

DAIMLER

Sustainability along the whole line:

Electric drive buses, Bus Rapid Transit systems and autonomous driving

November 15th, 2017, Reykjavik

Thomas Tonger, Product planning and management Daimler Buses



OMNI*plus*

BUS*STORE*

Daimler Buses focusing on TCO optimized vehicles and on emission free driving for city bus application

Nearly Emission Free

**Benchmark TCO and fuel economy
Euro VI products**



- Continuous CO₂ optimization
- NGT drivetrain
- Compact Hybrid
- EcoSteering



Partly Emission Free

Only partly emission free
driving possible < 30km

- Full size plug-in hybrid



Emission Free

**Zero emission driving
for city traffic**



- E-Mobility Platform Citaro
- Battery and fuel cell electric

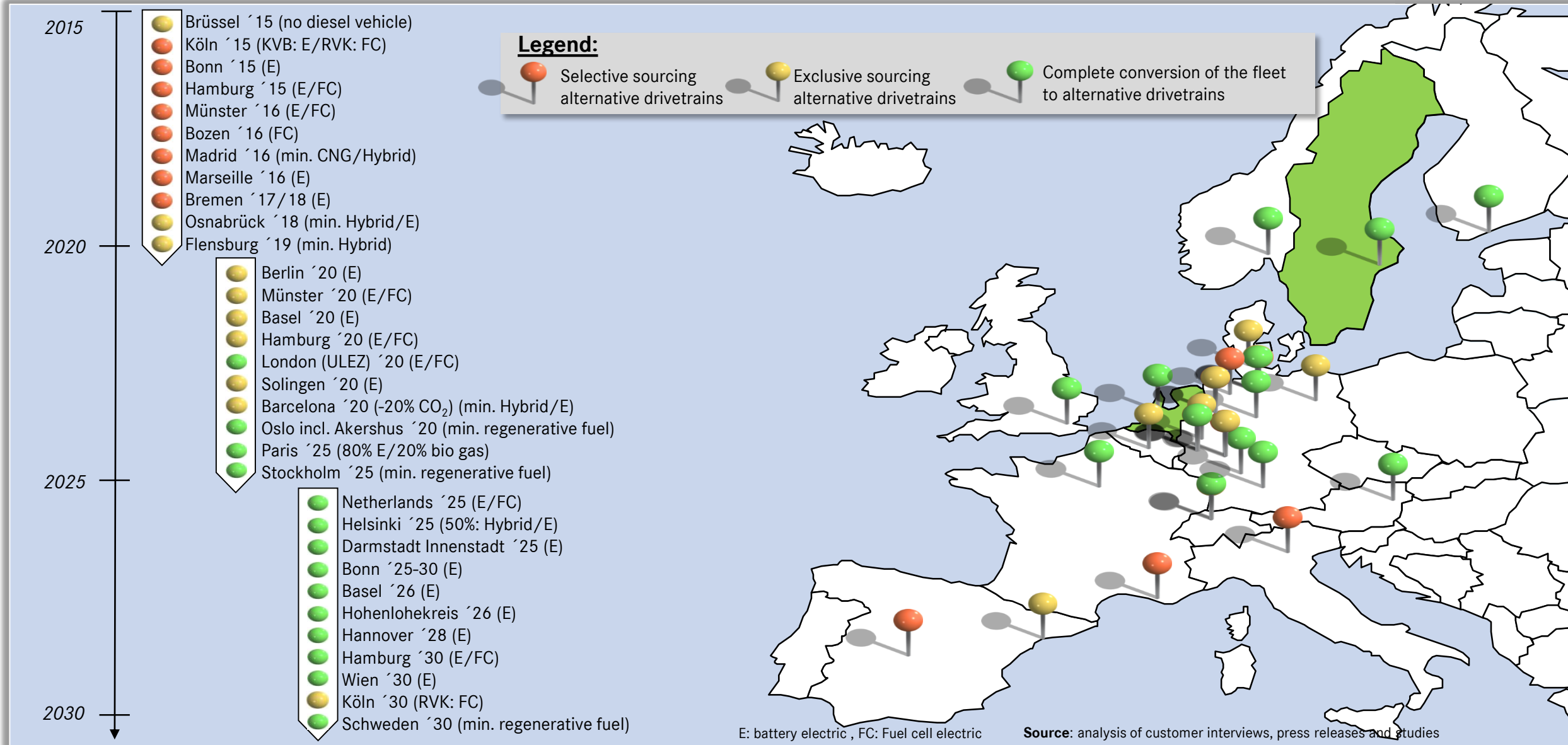


**In 2030, 70% of city buses sold in Western Europe
will have a zero emission drivetrain**



**Daimler Buses. Best Buses.
We provide the best mobility solutions.**

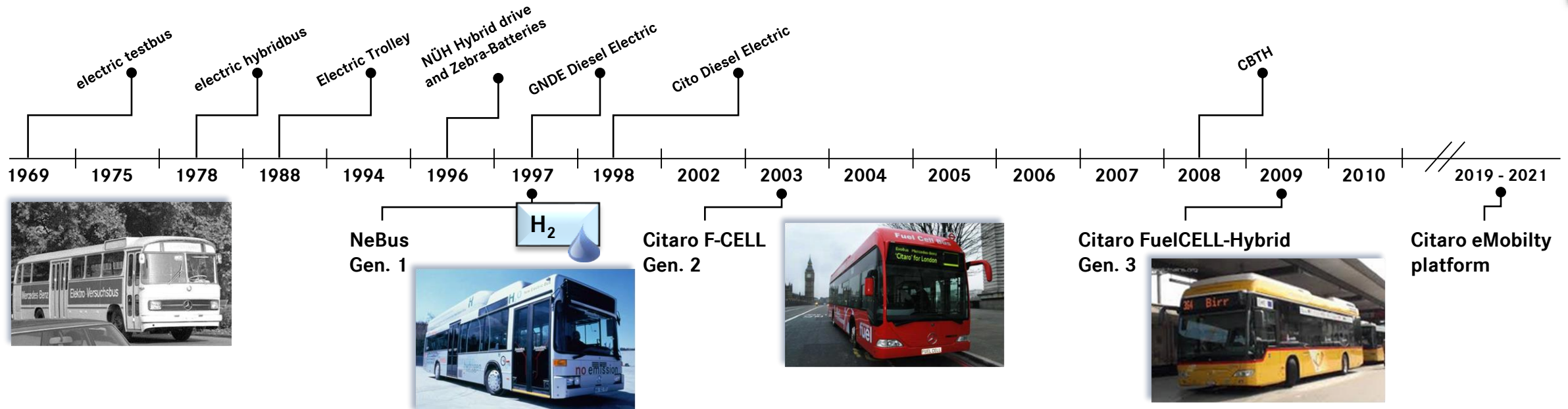
Concrete plans for alternative drivetrains in many European cities



Daimler Buses has been active in electro mobility for more than 40 years

Research and Product Engineering

ready for the market

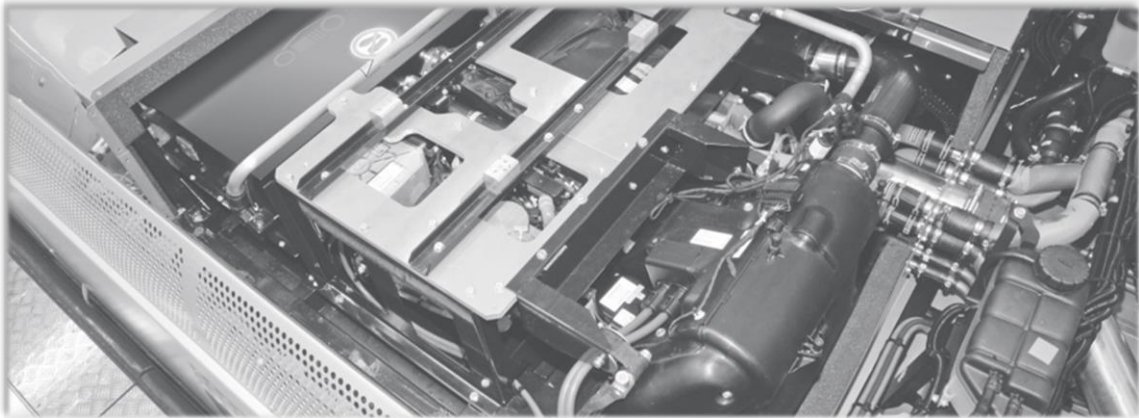
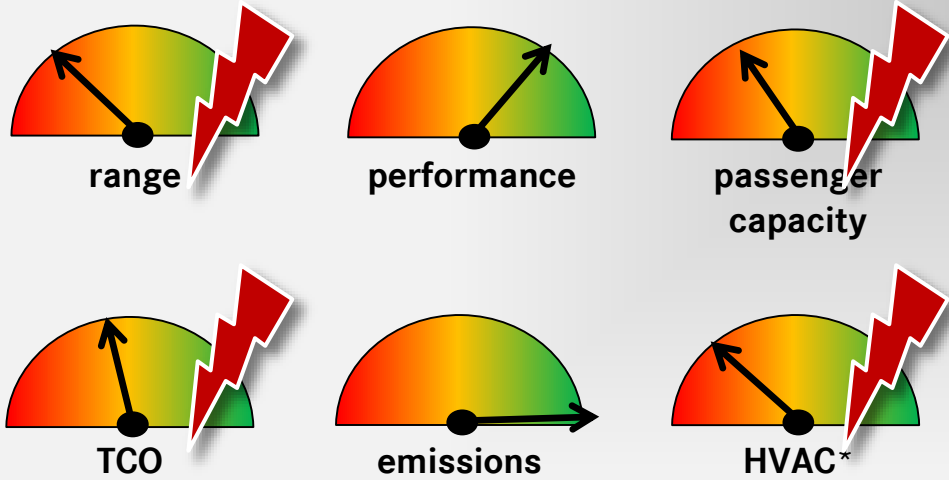


- O 520 Cito: 368 vehicles
- Citaro BlueTech®-Hybrid: 91 vehicles

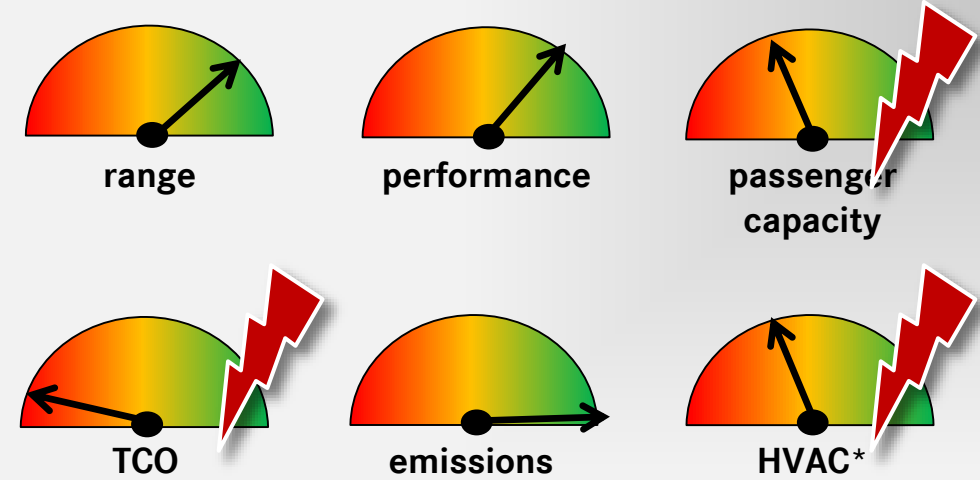
- Citaro F-CELL
36 vehicles, > 2.150.000 km
- Citaro FuelCELL-Hybrid
23 vehicles, > 1.600.000 km

As of today, no battery or fuel cell bus fulfills our demands for a series product

Battery bus

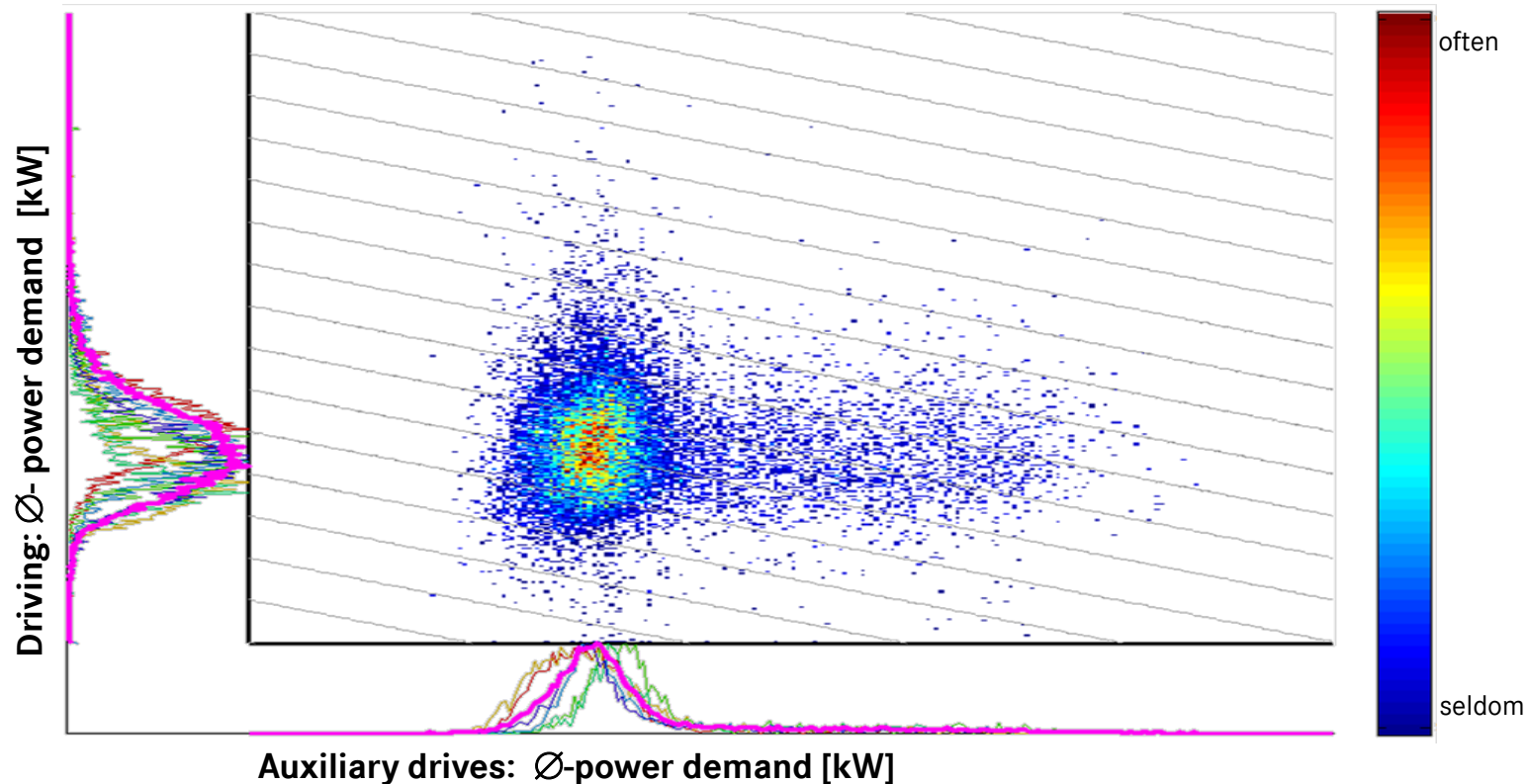


Fuel cell bus



In city bus operation the energy demand for auxiliaries is dominating

Bandwidth of power demand for traction and auxiliary drives based on more than 1million test fleet kilometers



source: evaluation of measured data, EvoBus 2009 - 2014

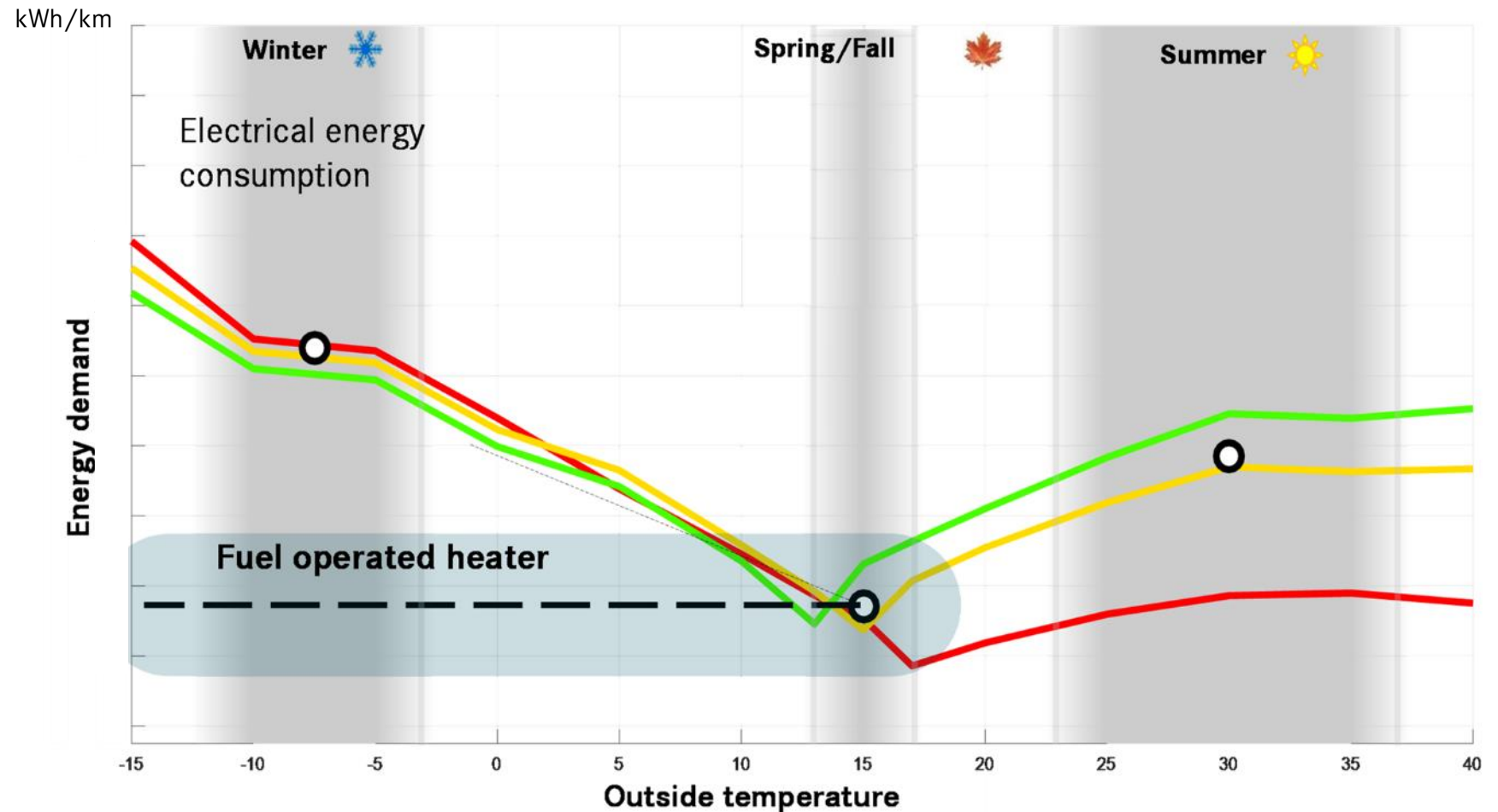
Demands for city bus operation

- More than 300 days per year in operation
- 16 hours in operation
- More than 200 km per day in city traffic
- Ca. 1000 braking and start-up procedures per day
- Air conditioning for 100 up to 200 passengers

Energy demand and range depend on operational scenarios (e.g. battery bus 12m)

Passenger load:

- Empty
- Average
- Maximum



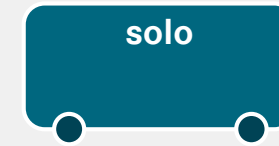
The battery electric Citaro is geared towards energy efficiency and modularity

Project status

- Concept vehicles and prototypes in trial
- Start of production end of 2018

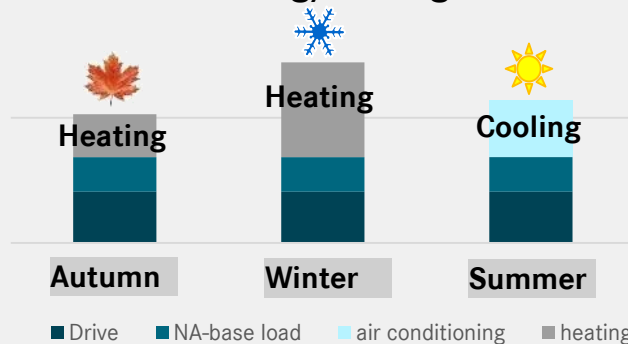


Vehicle portfolio



Aim: Energy efficiency

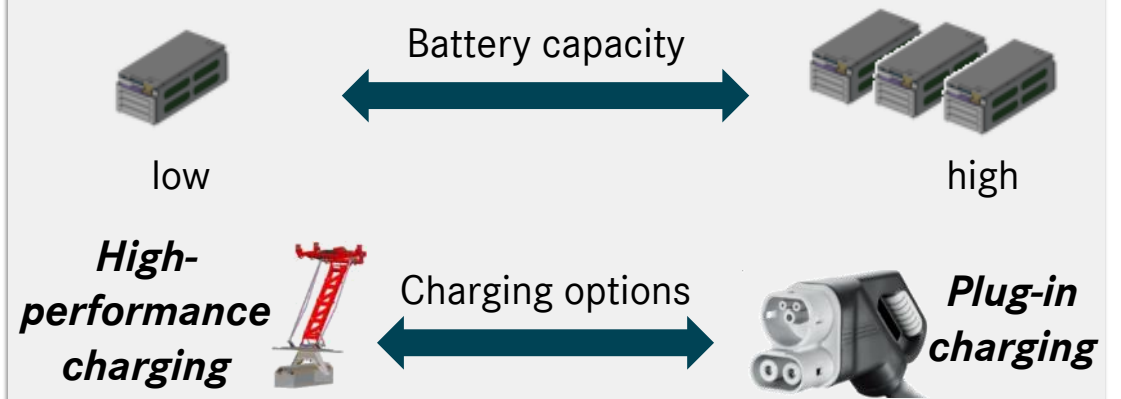
Energy consumption – Heating/cooling



- Thermal management
- Energy management

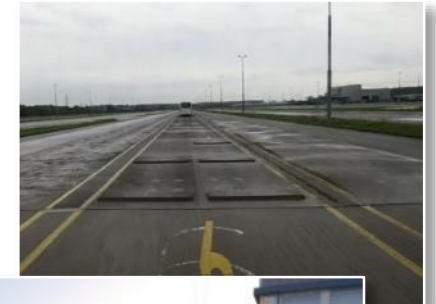
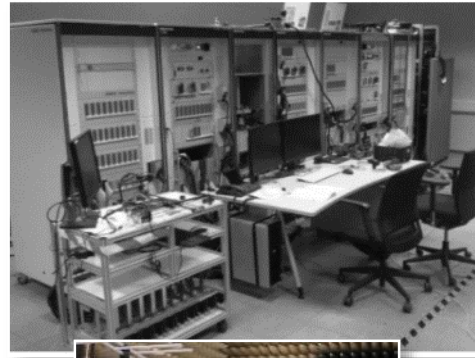
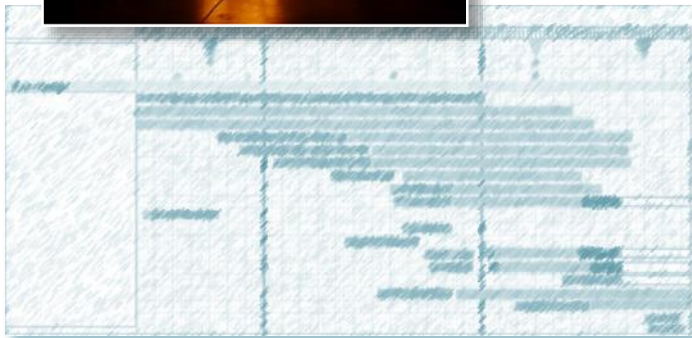
Maximum range

Aim: Modularity and flexibility



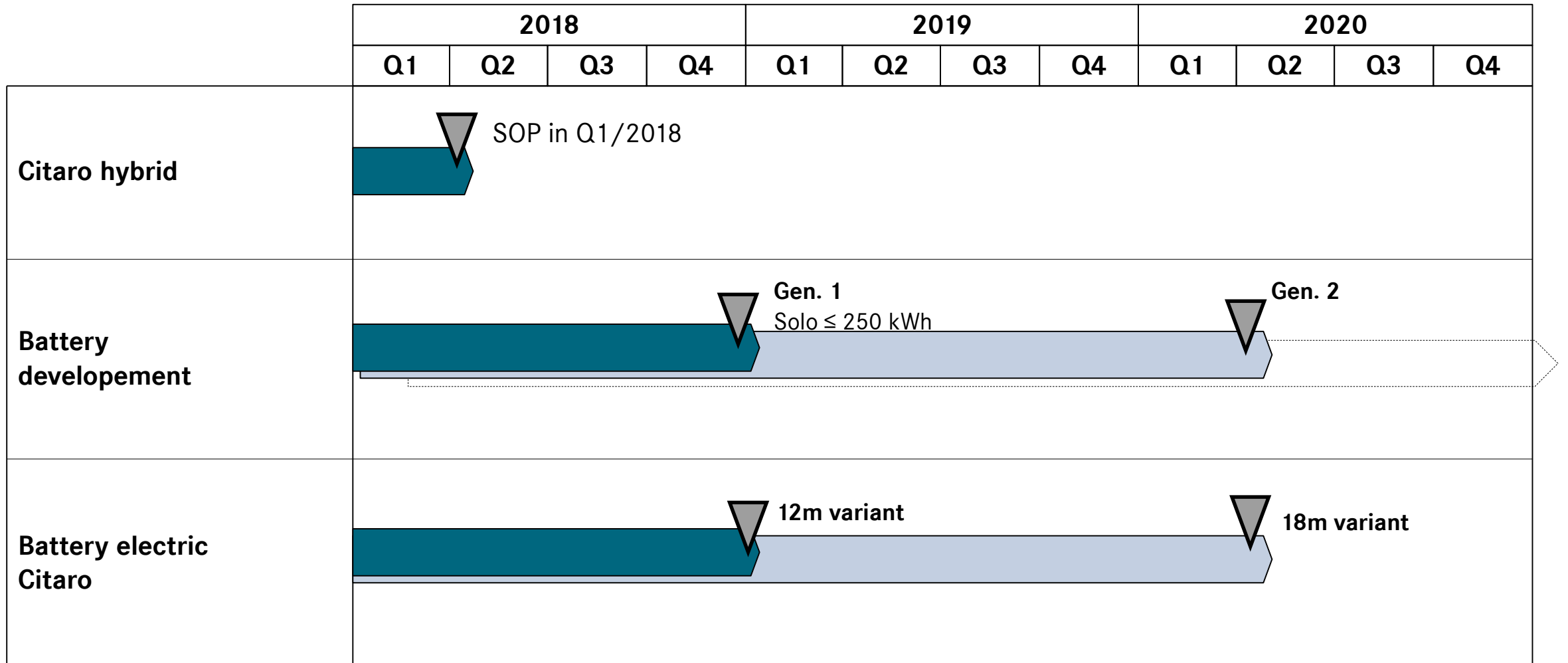
Challenge: Series maturity and Daimler quality in series quantities

The validation program is set up according to Daimler Buses standards

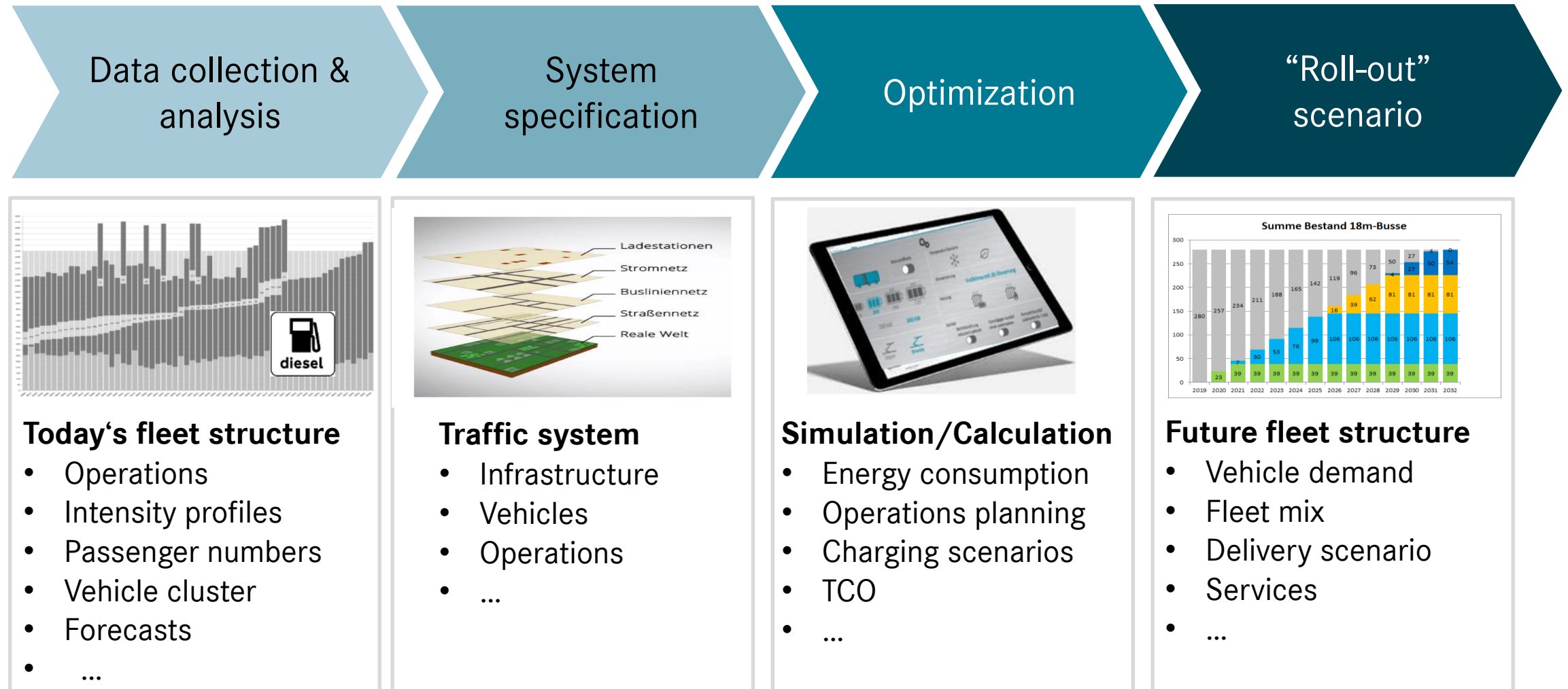


- Hardware in the Loop (HiL)
- Concept validation
- Summer test
- Winter test
- Functional test
- Endurance
- Durability
- Customer operation (KFE)

The battery electric Citaro will enter the market in Q4/2018



A comprehensive system consulting approach supports our customers to switch from diesel to an emission-free drive



Bus Rapid Transit – intelligent mobility in large cities



Passenger saves time:
Punctually and fast at their
destination



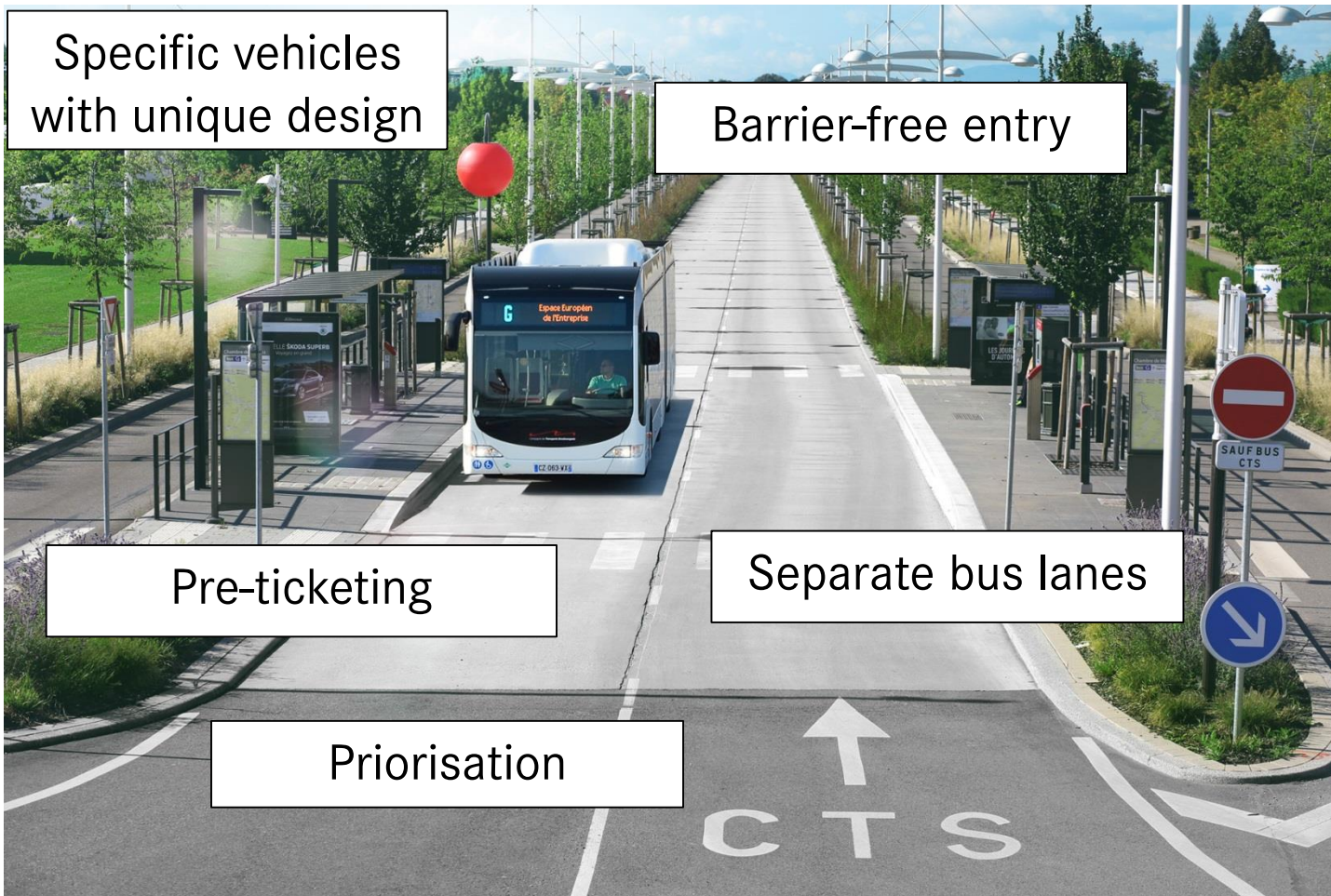
Investor saves money:
Quick and cost-efficient realization



City population profits:
Less traffic and less emissions



What are the features of a BRT system?



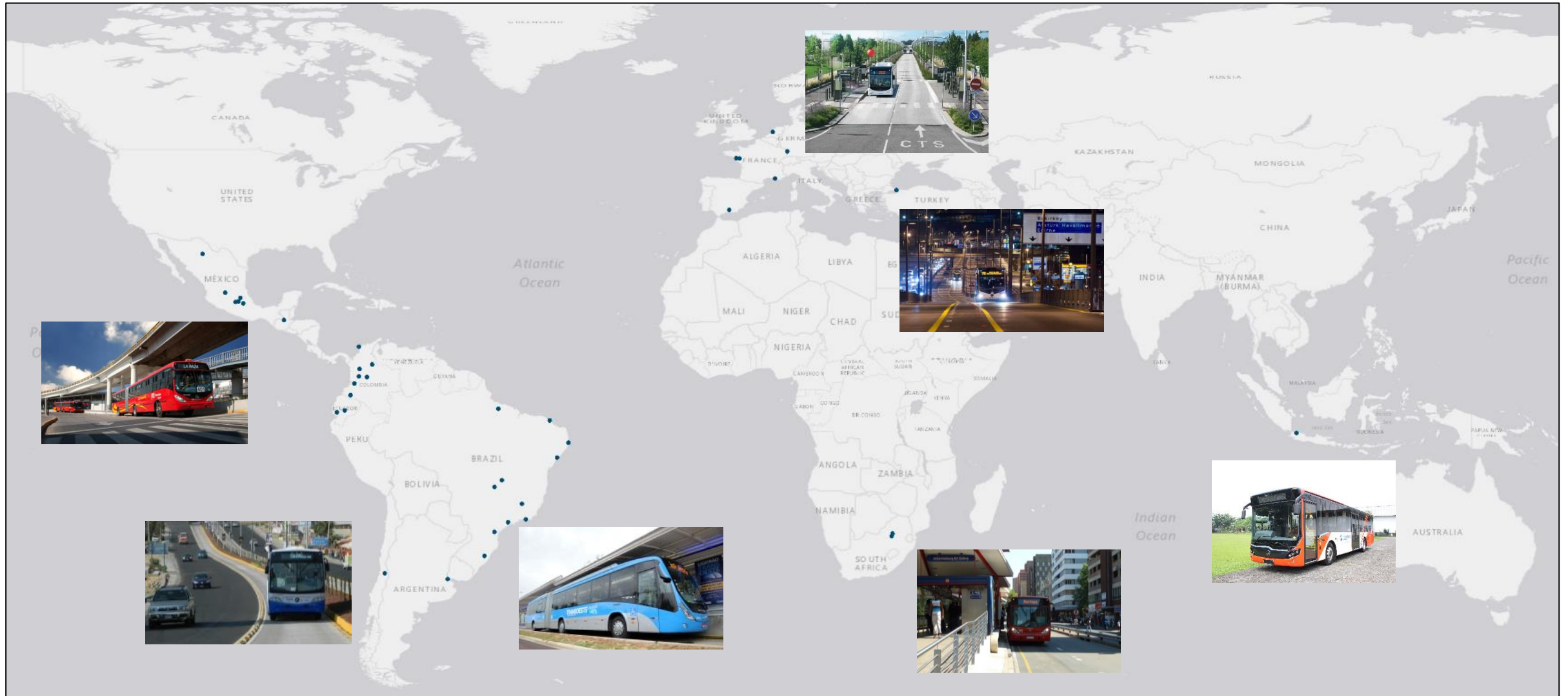
ADVANTAGES

- + Enhances security and safety
- + High flexibility
- + Reliability
- + Reduces travel time
- + Fuel savings
- + Low operating costs
- + CO₂ reduction
- + Environmental friendliness

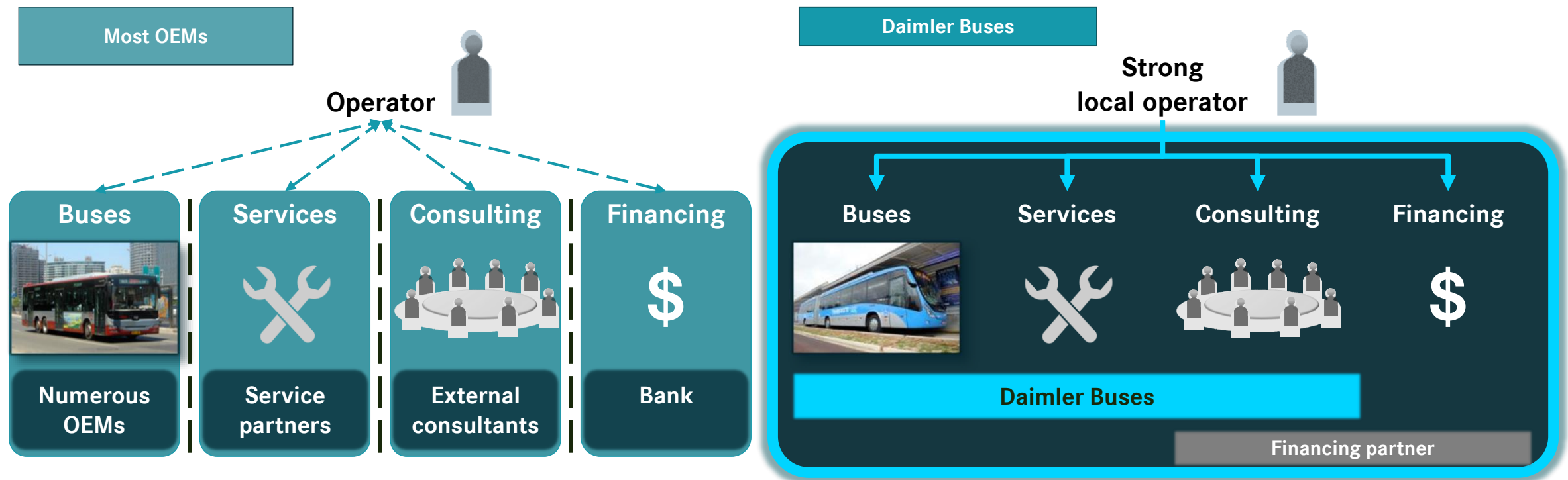
Bus Rapid Transit (BRT) is a high-quality bus-based transit system that delivers fast, comfortable and cost-effective urban mobility through the provision of segregated right-of-the-way infrastructure, rapid and frequent operations, and excellence in marketing and customer service.

(Source: ITDP (2007), Bus Rapid Transit – Planning Guide, 3rd edition, New York)

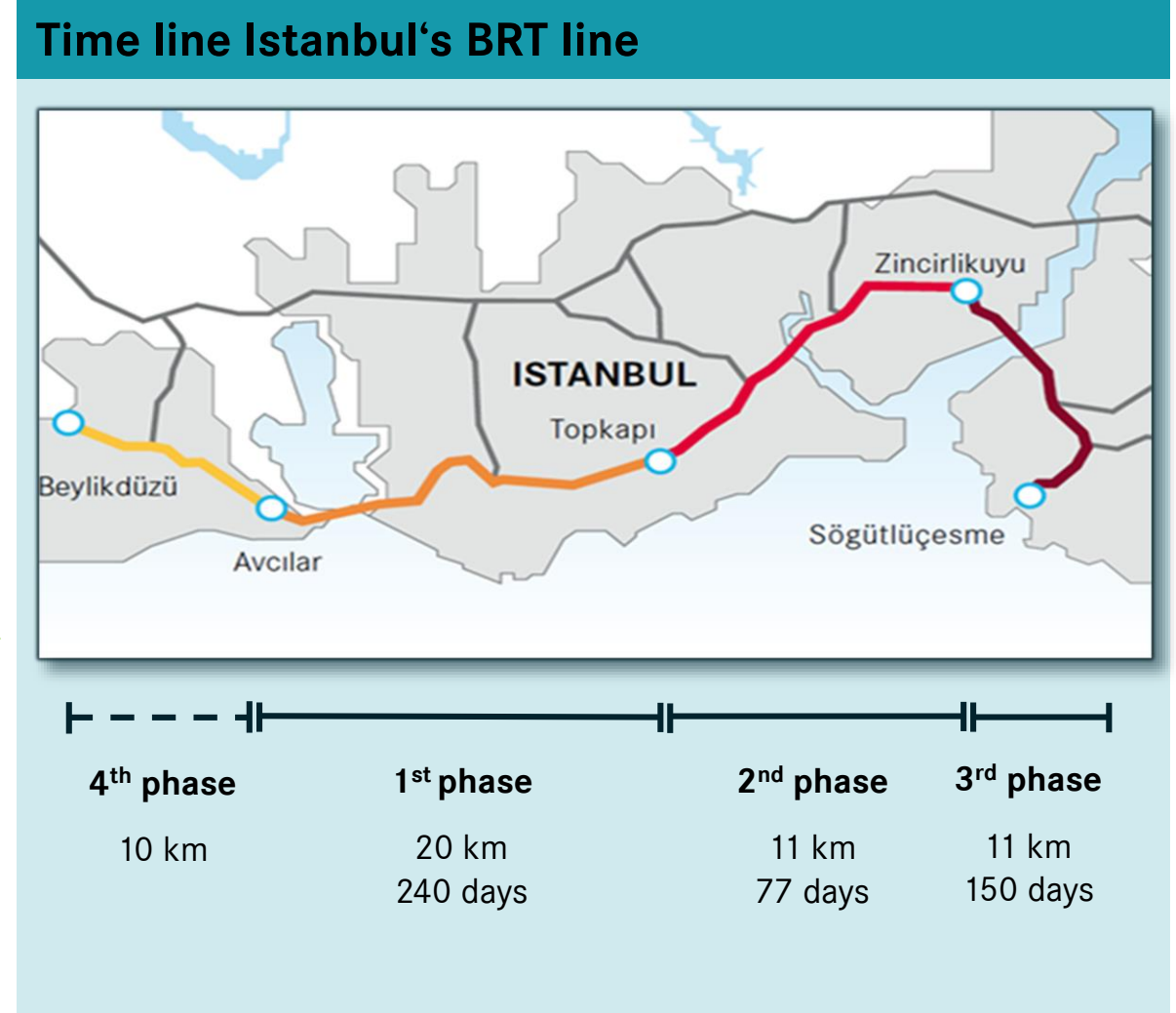
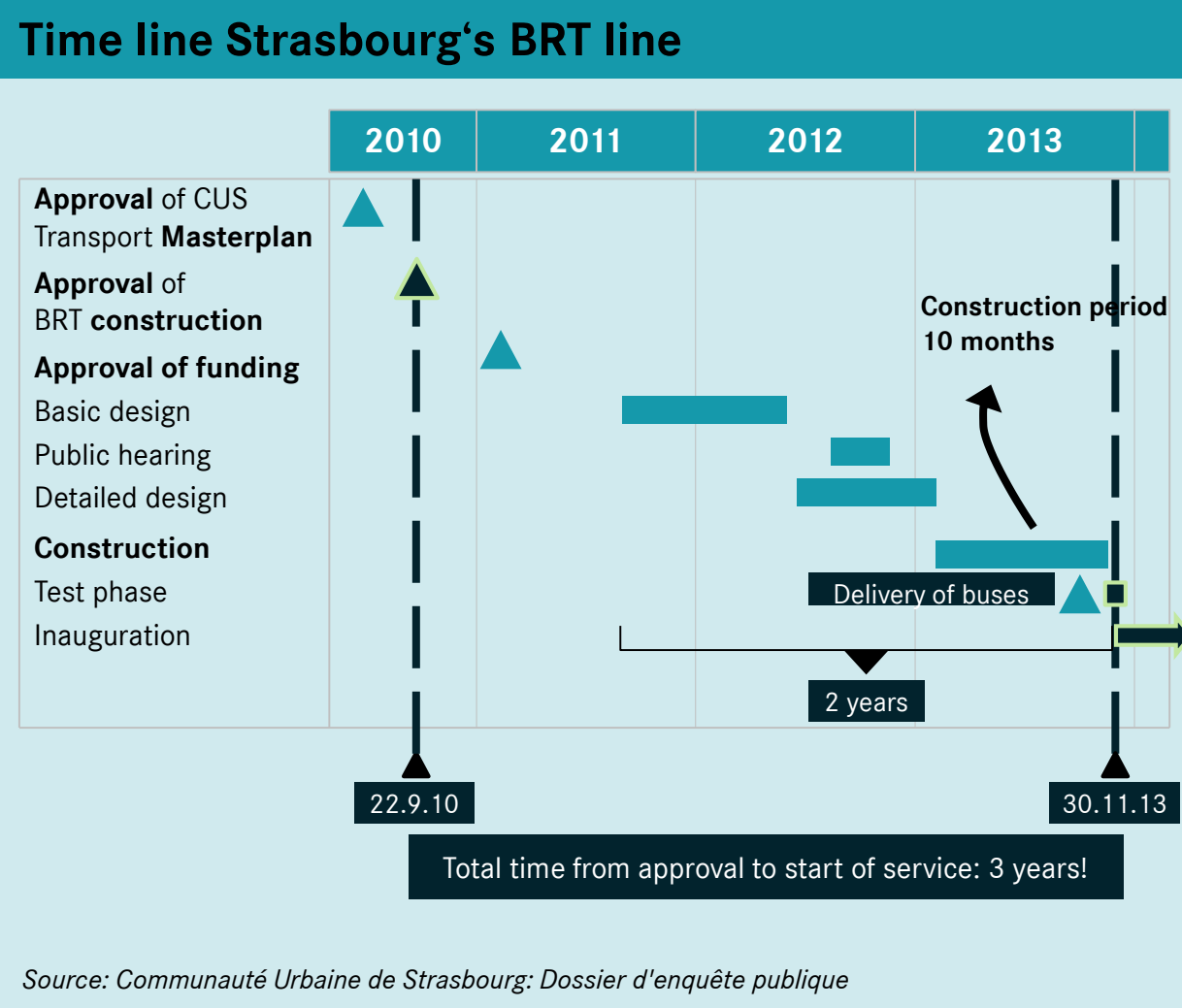
In 40 of 185 BRT systems worldwide, 20.000 MB buses are operating out of a total of 45.000 BRT buses



Daimler Buses offers a complete package of vehicles, services, consulting and financing



BRT is much faster to implement than Light Rail Transit (LRT)



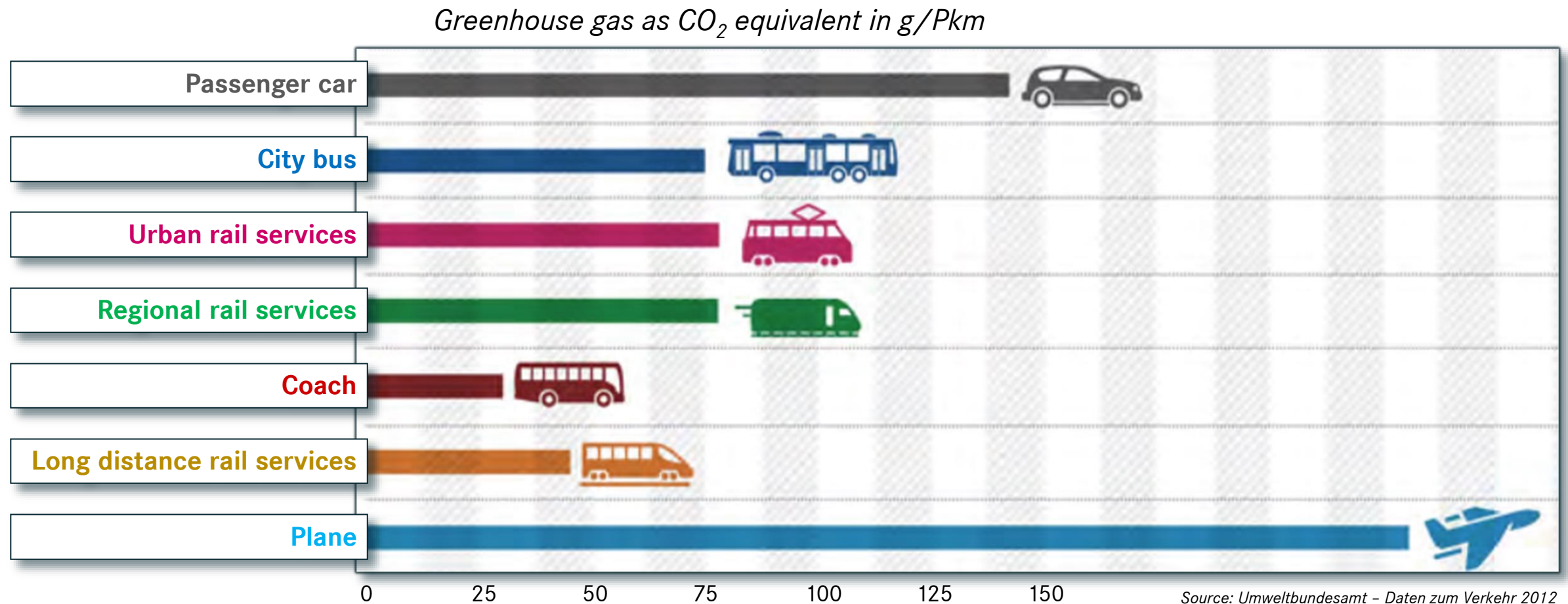
BRT systems often cost 4-5x less investment per km than tram systems

Project	Length [km]	Cost [m €]	Cost [m €/km]
BRT Strasbourg, Ligne G (2013)	5.2	24.5	4.7
BRT Saint-Nazaire, Hélyce (2012)	9.0	56.0	6.2
BRT Nantes, Ligne 4 (2006)	7.0	64.0	9.1
LRT Strasbourg, Ligne A Sud Illkirch (2014)	2.0	37.0	18.5
LRT Besançon (2014)	14.5	158.5	10.9
LRT Stuttgart, U12 Hallschlag (2013)	2.0	25.0	12.5
LRT Freiburg Gundelfingen (2014)	1.8	24.5	13.6
LRT Bergen (2010)	9.8	175.0	17.9
LRT Ulm, Straßenbahnlinie 2 (2019)	9.3	161.0	17.3

Sources: CUS Strasbourg, SSB AG Stuttgart, VAG Freiburg, Grand Besançon, Bybanen.

Regarding CO₂ footprint, a city bus is fully competitive with a tram

Emissions of different means of transportation, 2010



Autonomous driving at DAIMLER



2013:
Mercedes-Benz
S-Class
Bertha-Benz drive



2014:
Mercedes-Benz
**Future Truck
FT2025**



2015:
Mercedes-Benz
F015



2015:
Freightliner
Inspiration Truck



2015:
Mercedes-Benz
**Actros
Highway Pilot**



July 18th, 2016:
Presentation
Mercedes-Benz Future Bus

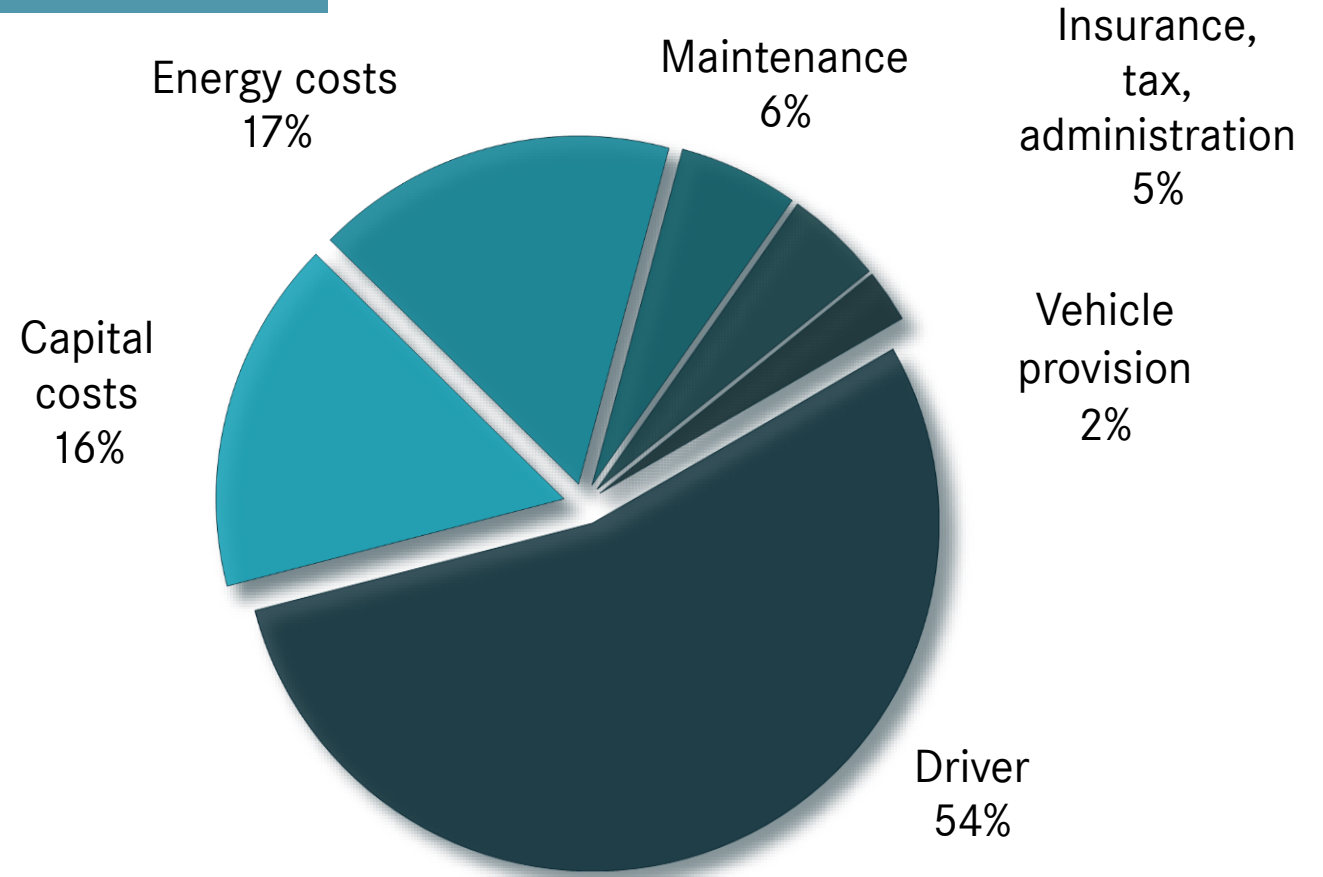
As of today, approx. 40% of the city bus TCO can be influenced by the manufacturer

- Capital costs
- Fuel, AdBlue, energy costs
- Service and repairs



Around 40%
of the TCO
can be influenced by
the manufacturer

Citaro 12m

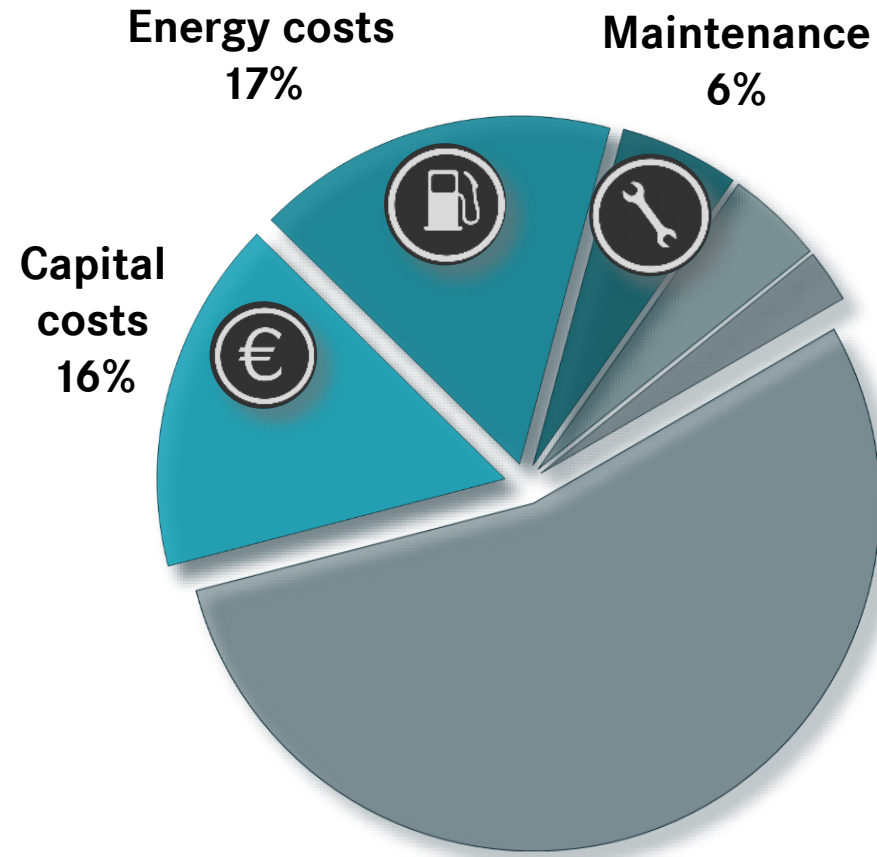


Autonomous driving improves all three variable TCO blocks...

Automated driving on structurally separated public transport, e.g. BRT lines



Automated start, positioning drive out the bus stop and depot



...and even has a positive effect on the operator's largest fixed cost block

Health report AOK, Germany (2015):

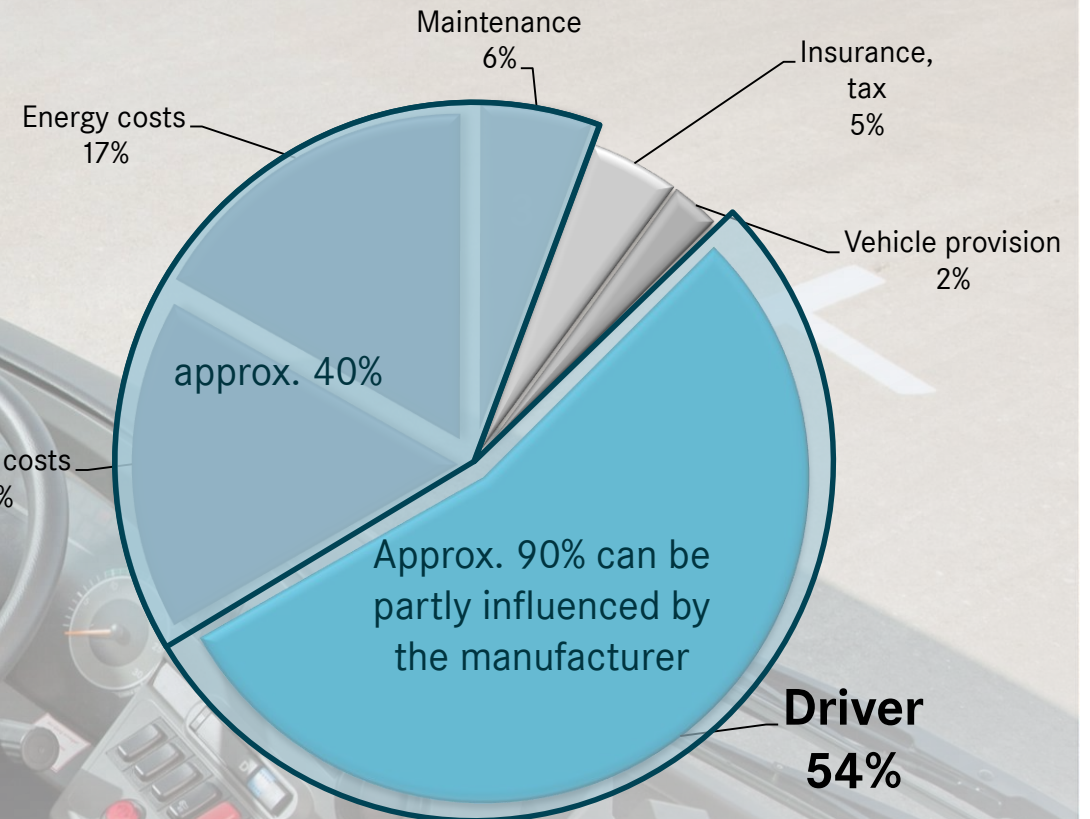
Bus drivers rank #3 in terms of sick days

Number of sick days per annum

... of the average employee: 19.8

... of bus drivers: 29.4

By reduction of stress and fatigue we can have a positive impact on driver availability, the biggest cost factors while operating a city bus



Sustainability along the entire bus line:

Zero-emission drives

Bus Rapid Transit

Autonomous driving



Environment-friendly

Fast & efficient

Safe & cost-effective

Thank you for your attention



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