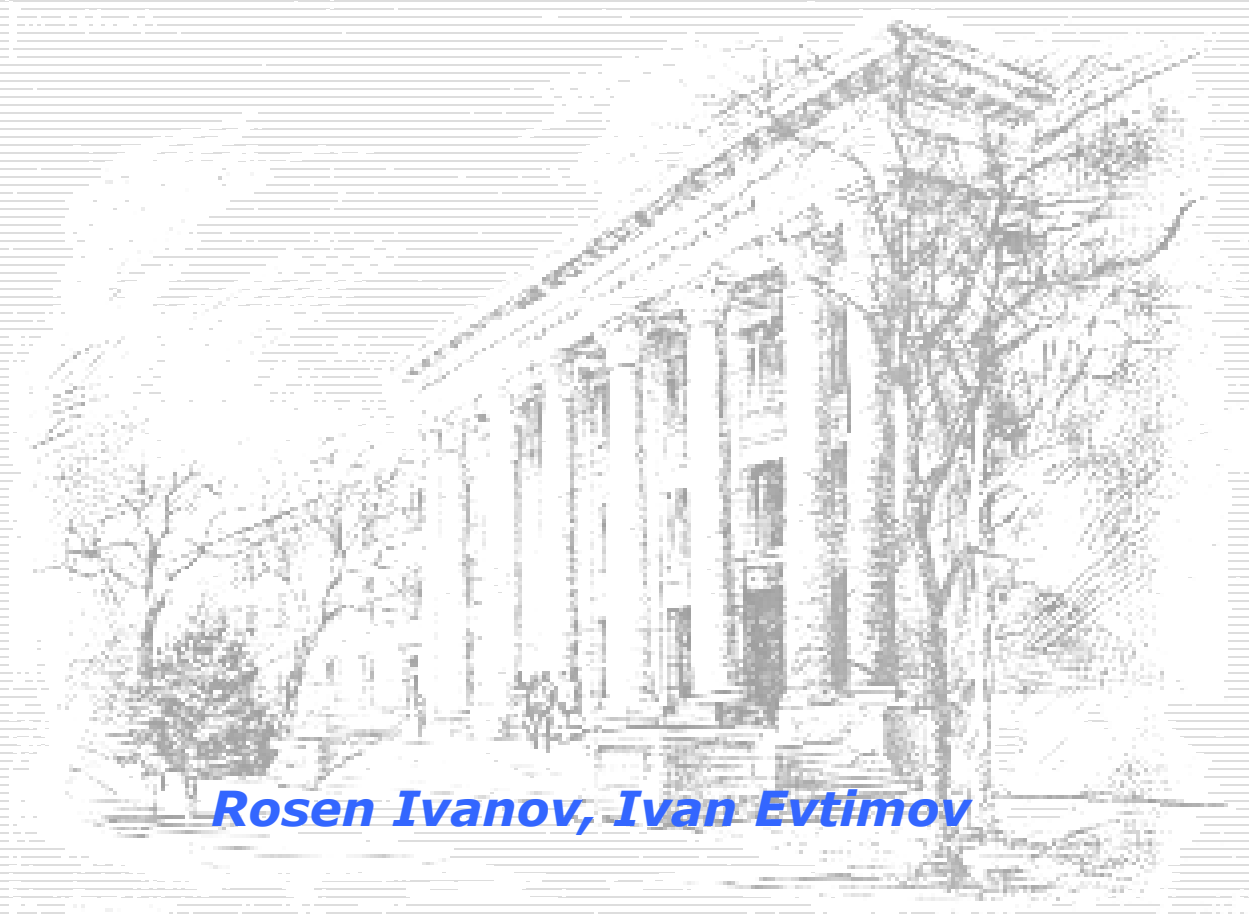


MAIN CHARACTERISTICS OF THE ELECTRIC CAR



Rosen Ivanov, Ivan Evtimov

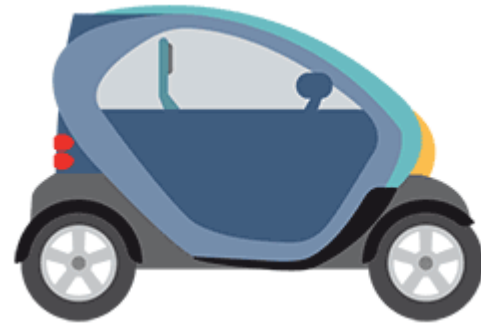


*University of Ruse, 8 Studentska Str., 7017 Ruse, Bulgaria
Department of Engines and Vehicles*

Main characteristics of the electric car

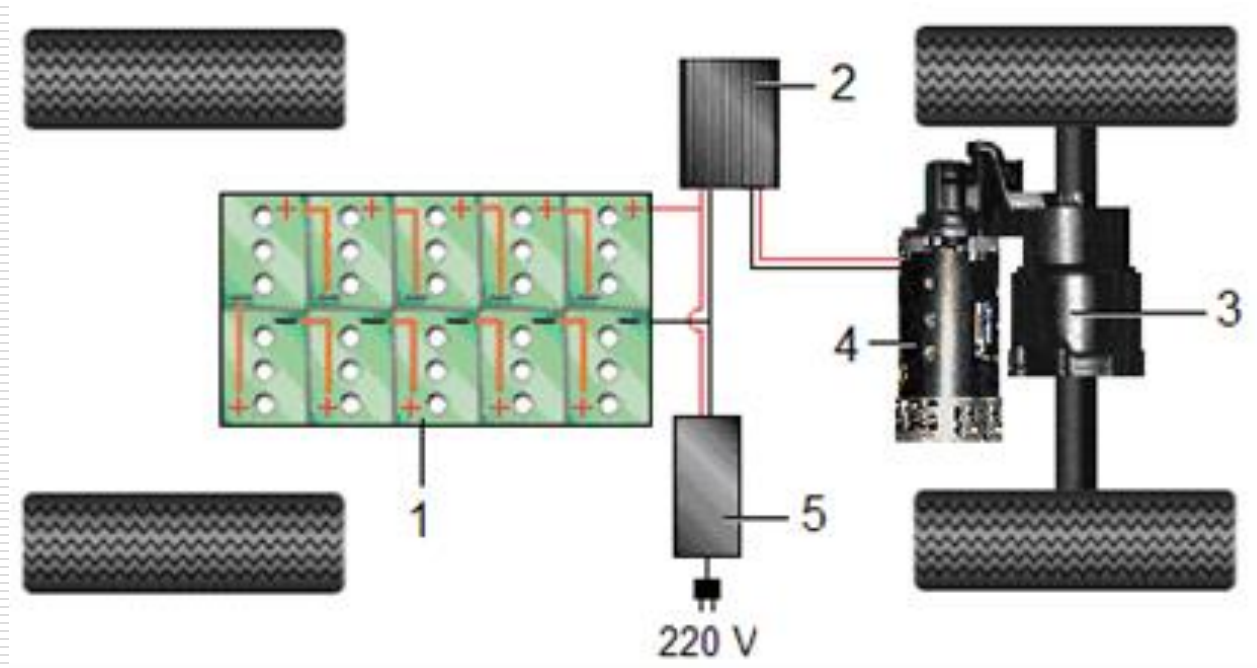
Content:

- **General design and Driving schemes**
- **Components**
- **Characteristics**

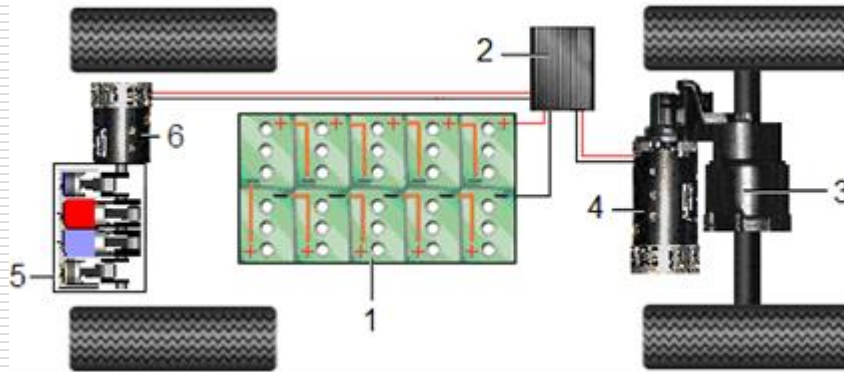


General design and Driving schemes

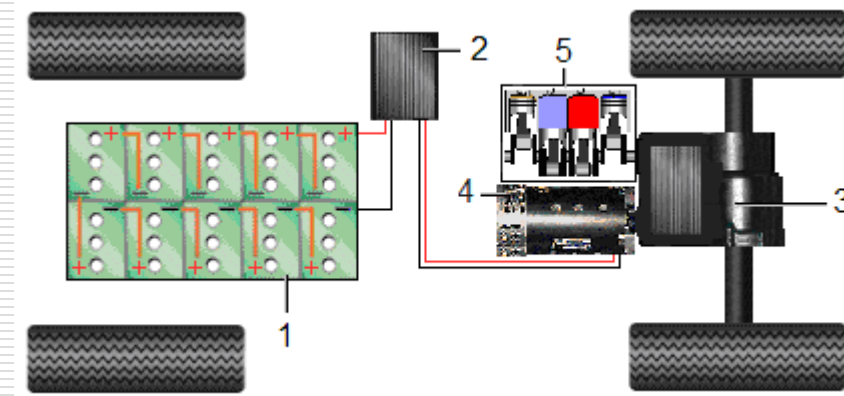
General scheme of an electric car



General design and Driving schemes

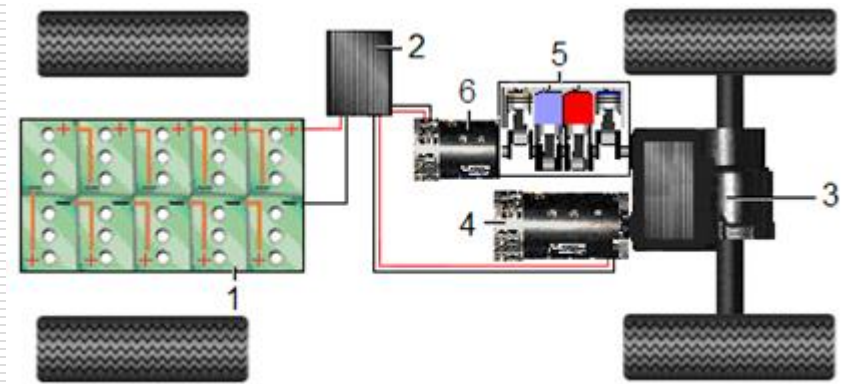


Serial Hybrid

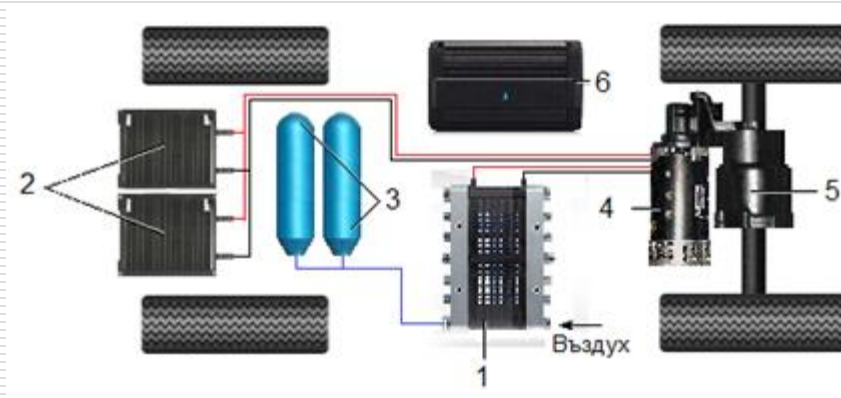


Parallel Hybrid

General design and Driving schemes

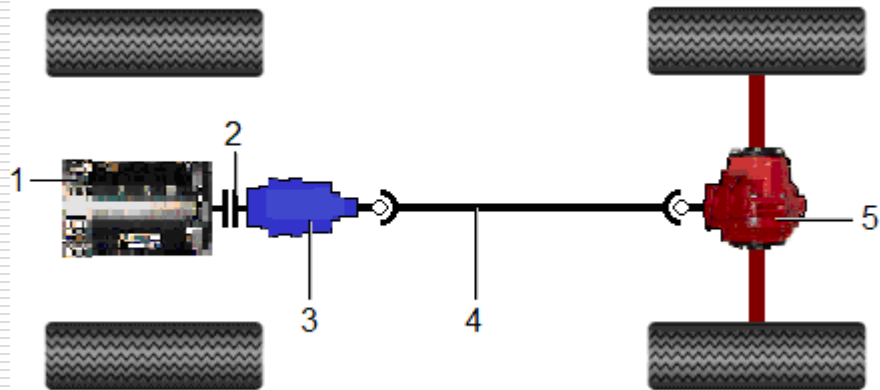


Combined Hybrid

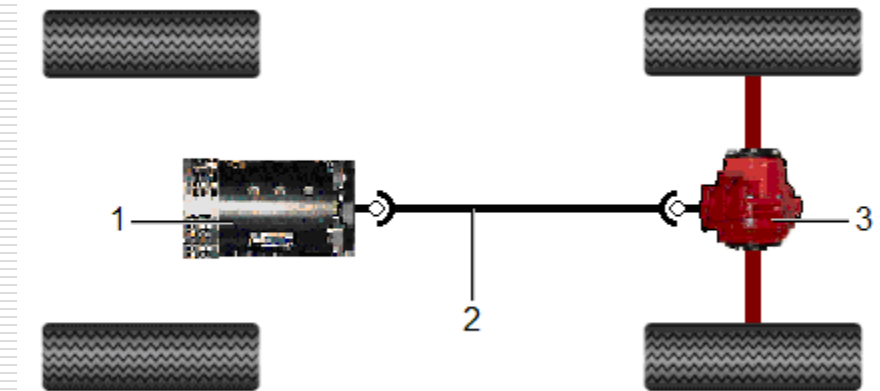


Electric car with Fuel Cells

General design and Driving schemes

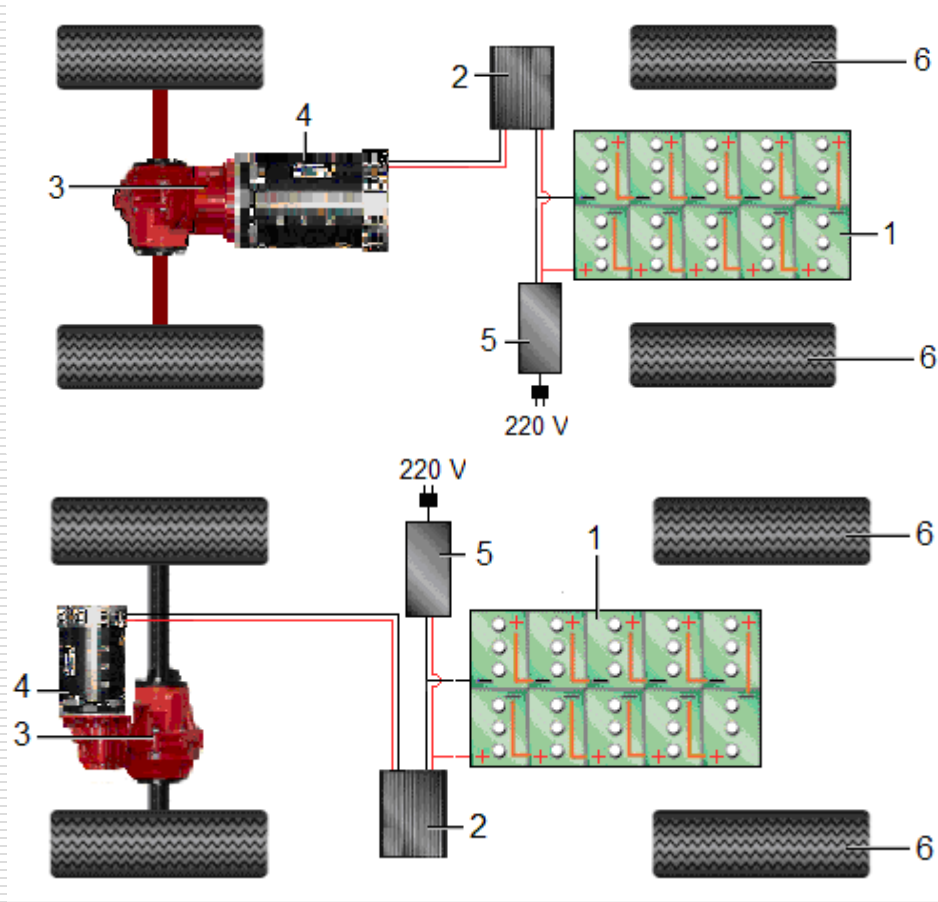


Electric car with gear box



Electric car without gear box

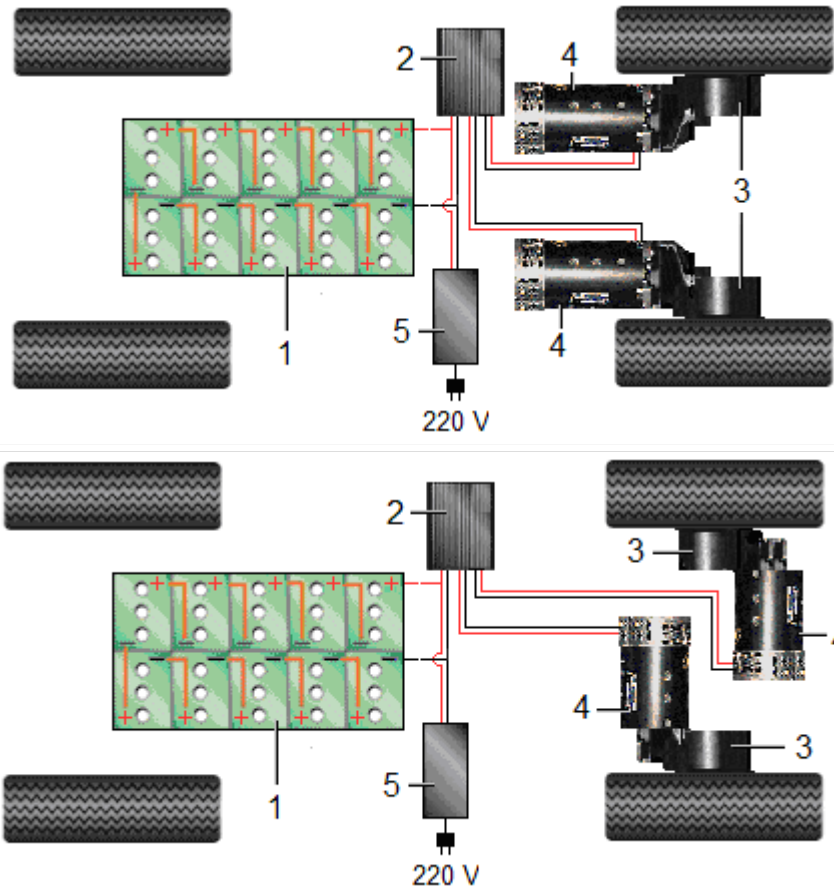
General design and Driving schemes



Front longitudinal displacement of the motor

Front lateral displacement of the motor

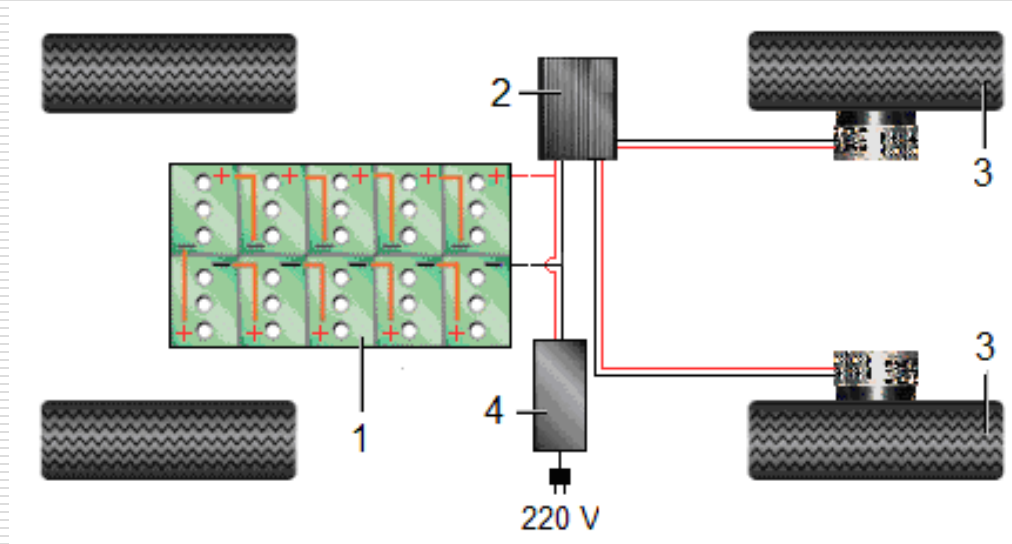
General design and Driving schemes



Rear longitudinal displacement of the motor

Rear lateral displacement of the motor

General design and Driving schemes

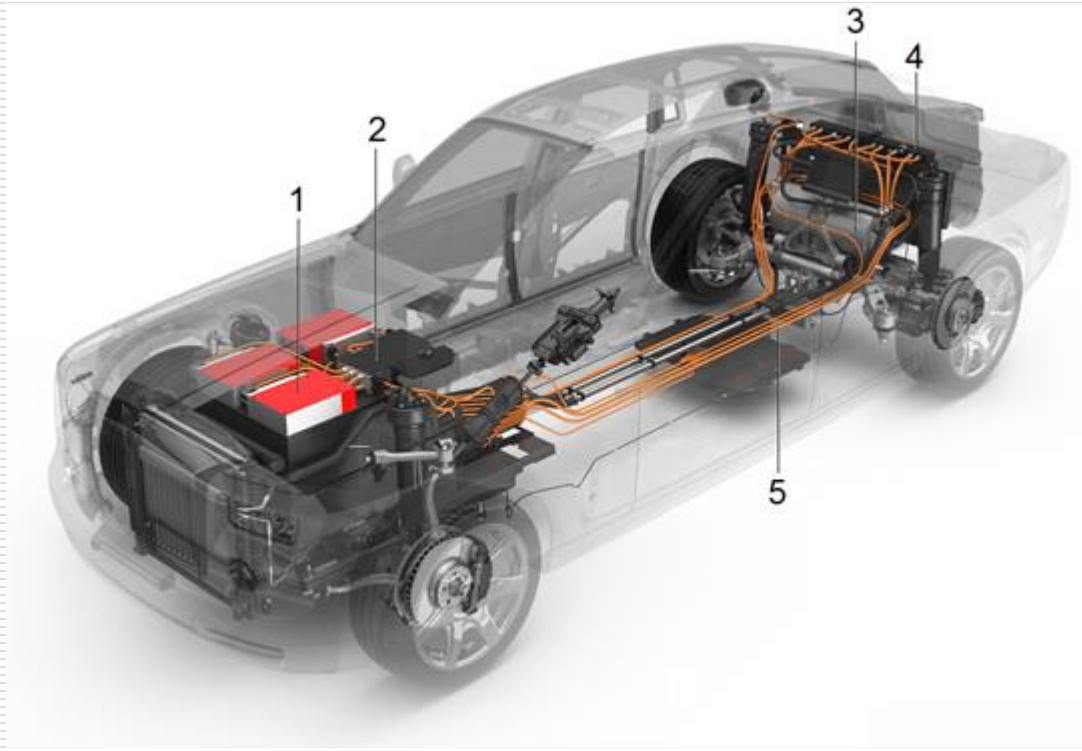


*Electric car with
Motor-wheels*

General design and Driving schemes

Rolls-Royce 102EX

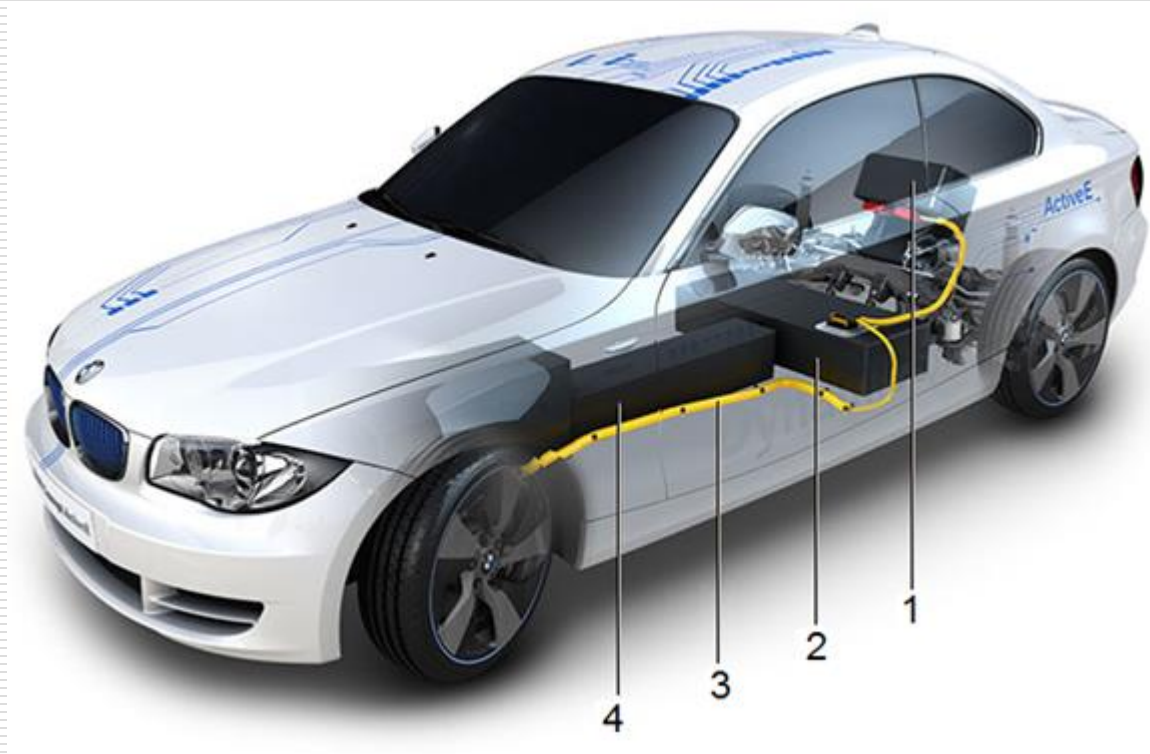
1 - battery; 2, 4 – power electronics; 3 - motors; 5 – power cables



General design and Driving schemes

Electric car BMW:

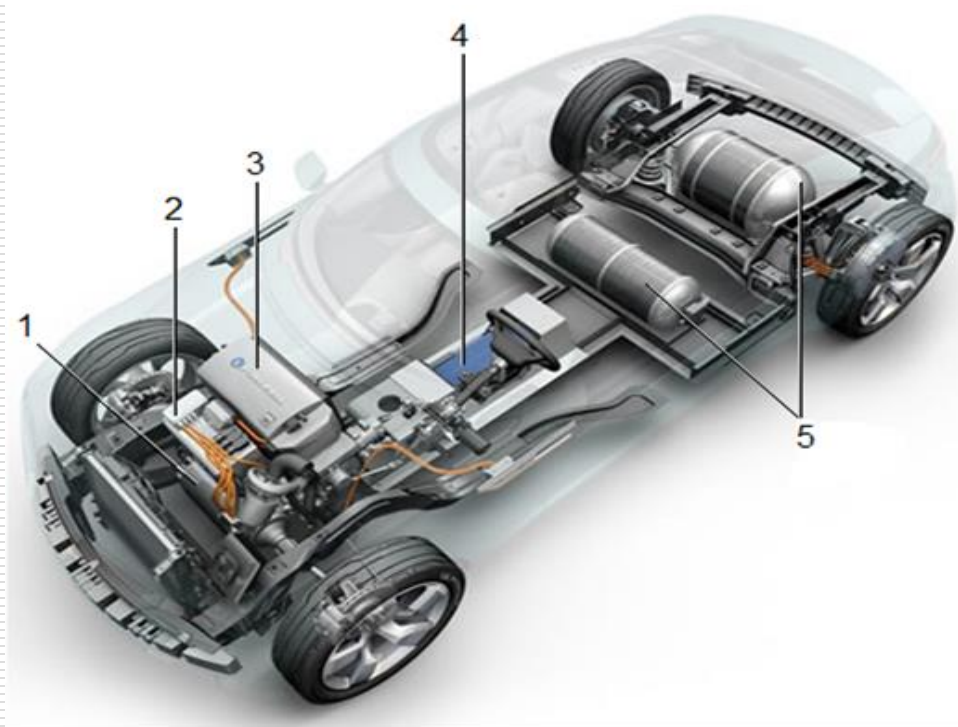
1 – power electronics; 2 - motor; 3 - transmission; 4 – power cables



General design and Driving schemes

Electric car with fuel cells:

1 - motor; 2 – power electronics; 3 – fuel cells; 4 – electric battery; 5 – fuel tanks



Components- Battery

Main characteristics of the battery:

- *cell and battery voltages;*
- *charge capacity, Ah;*
- *energy stored, Wh;*
- *specific energy, Wh/kg;*
- *energy density, Wh/m³;*
- *specific power, W/kg;*
- *charge efficiency, %;*
- *energy efficiency, %;*
- *self-discharge rates, %;*
- *battery geometry, mm/mm/mm;*
- *battery temperature, heating and cooling needs;*
- *battery life and number of - deep cycles*



Components- Battery

Main types of battery used in electric cars:

- **Lead-Acid batteries**

- **Nickel-based batteries:**
 - Nickel-Cadmium battery;
 - Nickel-Metal Hydride battery;

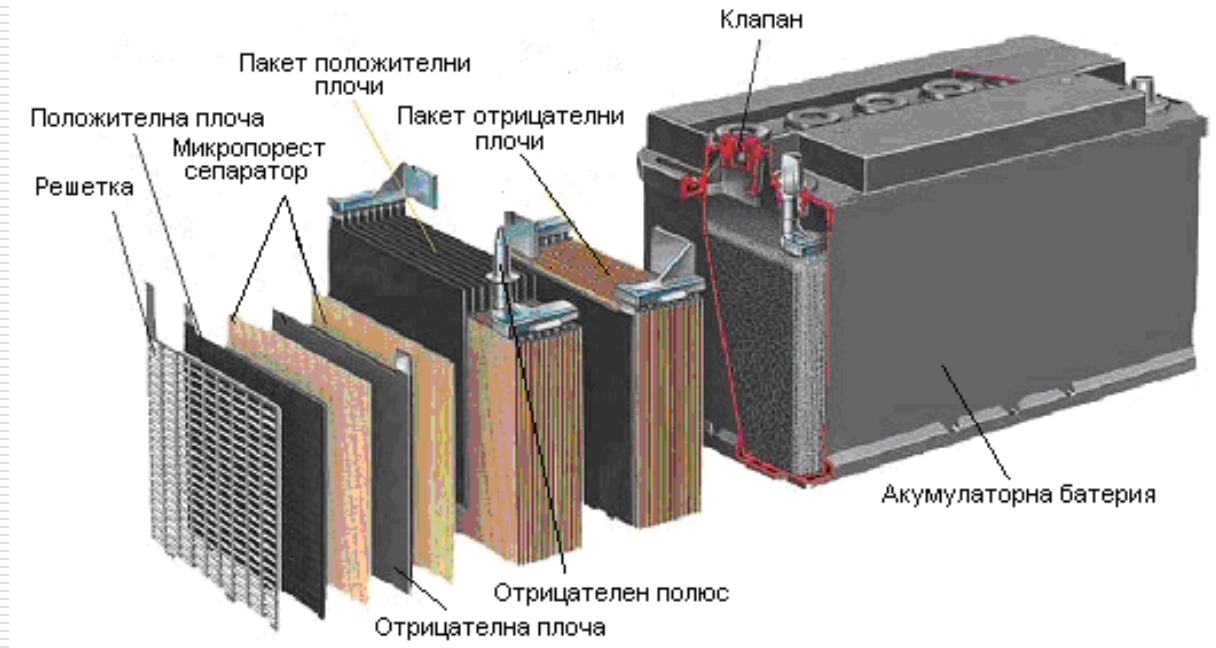
- **Lithium Batteries:**
 - Lithium battery;
 - Lithium-Polymer battery;

- **Fuel Cells**



Components- Battery

Lead-Acid battery



Components- Battery

Nickel-Cadmium battery



Components- Battery

Nickel-Metal Hydride battery



Components- Battery

Lithium battery



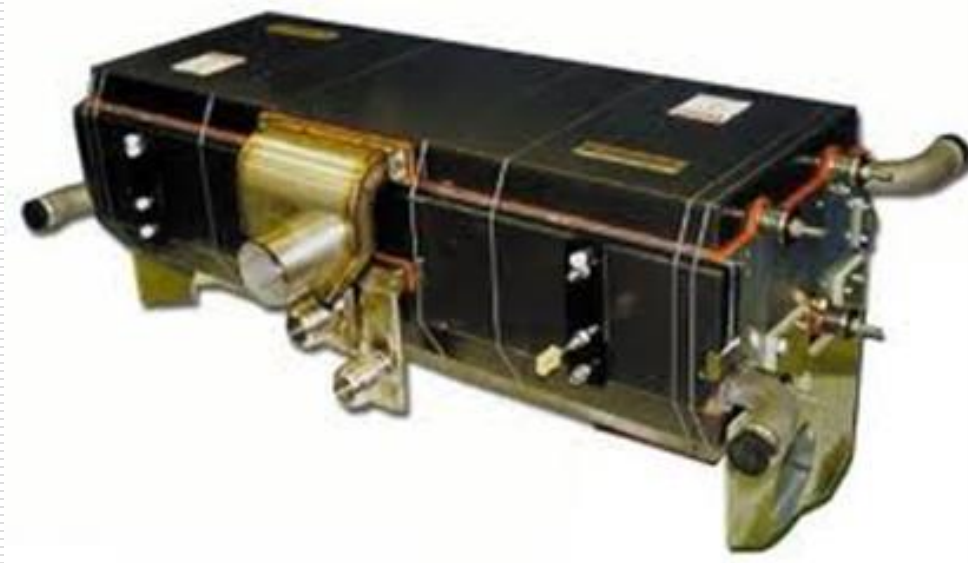
Components- Battery

Lithium-Polymer battery



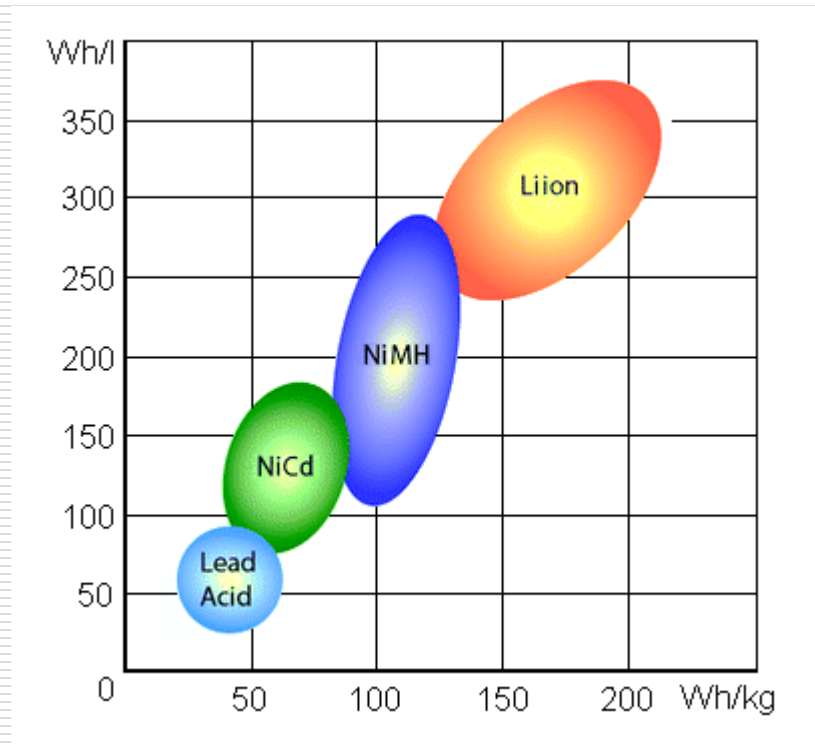
Components- Battery

Fuel cell type MCFC



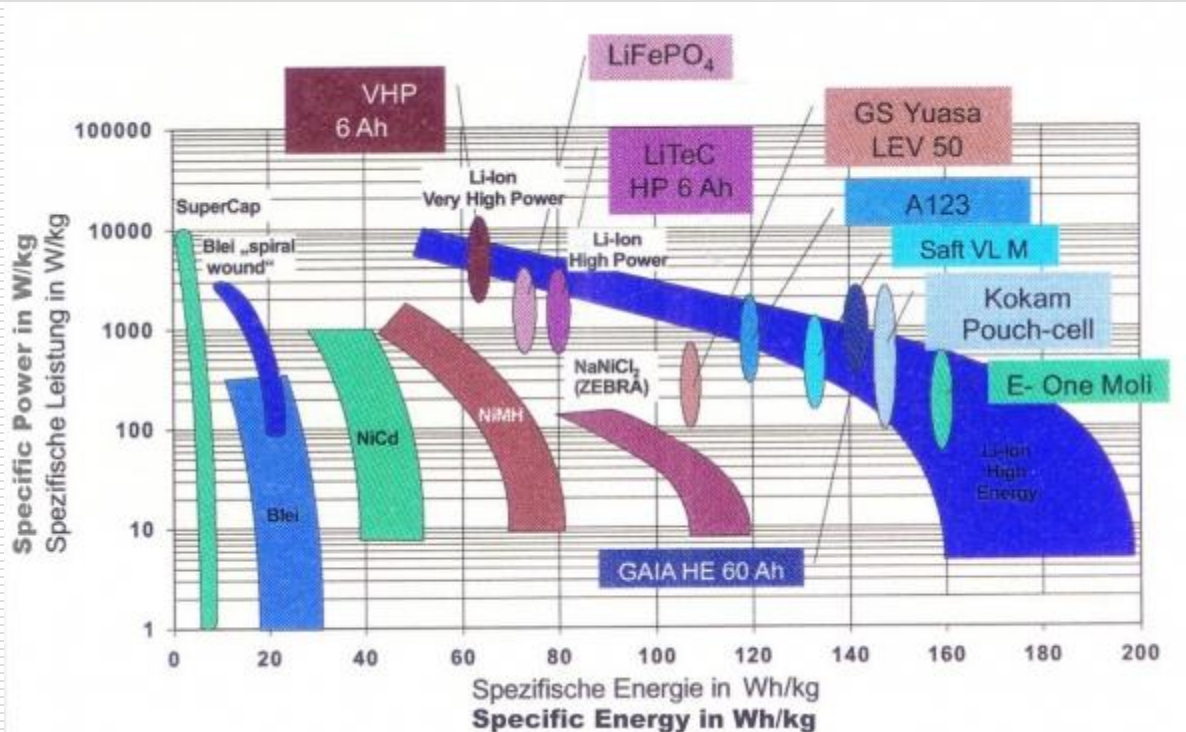
Components- Battery

Characteristics of different types of battery



Components- Battery

Characteristics of different types of battery



Components- Electric motor

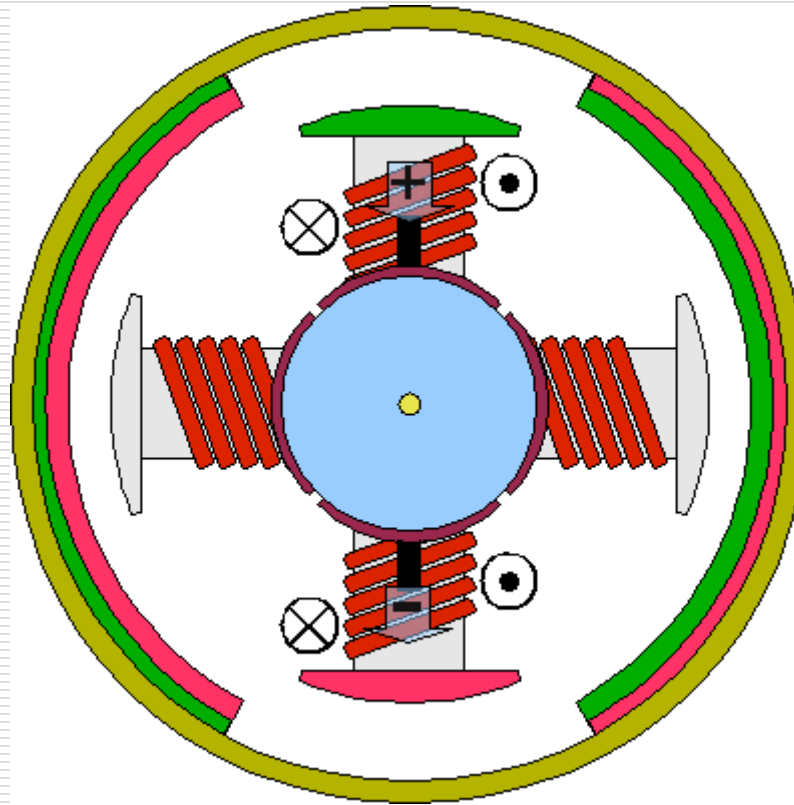
Main types of electric motors used in electric cars:

- Direct Current Motors – **DCM**
- Permanent Magnets Brushed Direct Current Motors – **PMBDCM**
- Brushless Direct Current Motors - **BLDCM**
- Alternating Current Induction Motors – **ACIM**
- Permanent Magnets Synchronous Motors – **PMSM**
- Switched Reluctance Motors – **SRM**



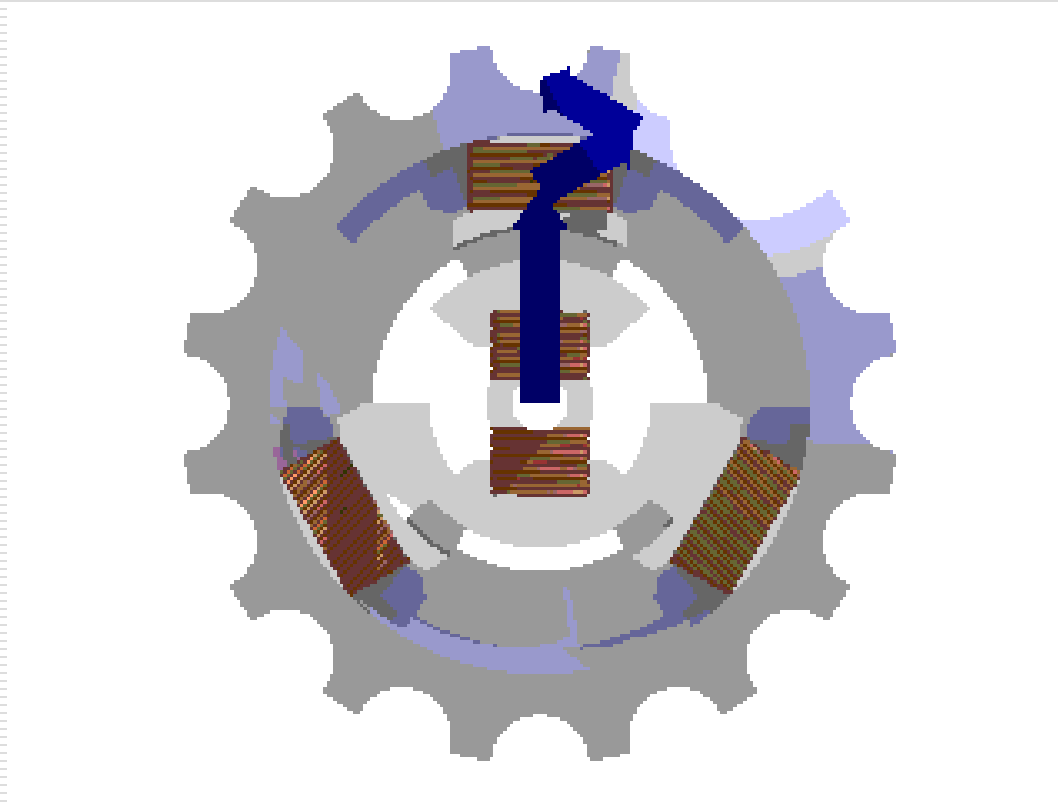
Components- Electric motor

PMDCM



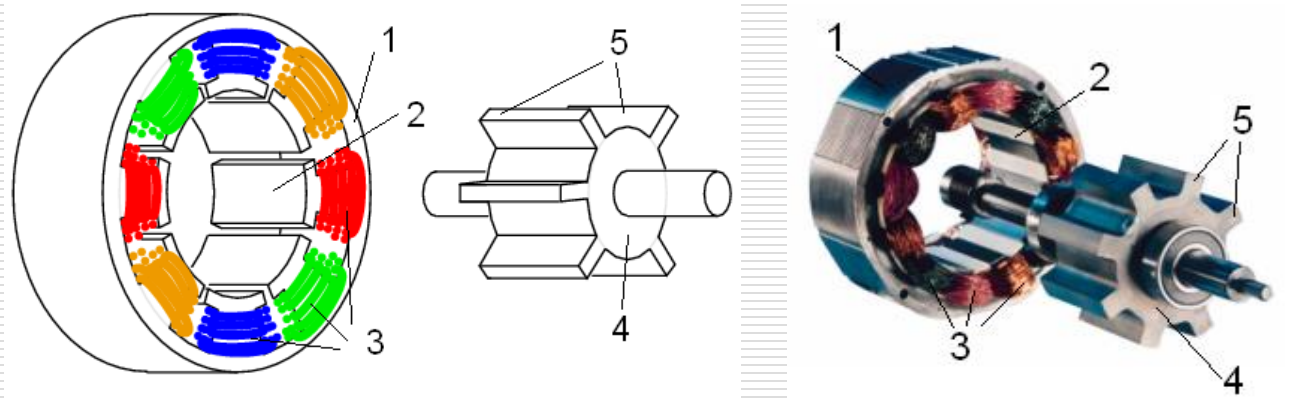
Components- Electric motor

Induction Motors – ACIM



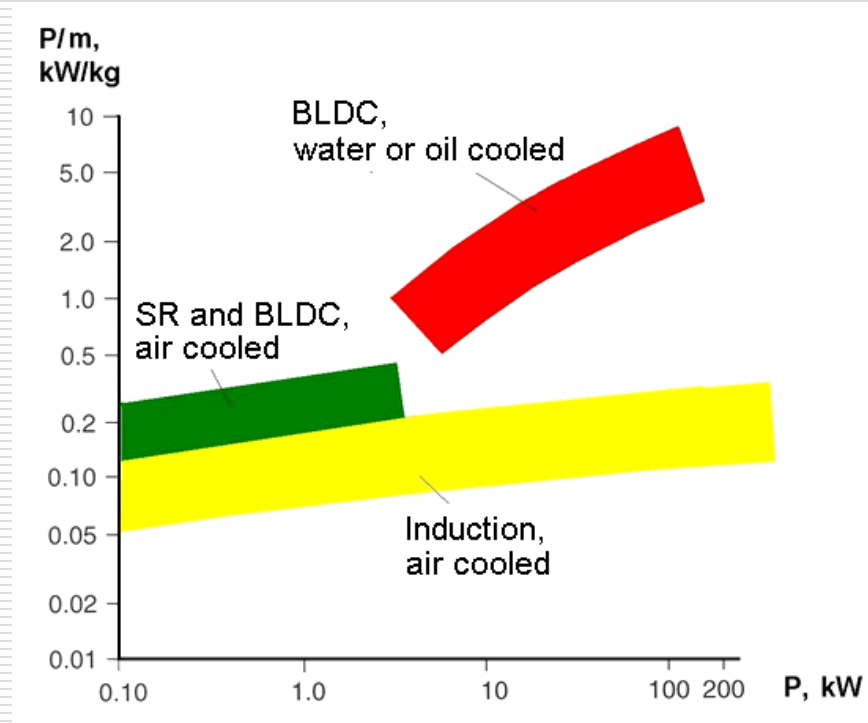
Components- Electric motor

SRM



Components- Electric motor

Application of different types motors



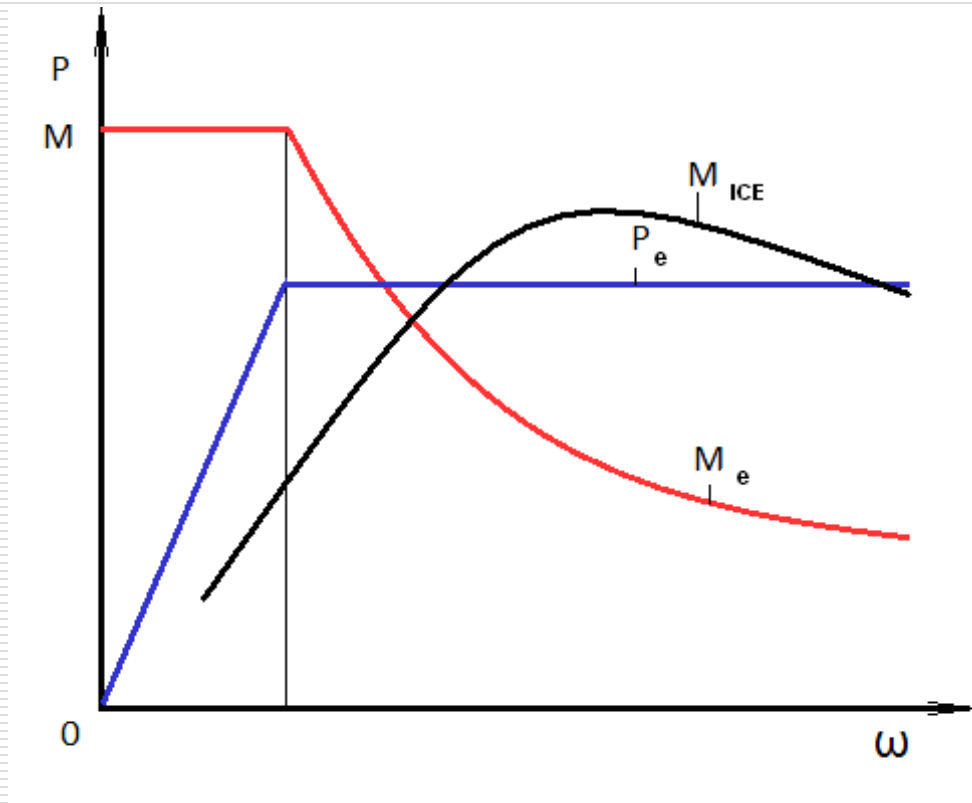
Components- Electric motor

BLDCM with power electronic (controller)



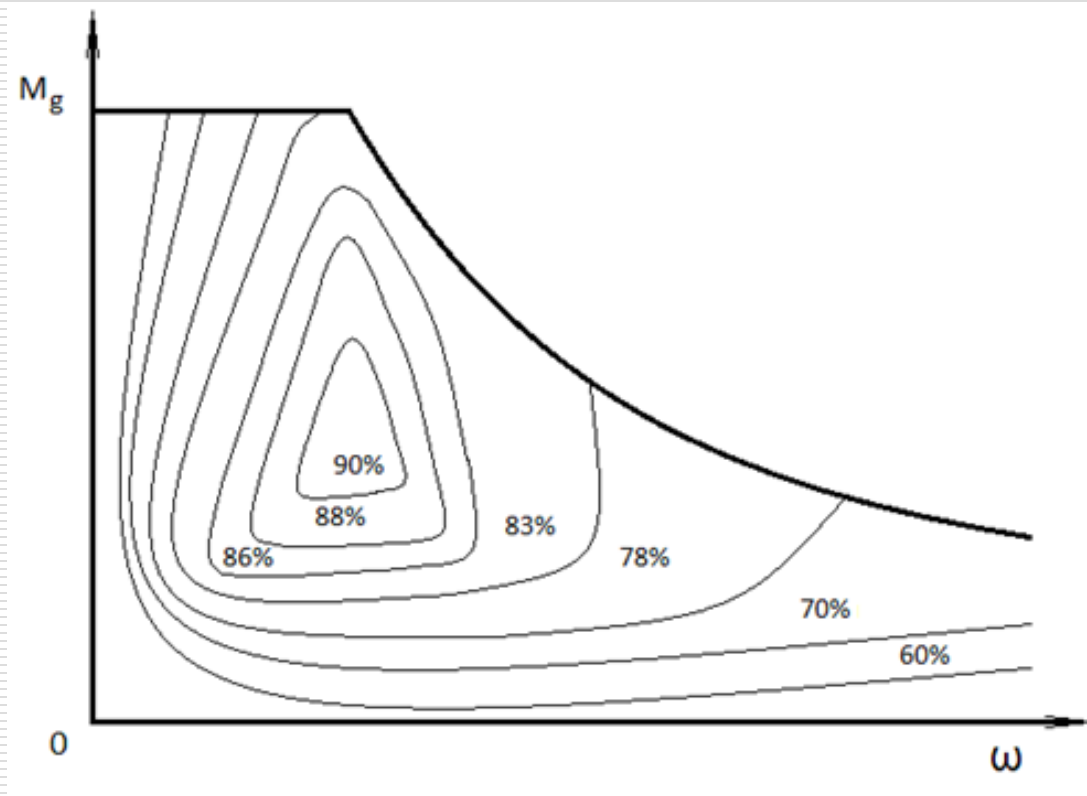
Characteristics

Comparison between curves of an electric motor and internal combustion engine:
 P_e , M_e – power and torque curves of electric motor; M_{ICE} – torque of ICE



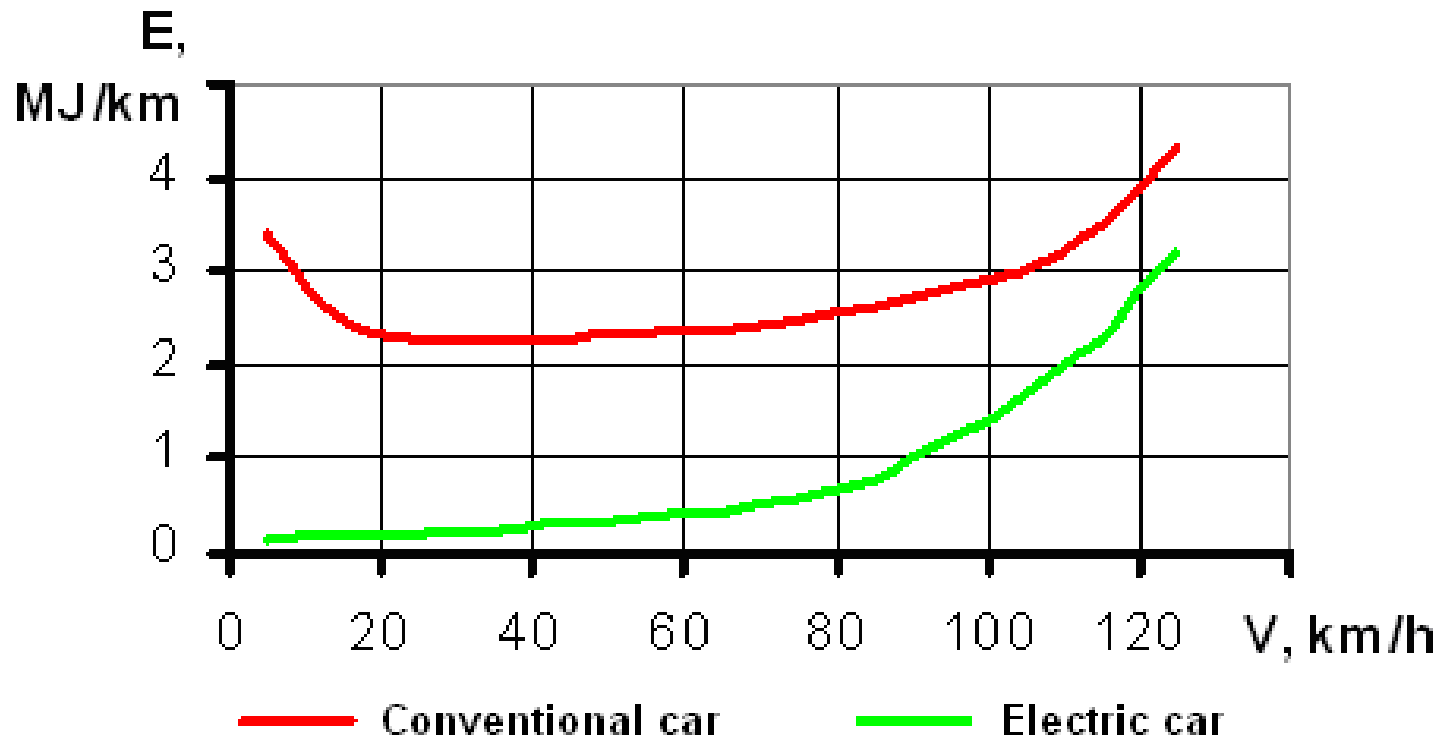
Characteristics

Efficiency of a DC motor



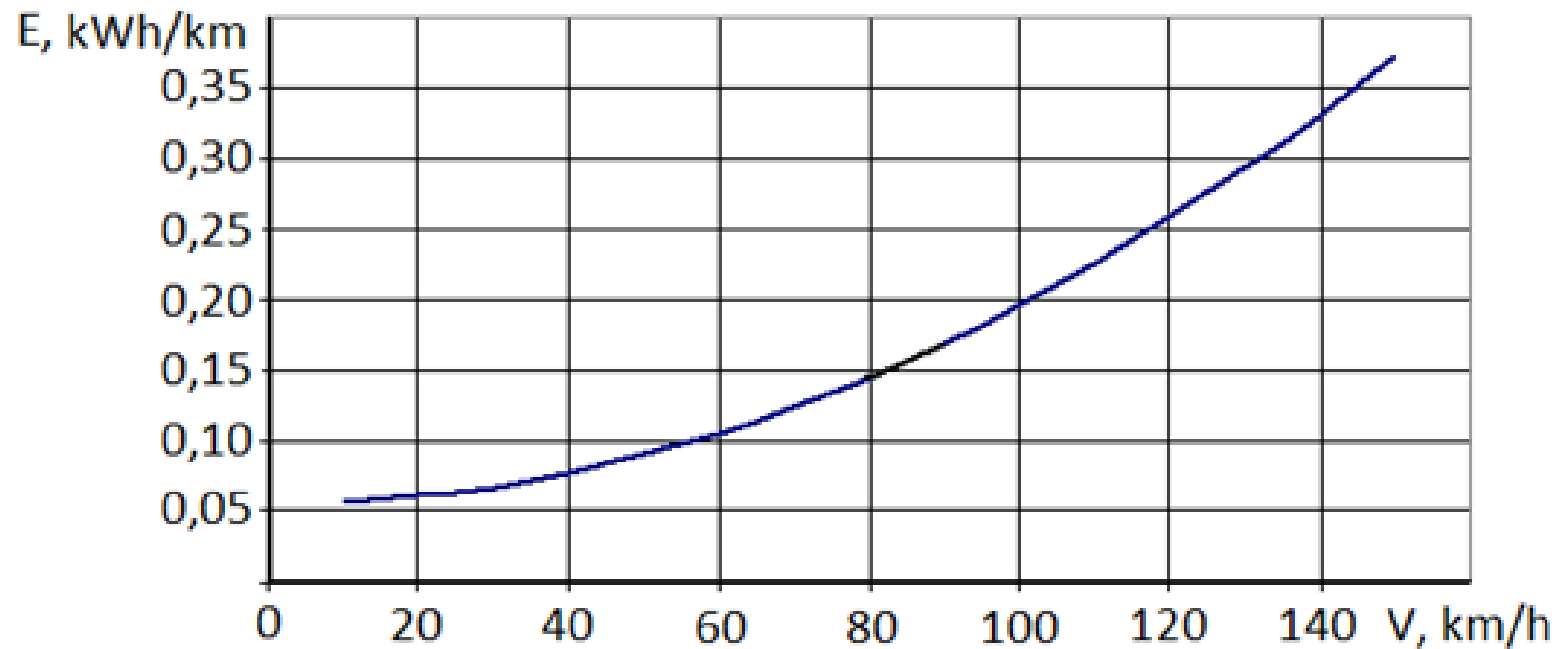
Characteristics

Energy consumption vs. vehicle speed



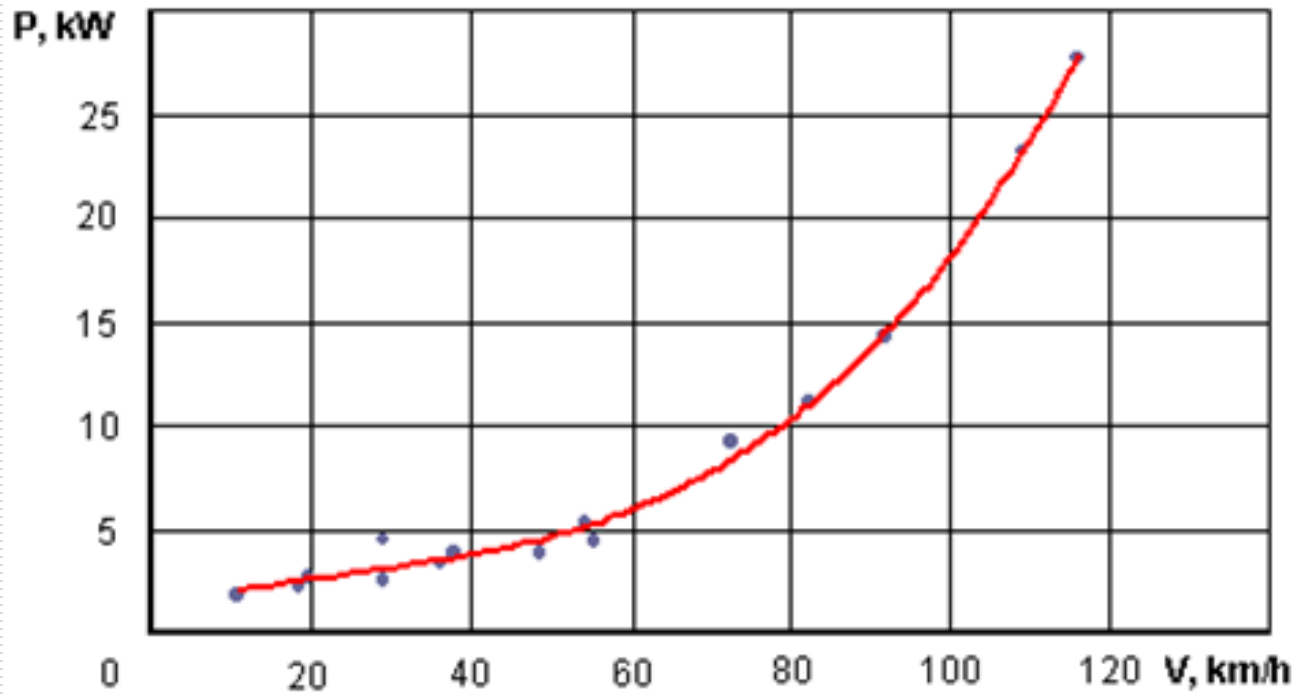
Characteristics

Real Energy characteristic of an electric car (mass 1000 kg)



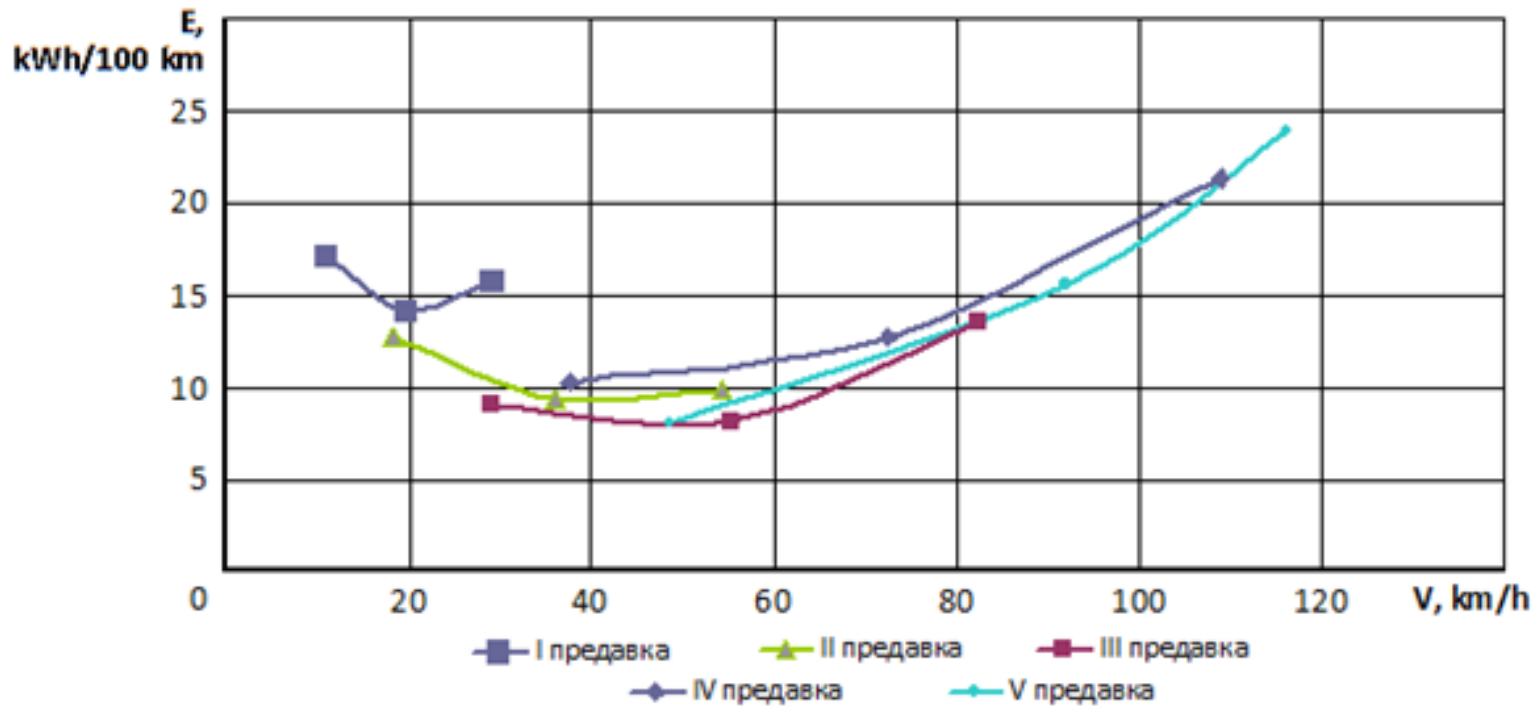
Characteristics

**Real Power characteristic of an electric car with gear box
(mass 1620 kg, motor 25 kW)**



Characteristics

Real Energy characteristic of an electric car with gear box (mass 1620 kg, motor 25 kW)



Thank you for your attention!
