Trend and Future Prospects of DC Charging for EV Feeding from

2018 April 19th
Nissan Motor Co., Ltd.
External and Government Affairs Dept.
General Manager
Makoto YOSHIDA

www.nissan-global.com
EV Sales Growth

(K units/Year)

EV Data source: JATO

- Others
- Chinese EV maker
- CHEVROLET
- FIAT
- KIA
- VOLKSWAGEN
- BMW
- RENAULT
- NISSAN (Cumulative 370K)
- TESLA

*EV TIV includes Small / Low Speed EV which we exclude from competition
**Source: Navigant Research “2013-2020 EV Market Forecast”

NISSAN MOTOR CORPORATION

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Variation of Electrified Vehicle

- With Core EV Technology, provide Appropriate Electrified Vehicle type to

Whenever needed
Whatever needed
However needed
Variation of Electrified Vehicle

- With Core EV Technology, provide Appropriate Electrified Vehicle type to

Electric → Battery → Engine
Petrol → Battery → Engine
Hydrogen → Fuel Cell
Bio Fuel → Battery
### Drastic Change

#### You can Charge

<table>
<thead>
<tr>
<th>@Home</th>
<th>Outside</th>
<th>On the Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>@Destination</td>
<td>@Destination</td>
<td>@Destination</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td><strong>Type</strong></td>
<td><strong>Charger</strong></td>
</tr>
<tr>
<td>Short</td>
<td>Normal</td>
<td>8hours (AC 200V)</td>
</tr>
<tr>
<td>Short/Mid</td>
<td>Normal or Quick</td>
<td>Normal or Quick</td>
</tr>
<tr>
<td>Long</td>
<td>Quick</td>
<td>30minutes (DC 500V)</td>
</tr>
</tbody>
</table>

- **Basic Charge**
- **Urgent Charge**

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**Normal**

- 8hours (AC 200V)

**Quick**

- 30minutes (DC 500V)
Curtail Issue for Charger

Customer Benefit

Whenever needed
Whatever needed
Whoever needed
Curtail Issue for Charger

Customer Benefit

Accessibility

Fuction

Cost

- Safety, Reliability, Compatibility
- High Power

Vehicle Charger

Fee
Curtail Issue for Charger

Customer Benefit

Accessibility

Fuction

Safety, Reliability, Compatibility
V2X
High Power

Cost

Vehicle
Charger
Fee
CHAdemo; Here or There

71 Countries 18046 as of Mar 2018
CHAdMEO; Here or There

Total

Japan

Europe

USA

Asia

7241

2362

6260

2018

100

45

0

1000

2000

3000

4000

5000

6000

7000

8000

0

2000

4000

6000

8000

10000

12000

14000

16000

18000

20000

2014

2015

2016

2017

Total

Japan

Europe

USA

Asia
QC in Japan

**Assortment**
1. Car Dealers: 2,283
2. Local Authority: 301
3. Road Stationary Mall: 687
4. SA・PA (High Way): 391
5. Shopping Mall: 391
6. Hotels: 162
7. Gas Station: 66
8. Convenience S: 1,032

7,241 Cgr

(As of 2017 Oct end By Zenrin)
Curtail Issue for Charger

Customer Benefit

Accessibility

Fuction
Safety, Reliability, Compatibility
V2X
High Power

Cost

Vehicle
Charger
Fee
Sustainable Business Model

**Electricity Price;**
- Expected Charging Fee: VERY Low
  - € 5/Charge

**Charger Cost;**
- 20kW Charger: Low (vs ICE/FCV)
  - € 10K or less
- 50kW Charger: € 20K
- 150kW Charger: € 30K
- 350kW Charger: € X00K?

**Efficiency @ Station;**
- Duration @ Station: Need Improve
  - 30 minutes/Charge

Regardless the Charging standard, Moderate Business Model is Mandatory Necessary

Cost Efficiency Increase, No Waiting Time, Less Maintenance Cost System, Shorter Charging Time with Balance to the Cost, Monthly Fee system„„
Where are they?

Asia

- Highway Rest Area
- Japan

Europe

- Shopping Mall
- Japan

- Public Parking

- Home Parking
- Office Parking
- Auto Dealer
- Gas Station
- Convenience Store
## QC in Japan

### Assortment

1. Car Dealers: 2,283
2. Local Authority: 301
3. Road Stationary Mall: 687
4. SSA-PA (High Way): 391
5. Shopping Mall: 391
6. Hotels: 162
7. Gas Station: 66
8. Convenience S: 1,032

### QC in Japan

- Hokkaido: 265
- Tohoku: 716
- Kanto: 1,766
- Chugoku: 256
- Koshin-etsu: 390
- Tokai: 834
- Kyushu: 1,012
- Shikoku: 303
- Kinki: 875

(as of 2017 Oct end By Zenrin)
Curtail Issue for Charger

Customer Benefit

- Accessibility
- Fuction
  - Safety, Reliability, Compatibility
  - V2X
  - High Power
- Cost
  - Vehicle
  - Charger
  - Fee
Technology Trend for Battery Capacity increase

DC charge @Home (6-10kW)

V2X Function

Batt Cap Up

Battery as Energy Device
- Peak Cut
- PV utilization
- Join VPP
- Emergency Reserve
- Leisure

High Power Charging (100kW ↑)

Various Charging

Not Full Charge (20kW)
Short Stay Charge
Low Cost, Power Charge
No Inverter in the Car
Guide by Connected AI
CHAdEMO High-power roadmap

50kW

100/150-200kW (Cont./Peak)

150-200kW (Const.)

350-400kW

125A x 500V

400A x 500V

350-400A x 1kV

Forced cooling connector & cable

Dynamic power control (Real time adaptive control)

2016 2018 2020

High Power needs to come with appropriate Vehicle
Appropriate Deployment Plan Necessary (Cost High)
Task of High-Power

Battery Acceptance
- Low Charge Rate

High Cost
- Cable, Radiator, Trans

Electrical Safety
- Heat Resistance for High Current, Electrical Shock for High Voltage
- Heavier Cable and Connector with Heavy Connectivity

Impact to the Power Grid
- Need Special High Power Contract

Multi-Arm with Power Share
- Low Installation cost, Low Operation cost
- Many Vehicle can be Charged at Same time
- Less Risk to Operate A Connector
- Multi-Inlet on Vehicle to Multiple the Power

<table>
<thead>
<tr>
<th>Capacity</th>
<th>50kW</th>
<th>150kW</th>
<th>350kW</th>
</tr>
</thead>
<tbody>
<tr>
<td>25kWh</td>
<td>30 min</td>
<td>10 min</td>
<td>×</td>
</tr>
<tr>
<td>50kWh</td>
<td>1 hour</td>
<td>20 min</td>
<td>×</td>
</tr>
<tr>
<td>150kWh</td>
<td>3 hours</td>
<td>1 hour</td>
<td>30 min</td>
</tr>
</tbody>
</table>
Future Combination of Chargers

**High Power (200kW-)**
- Bus/Truck
- 350kW (1kV x 400A)
- No need with current Connector (pantograph, large outlet)
- Charge at its own Base

**Current Chargers (50-150kW)**
- Power Increase 100-150kW
- IoT Support (Location Navi, Full/Vacancy, Reservation, History)
- Cost Efficiency increase with Active Maintenance
- Charger with Battery (Temp High Power, Join VPP, Battery Mkt)

**Low Power (20-30kW)**
- Cost Efficient
- Add-On Charge, Just Stay Charge
- DC Low Power Charging (no OBC)
- Increase Number of Chargers

2 wheeler, Super Mini Car, Asian Taxi
Contribute to diversity of Energy Source

- Oil
- Bio Mass
- Coal
- Natural Gas
- Nuclear
- Hydrogen
- Water, Wind, Solar

Electric Vehicle

Battery

Charge at low demand
Feed at high demand

Power Generation

Power Feeding

Home (10kW)

Building (10MW)

Mega City (600MW/day)
Virtual Power Plant

Source: Ministry of Economy, Trade, and Industry, Japan
V2H System

As of 2017 June 7000 sets Sold

- Corroboration with PV
- Peak Shift, Bill Saving
- Join VPP/Smart Grid Proj
- Emergency Power output
Other Usage as Energy Source

Power Transfer
- EV Transfer Power to Depopulated Area
- Battery Operated Truck Provide Power from its Battery to Customer

For Emergency Case
- EV Provide 3 days Power Consumption of Normal House
- EV can Transfer its Power to Isolated Area or Disaster Area

Load Output
- Work
- Leisure

Car Sharing, Battery Sharing
- Battery on Sharing Car also be Shared as Energy Source
Example at Earthquake

2011.3 @Tohoku Rent to Local Authority

Used as Transportation under the lack of Gasoline situation

2016.4 @Kumamoto Rent to Local Authority, NPO

Used as Transportation and Energy Source

Ref) Energy Source Study with Tohoku University
Summary

- EV Need Charger
- EV Contribute Power Grid

- Charging System need
  - Availability
  - Cost Efficiency
  - Good Function

- EV works as Energy Source
  - Grid Acceptance
  - Battery
  - System Cost
Thank you for your Attention
See You All in Kobe