Hibridna i elektro vozila

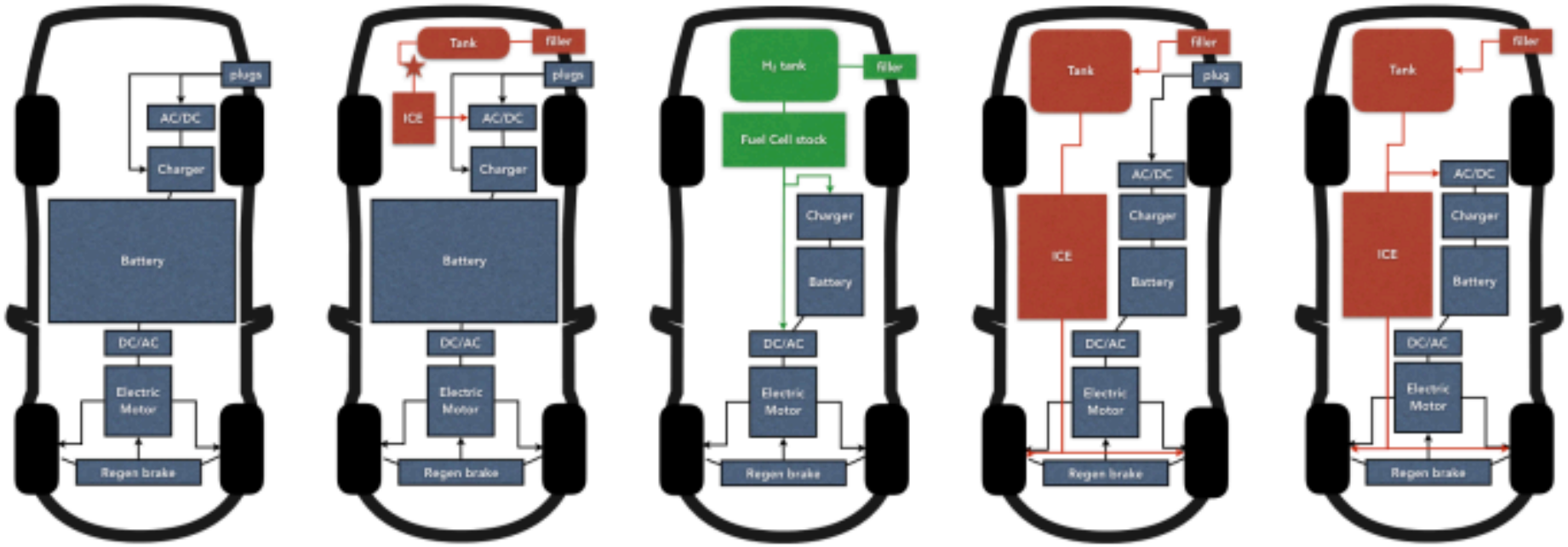
Laboratorijske vežbe blok 2

Visoka škola elektrotehnike i računarstva strukovnih studija,
Beograd 2019

• Tipovi hibridnih i elektro vozila

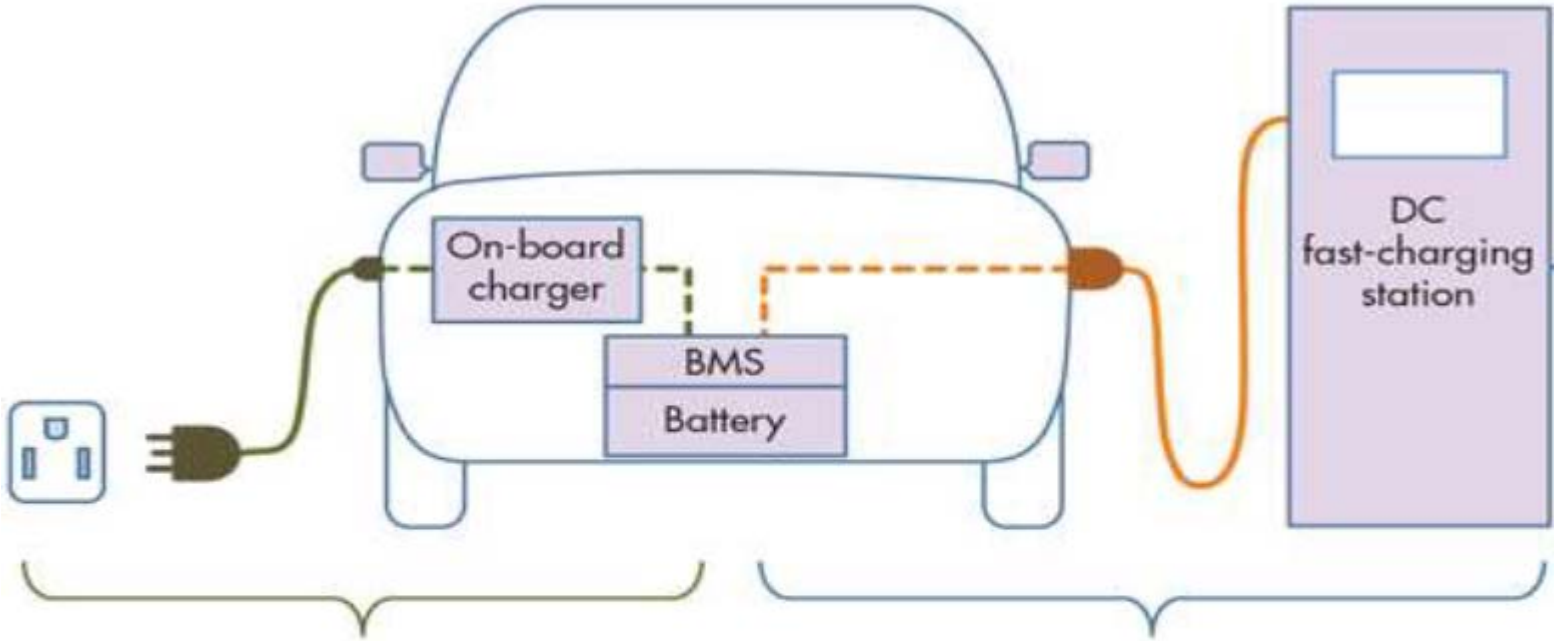
- **BEV** *(Battery Electric Vehicle)* – in this configuration, electric energy enters the vehicle as alternate current (going through an AC/DC converter) or direct current, according to the type of charger I am connecting: the internal charger charges a large (tens or, soon, hundreds of kilowatt-hours). From here it goes through an inverter to be fed to the electric motor, typically AC synchronous or – more rarely – induction). Wheels are also connected to a generator for the recuperation of energy when braking.
- **BEV + REx** *(Battery Electric Vehicle + Range Extender)* – this vehicle is laid out exactly like a BEV with the addition of a small gasoline generator to charge the battery when needed. Unlike the HEV configuration, however, this generator does not switch on automatically and the generator and attached tank capacities are very limited. Moreover, the generator is not capable of moving the wheels: its sole function is to charge a depleted battery.
- **FCEV** *(Fuel Cell Electric Vehicle)* – this vehicle only has an electric propulsion system, with the electric energy coming from the fuel cell stack where hydrogen is oxidized; such energy can be fed either directly to the electric motor or to the small battery.
- **PHEV** *(Plug-in Hybrid Electric Vehicle)* – this configuration has almost universally replaced the HEV layout from which it derives, replacing its internal battery charging to grid-based charging, typically only in AC.
- **HEV** *(Hybrid Electric Vehicle)* – in hybrid configurations, the vehicle carries both an internal combustion and an electric propulsion systems: for space and weight reasons, the latter uses a small battery (a few kWh); both are capable of moving the car, and the control electronics decide which one intervenes, a mixed drive being also possible. In this closed-cycle type, the battery is charged solely by the ICE motor or by regenerative braking.

- Tipovi hibridnih i elektro vozila

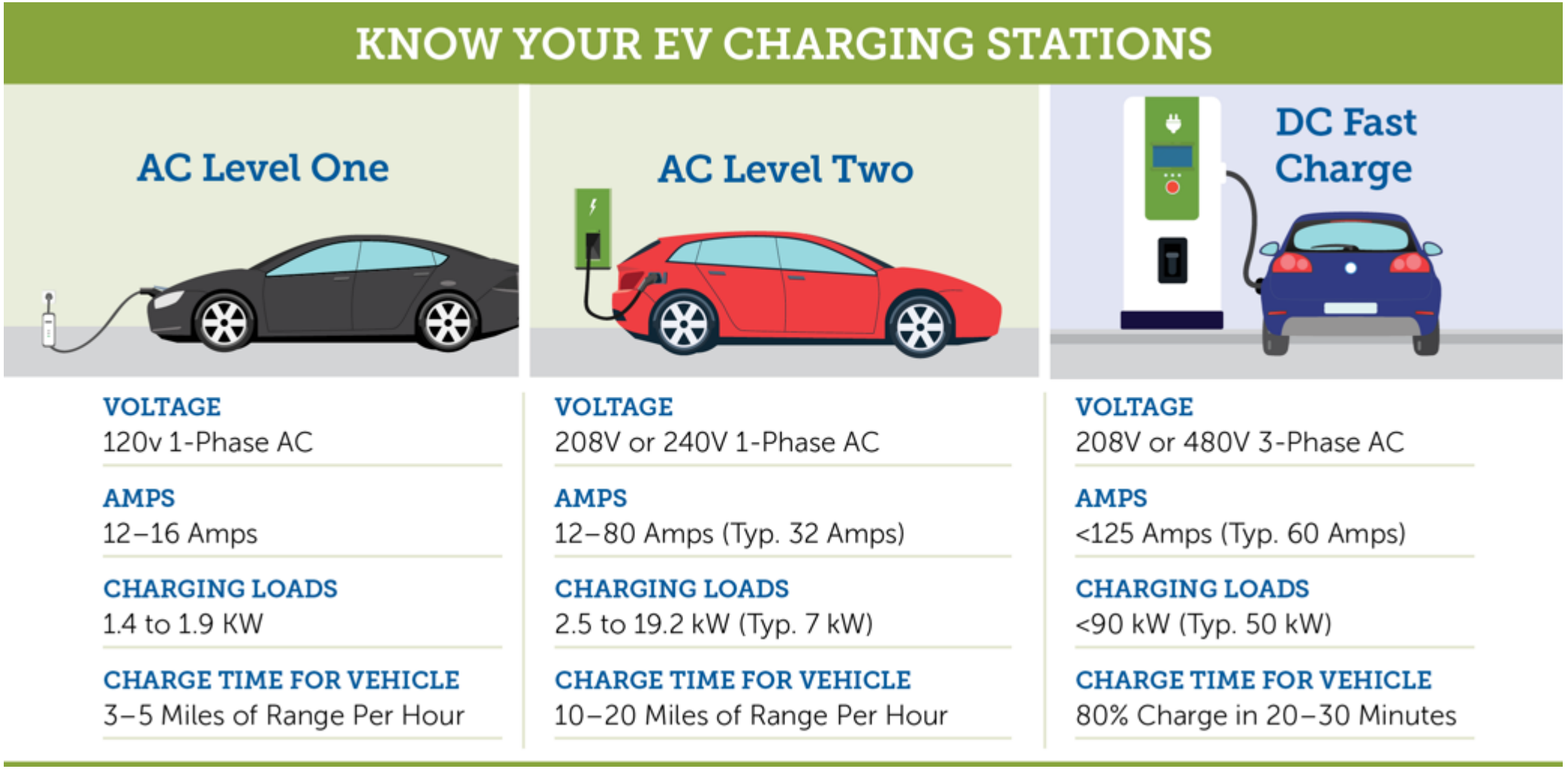


BEV	BEV + REx	FCEV	PHEV	HEV
Example: Tesla Model S	BMW i3	Toyota Mirai	Mini Countryman Plug-In	Toyota Prius
Energy efficiency: 73%	73% ↔ 20%	22% (???)	60% ↔ 17%	54% ↔ 15%
Transmission: NO	NO	NO	YES	YES / HSD
Gearshift: NO	NO	NO	YES	YES
Engine: AC induction/synchro	AC synchronous	AC synchronous	AC synchronous	AC synchronous
Emissions: -66% CO_2	-66% ↔ -8% CO_2	-50% (???) CO_2	-58% ↔ +2% CO_2	-57% ↔ +11% CO_2

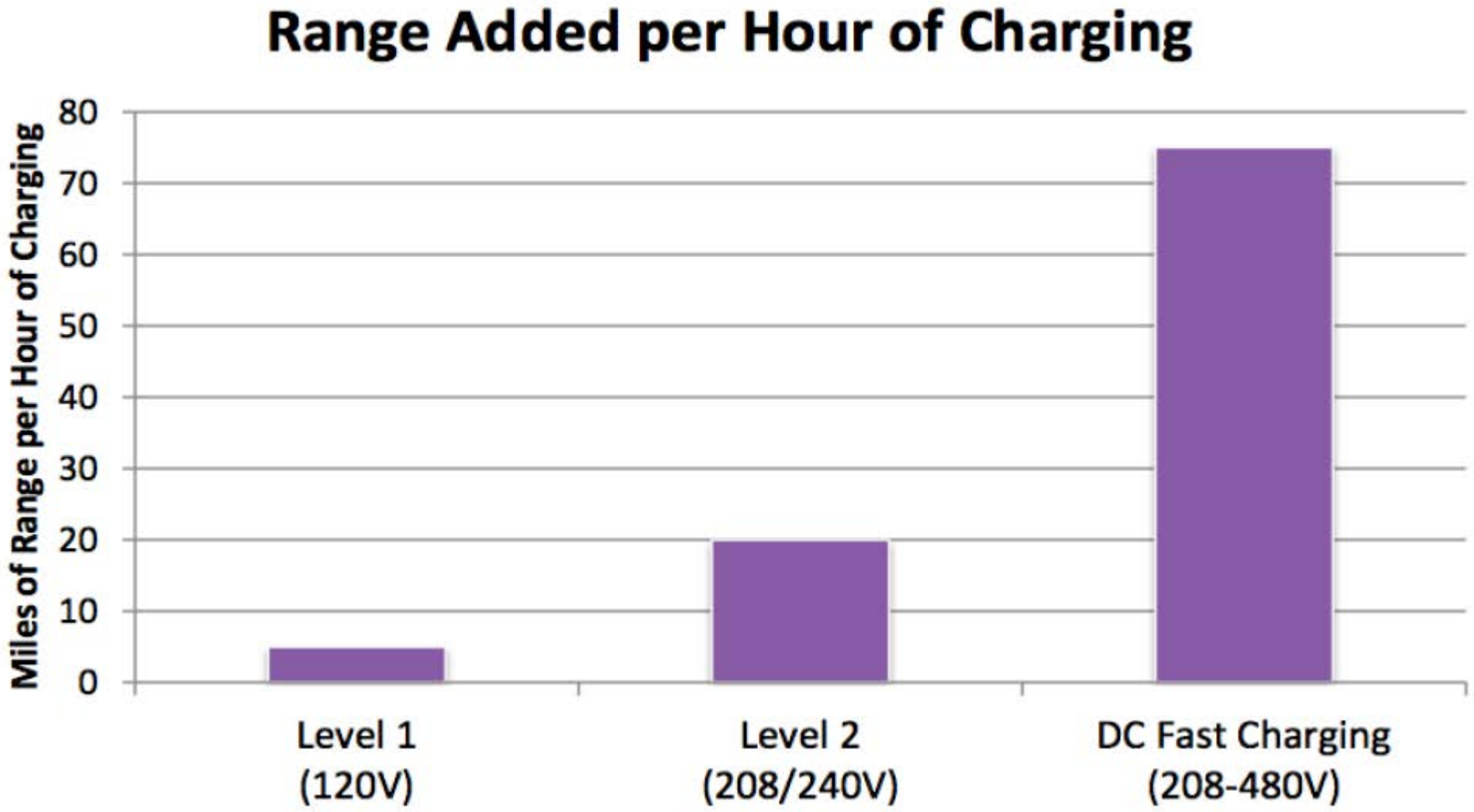
- Punjenje električnih vozila



- Punjenje električnih vozila



- Punjenje električnih vozila



• Punjenje električnih vozila-pregled konektora

- **Type 1: SAE J1772 (Level 1 and 2)**
  - North American Standard
  - 2 AC power lines, ground pin, proximity detection, and control pilot signals
  - Uses +/-12V Pilot interface
- **Type 2:** VDE-AR-E 2623-2-2 (Level 1 and 2) European Plug Standard
  - Additional pins for three phase connections
  - Signaling aligns with J1772
- **Type 3: Combined Charging System - CCS (Level 3)**
  - Additional DC pins for level 3 charging added to J1772 and Type 2
  - HomePlug GreenPHY communication protocol
- **Type 4: CHAdeMO (Level 3)**
  - Adopted in Japan and France
  - CAN interface to vehicle

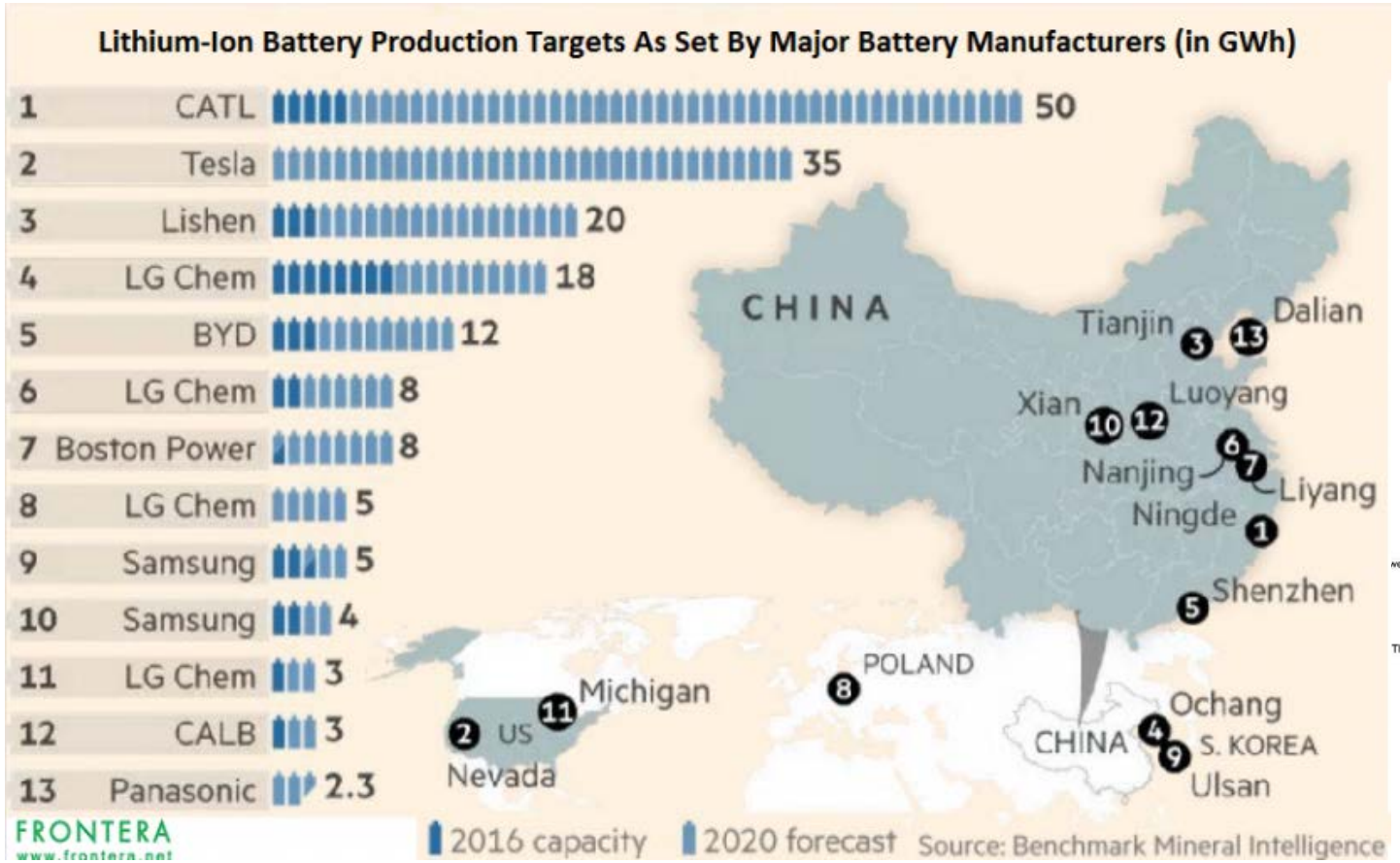

SAE J1772

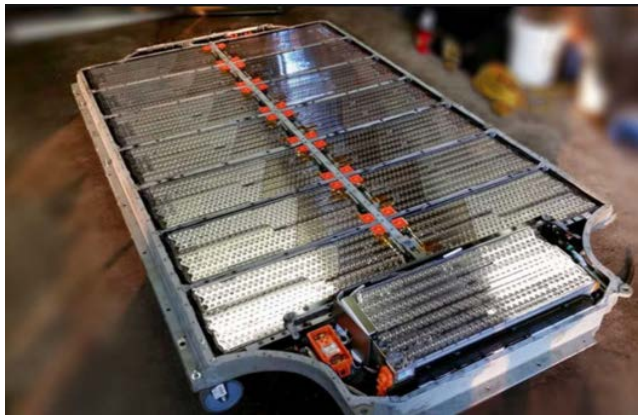

VDE-AR-E 2623-2-2

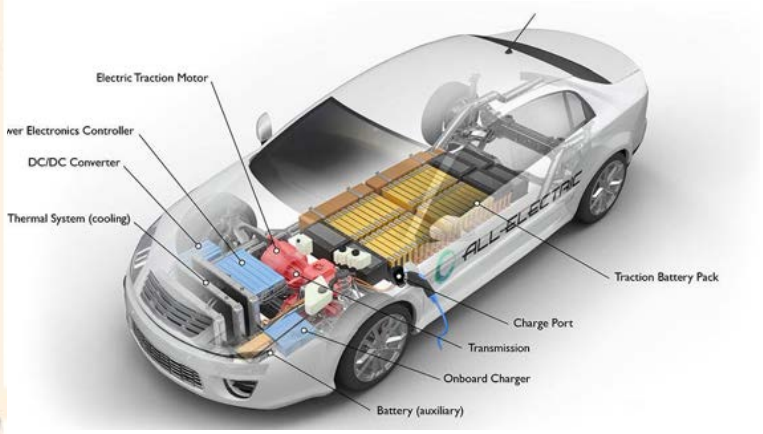

Combined Charging System


CHAdeMO

- Električna vozila-baterije

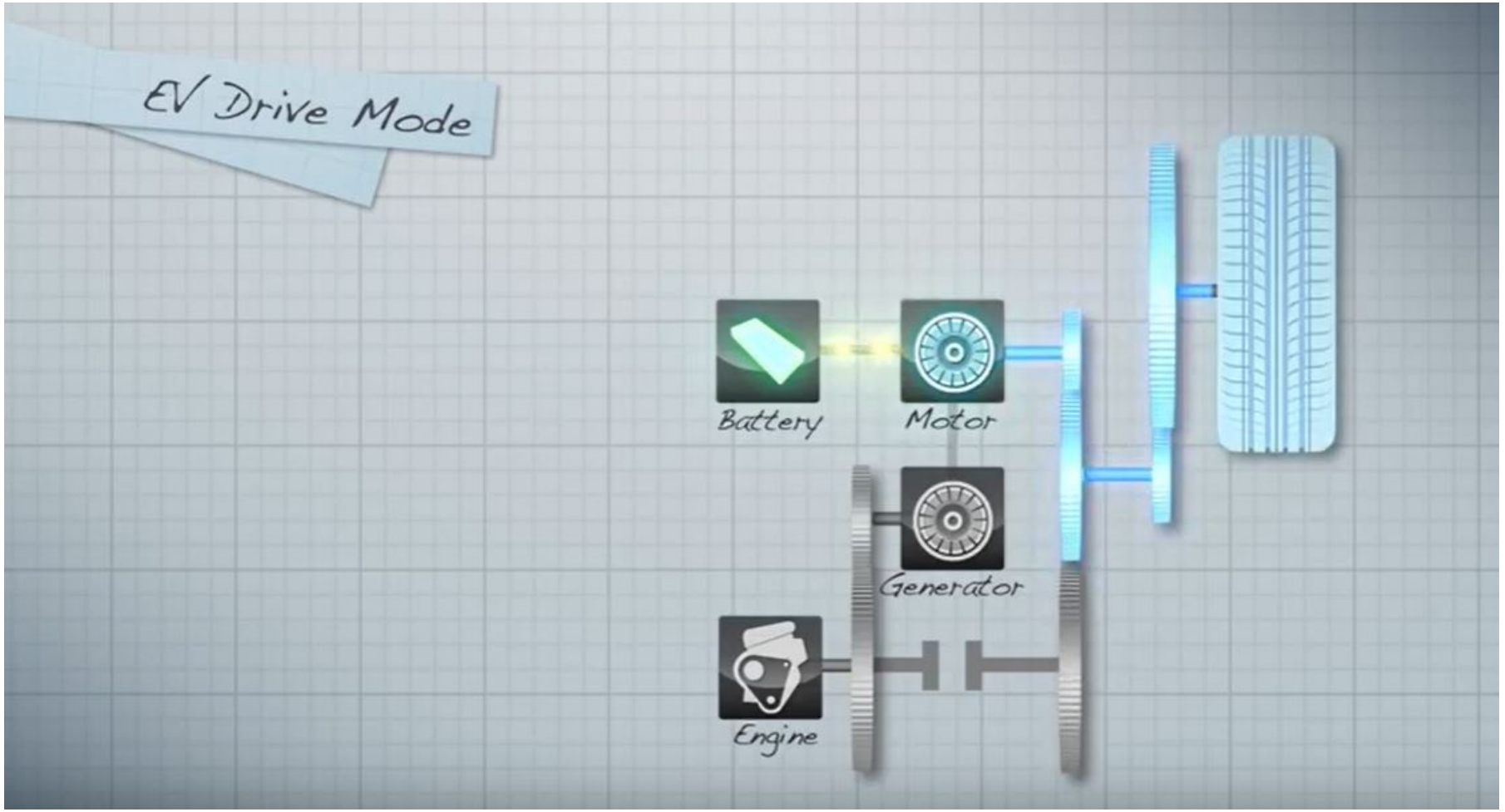




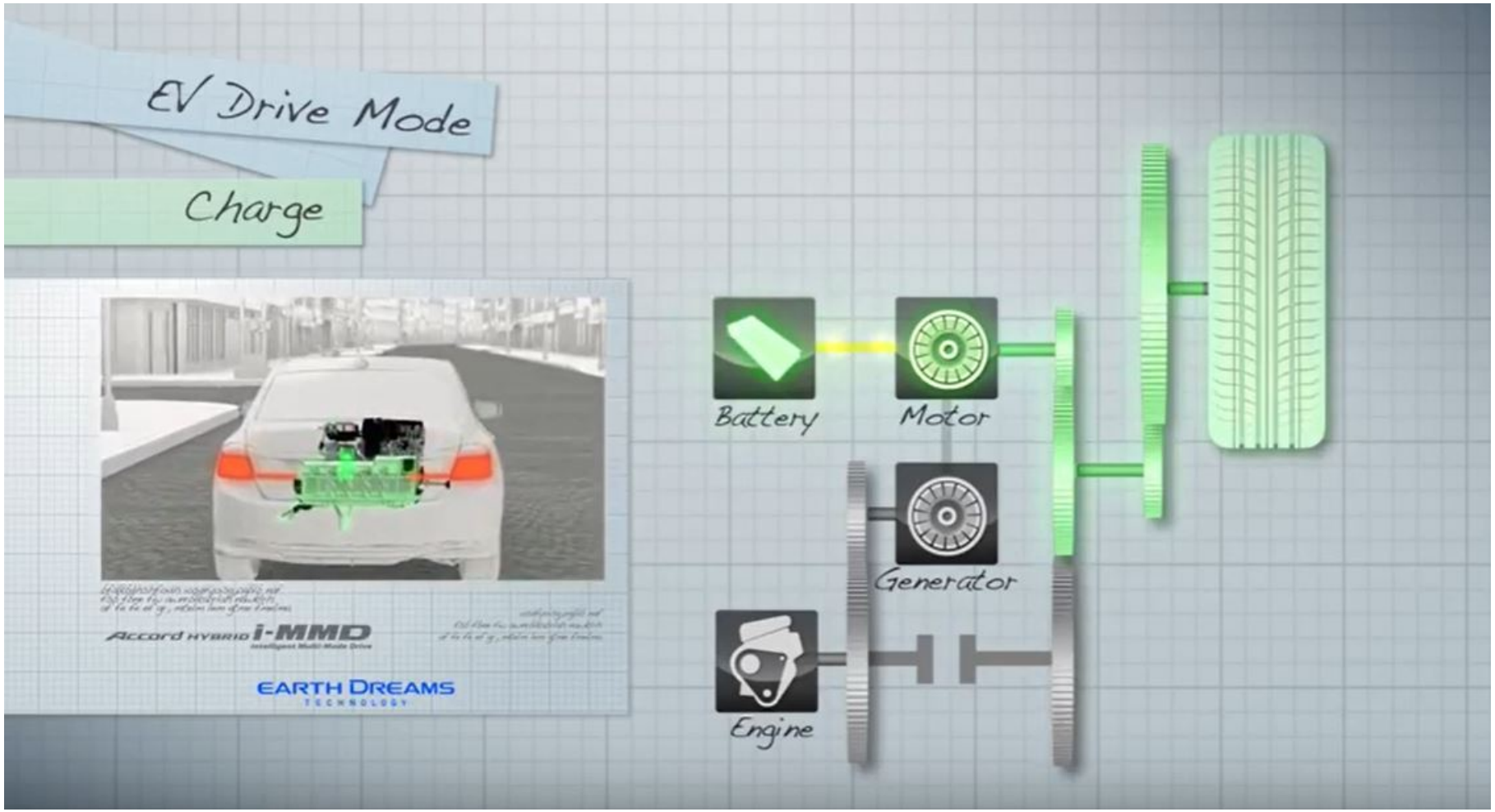


- Hibridna vozila-podela prema dizajnu
  - **Parallel hybrid**
  - **Through The Road (TTR) Hybrid**
  - **Series hybrid**

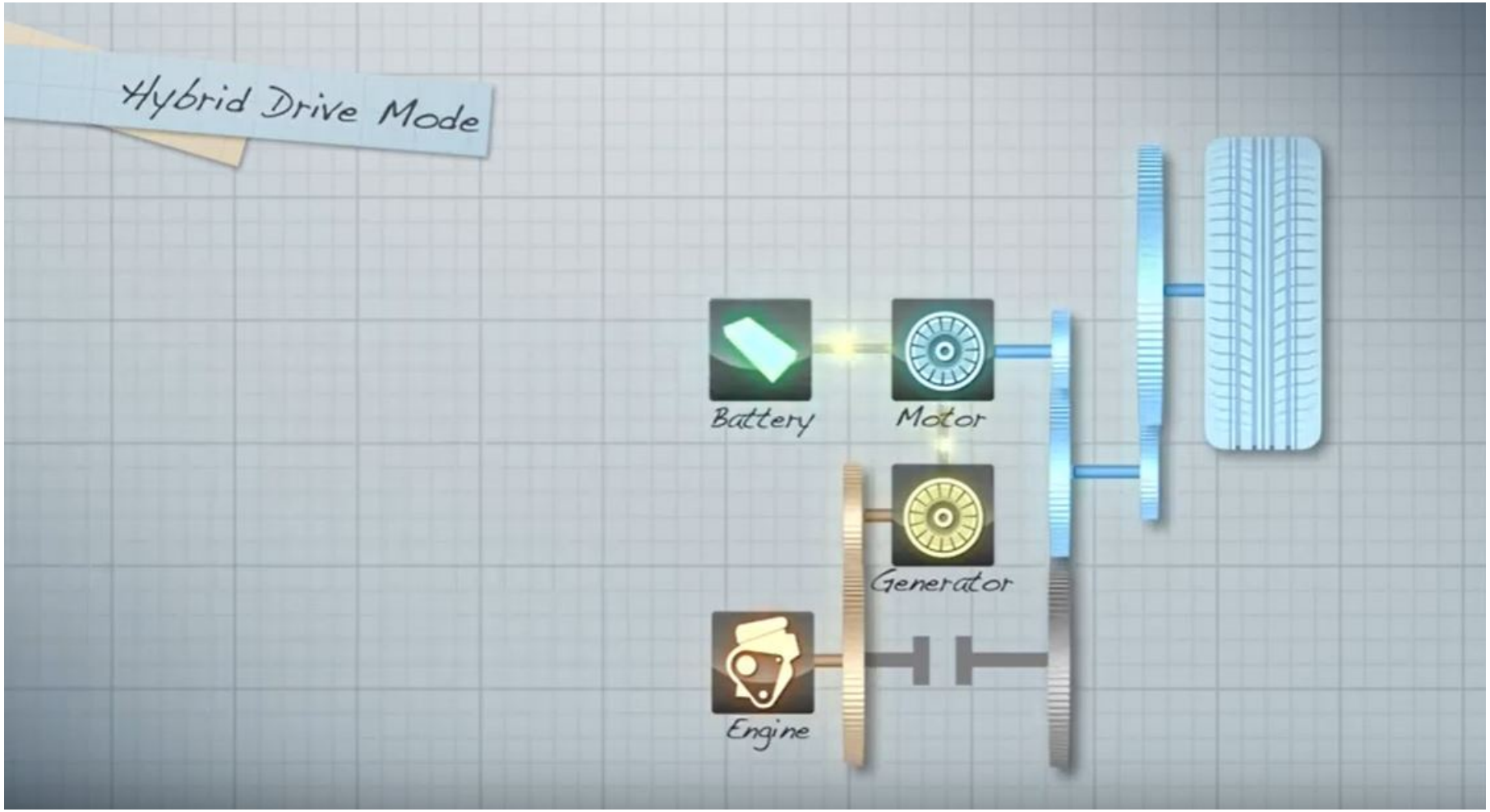
- Honda i-MMD



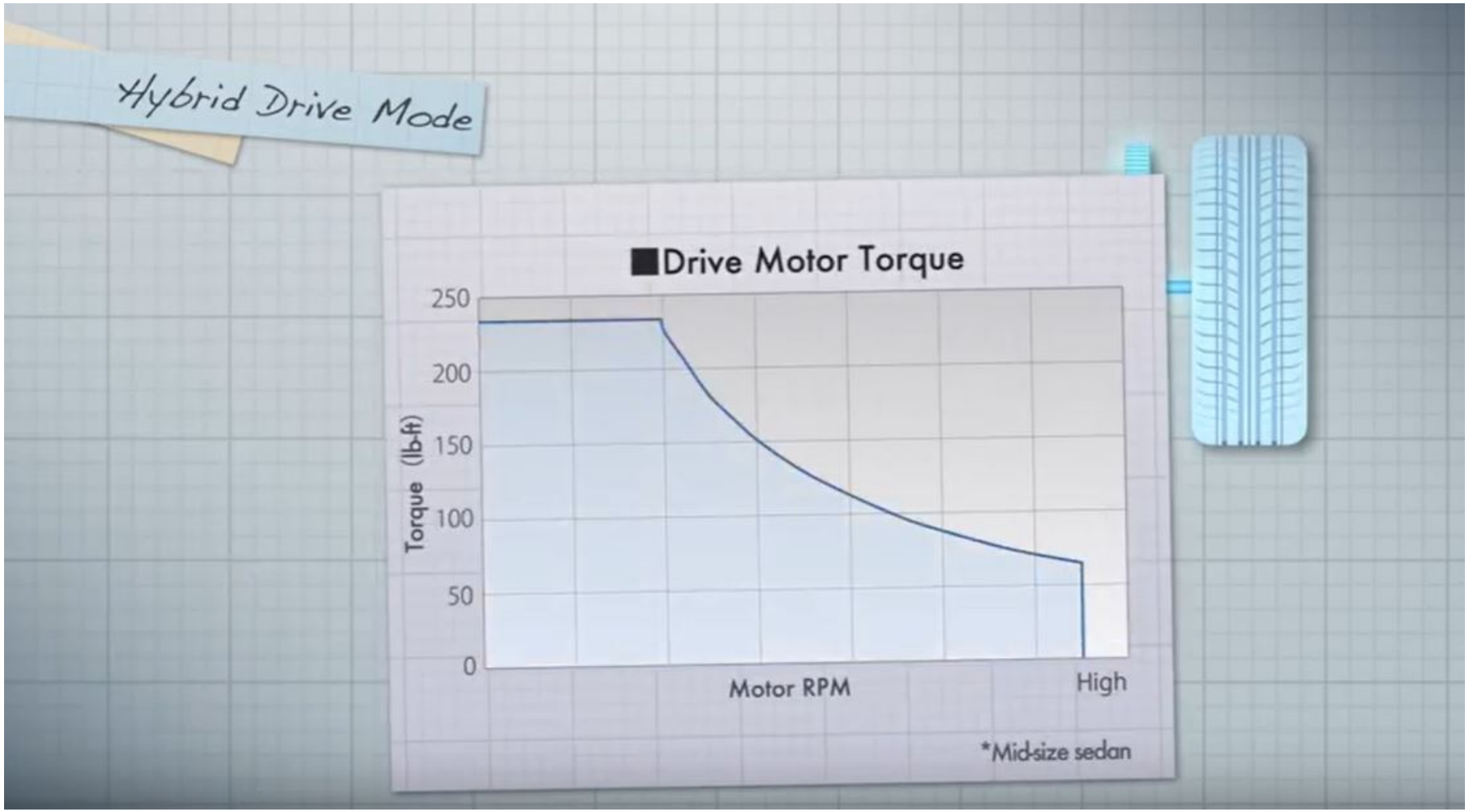
- Honda i-MMD


EV Drive Mode
Charge
Accord HYBRID i-MMD
Intelligent Multi-Mode Drive
EARTH DREAMS
TECHNOLOGY
Battery
Motor
Generator
Engine

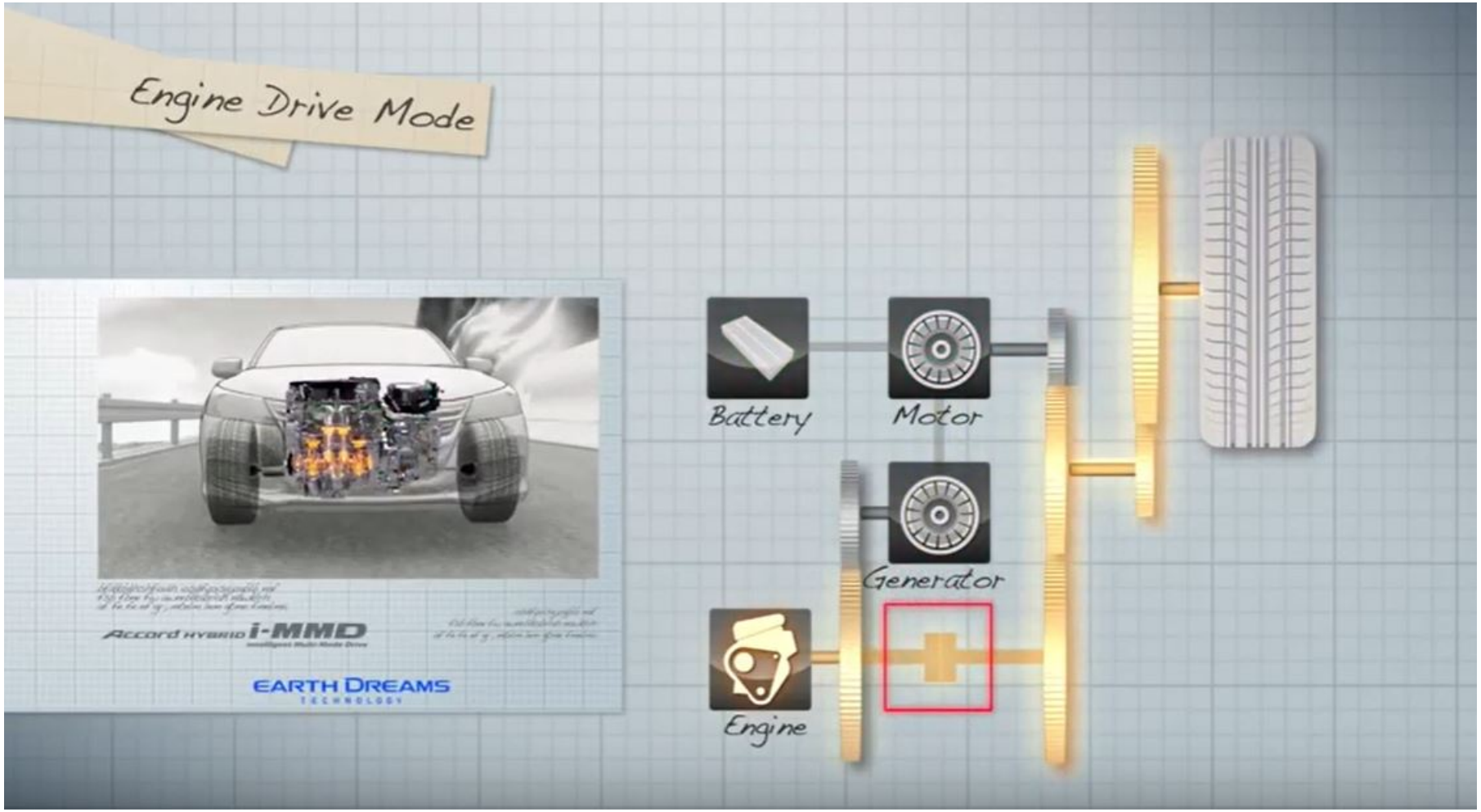
- Honda i-MMD



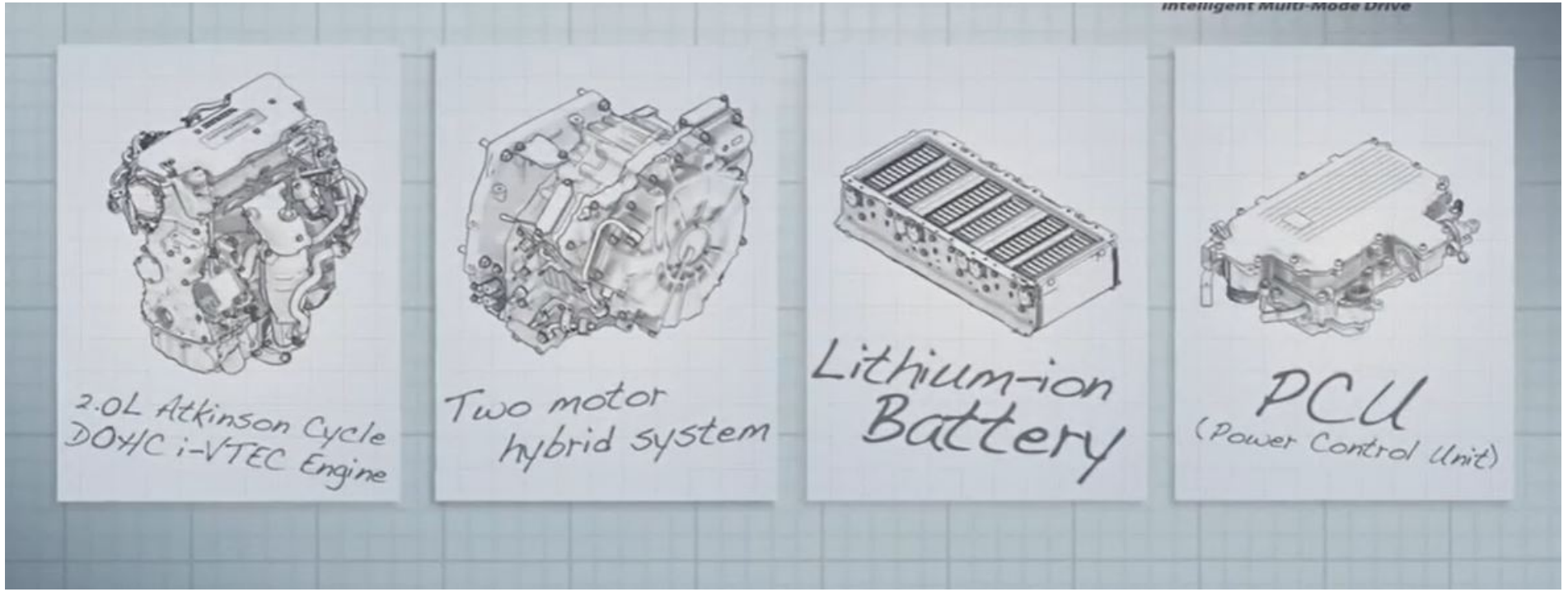
- Honda i-MMD


Hybrid Drive Mode
Drive Motor Torque
250
200
150
100
50
0
Torque (lb-ft)
Motor RPM
High
*Mid-size sedan

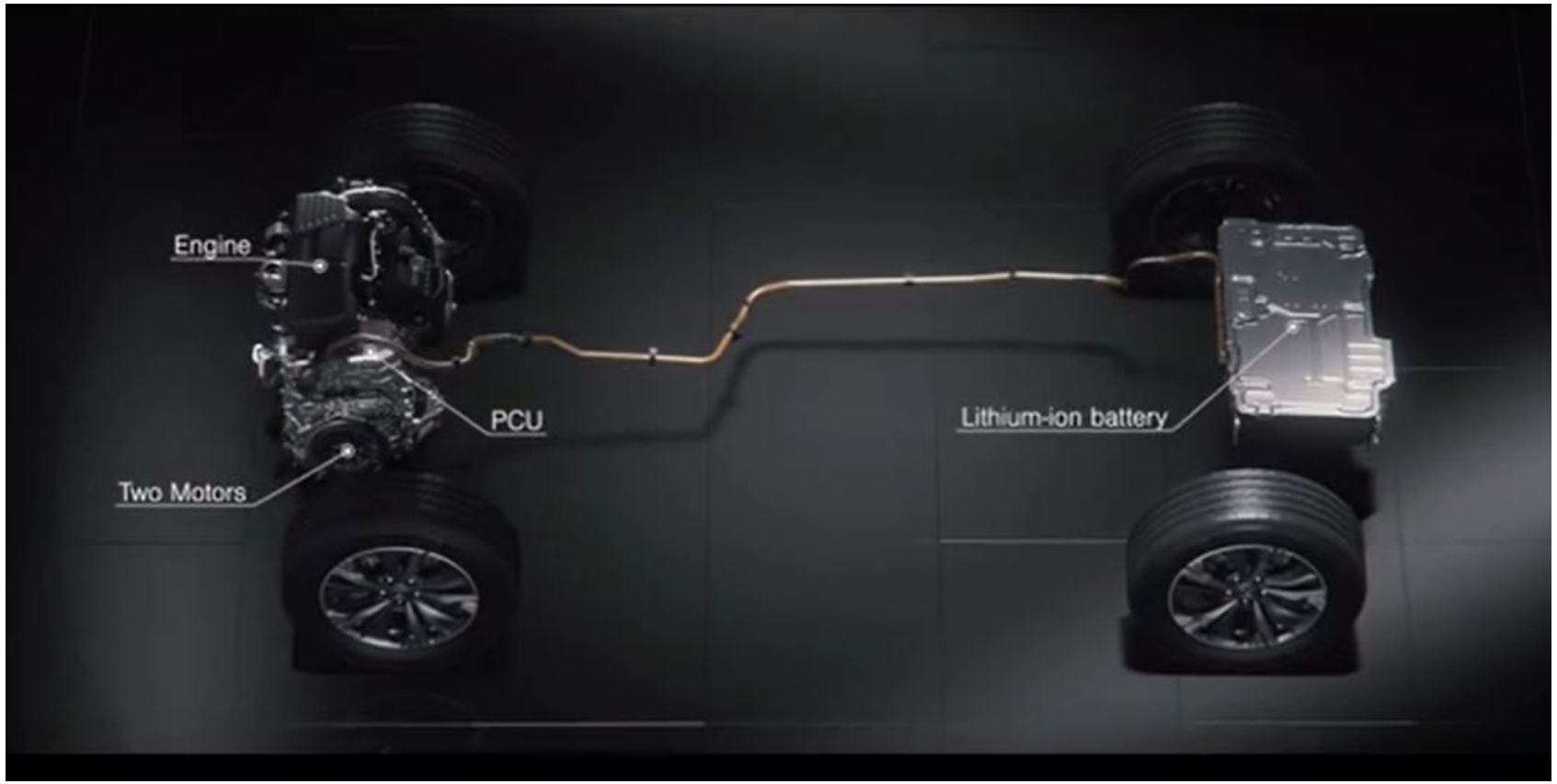
- Honda i-MMD


Engine Drive Mode
Battery
Motor
Generator
Engine
Accord HYBRID i-MMD
EARTH DREAMS
TECHNOLOGY

- Honda i-MMD


2.0L Atkinson Cycle
DOHC i-VTEC Engine
Two motor
hybrid system
Lithium-ion
Battery
PCU
(Power Control Unit)

- Honda i-MMD



- Honda i-MMD