

# DAIMLER

## Daimler's perspective on alternative propulsion systems and the new Mercedes GLC F-CELL

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# Daimler is shaping the future of mobility in many aspects. We re-invent the car!

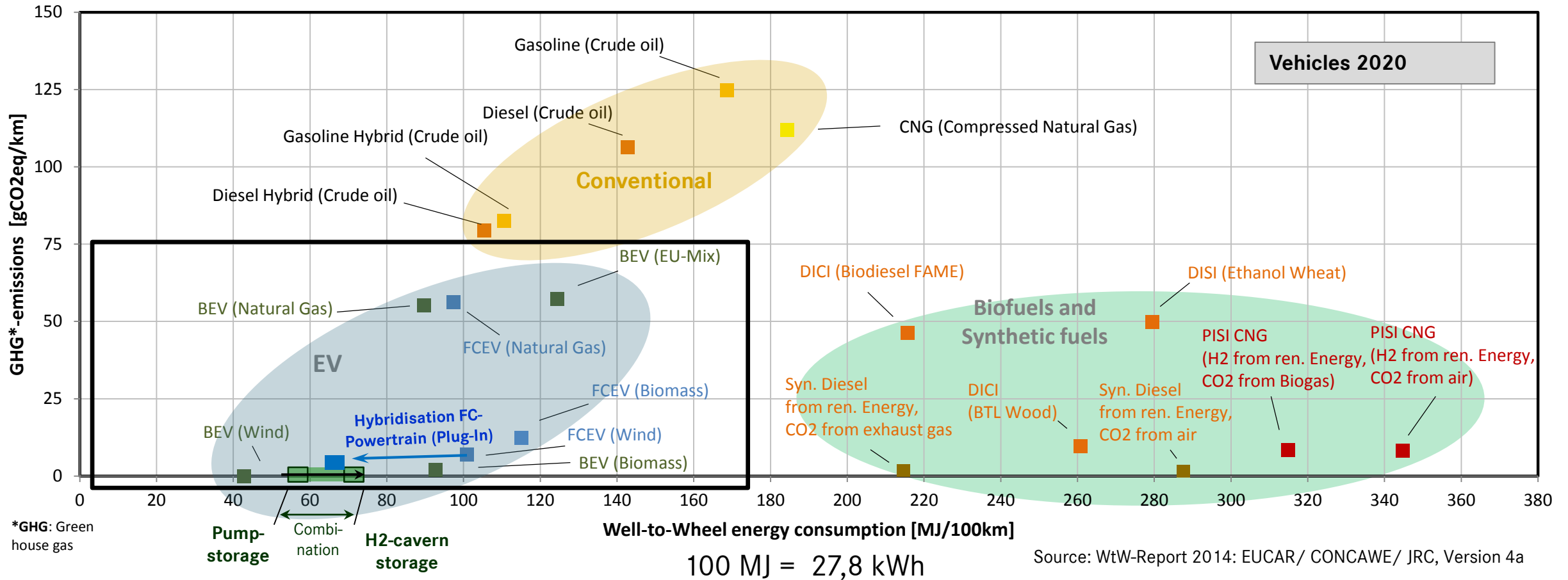


# Fuel Cell Technology is an Integral Part of Daimler's Powertrain Strategy

Highly efficient combustion engines	Full- and plug-in-hybrids	Electric vehicles with battery and fuel cell
 <p>A 180 CDI BlueEFFICIENCY 3,5 l/100 km, 89 g CO<sub>2</sub>/km</p>	 <p>S 560 e 2,1 l/100 km, 49 g CO<sub>2</sub>/km</p>	 <p>Combined H<sub>2</sub>-Consumption: 0,34 kg/100 km, Combined CO<sub>2</sub>-Emissions: 0 g/km, Combined electrical consumption: 13,7 kWh/100 km</p>

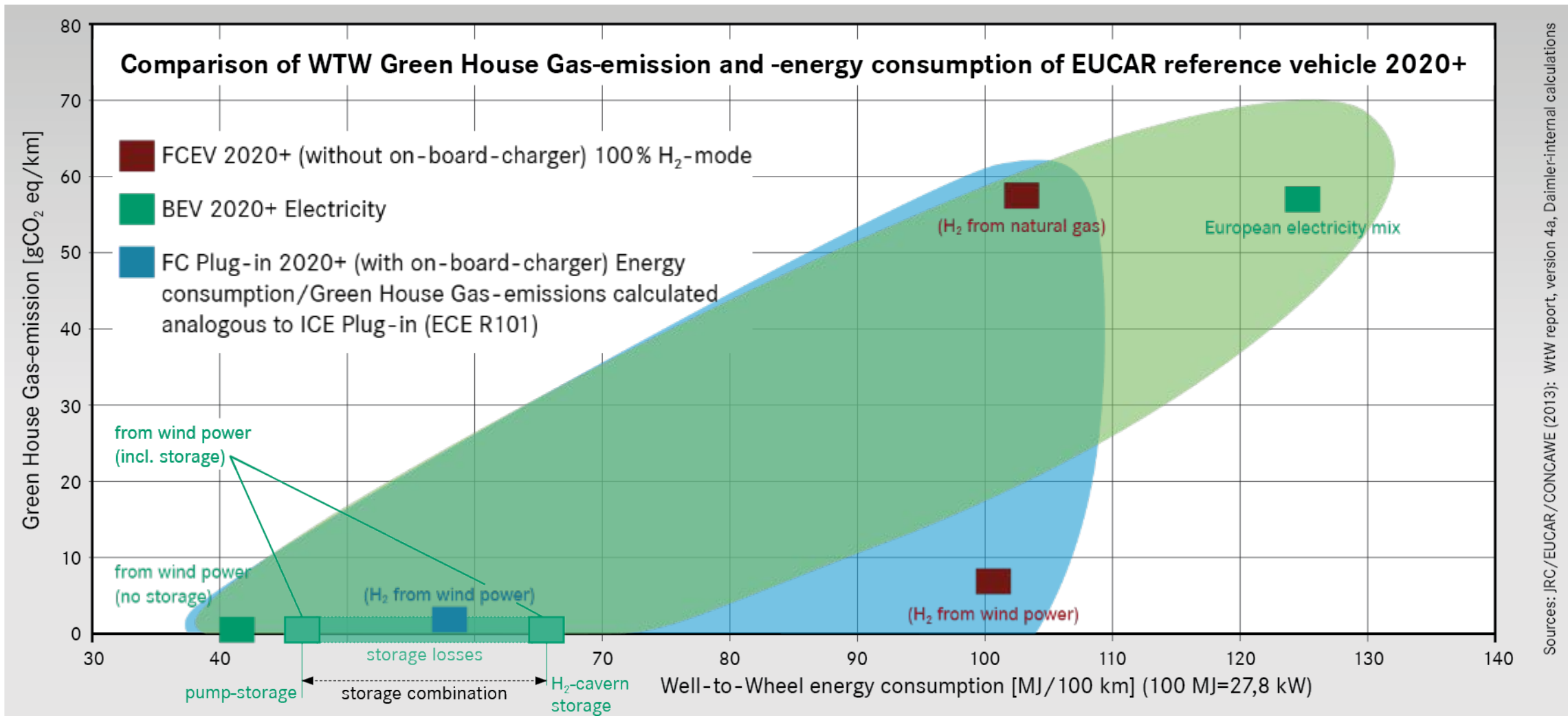


# Well-to-Wheel Comparison of Greenhouse Gas Emissions and Energy Consumption of EUCAR Reference Vehicles (C-segment passenger car) 2020+





# Well-to-Wheel Consideration of Fuel Cell Plug-in-Hybrid



Highly efficient combustion engines with additional 48 volt onboard network with a belt-driven starter/alternator

Example **C 200 Estate**

**EQ** BOOST



Fuel consumption combined: 6,2 l/100 km; CO<sub>2</sub>-emission combined: 142 g/km

# Next milestone in hybridization

## Example **560 e Plug-in-Hybrid**



Fuel consumption combined: 2,1 l/100 km, CO<sub>2</sub>-emissions combined: 49 g/km, weighted power consumption: 15.5 kWh/100 km, all-electric range of around 50 kilometres.



# Clear Commitment to E-Mobility

10 bn Euro invest in electric vehicle fleet

Various electrified alternatives in every segment - from the compact car to the major SUV

New brand EQ for electric vehicles

> 10 Electric vehicles on the market by 2022



Significantly more than 130 electrified vehicle variants on the market by 2022



# World premiere EQC – First Mercedes-Benz vehicle to be launched under the EQ brand





# smart fully electric in Europe & US by 2020



smart EQ fortwo: power consumption combined: 13,0-12,9 kWh/100km; CO2-emission combined: 0 g/km  
smart EQ forfour: power consumption combined: 13,2-13,1 kWh/100km; CO2-emission combined: 0 g/km



# eVito: Electrically powered, mid-sized van has been available to order since the end of 2017

- Ecosystem to electrify commercial fleets
- Range of up to 150 km
- Designed for inner-city delivery, commercial and passenger transport



# Electric, locally emission-free and silent: Our battery-powered commercial vehicles for urban areas



**Thomas Built Buses  
Jouley**

**2017:** World premiere  
**2018:** Innovation fleet  
**2019:** Small series



**Mercedes-Benz  
eActros**

**2016:** World premiere  
**2018:** Innovation fleet  
**~2021:** Market introduction



**FUSO  
eCanter**



**Freightliner  
eCascadia & eM2**

**2018:** World premiere  
**2019:** Innovation fleet  
**2021:** Market introduction



# The all-electric Citaro: Emission-free through the city

- Modular design of battery packs allows range to be tailored
- Innovative thermal management
- eMobility system:
  - eConsulting before procurement
  - eMobility service of brand OMNIplus
- World premiere IAA Commercial Vehicle Sept. 2018
- New generation FC bus with FC range extender





# Daimler has the broadest experience with fuel cell Technology: Highlights from fleet operation



## B-Class F-CELL

- > 10 million km in Europe and USA
- > 300.000 km driven in one single vehicle
- < 3 minutes average refueling time on the basis of 36,000 refuelings



## Customer - Feedback

Consistent positive feedback

- „After driving the F-CELL, you don't want to get back to your old car!“
- „My next car will be a Fuel Cell car again!“

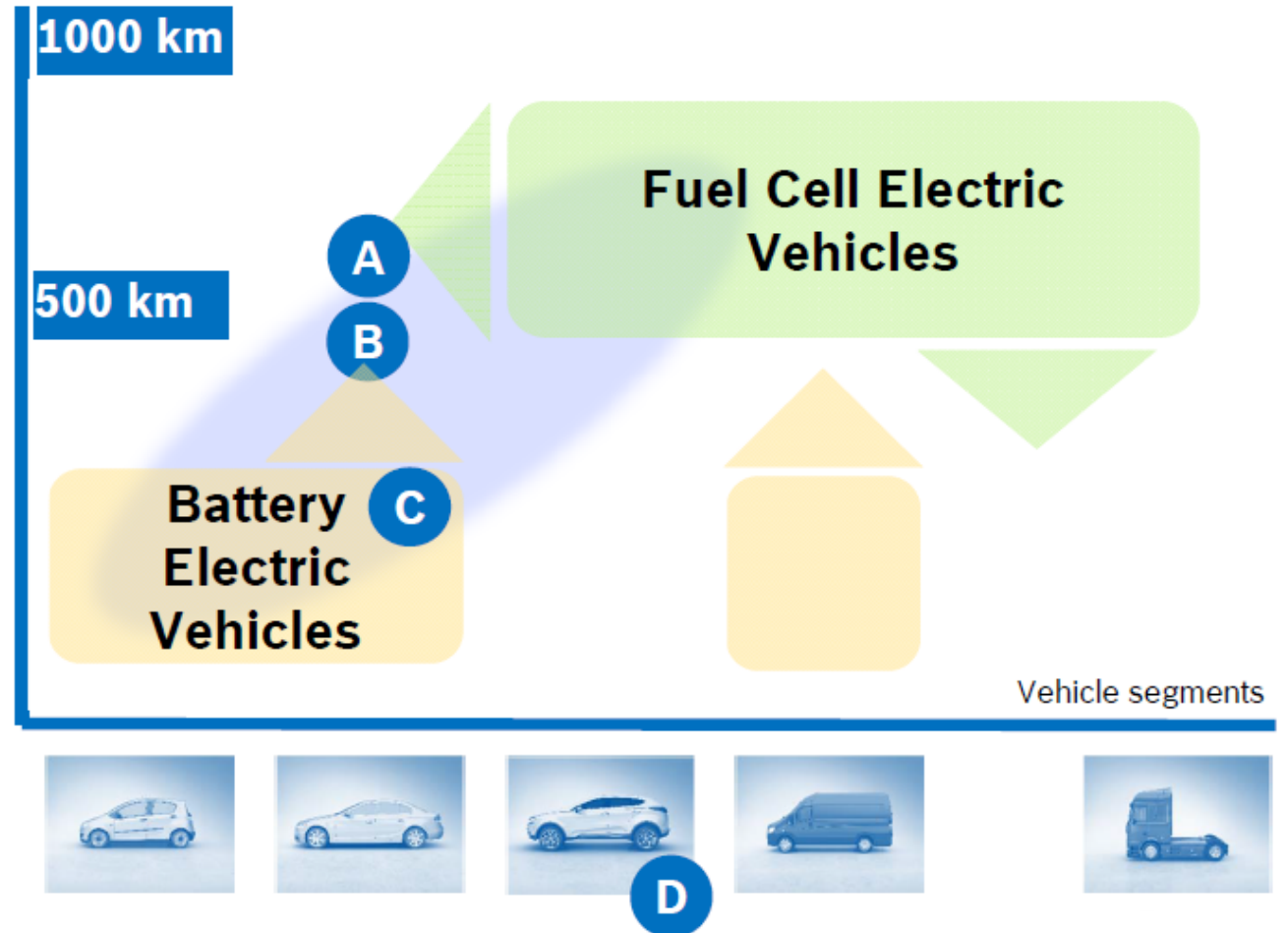


## Citaro FuelCELL-Hybrid

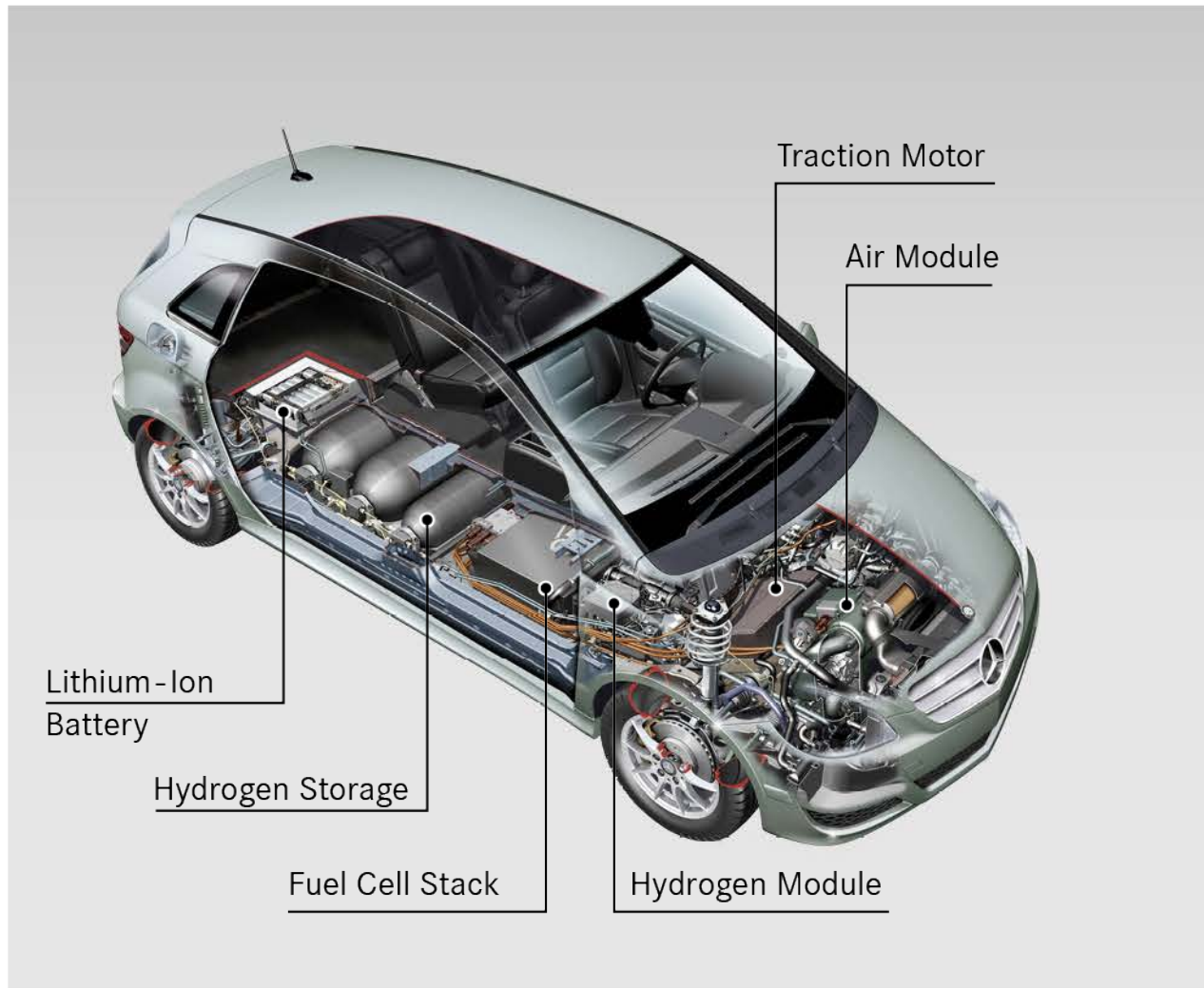
- > 5 million km in Europe
- Press release of an operator > 1 million km in regular operation  
1,200 tons of CO<sub>2</sub> avoided

# Wide field of applications for fuel cell drive - with different configurations

- A** Individual Mobility demand with long range requirements  
> 500 km also in middle segment
- B** High speed highway use cases requires higher storage capacity
- C** Use-on-demand applications (carsharing) with FCEV more robust vs. availability of cars
- D** Significant number of larger & heavier cars in the portfolio



# The current generation of fuel cell vehicles: Mercedes-Benz B-Class F-CELL

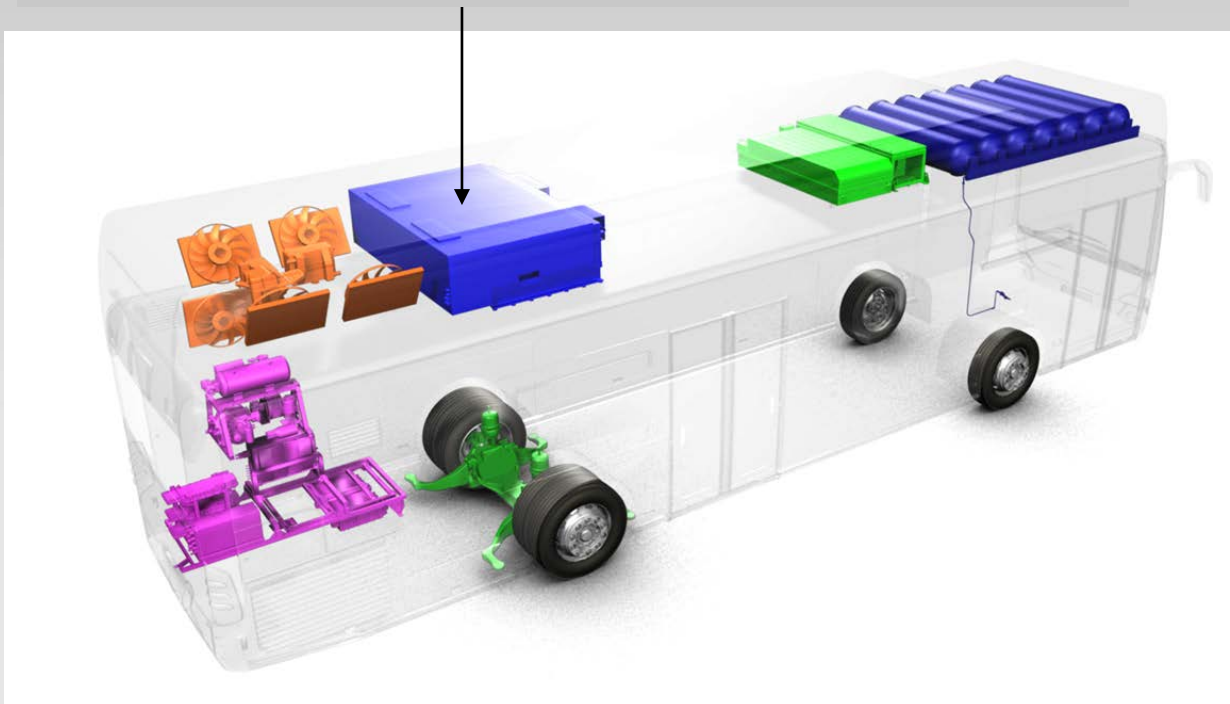


Specification	
Vehicle	Mercedes-Benz B-Class F-CELL
Fuel Cell System	90 kW (122 PS)
Traction Motor	Power (cont./peak): 70/100 kW (136 PS)
Range	380 km (NEDC)
Maximum Speed	170 km/h
Acceleration 0-100 km/h (0-60 mph)	11,4 s
High Voltage Battery (Lithium-Ion)	Power (cont./peak): 24/30 kW Capacity: 6,8 Ah, 1,4 kWh



# The current generation of fuel cell vehicles: Mercedes-Benz Citaro FuelCELL-Hybrid

Two identical fuel cell systems of the Mercedes-Benz B-class F-CELL



## Characteristics

Vehicle	Mercedes-Benz Citaro FuelCELL-Hybrid
Fuel Cell System	120 kW ( cont. ) / 140 kW ( peak )
Traction motor	<b>Power (continuous/peak)</b> 2 x 80 kW / 2 x 120 kW
Range	> 250 km
Hydrogen storage	35 kg hydrogen at 350 bar
H <sub>2</sub> consumption	10 - 14 kg/100 km
High-voltage battery	<b>Power:</b> 250 kW <b>Capacity:</b> 6,9 kWh

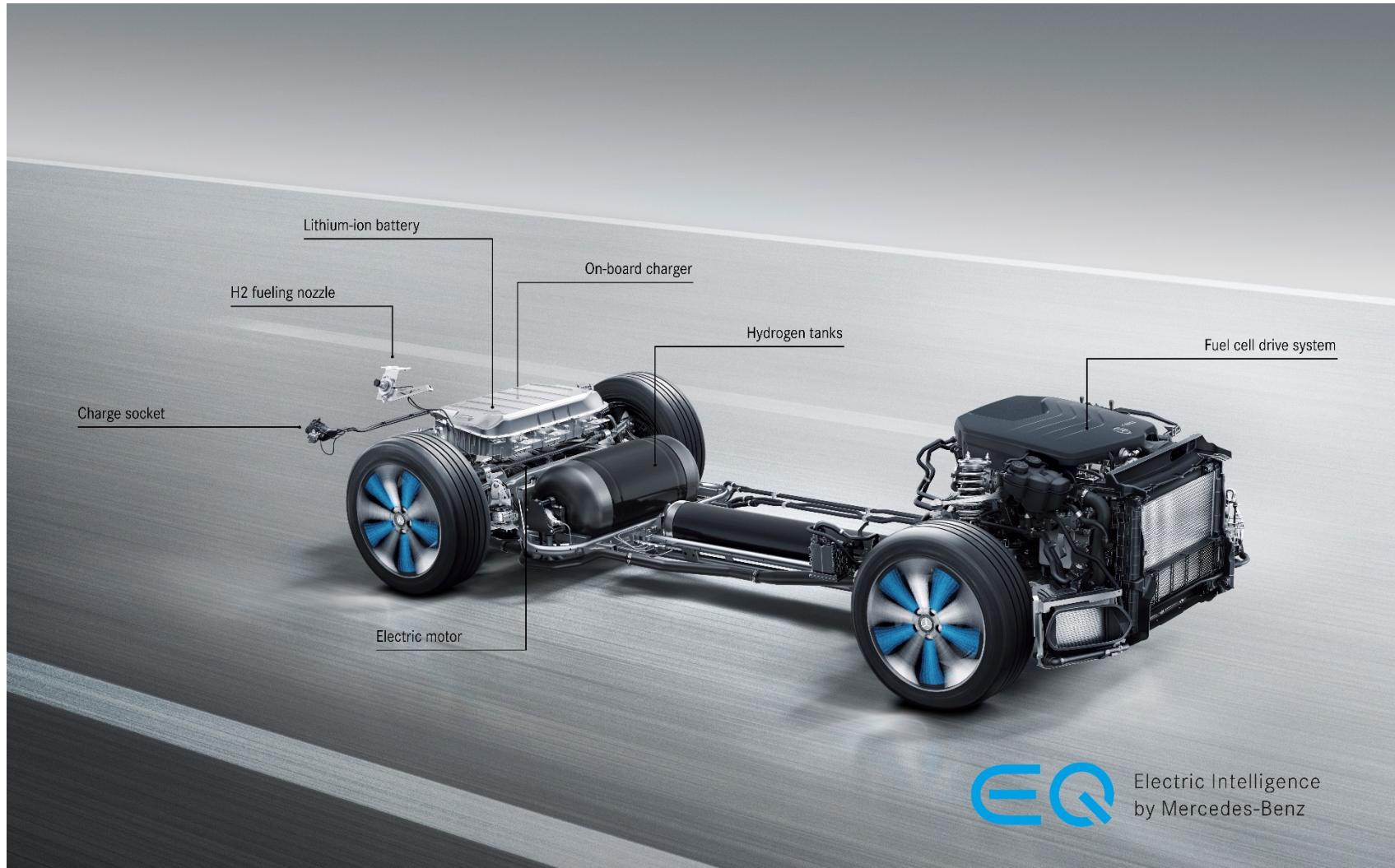


# Mercedes-Benz GLC F-CELL: Fuel Cell Electric Vehicle with Plug-in-Technology





# Next generation fuel cell powertrain



Combined electrical consumption (kWh/100 km)	13,7
H <sub>2</sub> -Range in hybrid mode (NEDC) (km)	478
Battery electric range in battery mode (NEDC) (km)	51
Engine	Electric motor
Rated output (kW/PS)	155 (211)
Peak torque (Nm)	365
Battery	Lithium-Ion
Energy content (gross/net) (kWh)	13,5 /9,3
Fuel cell	PEM
Hydrogen tank capacity (kg) (usable for SAE J2601, 2014 or more recent)	4,4
top speed (km/h)	160 (governed)

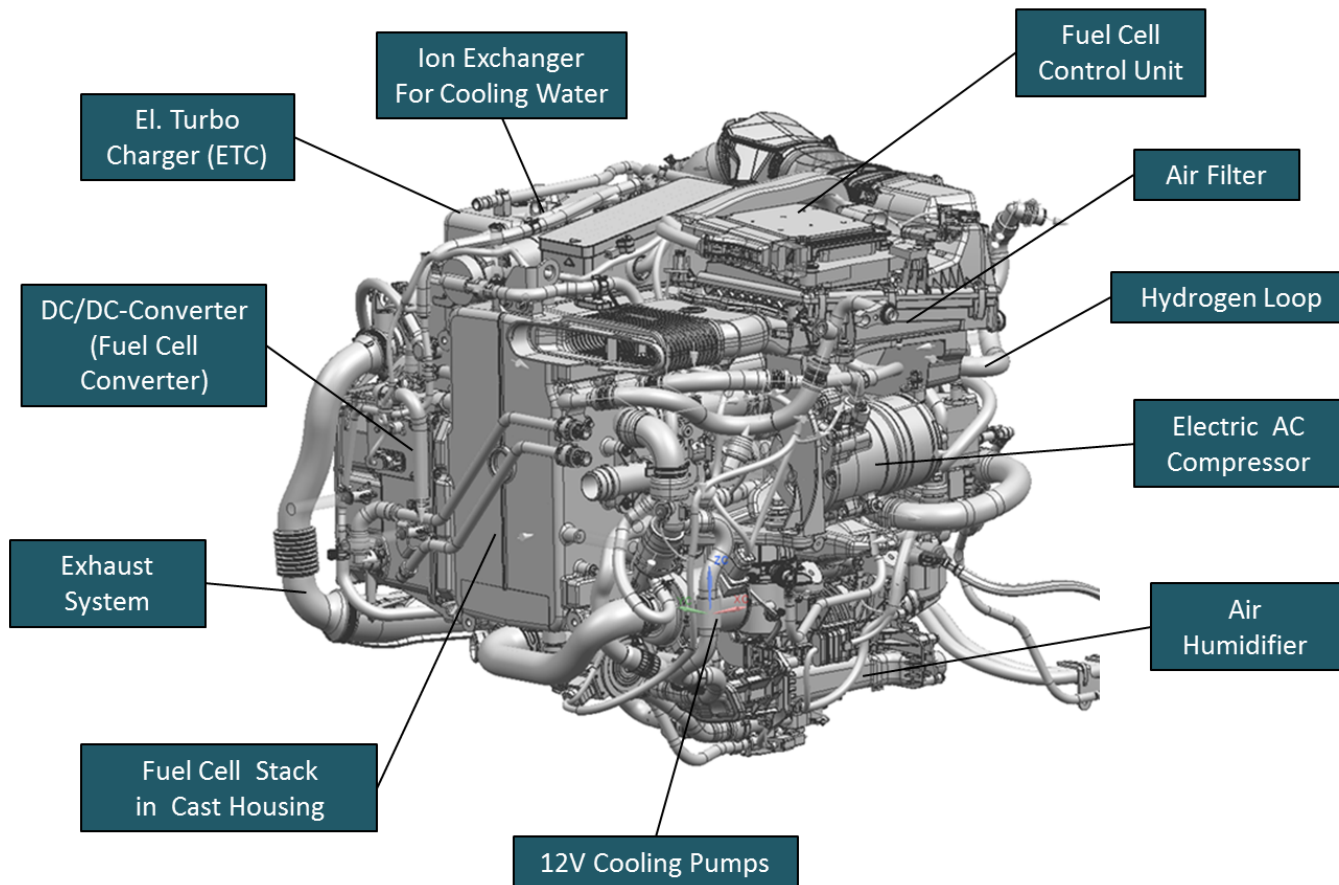


# Next Generation Fuel Cell Vehicle: „The Fuel Cell gets a Plug!“





# Daimler's Next Generation Fuel Cell Engine



- High level of component integration
- Increase in fuel cell stack power density by ~ 100 % compared to B-Class F-CELL
- Introduction of electric turbo-compressor for air supply
- Absolute platinum content in fuel cell stack reduced by 90% compared to B-Class F-CELL
- Increased amount of series-produced carry-over parts (e. g. air filter, coolant pump)

# Fuel Cell Power Train for Vans



Mercedes Concept Sprinter F-CELL presented in Hamburg July 2, 2018





# Important Parameters for Optimization of Fuel Cell Drive

## Technology

- Power density
- Energy density (Battery)
- Storeable amount of hydrogen
- Lifetime

## Cost

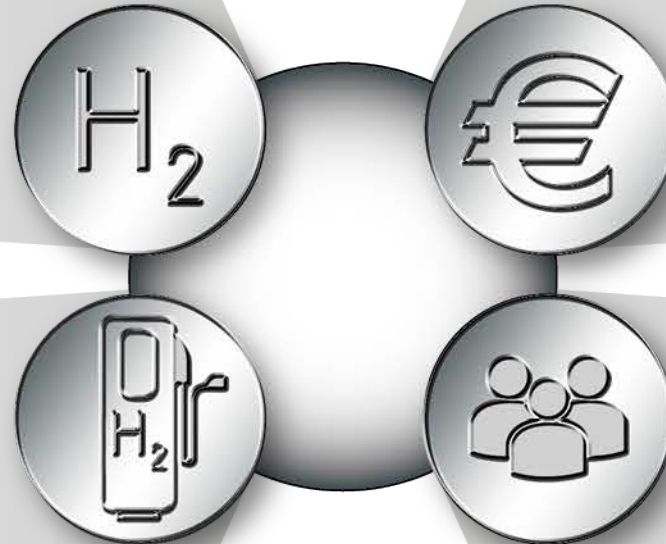
- Fuel cell system and stack
- HV-Battery
- H<sub>2</sub>-Storage and H<sub>2</sub>-Infrastructure
- Power electronics
- Electric drive
- Cost of hydrogen

## H<sub>2</sub>-Infrastructure

- Reliable refueling technology
- Built up of nationwide H<sub>2</sub>-Infrastructure
- H<sub>2</sub>-Production at competitive cost
- Renewable produced hydrogen

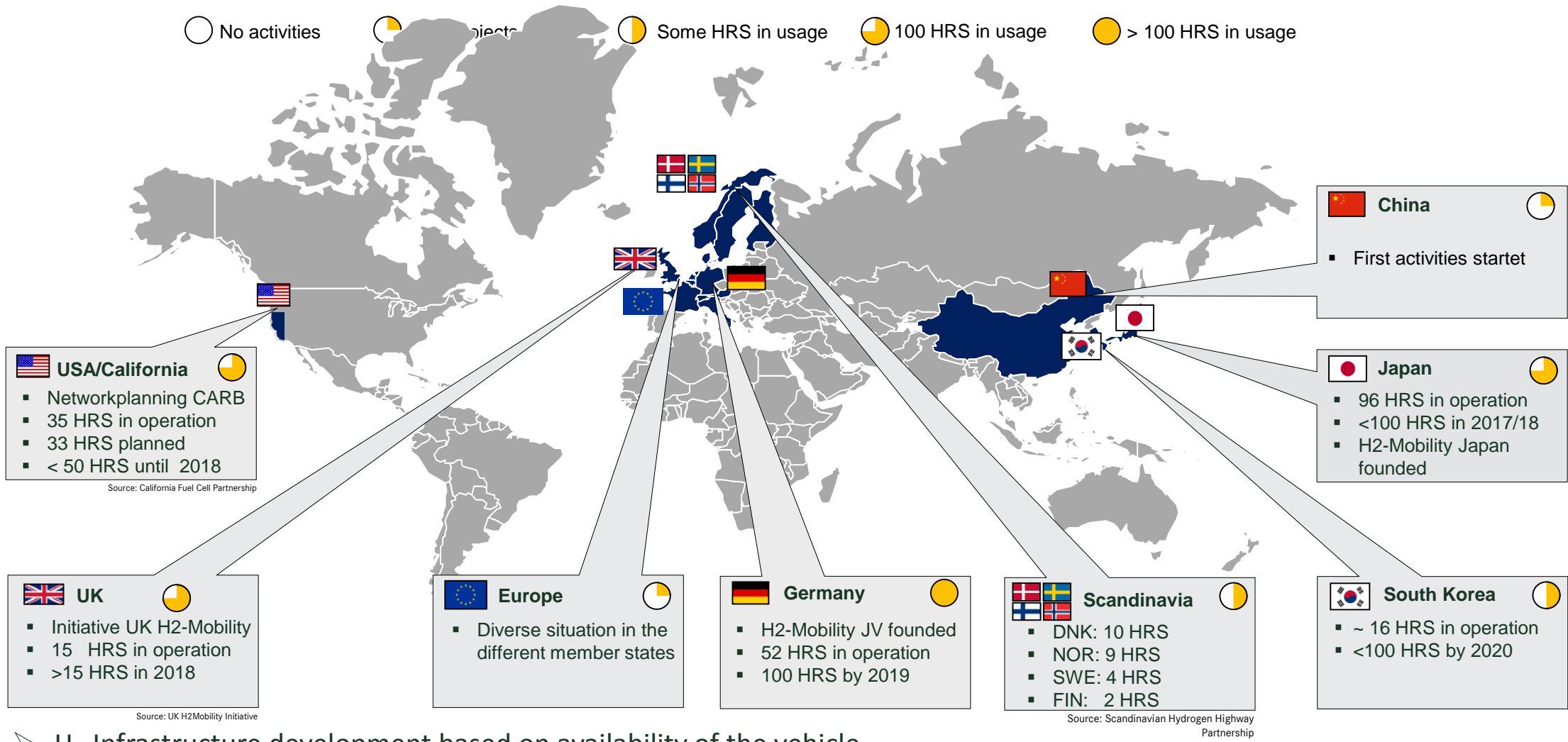
## Customer Wishes

- Attractive vehicle platform
- High range and low consumption
- Convincing driving performance
- Unrestricted availability of the drive system



# H<sub>2</sub>-Infrastructure – Activities Worldwide Overview

## Expected H<sub>2</sub>-Infrastructure Development in Germany



- H<sub>2</sub>-Infrastructure development based on availability of the vehicle
- Currently\* 328 HRS worldwide in usage, 227 HRS of them are useable in public

HRS: Hydrogen Refueling Station (700 bar PKW) | JV: Joint Venture   
 ZEV-States: Arizona, Connecticut, Maine, Maryland, Massachusetts, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Vermont, Washington

\* annual assessment 2017, LBST and TÜV SÜD Database



# H2Mobility Initiative in Germany

## Build-up of a Hydrogen Refueling Station-Network

### Partners (Shareholders) of Initiative

DAIMLER



Linde



### NIP-Contact



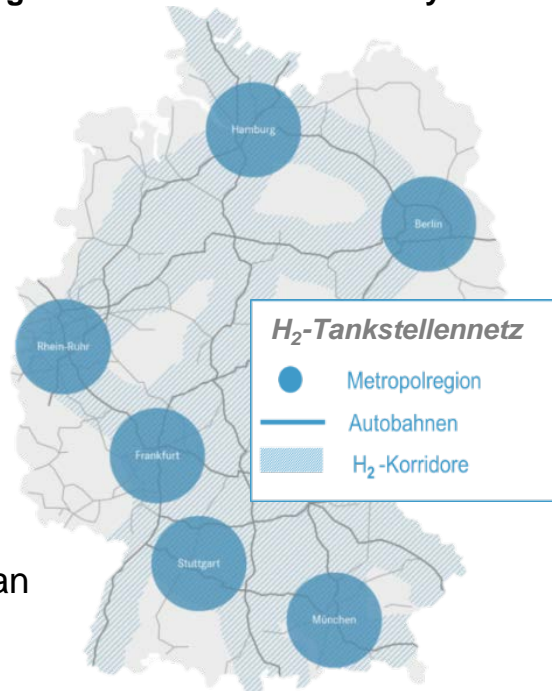
### Implementation-Plan

Build-up of a hydrogen refueling station network in Germany

~ 400  
public accessible HRS to  
be built-up in Germany

~ 90  
km distance between HRS  
on the Highways & around  
the Lighthouse-Regions

> 10  
HRS available in Metropolitan  
areas



H<sub>2</sub> Mobility Signing Ceremony  
Berlin – October 13th, 2015



### Associated Partners



HONDA



TOYOTA



# Thank you very much for your attention!

