



# The Karlsruher Model

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VBK | AVG | KVV

# Agenda

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**Introduction**

2

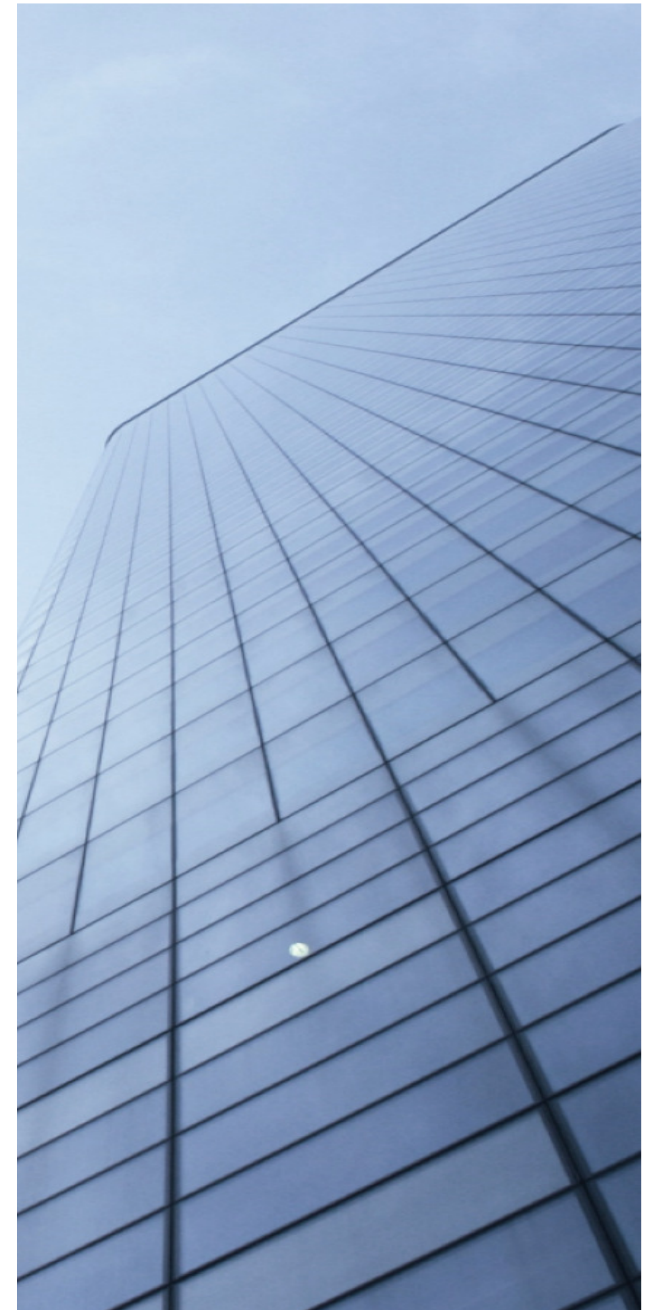
The Karlsruher Model

3

Technical and functional features of the network and the tram train development

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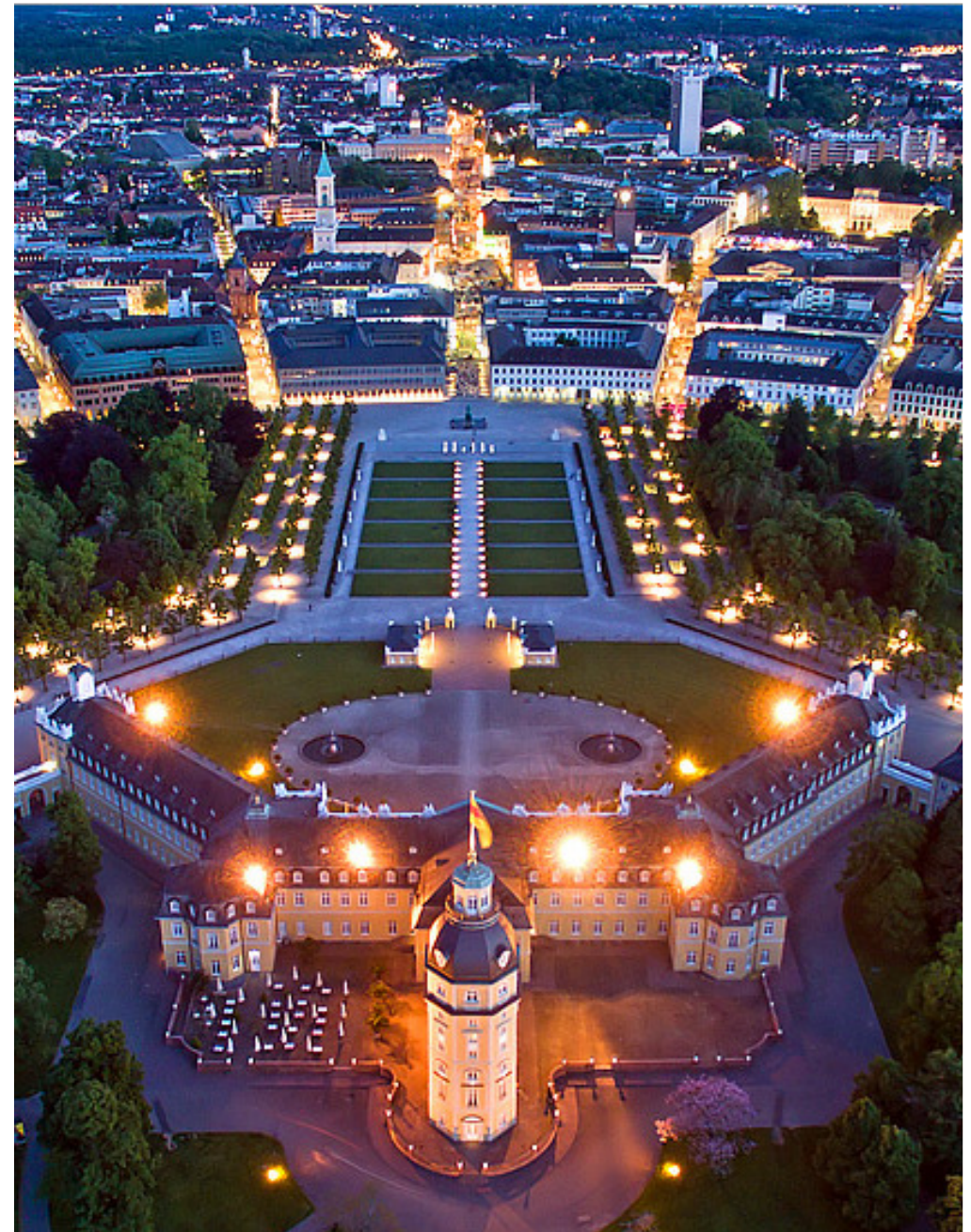
Future plans



# City of Karlsruhe

- Inhabitants: 308.000 (2015)
- Area: 173 km<sup>2</sup>
- Jobs : 218.000
- Unemployment rate: 4,4% (July 2017)
- Universities: 9
- Students: 43.000
- Cars per 1.000 inhabitants: 462\*
- Focus: research, technology, traffic
- Since many years very successful in the field of transport:
  - Public transport
  - bicycle
  - car

\*Germany: 517 cars/1000 Inhab.





# TechnologieRegion Karlsruhe (TRK)

TechnologieRegion  
Karlsruhe



Hightech trifft Lebensart

- Alliance of companies, chambers, scientific institutions and municipalities
- Goal: To strengthen and advance the economic, scientific and innovation region
- The focus is on the topics of mobility, energy and IT / digitalisation
- The "TechnologieRegion Karlsruhe" has a total area of 3,240 km<sup>2</sup> with around 1.3 million inhabitants, making it one of the leading economic and innovation regions in Europe



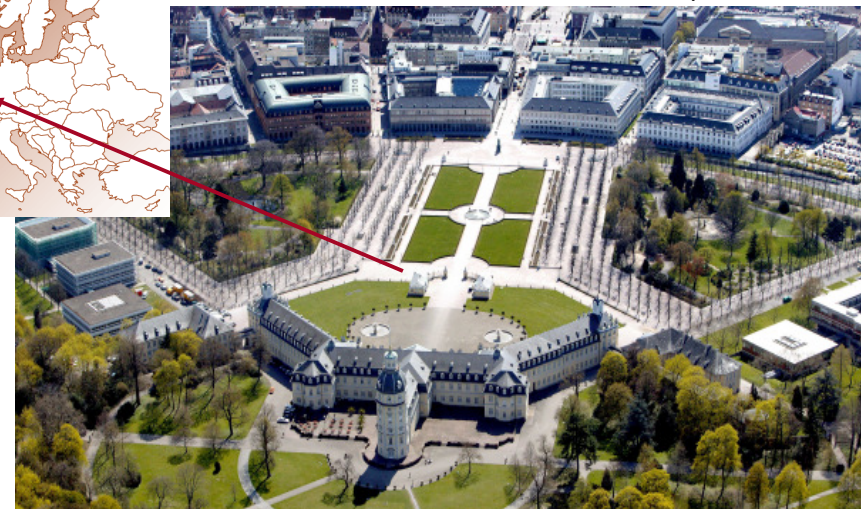


# Region Middle Upper Rhine

- 2.137 km<sup>2</sup> with 57 municipalities
- Is one of the most populated and economically strong among the twelve planning regions of Baden-Württemberg
- At a length of about 80 kilometers, the Rhine forms the western border and the "backbone" of the region



Karlsruhe – in the heart of Europe



# Albtal-Verkehrs-Gesellschaft mbH (AVG)



Pioneer of TramTrain

Regional bus and railway company

74,9 million passengers p.a. (2016)

833 employees

286,9 km AVG-owned and leased infrastructure

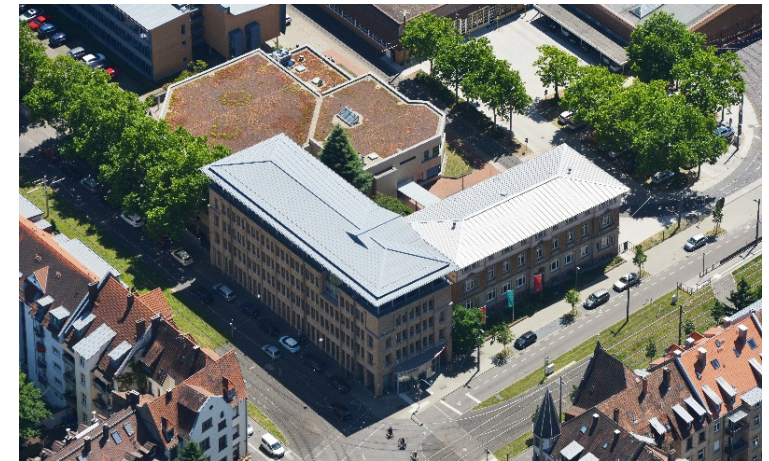
561,3 km total network

191 LRVs

218 million EUR turnover

36 Busses

Cargo (995,9 t)



# Verkehrsbetriebe Karlsruhe GmbH (VBK)



*Bewegt alle.*



106,4 million passengers p.a. (2016)

1.364 employees

71,5 km track length

2 tramway yards

123 trams

55 busses

7 tramlines, 1 suburban line

164 million EUR turnover



# TransportTechnologie-Consult Karlsruhe GmbH (TTK)



The TTK was founded in 1996 and is an stand-alone and independent engineering firm with over 30 employees in Karlsruhe and Lyon (branch office)

Divisions:

- Infrastructure
- Traffic planning, operation and vehicle technology

## Core competencies:



Direct access to the operator experience and infrastructure of the AVG



Wide range of experienced engineers



Decades of experience in advising German transport companies and public authorities



Extensive knowledge of the French public transport market



Know-how transfer between France and Germany as well as other countries

PTV GROUP

PTV 51 %

Planung  
Transport  
Verkehr –  
Transport  
Consulting

AVG 49 %

Albtal-Verkehrs-  
gesellschaft mbH –  
Public transport  
operators



*Bewegt alle.*

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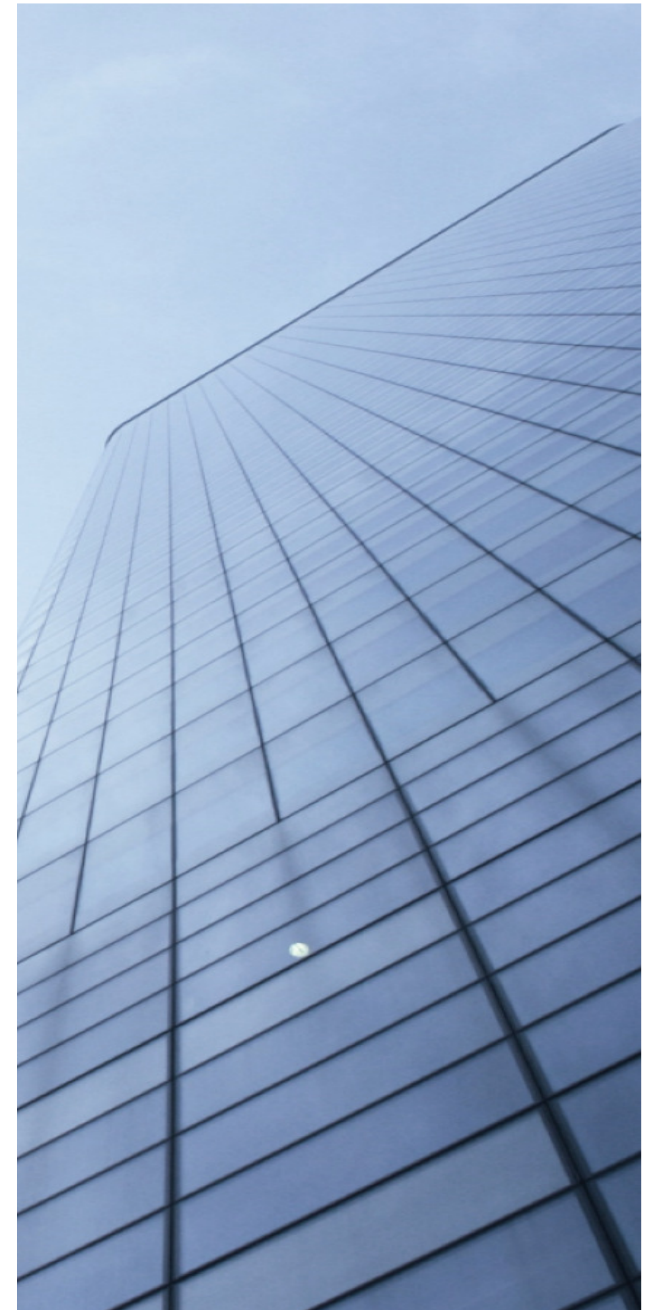
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# Essentials of the Karlsruher Model



Without changing trains from the countryside to the city



Connecting tram and train networks



Operating fast like a train on the heavy rail and flexible like a tram within the city



Improving urban and rural development through tram train



Best use of existing rail infrastructure



high frequency

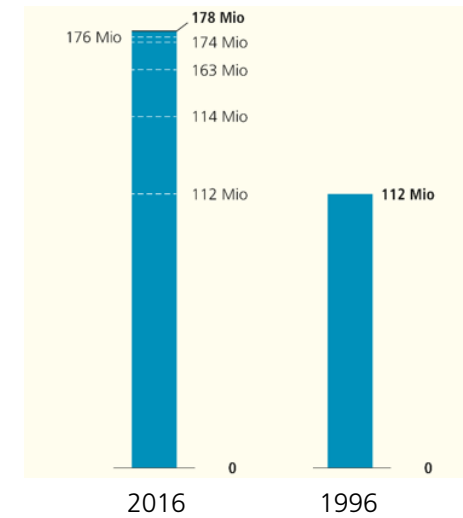
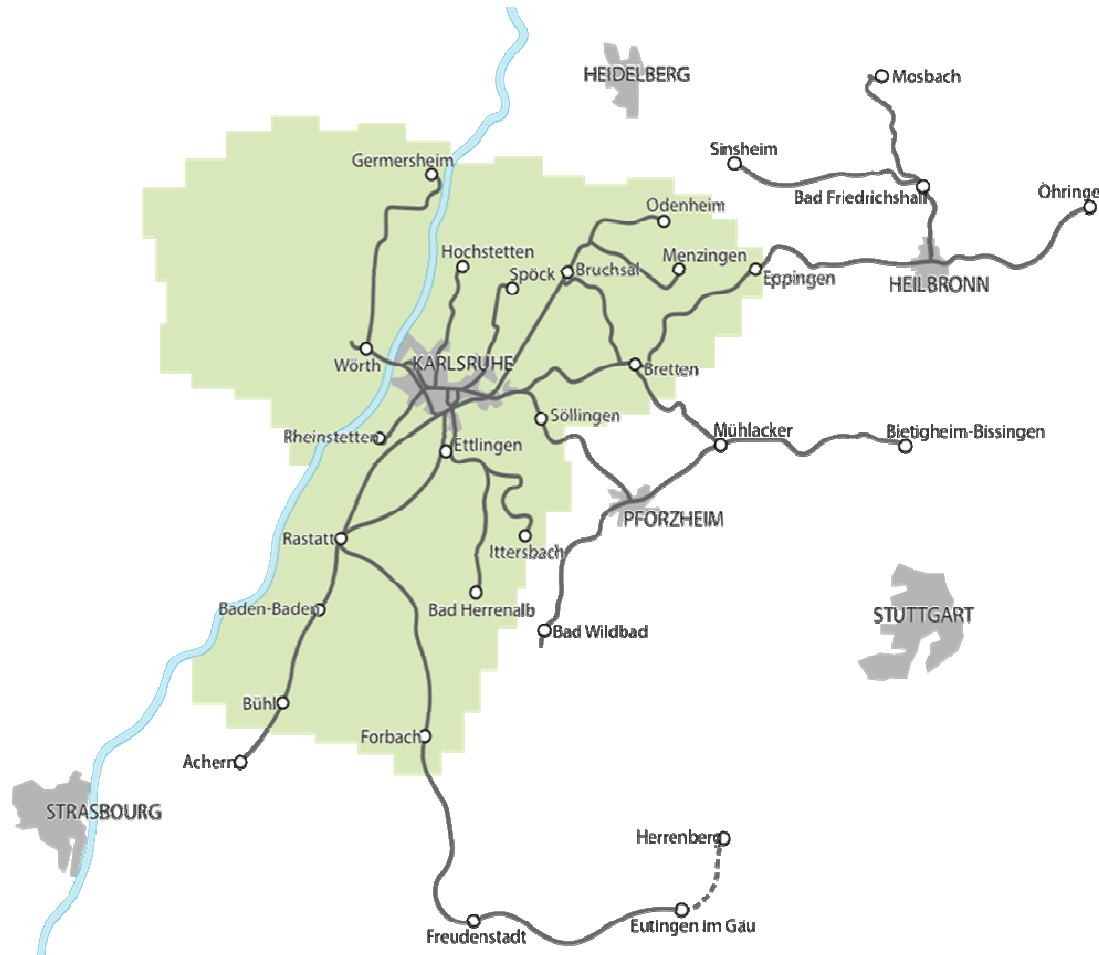


# Pilotline Karlsruhe – Bretten (1992)

- 30 km long route from Karlsruhe main station to Bretten
- The pilot line ran from the Karlsruhe main station over the marketplace towards the railway station Durlach and from there over a linking construction to Grötzingen and Wössingen to Bretten's district Gölshausen



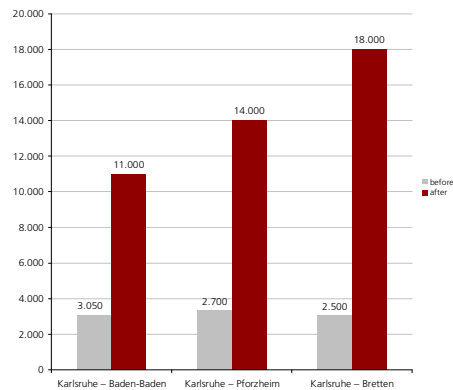
# Network development



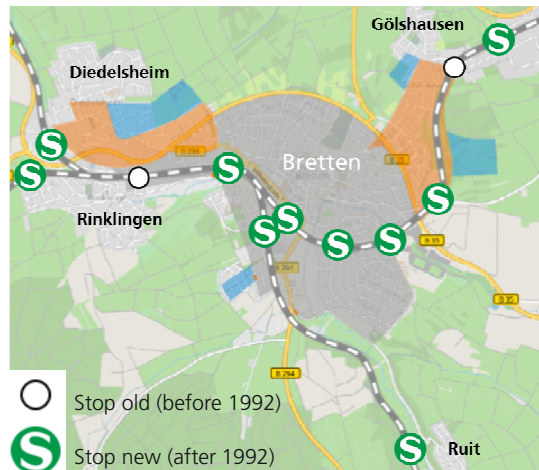
- Network length 1992: 140 km
- Network length 1996: 250 km
- Network length 2000: 360 km
- Network length 2005: 530 km
- Network length 2014: 538 km
- Network length 2016: 561 km

# 25 years Karlsruher Model

On 25.09.1992, the world's first dual-system city railway started operating and developed into a worldwide "export champ" in the following years



Development of the number of passengers



In retro look in the jubilee year

The excellent cooperation between the companies AVG and VBK is one of the greatest success factors



The railways of the AVG drive completely with green electricity

Public transport has been organized for example in Strasbourg, Alicante and Sheffield, on the basis of this tram-train principle



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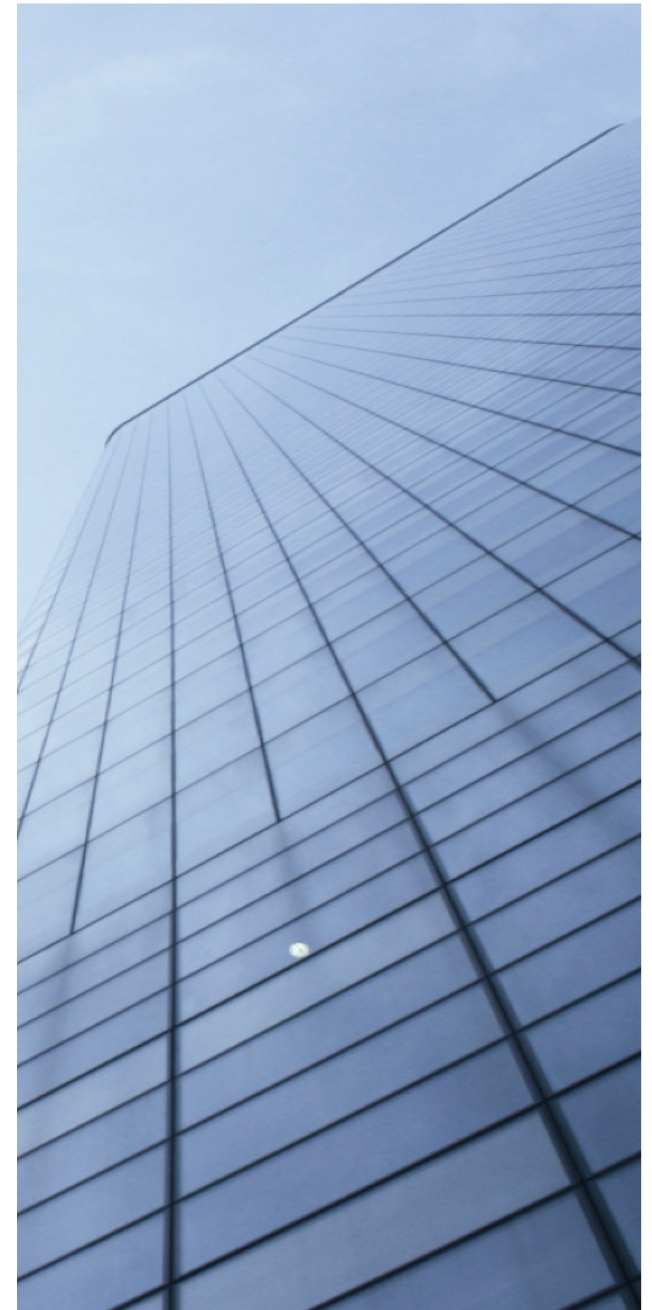
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# Network development Modernization and new construction of lines

## Murgtalbahn

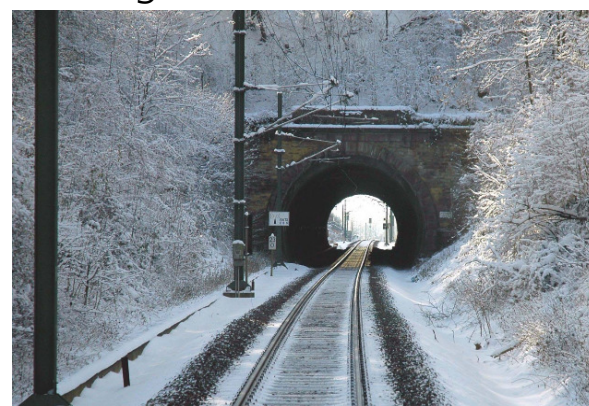


before



after

## Kraichgaubahn



Gölshausen tunnel, the track was moved to the center for electrification



New station "Bretten Stadtmitt"

## Blankenloch



before

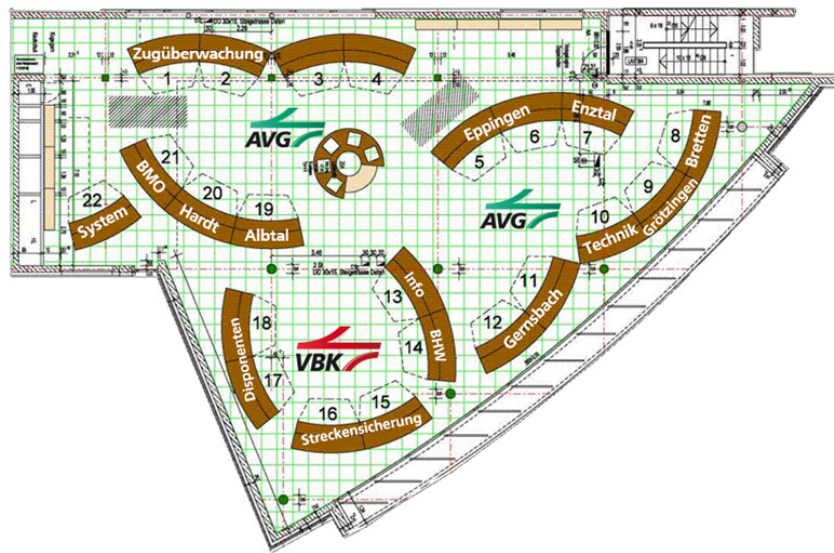


after



# Network development - Control Center

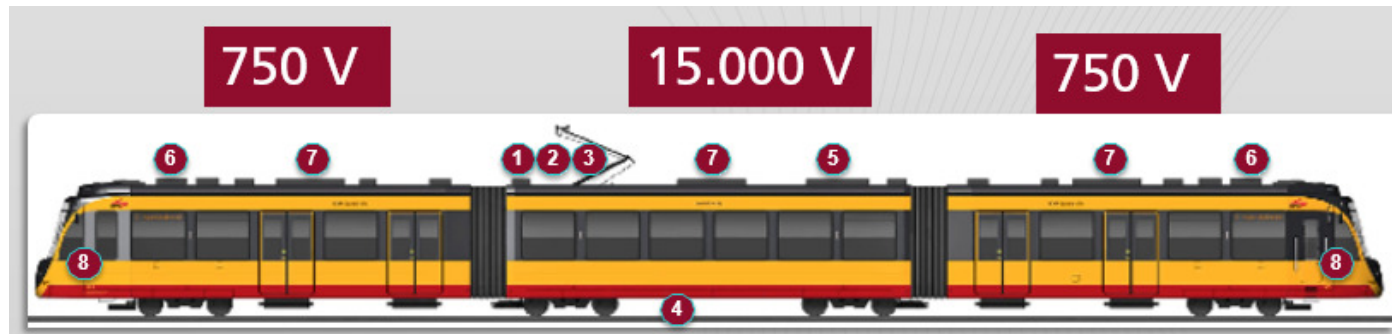
- The control center of the Verkehrsbetriebe Karlsruhe and the Albtal-Verkehrsgesellschaft
- 295m<sup>2</sup> accommodate the control center, train monitoring, trainline and dispatchers





# Tram train development

## The dual mode vehicle



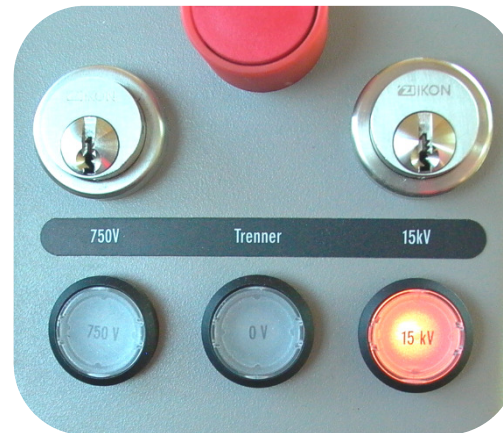
ET 2010

1. Power-System-Separator
2. Transducer for sensing system
3. 15kV circuit breakers
4. Transformer
5. Line power converter
6. Traction inverter
7. Air conditioner
8. Operating cab acc. BOStrab an EBO



# Tram train development - System changeover

Connecting the train with the tram network



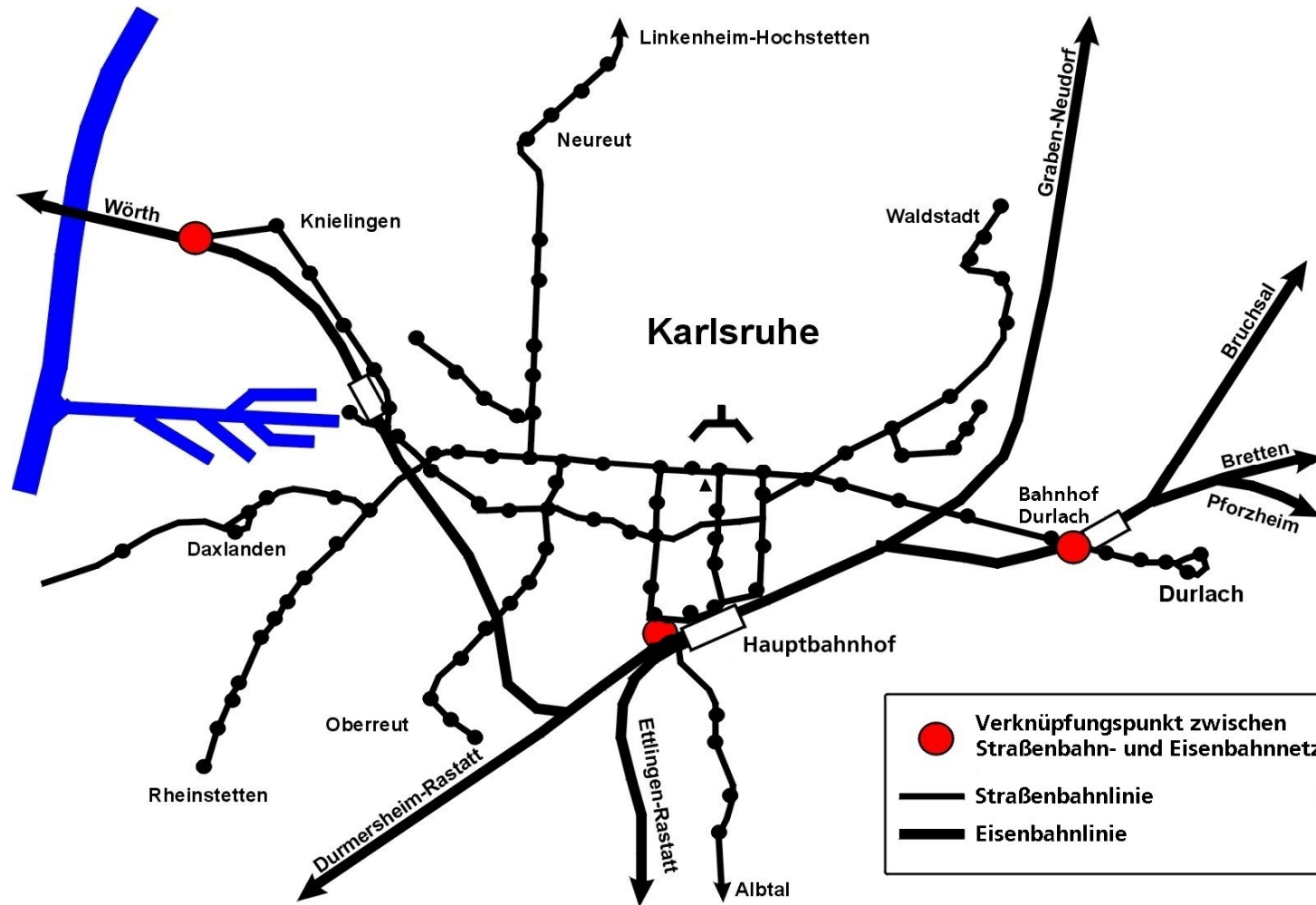
Change from 750 V DC to 15 kV AC

Legal change from tram decree (BOStrab) to rail decree (EBO)



Independent switch within the vehicle

# Tram train development - System changeover





# Tram train development

## The new generation - ET 2010 (Flexity Swift)



|            |          |                      |   |
|------------|----------|----------------------|---|
| Length     | 37,03 m  | Average acceleration | 0,6 m/s <sup>2</sup>                      |
| Width      | 2,65 m   | Seating              | 93 (incl. 9 folding seats)                |
| Height     | 4,0 m    | Standings            | 139 (4 Pers./m <sup>2</sup> )             |
| Max. speed | 100 km/h | Voltage              | 15 kV 16 $\frac{2}{3}$ Hz AC und 750 V DC |

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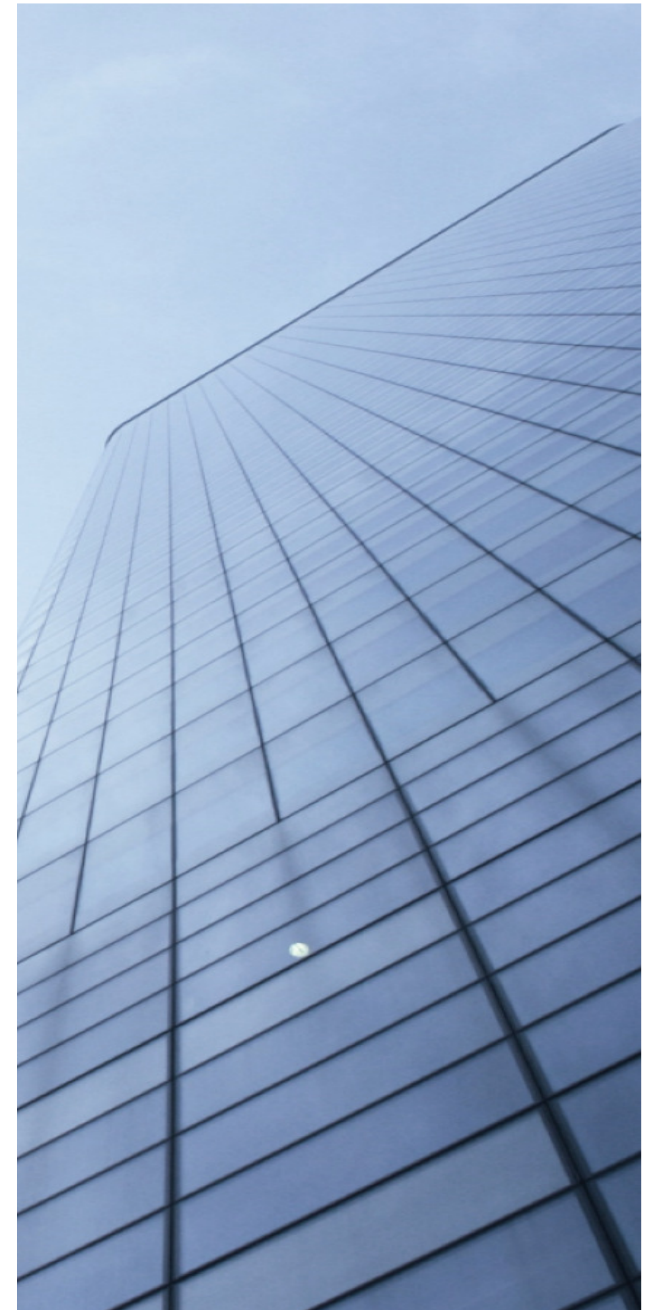
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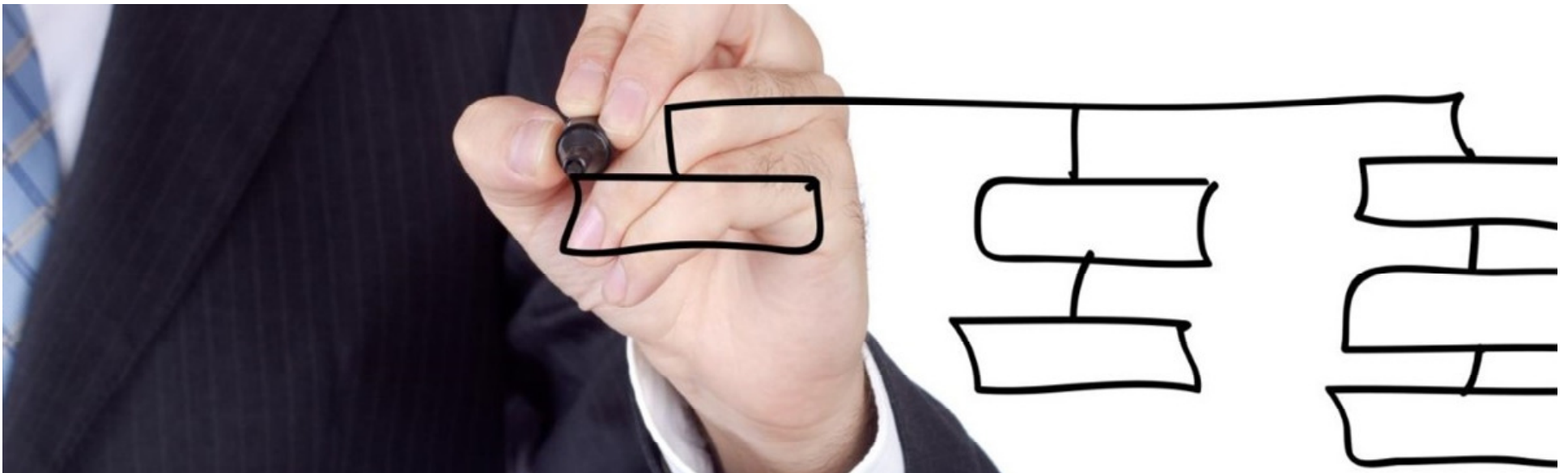
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**Future plans**



# Future plans

- VDV Tram Train Project
- Extension of infrastructure
  - Project: Network Conception 2020 / 2030
  - Realization of the Karlsruhe model in other cities / municipalities in the region
  - Optimization of total travel times → Combination of slow and fast network
  - Reactivation of existing tracks
- Project: @Train / autonomous operation





# Future plans – VDV Tram Train



Approximation of the procurement costs of two-system vehicles to the procurement costs of full-track vehicles

Harmonizing the competitiveness of two-system vehicles with the competitiveness of commercial vehicles not only in the economic, but also in a business comparison

Increasing the attractiveness of the Karlsruhe model at the different locations

Cost reduction by replacement of cost-intensive small series with high project costs

Retention of customization options for pricing (for example the quality specifications that allow different subcontractors)

# Future plans - Extension of infrastructure

- Project: Network Conception 2020 / 2030
- Realization of the Karlsruhe model in other cities / municipalities in the region
- Optimization of total travel times → Combination of slow and fast network
  
- What you need:

Interdepartmental, professional exchange on the future requirements, expectations, visions and challenges in the transport market

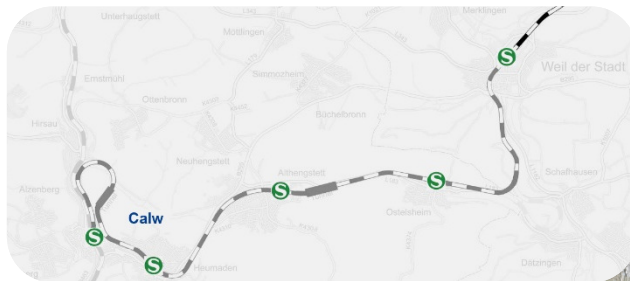
Open discussion - without "blinkers" and "ban on thinking" – of the topics of network, route development, vehicle use, traffic benefits, performance, public transport attractiveness and cost-effectiveness

Determination of cornerstones for a future target, on the basis of which definite network plans can be further developed, examined and recommended

# Future plans - Reactivation existing tracks

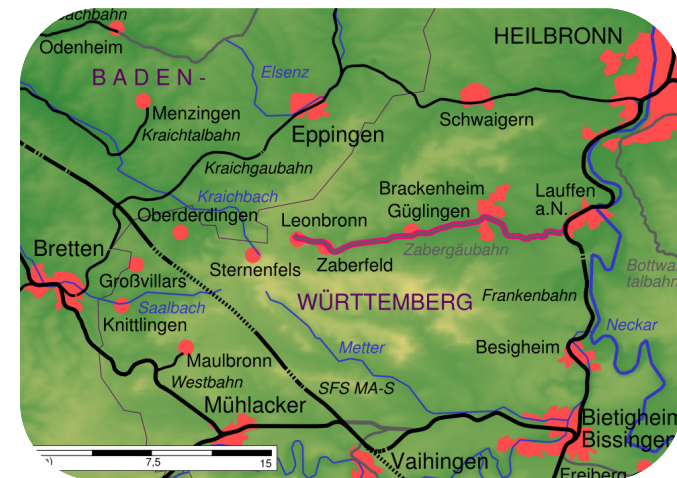
## Hermann-Hesse-Bahn

- In 1989 the railway Weil der Stadt - Calw was shut down
- In 2015, the district of Calw tendered the accompaniment of the reconstruction measures (lot 1) and the infrastructural operation of the line as EIU (lot 2) via NVBW
- The AVG won the entry contest
- 2020 is the planned commissioning



## Zabergäubahn


- The Zabergäubahn is a 20.25-kilometer branch line from Lauffen am Neckar to Leonbronn, which leads through the Zabergäus landscape of the same name
- In 1986 the passenger traffic was stopped, 1994 the cargo traffic
- Currently, a standardized evaluation is carried out by TTK








# Future plans - @Train / autonomous operation

Automatic and trolley-independent electric tram train for public transport.

- Project coordinator:    
*Bewegt alle.*
  
- Project consortium:
 

|  |  |  |
|--|--|--|
| <br>Institut für Fahrzeug-<br>systemtechnik (FAST) am<br>Karlsruher Institut für<br>Technologie (KIT) | <br>Kiepe Electric GmbH | <br>Thales Deutschland GmbH |
|--|--|--|
  
- Summary:
  - Increasing the modal split in public transport in rural areas requires the use of single-track non-electrified routes. These routes can not be economically operated from today's perspective with the existing vehicles.
  - The aim of the project is therefore to design a new type of rail vehicle that can be electrically operated automatically and independently of the power transmission line. So far, there is no vehicle that has these two attributes.





Thank you for your attention

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VBK | AVG | KVV