



DAIMLER

Optimal interplay between fuel cell and battery:
Mercedes-Benz GLC F-CELL

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Content

- 1. Drivetrain Strategy & Fuel Cell Experience at Daimler**
2. The new Fuel Cell Plug-in-Hybrid Drive
3. An Intelligent Combination: Interplay of Fuel Cell and Hybrid Battery
4. Future Outlook

Drivetrain Strategy for individual Customer Needs



**Highly efficient
combustion engines**



Plug-in hybrids



**Battery electric and
fuel cell vehicles**

Broad Experience with Fuel Cell Technology



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



Citaro FuelCELL-Hybrid

- > 5 million km in Europe
- Press release of an operator
> 1 million km in regular operation
1,200 tons of CO₂ avoided

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The Fuel Cell Powertrain gets a Plug



Increase of driving range to 427 km from hydrogen and 51 km from battery

Mechanical power: 160 kW

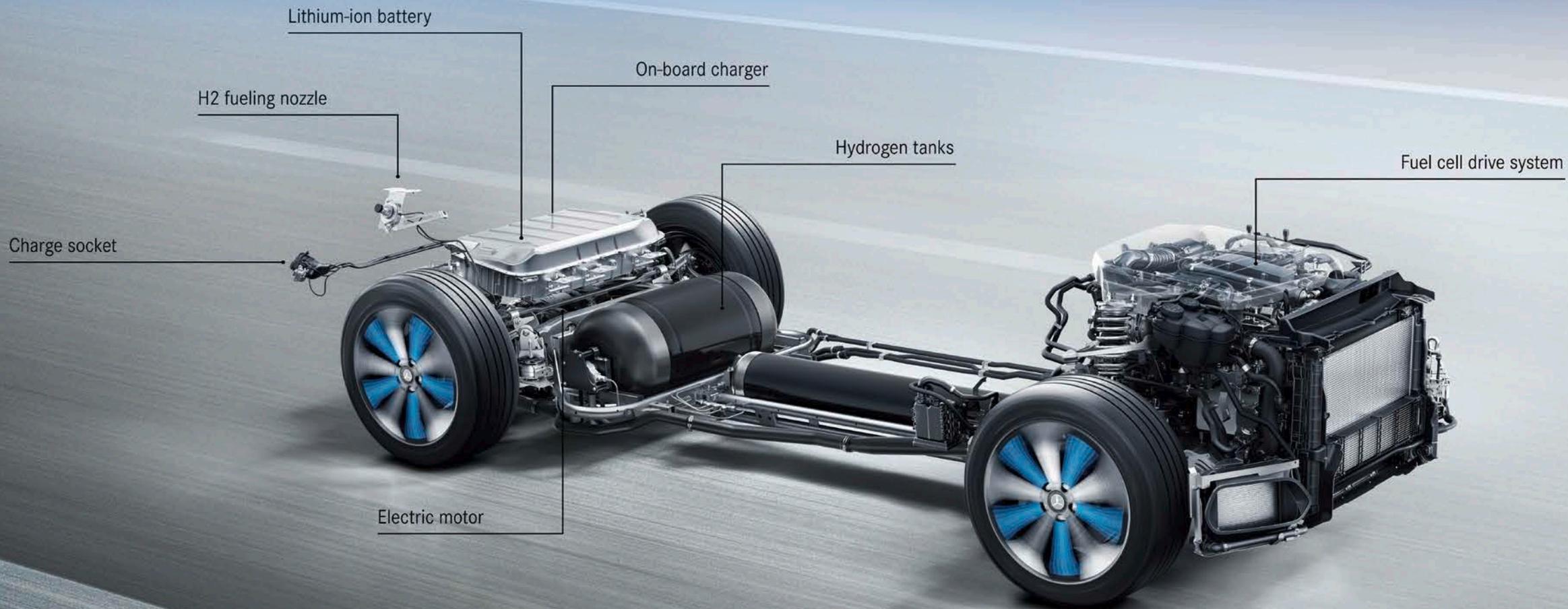
Reduction of packaging volume: -30%

Reduction of platinum loading: -90%

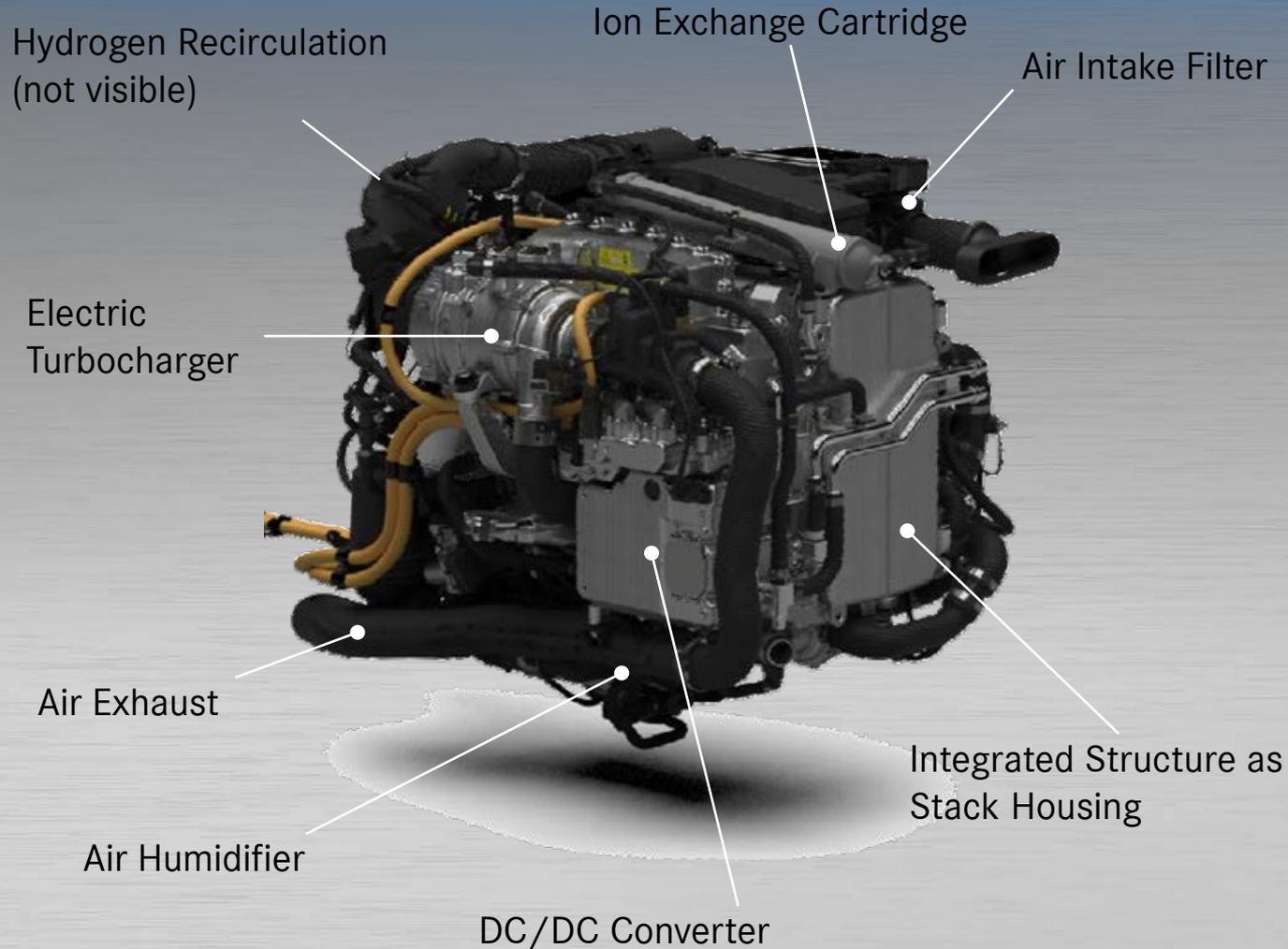
Implementation of plug-in battery to offer more flexibility in the build-up phase of the hydrogen infrastructure

Many HV components have been taken over from the Mercedes-Benz EV and hybrid vehicles to reduce cost

Powertrain of the Mercedes-Benz GLC F-CELL

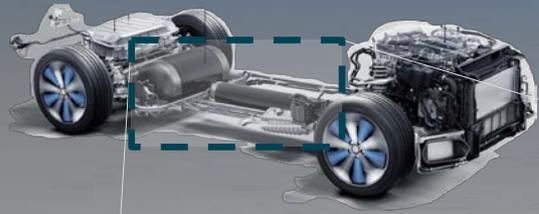


Fuel Cell Engine: Subsystems and Technical Data



Technical Data	
Fuel Cell Stack:	Appr. 400 PEM Fuel Cells Power: 75 kW
Air Supply:	Electric Turbocharger with Turbine
Air Humidifier:	Membrane Gas-to-Gas Humidifier
Hydrogen Recirculation:	Passive System driven by Jet Pump (no Active Blower)
DC/DC Converter:	Uni-directional Buck/Boost Converter
Cooling:	12V Cooling Pumps, Electric Thermal Control Valve

The Hydrogen Gas Fuel System as main Energy Storage with short refueling time



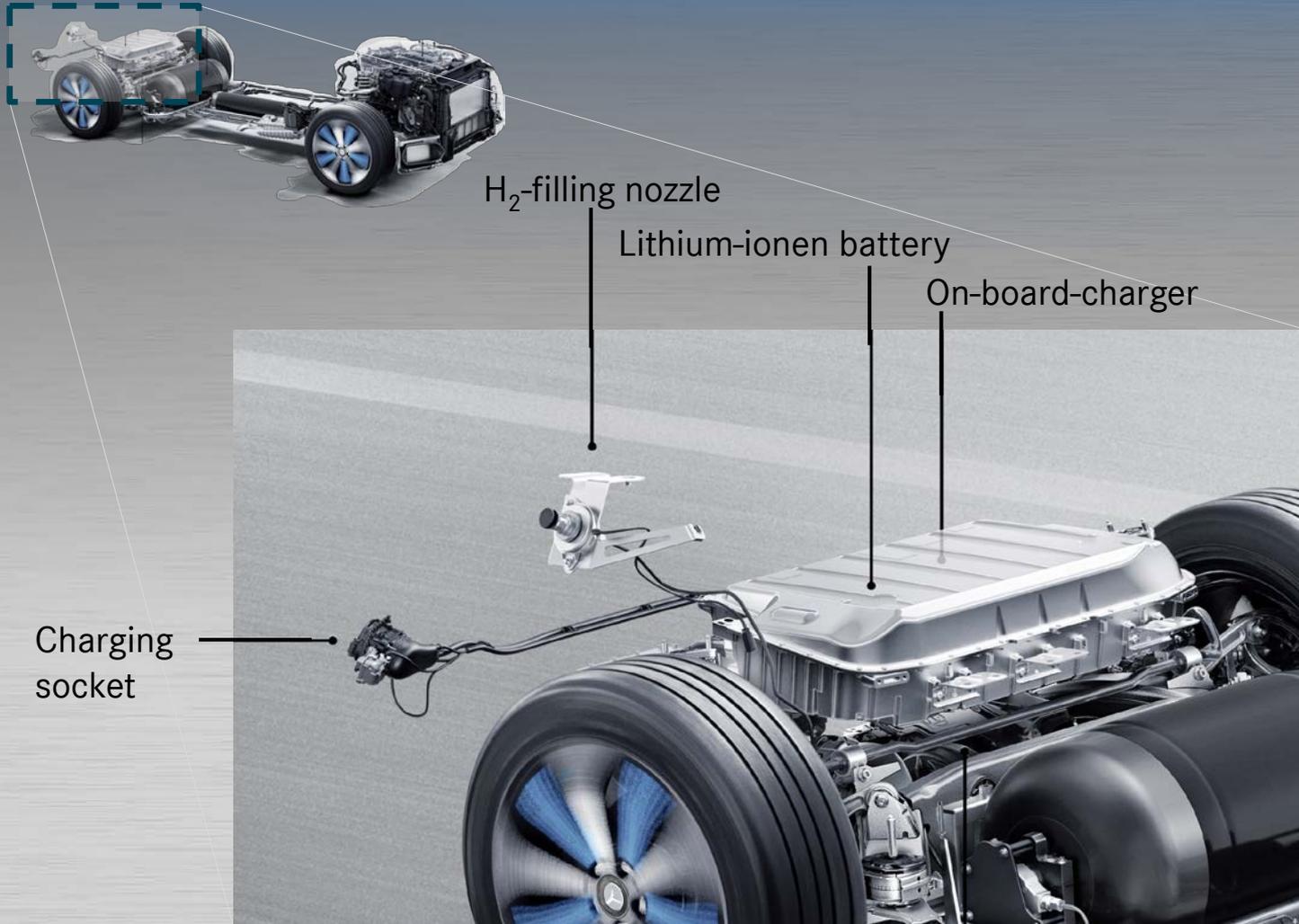
Hydrogen vessels



Specification:

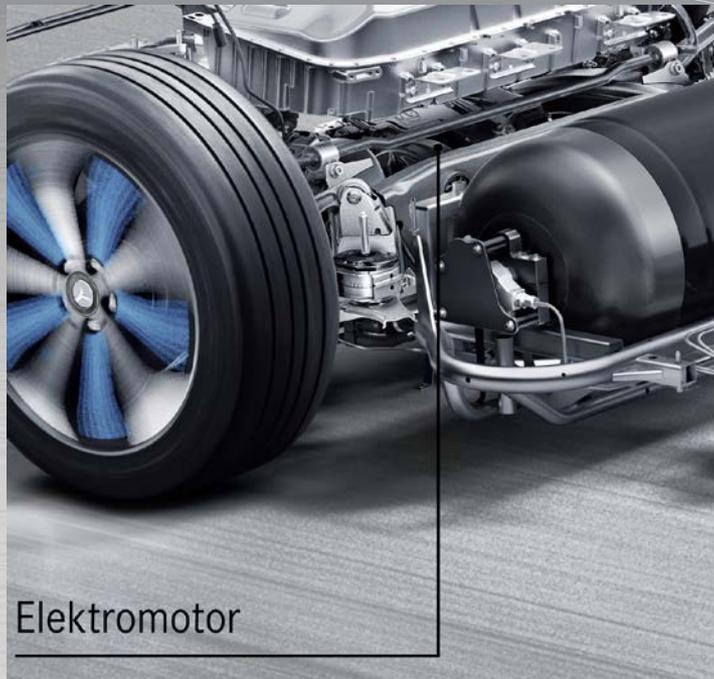
Type:	Carbon covered plastic container
Capacity (useable):	Appr. 4,4 kg
Operating pressure:	700 bar (worldwide standardized)
Time for complete refill:	Appr. 3 minutes
Number of vessels:	Two

Lithium-Ion Battery: Additional Energy Source for the Drive System



Specification	
Type:	Lithium-ion
Capacity: (installed/useable):	13,8 / 9,3 kWh
Max. charging power:	7,2 kW
Charging time:	1,5 hours with using the max. charging power

Perfectly integrated into the rear axle: The electric Traction Motor



Specification	
Type:	Asynchronous machine
Mech. power:	160 kW
Max. torque:	375 Nm

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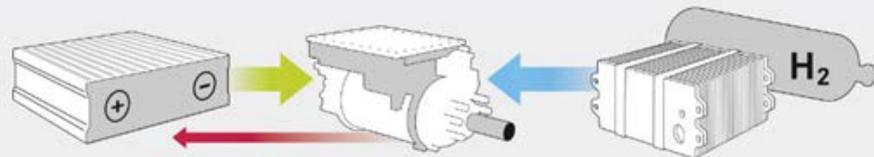
Fuel Cell and Battery: A perfect Symbiosis



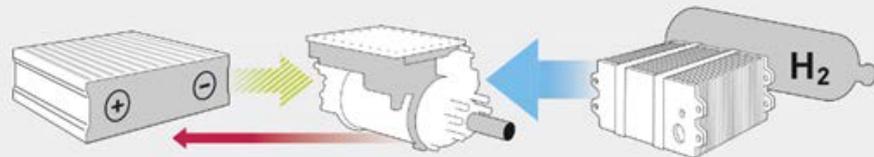
- Innovative plug-in fuel cell drive combines the advantages of both zero-emission drive technologies and, thanks to its **intelligent operating strategy**, continuously optimises the use of both energy sources in line with the current operating situation.
- Four operating modes: **HYBRID – F-CELL – BATTERY – CHARGE**
- **Energy recovery function** in all operating modes, which makes it possible to recover energy during braking or coasting and to store it in the battery.

Intelligent Operating Strategy with a unique Variety of possible Combinations

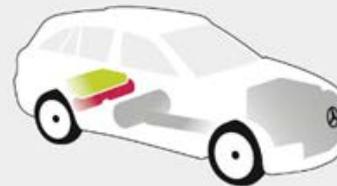
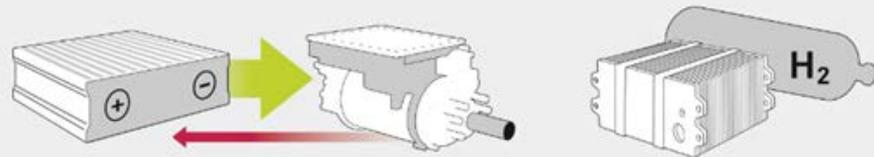
HYBRID



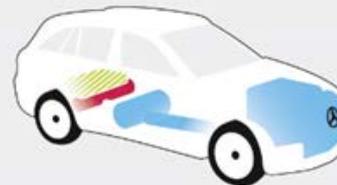
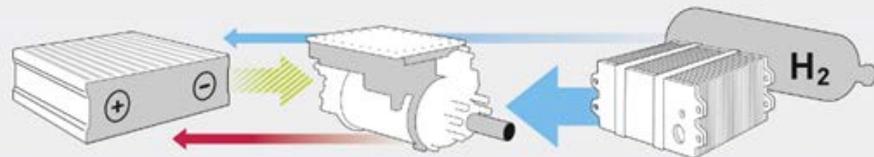
F-CELL



BATTERY



CHARGE



In **HYBRID** operating mode, the vehicle draws power from both energy sources. Power peaks are handled by the battery, while the fuel cell runs in the optimum efficiency range. The intelligent operating strategy means that the characteristics of both energy sources can be ideally exploited.

In **F-CELL** mode, the state of charge of the high-voltage battery is kept constant by the energy from the fuel cell. Driving almost exclusively on hydrogen is the ideal mode if the intention is to keep the electric range in reserve for certain driving situations.

In **BATTERY** mode the GLC F-CELL runs all-electrically and is powered by the high-voltage battery. The fuel-cell system is not in operation. This is the ideal mode for short distances.

In **CHARGE** mode, charging the high-voltage battery has priority, for example in order to recharge the battery for the maximum overall range prior to refuelling with hydrogen. This mode also creates power reserves for uphill or very dynamic driving.

→ Battery-electric energy → Fuel cell electric energy → Energy recovery

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One Engine – Three Applications



GLC F-CELL



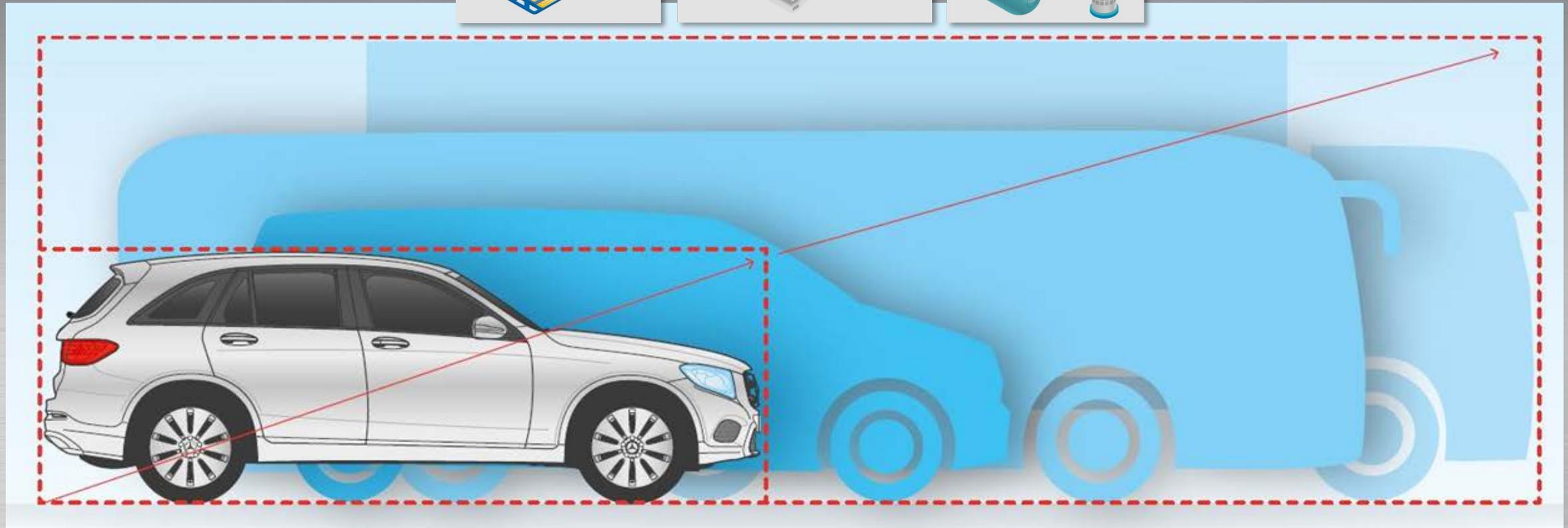
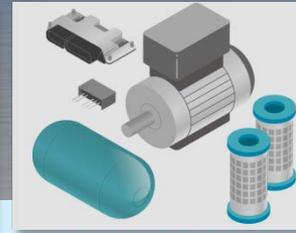
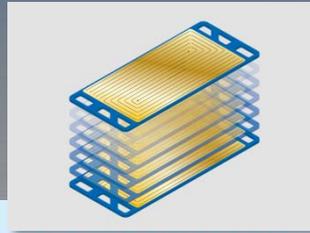
Concept Sprinter
F-CELL



Backup Power



Flexible and modular Application of Fuel Cell and Battery as Energy Sources from Passenger Car up to Commercial Vehicles



Thank you very much for your attention!

