Types of Electric Vehicle EV and its Charging Standards in North America

Allen Huang, MS EE, Lead Charging Engineer, Nidec Industrial Solutions

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Types of Electric Vehicles – 3 Types

**BEV** Battery Electric Vehicles, or BEVs. Vehicles that are powered only from an electric battery.

Large Battery Pack
Types of Electric Vehicles

PHEV Plugin Hybrid Electric Vehicle, Vehicles that are powered from an electric battery and an internal combustion engine.

Small Battery Pack
Types of Electric Vehicles

Hybrid EV, Vehicles that are powered from an electric battery and an internal combustion engine, but the battery is charged only charged by regenerative breaking.

Smallest Battery Pack
EV Powertrain

Power Conversion: Electric Motor

Mechanic Energy (Motion, Speed of Wheels) ➔ Electric Energy (Stored in Battery Pack)

BEV: 50-100 kWh; PHEV: 10-15 kWh; Hybrid: 0 kWh

Energy equivalence: 1 gal gasoline = 33.7 kWh

BEV: 25 kWh/100 mi or 3-4 mi/kWh. 12,000mi/year => 3,000-4,000 kWh. Cost: $300 – $600 of electricity per year

ICE car 25 mi/gal. $4.6/gal. Cost: $2200/y
Charging Speed, Duration of charging in minutes or hours?

How fast to charge an EV?
- Battery Capacity (kWh)
- Charging Power of Charger (kW)
- Battery BMS receiving power or actual charging power (kW)

Battery Capacity or Size, Unit: kWh

Volume \( (V) = \text{Cross Area} \times \text{Length} \)

Electric Charging power:
- Cross area -> P in kW
- Length -> Hours in h
- Battery Capacity: kWh

Time to charge:
\[ t = \frac{\text{Volume}}{P} \]

- \( t = \frac{50 \text{ kWh}}{50 \text{ kW}} = 1 \text{ h} \)
- \( t = \frac{100 \text{ kWh}}{200 \text{ kW}} = 0.5 \text{ h} \)
- \( t = \frac{42 \text{ kWh}}{7 \text{ kW}} = 6 \text{ h} \)

Thinking using a garden hose to fill a water tank:
Bigger the pipe, Shorter the time needed.

Charging Power = min (Charger Power, Battery receiving Power)
Types of Electric Charging – AC or DC charging

AC Charging

- Level 1 (L1): Voltage 110 – 120VAC; Current 16A, Charging power, 1.76 kW
- Level 2 (L2): Voltage 208-240VAC; Current 30-40A, Charging power, 7.6 – 9.6 kW
- Charger Connector J1772 for North America. Type 2 for EU. Electrical signal is the same, it differs only in shape.
- On Board Charger (OBC)
  - Convert AC power to DC power to charge battery
  - Bottleneck of EV charging
  - On the vehicle, Can’t be too much weight
- Typical Household Grid Power
  - 125-200 A panel.
  - 40 A accounts of 20-30%

[Image of AC charging equipment]
DC Fast Charging

DC Charging

- DC Voltage
  - AC
  - DC

- Bypassing OBC Directly to Battery Pack

- Battery BMS and Voltage Platform
  - Battery Management System (BMS)
  - 480VDC and 800VDC

- DC Charging Power
  - Power = V (v) x I (A) kW
  - Typical EV Charger 120-360 kW

- Major Charging Network
  - Tesla Supercharger Network
  - Electrify America
  - EVgo
  - ChargePoint
  - Greenlots

- APP PlugShare
Charging Connectors

**Tesla Connector**
One Type, both for AC and DC

**CCS1 (Combo Charge System)**
1 North Am. 2 for EU only for DC

**CHAdeMO EV Connector**
Only for DC – phasing out

**AC J-1772 Connector 250VAC/40A**
Charging Sites

EA BMW iX charging power @ 138kW
V2G (Vehicle to Grid), V2H, V2L and V2X

What is V2G?
To send the stored energy back to grid, home, any other load.

How?
To use an inverter. From DC power to AC power.

Examples: Ford F-150 Lightning Truck

F-150 Home Integration System @ 9.6kW only $3895
Nidec Corporation

A Leading Global Manufacturer of Electric Motors and Controls

- Founded in 1973
- HQ: Kyoto
- 2021 GROUP TURNOVER: $17.4B*
- Market Capitalization: $44.7B (as of 4/1/2022)

Mr. Nagamori, Founder & CEO
Nidec Competes in *Everything That Spins and Moves*

**INFORMATION TECHNOLOGY**
- PCs / Servers
  - Data Center Cloud
  - Smartphones
- Haptics / HMI
- Consumer Electronics
- Digital Recorders / Cameras

**VEHICLES**
- EV Traction Drives
  - (LSEV, Golf Carts, Utility, Passenger, Material Handling, Bus, Off Road Heavy…)
  - Passenger Car Peripherals & Electronics
    - (ADAS, Power Steering, Braking, Oil/Water Pump, Sunroof, Windows, Seats, HVAC…)

**ROBOTICS**
- Factory Automation
- Automated Guided Vehicles
- Power Assist Suits
- Personal Mobility
- Telepresence Robot
- Drones

**POWER GENERATION**
- Electric Generators
- Nuclear Energy
- Renewable Energy
  - (Solar, Wind, Hydro…)
- Battery Energy Storage Systems
- Grid Stability

**APPLIANCES**
- Washers
- Dryers
- Dishwashers
- Refrigerators
- Fans
- Air Conditioners

**INDUSTRY**
- Automation Systems
- Conveyors
- Compressors
- Fans
- Pumps
Nidec Global Footprint

- 300+ locations
- 40+ countries
- 145,000 employees
Nidec Industrial Solutions: EV Charging Infrastructure

Robust, high-performance, dependable EVCI Equipment for the United States

*Designed, Built, and Serviced in the US*

Our Focus:

- **DirectPower PS**
- **DirectPower 120**
- **DirectPower 360**

Jeffrey Lehman, PE
Director, EV Charging Infrastructure
Nidec EVSE Portfolio: DC EV Charging

**DirectPowerPS**
- Power Conversion Unit
  - 50kW Grid Input
- Battery Energy Storage (optional)

**Ideal For:**
- Electrical capacity constraints (facility or grid)
- Facility or fleet resilience
- Legacy corridor 50kW DCFC replace-in-place

**Dispenser**
- Up to 320kW Output
- Dynamic Power Sharing

**DirectPower120 & DirectPower360**
- All-in-One EV Chargers
  - Up to 360kW Output
  - Dynamic Power Sharing

**Ideal For:**
- Locations with no electrical capacity constraints
- Greenfield charging projects
- Corridor, fleet depot, multi-family, workplace:
  - Minimum wait times, maximum load management flexibility

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DirectPowerPS

DirectPower120

DirectPower360

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Q & A.
The End.
Thank you!