

VOLKSWAGEN

AKTIENGESELLSCHAFT

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# The Possibilities of E-Mobility for the Future

Volkswagen Group's Solutions for Sustainable Mobility  
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Group External Relations  
Future Technologies



2013-10-17  
E-mobility event  
Swedish Car Industry Association  
Stockholm, Sweden

## Why do we need sustainable mobility?

**Climate change – emissions**



**Smog and noise in megacities**



**The finite nature of fossil fuels**

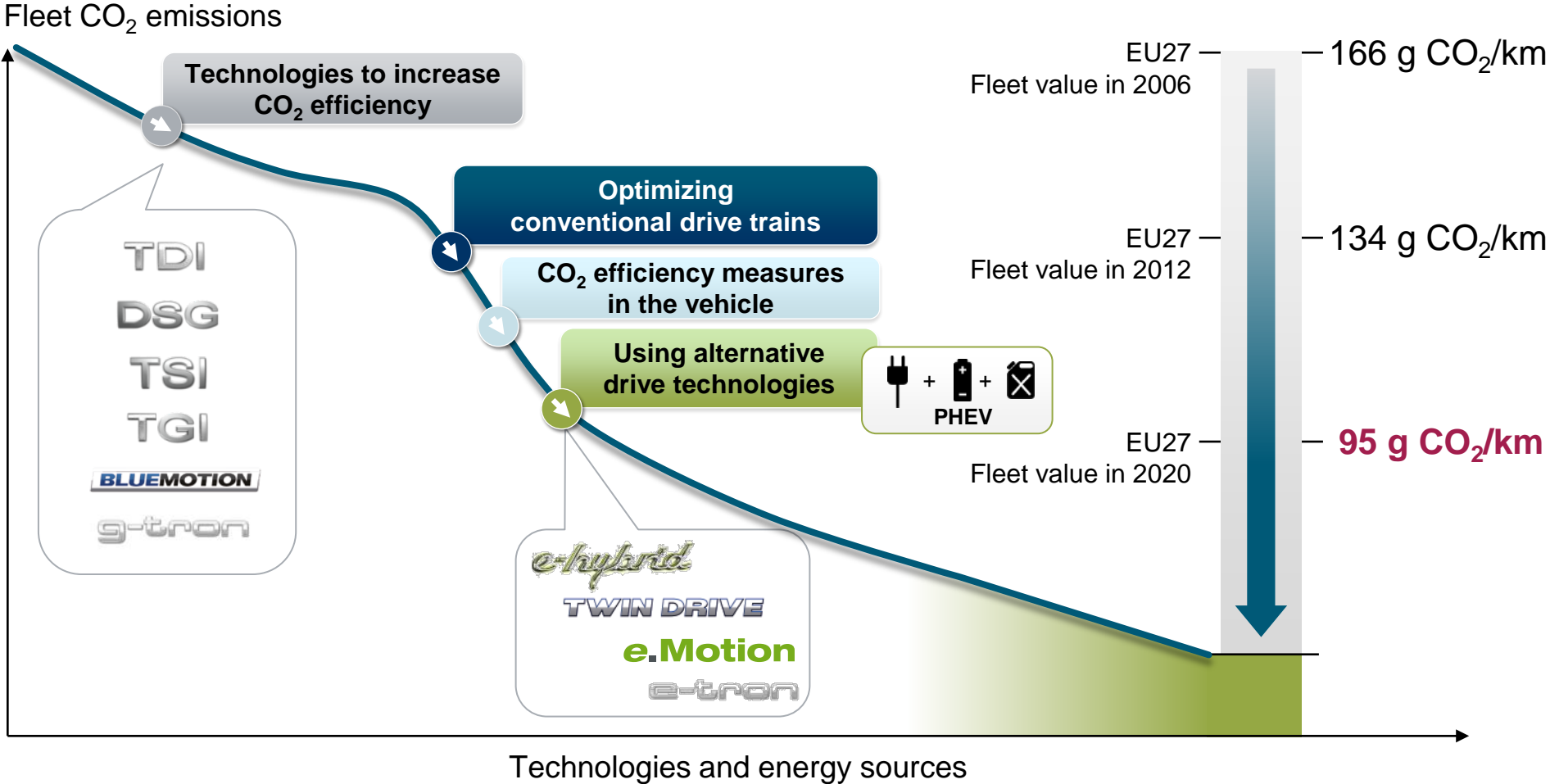


## Volkswagen XL1

Aerodynamics	<b>cd = 0.189</b>
Curb weight	<b>795 kg</b>
Top speed	<b>160 km/h</b>
Fuel consumption (NEDC)	<b>0.83 l/100 km</b>
CO2 emissions (NEDC)	<b>21 g/km</b>
All-electric range	<b>50 km</b>
Total range	<b>approx. 500 km</b>



# Carbon dioxide: Conventional drive technologies are not enough



## Volkswagen Group: Technologies to suit every need

What Volkswagen customers in Germany use their cars for most of the time (i.e., >75% of the time)



Golf TSI BlueMotion



Golf TDI BlueMotion



Jetta Hybrid



eco up!



Panamera Hybrid



Q5 Hybrid



**Golf TDI BlueMotion**  
**3,2 l/100km, 85gCO<sub>2</sub>/km**



# Measures to improve CO<sub>2</sub> efficiency

## Engine

## Gearbox

### Combustion system

High-performance combustion system

Combined turbo- and supercharging

Ignition systems

Variable valve train

Variable compression ratio



### Lightweight design

Alternative materials

Lightweight design through optimized structures



### Operational strategy

Active Cylinder Management

Optimizing engine mapping

Engine off while coasting

Downspeeding

NVH at low rpm



### Friction

Surface coating

Thermal management

Utilizing exhaust heat



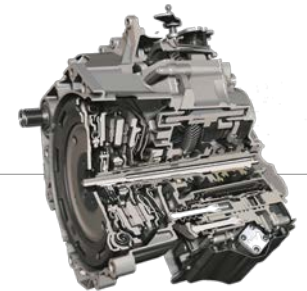
### Dual-clutch gearbox

Gear-ratio spread

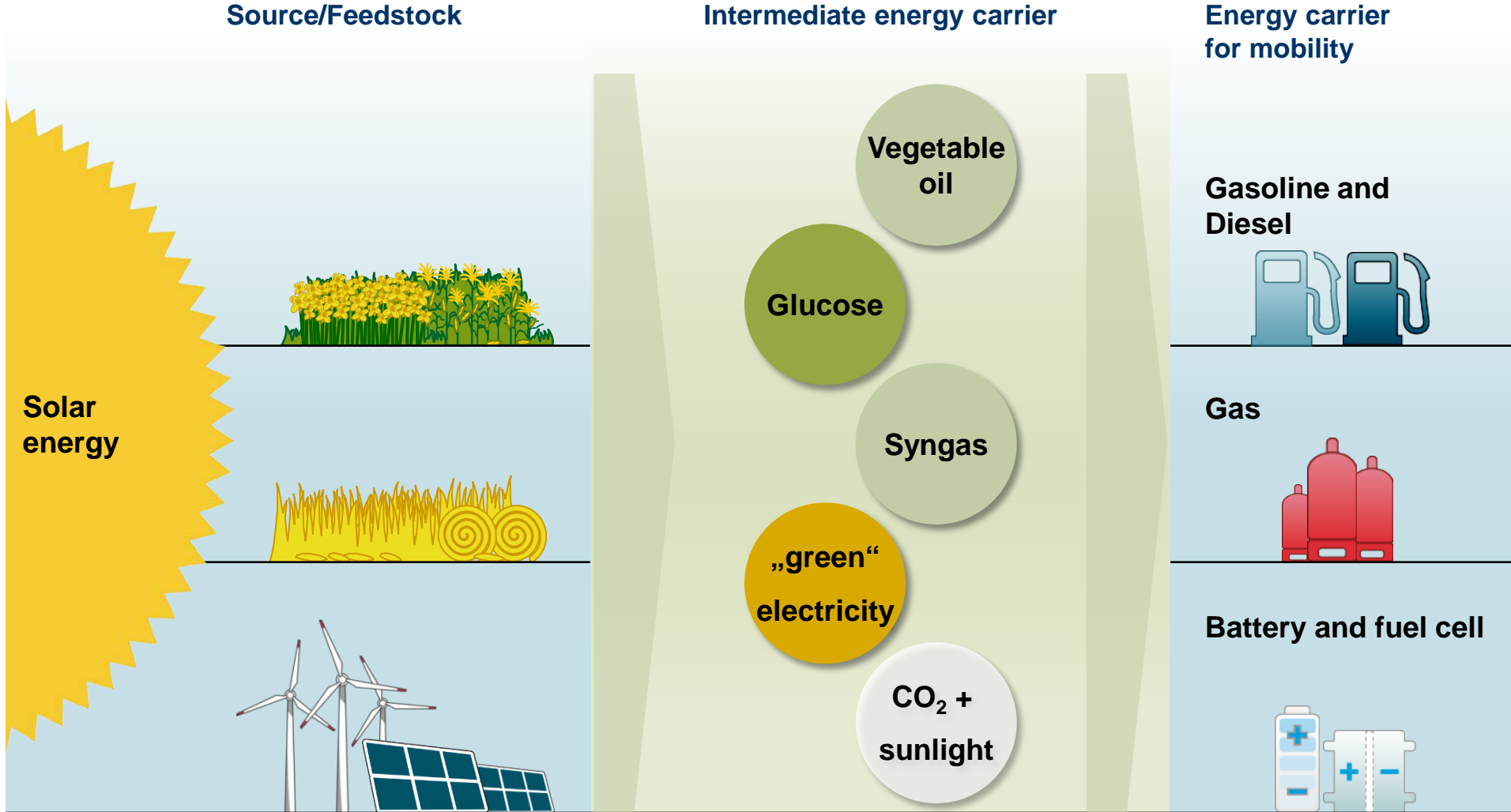
Efficiency

Performance when pulling away

Low-rpm solution

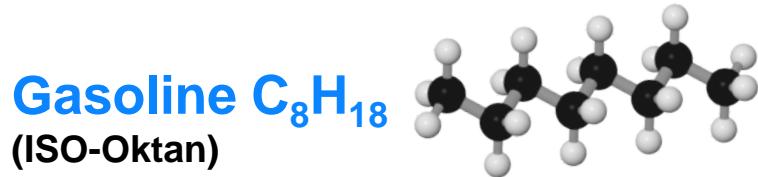


# Evolution of renewable energy pathways

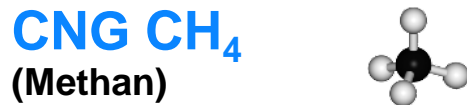




## The new CNG-powered vehicles: Advantages of CNG in terms of CO<sub>2</sub> emissions



1 kg of gasoline generates 3.1 kg of CO<sub>2</sub>  
(Heating value 41.0 MJ/kg)



1 kg of methane generates 2.75 kg of CO<sub>2</sub>  
(Heating value 47.7 MJ/kg)

Potential reduction in CO<sub>2</sub>  
emissions in consideration of  
the heating value

Methane



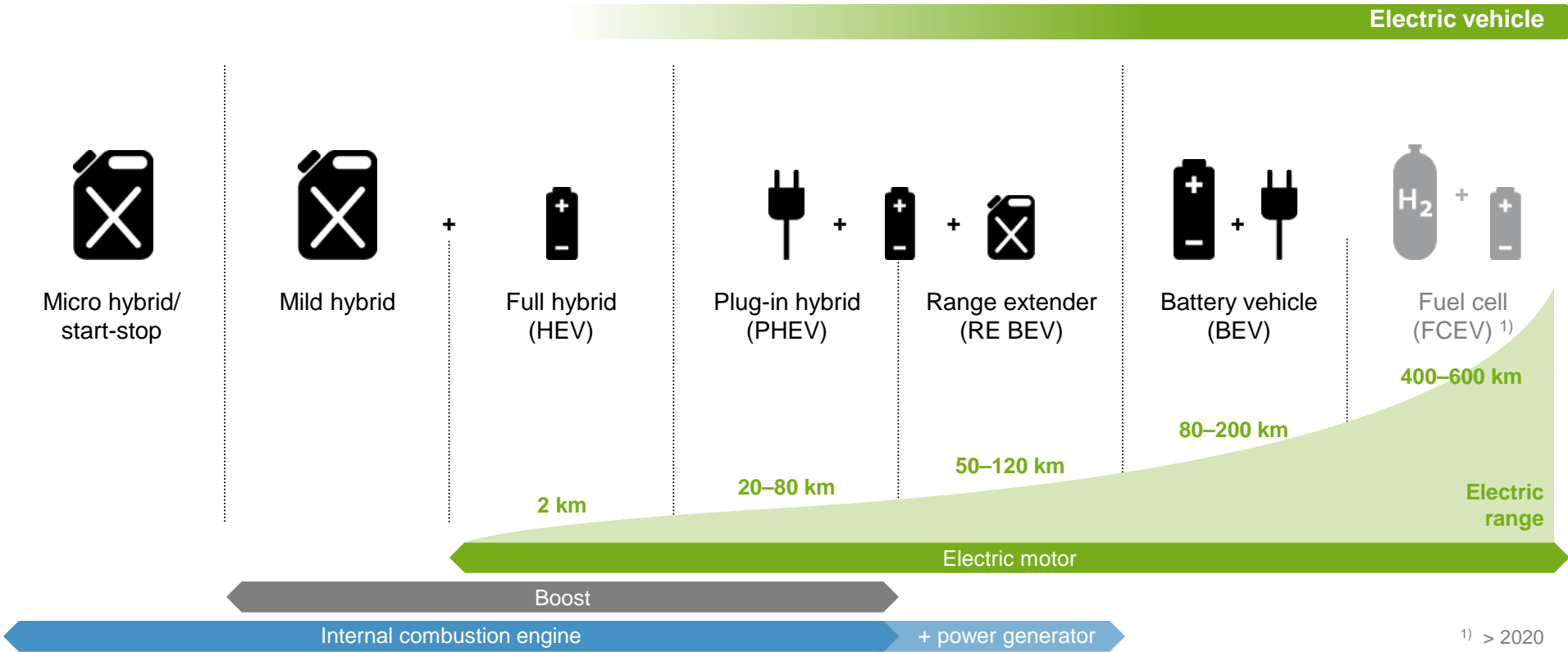
-25%



## Volkswagen eco up!, Volkswagen Golf TGI & Audi A3 g-tron

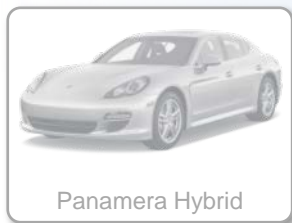


# Electrifying the Drive systems at Volkswagen



## Volkswagen Group: Technologies to suit every need

What Volkswagen customers in Germany use their cars for most of the time (i.e., >75% of the time)





## Volkswagen e-up!





## The electric drive system of the e-Golf

### Electric machine

Permanent magnet synchronous motor

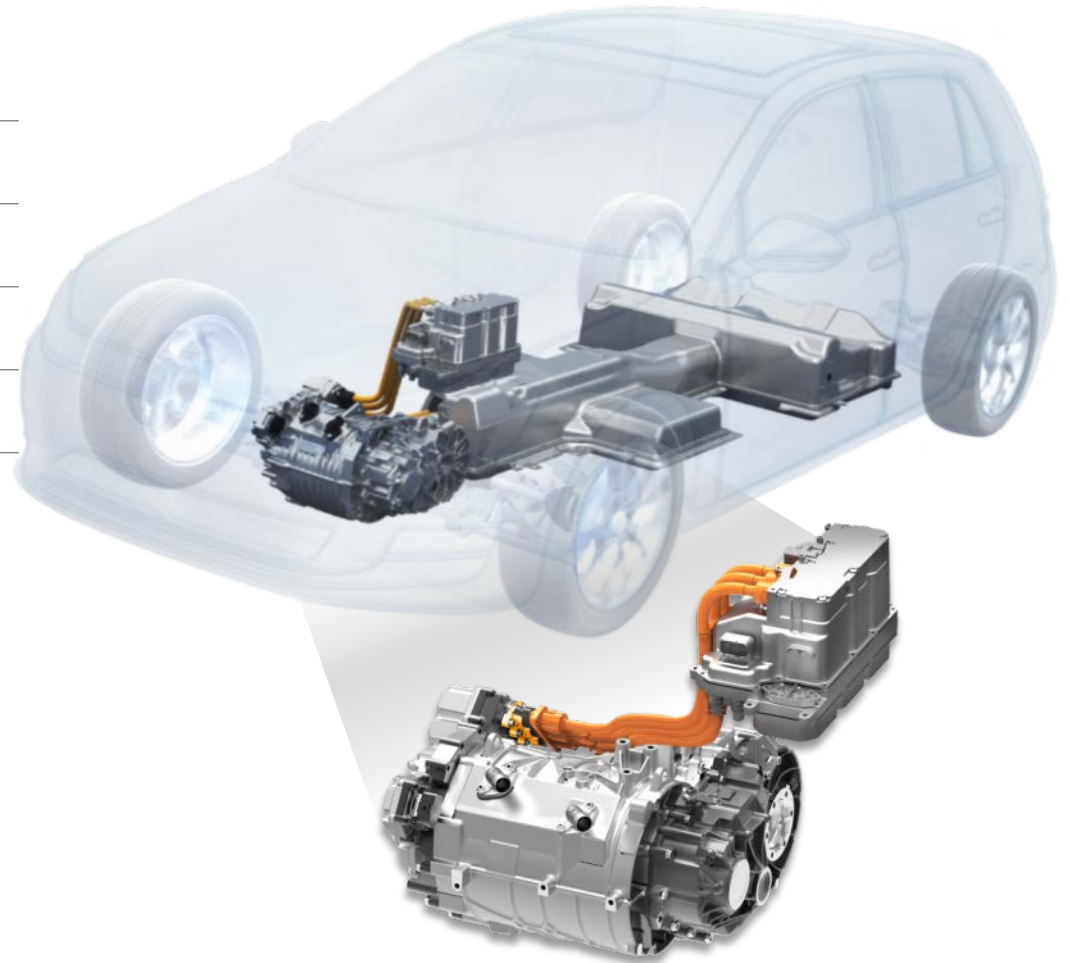
Max. power output **85 kW**

Constant power output **50 kW**

Max. torque **270 Nm**

Constant torque **160 Nm**

Range **175 km**



# Combined Charging System – One System for All

Easy Handling and Widely Spread User Acceptance

Uniform, open and standardised solution as future-proof investment

Simple – Safe – Flexible  
No need for variants



High Power DC



Type 2 Core



Charging Time

15 min

Ultra Fast

1 h

Speed of Charging

8 h

Basic

# Volkswagen Group: Technologies to suit every need

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Golf TSI BlueMotion



XL1



Golf TDI BlueMotion



Jetta Hybrid



Golf PHEV



Golf blue-e-motion



e-up!



Porsche  
Panamera S e-hybrid



eco up!



Panamera Hybrid



Audi A3 e/tron

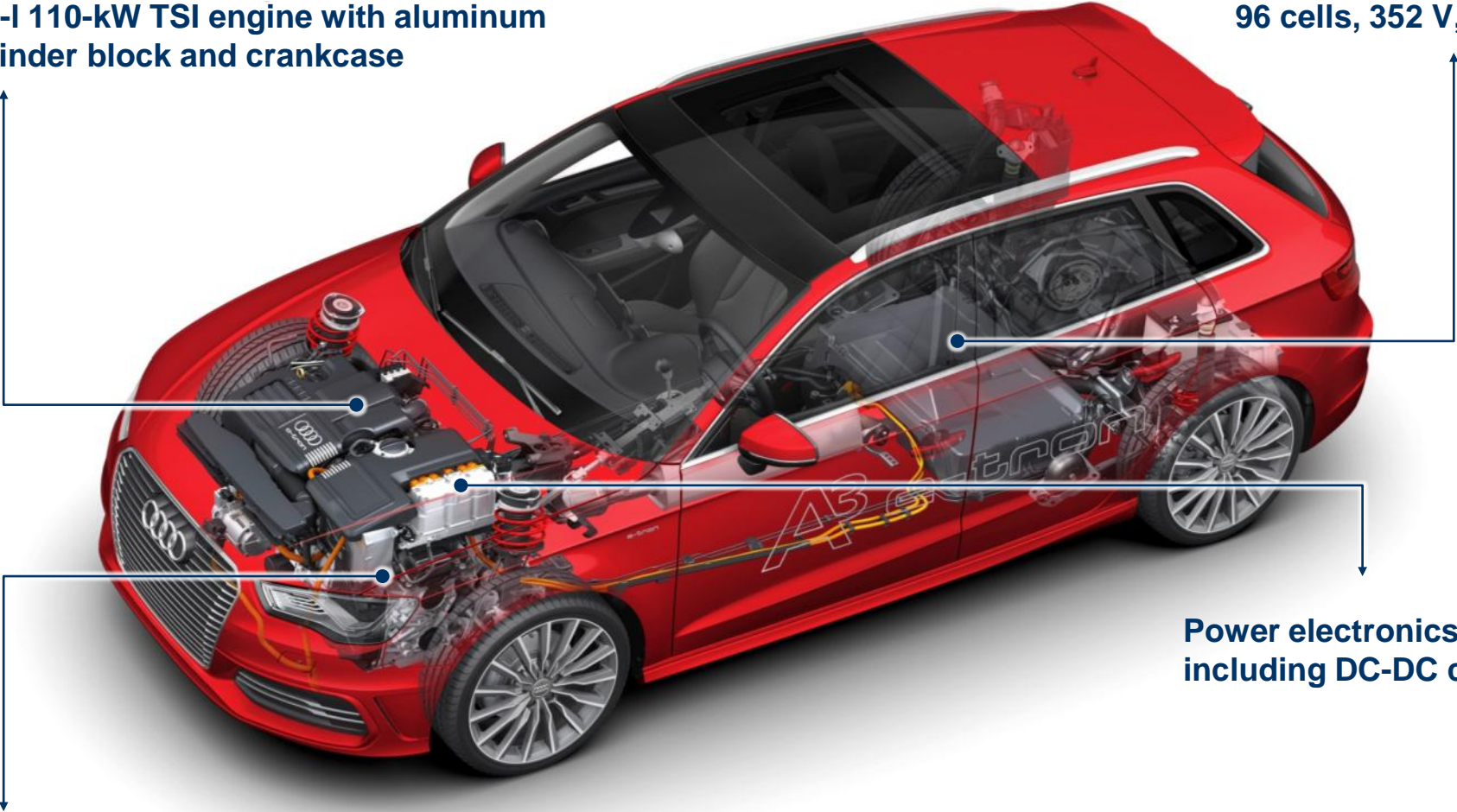


Q5 Hybrid

# Audi A3 e-tron

1.4-I 110-kW TSI engine with aluminum cylinder block and crankcase

Lithium-ion battery  
96 cells, 352 V, 8.8 kWh



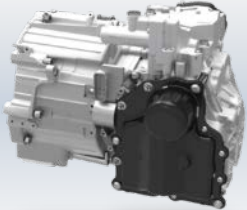




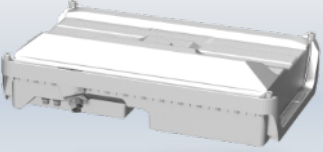
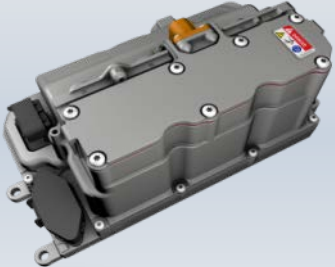




Power electronics  
including DC-DC converter

Dual clutch gearbox DQ400E with  
integrated electric machine (80 kW)

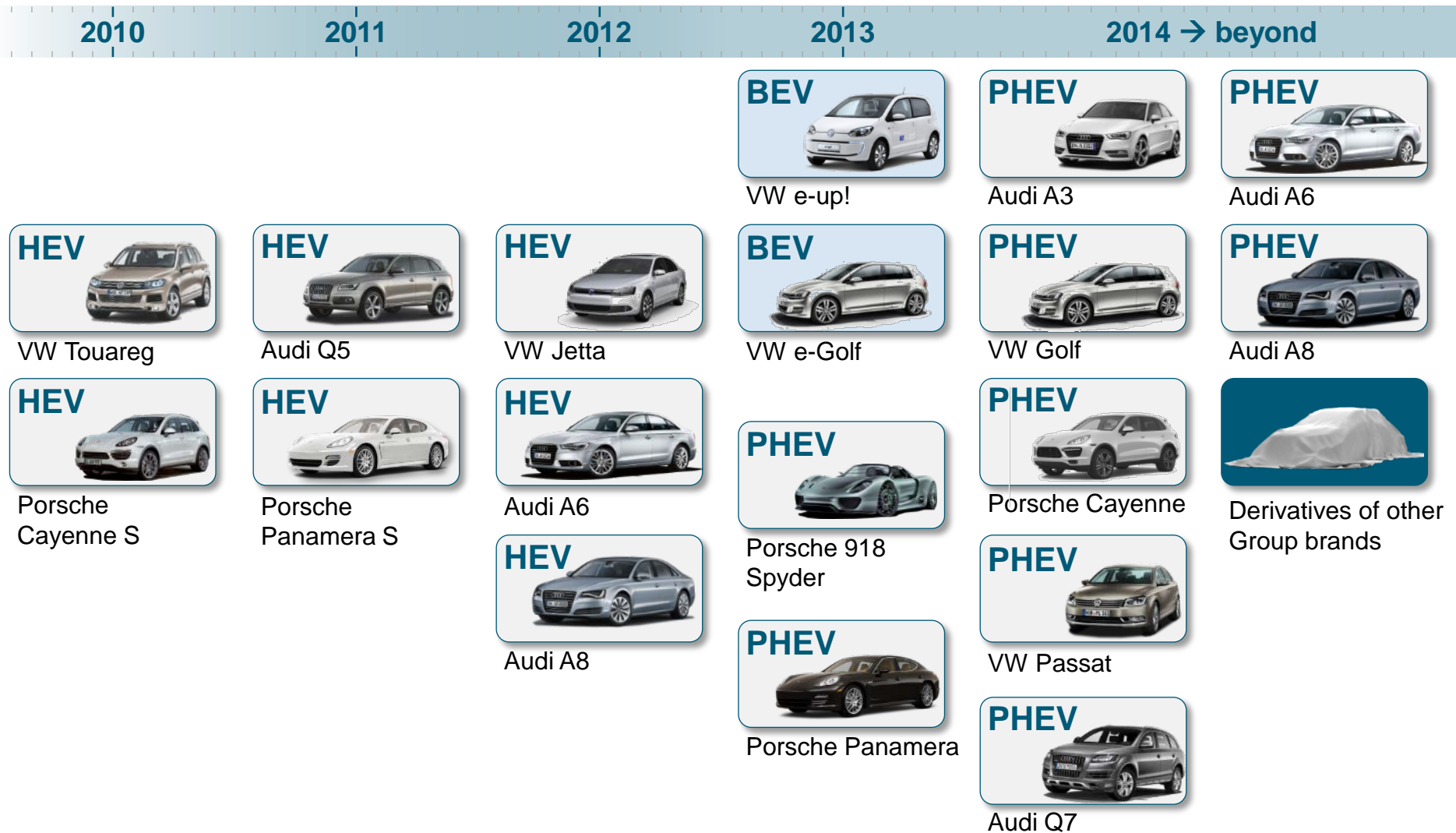


# Assembly kit for hybrid drive systems

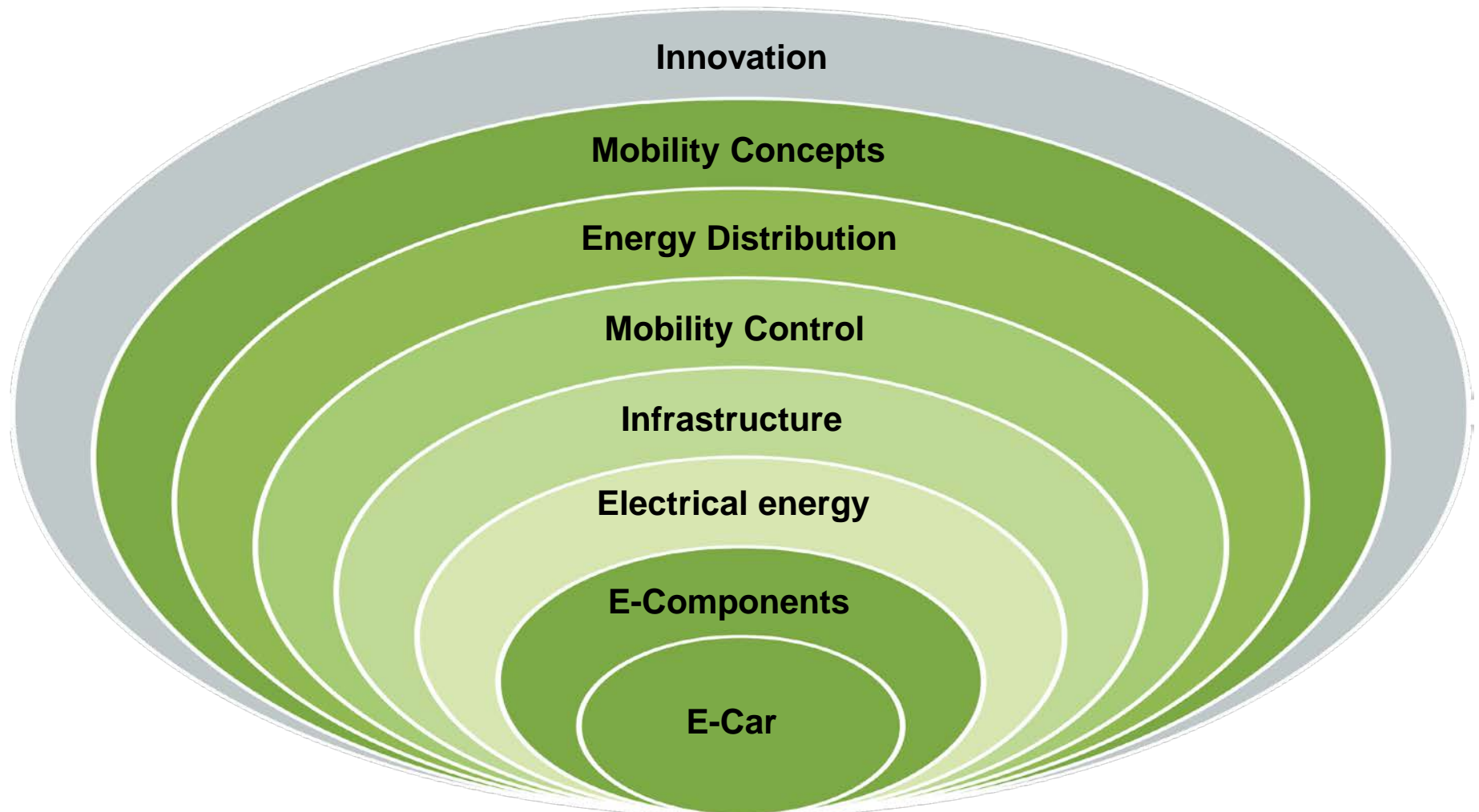
Engine	Electric machine	Gearbox	Battery	Power electronics
 <p>2-cylinder in-line TDI</p>	 <p>HEM 20</p>	 <p>DQ200E</p>	 <p>HEV</p>	
 <p>3-cylinder in-line TSI/TDI</p>	 <p>HEM 60</p>	 <p>DQ400E</p>	 <p>PHEV</p>	 <p>Power electronics</p>
 <p>4-cylinder in-line TSI/TDI</p>	 <p>HEM 80</p>			



# Volkswagen is electrifying all vehicle classes



## E-Mobility is more than just the development of E-Cars



# Megatrends Urbanization, Technological und Societal Change result in needs, often only partly addressed in urban environment

## Societal needs are changing continuously

### increasing Urbanisation



- Search for **modern center of living**
- **Places to Recover** from fast city live

### Technology-change



- optional, connected **Mobility system**
- **Communication** every time, every place

### Society change



- **Sustainability** for daily live
- **Support** und Integration of the **society**

## Adressing actual insufficient





# To adress the needs we must tackle three main challenges

## Ensuring city mobility

...despite Reductions in  
Innercity road traffic



...despite Noise- and  
exhaust emissions



## Connecting and interactive communication

Creation of seamless  
transport modes



Integration of modern  
Technology and Communication



## Creation of live worth city environment

Recapture  
public space



Support Community and  
Co-creation



## Solution: VW MicroCity as innovative answer to future challenges



- The VW MicroCity serves as modern **Mobility center**...
- ...connecting various **Mobility offers** with complementary services
  
- The VW MicroCity is creating an emotional connection to **customers**...
- ...through **Integration of the society**, support of **sustainability** and creation of a modern **center of living**

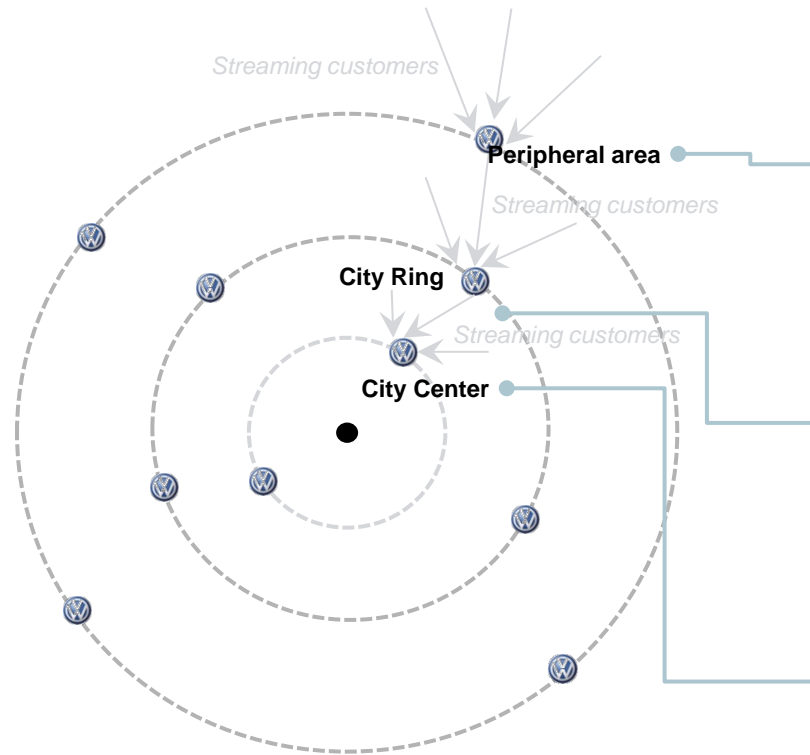
**Seamless Connection of cross sectorial services  
concentrated in a MicroCity**



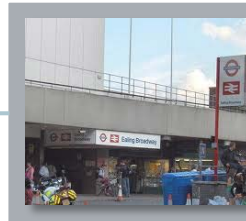
# The Concept enables reduced inner city traffic by guiding customer streams

## Define Customer streams...

## ...examples of MicroCities



VW MicroCity



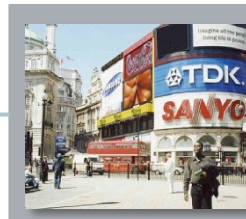
### MicroCity in suburban environment

- platform to change to alternative Mobility offers as well as shopping place for commuters and residents



### MicroCity in outer ring areas

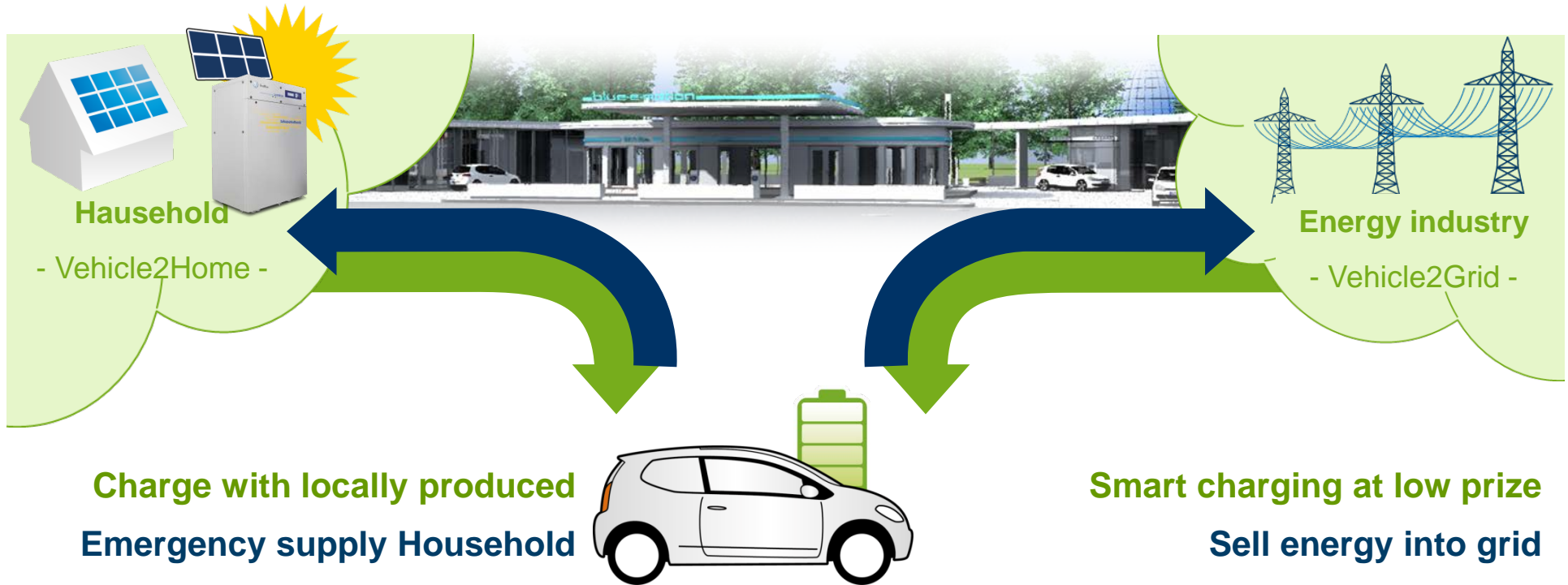
- Central docking station / traffic center for commuters from suburbs



### MicroCity in City center

- Near to city center to switch to last mile mobility

# Customer function Vehicle to Home / Vehicle to Grid

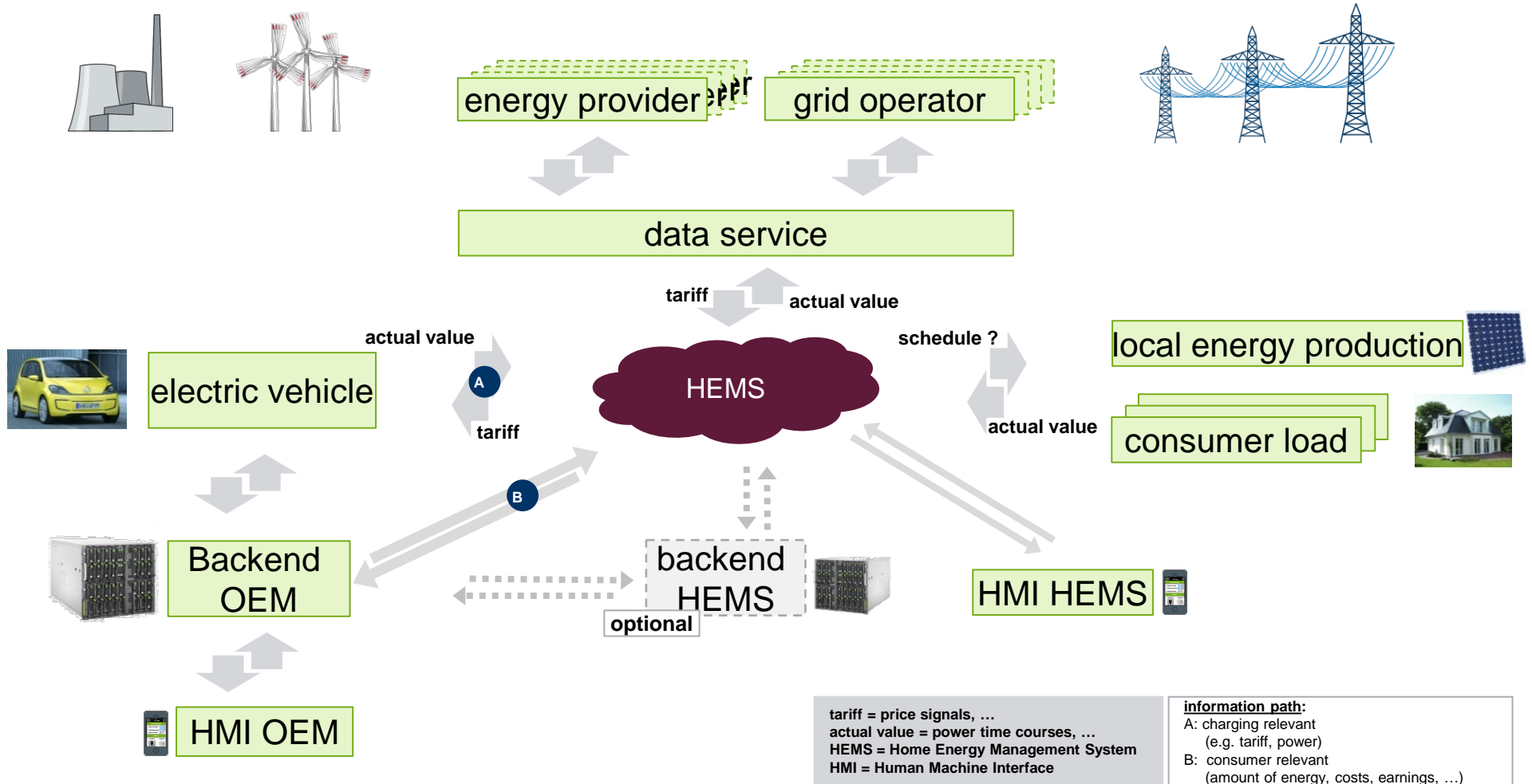


Development of an customer oriented energy management considering the car needs

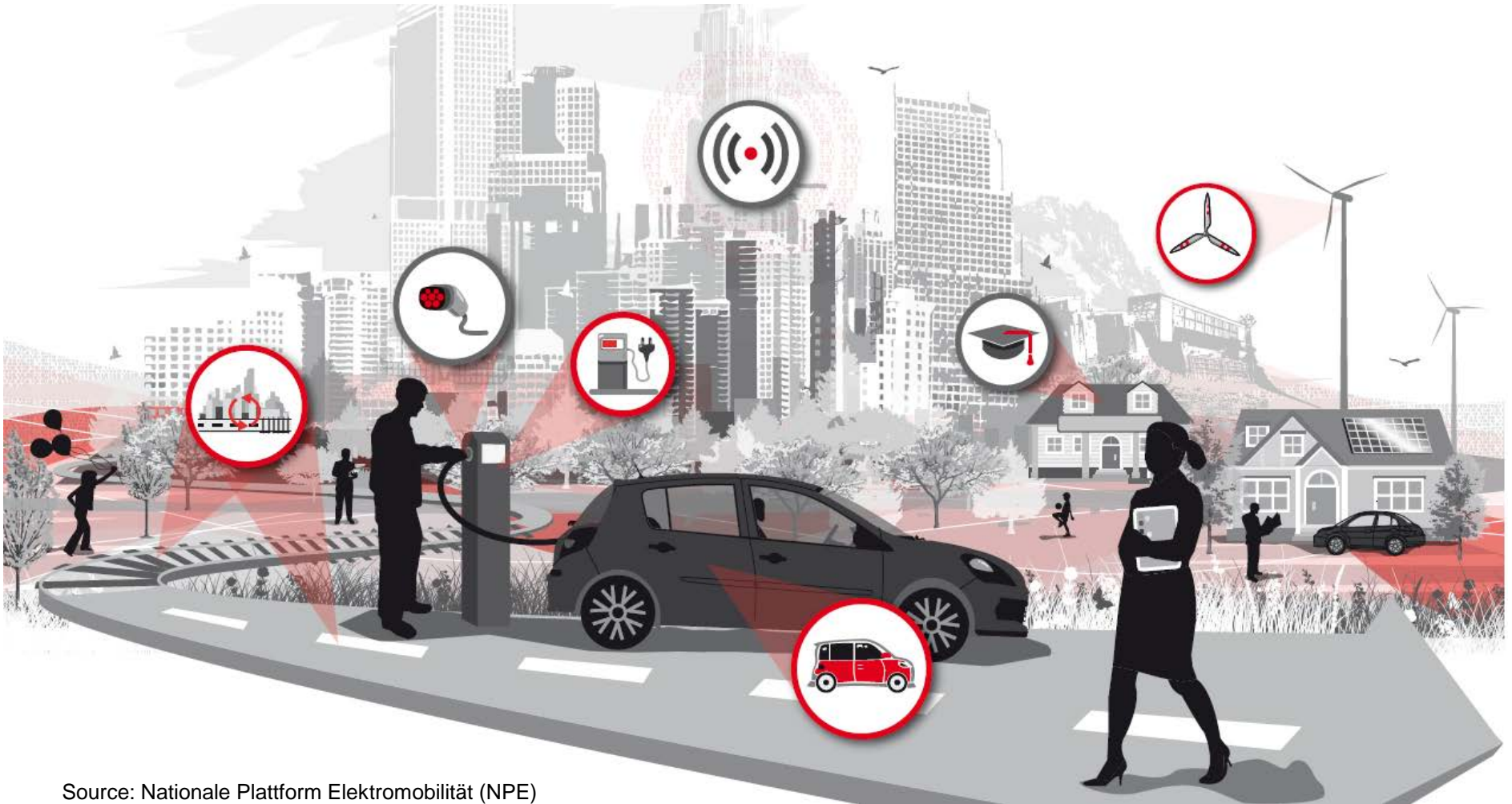
Electro mobility can failsave a continuous Increase of fluctuating energy supply

# Electric Vehicle Grid Integration

## Role model – BEV/PHEV Grid Integration



## Electro mobility – a systems approach



Source: Nationale Plattform Elektromobilität (NPE)



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**Thank you  
for your Attention!**

