Knowing the EV Charging Ecosystem
Fast Charging Infrastructure
Knowing the EV charging ecosystem

Presentation outline

- EVs snapshots and projection
- Charging standards
- AC vs DC charging
- The Products
- Chargers connectivity
The Charging Ecosystem
Enabling E-mobility today

10 km → RFID → Charging station → 30 min → 120 km
EVs in the world today
Snapshot

**EVSE Stock in EVI Countries**
(approximate, through end of 2012)

- Represents non-residential charging points

**Global EV Stock** (through end of 2012)

- Represents 0.02% of total passenger cars

180,000+

**Source:** International Energy Agency, Global EV Outlook, April 2013, Pg 6

**Global EV Sales More Than Doubled Between 2011 and 2012**

<table>
<thead>
<tr>
<th>Year</th>
<th>Approximate Annual Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>45,000</td>
</tr>
<tr>
<td>2012</td>
<td>113,000</td>
</tr>
</tbody>
</table>

**RD&D is Paying Off**

Research, development, and demonstration (RD&D) efforts are paying off with EVI governments providing over USD 8.7 billion in investment since 2008, helping to address one of the major hurdles to EV adoption by significantly reducing battery costs.

**2008**
- USD 1,000 kWh

**2012**
- USD 485 kWh

Source: International Energy Agency, Global EV Outlook, April 2013, Pg 6
Electric Vehicle Projection
20 million by 2020

Source: International Energy Agency, Global EV Outlook, April 2013
Follow the car through Europe: Which car, when? Which infrastructure is required?

- **On the roads**
  - **Only AC slow charging (3.6-7.2 kW)**
    - Think City
    - Smart ED Gen 1
    - Renault Fluence ZE
    - Renault Twizy
    - Renault Kangoo ZE
  - **AC charging (11 kW)**
    - Mercedes Vito E-cell
  - **AC semi-fast charging (22 kW)**
    - Smart ED (option)
    - Tesla Model S
  - **AC fast charging (43 kW)**
    - Renault Zoe ZE
  - **DC fast charging (CHAdeMO, 50 kW)**
    - Mitsubishi i-MiEV
    - Peugeot Partner-Electric
    - Citroën Berlingo Electric
    - Nissan Leaf UK
  - **DC fast charging (Combo, 50 kW)**
    - Mitsubishi Outlander PHEV
    - Nissan e-NV200
    - Chevy Spark
    - Kia Soul
    - Audi A1 e-tron
The EVs in Singapore
Have you seen them?
Charging Standards
Connection Vocabulary
Connection Vocabulary
Charging Case

Case A Connection
Cable is permanently attached to the EV (Electric Vehicle)

Case B Connection
Cable is not attached permanently

Case C Connection
Cable is permanently attached to the EVSE
Charging Modes

Charging Mode 1
Socket outlet
(domestic or IEC 60309)

Charging Mode 2
Socket outlet
(domestic or IEC 60309)

Charging Mode 3
Note: other architectures possible for mode 3 charging devices

Charging Mode 4: DC
Note: in DC charging the connection must be Case C
The OEM Fast Charging standards
CHAdeMO / 22 kW AC / Combo 2

CHAdeMO

22 kW AC
Type 2

Q4-2013
Combo 2
## Connectors and Inlets

**IEC 62196-1**

<table>
<thead>
<tr>
<th>Name</th>
<th>Mode</th>
<th>Region</th>
<th>Socket outlet</th>
<th>Plug</th>
<th>Connector</th>
<th>Vehicle inlet</th>
<th>Max Voltage and Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>Mode 2 or 3</td>
<td>USA, Japan, first gen. EVs in Europe</td>
<td>Case C only</td>
<td>Case C only</td>
<td>female</td>
<td>male</td>
<td>250V A.C. 32A – 1Phs</td>
</tr>
<tr>
<td>Type 2</td>
<td>Mode 2 or 3</td>
<td>Europe</td>
<td>female</td>
<td>male</td>
<td>female</td>
<td>male</td>
<td>480V A.C. 63A – 3Phs 70A – 1Phs</td>
</tr>
<tr>
<td>CHAdemo</td>
<td>Mode 4</td>
<td>Japan, Europe, USA</td>
<td>Case C only</td>
<td>Case C only</td>
<td>male</td>
<td>female</td>
<td>600V D.C. 200A</td>
</tr>
<tr>
<td>CONF. AA</td>
<td>Mode 4</td>
<td>USA</td>
<td>Case C only</td>
<td>Case C only</td>
<td>female</td>
<td>male</td>
<td>600V D.C. 200A</td>
</tr>
<tr>
<td>COMBO1</td>
<td>Mode 4</td>
<td>USA</td>
<td>Case C only</td>
<td>Case C only</td>
<td>female</td>
<td>male</td>
<td>600V D.C. 200A</td>
</tr>
<tr>
<td>CONF. FF</td>
<td>Mode 4</td>
<td>Europe</td>
<td>Case C only</td>
<td>Case C only</td>
<td>female</td>
<td>male</td>
<td>850V D.C. 200A</td>
</tr>
</tbody>
</table>
The 'Charging' story
Driving along happily?

10 km → RFID → Charging station → 30 min → 120 km
Why DC for fast charge?
On-board versus Off-board equipment

Every vehicle needs to have its own onboard equipment
Infrastructure investment is shared with hundreds of users
DC charging versus AC charging
Electrical representations

AC Charging

DC Charging

Slow charger

Fast Charger

Electric Vehicle

AC Charging

DC Charging
Use cases in electric vehicle charging
The products

Commercial, Offices & petrol kiosks

- DC fast charging
  
  - 15-30 mins/ 30-60mins

Home

- AC charging

- 6- 8 hours (overnight)
ABB’s Domain Competency in EV Fast Charging
Cutting-edge technology

Install base

- **Europe:**
  Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Northern Ireland, Norway, Poland, Slovakia, Slovenia, Sweden, Switzerland, Turkey, United Kingdom

- **North and South America:**
  Canada, Chile, USA

- **Asia:**
  China, Hong Kong, Singapore, Taiwan, Thailand

- **Africa:**
  South Africa
Smart EV Charging
400V, 32A, 3-phase power connection

- **Terra SC Duo**
  - 20kW DC CHAdeMO
  - 22kW AC
  - 30-60 min.

- **Terra SC C**
  - 20kW DC Combo
  - 30-60 min.

- **Terra SC**
  - 20kW DC CHAdeMO
  - 30-60 min.

October 2013
Terra SC: the Smart Connection
Effective fast charger for office, commercial and shopping malls

- Smart ultra-thin design
  - 510mm x 230mm x 1830mm, 140kg
  - 30-60 minutes charge time

<table>
<thead>
<tr>
<th>Product</th>
<th>Terra SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Input</td>
<td>3Φ, 400 VAC ±10%, 32A</td>
</tr>
<tr>
<td>Maximum output power</td>
<td>DC, 20kW</td>
</tr>
<tr>
<td>Output voltage</td>
<td>180-500 V</td>
</tr>
<tr>
<td>Output current</td>
<td>50A</td>
</tr>
<tr>
<td>Efficiency</td>
<td>93%</td>
</tr>
<tr>
<td>RFID system</td>
<td>13.56MHz, ISO 14443A</td>
</tr>
<tr>
<td>Communication</td>
<td>CDMA / 3G / Ethernet</td>
</tr>
<tr>
<td>Protection class</td>
<td>IP54</td>
</tr>
<tr>
<td>Temperature range</td>
<td>0°C … +45°C</td>
</tr>
<tr>
<td>Software</td>
<td>Remote update / download</td>
</tr>
<tr>
<td>User interface</td>
<td>Full color touch screen</td>
</tr>
</tbody>
</table>
Future-ready Charging Infrastructure
Multi-standard chargers

October 2013
Terra 53 CJ
DC Highway Charger
- 50kW DC Combo
- 50kW DC CHAdeMO
- 15-30 min.

December 2013
Terra 53 CJG
DC + AC Highway Charger
- 50kW DC Combo
- 50kW CHAdeMO
- 22kW AC
- 15-30 min.
Terra 53: Future ready charging
All EV fast charging solution

The Terra 53 is a secure future-proof investment,

- Supporting 3 outlets:
  - DC CCS 50kW
  - DC CHAdeMO 50 kW
  - AC 22 kW
- Simultaneous fast charging of two cars (DC and AC)
- Designed for:
  - optimal placement flexibility
  - all weather conditions
## Terra 53 CJG

### Main technical specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-10°C to +55°C, option: -35 °C to +55°C</td>
</tr>
<tr>
<td>Environment &amp; protection</td>
<td>Outdoor, IP54</td>
</tr>
<tr>
<td>Compliance and safety</td>
<td>CE / CHAdeMO</td>
</tr>
<tr>
<td>Input voltage range &amp; Max. current</td>
<td>400VAC +/- 10% (50 Hz), 125 A</td>
</tr>
<tr>
<td>Efficiency</td>
<td>&gt;94% at nominal output power</td>
</tr>
<tr>
<td>Maximum DC output power</td>
<td>50kW</td>
</tr>
<tr>
<td>Maximum DC output current</td>
<td>120 A (CHAdeMO), 165 A±5% (Combo)</td>
</tr>
<tr>
<td>Maximum AC output power &amp; current</td>
<td>22 kW, 32A (Zoe &amp; Smart compatible)</td>
</tr>
<tr>
<td>Output DC voltage range</td>
<td>50 (CHAdeMo) /200 (Combo) V - 500V</td>
</tr>
<tr>
<td>DC plug type(s)</td>
<td>JEVS G105 &amp; Combo 2</td>
</tr>
<tr>
<td>AC plug type</td>
<td>IEC 62196, Type 2, mode 3 charging</td>
</tr>
<tr>
<td>Network connection</td>
<td>10/100 Base-T Ethernet (OCPP) GSM/GPRS/3G/CDMA/EVDO</td>
</tr>
<tr>
<td>Operational noise level</td>
<td>45 dBA</td>
</tr>
<tr>
<td>Mass</td>
<td>400kg</td>
</tr>
<tr>
<td>Size (D x W x H) in mm</td>
<td>760 x 525 x 1900</td>
</tr>
</tbody>
</table>
The 'Charging' story

Oh no, How to find the chargers?

Is it available?

What form of payment is accepted?

Is the charger working?!
ABB’s connected services
Common interests of owners of charging infrastructure

- Manage installed base
- Statistics
- CO2 reduction
- Transactions & payment
- Transfer data to own back-office
- Roaming
- Navigation / GPS
- Power management
- Real-time status
- Configuration / settings
- Access control
- Transfer data to own back-office
- Navigation / GPS
Data Architecture
Designed for reliability and security

Cloud access
Your data can be accessed via the "cloud", a reliable interface which enables you to connect your own back office or user administration system directly to your charging network.

Galaxy
Via your Galaxy web interface you have the ability to see real-time status, charger usage and energy delivered to your sites and configure the chargers at your sites. Galaxy utilizes a secure HTTPS connection to access your data.

ABB Service Cloud
Your data is professionally stored via independent third-party cloud technology utilizing strict security standards and professional backup systems. Software updates are also provided via the cloud, separate from your data. ABB cannot access your raw data.

Data transportation and security
Your charger data, settings and software updates are transported via TLS and X509 certificates, a security standard widely used to protect classified industrial and governmental information.

3G GSM connectivity provided

Status and health monitoring

3G GSM connectivity provided

Network Operations Centre (NOC)
The NOC is your "eyes and ears" already deployed. The NOC keeps an eye on your charging network and is ready to intervene if necessary to optimize the overall performance of your charging network.
EV Charging Value chain
A possible scenario

Charging Service Operators

The end-users with different cars
Singapore’s slimmest Fast Charging Station
Live demonstration!