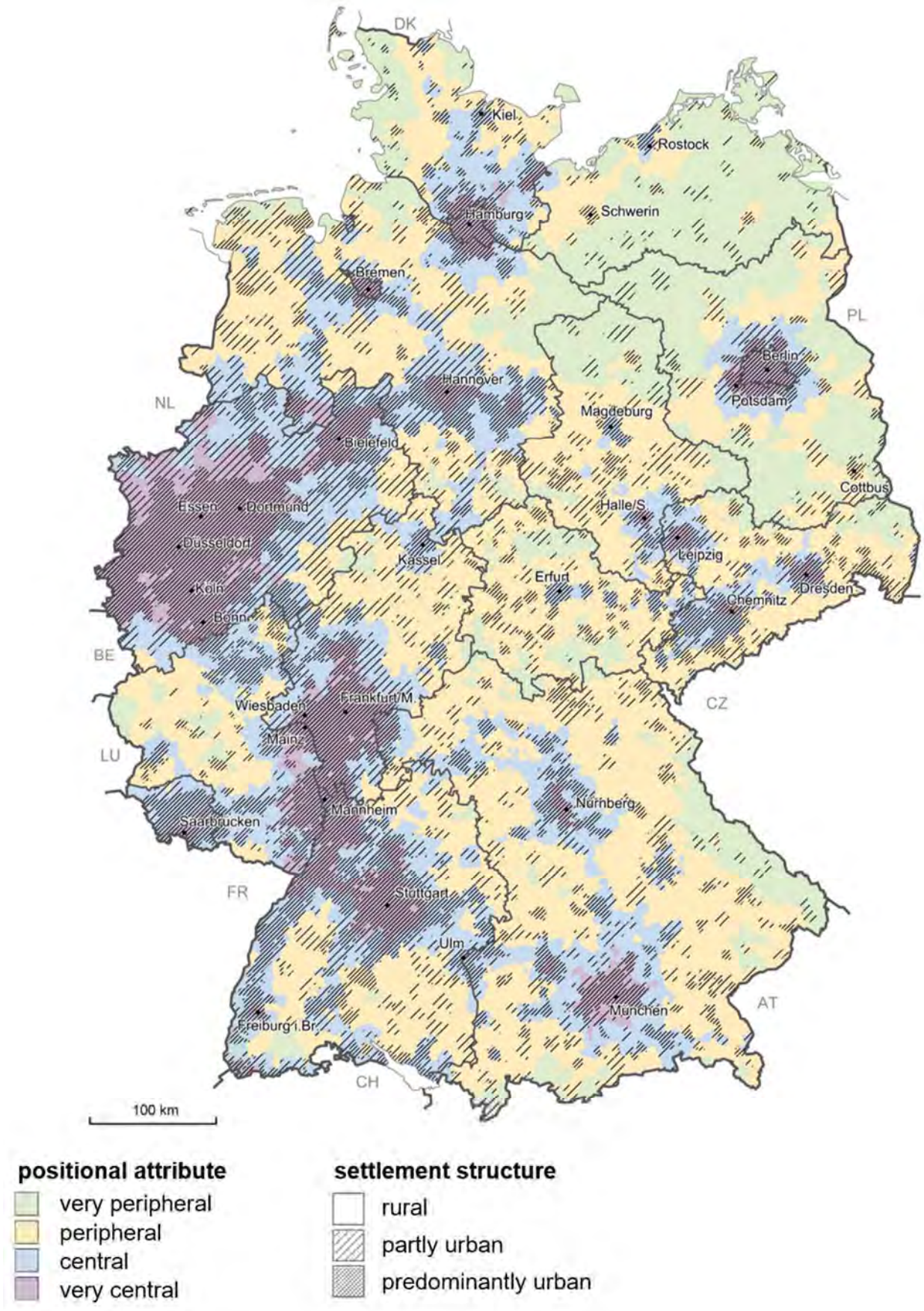
Map 2 and 3 illustrates the definition of both category systems for the Thuringian regions. It shows that except the main centres, almost all regions are defined as rural and peripheral. The rural countryside with small and medium-sized towns as well as the absences of real metropolitan agglomerations forms Thuringia's spatial characteristics.

The BBSR systems are developed to monitor the regional situation at a national scale, with the result that Thüringen's regions are defined as predominantly rural. To specify regional types within Thuringia and to identify spatial challenges the system requires more differentiation. Therefore, the Thuringian regional development plan applied an own category. This system discarded the duality concept of rural and urban, instead it concentrates on spatial challenges. In this respect, the regional development plan identifies regions with a) *favourable development condition*, b) *regions with balanced development potentials* and c) *regions with development challenges* (see Map 1). The regions with favourable development conditions are within a corridor of the main cities Erfurt, Jena and Gera.

Thuringia's settlement structure is polycentric – a net of small and medium-size towns surrounded by the countryside. The urban development is characterised by the string of cities, which reaches thru the middle of the state. This unique settlement structure, a countryside with small and medium sizes towns as their core at the one side and at the other urban areas of high population density as well as suburbanised region along the string of cities.



Map 2: Spatial structure of counties 2015 according the BBSR monitoring system, own illustration, source: [2]



Map 3: Spatial structure and positional attributes of counties 2010 according the BBSR monitoring system [3]

Sub-urbanisation

Suburbanisation is one of the driving force of increasing private car traffic as well as car-oriented mobility habits. In comparison to other German regions, the spread of urban sprawl in Thuringia is relatively moderate in there extend. The polycentral spatial structure with a dens net of small and medium-sized towns but without a prominent urban agglomeration prevented the Thuringian regions from extensive urban sprawl. Nevertheless, large-scale suburbanisation processes have been taken place along the string of cities after the reunification with a peak in 1997 [4]. Since then the suburbanisation process slowed down. Nevertheless, advanced housing development still stimulates private car traffic mostly in and around the cities of Erfurt and Jena.

Challenges for public transport and mobility

The dualism and uniqueness of Thuringians settlement structure is reflected by the present traffic flow and the mobility pattern: The main traffic flow in Thuringia is oriented to and between the main cities along the string. The commuter pattern (see Map 9) can be seen as an indicator for such interrelations in Thuringia. Beyond the greater region of the string of cities, the traffic flow, as well as the route network of the public transport, is in line with the rural cores – the small and medium-sized towns.

According to this, there are major traffic flows by private car as well as at the public transport to and between the urban settlements of the string of cities – which are the main destinations for the commuters. During peak hours, the transport infrastructure and the public transport are operating at the limits of its capacity. The rural cores certainly attract less traffic, but there is still a significant flow to and from small and mediums sized cities within the rural areas. In the rural regions of Thuringia the car is the main mode of private transport whereas the public transport take part in a struggle with declining passenger volumes.

2.2 Population and demographic development

The demographic change with nearly all there serious characteristics has affected Thuringia across the whole state. With high emigration rates and a decline in the birth rate, the population structure in Thuringia changed dramatically in the last two decades. Thus, the state face unique challenges and is in need of action to stabilise the population, it has to accompany and facilitate the change – especially in the countryside where the demographic development shows the most impact due to shrinking and aging population.

However, understanding demographic change only in terms of a declining population and ageing goes to short. Demographic aspects are broader and with much more societal impact. Besides (a) declining population and (b) ageing three more processes can be mentioned in this context: (c) increase of lifestyle heterogeneity, (d) individualisation and singularization and (e) globalisation. All processes are influencing the population and the living conditions in Thuringia, but there intensity and bias is quite diverse across the state.

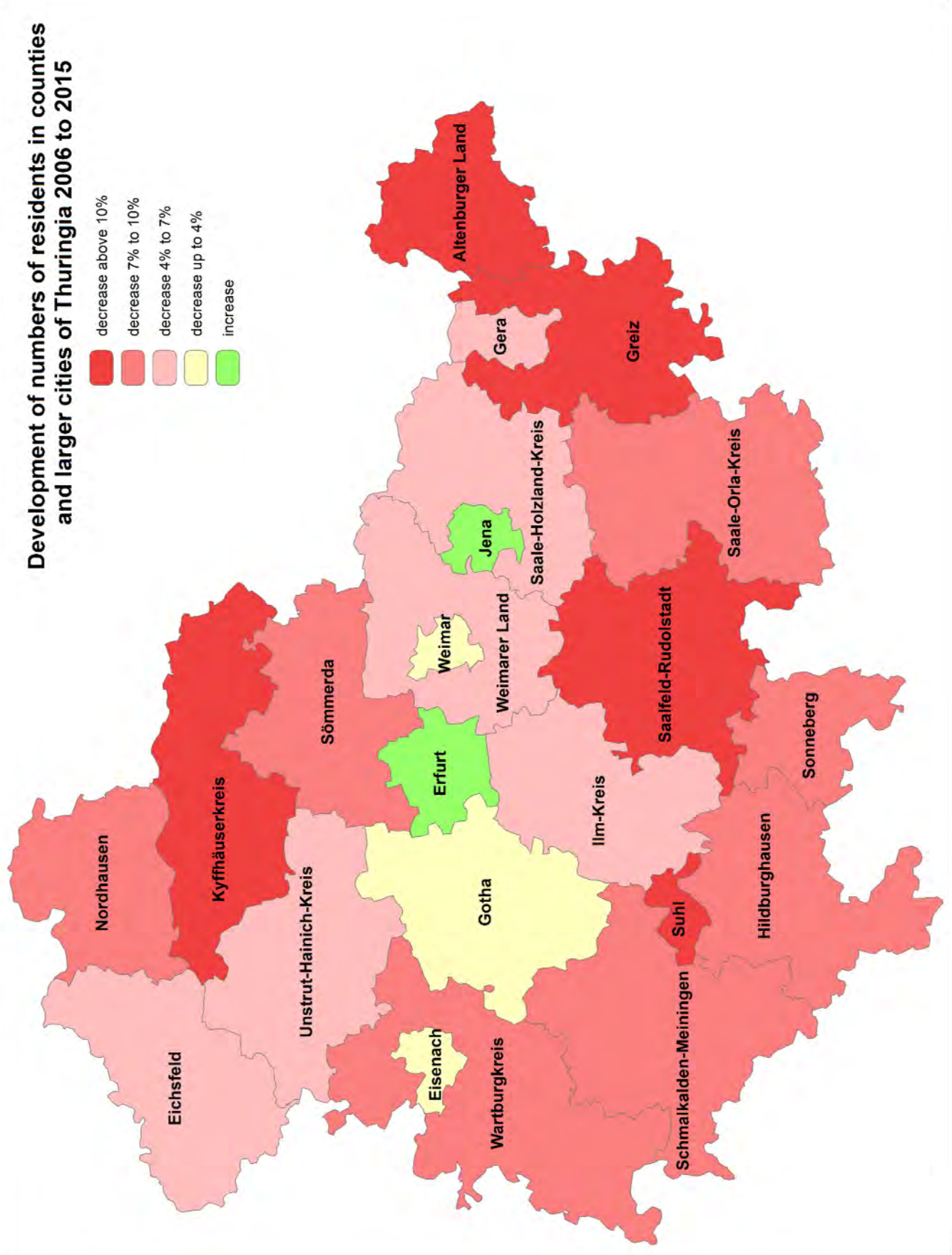
Current situation and Development

Thuringia, like all other states of former East Germany, experienced a dramatic loss of population after the reunification due to migration to western Germany. In the last decade, the migration rate stabilized and even considerable amounts of people are now returning, but this process is not going solve the demographic deficit. The overall loos and a decline in birth rates are still dominant issues in the current as well as future population development. Thuringia is, therefore, one of the states with a constant loss of population in the 10 years from 2006 to 2016 – only surpassed by Saxony-Anhalt (see Table 1).

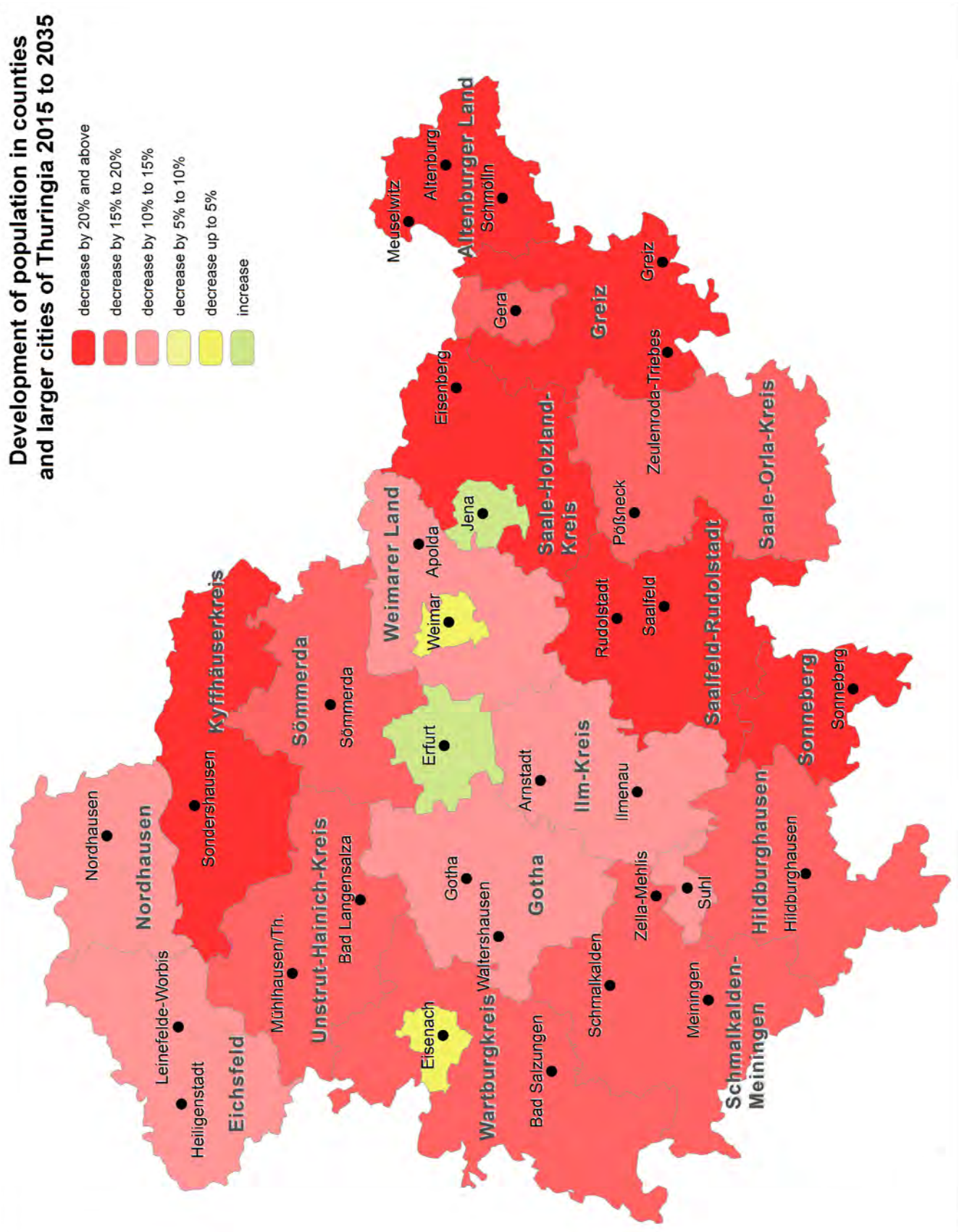
state	population		development in %
	31.12.2006	31.12.2016	
Berlin	3 404 037	3 574 830	+5,0
Bavaria	12 492 658	12 930 751	+3,5
Hamburg	17 54 182	1 810 438	+3,2
Hesse	6 075 359	6 213 088	+2,3
Bremen	663 979	678 753	+2,2
Baden-Wuerttemberg	10 738 753	10 951 893	+2,0
Schleswig-Holstein	2 834 254	2 881 926	+1,7
Rhineland-Palatinate	4 052 860	4 066 053	+0,3
Lower Saxony	7 982 685	7 945 685	-0,5
North Rhine-Westphalia	18 028 745	17 890 100	-0,8
Brandenburg	2 547 772	2 494 648	-2,1
Saxony	4 249 774	4 081 783	-4,0
Saarland	1 043 167	996 651	-4,5
Mecklenburg-Western Pomerania	1 693 754	1 610 674	-4,9
Thuringia	**2 311 140**	**2 158 128**	**-6,6**
Saxony-Anhalt	2 441 787	2 236 252	-8,4

Table 1: Total population development by states in 2006 and 2016

There is, of course, a spatial factor in the development figures. Again, most of the cities along the Thuringian string of cities with their economic potential and educational sector attract new residents. Besides other factors, they offer an attractive environment for families, which could be seen in an increase of the birth rate. Nevertheless, only the cities of Erfurt and Jena could not only stabilize their population but were able to generate a growth between 2006 and 2015. The situation in the other parts of the state is diverse, but with a constant decline of the population in all regions (Map 4). The situation is particularly severe within the rural areas as well as within the already structurally disadvantaged regions. It is unlikely that this situation will change in the near future. The state's population forecast predicts a decrease of the population in all regions of Thuringia until 2035 – except Erfurt and Jena. More striking: In most parts, the decrease is predicted by 15% and above (Map 5).



Map 4: Development of numbers of residents in counties and larger cities of Thuringia 2006 to 2015 [2]



Map 5: Development of population in counties and larger cities in Thuringia 2015 to 2035 [5]

Key aspects and challenges of transport and mobility

Despite the loss of population, the volume of private car traffic is at a relatively high level, this is caused by the overall trend of an increasing number of journeys and the growth in distances travelled. There is hardly a major drop in private car traffic predictable for the region of Thuringia. Without intervention, the private car will remain the main mode of transport – at the moment demographic change and population development do not cause an effect at the volume of the traffic.

The situation for the public transport sector is quite different. Between the places along the Thuringian string of cities is a strong demand for transport. During the peak hour, the passenger rail transport operates already close to the limit of its capacity – frequently exceeding the limit. Even the commuter flow to the main cities from the hinterland generates enough demand to operate with passenger rail transport. Deficits in public transports services arise in those regions without sufficient commuter flow or other significant transport demand. In those areas, the school-pupils' transfer is often the only remaining regular public transport service.

Therefore, school-pupils' transfer is one of the essential pillars of rural public transport. In Thuringia, like in all states of Germany, pupil transport is regularly done by public transport – in rural areas by far pupils are the most significant group of passengers. Public transport service, therefore, is closely tied to the school-pupils' transfer. A low birth-rate and, consequently, a decline in the number of school-pupil has a direct and immediate impact on the public transport services. Most transport financing authorities already struggle with a lasting maintenance of public transport, with the result that public transport services especially in structurally disadvantaged regions offer no more as the absolute basic services.

2.3 Economy and Economic Welfare

The economy in Thuringia is characterised by small and medium-sized enterprises in the manufacturing sector and several large corporations, like Jenoptik and Zeiss, Bosch and Siemens, Opel and BorgWarner. The concentration of manufacturing enterprises is quite different between the regions: The cities and their surroundings along the Thuringian string of cities are flourishing in means of industrial activities and source of zones. In addition, some regional centres in central and south-western Thuringia benefit of active industrial sites, such as Arnstadt or Schmalkalden. However, nearly all rural regions in the north and east of Thuringia suffer from a less-favoured economy situation with substantial unemployment.

The labour cost in Thuringia is one of the lowest in Germany (Fig. 1) but no exception within the five East Germany states. The data about the gross domestic product and the available income per inhabitant are showing the same pattern: Relatively low in compassion to the average value for Germany, but still within the league of the East German states (Fig. 2). However, this cannot conceal the fact that Thuringia steadily improved the GDP over the years, gaining a growth of 35.6 % in the last decade. The economic growth displays a positive development – with a 1.9 % growth from 2015 to 2016 Thuringia is well ranked (Fig. 3). The situation with the uneven development and employment hotspots within the main centres and there surrounding is one reason for the specific commuting pattern all over the state (Map 9).

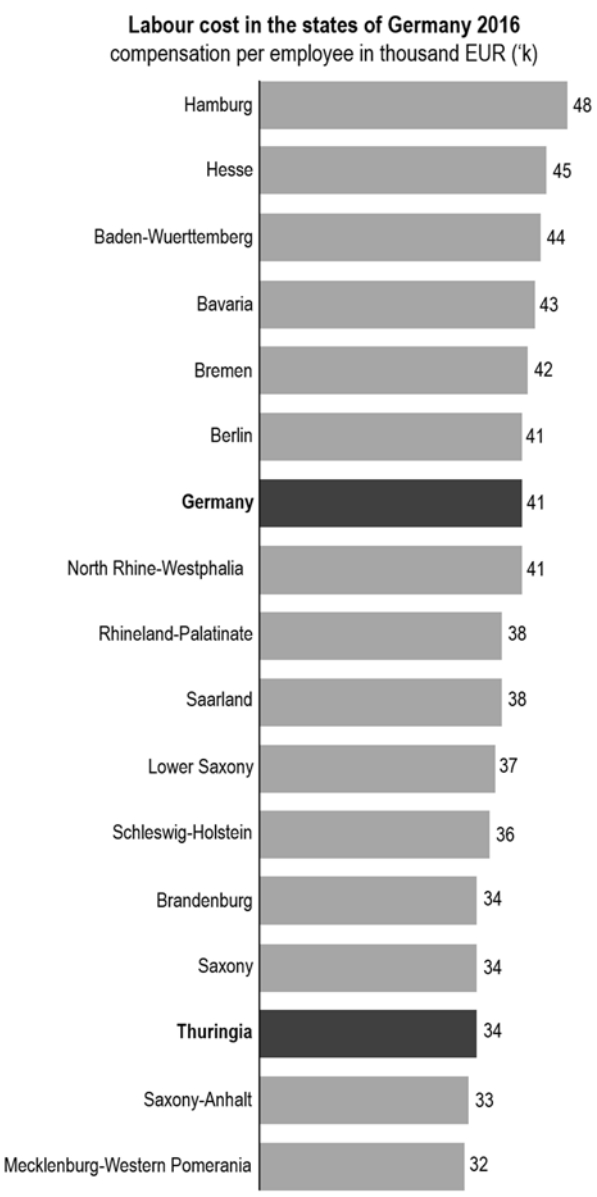


Fig. 1: Labour costs in 2016 [6]

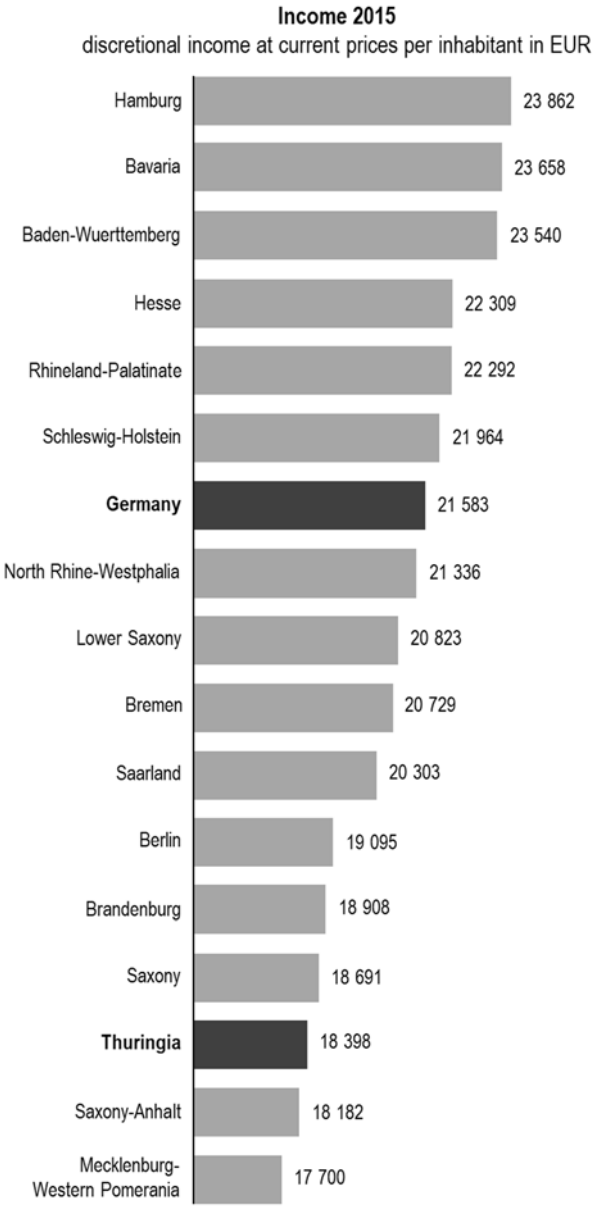


Fig. 2: Discretional income at current prices per inhabitant 2015 [6]

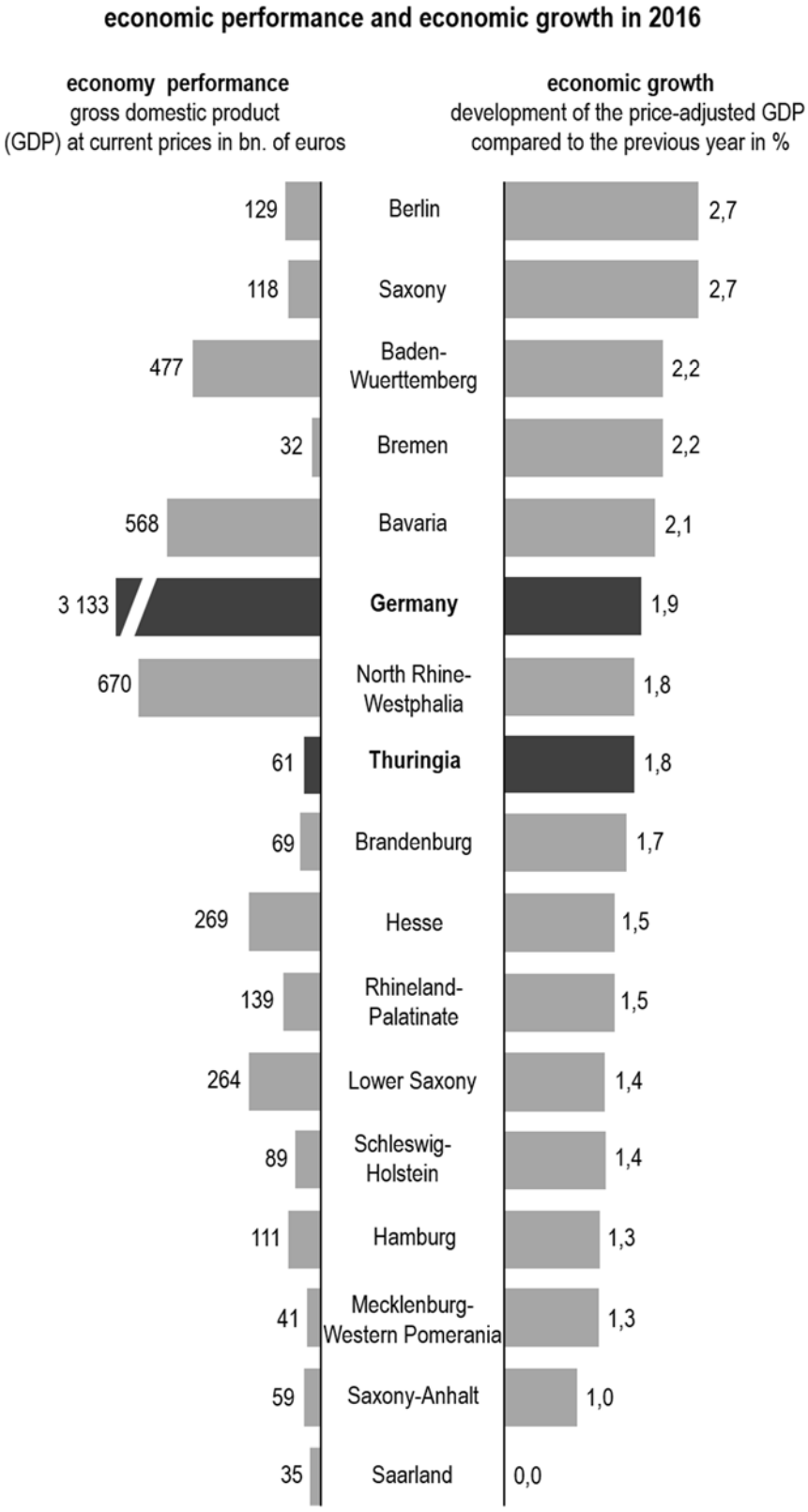


Fig. 3: Economic performance and economic growth in 2016 [6]

2.4 Main transport infrastructure

With the German Unity Transport Projects (VDE) after the reunification, the condition for car transport improved significantly. Several motorways crossing the state – with the motorway BAB4 as the main traffic link from east to west along the string of cities (see Map 7). Beside this interregional infrastructure, the regional road infrastructure has been rebuild and continually developed so that the accessibility conditions via private car are at a relatively high standard in almost all parts of Thuringia.

With a huge amount of funding the rail infrastructure has been continually rebuild after the reunification. In some parts of the state, especially the most rural regions, low passenger numbers and the closing of stations courses areas of conflict between the necessity to improve the infrastructure and the economic potential of further infrastructure investments. The results are leaner rail service or even closure of the branch line. Again, this is the situation in the structurally weak regions of Thuringia, whereas the service and infrastructure along the string of cities and to the main towns are continually developing – in this areas is a strong demand for passenger rail transport due to a high commuter flows as well as other transport demand.

Outside of cities, the infrastructure for cycling is exclusively for the purpose of pleasure and tourism. There are different theme routes along rivers or places of interest – like the Saaleradweg or a castle route. Those long distance infrastructure for cycling focus at routes thru picturesque and scenic landscape or along places of interests rather than travel speed or a freeway routing. Therefore, the trans-regional infrastructure is rather inappropriate for commuting by bike. Within the cities, the conditions for cycling have been improved in the last years. Nevertheless, with incoherent cycling networks, few bicycle parking facilities and the need for more bike lanes the environment for everyday cycling in the cities of Thuringia is still relatively comfortless.

Road Infrastructure

The road infrastructure in Thuringia is composed of a hierarchical system. According to their significance for (inter-)national, regional or local significance the roads are assigned to a class. There are *long-distance roads*, the federal motorways (BAB) and federal highways, *state roads* and *district roads*. In 2017 the road length of each class are as follow:

- federal motorways: 521 km
- federal highways: 1.512 km
- state roads: 4.220 km
- district roads: 3.309 km

The road density is 0.59 km road per km^2 of the state's area. In comparison, the average density of the road network in Germany is 0.64 km road per km^2 and 0.51 km per km^2 for the five East German states. Looking at the road network density alone sets Thuringia in an adequate position. In conclusion: Given the settlement structure of a predominantly rural state in Germany, the states road network is comparatively well equipped with a high level of density.

The infrastructure for cycling can be seen as part of the road infrastructure. Because of the focusing on leisure and bike tourism, commuting by bike misses attractive conditions. Within the cities, the conditions for everyday cycling are still rudimentary, even though that the traffic planning authorities pay more attention to cycling in the last decade.

Rail transport infrastructure and public transport service

The length of the railroad network is 1.521 km in total (data for 2016) – just 30 % of the tracks are electrified. Fig. 4 and 5 illustrate the network length and the status of the electrification in comparison to the other German states – showing that Thuringia represents the bottom of the league in electrification. The density of the network is 0.094 km rail track per km^2. Whereas in Germany the average density is by 0.108 per km^2 or 0.100 km per km^2 within the five East German states. After the reunification, the state face an increase of railway track closures. With the argument of an uneconomical operation or maintenance and repair, the closure amounts to 41 tracks with a total length of 467 km.

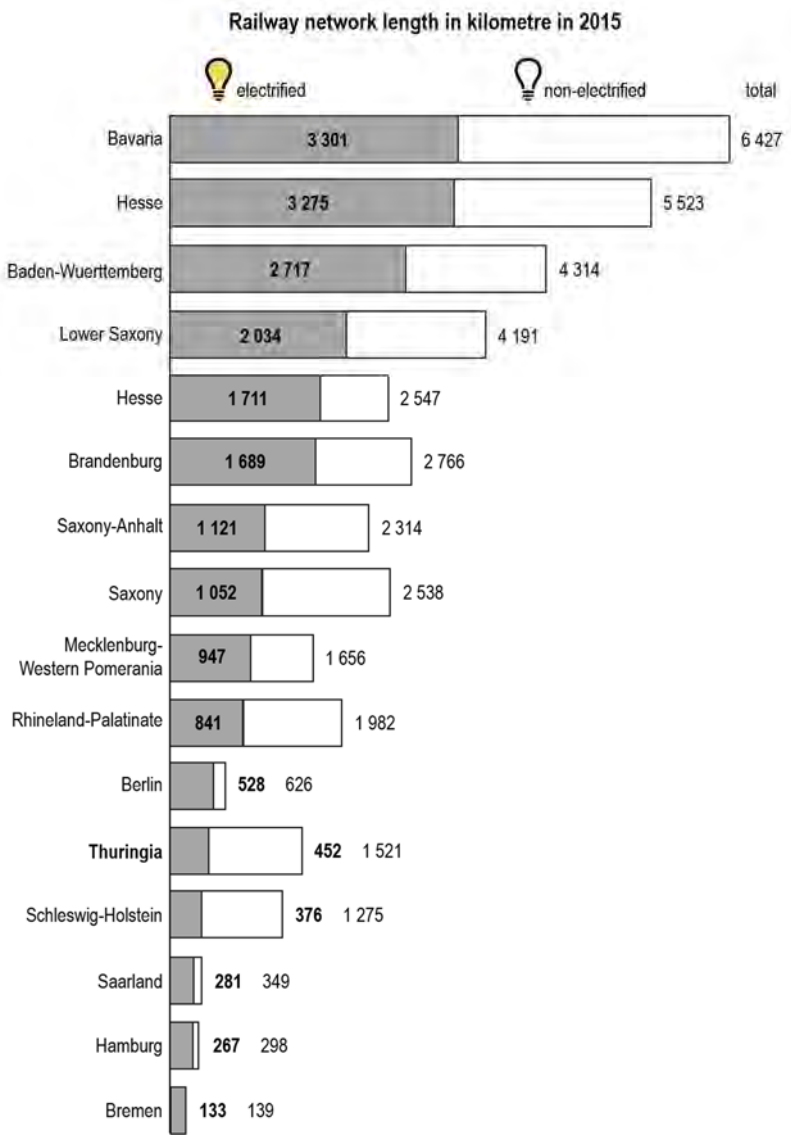


Fig. 4: Railway network length in kilometre in 2015 – electrified (grey), non-electrified (white) [7]

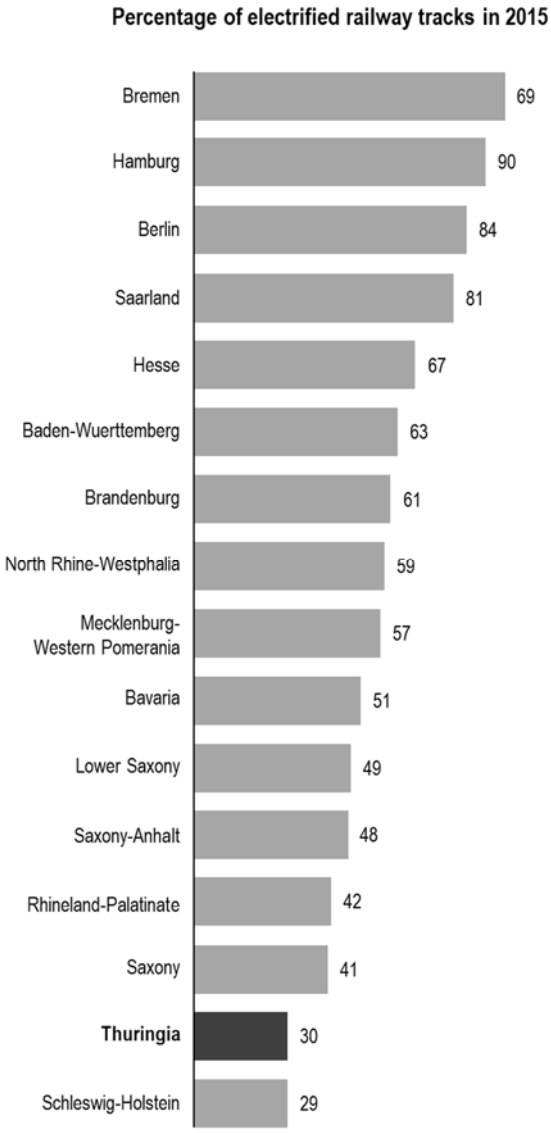


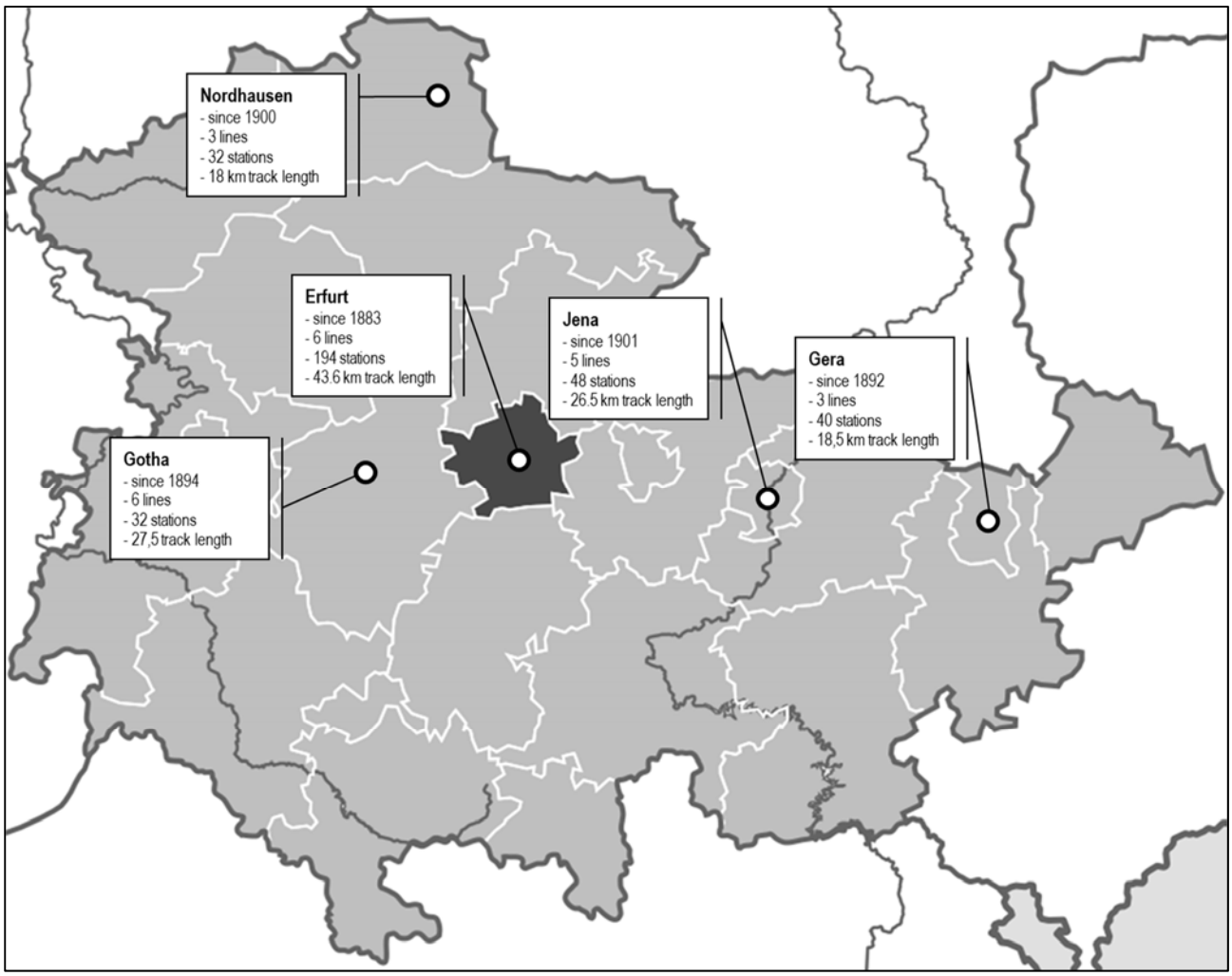
Fig. 5: Percentage of electrified railway tracks in 2015 [7]

Bringing into service the new high-speed line VDE8 from Munich via Erfurt to Berlin at the end of 2017, Erfurt gained in importance as the main hub for long-distance train services in Thuringia. One consequence is the reorganisation of the regional public rail transport service in most parts of Thuringia. The service improved to serve as a feeder for the interchange hub in Erfurt or to mitigate the loss of long distance services in another part of the state. In consequence and simultaneous with the opening of the new high-speed line, the regional service of the public rail transport was upgraded in many parts of the state.

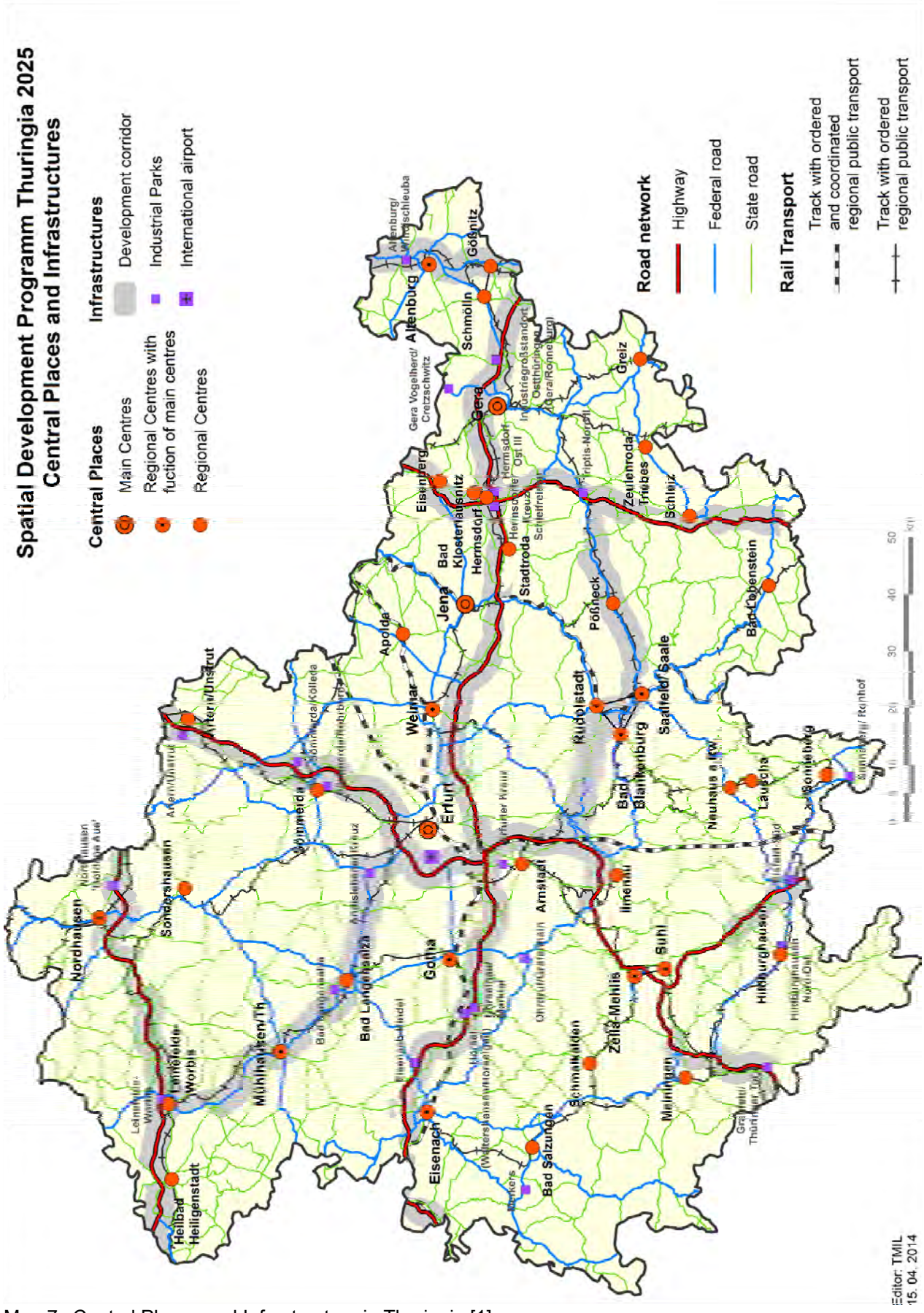
The regional train service is centrally organised by the Thuringian Nahverkehrsservicegesellschaft (NVS) on behalf of the Thuringian Ministry for Infrastructure and Agriculture. Several transportation companies operate the actual service, among them the Deutsche Bahn Regio, Erfurter Bahn and Abellio. Map 8 represents the current network of the public railway service, showing that the main lines are between the cities along the Thuringian

string of cities – especially between Erfurt, Weimar, Jena and Gera. Otherwise, the lines are directed mainly to Erfurt or serving regional centres like Saalfeld in the southern part or Nordhausen in the north.

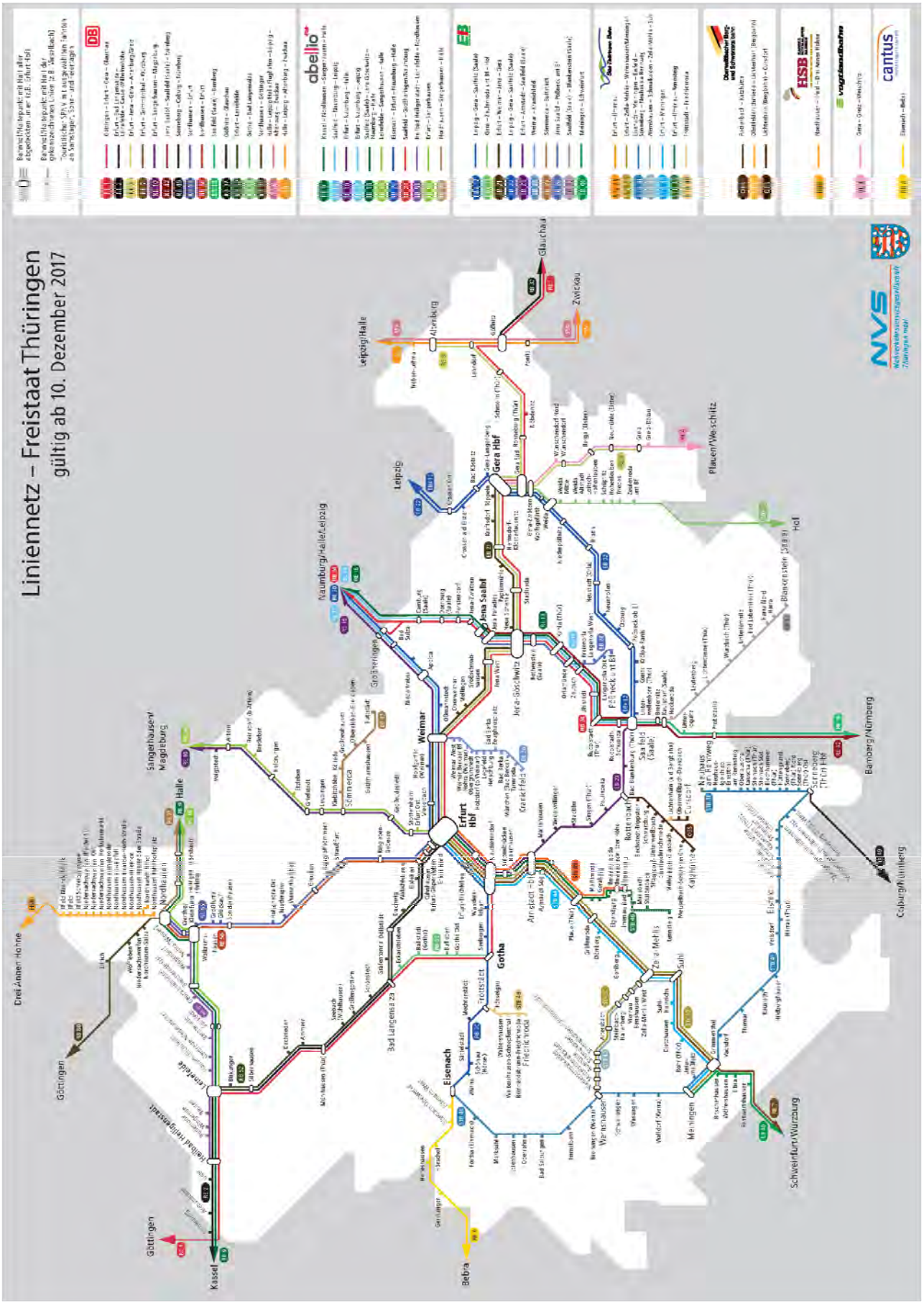
In Thuringia there are five cities with a tram system of different size (see Map 5). All of them where established around the turn of the century. There used to be four more cities with a tram system, but like in many European cities the tramway infrastructure was removed in the mid-20th century and the service replaced by bus and coach transport: Altenburg (decommissioning in 1920), Weimar (in 1937), Mühlhausen (in 1969) and Eisenach (in 1975). After the reunification the remaining five systems where continuously expanded and improved, so that today they are an important asset for the public transport within the cities.



Map 6: The five cities with a tram system in Thuringia



Map 7: Central Places and Infrastructure in Thuringia [1]



Map 8: Thuringians network of the public rail transport system in 2017/2018 [8]

Infrastructure conditions for modal shift measures

After the reunification, Thuringia benefits from the federal reconstruction program (Aufbau Ost). The infrastructure of both, road and rail, where rebuild and modernised from scratch. Nevertheless, the guiding principles for the reconstruction of the transport infrastructure are the standards of the western parts of Germany, with the effect that the program privileged the improvement of the conditions for private car transport. This led to an unbalance between the conditions for private car transport and public railway as well as cycling, with a competitive disadvantage for the public transport service and cycling in general. The fact that the people in East Germany seeking to catch up with private motorisation is an additional social-cultural element, that increases the unbalance between the conditions for private car, public transport and cycling. The rapid motorisation after the reunification pushed the transport planning authorities to provide road infrastructure.

Thuringia has a dense road infrastructure network today. An addition, while there is no distinct urban agglomeration with a high volume of traffic and regular traffic jams, the infrastructure provided sufficient capacity for the motorised traffic. With a dense network and no major delays thru traffic jams, the conditions to use the private car for everyday mobility is relatively attractive. The competitive situation is, therefore, in favour of the use of the private car, making a modal shift towards cycling or public transports more difficult.

2.5 Conclusion

Thuringia is unique in its development: On the one hand, it is characterised by relatively strong and stable industrial and educational centres along the string of cities and on the other hand by predominantly rural areas often suffering from structural weakness and economically underdevelopment. The settlement patterns, population development and economic welfare are the main parameters for traffic trends and mobility patterns. The transport infrastructure predefines the conditions for individual mobility and public transport services. This c conditions can be summarised as follows:

a) Thuringia's settlement structure is polycentric, with urban agglomeration along the Thüringen string of cities. Otherwise, the state is predominantly rural, small and medium-sized towns represent themselves as the cores of rural regions. The dualism in the overall settlement structure, a strong urban agglomeration in the centre of the state and a rural hinterland, characterises the mobility pattern of the state. The situation with the uneven development and employment hotspots within the main centres and there surrounding is one reason for the specific commuting pattern within the state.
b) The major traffic flow by private car as well as at the public transport service is between the urban settlements of the string of cities. During peak hours the transport infrastructure and the public transport are operating to the limits of their capacity. Whereas in the rural regions the car is the main mode of private mobility, public transport take part in the struggle with declining passenger volumes.
c) The population development situation is quite serious; Thuringia suffers from a constant demographic decline. The population forecast predicts a mitigation of the decline, but the overall population decrease will be a constant process. On the other hand, especially the cities of Erfurt and Jena with their strong economy experienced a growth of their inhabitants. A low birth rate and, consequently, a decline in the

number of school-pupil influences the public transport services in the rural area. In those regions of the state, the maintenance of the public transport service will get more difficult due to the demographic development. Most transport financing authorities already struggle with a lasting maintenance of public transport.

d) The transport infrastructure is well developed throughout the state. Nevertheless, the competitive situation is in favour of the use of the private car. There are disadvantages for sustainable mobility making a modal shift towards cycling or public transport more difficult.

3 Mobility and Public Transport: Between high-speed train and challenges of transport services in rural areas

This chapter focuses on the mobility behaviour and the mobility pattern using the available statistics in the field. To gain insights into the field mobility behaviour in Thuringia the official statistic where consulted, this includes basic mobility indicators such as existing vehicles or number of passenger. In addition, we illustrate the data from specific mobility statistics. One of the main indicators for regional interrelations and therefore transport demand are commuting patterns. Therefore, we use the commuting patterns of Thuringia to illustrate the interconnection of the cities.

The far-reaching aim is a reduction of emission caused by private transport. The Thuringian government recently developed a climate action plan. One part of the plan are measures to reduce emission in the transport sector. To monitor the effect an estimation of the current emissions has been included.

3.1 Mobility and transport statistics

Three types of statistics can be used do gain insights to the mobility aspects of the people in Thuringia: a) The official statistic, which contains key indicators like motorisation rate, b) the mobility survey „Mobility in Germany (MiD)", which is one of the main source for mobility data in Germany, and c) the survey „Household Mobility Surveys for Cities (SrV)", a survey which concentrates at particular cities, among them Erfurt, Jena and Gera from Thuringia.

Each statistics or survey has its own indicators and therefore particular significance. Together, they provide a comprehensive, even though limited, overview of the situation in Thuringia.

Key transport indicators – official statistic

The official statistics reports three types of data in the mobility and transport sector, which are able to illustrate the conditions of the overall situation in the states. This includes the times series about the cars in use, the transport performance in short-distance public transport and the figures about the passenger numbers.

Passenger Cars in use

The data about the passenger cars in use per 100 inhabitants of the last decade illustrate the dominance of the private car in all states of Germany. Thuringia is with its growth rate of 11.5 % from 2006 to 2017 not an exception among the states. Exceptions are the city-states – Berlin, Bremen and Hamburg – they show a far less rate of passenger cars in use per 100 inhabitants. Those states are suffering above average from negative consequences of the car traffic and offering at the other hand a well-developed public transport or alternative transport services. Overall, the data indicates a preference towards the private car as well as a high car dependency

State	cars per 100 inhabitant		development in %
	2006	2017	
Berlin	31.9	33.4	4.8
Hamburg	40.1	42.6	6.2
Bremen	39.0	42.7	9.7
Saxony	47.7	52.0	9.0
Lower Saxony	46.5	52.2	12.2
Saxony-Anhalt	47.7	53.7	12.5
Thuringia	**48.8**	**54.4**	**11.5**
North Rhine-Westphalia	48.4	54.8	13.3
Germany	**49.3**	**55.5**	**12.5**
Brandenburg	50.0	55.6	11.2
Schleswig-Holstein	49.9	56.0	12.2
Hesse	52.4	57.9	10.6
Mecklenburg-Western Pomerania	50.0	57.9	15.8
Baden-Wuerttemberg	51.8	58.5	13.0
Bavaria	52.6	59.5	13.1
Rhineland-Palatinate	53.1	60.2	13.4

Table 2: Passenger cars in use per 100 inhabitants in 2006 and 2017 by states, own calculation, source: [9]

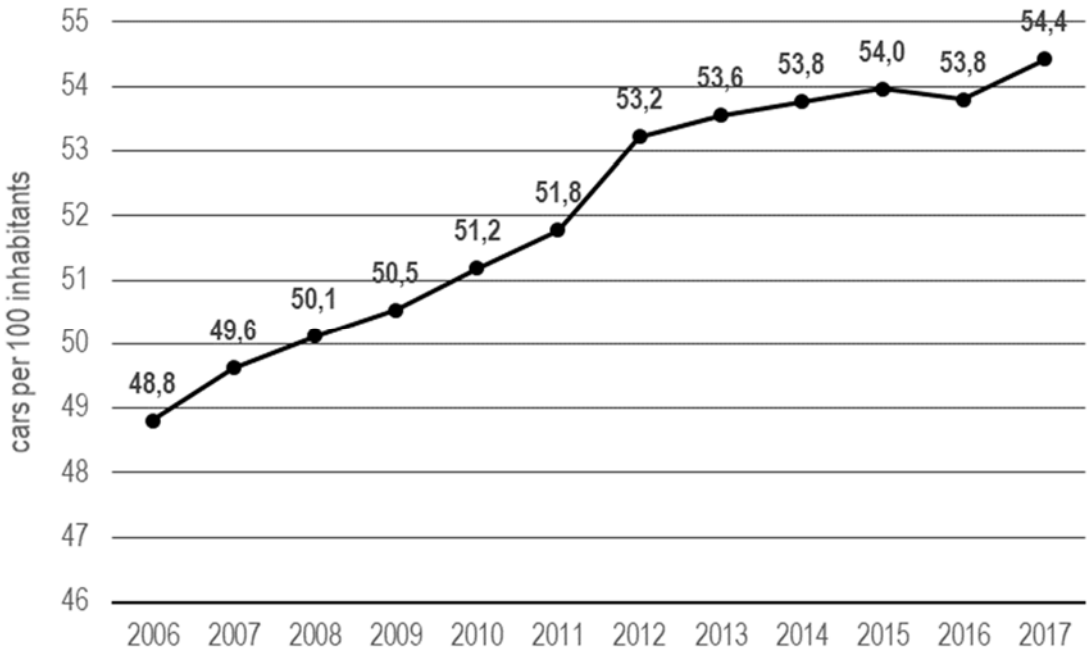


Fig. 6: Passenger cars in use per 100 inhabitants from 2006 to 2017 in Thuringia, own calculation, source: [9]

Passengers in regular short-distance transport[1]

The official statistics include the total amount of passengers in regular short distance transport – bus, tram and rail – per year and state. Those data are less explicit like the data about the passenger cars and because of methodological issues is the comparison between the states limited[1], nevertheless, they indicate an increase of 11.5 % in the total number of passengers in Germany between the years 2005 and 2016. For Thuringia, the data displays a decrease of -4.3 % within this period – the total number of passenger declines from 170.3 million passengers in 2005 to 162.9 million in 2016.

The impression of a declining number of passenger changes if we look at the passenger number per inhabitant – or in other words, trips per inhabitant per year: In 2005 the trips in regular short-distance transport was 72.9 per inhabitant, in 2016 was it 75.5 and therefore a growth of 3.5 % from 2005 and 2016 (Tab. 3). The decline in the total number passengers can be traced back to the population decrease in the same period – at least partly. Nevertheless, the passenger numbers are deficient over the years, even if they showing no clear trend (Fig. 7).

state	passengers per inhabitant		development in %
	2005	2016	
Berlin	372.3	414.7	11.4
Hamburg	302.1	392.9	30.0
Hesse	198.9	323.1	62.5
Bremen	218.5	229.8	5.2
Germany	**122.0**	**136.0**	**11.4**
North Rhine-Westphalia	131.9	125.6	-4.8
Saxony	100.7	109.2	8.5
Baden-Wuerttemberg	98.5	108.9	10.6
Bavaria	106.8	102.8	-3.8
Lower Saxony	69.2	78.4	13.4
Mecklenburg-Western Pomerania	63.1	77.5	22.9
Thuringia	**72.9**	**75.5**	**3.5**
Saxony-Anhalt	77.2	72.7	-5.8
Saarland	91.3	60.9	-33.3
Rhineland-Palatinate	61.5	58.9	-4.3
Schleswig-Holstein	85.2	54.9	-35.6

Table 3: Passengers in regular short-distance transport per inhabitant in 2005 and 2016 by states, own calculation, source: [9]

[1] Transport services provided in other states are reallocated exclusively to the state where the respondent business is headquartered – the comparison between the states is therefore limited.

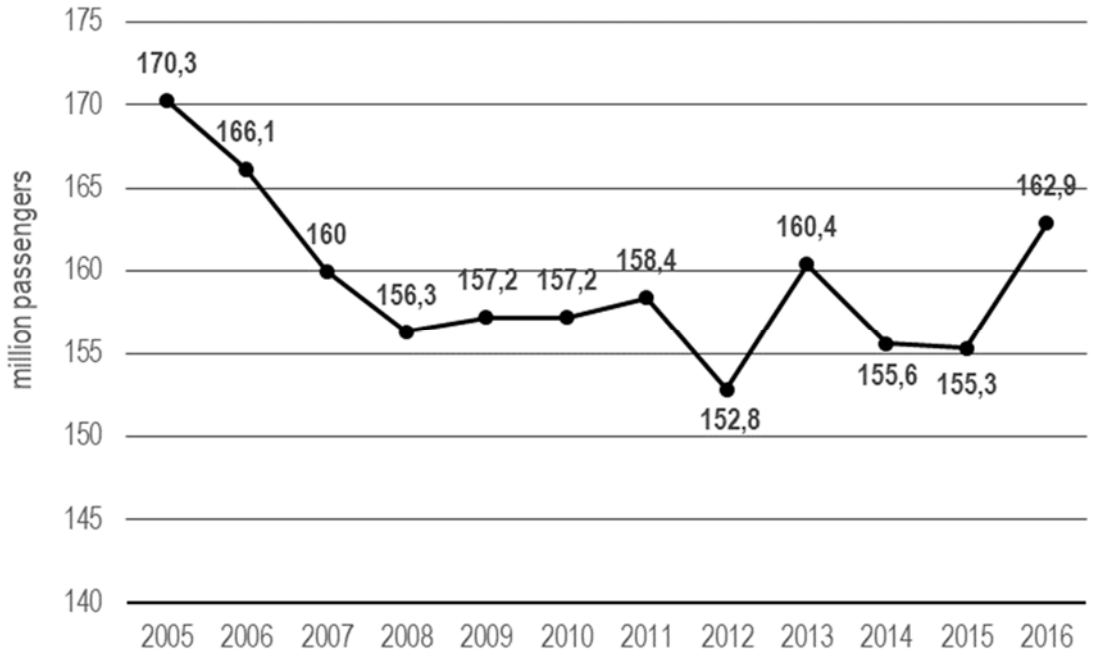


Fig. 7: Passengers in regular short-distance transport total by buses, trams and rails in Thuringia, own calculation, source: [9]

Transport performance in regular short-distance transport

The indicator for the transport performance is passenger-kilometre (p-km). The transport performance of the last decades is showing a clear trend: It decreases from 1,380 Mio. passenger-km in 2005 to 1,141.5 in 2016 – an overall decrease of -17.3 % in this period (fig. 8).

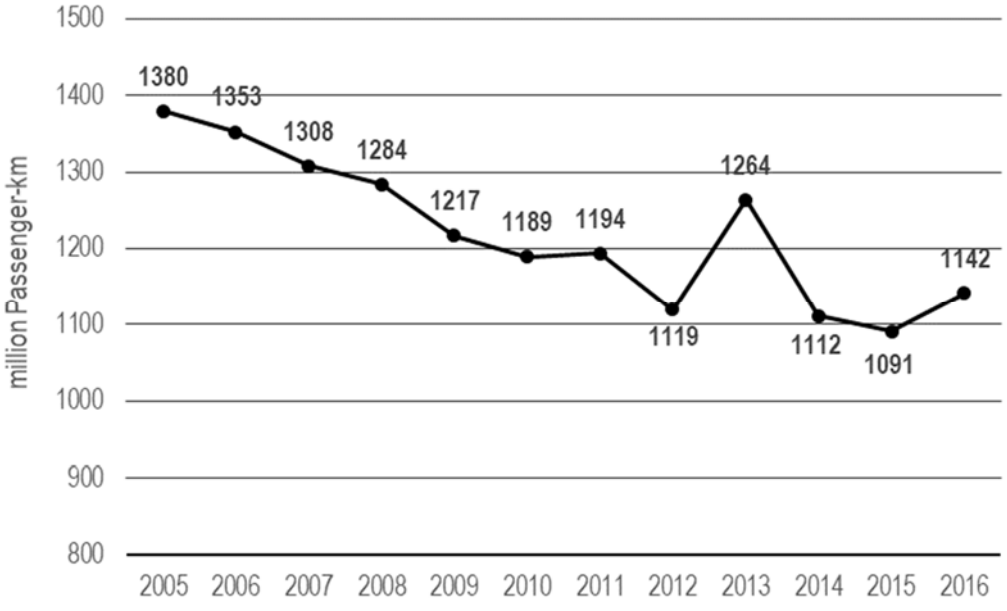


Fig 8: Transport performance in regular short-distance transport total by buses, trams and rails in Thuringia [9]

Mobility in Germany - 2008

The „Mobility in Germany (MID)" survey uses a sample of 25,000 households – making it the largest survey around the topic of mobility behaviour and transport pattern. The last data collection wave has been organised in 2008. Thus, the data is missing actuality. A new wave has been conducted in 2017 – unfortunately, the data of the new wave are not yet available.

Modal Split

The MiD uses five modes of transportation for the modal split: a) public transport, b) car (self-drive), c) car (passenger), d) cycling and e) walking. Fig. 9 represents the modal split in Thuringia. In comparison to the other states, Thuringia is more or less at one level by the use of the private car. It has a relative large share of walking, but a small in cycling.

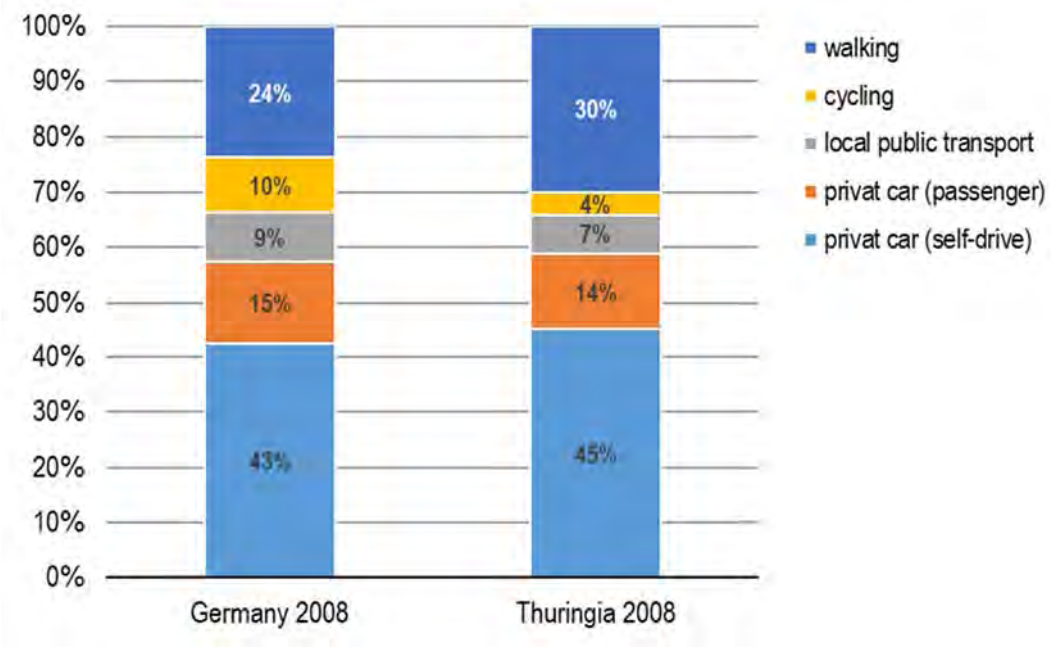


Fig. 9: Modal split – Germany and Thuringia MiD 2008 [10]

The MiD allowed a differentiation by the settlement structure (Fig. 10). This data illustrates the acknowledged fact, that the modes of sustainable mobility has a larger share in urban areas, whereas the use of the car is strong in the countryside. Nevertheless, cycling is still underrepresented in all kind of settlement structures and in comparison to the German average. In all samples and regardless the settlement structure, the use of passenger car is by far the main mode of transport.

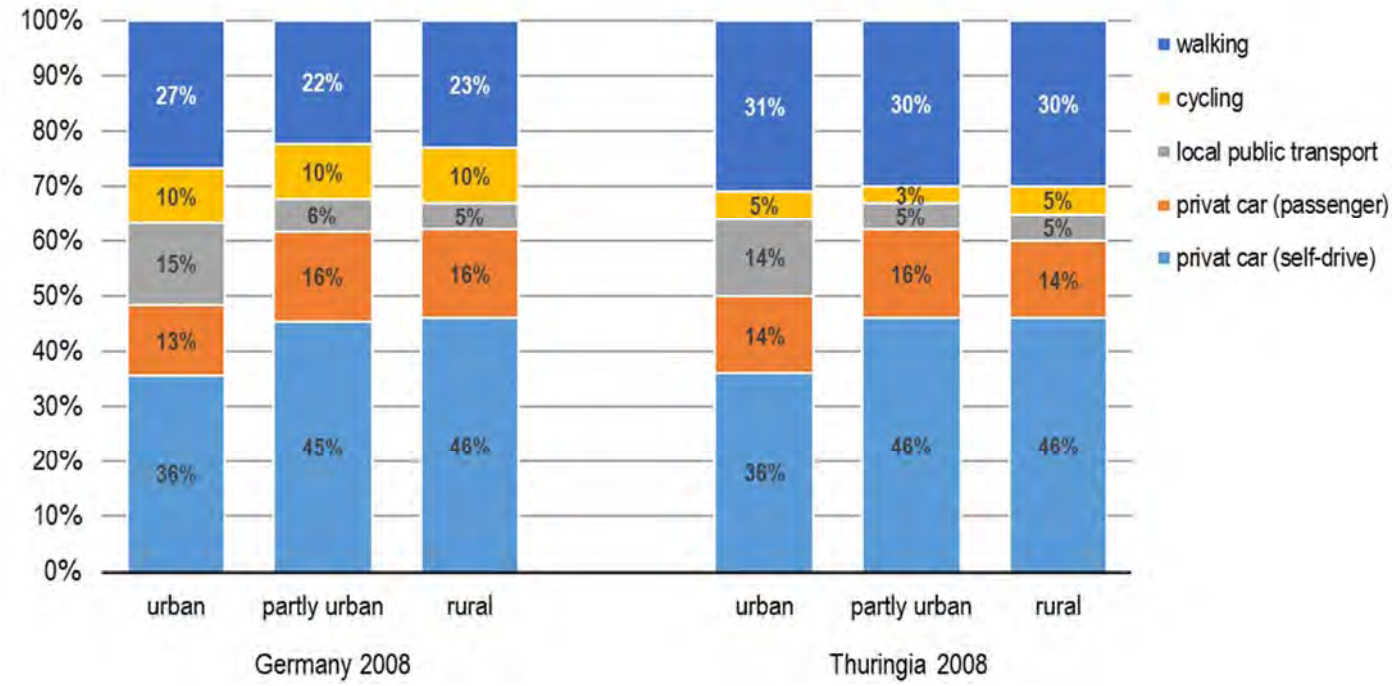


Fig. 10: Modal split by settlement structure – Germany and Thuringia MiD 2008 [10]

Equipment of households with private cars

There are 77% of all households with at least one car – 27% of all households are equipped with two cars or more. This value is in line with the official statistics. The sample survey of income and expenditure (EVS) reports an equipment of households with private cars of 78.9 % in 2013 for the East German states [11].

Use of public transport

The MiD data about the use of public transport in Thuringia unveils the dimension of the challenge towards a modal shift: 51 % of the participants in the sample reported that they never use public transport at all. In comparison, the average figure for Germany is 41 %. The percentage of the regular passenger is less than the German average as well, 20 % uses public transport services at least once a week in Thuringia, for Germany, the it is 26%.

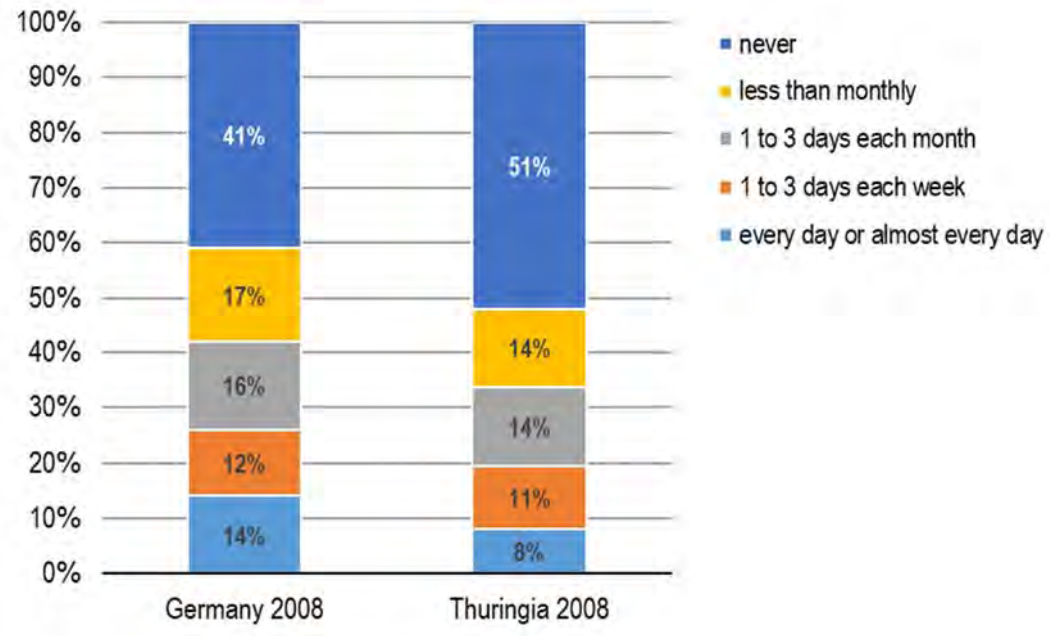


Fig. 11: Regular use of public transport – Germany and Thuringia MiD 2008 [10]

Household Mobility Surveys for Cities (SrV) – Erfurt, Jena and Gera

Like the MiD is the "Household Mobility Surveys for Cities (SrV)" a survey about travel behaviour and modal split. However, the SrV concentrates on cities in Germany. The survey is conducted every few years, so time series are available, which unveil the change of mobility behaviour of the inhabitants of a city over the last decades. In Thuringia, the cities of Erfurt, Jena and Gera participate in the survey. In the overall comparison, two of the cities represent extreme results in the total sample:

a) Gera, with the lowest use of cycling of all cities and
b) Jena, with the highest share of walking.

Jena is by far the city within the overall SrV sample with the highest proportion of walking – walking exceed even private car transport. Erfurt and Gera reflect the average share of walking. The use of public transport in the three cities is heterogeneous: Despite an improvement of the public transport infrastructure, Gera experienced a continuing decline since 1998, from 21% in 1998 to 13.5 % in 2013. Fluctuations are in Erfurt and Jena, nevertheless, the share of trips by public transport is above average. Cycling in Gera is quite unpopular, in 2013 only 4,3 % of the trips have been done using a bike. The data for Erfurt shows an increase between 2008 and 2013 – the investments in the cycling infrastructure in this period can be one reason for the increase.

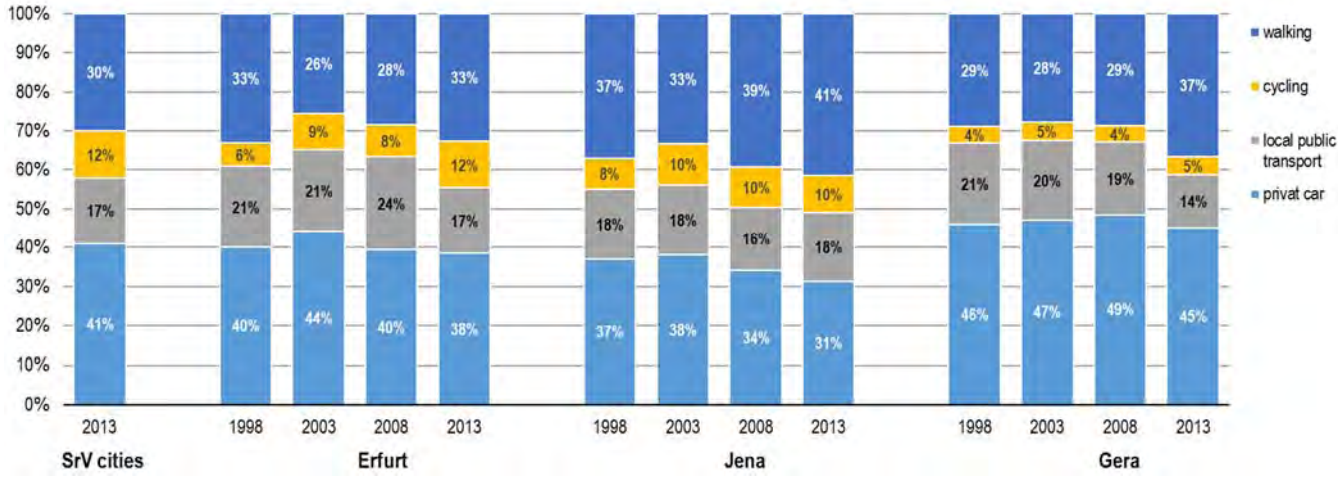


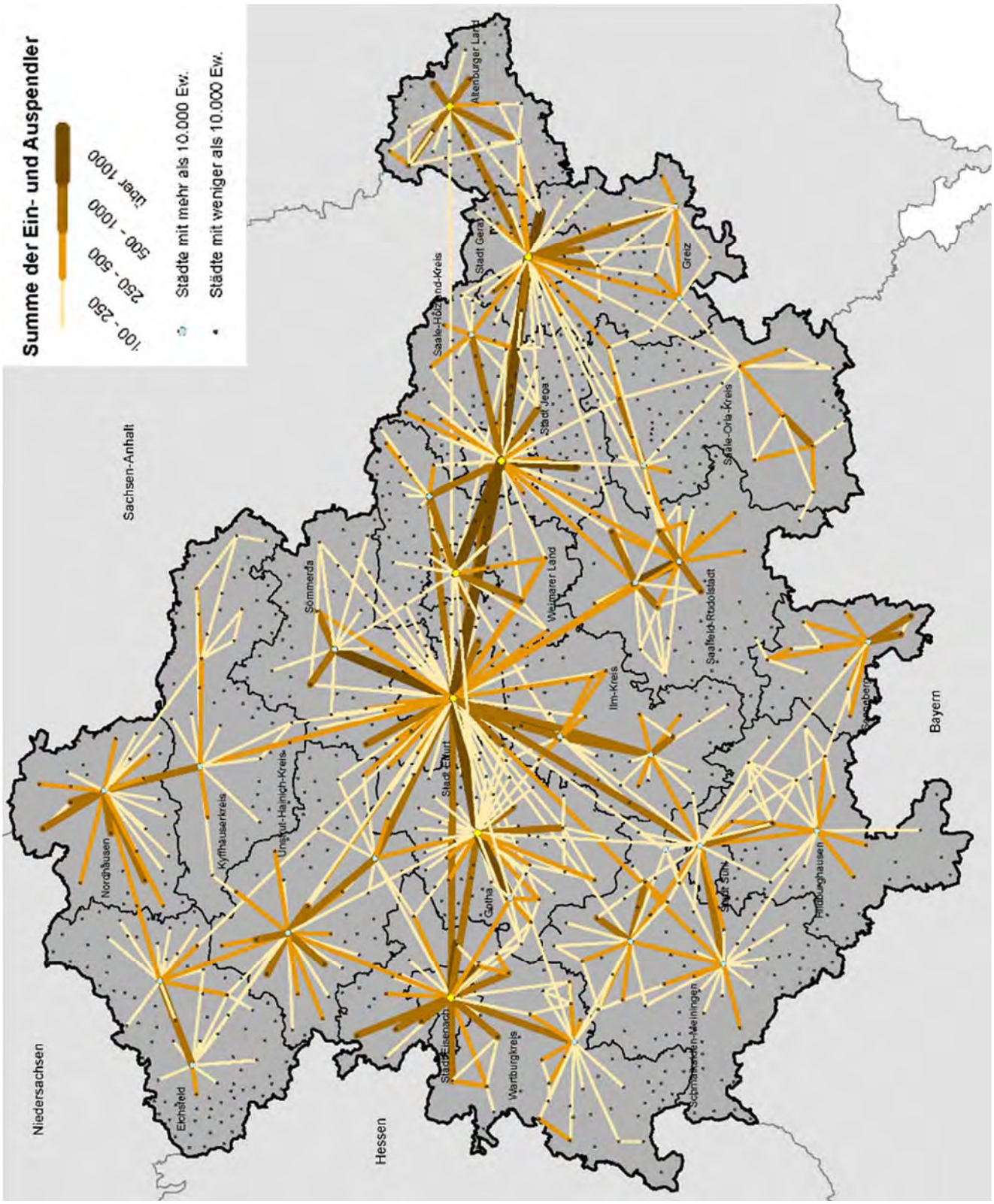
Fig. 12: Modal split – SrV sample, Erfurt, Jena and Gera [12]

With 31.2 % of trips by private car, Jena is the city with a significantly low percentage of car use – with this value; the city is in line with metropolitan regions like Berlin and Frankfurt/Main. Jena is also the only city within the Thuringian sample, which can show a significant drop in the proportion of the trips made by car, from 37% in 1998 to 31.2 % in 2013. Erfurt and Gera on the other hand, are relatively constant in the percentage of the trips by private car.

3.2 Commuter pattern

An important indicator for the interrelations of the cities with their hinterlands are commuter flows. According to their functions as economic and academic centres, the cities along the Thuringian string of cities are of importance as employment sites for their regions. The commuter pattern allows identifying the most popular living locations in the hinterland of the cities.

Map 9 highlights the urban settlements along the string of cities as most significant work and economic location in Thuringia. The commuter flow to and from Erfurt unveils the city as the most important economic location in Thuringia and shows the most widespread expanse. The comparatively high number of commuters to Erfurt results especially from the neighbouring cities Sömmerda, Gotha and Weimar, Jena and Gera. Nevertheless, these cities also dispose of a distinct commuter flow with their respective hinterland, showing their relevance as economic locations. Beyond this, the commuter patterns illustrate the importance of small and medium-sized cities as rural cores in the countryside.



Map 9: Commuter pattern in 2005, own illustration, source: Federal Labour Office (2006)

3.3 Greenhouse gas emission assessment and scenario-based prognosis

The Thuringia Ministry of Environment currently developed a climate protection strategy. This strategy will deal with different fields of actions – among them the transport sector. To prepare the strategy and to assess current climate policies a greenhouse gas emission study has been commissioned. The study evaluates the emissions of greenhouse gas from the transport sector of the last years and forecast the development for the next decades. This prognosis is based on three different scenarios, which include a number of measures at different scales to reduce greenhouse gas emissions until 2040.

Development of the greenhouse gas emission from 1990 until 2014

In the years from 1990 and 2014, the greenhouse gas emissions over all sectors in Thuringia has been decreased: from 33.8 million in 1990 down to 14.7 million t/a CO2-eq in 2014 (Fig. 13) – a reduction of 56.5 %. The reduction is mainly caused by the fundamental change of the energy production. The highest decrease could be obtained within the sectors energy, industry, household and CTS (commerce, trade, services):

Energy:	-4.97 million t CO2-eq
Industry:	-5.92 million t CO2-eq
Transport:	**+0.53 million t CO2-eq**
CTS:	-3.42 million t CO2-eq
Households:	-3.82 million t CO2-eq
Agriculture:	-0.98 million t CO2-eq
Others:	-0.49 million t CO2-eq

Transport is the only sector without reduction, quite the opposite; it is the one sector in which the greenhouse gas emissions increases. Because of this development, the transport sector is now the sector that causes the highest proportion of emission across all sectors: 25 % in total.

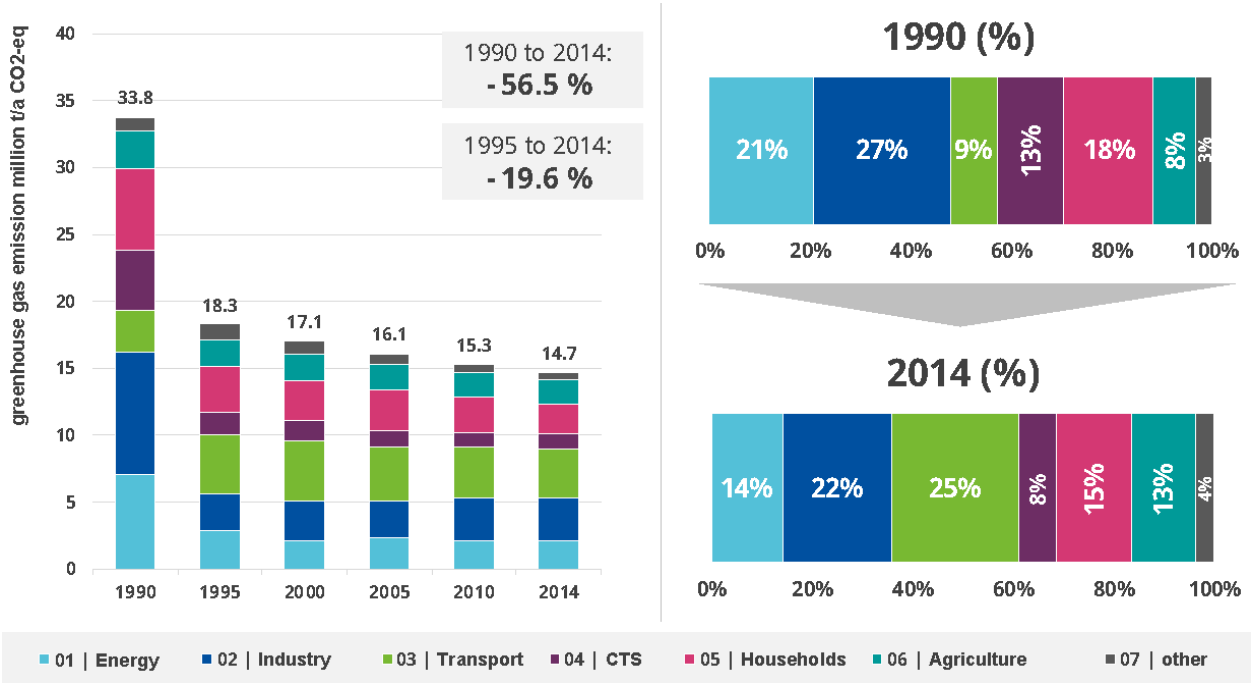


Fig. 13: Greenhouse gas emission from 1990 to 2014 [13]

Scenario-based prognoses of greenhouse gas emissions

By using three scenarios – 1. *Reference scenario*, 2. *Appropriate reduction targets* and 3. *Pro-active scenario* – the climate study estimates the development of greenhouse gas emissions up to the year 2040.

The basis is presumed measures to reduce the emissions, whereas the reference scenario includes no measures which have not already been applied in today's policies. The proactive scenario, on the other hand, assumes extensive interventions.

Across the scenarios the range of the overall reduction in the years from 2014 to 2040 stretch from -4.3 million t CO^2-eq in the reference scenario to -8.8 million t CO^2-eq within the pro-active scenario (Tab. 4). In each scenario, the transport sector is predicted as one of the sectors with the most reduction, but with a quite different amount: In the reference scenario, the reduction is estimated with -45.7% in the years from 2014 to 2040 whereas in the pro-active scenario the amount sums up to -80.3%.

sector	reference scenario	pro-active scenario
Energy	- 0.49	- 1.72
industry	- 0.42	- 1.81
transport	**- 1.69**	**- 3.69**
CTS	- 0.61	- 1.12
households	- 0.92	- 2.17
agriculture	- 0.14	- 0.59
others	- 0.08	- 0.33

Table 4: Reduction prognosis in reference and pro-active scenario in million t CO^2-eq - 2014 to 2040 [13]

Such a prognosis can only be a prediction and will unravel inaccuracy over the time. Nevertheless, it demonstrates the significant reduction potential of greenhouse gas emissions, especially for the transport sector. Moreover, it raises awareness of the difficulties to leverage existing opportunities and reduce greenhouse gas emission in the transport sector without appropriate measures.

3.4 Conclusion

The figures of the official statistics, as limited as they might be, illustrate the dominance of private car as the main transport mode in the everyday life of the people in Thuringia. The mobility surveys confirm the conclusion: The private car is the most important mode of transport. In respect for a modal shift towards sustainable mobility in Thuringia, the conditions are difficult:

a) In comparison with the German average, the data for Thuringia illustrate that cycling is underrepresented, not only in the countryside, where such a behaviour could be expected, but also in the urban areas.
b) The data from the SrV indicates the heterogeneity of mobility behaviour among the cities even in such a consistent region like Thuringia – showing that a modal shift is not impossible.
c) The high-quality standards for private car transport on the one hand and the car-dependency at the other can be considered as one of the main obstacles towards a modal shift from car to modes of sustainable mobility.
d) The commuter pattern unrevealing not only a strong flow towards the economic centres along the string of cities, they furthermore indicate the value of small and medium sizes cities as regional cores in the countryside. Commuters could be especially addressed as a target group. If measures succeeding in convince for public transport and sustainable mobility, the system of public transport and sustainable mobility could benefit.
e) In respect to the greenhouse gas emission, the transport sector is the only one, which records an increase in the past decades. Until now the benefit gained by the technological evolution of the motorised car where lost due to a rise in traffic volume (the so-called rebound effect) – leaving transport as one of the sectors with the main potential for greenhouse gas reduction. The crucial point lies in the actions, which will be taken to reduce as much greenhouse gas emission as possible.

4 Public Transport Organisation: Stakeholder and Institutions, Funding and Legal Framework

The responsibilities for public rail transport lies with the federal states whereas the counties are responsible for the public road transport – this is according to the principle of subsidiarity. The dichotomy in the organisation of public transport has the advantage that authorities are able to adjust public road transport services – with their distinctive local relevance – according to the specific situation and requirements on the local scale. Whereas the state authorities organise public rail transport service for the whole state. The disadvantage of such an organisational construct are the general coordination requirements between state and county – with the result that in many cases an absolute minimum of coordination takes place. This causes an unfavourable framework to implement intermodal connectivity, in terms of integrated ticketing and timetable scheduling.

4.1 Public Transport Organisation in Thuringia

The division between state and county in the organisation and responsibility of public transport services applies in Thuringia as well. The state has transferred the management of the public rail transport to an affiliated company – the Nahverkehrsservicegesellschaft (NVS). The counties are responsible for the organisation of the public road transport. Integrated transport associations existing with the Verkehrsverbund Mittelthüringinen (VMT) in central Thuringia and the Mitteldeutscher Verkehrsverbund (MDV) that includes the county of Altenburg in the east of the state.

Modes of public transport organisation – three level model

The relatively strict separation of the organisation, as well as their historical development, has produced specific coping strategies. The different approaches can be summarised with a model from one to three level (Fig. 14). This model is suitable to explain and understand public transport organisation, even though at a general level.

In the one-level-model is no separation between authority and operator – all responsibilities where executed under the ownership and control of local authority. With the deregulation and the liberalisation of the transport market, this model is no longer be possible to maintain and the authorities are encouraged to tender the transport service under competitive conditions. In its basic version of the two-level-model, the responsibilities for the management are with the transport authorities; they also specify the level of quality and service, whereas the transport companies operate as carriers. Within the three-level-model, an additionally specialised institution is responsible for the administration and management. The transport association still sets the standards for the transport service but has usually no direct relationship with their transport operators. The Transport association is responsible for the organisation of the transport services.

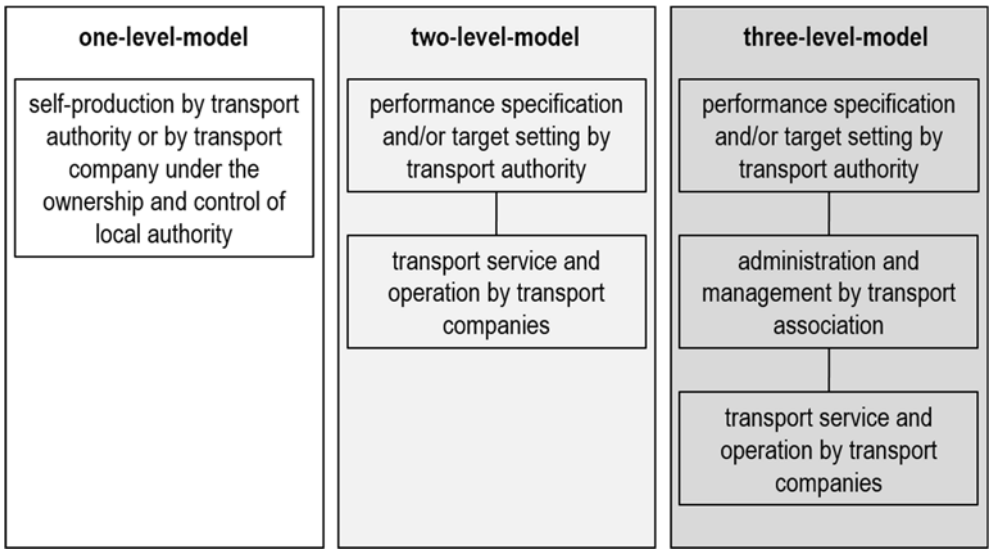


Fig 14: Modes of public transport organisation – 3 level model [14]

Public transport organisation in practice

The German states have implemented own transport associations for public rail transport. Either they are organised for the whole state – like in Bavaria and Saxony-Anhalt, Mecklenburg-Western Pomerania and Thuringia – or there are associations for different regions within the state – like in Hesse or North Rhine-Westphalia (Map 10). The Verkehrsverbund Berlin-Brandenburg (VBB) organises the transport service across two states. The states, therefore, implement the tree-level-model.

The Nahverkehrsservicegesellschaft (NVS) is responsible for the management of public rail transport in Thuringia on behalf of the Thuringian Ministry for Infrastructure and Agriculture. The NVS is a cooperation held by the Thuringian state with 90 % interest and 10 % by the Thüringer Landkreistag e. V. (Association of Thuringian Counties). The NVS is responsible for the whole management and organisation of the public railway service in Thuringia, the contract controlling with the transport operators, demand analysis, infrastructure planning and marketing.

Map 10: Public railway transport organisations in Germany [15]

The organisational structure of the public road transport is even more complex. There are basically three forms of road transport associations: a) association of transport companies (UV), b) association of transport authorities (AV) and c) a mix of both, companies and authorities (MV) – Fig. 15. The association of transport companies usually combining marketing activities and ticket fares. Only if the transport authorities are involved can the association take over the responsibilities of the public authorities – like the definition of the service quality.

The landscape of transport associations in Germany is heterogeneous. One of the main distinctive features is whether they are integrating the railway service or not. From the perspective of the passenger, the most useful structure of a transport association includes the railway service. Only with such an organisational structure, a shared influence of both, authorities and operators, is implemented and therefore a more distinctive coordination between rail and road service as well as integrated ticketing is feasible. Transport associations that integrates both, railway and road transport services, operates in most parts of Germany – even if not in all parts (Map 11).

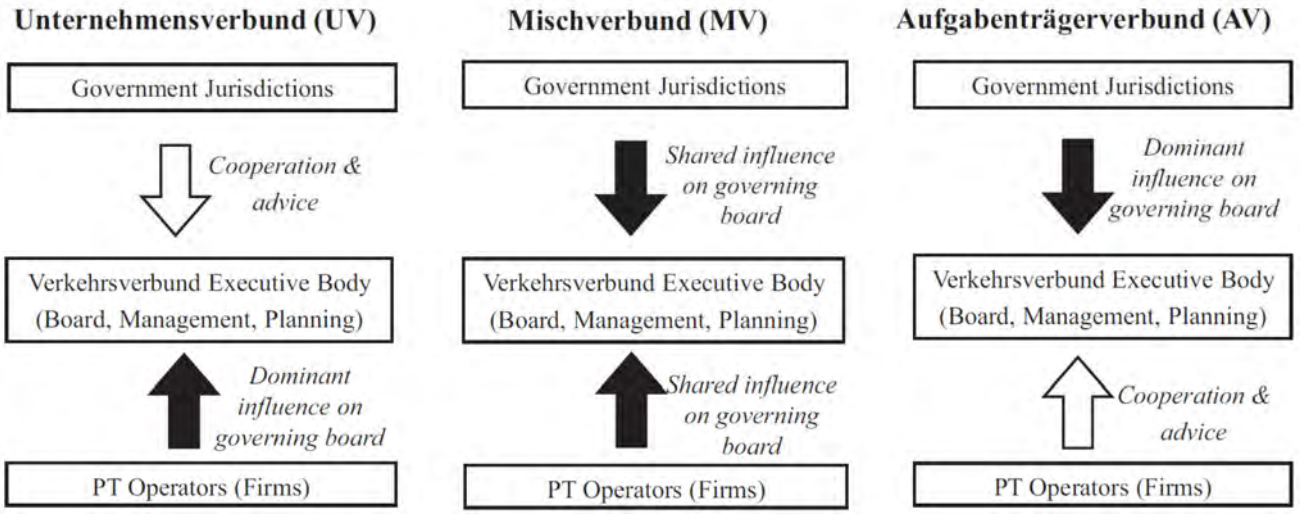
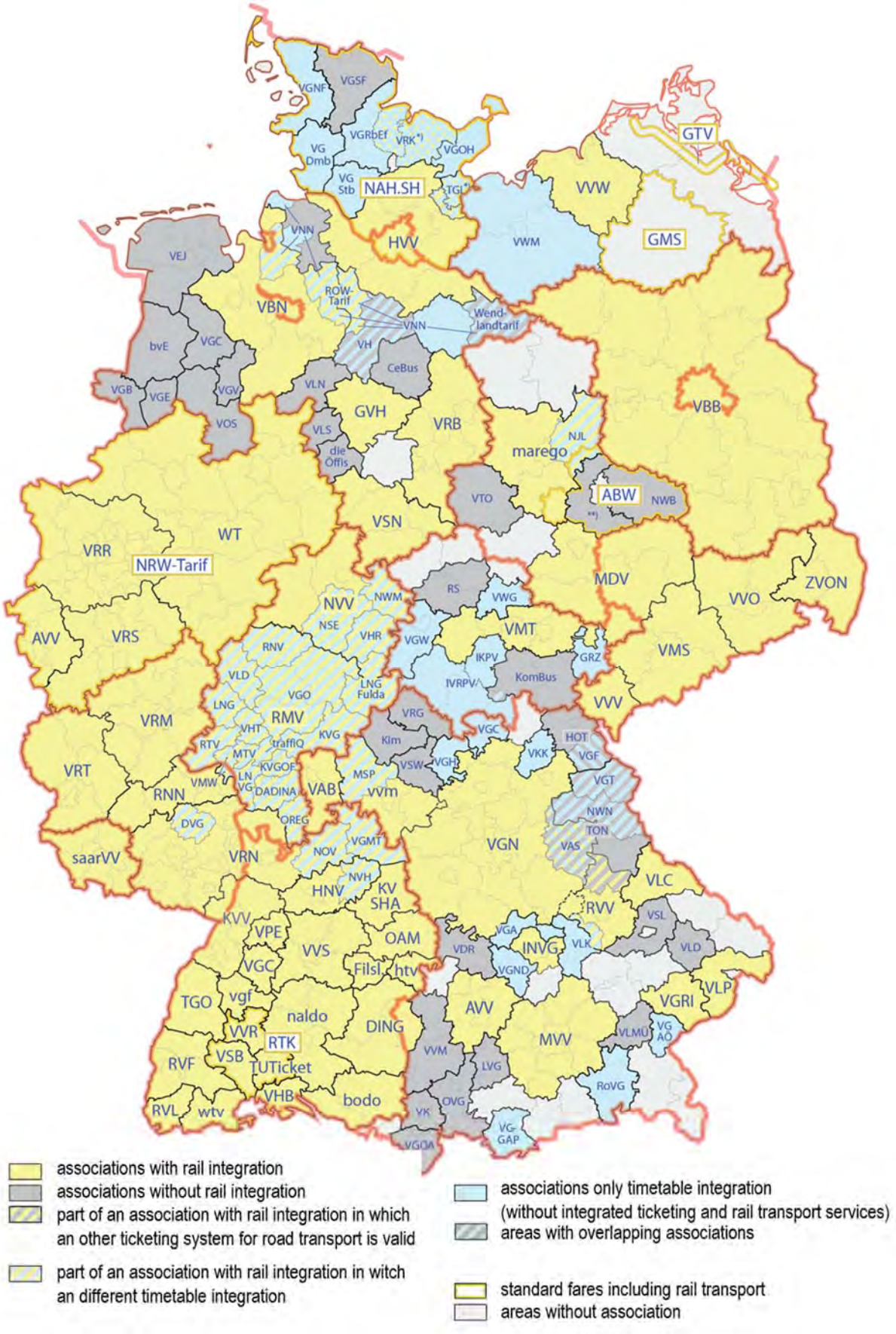


Fig. 15: Organisational structures of transport associations [16]



Map 11: Transport and tariff associations in Germany [17]

Organizational Landscape in Thuringia

Nine different transport associations existing in Thuringia – two of them are integrated associations combining road and rail transport services (Tab. 5). The other seven are groups of public road transport operators and serving usually as tariff and marketing associations. Due to the structure and the variety of the counties, Thuringia is characterised by a regional fragmentation making it challenging to implement transport association across the county borders.

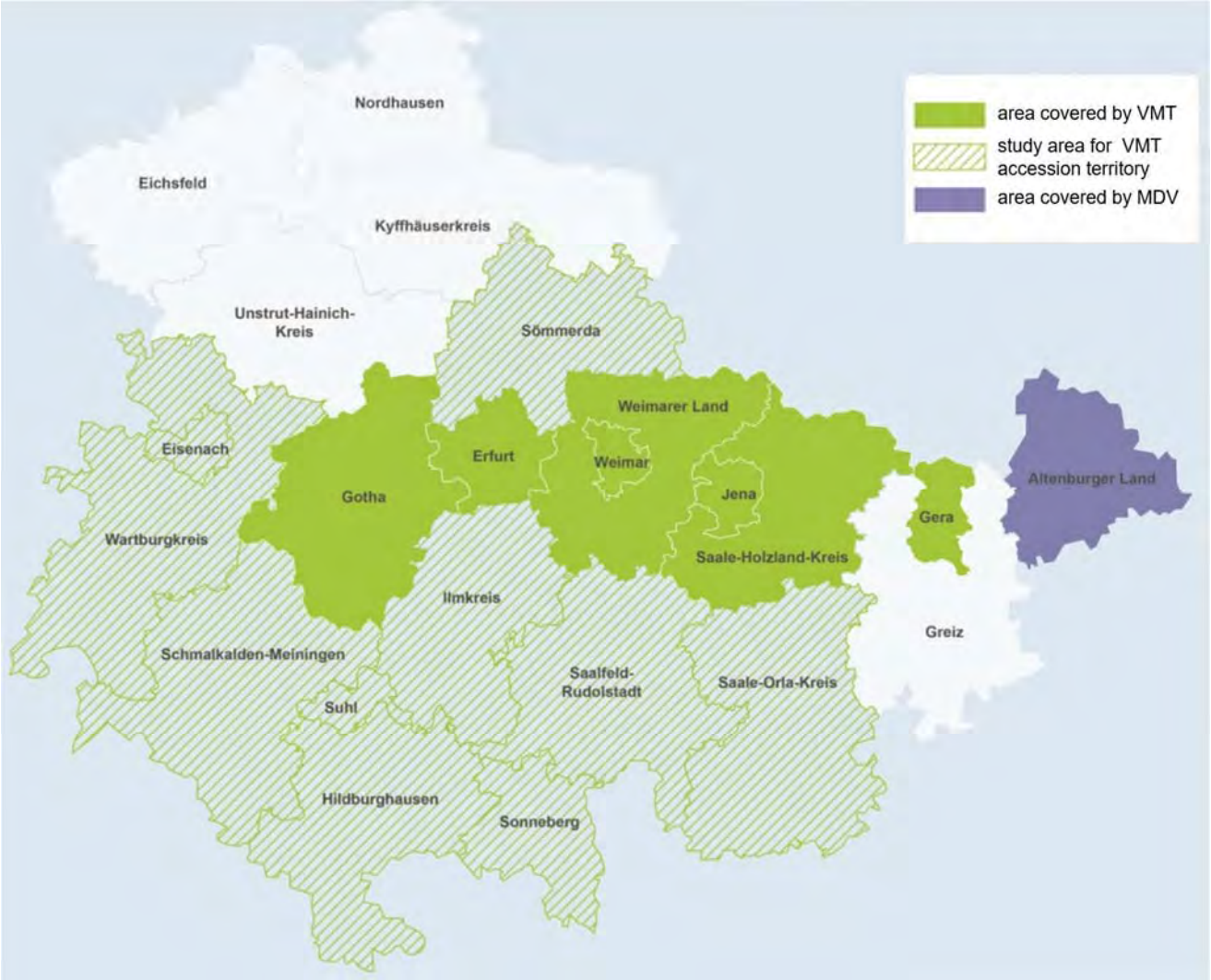
type of association	transport/tariff association	
integrated associations combining road and rail transport services	Verkehrsverbund Mittelthüringen (VMT)	- 13 transport operators - association tariffs (integrated ticketing)
	Mitteldeutscher Verkehrsbund (MDV)	- cross-border Saxony, Saxony-Anhalt - 20 transport operator - association tariffs (integrated ticketing)
associations with integrated ticketing between operators, without rail transport services	KomBus Regionalverkehr	- 62 bus lines - 4 different tariff areas
	Regionalbus-Gesellschaft Unstrut-Hainich- und Kyffhäuserkreis (RS)	- 50 bus lines
associations only timetable integration (without integrated ticketing and rail transport services)	Service- und Verwaltungsgesellschaft mbH Greiz (GRZ)	- local transport operator fir Gera county and Greiz
	Ilm-Kreis Personenverkehrsgesellschaft (IKPV)	- 29 regional bus lines - 4 city bus lines in Arnstadt, 3 in Ilmenau
	Interessenverband Reionaler Personenverkehr IVRPV	- 11 local road transport operators - no integrated ticketing
	Verkehrsgesellschaft Wartburgkreis (VGW)	- 13 shareholder
	Verwaltungsgesellschaft der ÖPNV Sömmerda (VWG)	- 20 bus lines - three tariff areas with different fares

Tab. 5: Transport and tariff associations in Thuringia

The county of Altenburger Land, with its proximity to the urban agglomeration of Leipzig, is integrated into the cross-border transport association of the Mitteldeutscher Verkehrsverbund (MDV). The mobility pattern of the people in Altenburg County are orientated towards Leipzig and its urban surrounding – the integration in the MDV is, therefore, an advantage for passengers, and especially commuters working in the agglomeration of Leipzig.

The Verkehrsverbund Mittelthüringen (VMT) was established in 2006 as an association of transport companies with integrated ticketing. Since the start, it includes the cities Erfurt, Weimar, Jena and Gera and is constantly

extended during the years so that in the meanwhile the VMT covers a broad corridor in central Thuringia (Map 12).



Map 12: Area covered by the VMT and MDV transport associations and possible VMT accession territory [18]

The VMT is keen to expand, although the efforts are complicated. The area of the VMT is one of the most polarised regions of Thuringia. There are the rail links between the main economic and academic centres along the string of cities, well connected with railway infrastructure. And there is the rural countryside with mainly regional bus transport. The advantage of the integrated ticketing applies for intermodal connections – if the passenger uses more than one transport operator and/or an intermodal connection via road and rail. Counties with manly intra-regional passenger flows worry about fare increases for the people, if they join the VMT. Correspondingly, in the early years of the VMT, passenger associations and lobby groups for passengers criticised the fare increase for journeys crossing more than one fare zone or passengers who are using exclusively the rail service between the cities – like many commuters [19].

Therefore, the expansion of the VMT area is combined with challenges and resentments. The Thuringian government strives to implement a state-wide transport association with responsibilities for the management and

organisation of integrated transport services. The VMT shall serve as the initial area and ideally extend to the areas in the west and south Thuringia (Map 12). The Thuringian government, as the states rail transport authority, implemented the support for the VMT and a strategy for a state-wide transport association within the draft of the next transportation plan 2018-2022 [18].

4.2 Public transport funding

The funding scheme of the public transport in Germany is characterised by a confusingly large number of various resources and instruments (Fig. 16). It is nearly impossible to find official statistics about the various funding channels. This makes it challenging to compare the public funding in the transport sector for financial expenditure between the states in Germany.

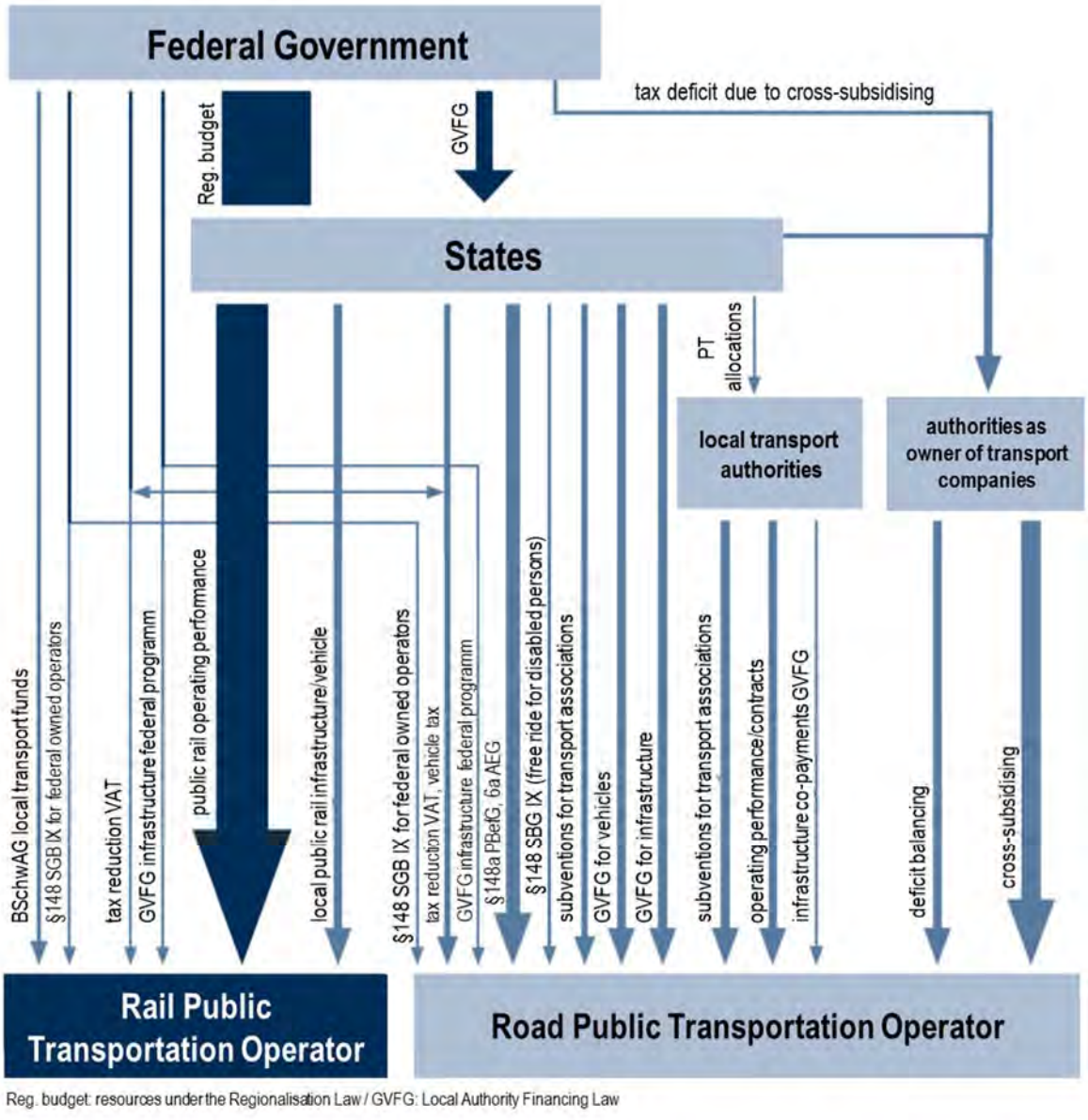


Fig. 16: Financing instruments of public transport in Germany [20]

The main funding in the states are resources under the Regionalisation Law (Regionalisierungsgesetz) and the Local Authority Financing Law (Gemeindeverkehrsfinanzierungsgesetz). This resource is provided by the German state using federal budget for the states operation and investment of local and regional transport services and networks. The resources undergo a reformation in the last years before the previous duration of the law expired.

state	2015			2016			2017		
	road construction	public road and rail trans.	total	road construction	public road and rail trans.	total	road construction	public road and rail trans.	total
Baden-Wuerttemberg	63.2	190.6	244.2	60.4	193.3	253.7	90.5	125.0	215.5
Bavaria	113.0	67.0	180.0	113.0	79.8	192.8	113.0	138.1	251.1
Berlin	8.0	56.2	64.2	8.0	73.2	65.2	8.0	64.5	72.5
Brandenburg	27.1	23.4	54.2	25.7	36.1	54.2	27.1	27.1	54.2
Bremen	11.1	0.7	11.8	11.1	1.7	12.8	11.1	10.0	21.1
Hamburg	8,3	30,1	38,3	8,3	50,6	58,9	8,3	21,4	29,7
Hesse	60.0	12.9	96.5	85.9	14.0	120.5	85.9	14.0	114.0
Lower Saxony	61.7	63.0	124.7	85.4	38.1	123.5	55.6	67.9	123.5
Mecklenburg-W. Pomerania	11.3	12.3	52.0	16.9	11.2	53.5	20.8	13.2	51.1
North Rhine-Westphalia	129.8	214.8	344.6	129.8	214.8	344.6	129.8	214.8	344.6
Rhineland-Palatinate	47.6	27.5	75.1	48.6	31.5	80.2	48.7	16.5	65.2
Saarland	6.5	10.5	17.8	0.6	8.5	17.5	3.3	12.3	17.5
Saxony	69.3	19.7	89.0	99.9	12.3	112.2	72.8	32.8	105.6
Saxony-Anhalt	40.4	15.0	55.4	38.4	30.1	68.5	43.6	38.3	81.9
Schleswig-Holstein	18.5	s16.9	43.3	6.9	5.8	43.3	22.0	21.3	43.3
Thuringia	31.8	15.1	46.9	24.8	15.1	39.9	35.1	21.7	56.8

Table 6: Federal funding under the Unbundling Law (Entflechtungsgesetz) and the Local Authority Financing Law (Gemeindeverkehrsfinanzierungsgesetz) and there use for road construction projects resp. public road and rail transport in the states, in million Euro [21]

state	allocation of resources for public railway services in million Euro			total output (m train-km)
	2013	2014	2015	2015
Baden-Wuerttemberg	722.4	745.7	773.4	77.1
Bavaria	958.8	922.1	945.3	122.5
Berlin	318	335.4	356.9	38.6
Brandenburg	348.9	348.7	382.6	37.1
Bremen	24.2	27.3	27.3	3.2
Hamburg	102.2	105.7	109.1	14.4
Hesse	445.1	471.2	477.3	51.4
Lower Saxony	191.6	193.9	195.2	17
Mecklenburg-W. Pomerania	378.2	403.4	413.4	51.8
North Rhine-Westphalia	903.1	947.4	943.6	102.9
Rhineland-Palatinate	340.9	364.1	357.5	39.9
Saarland	89.4	90.3	81.3	7.8
Saxony	314.4	340	372.4	37.5
Saxony-Anhalt	272	273.2	282	25.7
Schleswig-Holstein	187.4	189.8	192.7	25.3
Thuringia	203.7	205.5	210.6	21.4

Table 7: Allocation of resources for public rail transport services (calculation) and total output in 2015 in train kilometre [22]

The revived Regionalisation Law with a new duration until 2031 provides the German states with a long-term funding perspective at the expense of cuts in the next decades. In the five years to come, the government of Thuringia will receive between 333 and 324 million Euro every year (Fig. 17).

The funding of the public rail transport service in Thuringia exclusively is provided with the resources from the Regionalisation Law, coming therefore from the federal government – there is no funding provided thru the original state budget of Thueringia. The state invested 221.76 million Euro to subsidise public rail transportation services in Thuringia. Beyond that sum, the state invested further 17.45 million Euro in capital expenditures and 67.11 million Euro for further assignments in the public transport sector. The investment programme until 2022 includes an increase of the public rail transport service fund by 10.5% (Fig. 18)

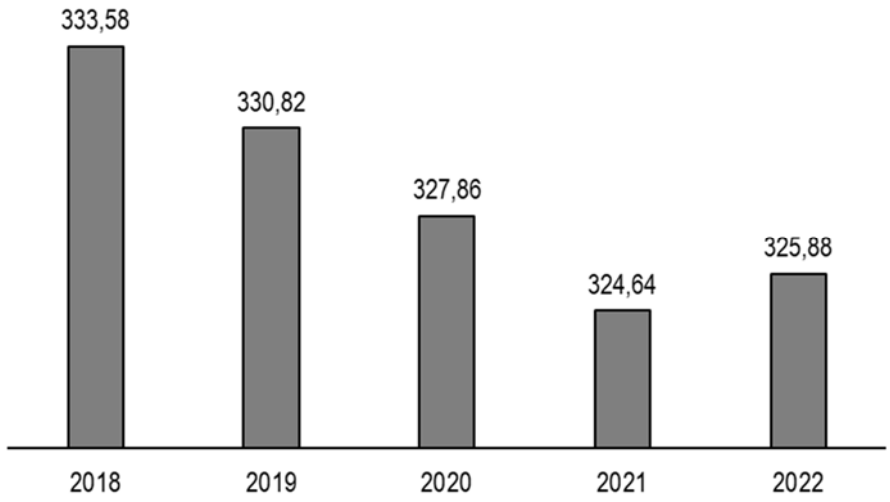


Fig 17: Annual federal funding under the Regionalisation Law – 2018 to 2022 for Thuringia in million Euro [18]

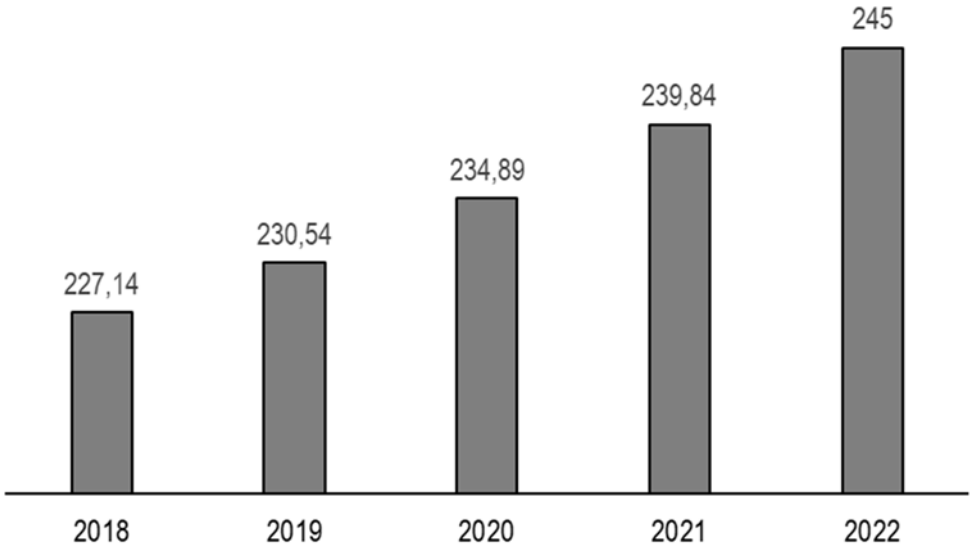


Fig 18: Thuringians investment programme for public rail transport services until 2022 in million Euro [18]

4.3 Prospects

The future organisation of public transport services in Thuringia is addressed in a study from 2011 [23]. Drawing from the experiences in other German states, the authors recommend a series of strategies, the concentration of resources and a funding of integrated transport services to cope with the challenges in public transport as well as to improve intermodal transport services:

1. With respect to the relatively large regional fragmentation of Thuringia, a concentration of the responsibilities of the transport authorities might be inevitable to gain an economy of scale for transport services.
2. The support of integrated transport associations and a structure that includes the responsibilities of the transport authorities. In order to aim for a competitive public transport a transport association coordinates not only fares, marketing and integrated timetable but ideally also defines the quality and standards of the service.
3. The VMT could potentially be the basis for an extended transport association in central Thuringia. Generally, larger transport associations integrate an extensive area and avoid therefore an unmanageable number of different fare schemes and cross-border difficulties.
4. For the funding of public transport service further additional state funding is necessary – especially for the advanced coordination of the different transport services.

Altogether, the references increase towards a territorial concentration across borders of a large number of counties. A Thuringian territorial reform was suspended in 2017, a concentration of the administration landscape can therefore not be expected within the next years. This opens the question of the possibilities to unite the responsibilities of the transport authorities across the counties borders. This is still an unsolved issue in the transport organisation of Thuringia.

Not mentioned in the previews statements and analysis are the issue of persistent policies to improve the conditions for the use of private cars. Despite the policy objectives towards a modal shift and the support of sustainable mobility, the policy for the use of private cars is still unchanged. It is widely recognised, that a turn in transport policies is needed to prevent the impacts of climate change and to improve the quality of life within the cities and villages. This calls for measures towards an competitive public transport and new modes of transport, these efforts are desperate if not accompanied on the other hand by restrictions towards unnecessary private car transport. The Thuringian government and the administration in the counties are not yet prepared to aim for measures of eco-mobility, which implies restrictions towards the private car – given their political and social consequences.

5 Challenges and Opportunities: Unlocking the power of small and medium-sized towns and a connected rural hinterland

Thuringia is a state of contrasts and contradictions: a predominantly rural countryside and prosperous cities, strong industrial zones and vulnerable regions, attractive public transport in the urban areas and poor demand in the countryside, car-oriented mobility habits and hope of a cultural change towards eco-mobility in the cities. This contrasts and contradictions characterise the challenges as well as opportunities in Thuringia's transport planning and policies.

With the climate action plan and its measures to improve green transport and eco-mobility, Thuringia already started to provide support for the change towards sustainable transport systems.

5.1 The climate action plan: Measures to reduce greenhouse gas emissions in the transport sector

The Thuringian government under the lead of the Ministry of Environment is currently preparing a climate legislative package. The climate legislative package defines climate protection targets including greenhouse gas reduction targets for the decades ahead. The target of reducing greenhouse gases is set by 60 to 70% until 2030 compared with 1990. The legislative package is well under its way in the legislative process but has still to pass the state parliament.

The climate legislative package is accompanied by a climate action plan which defines the measure to accomplish the reduction targets [24]. The field of actions going from energy production and industry to households and agriculture, the range covers the transport sector as one of the main action fields as well.

The measure to reduce greenhouse gas emission in the transport sector aiming with its seven packages mainly at the passenger transport, only one package dealt with the conditions for green freight transport. The packages of measures were developed over several months including public as well as stakeholder participation and have been adapted, extended and elaborated during the process. In the field of passenger transport, the Thuringian government aims to reduce greenhouse gas emissions and transform the conditions for public transport towards a more sustainable system by seven measures:

1. *Promoting cycling to gain a greater share in modal split*
   The improved condition for everyday cycling is bound up with the hope of a modal shift from private car use to cycling and therefore eco-mobility. The cycling measures within the climate action plan are tightly connected to the general cycling plan of the state, which is currently in the process of an update. On major action is an improved intermodal connectivity between bike and rail. This includes parking facilities

at the station, bike sharing and the possibility of transporting bikes on public transport. The responsibility for the cycling infrastructure is part of the local authorities, leaving less space for influences by the state. But the state aims to extend their funding opportunities for cycling infrastructure in the municipalities.

2. *Attractive public transport services*
   Attractive public transport services are one cornerstone of sustainable mobility – only competitive services are able to attract new passengers. The climate action plan concentrates on two priorities: a) optimising frequency and intermodality and b) implementing attractive and group-specific fares. This includes plans to improve service infrastructure. The plan refers to the need for additional funding from the original state budget beyond the funding according to the Regionalisation Law. It refers to a state-wide transport association as well.

3. *Electrification of the railway infrastructure*
   The vast majority of the Thuringian railway infrastructure is non-electrified. The railway transport therefore mostly is operated by diesel engines. The plan suggests an electrification of the railway infrastructure within the frame of possibilities in order to allow the operation of electric trains . For tracks, which electrification is unconvertible in the foreseeable future, it shall be evaluated in which extend new and alternative modes of propulsion could be adopted in order to replace diesel engines – like trainsets powered by electric accumulators or hydrogen fuel cell.

4. *Support of a state-wide charging infrastructure for electro-mobility*
   The charging infrastructure has to be developed in order to promote electro-mobility. To archive the development, the interoperability of the existing charging and billing systems shall be standardised across the country. A state-wide regulation is intended to ensure that such an interoperability will be established. For the funding of the charging infrastructure, the plan refers to the national support and subsidy program. In areas where the national subsidy program does not apply a program funded by the state could be implemented. Besides the charging infrastructure, the plan refers to additional measures to promote electro-mobility, like a marketing program for commuters, where pedelecs and electric cars can by tried out, or the development of electro-mobility in range of authority of the Thuringian government.

5. *Integrated settlement and transport development*
   A compact settlement structure is a key to avoid traffic. Integrated settlement and transport development planning provides the tools to implement compact settlement structure. One of such a tool is the traffic impact assessment for settlement project. For disadvantaged rural areas, the plan proposes the support the combination of local supply and services of the everyday need in village supply centres.

6. *Communication Strategy on Mobility and Transport*
   Communication Strategy on Mobility and Transport aims to achieve best possible and sustainable outcomes of the measures, but above all to motivate the Thuringian people to reflect on their mobility behaviour and to change their behaviour towards eco-mobility at best. The communication strategy consists of a number of instruments to inform and motivate the people for eco-mobility. This includes information's about alternative modes of transport and the promotion of a mobility culture with a focus on with respect for walking and cycling.

7. *Sustainable Mobility Plans in the municipalities*

   A sustainable mobility plan presents a long-term strategy for the future development of the urban area and its hinterland and therefore for the future development of transport and mobility infrastructure and services. The sustainable mobility plans foster a development of all relevant transport modes while encouraging a shift towards more sustainable modes of transport. It puts forward an integrated set of technical, infrastructure, policy-based, and soft measures to improve performance and cost-effectiveness with regard to the shift towards eco-mobility. Within the climate action plan, the Thuringian government aims to initiate two pilot studies, which shall design and evaluate the frame for future sustainable mobility plan throughout Thuringia. Key elements of the sustainable mobility plans are measures for mobility management or the revision of the official statute for parking lots, but the improvement of the conditions for walking and cycling as well – such as speed limits or establishing equal space for all modes of transport.

5.2 SWOT Analysis

The SWOT analysis is based on the previous statements and assessments and focuses on four topics:

a) mobility behaviour,
b) transport services and intermodal integration,
c) transport infrastructure and
d) funding and policies.

The SWOT analysis can be understood as an overview or snapshot to help summarise the current position of mobility behaviour and passenger transport in the state and highlight possible developments for future improvements.

Field	Strengths (S)	Weaknesses (W)	Opportunities (O)	Threats (T)
mobility behaviour	- distinguish traffic flows across the state, clear origin-destination relationships - comprehensible commuter pattern - strong public transport demand along the string of cities	- low cycling usage rates - heavy use of/dependence on private car, car-oriented mobility habits - settlement structure in favour of private car use (rural-urban continuum)	- shift towards an eco-mobility culture at least in the urban areas - significant potential for cycling if condition improves - commuter pattern in favour of public transport use	- manifestation of car-oriented culture and mobility habits - individualised lifestyles with rejection of public transport use and orientation towards private car - cycling is seen exclusively as a recreational activity
transport services and intermodal integration	- VMT as transport association in central Thuringia allow for intermodal bus and rail transport with integrated ticketing - devise landscape of transport operators - attractive local public transport in major cities - new hub for high-speed trains in Erfurt results in improved local rail transport services across the state	- regional fragmentation causes unfavourable condition to implement intermodal connectivity - predominantly rural settlement structure throughout the state - rudimentary local public transport services in large parts of the rural areas	- concentration of transport authorities responsibilities with support of integrated transport associations - VMT could potentially be the basis for an extended transport association in (central) Thuringia - combination of cycling and public transport services	- integrated ticketing leads partially to fare increases and therefore reducing public acceptance - demographic decline intensified reduction in demand for transport services
transport infrastructure	- development of the railway infrastructure along the string of cities	- low electrification rate of railway tracks - lack of bike parking facilities at stations - periodization to improve the conditions for private cars at road construction projects	- development of cycling and walking infrastructure - electrification of most parts of the railway tracks or/and alternative systems	- failure to regard the impact of improved conditions for cycling and walking - insufficient (national) public financing to electrify railway tracks
funding and policies	- climate action plan including measures for green transport and eco-mobility on its way - comprehensive greenhouse gas reduction targets - increasing budget for public rail transport despite declining national annual financial allocations - lead in actions towards greenhouse gas reduction is the Ministry of Environment - steady development of GDP	- essential responsibilities at national or local level, leaving little space for federal activities - diverging political interests and persistent car-oriented policies - budget for public rail transport supplied exclusively by national funds - imbalance in funds for road infrastructure and infrastructure for walking and cycling - particularism within counties frequently prevent collaboration in public transport planning	- climate action plan as starting point for significant activities and political awareness - political awareness of the importance of a modal shift across all political department and areas of responsibility - cooperation across local administrations and between counties and state towards integrated public transport planning	- climate package including action plan does not pass the legislative process or aims will be diluted - financial constraints lead to reductions in public transport budgets - measures to foster green transport and eco-mobility could be fragmented

5.3 Prospects

The climate legislative package and the climate action plan can be understood as an outline for a comprehensive master plan, setting out the overall strategy to reduce greenhouse gas emissions in the transport sector. It is now up to the legislative process to authorize the package without further dilution of the aims. On the other hand, the authorities and the government are responsible to enforce the measures in order to implement the conditions to foster sustainable mobility throughout the state.

The authorities and government are encouraged to work on the best ways to implement the long-term vision of sustainability beyond the measures outlined in the climate action plan. Therefore, full integration of sustainability principles into the transportation authority's culture, functions, and stakeholder relationships could result in a robust, affordable, efficient, and safe transportation system.

With special reference to the unique structure and given mobility pattern in Thuringia, possible future direction towards sustainable mobility and greenhouse gas reduction within the transport sector could the emphasis of the work be as follow:

a) Intermodal integration is crucial for sustainable transport systems. Therefore, public road and rail transport should be coherent and closely linked to each other in terms of integrated ticketing and timetable.
b) Possibilities to enlarge existing transport associations (like the VMT) or implement new associations that cover specific regions of Thuringia in a reasonable way with integrated ticketing and cross-border transport connections.
c) Bringing the benefits from the new high-speed train into the country, but without neglecting the difficulties and challenges within the polycentric regions of the state.
d) Cycling is in Thuringia a still underestimated mode of transport with a high value to encourage a modal shift from private car. Not only in the cities, but also in the countryside is the cycling infrastructure still underdeveloped. The pedelec offers new opportunities to cover long distances and handle uneven terrain. The rapid increase of pedelec use represents a new challenge in transport planning.

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