

DAIMLER

Workshop Fuel Cells and Hydrogen within the European Initiative for Smart Cities



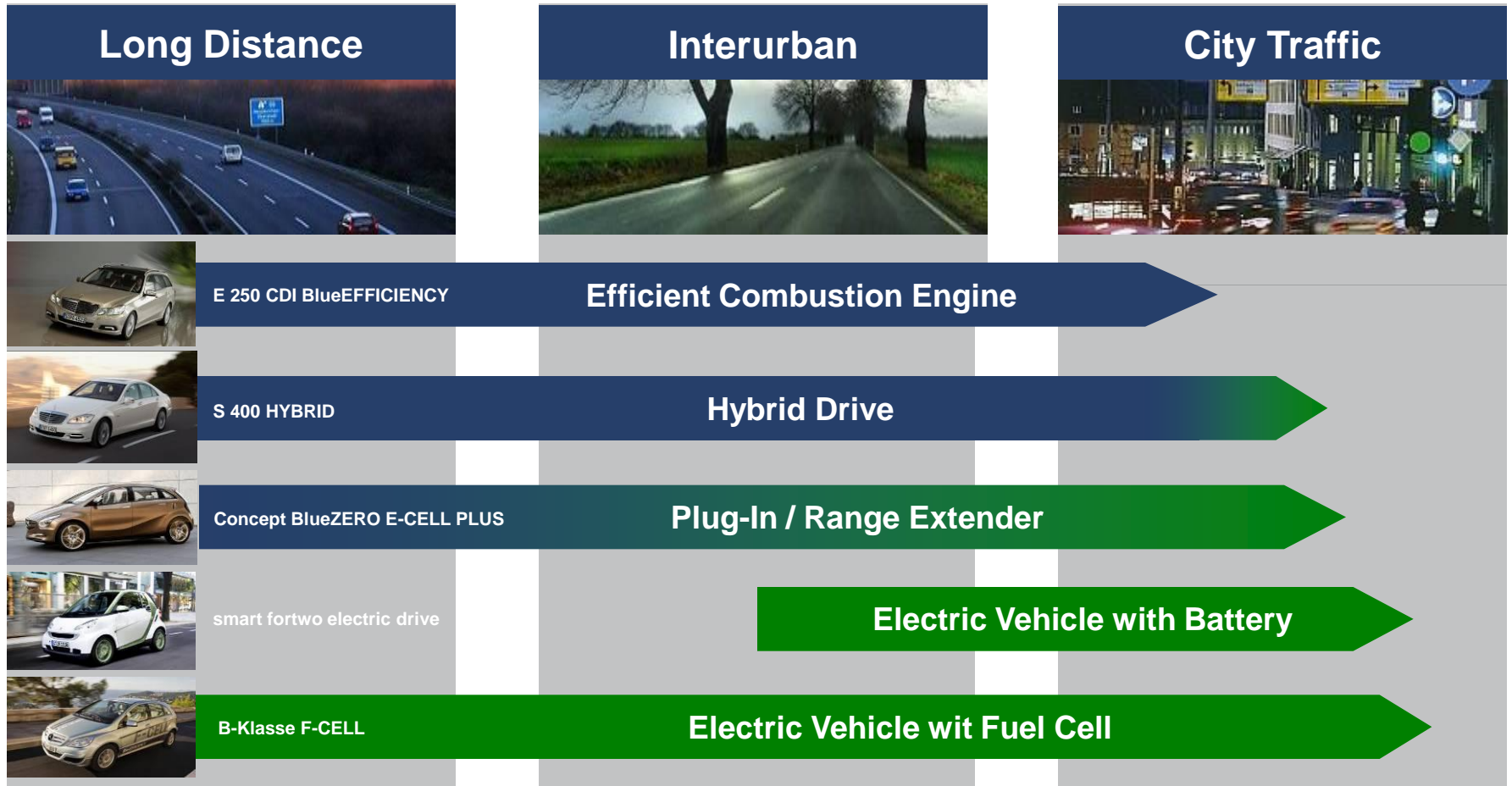
Emission-free mobility with fuel cell vehicles

Dr. Jörg Wind

Strategic Energy Projects and Market Development Fuel Cell Vehicles

Drive Portfolio for the Mobility of Tomorrow

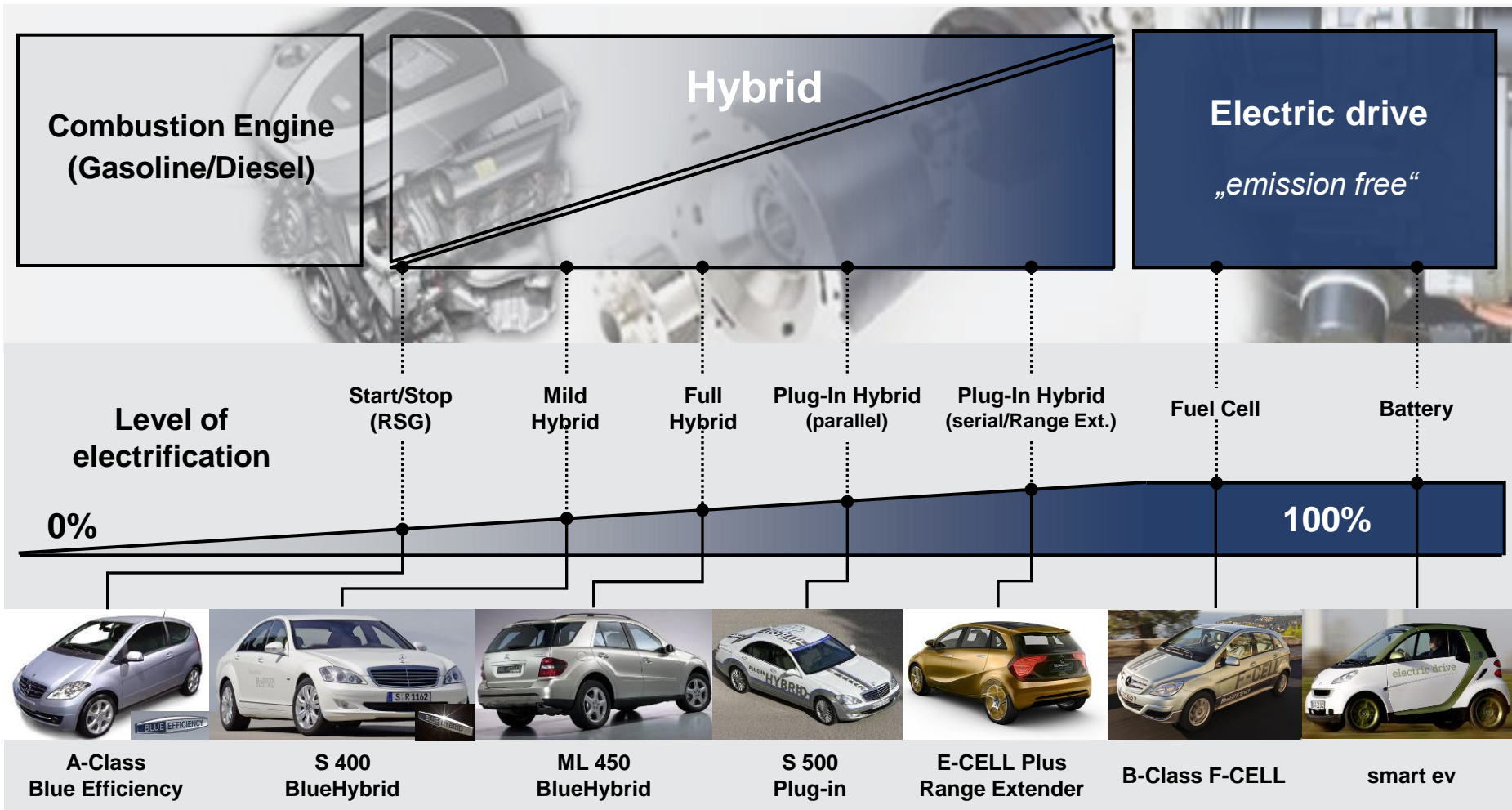
Different mobility scenarios



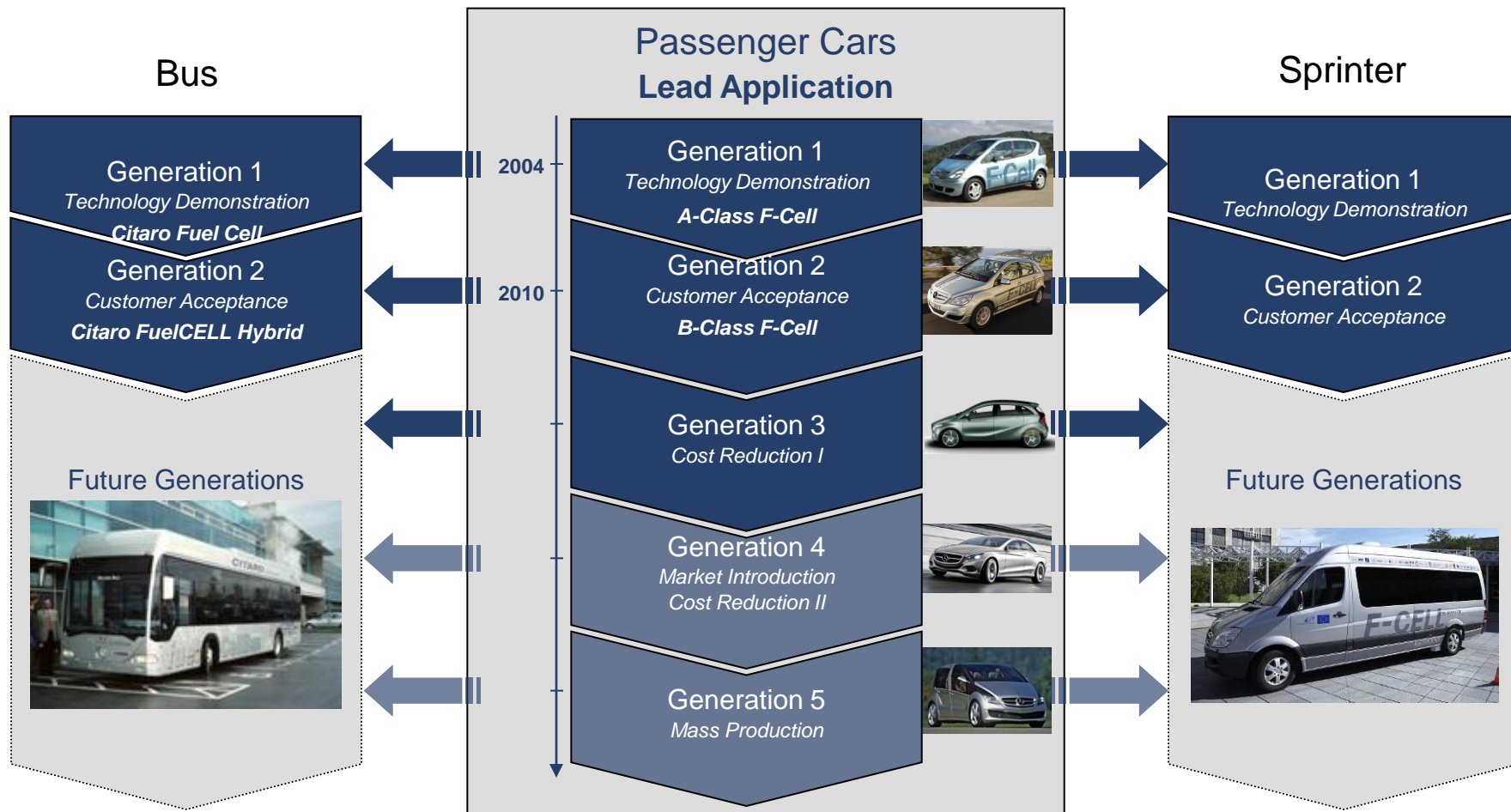
 Combustion drive

 Emission free mobility

Future Mobility will be characterized by the Electrification of the Drive Train



Daimler's Fuel Cell Technology Roadmap



Daimler is dedicated to commercialize fuel cell vehicles

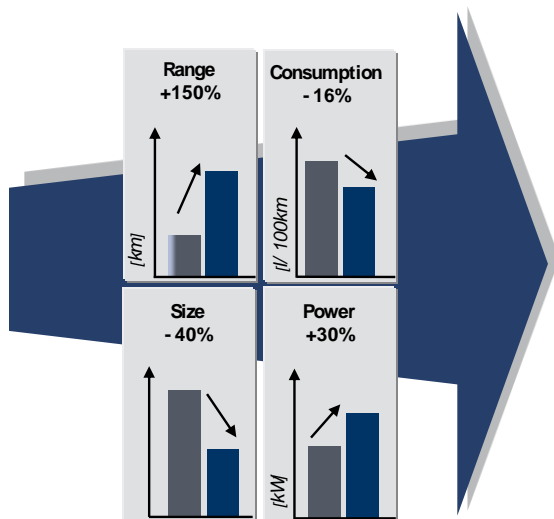
Worldwide Fleet Operation with the first Generation of Fuel Cell Vehicles

- Worldwide fleet operation in demo projects with Daimler vehicles from 2004 to 2010
- Large fleet demonstration projects for generating public interest, raise awareness and motivate hydrogen-infrastructure build-up



60 F-Cell Vehicles in customer operation	36 Buses (Citaro) in Europe, Australia, China	3 Sprinter Europe, USA
~ 2.200.000 km ~ 64.000 h	~ 2.240.000 km ~ 143.000 h	~ 64.000 km ~ 2.400 h

Technical Advancements of Daimler's Fuel Cell Vehicles



Technical Advancements

- Higher efficiency of the fuel cell system
- Longer durability of the fuel cell stacks
- Cold start feasibility down to -25°C (-13°F)
- Improved high voltage battery
- Advanced tank system (70 MPa instead of 35 MPa)
- Improved driving performance (range, acceleration, top speed)

Technical Data B-Class F-CELL

Vehicle	Mercedes-Benz B-Class
Fuel Cell Techn.	PEM (Proton Exchange Membrane)
Engine	Output (const./max.) 70 kW / 100 kW (136 hp) Max. Torque: 290 Nm
Fuel	Compressed Hydrogen (700 bar)
Range	ca. 250 miles
Top Speed	107 mph (limited)
Li-Ion Battery	Output (const./max.): 24 kW / 30 kW (40 PS) Capacity: 6.8 Ah, 1.4 kWh

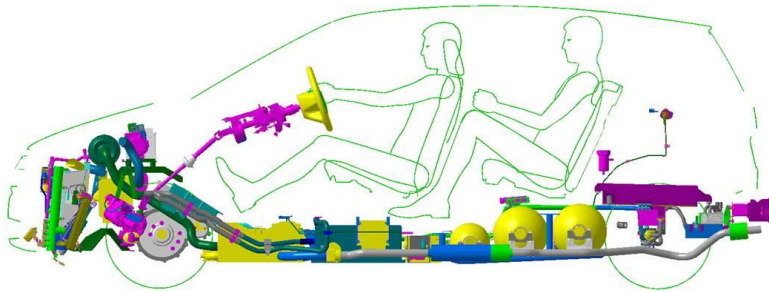
The Future of the Fuel Cell Technology

- The Mercedes Benz concept car F800 shows the future capabilities of the fuel cell technology
- Through a further modularization of the fuel cell specific components, the packaging of future generations of FC vehicles will be simplified

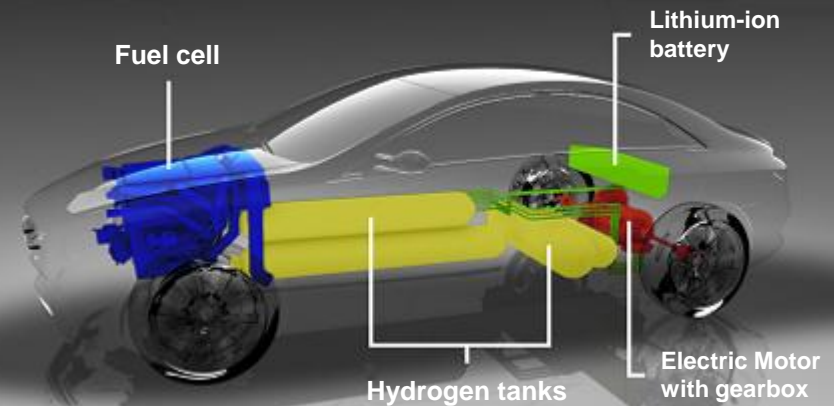


➔ In the future the packaging will not depend on a sandwich under floor, to store the fuel cell specific components

Packaging of Fuel Cell Vehicles



Today ...

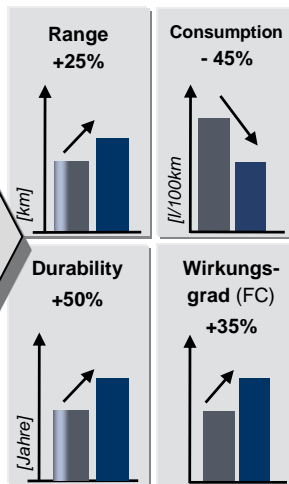


... in the future

The Citaro FuelCELL-Hybrid is the next Generation of Fuel Cell Bus*

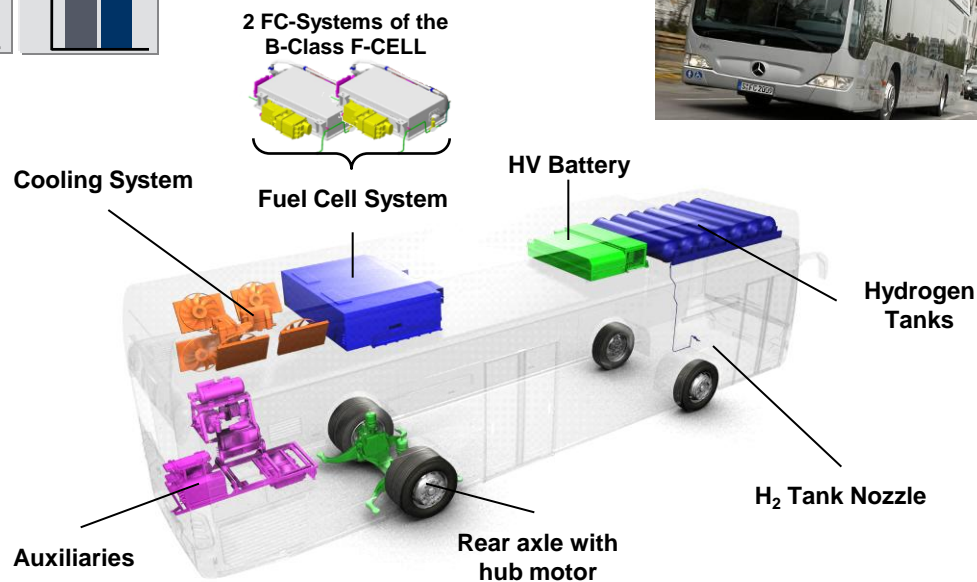
Technical Improvements to the last generation:

- Energy retrieving through hybridization (recuperation)
- Higher efficiency
- Higher lifetime and availability



Citaro FuelCELL-Hybrid

Technical Data	
Power FC-System	120 kW (const.) / 140 kW (max.)
Durability (FC)	6 years
Drive power	Output (const. / max.): 2 x 80 kW / 2 x 120 kW
Hydrogen Storage	35 kg Hydrogen (350 bar)
Range	> 250 km
HV-Battery	26,9 kWh, Output 250 kW
Efficiency FC-System	58 - 51 %
H ₂ -Consumption	10 – 14 kg / 100 km



FCH-JU project CHIC

- 26 partners from 9 countries worldwide
- 26 fuel cell buses operated in 5 cities (Aargau, Bolzano, London, Milano, Oslo)
- at least 3 different bus manufacturers
- 2 filling stations per city
- Demonstration phase 2010-2016
- 26 Mio. EUR funding, 81.8 Mio EUR costs

Key Data FC Buses

Key technical data of the vehicle	Unit	Phase 0 regions		Phase 1 regions		
		APTS	New Flyer	Citaro	Wrightbus	Van Hool
Overall Length	m	18,4	12,5	12	12	13,12
Net weight	kg	16.650	13.000	13.400	11.707	16.900
Max. passenger number	No.	120	97	76	49	74
Number of Axles	no	3	2	2	2	3
Drive power	kW	200	2x 85 kW	2 x 80	2 X 67	2 x 85
Power fuel cell system	kW	140	150	140	75	150
Energy Storage Type (Type of Battery, Supercap)	txt	Li-Ion battery + Supercap	Lithium Phosphate	Li-Ion battery	Ultracaps	Li-Ion battery
Energy Storage Power	kW	approx 100		250	105	100
Energy Storage Capacity	kWh	Supercaps: 2, Battery: 25	47	26	0.748	17,5
Hydrogen Cylinders (@350 bar)	No.	8		7	6	7
Storage capacity	kg	40		35	46.2	35

Technical goals of CHIC

Hydrogen infrastructure goals:

- Hydrogen fueling station capacity of 200 kg/day
- Average availability of fueling station 98% (based on operation time)
- Production efficiency for H₂ between 50 and 70%
- H₂ OPEX costs less than 10 EUR

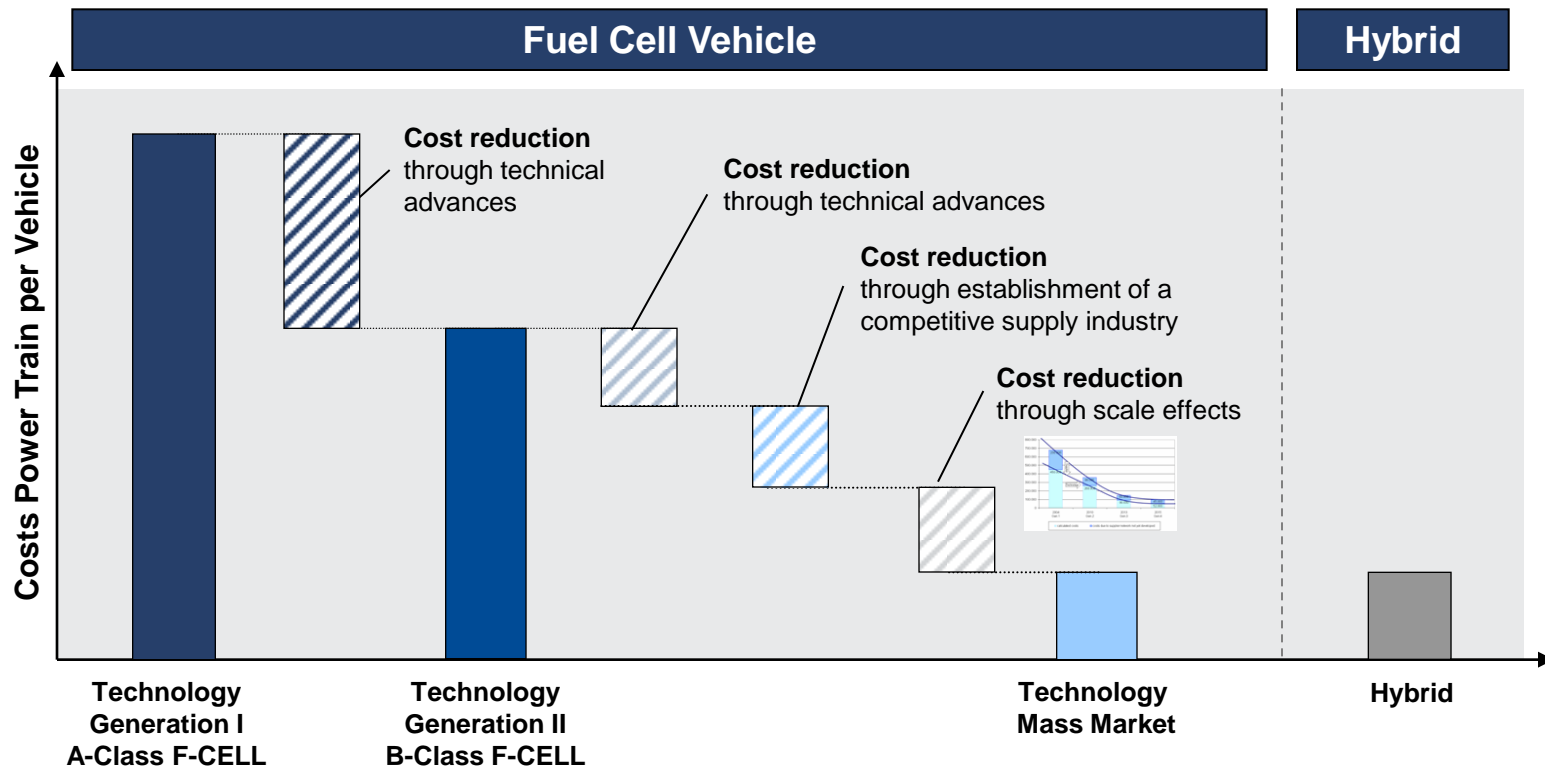


Fuel Cell Bus goals:

- Fuel cell lifetime greater than 6000 h
- Average availability of all fuel cell buses greater than 85%
- Average fuel consumption less than 13 kg/100 km (dep. on drive cycle)



Cost Potentials of the Fuel Cell Technology



- The costs for the fuel cell power train are currently much higher than those from conventional drive systems. They can be reduced considerably through scale effects and technology advances.
- A reduction of the costs on the level of conventional drive trains is possible.
- Regarding the TCO¹ comparable values to conventional drive systems are reachable.

Technical Configuration of a Hydrogen Fueling Station



Status quo of hydrogen filling stations:

- Pre-cooling down to -40° Celsius
- Pressure of the hydrogen 350 and 700 bar
- Infrared data interface for communication vehicle <> filling station
- Standard: SAE J2601, SAE J2799
- Refueling time: approx. 3 minutes for the B-Class F-CELL (ca. 4 kg hydrogen)
- Unitized construction / scalable

B-Class F-CELL World Drive 2011



- First world tour with fuel cell (FC) vehicles
- The new B-Class F-CELL stands for MB as a reinvention of the mobility
- Demonstration of the technical maturity and performance of FC technology and their potentials for sustainable mobility
- Demonstration of a daily use of the FC technology in different climate
- Long local emission free range in combination with short refueling time
- Appeal to all involved partners to push the development of H₂-Infrastructure

Thank you for your attention!

