EV Charging Infrastructure – Global Experience

Prof. Pablo Frias,
IIT Comillas, Spain
Agenda

01 Charging Infrastructure Classification
02 Global EV Charging Infrastructure
03 Global share of private chargers
04 UK EV Market and Charging Infrastructure
05 USA EV Market and Charging Infrastructure
06 Charging Infrastructure of Norway and Germany
07 Comparative Analysis of Charging Infrastructure
EV Charging Infrastructure Classification

- **Charging Speed**: Slow, Medium, Fast
  - Slow: Mode 1
  - Medium: Mode 2
  - Fast: Mode 3, Mode 4

- **Charging Mode**: Mode 1, Mode 2, Mode 3, Mode 4
  - Mode 1: AC Charging
  - Mode 2: DC Charging, Type 1, Type 2
  - Mode 3, Mode 4: CCS

- **Connector Type**: CHAdeMO, CCS, Tesla superchargers

- **Use**: Private Charging, Public Charging, Semi-public charging
  - Private Charging: Plugin
  - Public Charging: Swap, Wireless
  - Semi-public charging: Bidirectional, International

- **Process**: Unidirectional, Bidirectional

- **Power Flow**: National, International
Connector Types Used Globally

For AC Charging
- Type 1 AC/ SAE J1772
- Type 2 AC/ Mennekes
- GB/T

For DC Charging
- CCS1: Predominantly used in USA
- CCS2: Predominantly used in Europe
- GB/T: Predominantly used in China
- CHAdeMO: Predominantly used in Japan
Global EV Charging Infrastructure

- The global stock of EV chargers grew by almost 40% from 5.2 million in 2018 to almost 7.3 million in 2019.
- 6.5 million chargers were private chargers.
Global share of private chargers

- EVs are generally provided with at least a charger cable or a designated wall-mounted charger.
- As per global statistics, excepting China and Japan, all other countries has roughly 1.1 private chargers per private EV.
- China and Japan has 0.7 private charger per private EV.
- Private charger = Residential + Workplace
United Kingdom, EV Market

- Initially PHEV had a much higher annual growth
- Since 2018, the EV sales market have been predominantly BEVs

United Kingdom, Charging Infrastructure

Fast charging is the dominant charger type

Source: Zap-Map
United States of America, EV Market

- Early 2010’s PHEV had higher stock compared to BEVs.
- Since 2013, the annual sale of BEVs were always higher than BEVs with a huge boost in 2017-2018 with the launch of Tesla Model 3 in 2017.

Source: US Department of Energy
Among public chargers Level 2 chargers are most common

Around 1.56 million private (residential) chargers.

Source: US Department of Energy
Norway and Germany

Share of EV chargers in Norway (17124 total chargers by Q1 2021)

- Blue industrial 3-pin: 11%
- CCS/CCS2: 14%
- CHAdeMO: 14%
- Schuko: 18%
- Tesla Connector: 6%
- Type 2: 49%
- Type 1: 0%
- Blue industrial 3-pin: 0%
- Type 2 + Schuko: 2%

Power output of EV charge points in Germany (26590 total chargers by Q1 2020)

- 22 kW: 78%
- 11 kW: 8%
- 50 kW: 5%
- 43 kW: 3%
- 3.7 kW: 2%
- 350 kW: 1%
- 150 kW: 1%
- 42 kW: 2%
- 20 kW: 0%
- 53 kW: 0%
- Others: 1%
- 11 kW: 8%
- Others: 1%
Comparative Analysis of EV ecosystem in Selected Countries

- **Number of Charging Points**: The chart shows the number of charging points across different countries (UK, USA, Norway, Sweden, Germany) categorized by slow, fast, and rapid. The data is presented in thousands.

- **Number of Vehicles**: The chart illustrates the number of BEV (Battery Electric Vehicles) and PHEV (Plug-in Hybrid Electric Vehicles) across the same countries. The data is presented in millions.

- **Percentage of Charger Type**: The chart demonstrates the percentage of slow, fast, and rapid chargers in each country. The classification of charger types is as follows:
  - **Slow**: Power Rating <7 kW
  - **Fast**: Power Rating Between 7 and 22 kW
  - **Rapid**: Power Rating > 22 kW
Comparative Analysis of EVs per charger
Unique Charging Infrastructure Examples

- Retrofitted Lamp post as EV charging station, UK
- Kerb Side Charging, UK
- Pantograph Charging, Sweden
- Electrified Road, Sweden
- Wireless Electrified Road, Norway
Conclusion

• Standards vs. Policies
• Policies for public/private charging vs. Business Models
• Fast chargers (7-22 kW) are most dominant in the public EV charging infrastructure domain.
• Rapid and ultra-rapid chargers are being added aggressively from the past 4 to 5 years.
• Norway with the most share of EV in its market is quite behind in its charging infrastructure. Compared to the European Union target of 10 Evs per charger it has almost 28 EVs per charger.
• UK, Germany and Sweden has a commendable public charging infrastructure
• UK has the most aggressive rapid (>22 kW) charging infrastructure deployment.
Thank You