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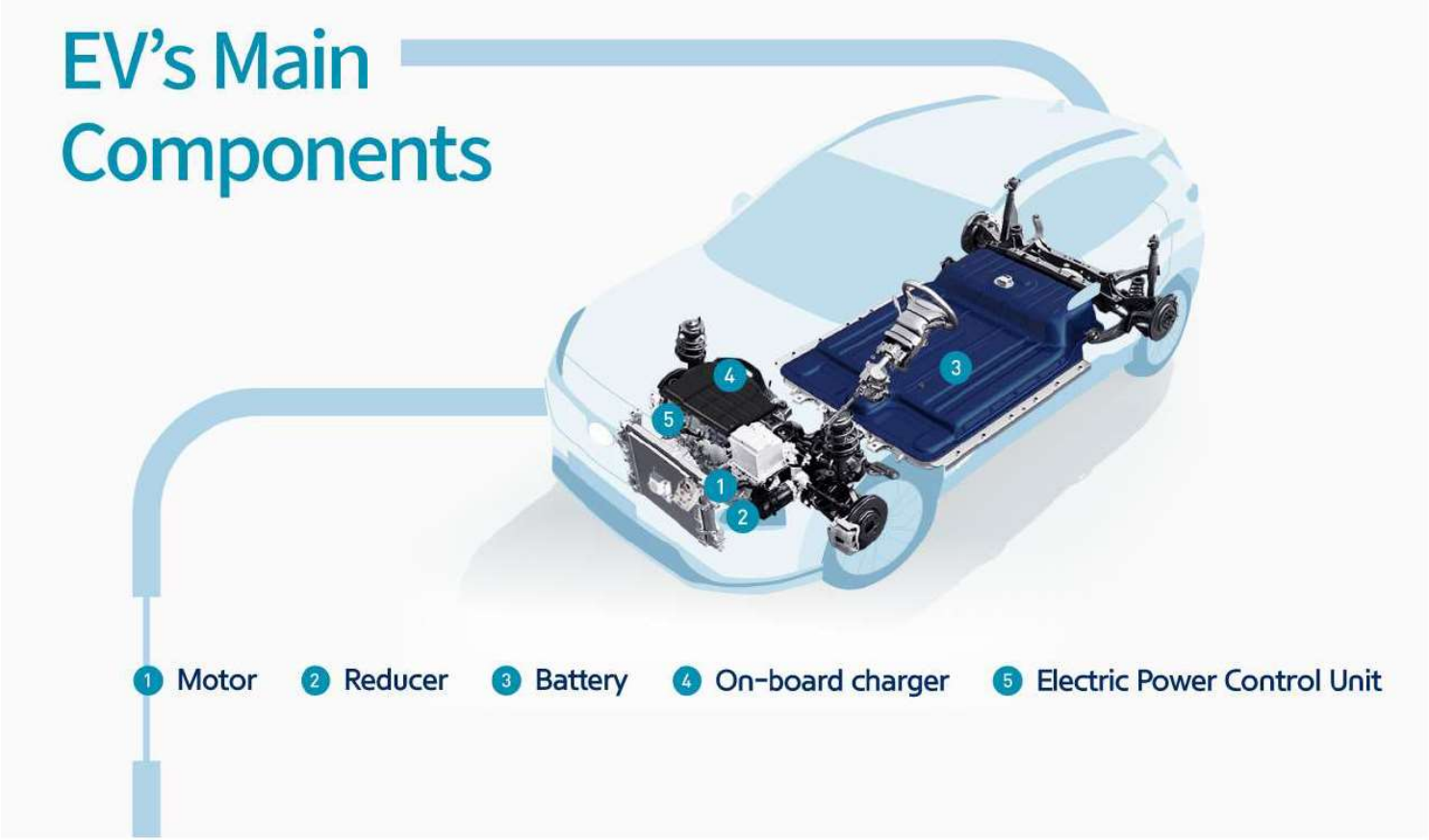

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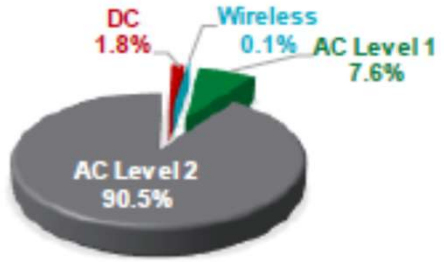
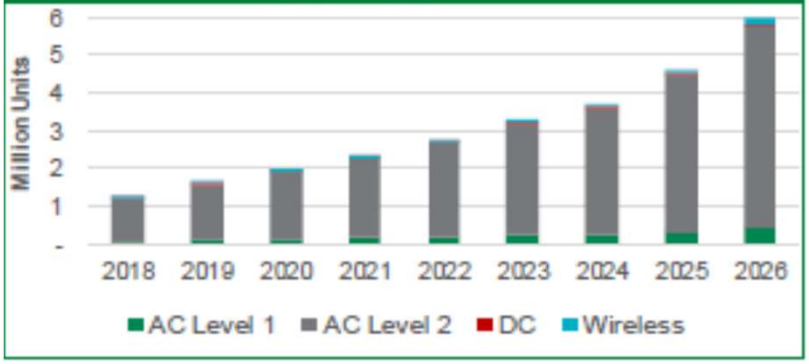
Global electric vehicle charging equipment market

EV Charging Equipment, by Type, in 2018



EV Charging Equipment Forecast



Market Trends and Drivers
The production of electrified vehicles is increasing: estimated 6 million vehicles in 2019, growing to 16 million vehicles in 2023
There is limited charging infrastructure in most regions
The production of new EV charging equipment will increase at a compound annual growth rate (CAGR) of 22% between 2018 and 2026
The majority of charging occurs at the home or workplace during a span of several hours (AC charging)
There is consumer demand for charging times that emulate fuel refilling time for long-distance trips (DC charging)
The voltage and power output of DC chargers is increasing to support fast charging
Business models are evolving: increase property value; revenue generation

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CLASSIFICATION OF CHARGING EQUIPMENT.

- Charging equipment is classified by the maximum amount of power in kilowatts provided to the battery.
- **AC Level 1**, which is a 120-volt (V) alternating current (AC) plug. A full charge at Level 1 can take between 8 and 20 hours, depending on the battery capacity of the vehicle. Charging rate is approximately 1 kW.
- **AC Level 2**, which is a 240-volt AC plug and requires installation of home charging equipment. Level 2 charging can take between 3 and 8 hours, again depending on the battery capacity of the vehicle. Charging rates fall within a range of 3 kW to 20 kW.
- **Direct Current (DC) fast charging**, which is as high as 600 V, enables charging along heavy traffic corridors and at public stations. A DC fast charge can take less than 30 minutes to charge a battery to most of its capacity.

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CHARGING --

- It is expected that most PHEV and EV owners will recharge their vehicles overnight at home. Level 2 charging equipment will be the primary option for home charging. Vehicle manufacturers have already developed stations for home charging in India.

- **Charging Standards**

Standardization in charging outlets assures that all vehicles can be charged at any charging outlet. North America had agreed on standards. Many European countries are in the process of discussing standards for charging infrastructure.

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BHARAT EV SPECIFICATIONS FOR AC and DC CHARGING.

Bharat EV charger AC-001

Bharat EV charge DC -001

Home charging –

The home charger or on board charger are generally used with 230V/15A single phase supply which can deliver up to 2.5 KW of power. Recommended connector type IEC 60309 for both ends.

AC Slow charging –

Slow AC charging is the most common method of charging EV's. An EVSE supply AC current to on board charger which converts it to DC allowing batteries to be charged.

Fast AC charging –

Electric cars like Nissan leaf have on board chargers capable of fast charging at 7.7 to 22 KW.

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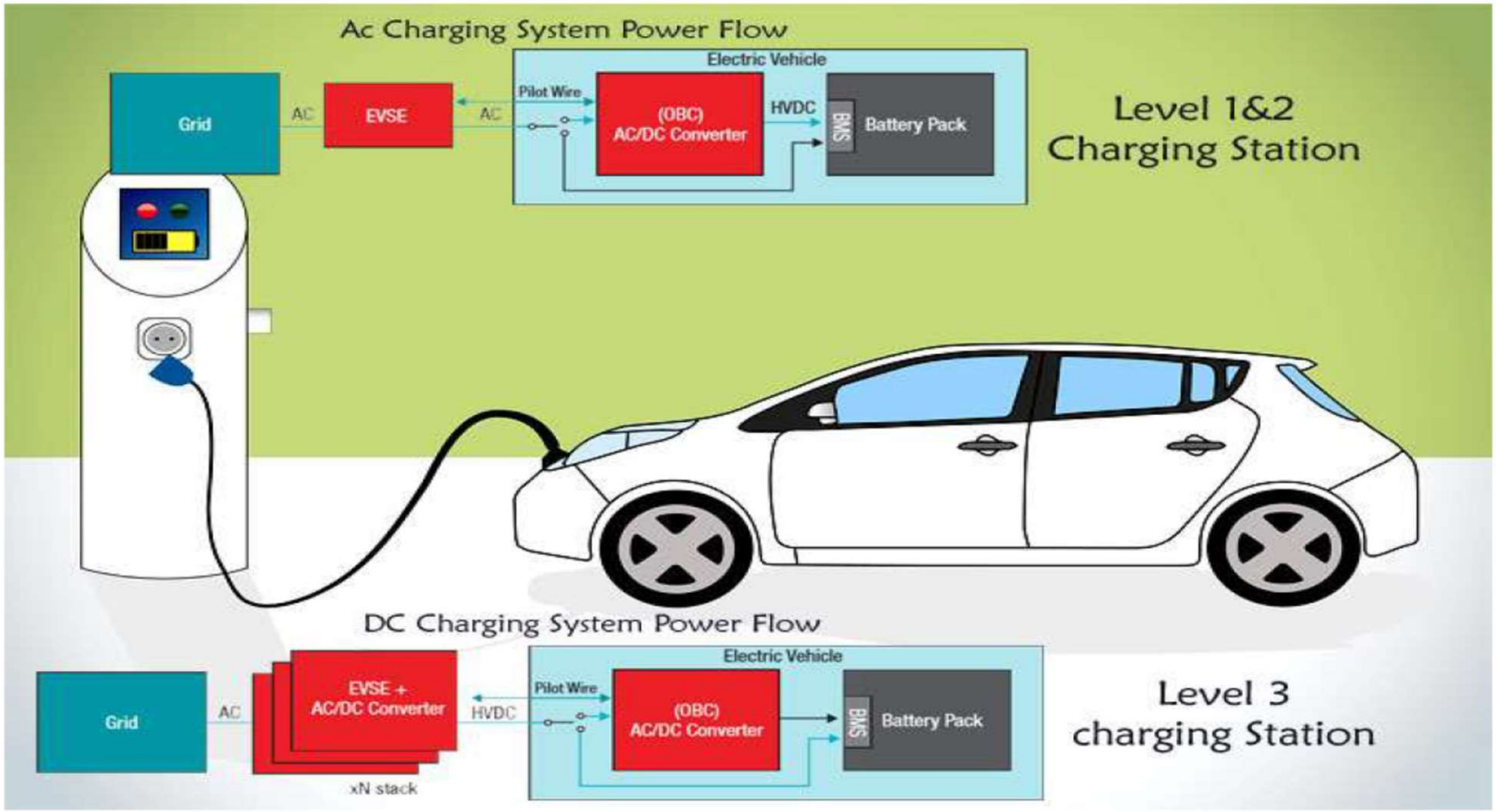

Electric Vehicle On-board Chargers and Charging Stations

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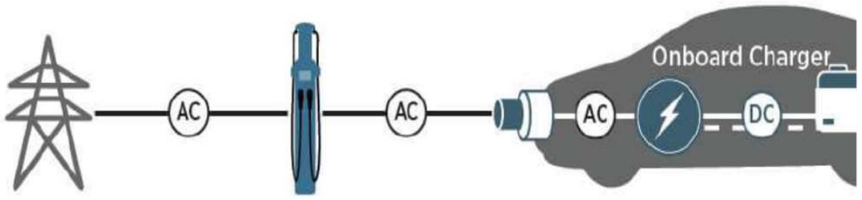
What Differentiates Level 2 (AC) and DC Fast Charging

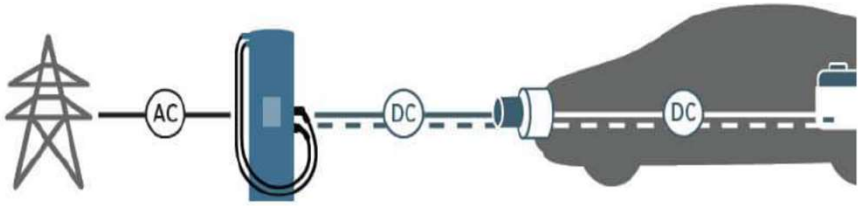
Level 2 Charging

AC power is supplied from the charging station to the on-board charger, which supplies DC power to the battery.



DC Fast Charging

The charger is off board the vehicle and supplies DC power directly to the battery.



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EV Battery Charging Times Using the Maximum Available Power from Different Chargers

Representative Vehicles and Chargers (Many variants are possible)				Charging Times and Rates (Hours and Equivalent Battery C Rates Supplied by Charger)								
				Charger	Level 1				Level 2		Level 3	
				Available Power	2 kW US Domestic		3kW Euro Domestic		20 kW 3 Phase Domestic/ Industrial / Public		50kW DC Public Fast Charge	
Vehicle	Charge Level and Equivalent C Rate	Battery Capacity (kWh)	Battery C Rate (Amps)	Charger Efficiency(%)	Hours to 80%	Charger Equiv C Rate (C)	Hours to 80%	Charger Equiv C Rate (C)	Hours to 80%	Charger Equiv C Rate (C)	Hours to 80%	Charger Equiv C Rate (C)
	Electric Bike	0.5	20	85	0.2	4.3	0.2	6.4	0.02	42.5	0.002	425.0
	Plug In Hybrid PHEV	10	41	85	4.7	0.2	3.1	0.3	0.5	2.1	0.05	21.3
	EV Passenger Car	24	66.2	85	11.8	0.1	7.8	0.1	1.2	0.9	0.1	8.5
	Heavy Delivery Van	50	200	90	22.2	0.05	14.8	0.1	2.2	0.5	0.2	4.5

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AC Plug Connectors –

- Bharat EV specifications recommend using IEC 60309 plug. Mostly used on E rickshaws.

- IEC 62196 Type 2 connector used by Indian cars like Renault Zoe, Nissan Leaf, Mahindra e2O

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DIFFERENT TYPES OF CONNECTORS USED FOR CHARGING ELECTRIC VEHICLE.

EV Charge Couplers

USA UK Germany France

A Small Sample of the Different National Domestic Electricity Supply Socket Outlets Available for Level 1 Charging

Mennekes AC Coupler

IEC 62196 Type 1 AC Socket

IEC-62196-2 Type3 SCAME 3 Phase AC Coupler

SCAME AC Plug with Safety Shutters

SAE J1772 AC Coupler

J1722 AC and DC "Combo" Coupler

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CHAdeMO DC Plug

China GB Standard DC and AC EV Charging Plugs

CCS Connector

CHAdeMO DC and J1772 AC, Alternative Sockets as Mounted in the Nissan Leaf

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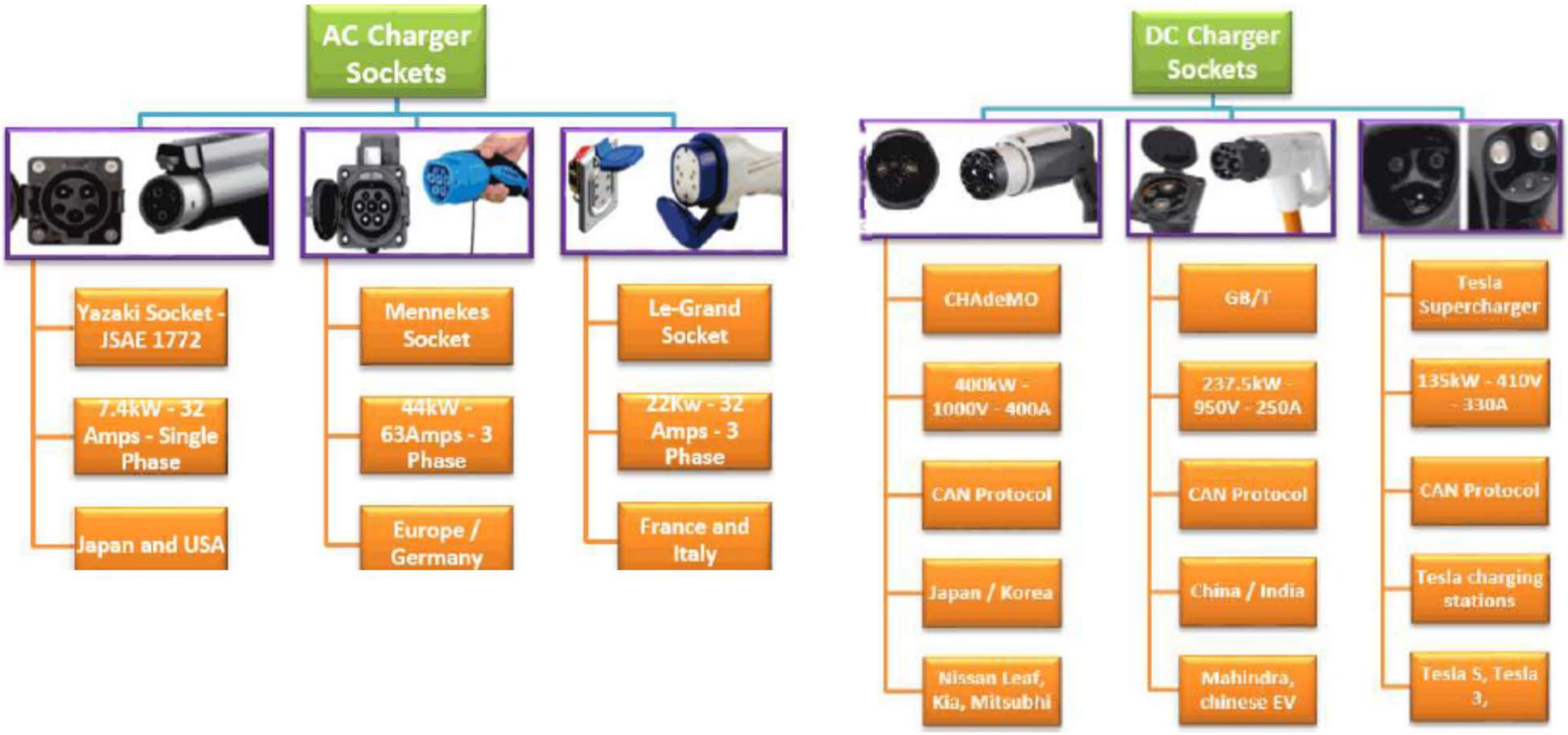

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Type 2	CCS	CHAdeMO	GB/T 20234
			
AC-Charger	DC-Charger	DC-Charger	DC-Charger
U_{max} = 400 V, 3-phase	U_{max} = 850 V	U_{max} = 600 V	U_{max} = 750 V
I_{max} = 63 A	I_{max} = 200 A	I_{max} = 200 A	I_{max} = 250 A
$P_{Connector}$ = 43,5 kW	$P_{Connector}$ = 170 kW	$P_{Connector}$ = 120 kW	$P_{Connector}$ = 187,5 kW
Communication = PWM/PLC		Communication = CAN	

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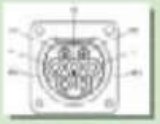
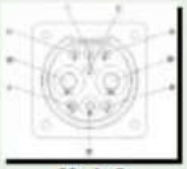
SUMMARY OF COUPLERS AVAILABLE FOR TYPE 2 AND 3 CHARGING.

		US	EU		CHINA	JAPAN
 AC Charging	Single-Phase (1Ø)	 SAE J1772™	 IEC 62196-2 Type 1		 Type 2	 SAE J1772™ *
	Single- or Three-Phase (1Ø or 3Ø)		 IEC 62196-2 Type 2  IEC 62196-2 Type 3	*SAE and IEC AC standards have common control signals*	*China charge couplers (not standard yet) have unique control signals and overall physical shape*	*JARI/ChADeMO standard has unique control signals and overall physical shape*
 DC Charging		 SAE J1772™ 'Hybrid'	 IEC 62196-2 Type 2 'Hybrid'	*SAE and IEC working toward harmonization of DC 'Hybrid' charge couplers*	 Mode 3	 JEVS G105-1993 (ChADeMO)

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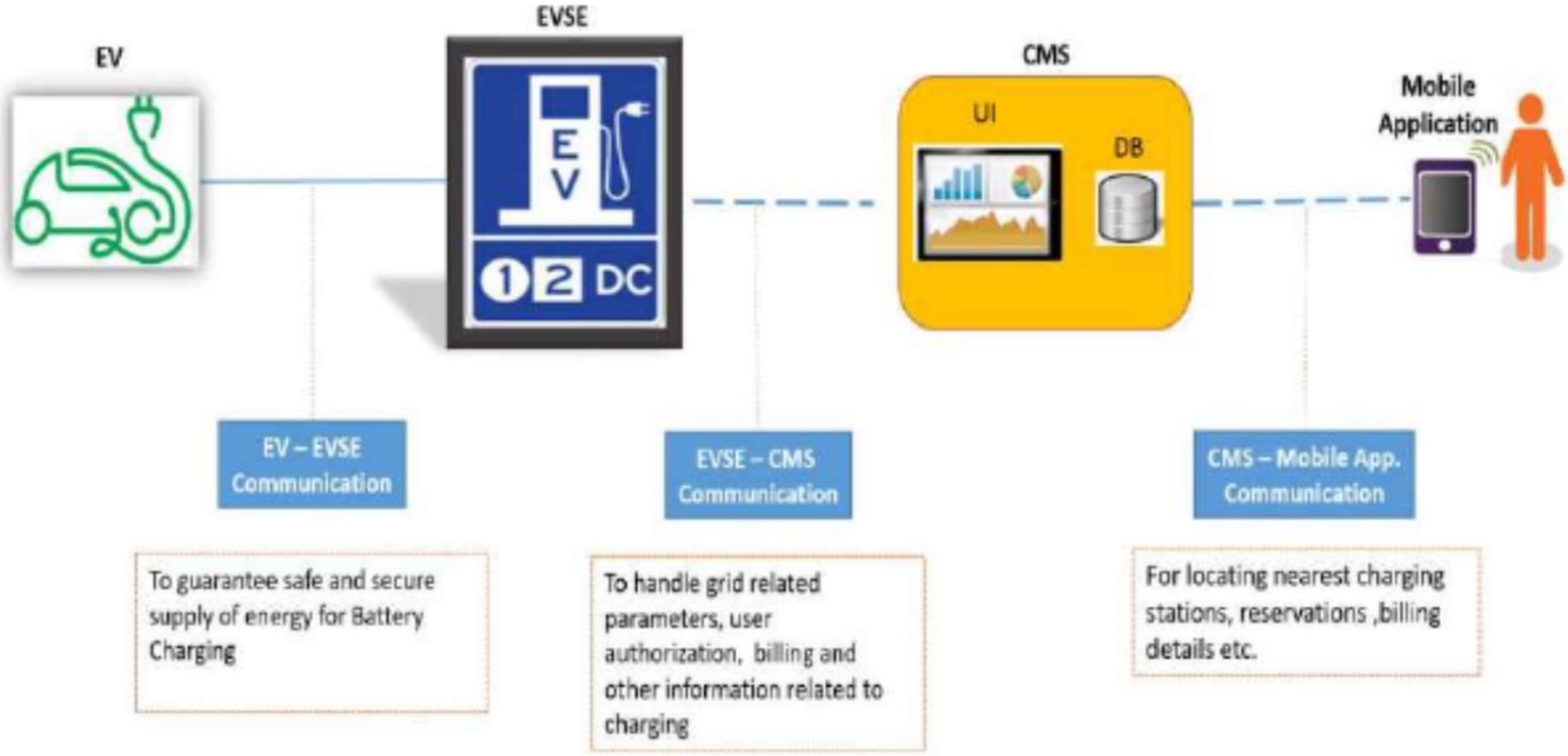
Architecture of EV and Charging infrastructure.



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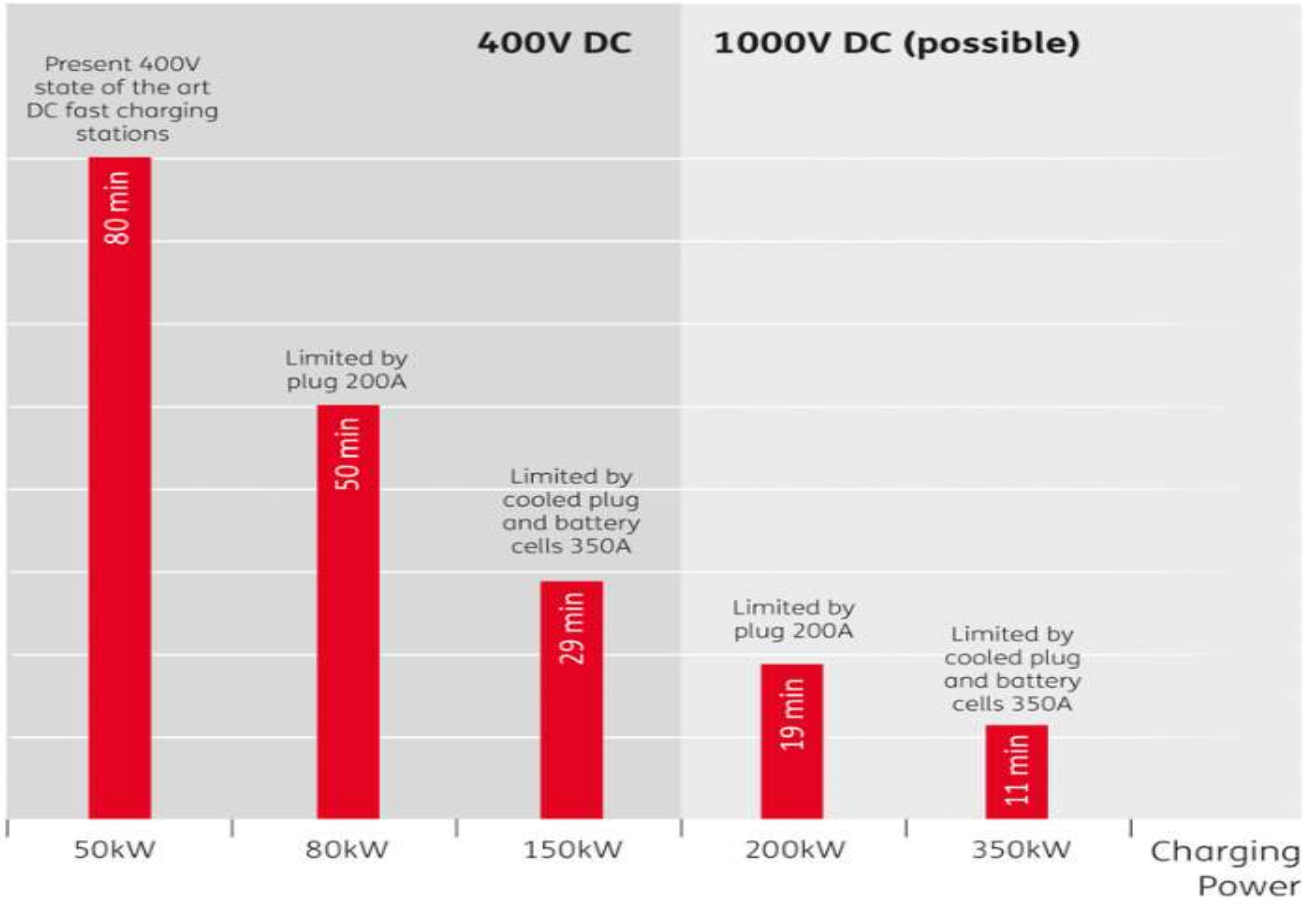
Charging time and the charging power relationship.



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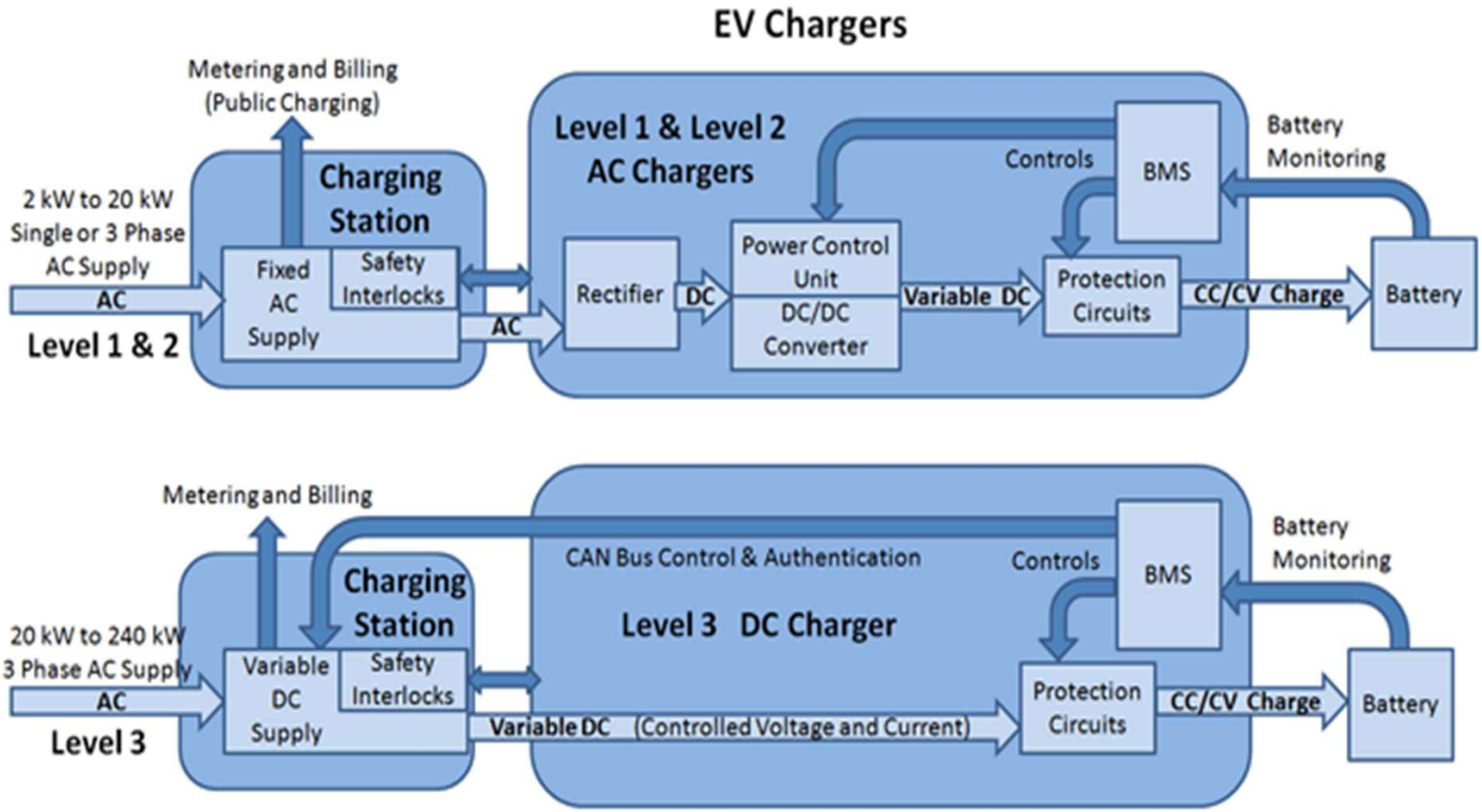

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DC FAST CHARGING.

In this method of charging, DC current is supplied to battery directly via the DC charge port. DC fast charge rates are usually 50 KW and above, up to 350 KW. They supply usually 100 km range per hr of charging.

As per BHARAT DC charging specifications, power rating for fast chargers are –

10 kw/15 kw/30 kw/50 kw or even higher.

Voltage rating – 48V/72 V for India electric cars like Mahindra e2o Plus 8, e-varito, and upcoming Tata electric cars.

Up to 750 V or higher, used by Global electric cars like Nissan leaf and others.

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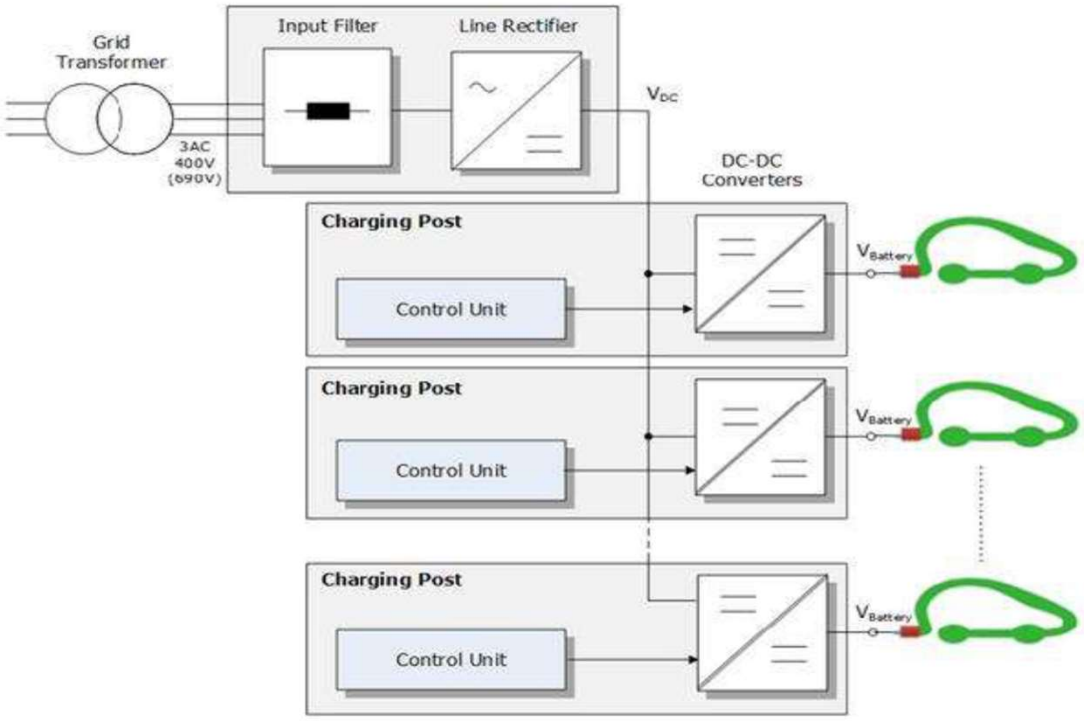
Basic circuit diagram of a charging station with multiple DC fast charging points.



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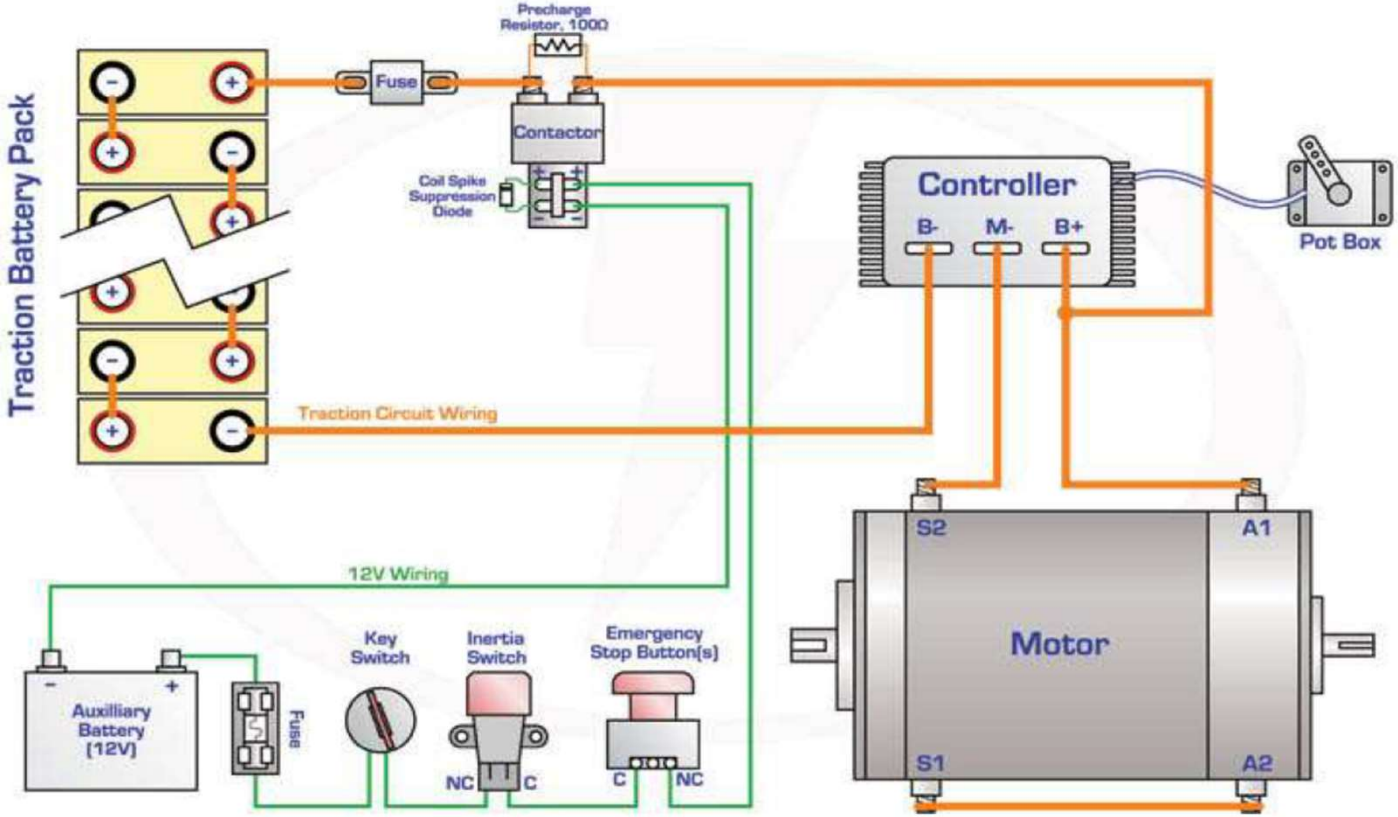
Simple Wiring Diagram For DC Electric Vehicle.



The diagram above shows the "bare bones" wiring for the traction circuit in a typical electric vehicle, with a series DC motor and controller.

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TABLE 1. Technical specifications of commercially available dc fast chargers.

Manufacturer and Model	ABB Terra 53	Tritium Veefil-RT	Tesla Supercharger	EVTEC espresso&charge	ABB Terra HP
Rated power	50 kW	50 kW	135 kW	150 kW	350 kW
Supported standards	CCS Type 1 CHAdeMO 1.0	CCS Types 1 and 2 CHAdeMO 1.0	Supercharger	SAE Combo 1 CHAdeMO 1.0	SAE Combo 1 CHAdeMO 1.2
Input voltage	480 Vac	380–480 Vac 600–900 Vdc	200–480 Vac	400 Vac ± 10%	400 Vac ± 10%
Output dc voltage	200–500 V 50–500 V	200–500 V 50–500 V	50–410 V	170–500 V	150–920 V
Output dc current	120 A	125 A	330 A	300 A	375A
Peak efficiency (charger only)	94%	>92%	92%	93%	95%
Volume	758 L	495 L	1,047 L	1,581 L	1,894 L
Weight	880 lb (400 kg)	364 lb (165 kg)	1,320 lb (600 kg)	880 lb (400 kg)	2,954 lb (1,340 kg)

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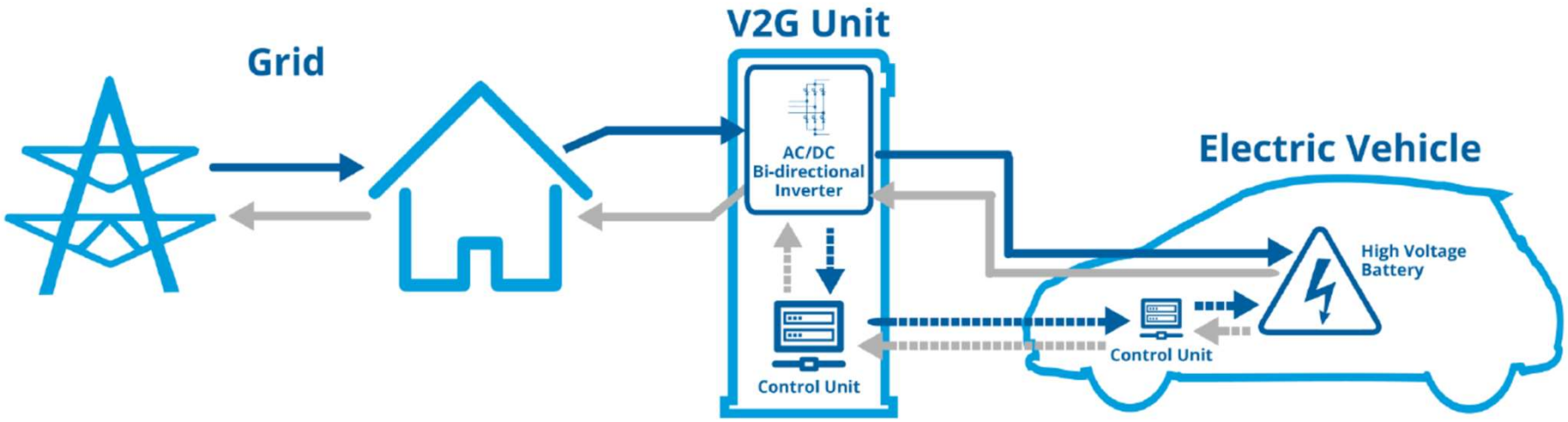
The future V2G?



- Vehicle-to-grid (V2G) describes a system in which plug-in electric vehicles, such as electric cars (BEV) and plug-in hybrids (PHEV), communicate with the power grid to sell demand response services by either returning electricity to the grid or by throttling their charging rate
- Since at any given time 95 percent of cars are parked, the batteries in electric vehicles could be used to let electricity flow from the car to the electric distribution network and back. This represents an estimated value to the utilities of up to $4,000 per year per car.

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Charging station for charging Car or two rickshaw at a time- Origin Europe.

Model	CHARGING COLUMN FOR CARS – ELEKTRO COLUMN	
INPUT	**MONOPHASE**	**TRIPHASE**
Electric net	1x monophase (L+N+PE)	1x triphase (3L+N+PE)
Nominal voltage (AC)	230V	400V
Nominal current	16A	32A
Nominal power	3,7kW | 7,4kW	11kW | 22kW
Cable section (L,N,PE). L_{max} 20m	3x4 mm^2	5x6mm^2
CONFIGURATIONS		
N° Type 2 Mode 3	1	2
OUTPUT		
Charging mode	**Mode 3**	
Socket type	**Type 2**	
Plug lock	Yes	
Socket cover	No	
Shutter	Yes (mandatory in Italy)	
Control BOX for PWM communication	Yes	
Power supply	No voltage without communication established between car and column	
PROTECTION		
Magnetothermal	2p (monophase)	4p (triphase)
Differencial	Type "A" - 30mA	Type "B" - 30mA
SERVICE ACCESS		
RFiD cards	Yes, design and graphic customization	
App Mobile	Yes, design and graphic customization	
DIMENSIONS AND WEIGHT		
Dimensions	38 x 31 x 153 cm	
Weight	~ 60kg	
OPERATING SPECIFICATIONS		
Operating temperature	-20°C ÷ +40°C	
Altitude	Max 2000m s.l.m.	
Internet connection	LAN or SIM card (at least 3GB/month)	

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PL. Feels free to contact us for --

- Additional information on the subject.
- Design consideration and selection of charging station.
- EV related any other information

We are project consultant having over 42 years of experience in local as well International market. Have successfully implemented more than 24 projects with customer base in India, Kenya, Tanzania, Nigeria, South Africa, Kuwait etc.

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