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IV KEPCO Implementation Status for EV Deployment
I Domestic/International EV Trend
1. Domestic & International EV Trend

**Overseas**

### Europe
- **EV Sales Increased by 54% in 2014**
  - Year | ‘12 | ‘13 | ‘14
  - Qty  | 20,000 | 42,000 | 65,000
- [France] EV Subsidy: 7,000 Euro
  - Differs by CO2 Emissions
- [England] Congestion charge exemption
- *Volkswagen 700km Driving EV Development (11.‘15)*

### USA
- **EV Sales Increased by 33% in 2014**
  - Year | ‘12 | ‘13 | ‘14
  - Qty  | 14,000 | 48,000 | 63,000
- EV Subsidy: Max 7,500$  
  - EV/PHEV: 7,500$, HEV: 2,500$
- Charging Infra.: Installation costs 30% Support
- Tesla model S 426km Driving (85kwh Battery)

### China
- **EV Sales Increased 350% in 2014**
  - Year | ‘12 | ‘13 | ‘14
  - Qty  | 12,000 | 14,000 | 49,000
- EV Subsidy: 60,000 Yuan (9,500 $)
- BYD E-6 300km Driving (61.4kwh Battery)

### Japan
- **EV Sales Increased slightly in 2014**
  - Year | ‘12 | ‘13 | ‘14
  - Qty  | 16,000 | 16,000 | 17,000
- Charging Infra.: Quick Charger 50% Support
- Nissan Leaf 121km Driving (24kwh Battery)

※ Driving Distance of Korea Kia Motors Soul EV: 150km (27kwh Battery)

[Implications] Major country governments offer various EV subsidies Encourage EV deployment
Current Status of EV & Charging Infra. in Korea

- **Seoul**: 890 EV, 915 Chargers
- **Daejeon-Chungnam**: 147 EV, 170 Chargers
- **Gwangju-Jeonnam**: 341 EV, 373 Chargers
- **Kyeongnam**: 266 EV, 271 Chargers
- **Others**: 653 EV, 679 Chargers

Total Qty:
- **EV**: 3,044
- **Chargers**: 3,201

**EV Supply Plan**

- **200 Thousand in 2020**

[unit: Thousand]

**Implications**

Early stage (0.02% Market Share) → Needs to develop new energy industry related expansion model
## Domestic & International EV Trend

### KEPCO

- *Jeju SG pilot project, Kepco’s other pilot project ➔ 65 EVs, 173 Chargers*

### EV

**Owned:** 65 EVs (As of 12.‘14)

<table>
<thead>
<tr>
<th>Blue-on</th>
<th>RAY</th>
<th>SPARK</th>
<th>SM3</th>
<th>SOUL</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>25</td>
<td>19</td>
<td>10</td>
<td>1</td>
<td>65</td>
</tr>
</tbody>
</table>

**EV Purchase Plans for business use**

<table>
<thead>
<tr>
<th>Div.</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qty</td>
<td>105</td>
<td>120</td>
<td>160</td>
</tr>
<tr>
<td>Ratio</td>
<td>50%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>Total(cumulative)</td>
<td>170</td>
<td>290</td>
<td>450</td>
</tr>
</tbody>
</table>

### Charger & Operation System

- *Chargers: 173 (Quick 29, Normal 144)*

<table>
<thead>
<tr>
<th>Div.</th>
<th>Head</th>
<th>Seoul</th>
<th>Gyeonggi</th>
<th>Chungnam</th>
<th>Jeju</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quick</td>
<td>2</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>29</td>
</tr>
<tr>
<td>Normal</td>
<td>10</td>
<td>38</td>
<td>22</td>
<td>7</td>
<td>31</td>
<td>36</td>
<td>144</td>
</tr>
</tbody>
</table>

**Operation System: 3**

1. Jeju SG Pilot project
2. High-way Pilot project
3. EV-Sharing Pilot project
## 1. EV Pilot Project & Main Achievements

### Jeju Smart Transportation Test bed Development

- **GOALS**: Development an optimal EV charging & commercialization business model
- **Period**: ’09.12~’13. 5 (42 months)
- **Participations**: KEPCO Consortium (21 Companies)

### Div. Station Charger

<table>
<thead>
<tr>
<th>Div.</th>
<th>Station</th>
<th>Quick</th>
<th>Normal</th>
<th>Wireless</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qty</td>
<td>18</td>
<td>13</td>
<td>29</td>
<td>4</td>
<td>6</td>
<td>52</td>
</tr>
</tbody>
</table>

### EV

<table>
<thead>
<tr>
<th>High-speed</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>4</td>
<td>18</td>
</tr>
</tbody>
</table>

---

**Jeju Smart Transportation Test bed Development**

- **SG Information Center**
- **ST Operation Center**
- **Smart Phone App**
- **I-Park APT**
- **ST Information Center**
- **EV Navigation**

**GOALS**: Development an optimal EV charging & commercialization business model

**Period**: ’09.12~’13. 5 (42 months)

**Participations**: KEPCO Consortium (21 Companies)
II. EV Pilot Project & Main Achievements

1. Jeju Smart Transportation Test bed Development

- Results: EV Charging Technology & Biz-Model Development → Base for Commercialization

Technology Development

Various Type of Chargers
- Quick, Normal, Wireless etc.

Payment System

V2G System

ST Operation System

Power supply standard

Various Pilot project

Charging fees Pilot Test
- Charging power + Service = Total fees

V2G & Demand Response Test

Pilot Test for Developing Biz Model

Harmonic Measurement

Two-way Power Trade

Base for Commercialization

EV Charger Business Model
- Home Charging
- V2G Service
- Public Quick Charging
- EV Charging Infrastructure

NO of Applications: 43

Establishment of Procedures for Charging Installations
### II. EV Pilot Project & Main Achievements

#### 2. Highway charging station pilot project

- **Achievement of base ability and experience accumulation for charging business**
- **Period/budget:** ’09. 9~’13.12(39months) / 1.8billion won
- **Remote monitoring chargers by operation system, real-time billing system, etc**

#### Table: Highway Charging Stations

<table>
<thead>
<tr>
<th>Status</th>
<th>Stations</th>
<th>Chargers</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Num</td>
<td>8</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Map of Key Locations

- **KEPCO HQ [DC1, AC3]**
- **Icheon express rest [DC 2]**
- **Umsung express rest [DC 2]**
- **Ochang express rest [DC 2]**
- **Kepco’s research center [DC1, AC1]**

#### 1st business launching case ‘11. 1 charging stations at express rests’
GOALS: Increase public awareness & develop EV sharing System [09.'14~ 12.'11 (34months)]

Main Content: EV Sharing System Development & Pilot Test

Results: Korea’s First EV Sharing Service Offered to the Public, Proof of EV deployment model

Operating Results

<table>
<thead>
<tr>
<th>No of Members (users)</th>
<th>No of EV rentals</th>
<th>Total distance on the road</th>
<th>Used(average)</th>
<th>Travelled(average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,373</td>
<td>6,259</td>
<td>420,000Km</td>
<td>5.3h’</td>
<td>67km</td>
</tr>
</tbody>
</table>
GOALS: Secure Reliability of Distribution line by Shifting, charging load ['14.10~12.'11 (24month)]
Main Content: Load Alleviation & Control of Distribution lines by load shift
Results: Development of Distribution line Charging Information Management System to control Load

Effect of Controlling Load

Avoid power peak by shifting, Charging Load

Daily Power Load Curve

19 21 24 03 06
Goal: To Build EV charging infrastructure throughout Korea for EV charging availability

Stage 1 (5.'15)
- Innovation City
  - (quick: 5, normal: 13)

Stage 2 (8.'15)
- Energy Valley
  - (quick: 6, normal: 11)

Stage 3 (10.'15)
- Nationwide Star-Network
  - (quick: 19, normal: 46)
III EV Charging Commercialization Strategy
Background

Barriers to EV Deployment

① High EV Price, ② Short driving distance, ③ Shortage of Charging Infrastructure

①, ② Can be relieved with Mass Production & Tech, but ③ Requires proactive approach

3-year plan for Economic Innovation of the Government

Organize 「New Energy Industry/Market Biz model Development T/F」

① 8 business categories (EV part) Paid EV charging business model
② 8 Businesses: EV, Renewable, CCS, SG, ESS, EMS, Intelligent DR, ESCO

Role of KEPCO

Respond to EV & Charging Infra. Expansion Policy of the Government

MOE
- Provide Subsidies for EV deployment
- Build Quick Charger public Infra
- 200,000 EVs by 2020

KEPCO
Pursue Charging Project & Foster New industries

MOTIE
- Public institutions, Obligation to buy EV
- Commercialization of low-Priced EVs
- Install 150,000 EV Chargers by 2016
Progress

New Industry Creation Energy (3-year plan for Economic Innovation)

14.2 New Energy industry Biz Model development T/F Organized

14.3~7 Government Included EV & New Energy Business

14.7 Private Sector Participation in paid EV Charging Business SPC Considered

14.8 Business Seminar

14.8 Business Model developed for Private Sector Participation EV Charging T/F Organized (10 Companies: KEPCO, KT, HYUNDAI, SKI, GSC, LG CNS 등)

14.9 Business Model developed for Private Sector Participation

14.10 Participants Recruited

14.11 Participants Confirmed

14.12 MOU

15.3 SPC Establishment (T/F organized)

15.5 Paid EV Charging Business

11/25
### EV Charging Commercialization Strategy

#### Direction

<table>
<thead>
<tr>
<th>Foster</th>
<th>Build Nationwide EV Charging Infra. In cooperation with Public Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>Utilize Optimized EV charging technology developed in SG pilot project</td>
</tr>
<tr>
<td>Visualization</td>
<td>Establish New Energy industry for EV through private participation and investment</td>
</tr>
<tr>
<td>System</td>
<td>Develop Self-Charging Automatic System Using Station Operation System, Homepage, APP</td>
</tr>
</tbody>
</table>

#### Policy

- Stimulate private-sector to lead EV charging business via SPC Participation (Government support)
- Establish charging stations in Public areas using overseas Benchmarks, biz-connection, Researches etc.

#### Implementation Strategy

**Step 1: Business Development**
- EV Station Infra in Jeju (Jun.~)
- Star-Network (Oct.)

**Step 2: EV Station Installations**
- Seoul-Daejeon-Pusan
- Seoul-Daejeon-Gwangju

**3단계: Business systems Completion**
- Nationwide EV Charging stations
- Cooperative projects with International Power companies
III. EV Charging Commercialization Strategy

4. Paid EV Charging Business Promotion

**Outline**

<table>
<thead>
<tr>
<th><strong>Goal</strong></th>
<th>To Create a new energy business through developing paid EV charging Biz</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>EV Charger 5,580 units (Home 2,750, Slow 2,655, Quick 175)</td>
</tr>
<tr>
<td><strong>Period/Budget</strong></td>
<td>‘15 ~ ‘17 (3 years) / 322 hundred million won (US$ 29,000 thousand)</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
<td>KEPCO, HYUNDAI, KT, KDB, Begins, SG cooperation etc.</td>
</tr>
<tr>
<td><strong>Place</strong></td>
<td>Public institutions: 1,830, Jeju: 3,750</td>
</tr>
</tbody>
</table>

**Business Plan**

**Policy Support**
- MOE/MOTIE
  - Policy improvement
  - Budget Support
  - Municipalities
  - Charging spot lease (for free)

**Business Developer**
- Establish SPC
- Develop Biz. Model
- Define Process Standardize

**Biz Participation**
- Private Sector Participants
  - Investment
  - Biz. Model development
  - O/S development

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Establish paid EV Charging Business SPC & Develop Business
III. EV Charging Commercialization Strategy

4. Paid EV Charging Business Promotion

**Biz. Model**

- **Home charging**
  - Basic (5~6 hour)
  - Membership

- **Slow charging** (market etc.)
  - General (1~2 hour)

- **Quick charging** (Rest area etc.)
  - Long Distance (10~30 min)
### III. EV Charging Commercialization Strategy

#### 4. Paid EV Charging Business Promotion

**EV Charging Business**

- **Direct Station**
  - Quick/Normal Charging Service

- **Charging Stations**
  - Station EPC, etc.

- **Branch Station**
  - Partnership with Private charging Stations

**Additional Services**

- Location Information etc.

**Business**

- **B2B(Step 1)**

- **B2C(Step 2)**

**Corporate**

- Taxi
- Car Rental
- Car Sharing

**Private**

- Private EV
- Public Sectors EV
- Corporate Business EV

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**Quick/Normal Charging Service**

**Partnership with Private charging Stations**

**Station EPC, etc.**

**Location Information etc.**

**Paid EV Charging Business Promotion**
III. EV Charging Commercialization Strategy

4. Paid EV Charging Business Promotion

Plans

- Participation & Operation (3.'15 ~ 5.'15)
  - Build Operation System, Institute Terms and corporate bylaws

- Economic Analysis & Product Pricing (3.'15 ~ 5.'15)
  - Review a validate Charging Business model & Operation Plan Financial Issues, etc.

- HR Recruitment, Incorporation, Business Registration (6.'15)
  - Goal: Expand to nationwide after reviewing successful development of Jeju’s business model.

- Build & Operate Charging Infra. (7.'15~)
III. EV Charging Commercialization Strategy

5 Expected Results

1. Develop base for EV deployment
   - 200,000 in 2020 under EV Dissemination policy
   - Develop Jeju Carbon-free Island by 2030

2. Accomplish New Energy Outcomes
   - Foster new energy industries through private investments
     - Improve a revise related System & policies → Induce private sector participation → stimulate Charging Business

3. Build successful Jeju SG Pilot Project commercialization model
   - Models developed in conjunction as ESS, Micro grid, AMI
   - V2G etc. Secure foreign markets model

- Increase Energy Efficiency & Reduce Co2
- Contribute to foster “innovate economy”
- Contribute to share growth with companies
IV KEPCO Implementation Status for EV Deployment
IV. KEPCO Implementation Status for EV Diffusion

Establishing Business Foundation

Installation Guideline for Charging Station

KEPCO’s Service Contract Revised

- 2 Service Line exceptionally allowed only for a charging station → Installation cost & period saved
- Power Capacity by LV network enlarged (99→499kW)

Guideline for Inner Wire Installation

- Installation Guideline for Distribution box, Branch line, WH meters, etc
- Standard Wiring Diagram by service voltage to ensure safety & security

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A type</td>
<td>KEPCO → PCC → DC, AC, AC → Load (Slave)</td>
</tr>
<tr>
<td>B type</td>
<td>KEPCO → PCC → LV, PCC → HV, DC, AC, AC → Load</td>
</tr>
<tr>
<td>C type</td>
<td>KEPCO → PCC → LV, PCC → LV, DC, AC, AC → Load</td>
</tr>
</tbody>
</table>

Wiring Diagram(<500kW)

- [Concept]
  - Separate Power Supply Circuit to impose EV Power Tariff
  - Circuit breaker by each charger

- [Symbol(EX)]
  - 4M175 : MCCB 4P 175A
  - SE 40 : ELB 2P 40A
  - 4SE 40 : ELB 4P 40A

<Power Supply Type by PCC>
The electricity fare supplied to the charging stations (not accumulative)
※ The owner of charging station imposes EV Charging tariff, sum of Power tariff and service fare

The unit price varies with the time/season to shift charging demand

EV Power Tariff established in July, 2010
Various types of Commercial Charging Systems

1st Commercial purpose DC, AC chargers developed in 2010, adopted as standard in Korea

<table>
<thead>
<tr>
<th>DC Charger</th>
<th>AC Charger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply DC power to Battery</td>
<td>Supply AC power to OBC</td>
</tr>
<tr>
<td>DC 450V (&lt;110A)</td>
<td>AC 220V (&lt;35A)</td>
</tr>
<tr>
<td>50kW</td>
<td>7.7 kW (O.B.C. 3kW)</td>
</tr>
<tr>
<td>10 ~ 30 min</td>
<td>5 ~ 6 hrs</td>
</tr>
</tbody>
</table>

※ provide real-time user checking, billing, bi-directional data monitoring etc.
## IV. KEPCO Implementation Status for EV Diffusion

### Cost-effective Chargers

#### Apt. type (home)

- **Motive**: Home charger optimized function for APT. (User checking, billing, etc)

- **Chrs.**
  - Simple User checking, Billing
  - No Communication cost
  - Electricity fare added to household’s Apt maintenance cost

- **Benefit**: Optimized system solution for Korean residence style

#### Master/Slave

- **Motive**: Cost-effective chargers required for the site where a number of chargers are to be installed (like public parking lot)

- **Chrs.**
  - Slave charger has basic function, and master charger has core function (communication & billing, etc)

- **Benefit**: 30% of Initial budget, 60% of maintenance cost saved by simplifying charging system

### Configuration

- **Master**
  - Communication: Yes
  - User checking: No

- **Slave 1**
  - Communication: No
  - User checking: Yes

- **Slave 2**
  - Communication: Yes
  - User checking: Yes

### Site (Public parking lot)

- **Master**
  - slave 1
  - Slave 2
IV. KEPCO Implementation Status for EV Diffusion

Other types

**Inductive Charger**

- **Motive**: Special chargers for disabled people, and some places such as factory, recreation site
- **Feature**: Connector is not necessary - power transfer by Electro Magnetic induction
- **Benefit**: Easier, Simpler charging than plug-in type chargers, Support inductive charging when driving

**DC charger for DC distribution network**

- **Motive**: Charger for DC distribution network, preparing renewable energy expansion
- **Feature**: DC charger is supplied with DC power by large capacity DC converter, which has simple configuration.
- **Benefit**: Initial budget can be decreased if more and more DC chargers is installed

---

<Inductive charger(KAIST)>  <Inductive charger(Green power)>  <System Config.>  <Site(Lotte Hotel)>
IV. KEPCO Implementation Status for EV Diffusion

Charging System for power trade (B2G, V2G)

**ESS & DC charger**

**Motive**
ESS charges power in low-price time, and discharges power to the EV(or power grid).

**Feature**
- 150 kWh ESS system, ESS charger and Operation system for B2G
- ESS sells the power to the grid(B2G) through 20 kW inverter, and also charges the EV through 50 kW DC charger

※ 1st case that ESS charges/discharges power connected to the real distribution network

**Bi-directional DC charger for Quick V2G**

**Motive**
To develop the power trade system for V2G model

**Feature**
- Bi-directional power trade system based on quick discharge
- Bi-directional DC charger can charge EV, and discharge the energy to the Grid

※ 1st success case of Quick V2G connected to real time distribution network
Overall management System to support EV charging business such as Remote monitoring, History, Billing & Payment data

- Real time monitoring by station
- User checking, Billing & Payment process
- Station/Charger/Customer history
- Interconnection with TOC
- Power Trade & Demand Resource Management Support
- Additional service provision

- Real time monitoring by chargers
- Billing & Payment Data Management
- Interconnection with ST operation center
- Statistics for Service Operator / Member
IV. KEPCO Implementation Status for EV Diffusion

4. Additional Service to enhance user convenience

**EV Navigation**
- Real time data provision station location/status/price of charging station

**Web page for members**
- Total Data to members such as charging history, charging fair, EV driving gaps data, etc

**Mobile CSOS**
- Management resource saved and efficiency enhanced by providing real-time status of stations

**Smartphone Application**
- Application providing information regarding charging station, and additional service
Beyond Today, Create Smart Grid Together!