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Session 3 - Innovation for Development Case Studies
Tram-train technologies: concepts and comparisons

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The brief

- > *Karlsruhe pioneered tram-train back in 1992. The technology has since been developed and taken on by other cities and regions.*
- > *What is meant by tram-train today?*
- > *We will consider where tram-train can provide a cost effective solution and how far available experience supports the investment case.*



Content

- > Success factors of Tramtrain
- > The Karlsruhe model – starting point and latest developments
- > Other applications of the Karlsruhe model in Europe
- > Where can tram-train provide a cost effective solution?
- > How far available experience supports the investment case?



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Success factors of Tramtrain

- > High passenger acceptance
- > Change of Modal Split –
More passengers (even former car users) and increase of car use (CO2) can be slowed down
- > Stimulation of regional and urban development



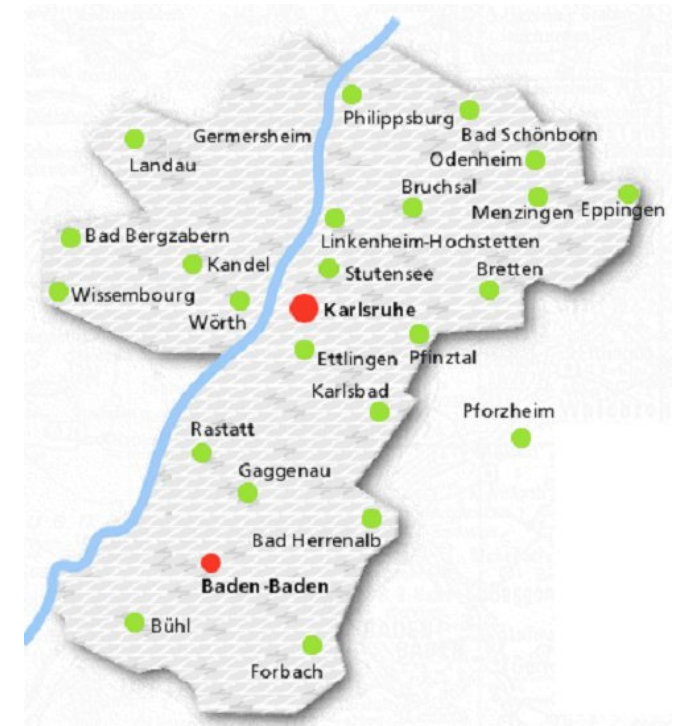
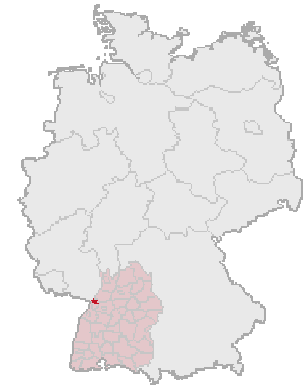
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Karlsruhe transport area - Statistical data (Dec.2009)

- > 1.33 Mio. population
- > 3,550 km² area
- > 120 cities and municipalities
- > Shareholders = 7 cities and districts
- > 20 public transport companies
- > 226 tram, bus and local railway lines
- > 175 Mill. passengers
- > 115 Mill. € fare revenues
- > 85.50 € revenue/inhabitant

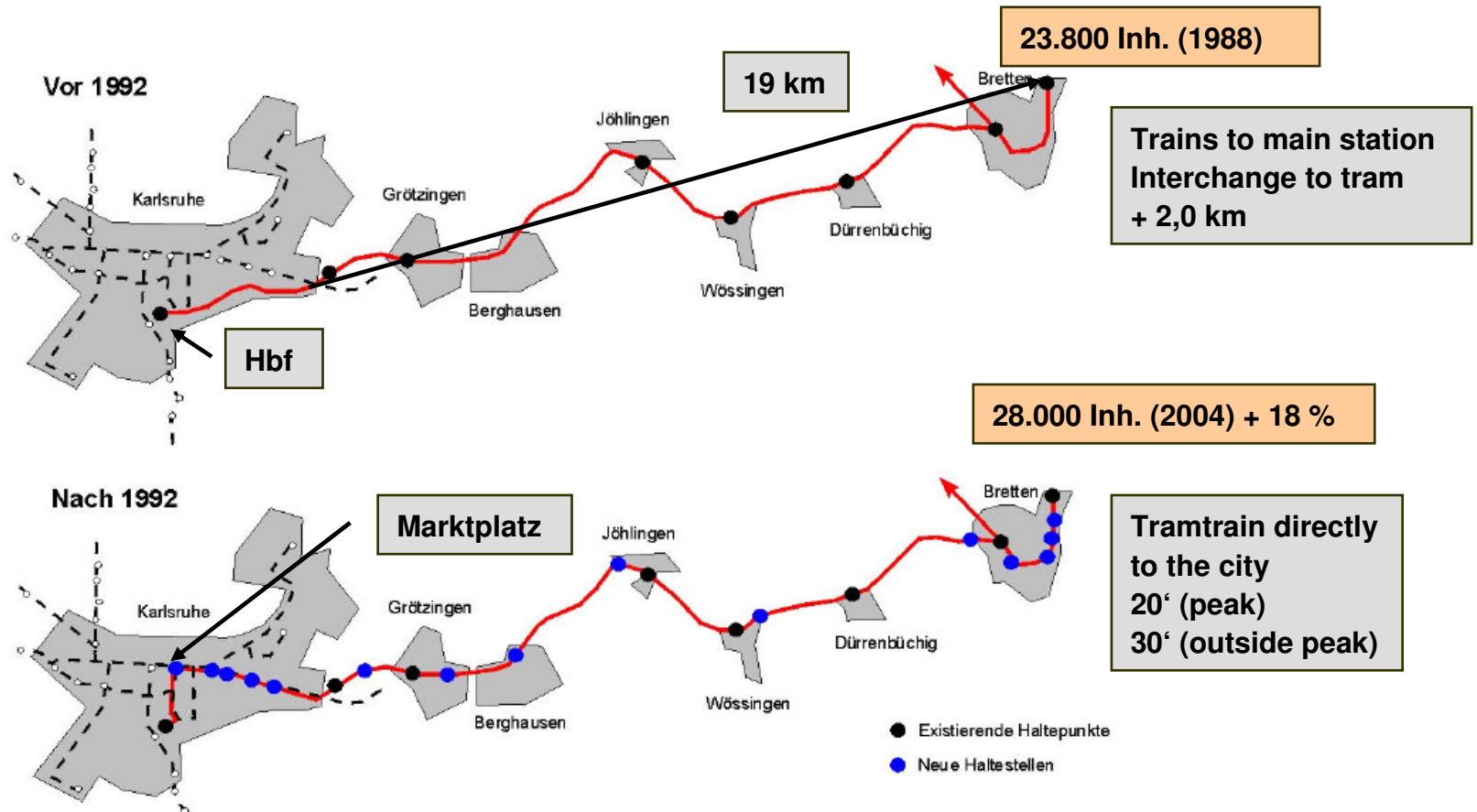


Why Karlsruhe started tramtrain?

- > Individual initiative
- > Vision
- > Transportation needs
- > The Bretten story will explain it all....



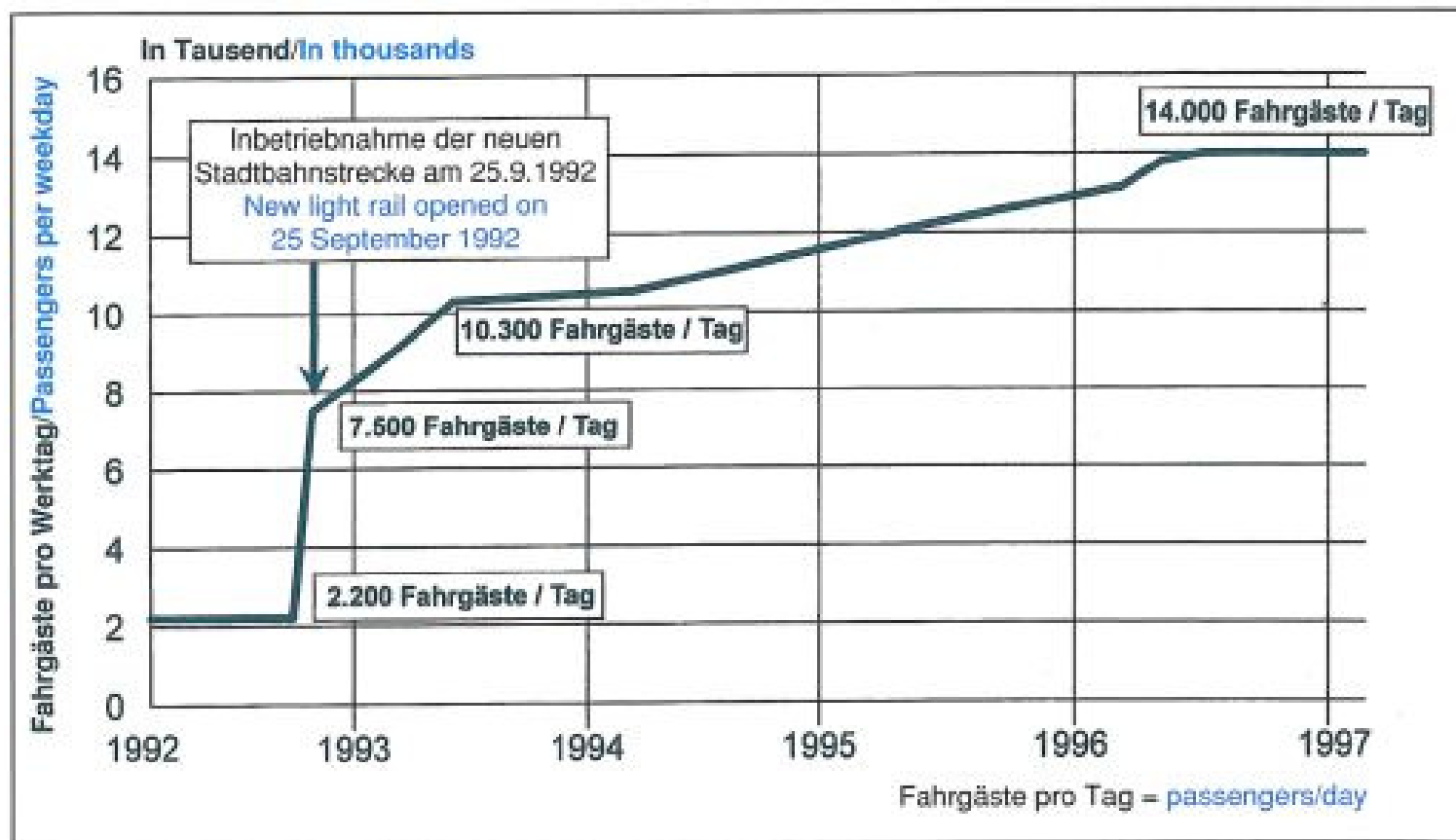
Why Karlsruhe started tramtrain, the Bretten story...



Interchange-free and regular connections until late at night with additional stops are the pre-condition to motivate car-users to change to PT

Benefit: Passenger acceptance Bretten before-after

Passengers between Karlsruhe and Bretten



Operations

Long hours of operation

> 05:00 - 01:00 / 02:00

Continuous, scheduled operation

> Fixed intervals, same recurring minutes

Interconnected timetables (bus ↔ rail)

> Buses as feeder services

Comfortable Vehicles

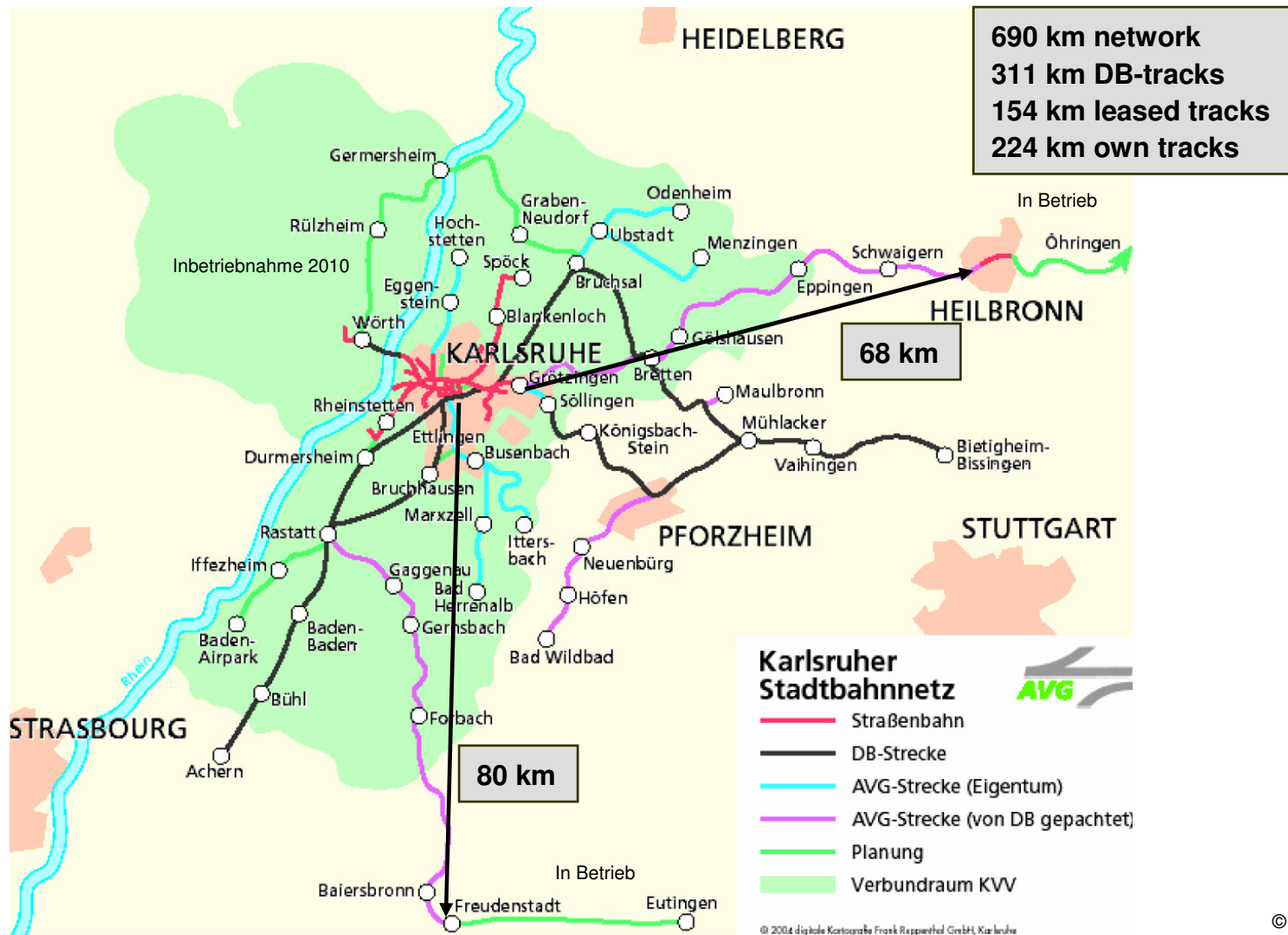
- > A/C
- > Bistro
- > panorama windows

Legally a tram in the city and a train in the region

→ passengers don't care!

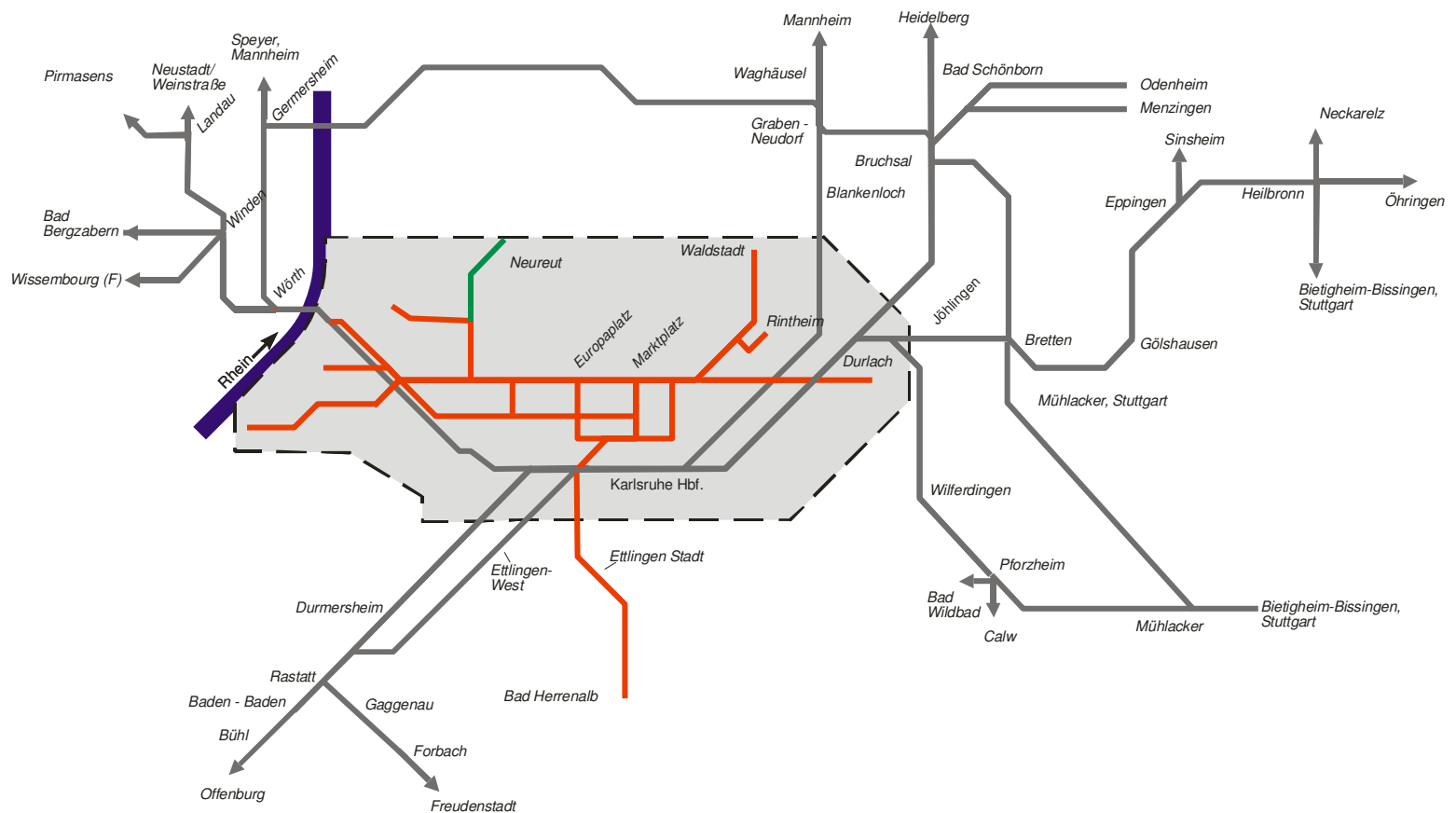


The network



Development of the Tram and Tram-train network in Karlsruhe

Network layout 1970



Network layout 1979



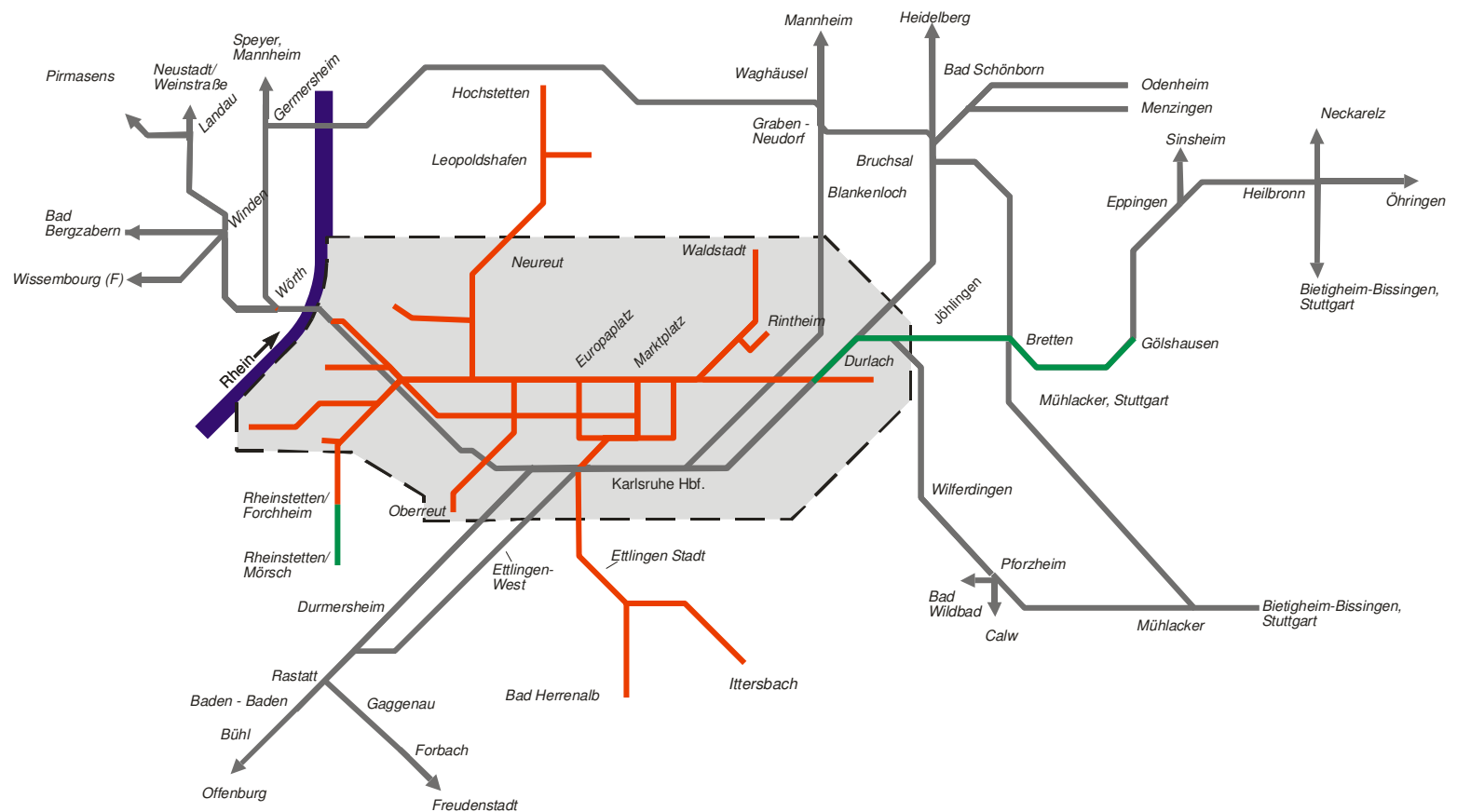
Development of the Tram and Tram-train network in Karlsruhe

Network layout 1989

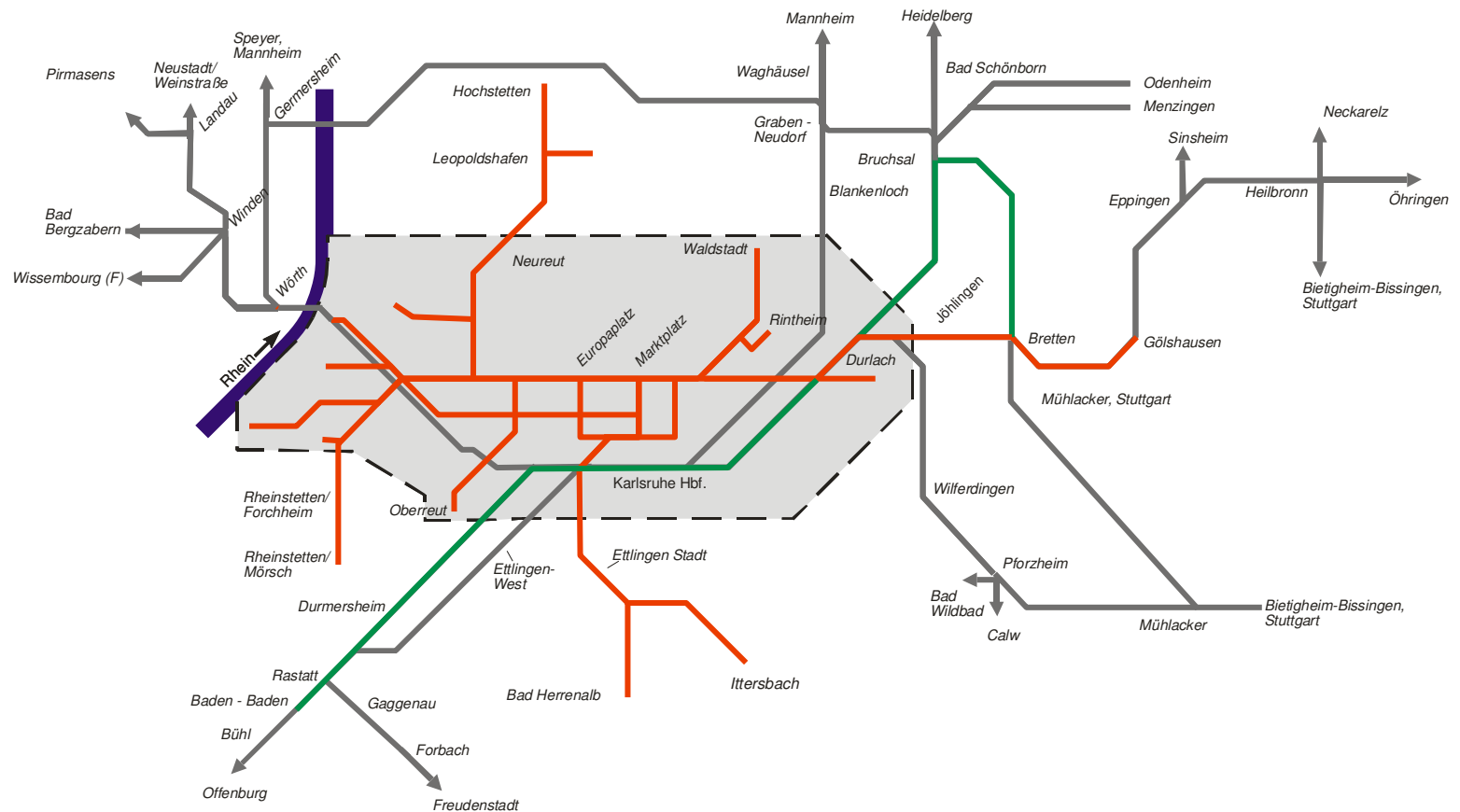


Development of the Tram and Tram-train network in Karlsruhe

Network layout 1992

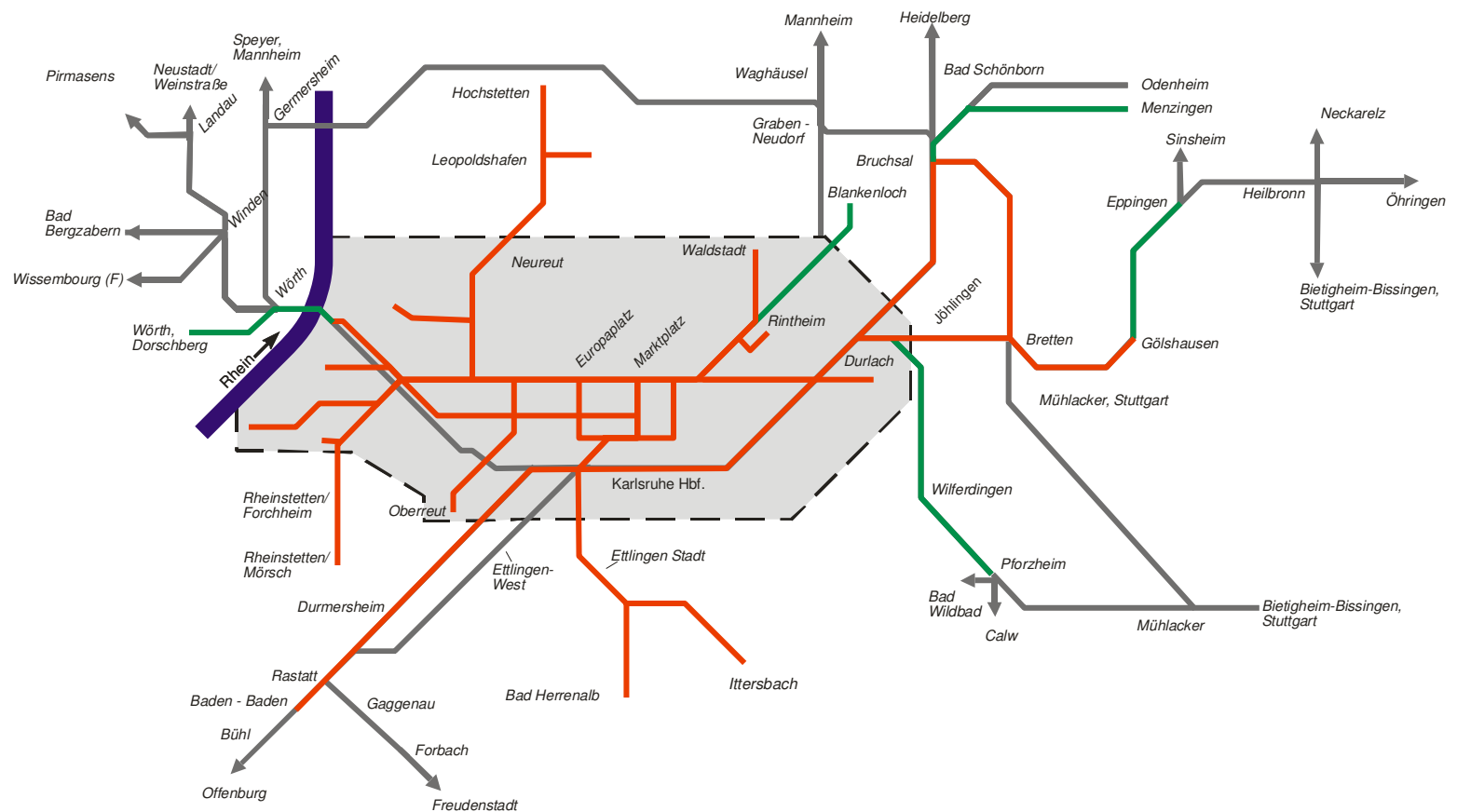


Network layout 1994

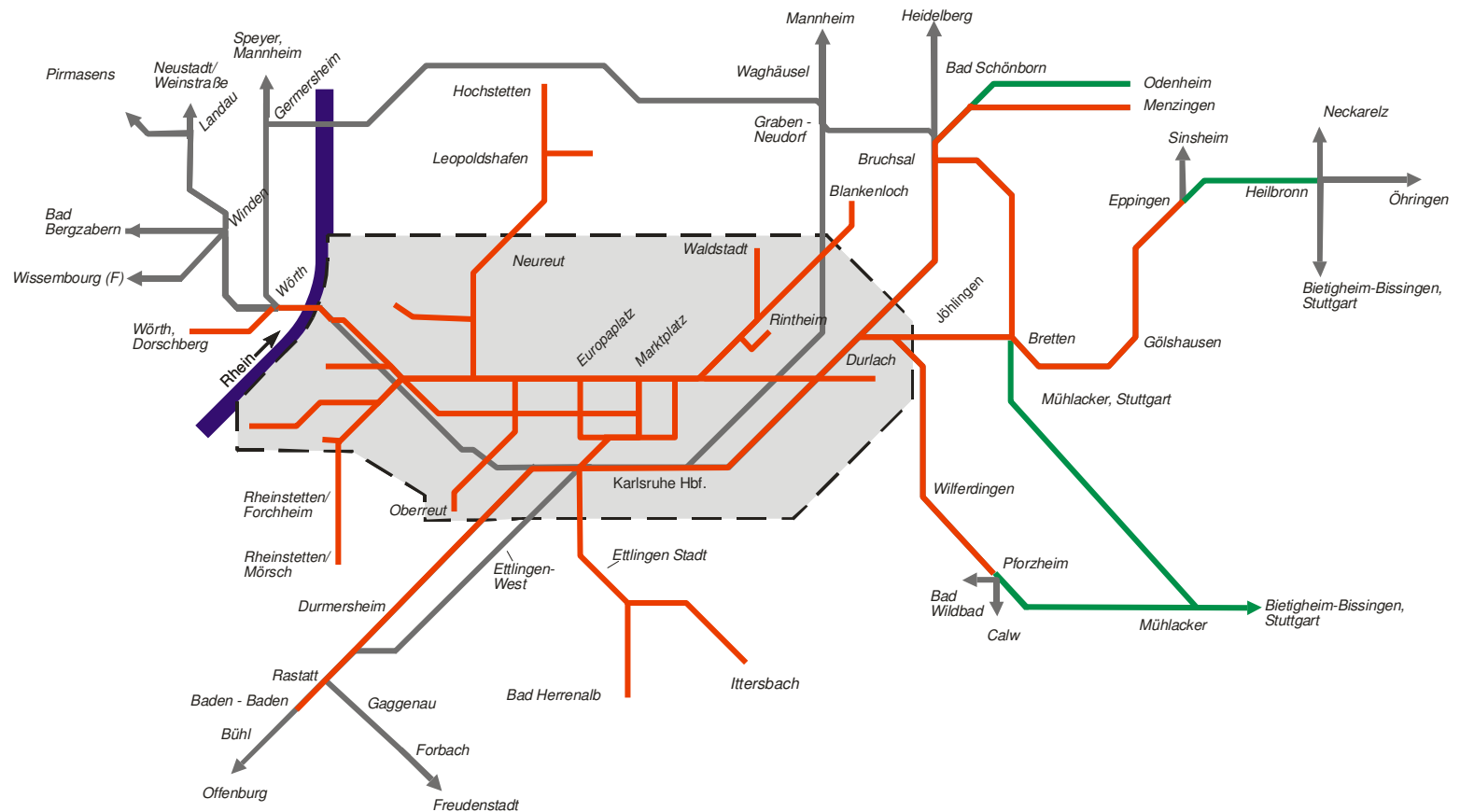


Development of the Tram and Tram-train network in Karlsruhe

Network layout 1997

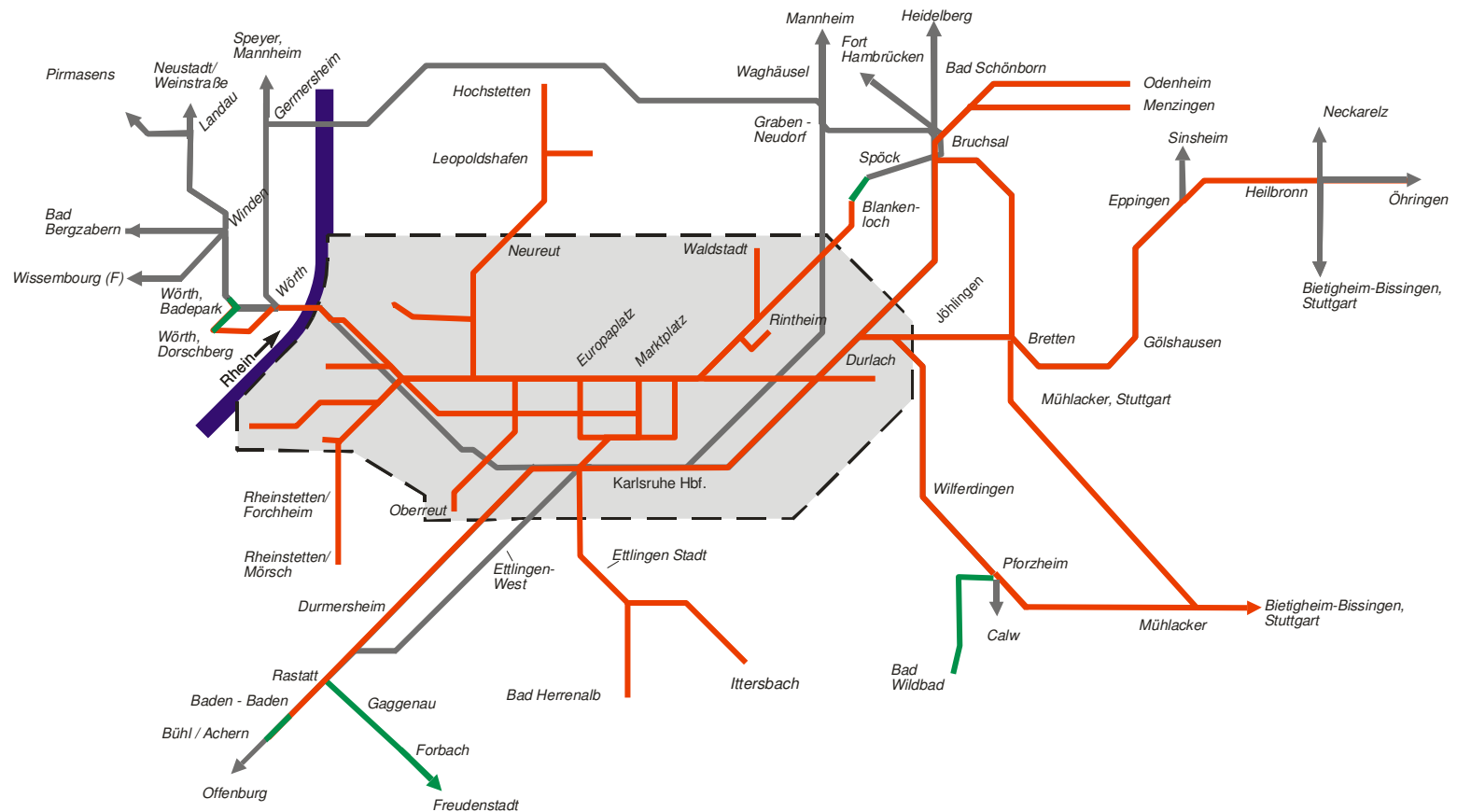


Network layout 2000



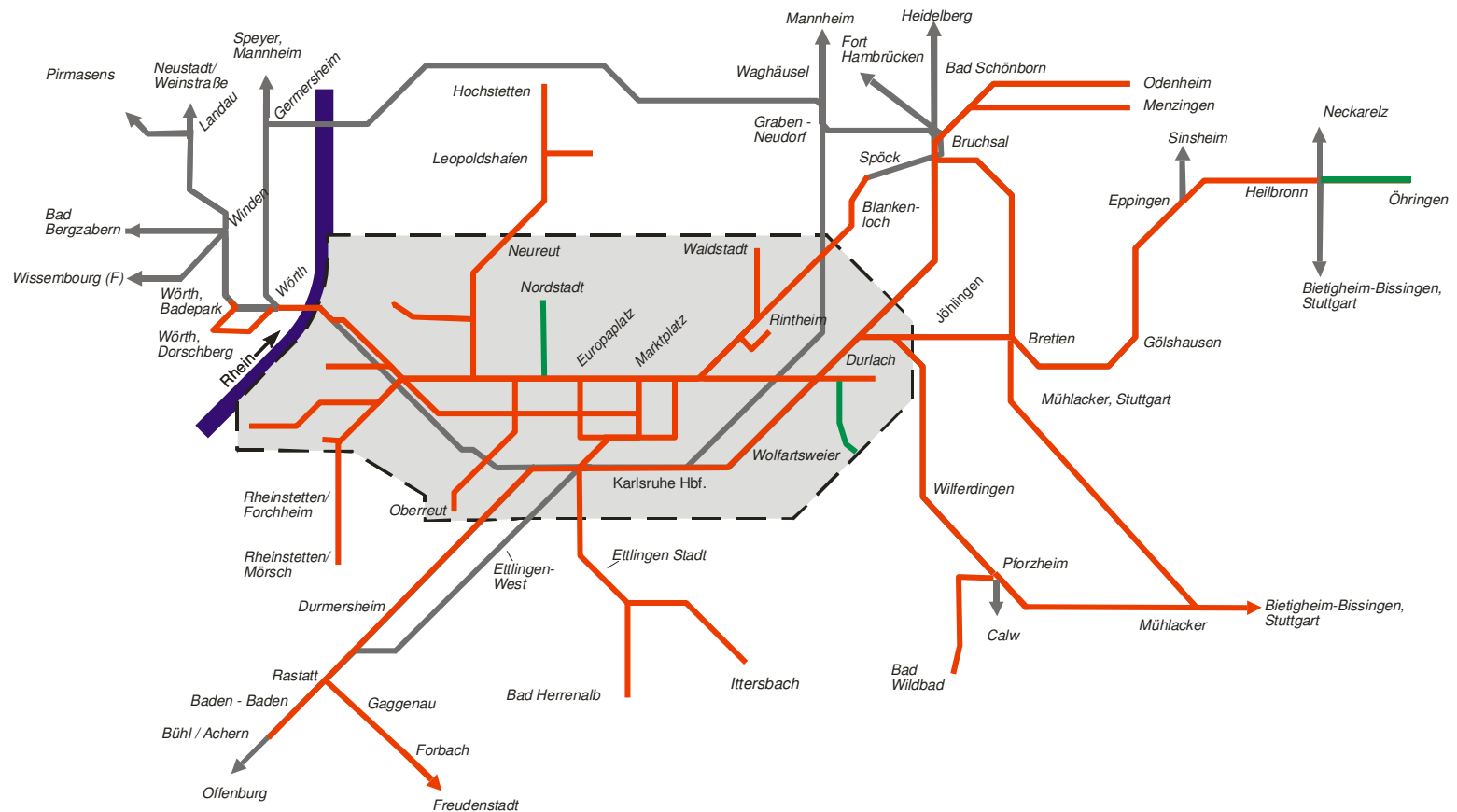
Development of the Tram and Tram-train network in Karlsruhe

Network layout 2004



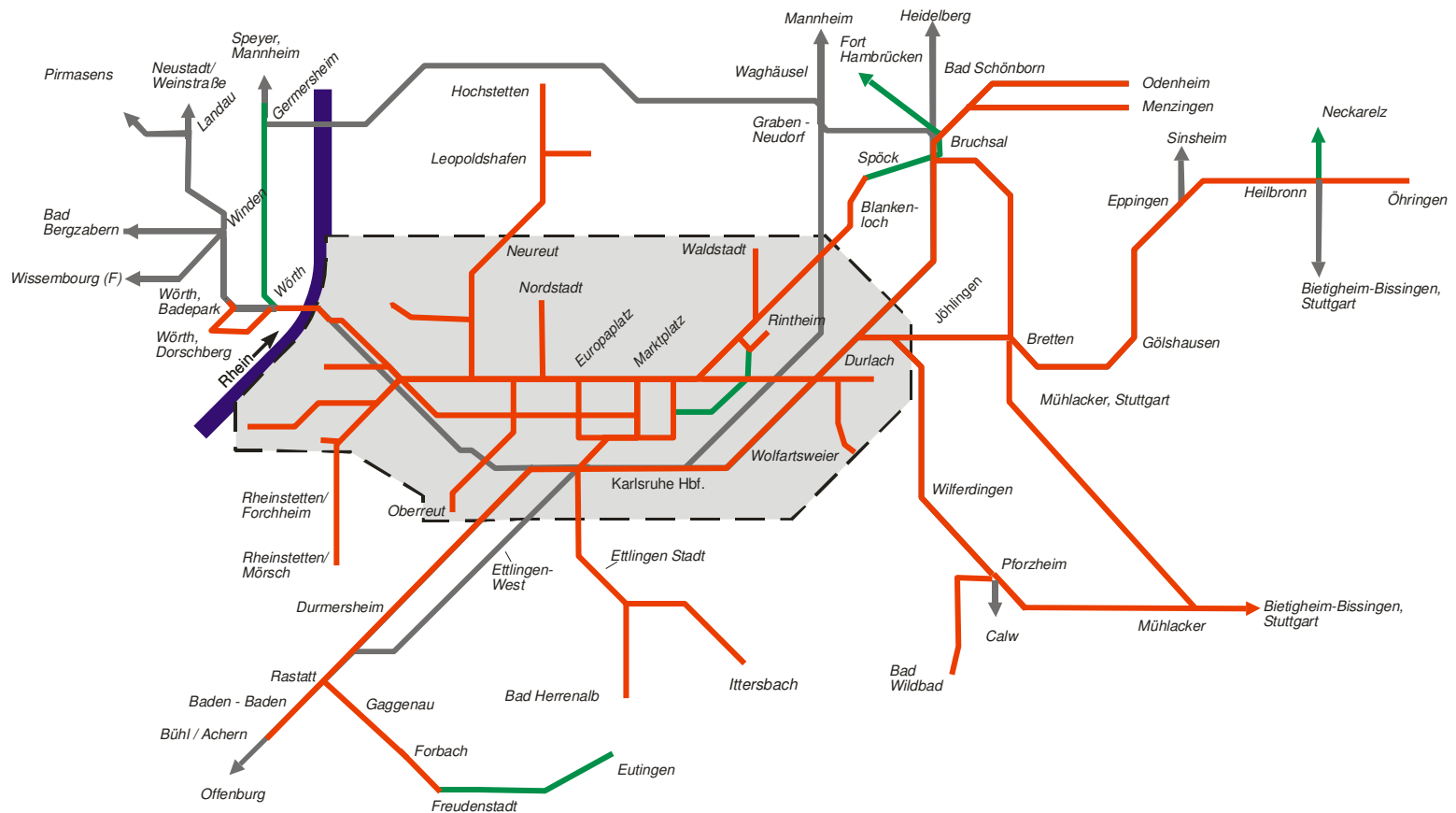
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Network layout 2006

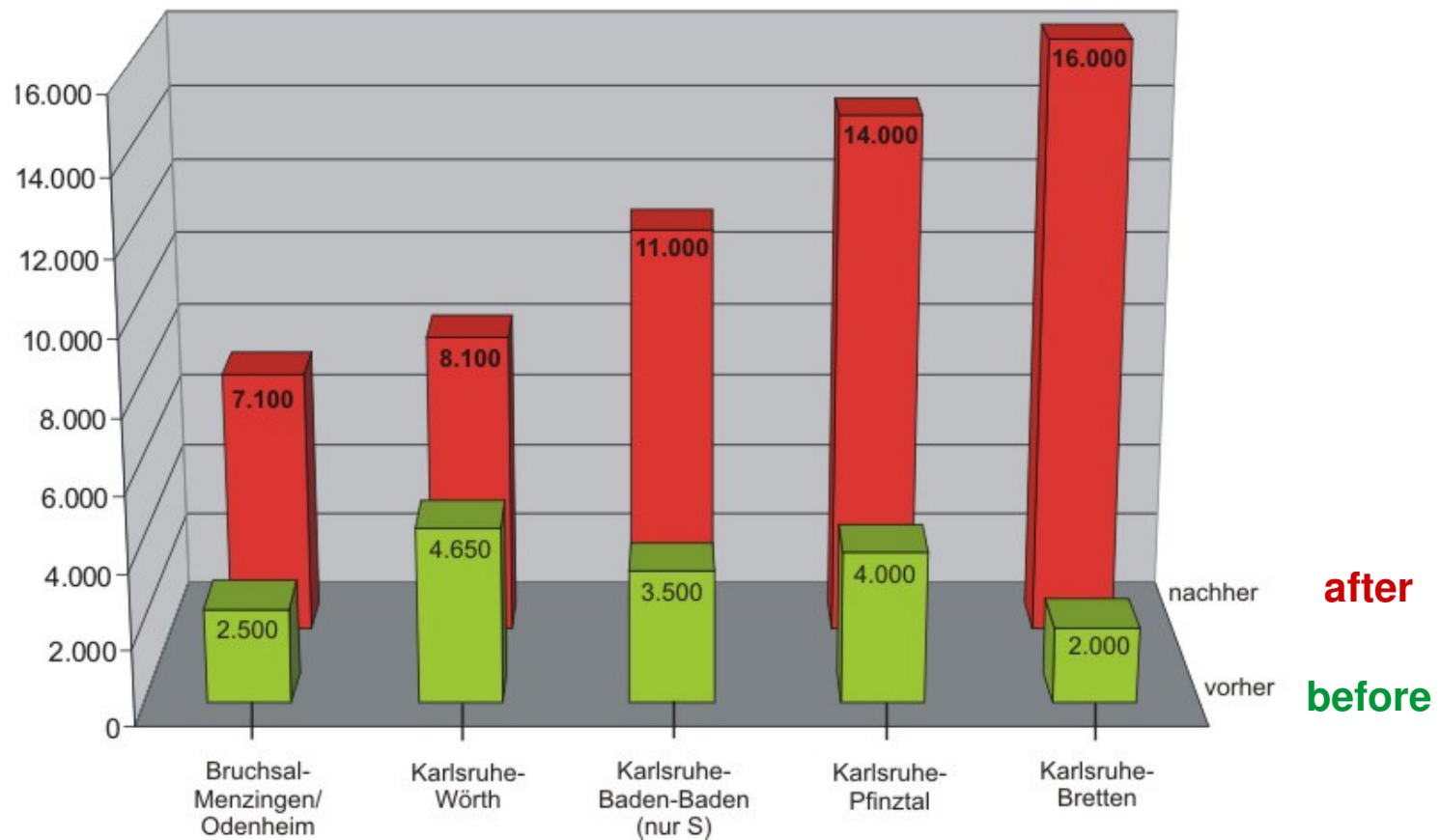


Development of the Tram and Tram-train network in Karlsruhe

Network layout 2013



Commercial success



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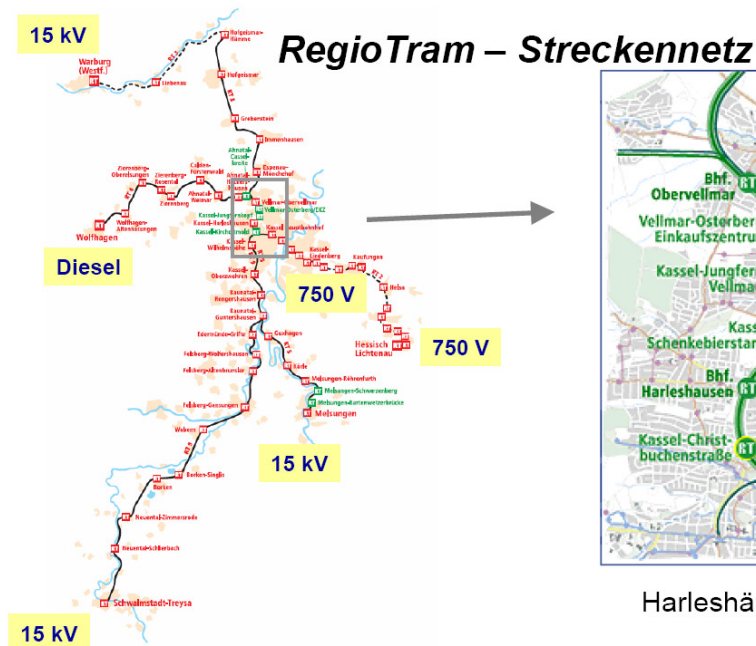
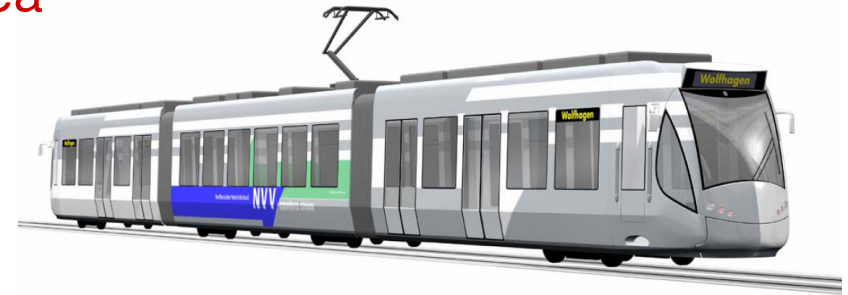
Tramtrain in Europe



- > German development becomes more and more difficult
- > France is a dynamic market under the SNCF/Alstom umbrella
- > CAF and Vossloh supplied vehicles for the first (smaller) Spanish tramtrain projects
- > UK tramtrain trial is progressing

Tramtrain in the greater Kassel area

- > Opening in 2006
- > 4 lines
- > Based on an existing tram network
- > Innovation: Diesel-electric vehicle

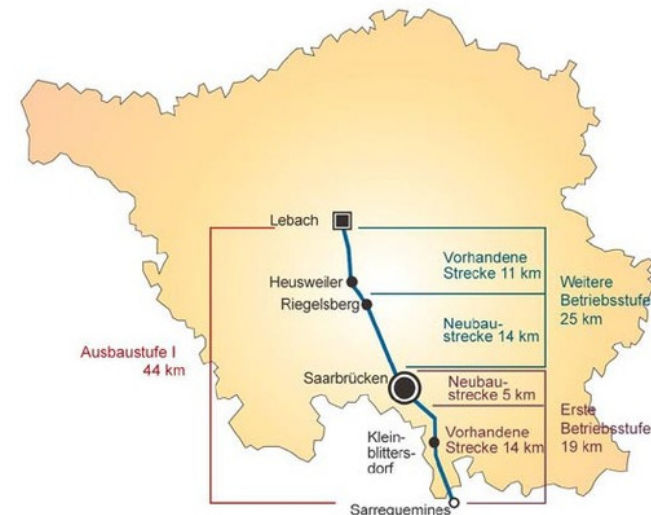


Tramtrain in the greater Saarbrücken area

- > Opening 1997
- > Innovation: First tramtrain low floor vehicles
- > 28 vehicles, which were not used for a longer time
- > Several delays during the construction: The whole project will come into service 201x !!!!
- > Tramtrain operation to France, Saarguemines station



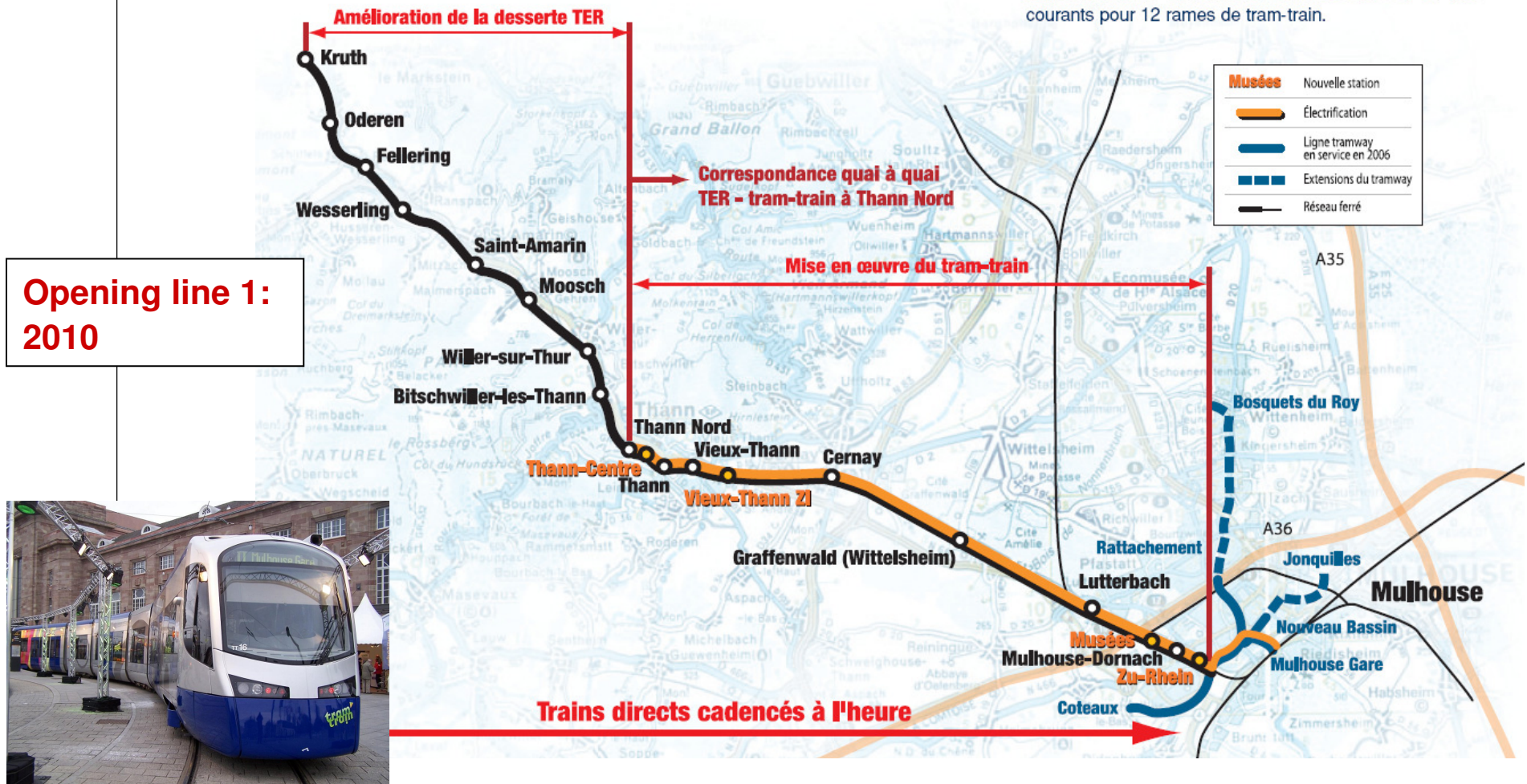
Betriebsstufen der
Ausbaustufe I



Tram-train technologies: concepts and comparisons

Tramtrain in Europe – Mulhouse Real tramtrain – dual voltage – tracksharing with heavy rail

La carte de la première phase



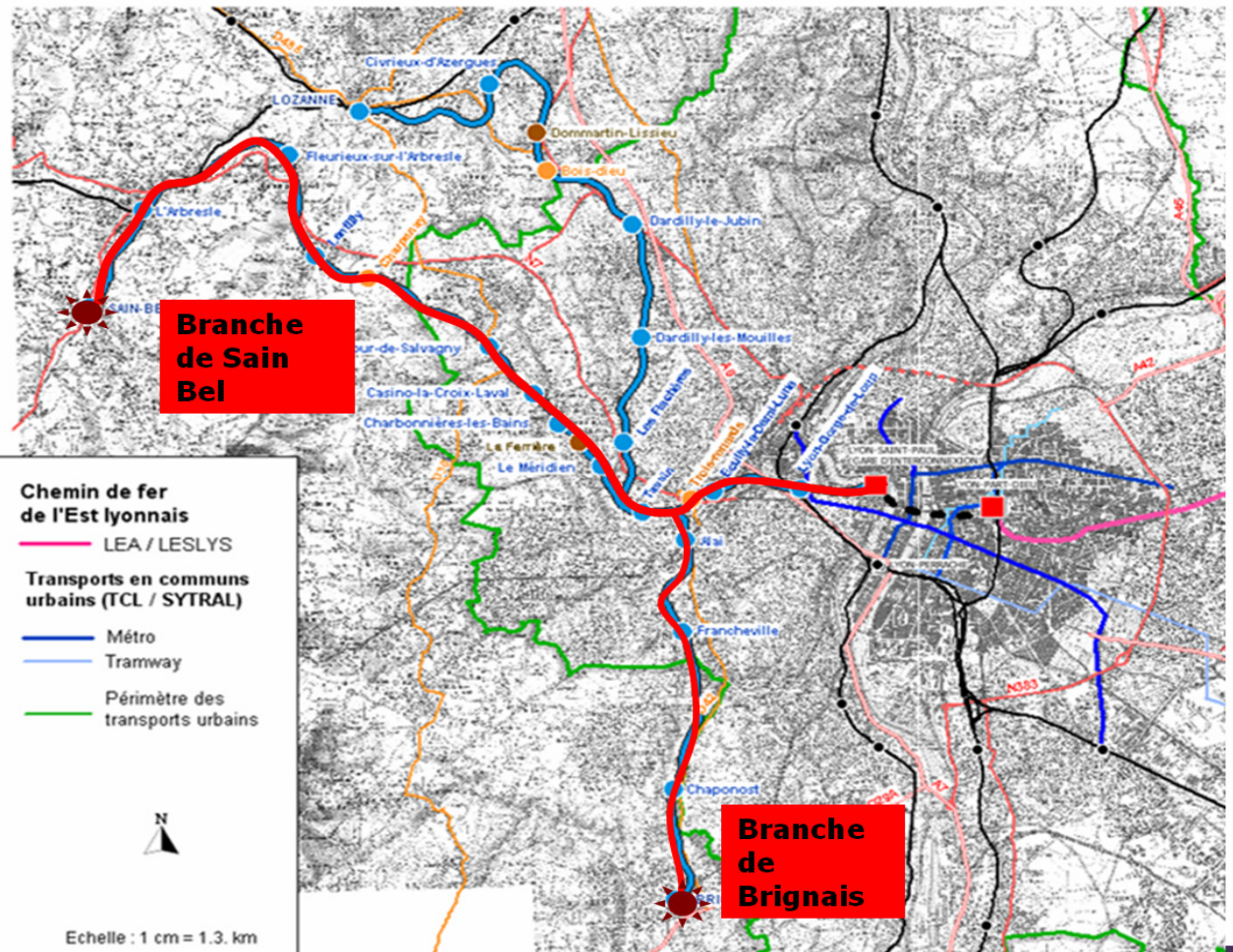
Tram-train technologies: concepts and comparisons

Tramtrain in Europe – Lyon West

“semi-tramtrain” - Operation only on heavy rail tracks under 25 kV –
no service in the tram network – TER replacement

Projet périurbain
de l'Ouest lyonnais

**Planned opening:
2011**



Tramtrain in Europe – Lyon Leslys (Airport link)

“Tram rapide” – not really tramtrain – 750 V only, 100 km/h – no heavy rail track sharing



**In service
since 2010**



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How can tram-train provide a cost effective solution?

- > Tramtrain in itself is not cheap!
- > Tramtrain should be based on an existing tram system
- > Use “underperforming” regional railway infrastructure
- > Need a certain density of population
- > Can not simply replace heavy rail services
- > Should not be overloaded with high track access fees (railway side)



Infrastructure Cost Savings: Short Platform



General Rule:
Platform length = vehicle length
For double units, a length of 80 m is required



At (very) low demand stops, the solution was a 20 m “short” platform
> 60% cost savings

Infrastructure Cost Savings: Passenger Access



**Rule on DB tracks:
No level crossings, but step free
access**

> Ramp length at least 80m



**Solution: level crossings, secured by
signals if necessary**

> Standard on AVG tracks

Vehicles and cost...

Karlsruhe: 30 (+30 options) new vehicles ordered from Bombardier (fulfilling all new norms) will come in 2012

- > Price per vehicle is about 4.3 million €
- > Acceptable in comparison to many other tramtrain projects

Alstom Dualis: Large SNCF order (approx. 200 units)

- > Price for the Nantes vehicle is about 3.5 million €
- > Large fleet sizes reduce the investment

Other examples

- > Léon: 6.18 million €/vehicle
- > Brunswick (Project cancelled): 7.1 million €/vehicle
- > Alicante: 4.0 million €/vehicle

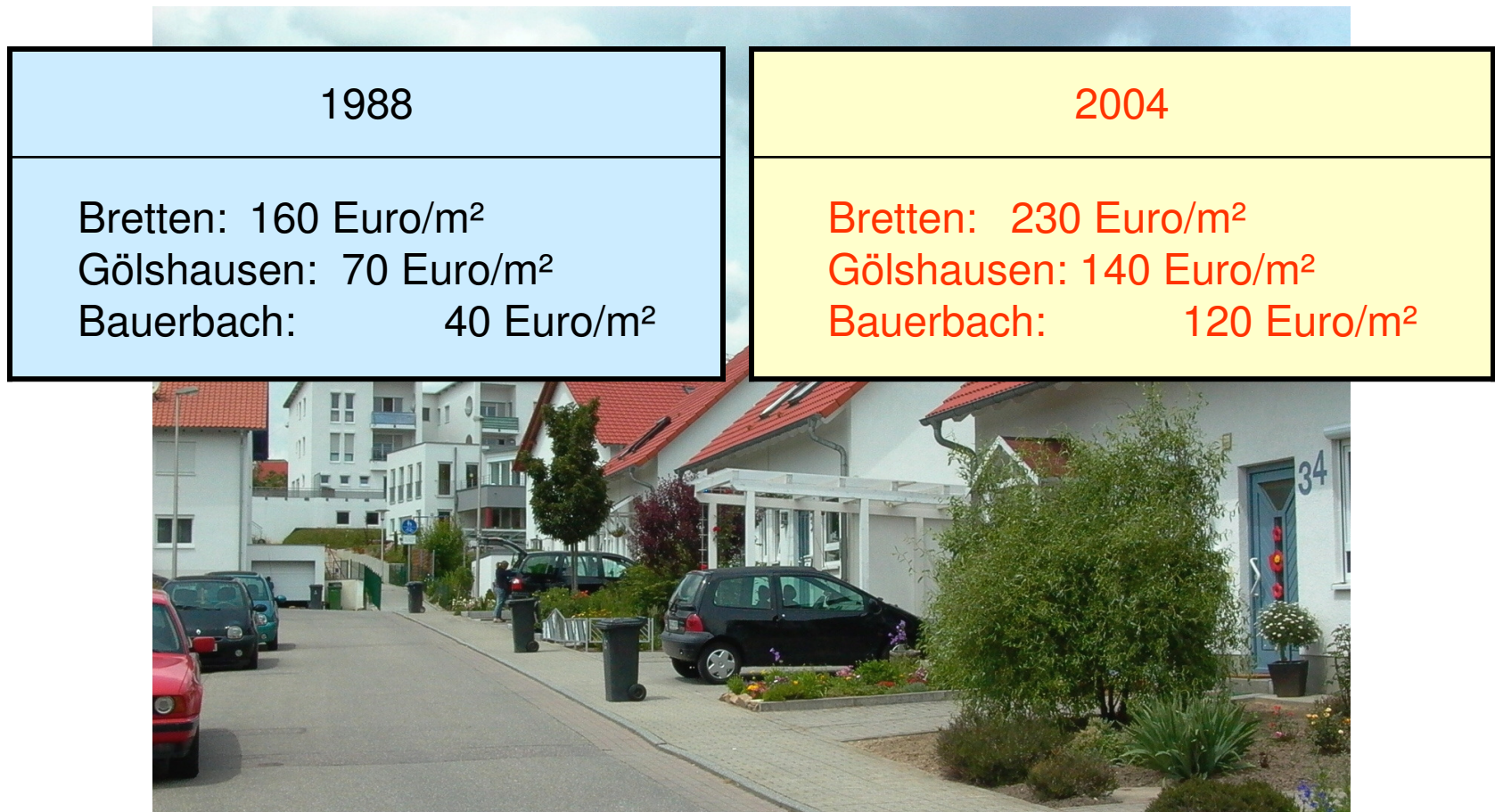


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Benefits - the Bretten example: Property market Bretten, land value



Inner City Line – Bad Wildbad



Inner City Line – Bad Wildbad



Inner City Line – Bad Wildbad



Murgtal - before



Murgtal - after





Thank you

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