Baden-Württemberg

MINISTRY OF TRANSPORT




TRANSPORT INFRASTRUCTURE 2030:

A CLIMATE PROTECTION SCENARIO FOR BADEN-WÜRTTEMBERG

TRANSPORT INFRASTRUCTURE 2030: A climate protection scenario for Baden-Württemberg[1]

The role of transport policy

Baden-Württemberg has set itself the target of becoming a driver of modern and sustainable mobility for the future. This is particularly significant in view of the enormous transformations the mobility economy is undergoing today.

Climate change continues fast and is forcing us to act. A "Business as Usual" attitude would massively endanger our livelihoods, and push the costs of climate change even higher. That is why the international community ratified the Paris climate agreement in 2016. The aim is to keep global warming at least below 2.0 degrees Celsius or even 1.5 degrees Celsius compared to pre-industrial times. This considerably increases the pressure for measures in the transport sector.

In addition, countries are seeking to achieve global greenhouse gas neutrality in the second half of this century. This means that they must operate without fossil fuels such as gas and oil. If we wish to meet these goals we need to move towards emission-free motors and a climate-neutral mobility system in the near future. The energy transition is paramount here, because without renewable energies the transport transition cannot succeed.

The German government's Climate Protection Plan 2050 also sets a sector target for transport in 2030 of a 40-42 percent reduction in CO2 emissions compared with 1990. The present climate protection scenario for Baden-Württemberg, which uses the same database as the Federal Transport Infrastructure Plan 2030 (BVWP) and has adapted it to this goal, proves that this is very ambitious.

Within the Transport Infrastructure Plan, BVWP 2030, as passed by the federal government, neither the climate protection targets of Baden-Württemberg nor those of the federal government will be achieved. To meet those targets, far more effective rail transport projects should have been included. The climate protection scenario for 2030 and the 'sensitivity analyses' are intended to show how the world would look like in which the climate protection targets were met: What role would different means of transport play and what would the infrastructures look like? The good news is that our mobility needs can continue to be met. But the infrastructures would be different and achieving these goals would mean changes to the way we live our daily lives. This scenario shows how the country's ambitious climate protection goals could be met.

[1] This article summarises key aspects of rail transport from the abridged version of the report of the same name. The complete summary and various individual reports are available online at www.vm.baden-wuerttemberg.de/

Scenarios are not forecasts. Even a scenario such as this cannot describe future developments with any certainty, but rather it sets out objectives that could be achieved. Achieving our climate protection goals, therefore, depends on many external factors and choices made at various political levels.
The climate protection targets have been set. The path to meeting these targets is clear. The Climate Protection Scenario and the Ministry of Transport policy are not, however, one and the same thing, especially as most of the assumptions made in the scenario do not fall within the competence of the regional government. What it does show, however, is that we must make considerable efforts in infrastructures if we are to achieve our goals.

The climate protection goals and other environmental goals can only be achieved if the transformation process in the transport sector is sustainable. This also secures the prosperity of our country in the long term. This scenario is intended to stimulate public debate and encourage citizens to adopt new types of mobility.

The Climate Protection Scenario

The Ministry of Transport for Baden-Württemberg has commissioned a study entitled “Climate Protection Scenario” to show how climate protection targets in the transport sector can be achieved. It uses the same models and methods as the BMVI's Interdependency Forecast so that results can then be extrapolated at a federal level. The difference between the two studies is that the former foresees a greater reduction in CO2 emissions from transport in 2030 compared to 1990.

According to the Interdependency Forecast, only 21 percent reduction will be achieved for Baden-Württemberg and 26 percent nationwide. One reason for this is the further economic and population growth forecast for Baden-Württemberg. The Climate Protection Scenario for Baden-Württemberg, which primarily focuses on measures to shift traffic to more environmentally friendly modes of transport, achieves a reduction of 34 percent. Furthermore, the Climate Protection Scenario shows that the climate protection goals of neither the German federal government nor those of the regional government of Baden-Württemberg for 2030 are likely to be achieved solely through improved vehicle technology or the use of electric vehicles.

This Climate Protection Scenario is only feasible if the corresponding investments in infrastructure (railway track) and organisation (rail transport, public transport) are started as soon as possible. The study shows that the investments of the Federal Transport Infrastructure Plan (BVWP 2030) in rail transport are not sufficient. In Baden-Württemberg, a significant shift from road to rail transport can only be achieved through greater expansion of rail capacities and the removal of obstacles to the use

of rail. On-going expansion of the rail infrastructure, beyond the scope of the Federal Transport Infrastructure Plan (BVWP 2030), particularly in built-up areas, is essential. The investments will be substantial and it is now time to create the necessary financial framework for this.

Rail transport within the Climate Protection Scenario

In the climate protection scenario, the costs of rail passenger transport increase significantly - up 53% on the BVWP scenario, which corresponds to an overall hike of 101 % compared to 2010. Price increases vary depending on the individual sections of the route and considerable infrastructure measures may be required. In particular, urban routes into major cities (radial lines) would be hard pressed to reach the level of activity assumed in the BVWP concept. Rural lines and most tangential lines less so.

For this reason, the volume of rail passenger traffic would be augmented by increasing the available space on the trains, either by moving to exploiting maximum train lengths, using trains with higher capacities, such as double-decker trains, using additional trains and increasing train frequency. The Climate Protection Scenario counts on the following capacity increases as compared to 2010:

Train kilometers	BVWP-Scenario against 2010	**+ 22,7 %**
	Climate Protection Scenario against BVWP-Scenario	+ 13,1 %
	Climate Protection Scenario against 2010	**+ 38,8 %**
Seats per km	BVWP-Scenario against 2010	+ 45,4 %
	Climate Protection Scenario against BVWP-Scenario	+ 21,9 %
	Climate Protection Scenario against 2010	**+ 77,2 %**

Table 1: Increase in capacity in climate protection scenario in comparison

With additional capacity on existing trains or on new trains deployed by 2030, along with somewhat higher occupancy rates, the Climate Protection Scenario could be implemented for local rail passenger transport and long-distance rail passenger transport (over 50 km) in terms of capacity. However, the study only looked at passenger transport. A detailed examination of the Stuttgart S-Bahn did not take place. In some parts of the network, significant overloads are to be expected, which would be even greater than in the BVWP 2030 scenario.

The BVWP scenario does not foresee any major bottlenecks in the infrastructure network in Baden-Württemberg in 2030. In the Climate Protection Scenario, however, local public transport services

would be significantly expanded. The increase in train-kilometres for individual passenger transport would impact upon remaining capacity for rail freight traffic.

The increase in local rail services would affect the regional capital Stuttgart, as well as the southern Rhine Valley Railway and the southern railway, Südbahn. In Stuttgart, in order to to cope with the additional demand, extensions of the local transport services by between 36 and 174 train pairs per day would be necessary. In addition, local public transport services in services look set to increase at an above-average rate per day on the following sections of the route:

- between Karlsruhe and Stuttgart, plus 36 - 45
- between Stuttgart and Aalen, plus 21
- between Stuttgart and Heilbronn, plus 27
- between Stuttgart and Backnang, plus 111
- between Stuttgart and Ulm, plus 36
- between Stuttgart and Herrenberg and between Reutlingen and Tübingen, plus 57
- between Offenburg and Basel, plus 36
- on the Südbahn, plus 27

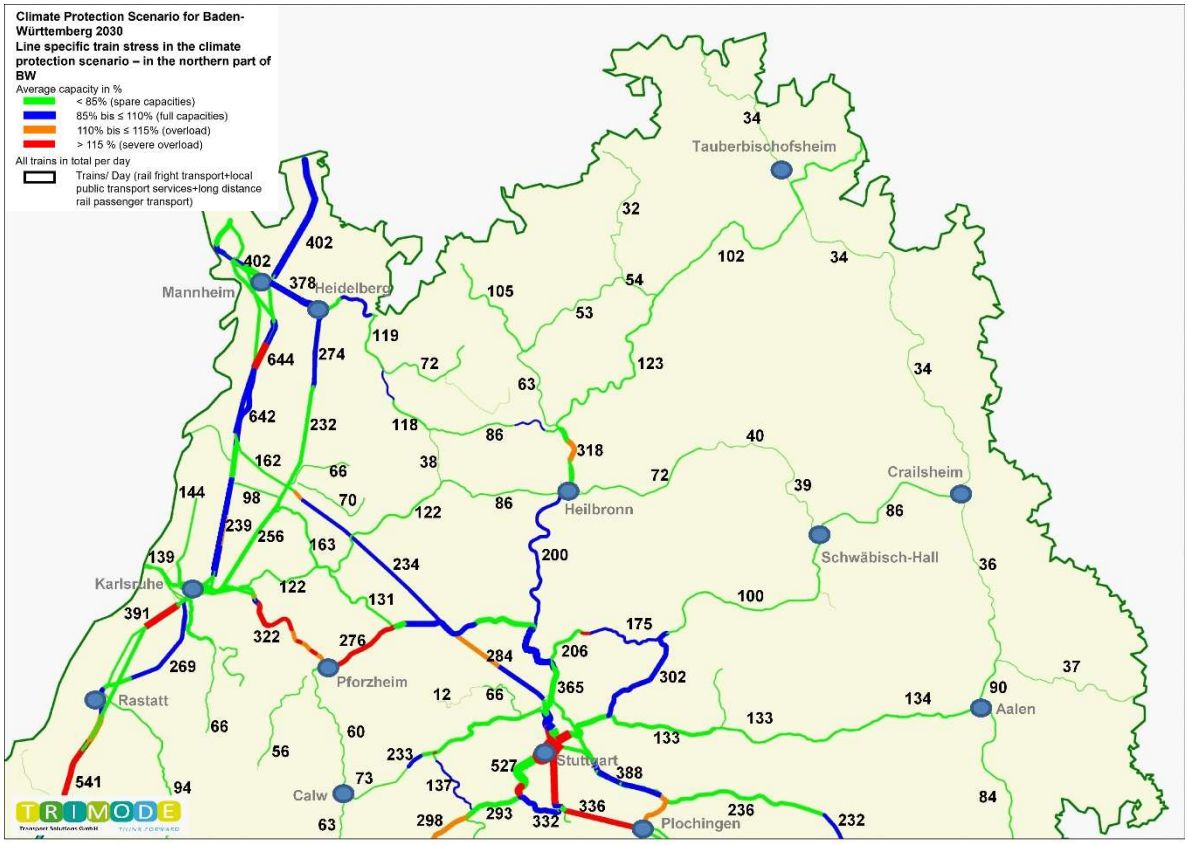

Figure 1: Change in train traffic in Baden-Württemberg 2030 (Climate Protection Scenario vs. BVWP 2030 scenario)

In the Climate Protection Scenario, rail freight transport will also increase nationwide by around 60 million tons and in Baden-Württemberg by around 10 million tons, or approx. 25 per cent. The increase in rail passenger and freight traffic in 2030 will lead to a higher burden on the rail infrastructure. No major re-routing or spatial changes are to be expected in rail freight transport as a result of the Climate Protection Scenario. The Rhine Valley Railway and the lines between Mannheim, Stuttgart and Ulm will remain the most important freight traffic routes. According to the model calculation, no major shifts in freight traffic to the Gäu and Südbahn are to be expected, despite the assumed electrification or expansion.
The route-specific change in rail traffic in the Climate Protection Scenario compared to the BVWP 2030 scenario can be seen in Figure 1. Strong changes can be observed in and around Stuttgart, between Mannheim and Karlsruhe and further to Basel, on the Gäubahn and on the Südbahn. These changes are mainly due to local public transport.

The rail network in the Climate Protection Scenario

The Climate Protection Scenario identifies severe congestion of the rail network in
- Baden-Baden
- between Karlsruhe and Rastatt (tunnel)
- between Schwetzingen and Molzau
- between Mannheim and Heilbronn-Wiesloch
- around Stuttgart
- between Karlsruhe - Pforzheim and Mühlacker
- between Böblingen and Herrenberg
- near Appenweier
- between Wernau and Reutlingen/Tübingen

Here, the congestion is so severe that there is a risk of increased delays without the implementation of further infrastructural expansion measures.

Large parts of the rail network, e.g. between Mannheim and Karlsruhe, are already fully exploited despite numerous assumed expansion measures. This means that the expected average daily traffic can be handled without major restrictions, and further trains can only be picked up to a limited extent. Short-term bottlenecks, linked to problems on the roads, are to be expected, especially in rush-hour traffic.

The situation is critical on many sections of the route, which are used almost entirely or exclusively by passenger traffic. In the Climate Protection Scenario, capacity utilisation averages over 125 percent during the day between 6:00 am and 10:00 pm. The most notable stretches are:

- Zuffenhausen - Stuttgart main station (167%)
- Stuttgart-Mittnachtstr. - Stuttgart University (160% - 185%)
- Stuttgart Central Station - Stuttgart Filderbahnhof (160%-190%)
- Stuttgart-Vaihingen - Stuttgart Airport (124% -146%)
- Plochingen - Wendlingen (125%)
- Pforzheim - Mühlacker (150%)
- Söllingen - Wilferdingen-Singen (150%)
- Dammerstock - Rastatter Tunnel (140%-145%)
- Vaihingen (Enz) - Markgröningen (132%)
- Nürtingen - Tübingen (160%-185%)

On these sections there is a risk that the train services foreseen in the Climate Protection Scenario will not be able to be implemented. Extensive expansion measures are required to relieve the situation, which will enable us to increase local public transport services during the day. Capacity utilisation between Stuttgart-Zuffenhausen and Stuttgart-Heerstraße is particularly intense. Any strong increase in demand will result in above-average and impossibly high capacity utilization.

As it is not possible to shift service offers to other routes in local public transport, further measures to alleviate the situation are absolutely essential. Also to the south of Stuttgart, between Plochingen and Tübingen, and between Stuttgart and Böblingen, but also on the Südbahn, difficult situations occur in the Climate Protection Scenario which were still manageable in the BVWP scenario. Between Karlsruhe and Mühlacker in daytime the situation is also difficult, due not only to the sharp increase in demand, but also in particular to very different speeds of local passenger and freight transport. South of Baden-Baden, however, no major bottlenecks are expected due to the assumed expansion of the Rhine Valley Railway.

CO2: How does the Scenario help the climate?

The report on the Climate Protection Scenario looks at the climate effects according to the more common Kyoto definition. Therefore, they only record the direct emissions of traffic. CO2 emissions from power generation, for example, are therefore attributed to the power plants. CO2 emissions from all modes of transport are dominated by road transport emissions, which account for 95 percent. In the Climate Protection Scenario, emissions from all modes of transport will be 16 percent lower than in the BVWP 2030 scenario and 34 percent lower than in 2010. Compared to 1990, the reference year of the reduction commitments under the Kyoto Protocol, the figures are very similar. Overall, the changes for Germany scarcely deviate from those for Baden-Württemberg: In the climate protection scenario they are 17 percent below the BVWP scenario, and 35 percent below 2010.

In the BVWP scenario, CO2 emissions from road traffic will fall by 22 percent between 2010 and 2030, especially for private car traffic. However, this only applies if the cars consume significantly less as assumed in the study, and moreover that we have six million electrically powered cars on the roads. Total CO2 emissions from road transport, including biofuels and electricity generation, fall slightly at 20.5 percent. The total emissions from road traffic (according to TREMOD) are reduced to a similar extent in the Climate Protection Scenario compared with both 2010 (-35 percent) and the BVWP scenario (-18 percent).

In the BVWP scenario, the CO2 emissions of rail transport will decrease by 19 percent, although final energy consumption will increase. The reason for the considerable divergence is that the proportion of diesel locomotives will fall sharply. In the Climate Protection Scenario, emissions will increase by 27 percent compared to the BVWP scenario in line with the higher transport volume. This represents an increase of four percent points compared to 2010.

	2010	**2030**		**2030**		
		BVWP-Forecast		**Climate Protection scenario**		
	Mio. t		% difference with	Mio. t	% difference with	
			2010		**2010**	**BVWP-Szenario**
Direct Emissions, Kyoto-Monitoring						
Road transport	19,71	15,39	-21,9	12,71	-35,5	-17,4
Rail transport	0,14	0,12	-18,5	0,15	3,7	27,3
Air Traffic	0,22	0,20	-10,0	0,19	-14,2	-4,7
Inland waterway navigation	0,08	0,09	3,1	0,09	5,6	2,4
Other traffic	0,54	0,54	0,0	0,54	0,0	0,0
Total	20,70	16,33	-21,1	13,68	-33,9	-16,3
Total Emissions, TREMOD						
Road transport	24,57	19,54	-20,5	16,01	-34,9	-18,1
Rail transport	1,51	1,23	-18,2	1,60	6,6	30,3
Air transport	3,18	4,01	26,2	3,82	20,3	-4,7
Inland waterway navigation	0,21	0,21	3,1	0,22	5,6	2,4
Total	29,46	24,99	-15,2	21,66	-26,5	-13,4
For comparison: Germany						
Direct Emissions	153,5	119,8	-22,0	99,18	-35,4	-17,2
Total Emissions	225,5	190,1	-15,7	164,0	-27,3	-13,8

Table 2: Mapping CO2 emissions in Baden-Württemberg in both the BVWP 2030 and the Climate Protection Scenario

It should also be mentioned that air traffic (domestic German traffic alone) is growing more slowly (up 15 percent) than international air traffic (up 77 percent). Since specific fuel consumption is also significantly reduced, energy consumption and thus direct emissions are noticeably reduced, by 10 percent. According to the location principle, energy consumption is 13 times higher because of the foreign traffic included here and CO2 emissions are even 14 times higher because emissions upstream. In the Climate Protection Scenario, air traffic's CO2 emissions would be reduced by just 5 percent compared to the BVWP scenario.
Ultimately, fuel consumption in inland navigation (up 7 percent) will increase significantly less than its transport performance (up 27 percent) due to the reduction in specific consumption. CO2 emissions are rising even more slowly (3 percent). Inland navigation is the one area of transport least affected by Climate Protection Scenario measures. Here, transport capacity and CO2 emissions increase by only 3 and 2 percent respectively compared to the BVWP 2030 scenario, but remain insignificant, amounting to less than 1 percent of all emissions.

Conclusions

The Paris Climate Agreement and the German government's Climate Protection Plan 2050 underlined the need to give climate protection a high priority in all sectors. The results of the Climate Protection Scenario and its impact on infrastructure allow the following conclusions to be drawn, which are important for further discussion and policy orientation:

In order to reach the desired effects, one would impose a serious burden on various modes of transport, which will impact upon infrastructure planning. Traffic volume on the roads is 12% down on 2010, mainly in built up areas. This has several positive effects, as well as reducing CO2 emissions: Less traffic on the roads leads to fewer bottlenecks and thus to higher average speeds, higher reliability and less congestion; despite a speed limit of 120 km/h, the average speed on motorways would increase. A corresponding scenario would be particularly important for the future planning of inner-city road infrastructure, as in towns, road space is subject to the competitive pressure from other urban space uses and functions. The diminishing importance of roads in providing connection could mean additional space is available for modern urban planning and mobility.

Passenger traffic on the railways will double compared to 2010 and strong growth can also be expected in freight traffic. Although some of the increases can be offset by higher capacity utilisation and larger trains, in many cases there are signs of a massive need for investment in infrastructure measures. The bottlenecks occurring in the Climate Protection Scenario suggest starting points for further investigations.

The scenario shows that a 40 percent reduction in CO2 emissions from transport compared with 2010 is very ambitious and can only be achieved if effective measures are implemented in a timely manner. In view of the results of the BVWP forecast on the one hand and the long-term objectives of Paris on the other, achieving a 34% reduction is already an ambitious goal.

Sensitivity analyses confirm that an “either - or” discussion is not the right approach, but rather an intelligent discussion coupling incentives and restrictions is required. The strengths and advantages of the environmentally friendly have little impact if they are not combined with restrictions. At the same time, they are associated with enormous investment costs and current expenditure. However, such expenditure is a prerequisite for the introduction of more restrictive measures, as they offer an attractive alternative for the mobility of persons and goods. At the same time, the additional revenues resulting from such measures would, in turn, enable us to finance an attractive environmentally friendly network.

With regard to the infrastructure, the calculations clearly show that, according to the current BVWP, the rail network is not being expanded sufficiently and what expansion is taking place is moving too slow. The necessary improvements in all conurbations described above must be accompanied by further improvements in the urban, light rail and tramway networks, which are not looked at in detail here. As it is uncertain whether this great effort will be successful, the capacities that will become available on the road must be used for the expansion of public transport. At short notice the expansion of bus transport is more feasible than rail. In order to make the bus competitive in terms of comfort and travel time, separate types of bus lines must be tried out, up to and including Bus Rapid Transport Systems.

The Climate Protection Scenario for Baden-Württemberg shows it is possible to make regional transport more climate-friendly. At the same time, it shows the limits and challenges of such a development. There are also some surprising advantages (e.g. less congestion, less pollution from noise and air pollutants). However, to get from the Scenario into the Future, there is still a long, long way to go.

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