ASCENT

Advanced vehicle aspects

1st Training in Bahia Blanca, ARG

12-14th of November 2018

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48V electric system

- High power at low voltage => high currents => low efficiency
  - 12V not enough anymore
- For many components a switch to 48V would be beneficial:
  - Electric oil/water pumps
  - Power steering
  - Electric brake systems (incl. ESP)
  - Air conditioning compressor
  - Electric super chargers
  - Etc.
- 48V as a promising alternative
  - Lower currents for same power demands => higher efficiency
  - Still „save to touch“ (limit by law is 60V)

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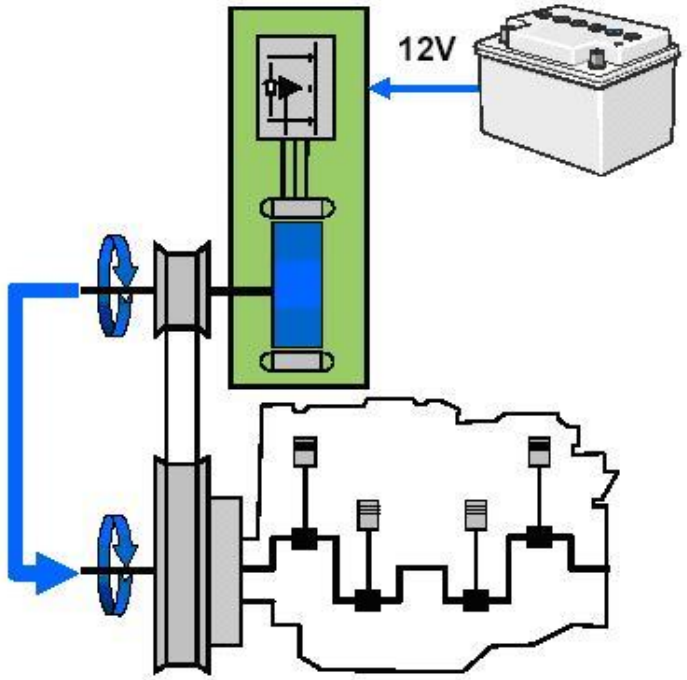
48V electric system – hybrid



- 48V would be enough to power:
  - micro hybrid power trains
  - Small electric cars => Renault Twizy
- Power levels of 8-10kW possible
  - Still difficult to handle the high currents
  - For micro hybrid a belt alternator starter is the best option
- In a micro hybrid the electric motor is only assisting the ICE
  - Load point shift possible
  - Performance boost possible
  - No pure electric driving

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Renault Twizy

Specs:

- Weight of 450kg
- Electric motor power: 4 or 8kW
- Battery voltage: 58V (just below limit)
- Range: 100km
- More than 20000 cars sold
- Price: starting at 8000€

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Alternative/Hybrid power train layouts

- Series Hybrid
  - Not common in the automotive industry
  - Only used in range extender power trains
- Parallel Hybrid
  - Very common in the automotive industry
  - Many different layouts possible
- Power Split
  - Very variable power flow in the drive train
  - Example Toyota Prius

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Series Hybrid architecture

- All components are arranged in series:
  - ICE => generator => rectifier => buffer battery => inverter => motor => wheel
- ICE can be built simpler => only needs to run in one operating point
- Efficiency is compromized by the many energy conversions
- Series hybrids are often heavy
  - For a 100kW power train you need an ICE , a generator and a motor all capable of 100kW
  - So you have 3 big machines in your power train
- Not used often in passenger cars
  - Can be a good option for buses, trains, ships, heavy machinery

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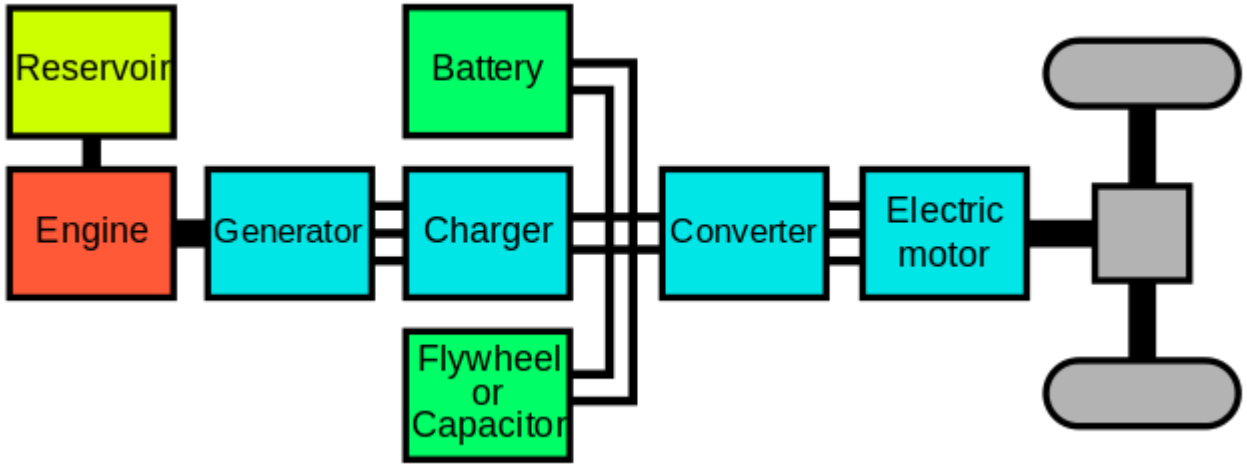
Series Hybrid architecture



General layout of a series hybrid power train

Often used in ships or trains

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Series Hybrid architecture - range extender

Examples of cars with a range extender

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Parallel Hybrid architecture

- e-motor and ICE are arranged in parallel
- Both can directly drive the wheels
  - Slightly better efficiency
- Only one e-machine is necessary
- Many different layouts possible
  - Different location in the power train
  - Different number of e-machines
- most used hybrid concept for passenger car

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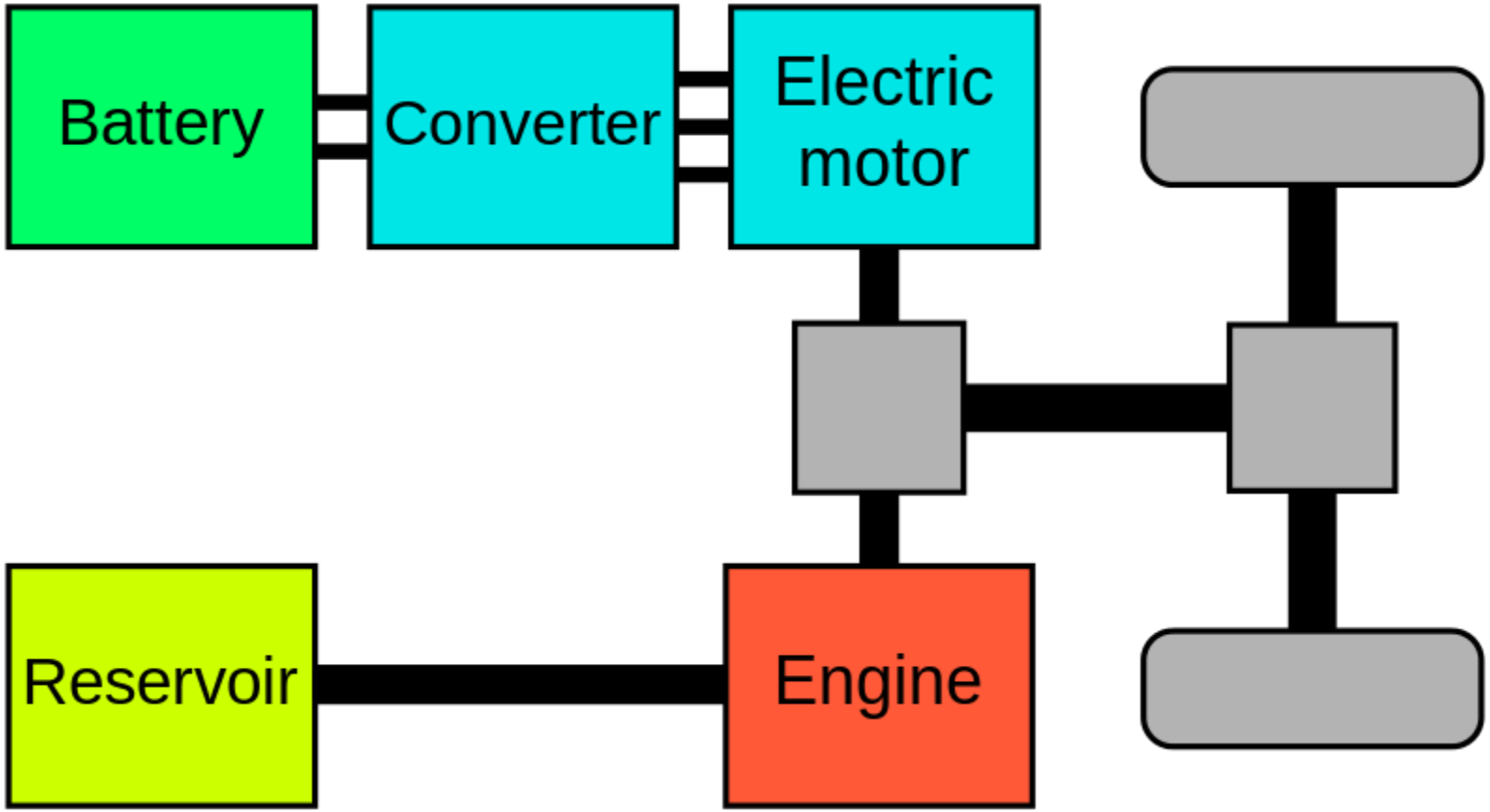
Parallel Hybrid architecture



General layout of a parallel hybrid power train

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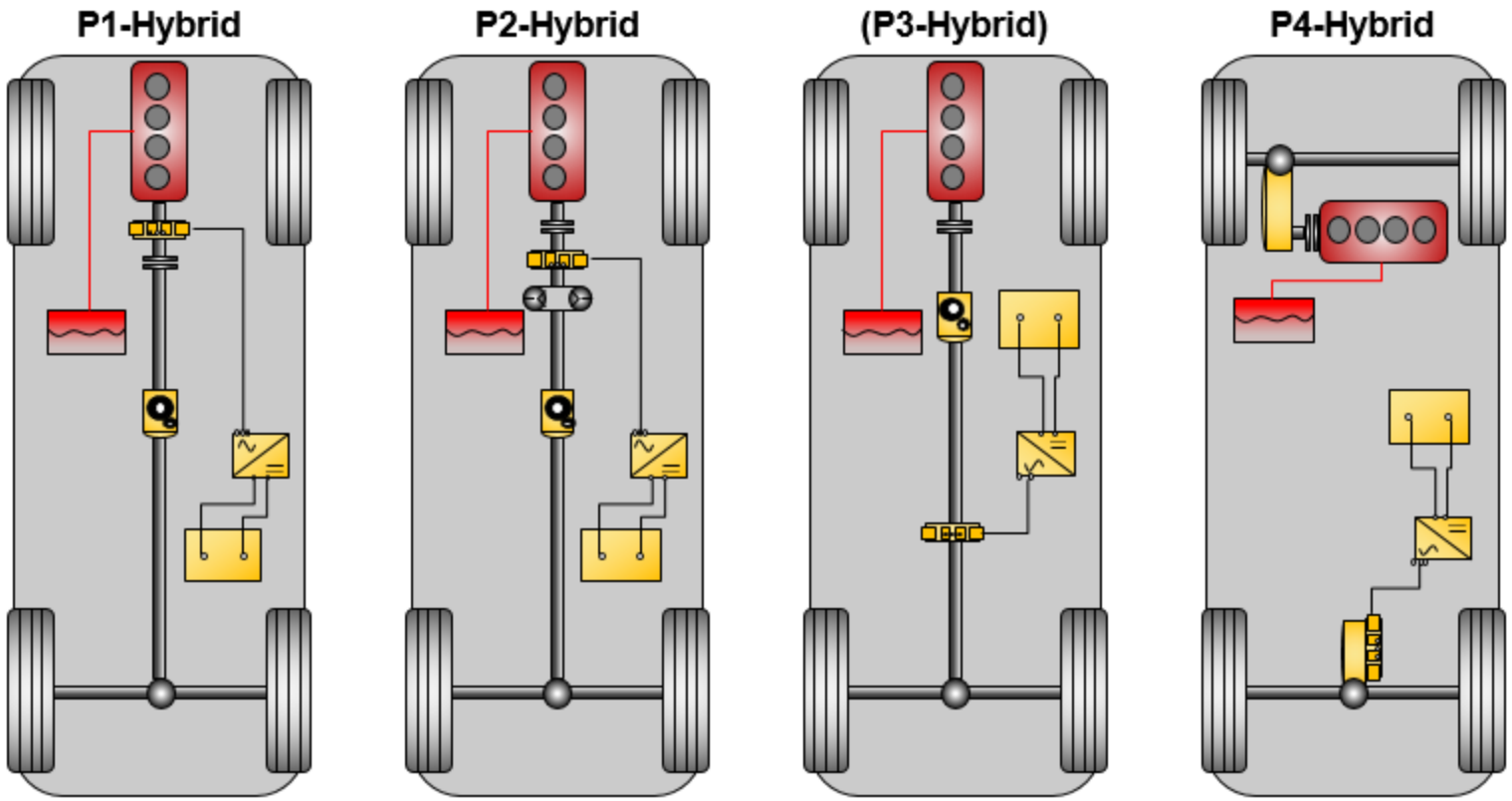
Parallel Hybrid architecture - layouts



different layouts/categories of a parallel hybrid power train

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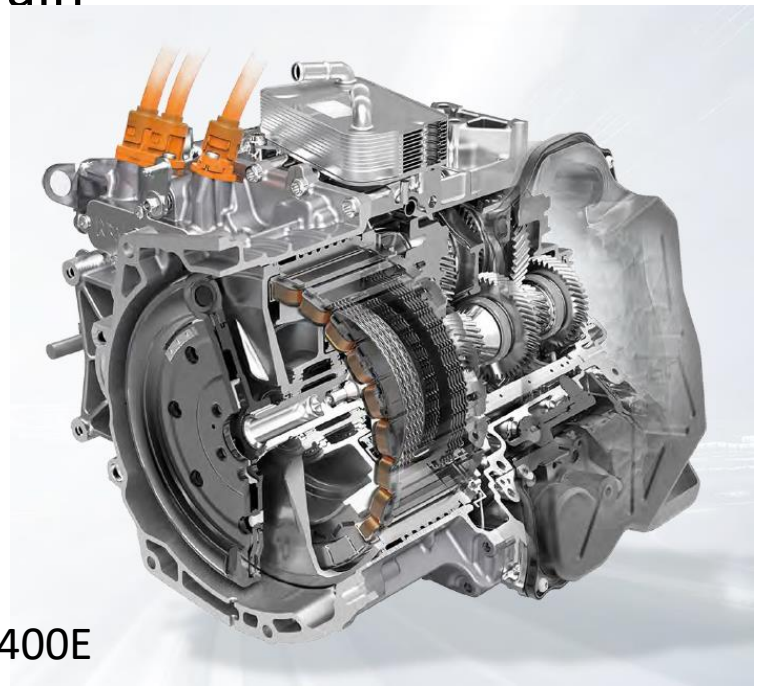
Parallel Hybrid architecture – hybrid

- Integration of parts is a common methode to save weight
- Volkswagen integrated an e-motor in their DCT
  - Light and compact way to include e-motor in power train
  - Capable of up to 400Nm of input torque
  - 80kW of electric power
  - P2 hybrid architecture



Volkswagen DQ400E

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Parallel Hybrid architecture - examples

New generation Honda NSX is using a combination of P1 and P4

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Power split Hybrid architecture

- Technology invented by Toyota (used in the Prius)
- This makes it the most succesfull hybrid concept by sales numbers
  - Since 1996 more than 10 Mio. pieces have been produced
- The THS (Toyota Hybrid System) consists of:
  - One internal combustion engine
  - 2 electric machines (1 motor, 1 generator)
  - The power split device => planetary gear set
- Main driver is ICE, e-machines are used to act as a CVT transmission

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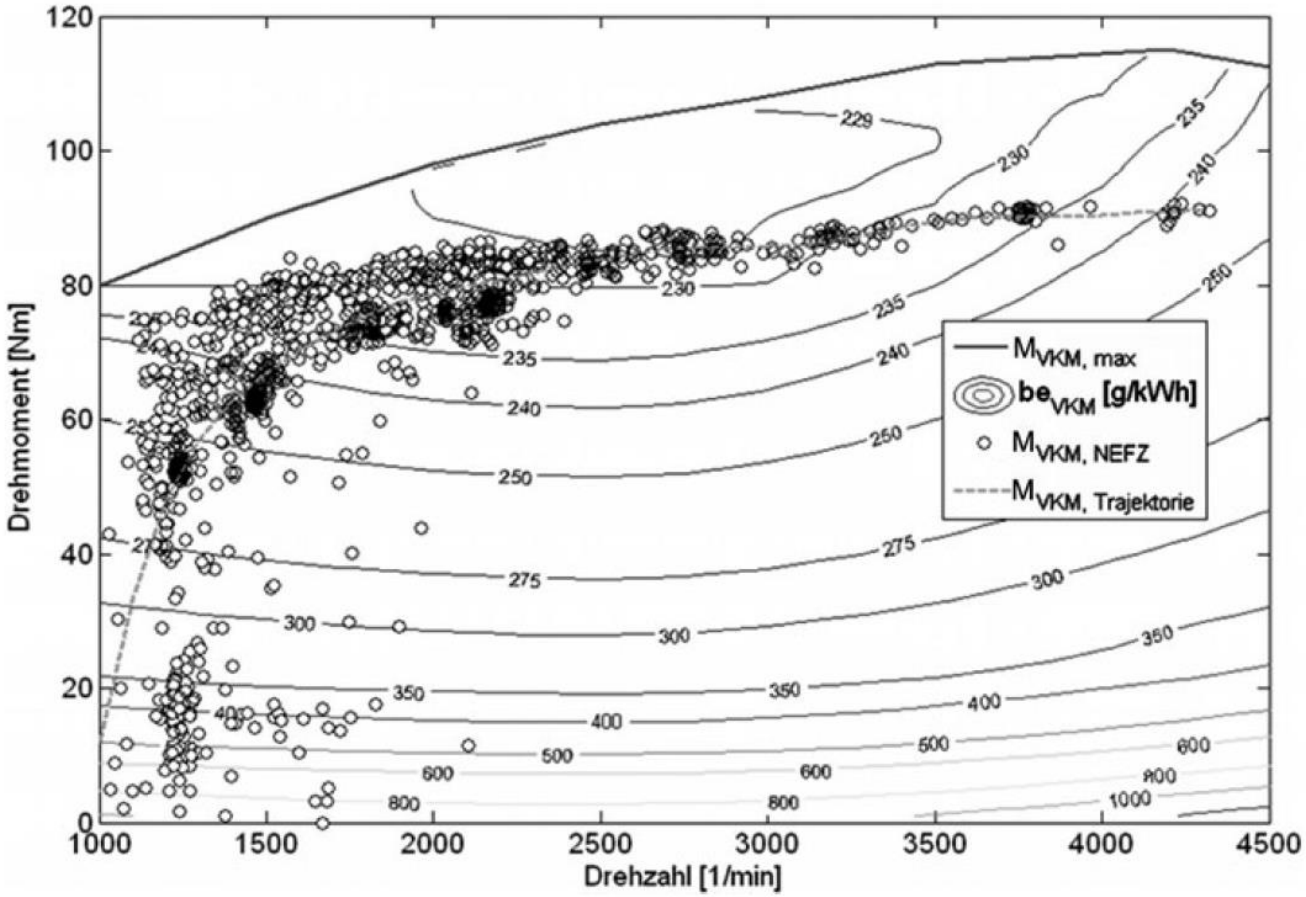
Power split Hybrid architecture



Operating points of the Prius ICE due to the CVT like strategy

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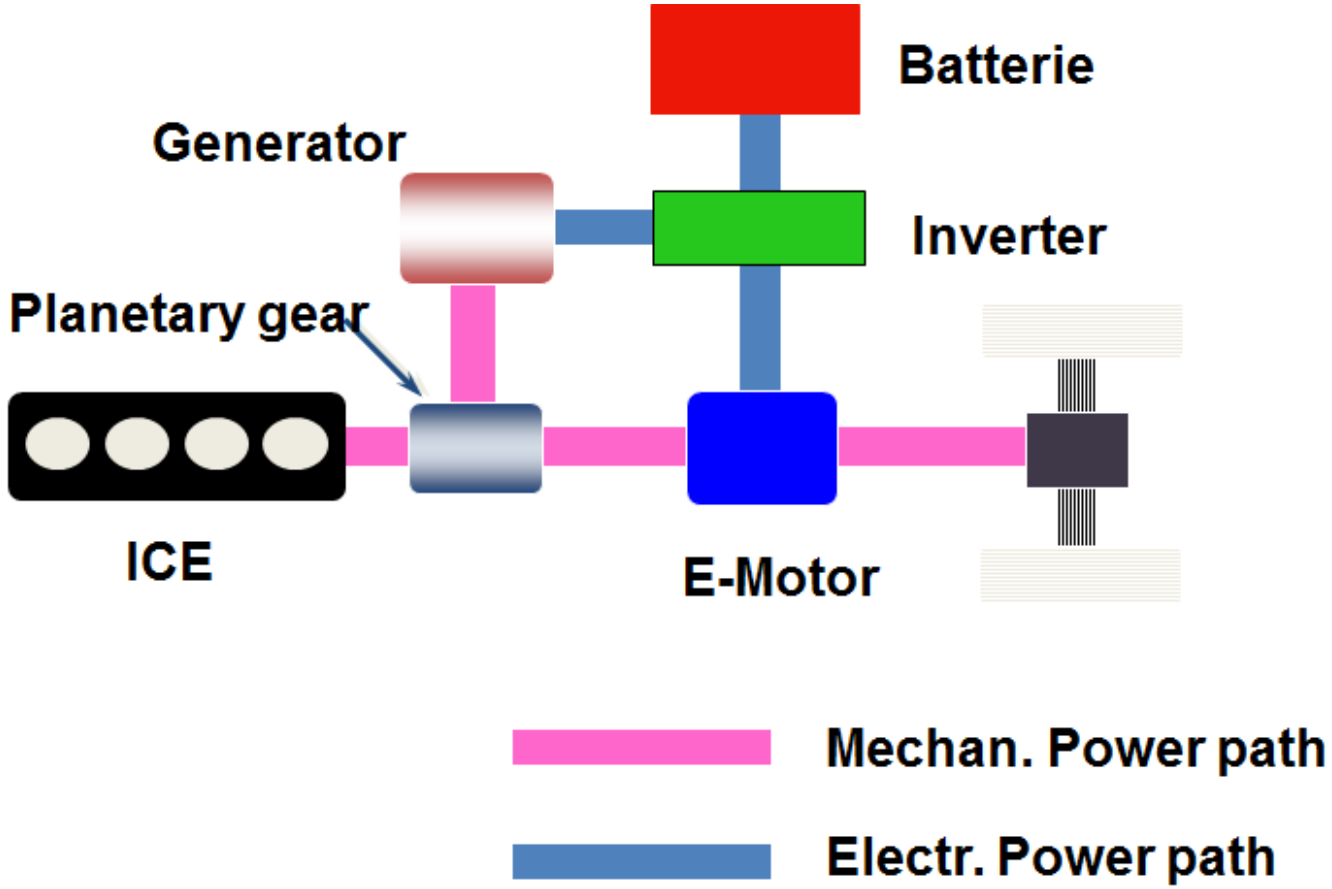
Power split Hybrid architecture



Layout of the THS (Toyota hybrid system)

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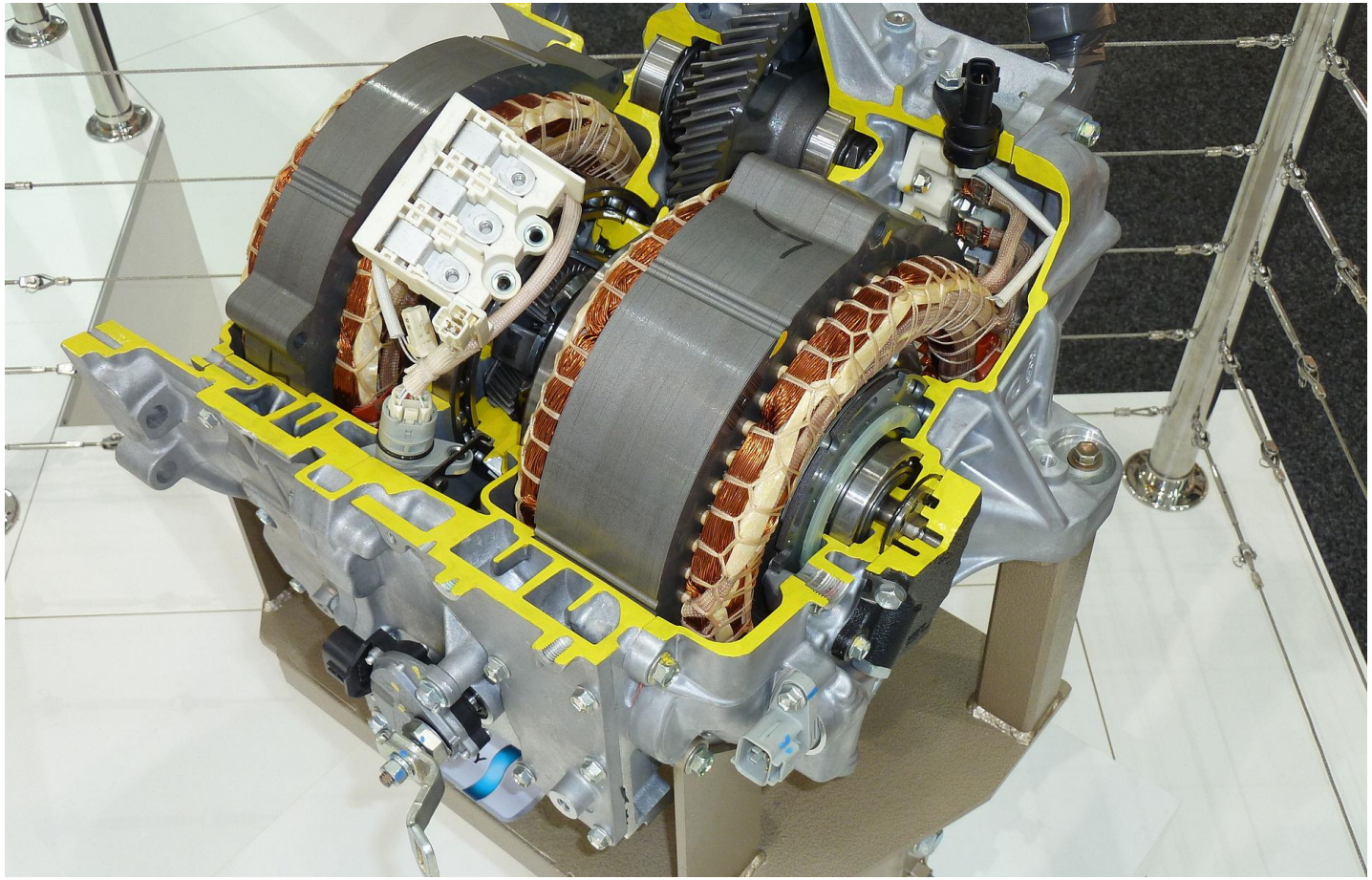
Power split Hybrid architecture



Cross section of the THS (Toyota hybrid system)

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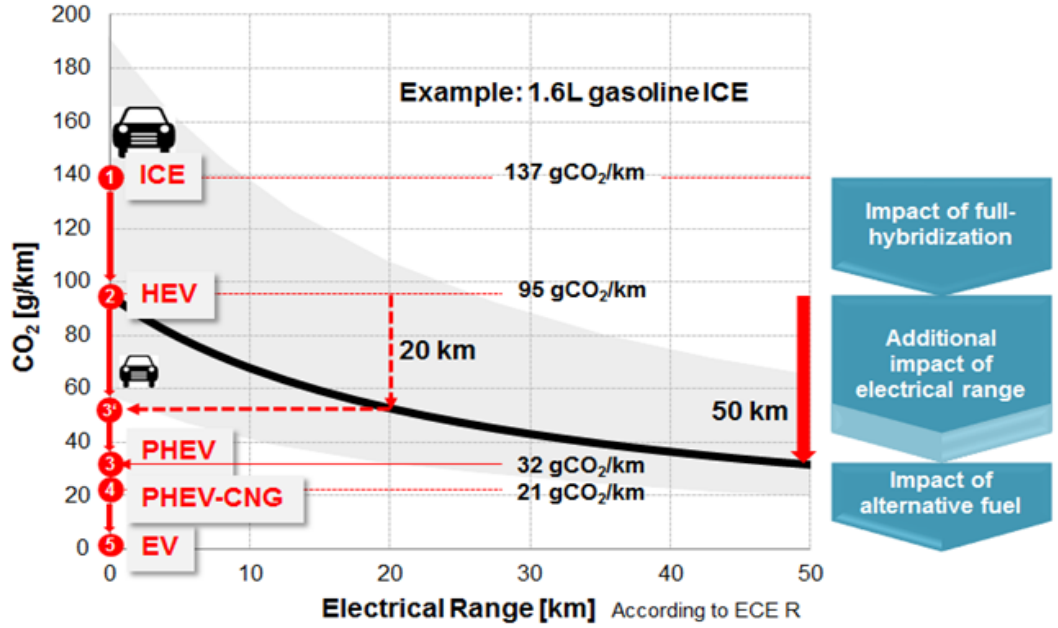
Trends in hybrid architecture – PHEV

- PHEV (Plug-In hybrid electric vehicle) are becoming more important
  - Bridge technology between hybrid and electric cars
  - Short distances can be driven pure electric
  - Benefits in european legislation



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Electrified, automated and connected – Future???

costs hybrid e-motor
eBike power electronics

electrified

plug-in eScooter range
fun-to-drive battery
charging infrastructure

legislation driver assistance
emergency braking autopilot

automated

highway-pilot
redundancy sensors
electric steering
valet parking

electronic horizon
smartphone integration

connected

eCall cloud
services fleet management
car2car augmented reality

Change in Mobility according Bosch 10/2016

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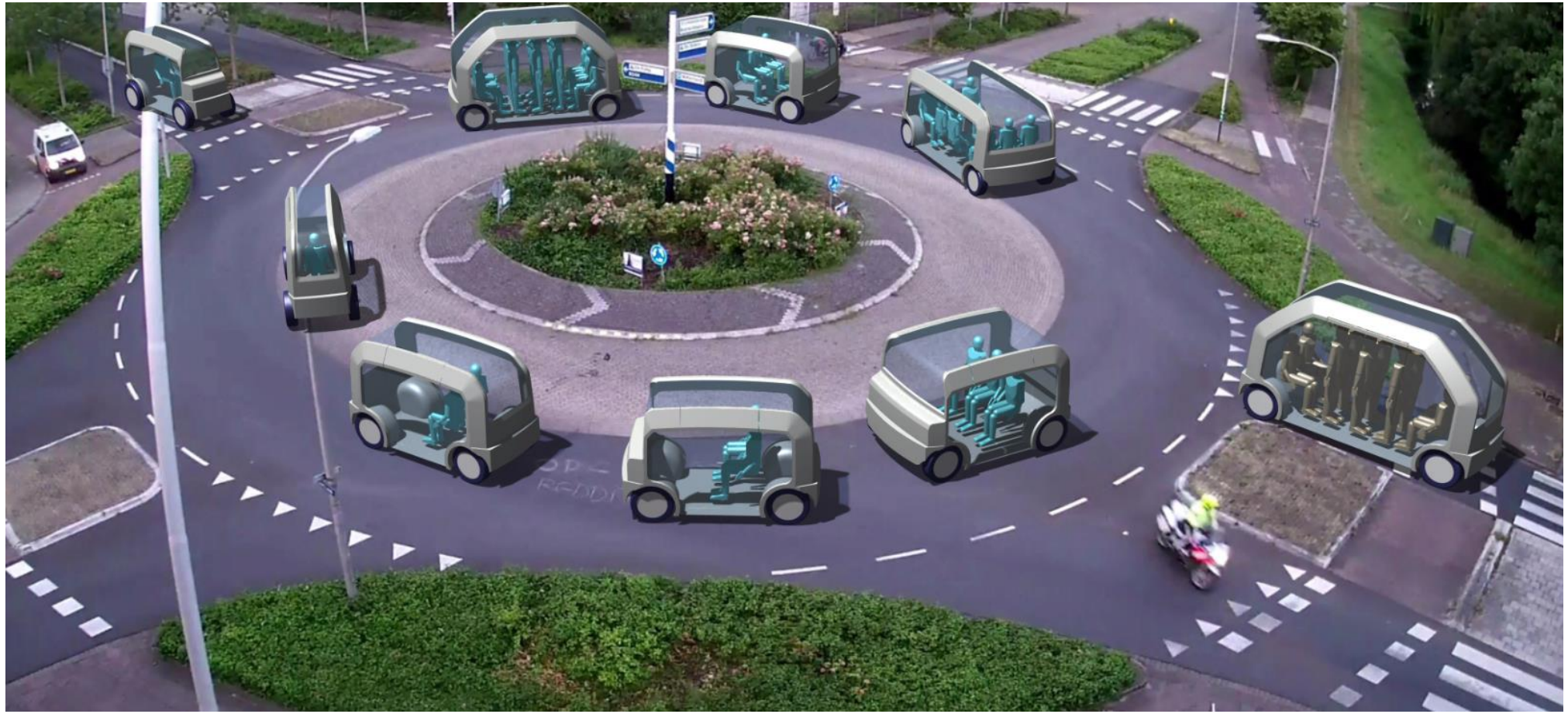
Automated vehicles as a new form of public transport???



Example picture of „people mover“ concept

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Advanced vehicle aspects

Questions??

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