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Innovative EV and EV Charging Technologies in Korea
Strengthen the regulation of fuel efficiency to solve environmental problems in each region

’20 : USA 44.8mpg, Europe CO₂ 95g/km, China 5ℓ/100km

**USA**

**CAFE** (Corporate Average Fuel Economy)

- Fuel Efficiency Regulation
  - ’15: 36.2 mpg
  - ’20: 44.8 mpg
  - 24% upswing

- Penalty: $5.5 per 0.1mpg X Total Sales (ex) 1 Million Sales, $55M under 1mpg

**Europe**

**CO₂ Emission**

- Average Regulation
  - ’15: 130 g/km
  - ’20: 95 g/km
  - 27% tightened

- Penalty: €5–95 X Total Sales (Gradually progressive, €95 after ’19) (ex) 1 Million Sales, 95M exceeding 1g/km (after ’19)

**China**

**Fuel Efficiency**

- Average Regulation
  - ’15: 6.9 ℓ/100km
  - ’20: 5 ℓ/100km
  - 28% tightened

- Penalty: in the Review

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’15 ’20
To achieve target, need new green technologies to emit less CO₂ for the road transportations

Korean Government is Tightening the National Target of CO₂ Emission Reduction

**Greenhouse gas emission by sector**

- Industry (50%)
- Transportation (17%)
- Waste (3%)
- etc (2%)
- Household (13%)
- Business, public (13%)

- 17% of greenhouse gas emission from road transportation

**Presidential Commission on Green Growth Announced Target**

- **1990**
  - CO₂ emission 298 million tons
- **2005**
  - CO₂ emission 594 million tons
- **2020 Forecast**
  - CO₂ emission 813 million tons
- **2020 Target**
  - CO₂ emission 569 million tons
Optional Regulation for Fuel Efficiency & Greenhouse Gas Emission

Upswing target

- Fuel efficiency: 18.6 km/ℓ ('16) → 24.3 km/ℓ ('20)
- CO₂ emission: 127 g/km ('16) → 97 g/km ('20)
- Gradual upswing from 2012
- Corporation could optionally meet a regulation
  - either fuel efficiency or gas emission
- Impose penalty on corporations that cannot fulfill
  either regulation
### Domestic EV Dissemination Status

- Expanded to three models from the second half of 2013, added 2 models in 2014

* Mainly spread in Seoul (688), Jeju Island (360)

- Plan for disseminating EVs: ('16) 0.487 million \(\rightarrow\) ('20) 2 million

<table>
<thead>
<tr>
<th>Model</th>
<th>Manufacturer</th>
<th>Max. Speed</th>
<th>Battery Type</th>
<th>Battery Capacity</th>
<th>Driving Range per Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ray EV</td>
<td>KIA</td>
<td>130 km/h</td>
<td>Li-Polymer</td>
<td>16.4 kWh</td>
<td>91 km</td>
</tr>
<tr>
<td>SM3 EV</td>
<td>Renault-samsung</td>
<td>135 km/h</td>
<td>Li-Polymer</td>
<td>26.6 kWh</td>
<td>135 km</td>
</tr>
<tr>
<td>Spark EV</td>
<td>GM Korea</td>
<td>145 km/h</td>
<td>Li-Polymer</td>
<td>18.3 kWh</td>
<td>128 km</td>
</tr>
<tr>
<td>i3 EV</td>
<td>BMW Korea</td>
<td>150 km/h</td>
<td>Li-Polymer</td>
<td>21.3 kWh</td>
<td>132 km</td>
</tr>
<tr>
<td>Soul EV</td>
<td>KIA</td>
<td>145 km/h</td>
<td>Li-Polymer</td>
<td>27 kWh</td>
<td>148 km</td>
</tr>
<tr>
<td>Leaf EV</td>
<td>Nissan</td>
<td>140 km/h</td>
<td>Li-Polymer</td>
<td>24 kWh</td>
<td>132 km</td>
</tr>
<tr>
<td>Ionic EV</td>
<td>Hyundai</td>
<td>165 km/h</td>
<td>Li-Polymer</td>
<td>28 kWh</td>
<td>191 km</td>
</tr>
<tr>
<td>OLEV EV (WPT)</td>
<td>Dongwon</td>
<td>80 km/h</td>
<td>Li-Polymer</td>
<td>98.2 kWh</td>
<td>175.5 km</td>
</tr>
<tr>
<td>E-Primus EV</td>
<td>Hankuk Fiber</td>
<td>100 km/h</td>
<td>Li-Polymer</td>
<td>85.8 kWh</td>
<td>69.8 km</td>
</tr>
</tbody>
</table>
Domestic charging station dissemination status

- Charging station dissemination status: Normal 5,405, Fast 337

- Plan for disseminating fast charging system: (’16) 487ea → (’20) 1,400ea

### Normal Charging Station

- **KODI-S**
  - Input Voltage: AC 220V
  - Output Voltage: AC 220V/32A
  - Rated Power: 7.7kWh

- **Signet System**
  - Input Voltage: AC 220V
  - Output Voltage: AC 220V/32A
  - Rated Power: 7kWh

- **LG CNS**
  - Input Voltage: AC 220V
  - Output Voltage: AC 220V/30A
  - Rated Power: 7kWh

- **ChungAng Control**
  - Input Voltage: AC 220V
  - Output Voltage: AC 220V/32A
  - Rated Power: 7kWh

- **PNE Solution**
  - Input Voltage: AC 220V
  - Output Voltage: AC 220V/32A
  - Rated Power: 7kWh

- **Clean inlex**
  - Input Voltage: AC 220V
  - Output Voltage: AC 220V/32A
  - Rated Power: 7.7kWh

### Fast Charging Station

- **KODI-S**
  - Input Voltage: AC 380V
  - Output Voltage: DC 50~450V/110A
  - Rated Power: 50kWh

- **PNE Solution**
  - Input Voltage: AC 380V
  - Output Voltage: DC 50~450V/110A
  - Rated Power: 50kWh

- **Signet System**
  - Input Voltage: AC 380V
  - Output Voltage: DC 500V/125A
  - Rated Power: 50kWh

- **Signet System**
  - Input Voltage: AC 380V
  - Output Voltage: DC 50~400V/125A
  - Rated Power: 50kWh
Location: Seoul(3ea), Sungnam(1ea), Daegu(3ea), Sunchun(2ea)

Unit cost: 313.1 won/kWh

Full charging cost: 8 dollars

Increasing 20 fast charging station at the telephone booth every year

Input voltage: AC 380V

Output voltage: DC 500V/125A

Rated power: 50kWh
**Pilot Project of the WPT system in Korea – OLEV**

- Construction of power supply infrastructure in Seoul Grand Park (Since July 2011)
  - Lunched the commercial OLEV tram service in 2011
  - Power supply infrastructure: Built on 372.5m, 16% of the 2.2km circular road

- Construction and operation of power supply infrastructure during Yeosu EXPO 2012
  - Power supply infrastructure: Built on 36m, 6% of the 600m road

- Construction commercial power supply infrastructure and operation of the on-campus OLEV shuttle service (since October 2012)
  - Power supply infrastructure: Built on 60m, 1.6% of the 3,760m road
  - Max. output: 240kW (320 hp), Max. efficiency: 80%, air-gap: 20cm, rated
  - First commercialized model

- Construction commercial power supply infrastructure and operation of the public OLEV bus service in Gumi (since October 2014)
  - Power supply infrastructure: Built on 24km, 0.6% of the 24km road
  - World 1st commercialized model in public road

- Construction commercial power supply infrastructure and operation of the public OLEV bus service in Sejong (since October 2014)
CT&T NEV eZone

- Power Factor: 0.99, THD: 3%
- Output Power: 3.3kW, DC 250~350V, 12A, 60kHz
- Efficiency: 90% @ 100mm Air gap
- Tolerance: X-Y (> ± 100mm), Z (> ± 5mm)
- Jeju Lotte Hotel (2set)
- Period: 2 years
Switching Freq.: 60kHz/85kHz

- Tolerance: X (± 100mm),
  y (± 50mm),
  Z (> ± 120mm)

- EMF: ICNIRP 1998

- Efficiency: < 90%
6.6kW WPT system applied on SOUL EV (under developing since 2015 for 3 years)

- Switching Freq. : 85kHz
- Tolerance : X (± 130mm), y (± 75mm) \( Z (> ± 160\sim120mm) \)
- Auto-tuning
- FOD (Foreign Object Detection)
- EMF : ICNIRP 1998
- Efficiency : > 90%
20kW WPT system applied on SM3 EV (under developing since 2016 for 3 years)

Follows J2836 SAE Standards
Continue to governmental support program for expanding market at early dissemination stage and support for commercialization of private service provider in parallel

<table>
<thead>
<tr>
<th>Policy</th>
<th>Necessary to EV and EV infrastructure dissemination related with national strategy such as reducing CO2, metropolitan traffic infrastructure with cooperation of governmental department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Necessary to establish detail supporting strategy based on predication of energy market and need with government energy policy</td>
</tr>
<tr>
<td>Support</td>
<td>National Support for Market Expansion of a EV and EV infrastructure (Subsidy , Tax Benefit)</td>
</tr>
</tbody>
</table>
| Infrastructure                                                        | Establish and Announce Roadmap for Battery Charging Infrastructure  
                                                                                         Promote the Spread of EV and EV infrastructure through a Private Enterprise step by step                                                                 |
Thank you very much!

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