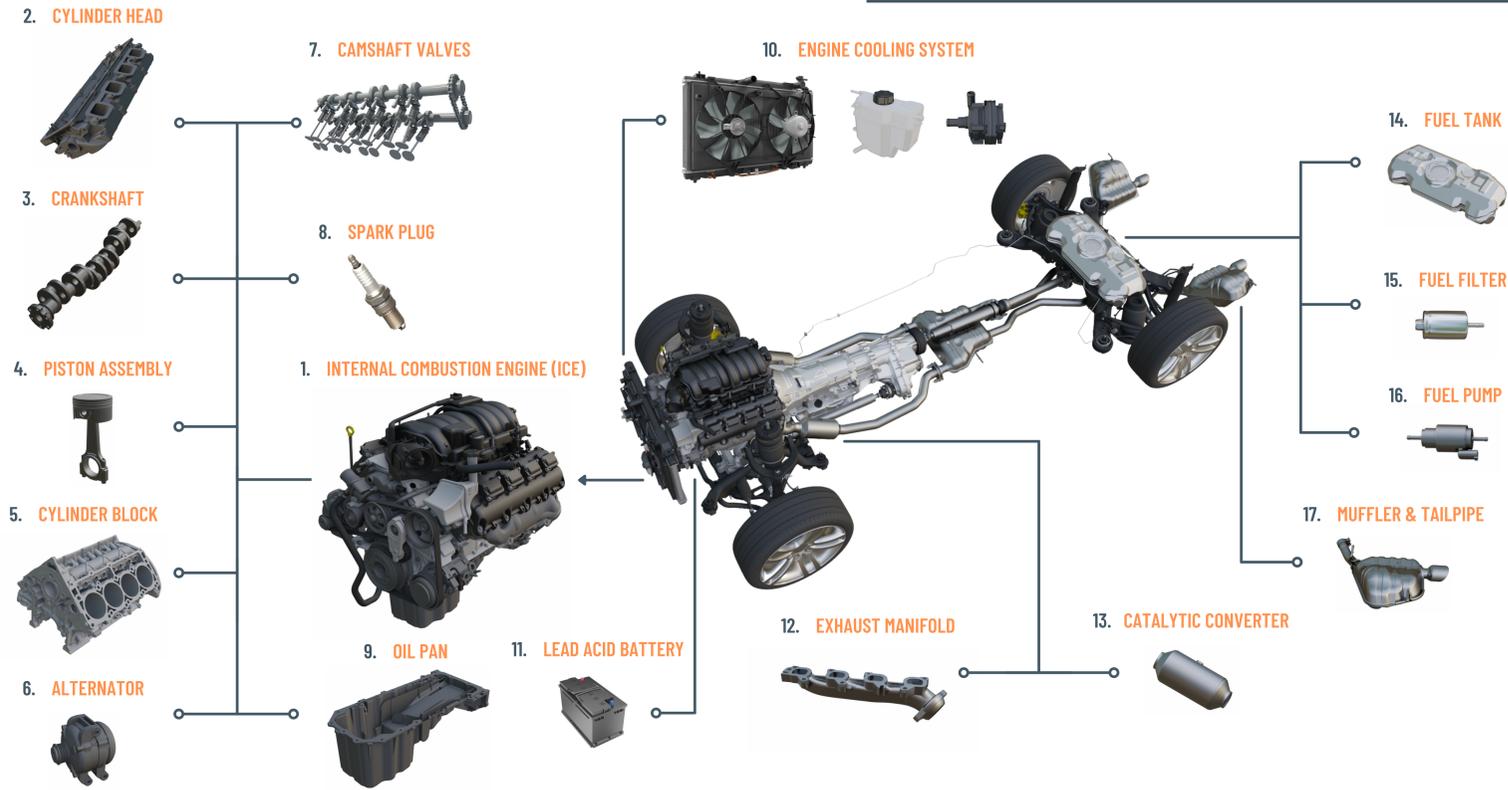


FROM INTERNAL COMBUSTION ENGINE VEHICLES (ICEV) TO BATTERY ELECTRIC VEHICLES (BEV): WHAT IS CHANGING?



1. Internal Combustion Engine (ICE):

An engine where the combustion of an air/fuel mix occurs to propel the vehicle.

2. Cylinder Head:

A structure that sits above the cylinder block and closes the top of the engine cylinders where combustion occurs.

3. Crankshaft:

A mechanism which changes linear reciprocating motion to rotational motion. The piston assemblies are connected to the crankshaft.

4. Piston Assembly:

Consists of a piston and a connecting rod contained in the engine cylinder.

5. Cylinder Block:

A core structure of the engine that houses the cylinders and other parts.

6. Alternator:

Transforms the engine's mechanical energy to electrical energy to power vehicle accessories and charge the battery.

7. Camshaft Valves:

Controls the input of air/fuel mix and the exhaust of fumes.

8. Spark Plug:

A device that delivers an electric spark that ignites the air/fuel mixture in the engine cylinders.

9. Oil Pan:

Holds engine oil that is circulated and used to lubricate engine parts.

10. Engine Cooling System:

A system that monitors and regulates the operating temperature of the engine. The system consists of a radiator with fans, a coolant tank, and a coolant pump.

11. Lead Acid Battery:

Stores electrical power to start the engine and run vehicle accessories.

12. Exhaust Manifold:

Collects emissions from the engine and channels them through the exhaust system.

13. Catalytic Converter:

A unit for emission reduction through a chemical reaction.

14. Fuel Tank:

A container for the safe storage of fuel.

15. Fuel Filter:

Removes dirt and particulate from the fuel before it is fed to the engine's fuel injection system.

16. Fuel Pump:

Moves fuel from the fuel tank to the engine.

17. Muffler & Tailpipe:

The muffler is a device that reduces the noise of the exhaust and the engine. The tailpipe is the last part of the exhaust system where emissions exit the vehicle.

210 out of 850

ICEV parts are either slightly altered, fully eliminated, or have become optional with the shift to BEV manufacturing.¹



6x to 10x

more semiconductor content in an EV drivetrain compared to an ICEV drivetrain.²

80%

less moving and wearing parts in a BEV compared to an ICEV.²



\$137 / kWh

was the average price for a lithium-ion battery pack in 2020.³

FIVE

global battery suppliers seized 82% of the lithium-ion battery market in 2020.⁴



59.4%

of the global vehicle sales in 2032 are forecast to be electric vehicles, of which 53.4% are forecast to be BEVs.⁵

1. INVERTER & POWER CONTROL UNIT



2. ON-BOARD CHARGER



3. DC-DC CONVERTER



4. E-MOTOR



1. Inverter & Power Control Unit:

The inverter converts DC (direct current) power to AC (alternating current) power which is subsequently delivered to the e-motor. This unit also regulates and controls the speed of the motor by changing the frequency of the AC.

2. On-board Charger:

Converts AC power to DC power to charge the battery pack. The charger also monitors battery indicators while charging.

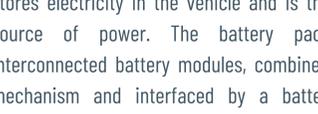
3. DC-DC Converter:

Changes DC power from the on-board high-voltage battery to lower voltages to run the in-vehicle systems. This unit also charges the auxiliary battery.

4. E-motor:

Also known as the electric traction motor, the e-motor uses AC electric supply from the battery to provide traction for running the vehicle. The unit consists of a rotor inside a stator, reduction gears, and cooling channels.

6. POWERTRAIN THERMAL MANAGEMENT



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5. Auxiliary Battery:

Powers the in-vehicle accessories.

6. Powertrain Thermal Management:

Maintains the operating temperature of the e-motor, the battery pack, and other on-board units by regulating the heat flow.

7. High-Voltage Power Cables:

Deliver power across the various vehicle units, including the battery pack, e-motor, inverter and DC-DC converter.

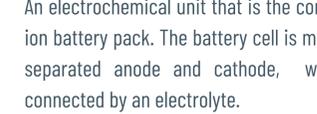
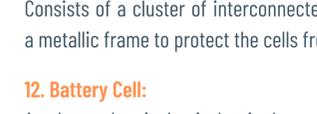
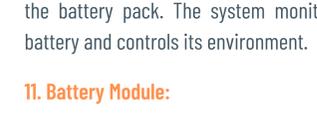
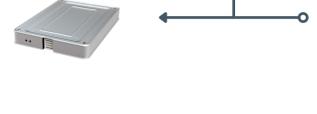
8. Charging Port:

Serves as an interface between the off-board EV charger and the vehicle.

9. Battery Pack:

The battery pack, also known as the traction battery pack, stores electricity in the vehicle and is the vehicle's main source of power. The battery pack consists of interconnected battery modules, combined with a cooling mechanism and interfaced by a battery management system (BMS).

7. HIGH-VOLTAGE POWER CABLES



10. Battery Management System (BMS):

An electronic system that manages the power delivery in the battery pack. The system monitors the state of the battery and controls its environment.

11. Battery Module:

Consists of a cluster of interconnected battery cells within a metallic frame to protect the cells from external shocks.

12. Battery Cell:

An electrochemical unit that is the constituent of a lithium-ion battery pack. The battery cell is made up of a physically separated anode and cathode, which are electrically connected by an electrolyte.

1. According to FOCAL Initiative research.
2. According to UBS Group.
3. According to BloombergNEF.
4. According to Marklines Global Automotive Data.
5. According to LMC Automotive.