Energy Storage System (ESS)  
Plus solar and wind

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What is ESS?

Source: http://www.energy.ri.gov/renewable-energy/energy-storage/
ESS in the global context

Figure 2. Global LiB-ESS Demand
(Capacity in GWh)

Global ESS Annual Capacity

# ESS in Korea

## ESS Installation Ranking of Major Countries

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Country</th>
<th>No. of projects</th>
<th>Installation (MW; market share)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>292</td>
<td>570.6 (35%)</td>
</tr>
<tr>
<td>2</td>
<td>Korea</td>
<td>55</td>
<td>291.4 (17.9%)</td>
</tr>
<tr>
<td>3</td>
<td>Japan</td>
<td>47</td>
<td>254.6 (15.6%)</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
<td>38</td>
<td>122.2 (7.5%)</td>
</tr>
<tr>
<td>5</td>
<td>Italy</td>
<td>31</td>
<td>56.2 (3.4%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>1,629.1</strong></td>
<td><strong>1629.1 (100%)</strong></td>
</tr>
</tbody>
</table>


## Comparison of Competitiveness by ESS Size (2017)

<table>
<thead>
<tr>
<th>Type</th>
<th>Best Companies</th>
<th>Competitiveness of Korea Companies (Top country=100)</th>
<th>Price (USD/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Global</td>
<td>Domestic</td>
<td>Fundamental technology</td>
</tr>
<tr>
<td>Small</td>
<td>SMA (Germany),</td>
<td>Samsung SDI, LG Chem, LSIS</td>
<td>83</td>
</tr>
<tr>
<td>Independent</td>
<td>ABB (Swiss), Younicos, SMA (Germany), Parker, GE, AES (USA)</td>
<td>Hyosung, LSIS, LG CNS, Woojin Industrial Electricity, Destin Power, LG Chem, Samsung SDI</td>
<td>82</td>
</tr>
</tbody>
</table>

*Source: IEM RIEC(2017), Supporting policy and strategy for strengthening of Industrial competitiveness of ESS Industry, March 2017*
Factors shaping the Korea’s ESS: Government policy

- Long-term strategy
  - Institutional and financial support for technology development and market creation
- Promotion of public and private collaboration and partnership
Factors shaping the Korea’s ESS: Government policy on Tariff

Korea's Tariff Structure for ESS Users

[Diagram showing tariff structure with labels and percentages]

1. Discount on the base rate (500kW/8.320/kW x 12 months)
2. Further discount on the base rate offered by KEPCO
3. Tariff reduction from replacing B by A
4. 50% discount on charging at Light load (2100 – 0900)

2020-09-09
Factors shaping the Korea’s ESS: Technology

Table 1. Patent Application for EV Battery System

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Manufacturer</th>
<th>No. of Patents</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LG Chem</td>
<td>757</td>
<td>17.1%</td>
</tr>
<tr>
<td>2</td>
<td>Samsung SDI</td>
<td>528</td>
<td>11.9%</td>
</tr>
<tr>
<td>3</td>
<td>Hitachi</td>
<td>349</td>
<td>7.9%</td>
</tr>
<tr>
<td>4</td>
<td>Hyundai Motor Company</td>
<td>244</td>
<td>5.5%</td>
</tr>
<tr>
<td>5</td>
<td>Toyota Motor Corporation</td>
<td>242</td>
<td>5.5%</td>
</tr>
<tr>
<td>6</td>
<td>Panasonic</td>
<td>233</td>
<td>5.3%</td>
</tr>
<tr>
<td>7</td>
<td>SB LiMotive</td>
<td>223</td>
<td>5.0%</td>
</tr>
<tr>
<td>8</td>
<td>Nissan Motor Co.</td>
<td>146</td>
<td>3.3%</td>
</tr>
<tr>
<td>9</td>
<td>Mitsubishi Motors</td>
<td>101</td>
<td>2.3%</td>
</tr>
<tr>
<td>10</td>
<td>Lithium Energy Japan</td>
<td>97</td>
<td>2.2%</td>
</tr>
<tr>
<td>11</td>
<td>Primearth EV</td>
<td>88</td>
<td>2.0%</td>
</tr>
<tr>
<td>12</td>
<td>Tesla</td>
<td>65</td>
<td>1.5%</td>
</tr>
<tr>
<td>13</td>
<td>LG Electronics</td>
<td>63</td>
<td>1.4%</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>1,291</td>
<td>29.2%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4,427</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: SNE Research, Jan 2015

Korea's Green Technology Roadmap for ESS, 2008
Factors shaping the Korea’s ESS: Infrastructure

- Technology platform
  - Well developed forward and backward industries for the Lib battery industry

Table 3. ESS Industry Composition by Sub-sectors in Korea

<table>
<thead>
<tr>
<th>Area</th>
<th>Large Companies</th>
<th>SMEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Manufacturing</td>
<td>GS Caltex and 9 others</td>
<td>Ecopro and 8 others</td>
</tr>
<tr>
<td>PCS</td>
<td>Samsung SDI and 4 others</td>
<td>Rebo and 3 others</td>
</tr>
<tr>
<td>Control Devices</td>
<td>POSCO ICT and 1 other</td>
<td>Wellstelesys and 1 other</td>
</tr>
<tr>
<td>Installation and O&amp;M</td>
<td>Hyundai Heavy Industry and 3 others</td>
<td>Namji and 4 others</td>
</tr>
<tr>
<td>Engineering</td>
<td>Hyosung and 1 other</td>
<td>Elecpower and 2 others</td>
</tr>
</tbody>
</table>

Source: Compiled by the author
2nd Battery Supply Chain

**SAMSUNG SDI**
**LG CHEMICAL**

**Anode**
DOMESTIC
- POSCO Chemical Technology
- GS Caltex
- SK Innovation

OVERSEAS
- Hitachi Chem
- Nippon Carbon
- Mitsubishi Chem
- Ningbo shanshan
- BTR New Energy
- JFE CEM

**Elecfoil**
DOMESTIC
- Iljin Materials
- LS Mtron

OVERSEAS
- Furukawa
- Nippon Denka
- Mitsui

**Separator**
DOMESTIC
- SK Innovation
- LG Chem
- Toptec
- Samsung SDI

OVERSEAS
- Taiyo Yuden
- BYD
- Mitsui

**Cathode**
DOMESTIC
- L and F
- EcoPro
- COSMO AM&T
- LG Chem
- Samsung Fine Chemical
- Hanwha Chemical

OVERSEAS
- Nichia
- Umicore
- Toda
- Ningbo ShanShan
- Hunan Reshine
- Beijing Easpring
- Sumitomo Metal
- Mitsui Metal
- Nippon Denko

**Precursor**
DOMESTIC
- Cosmo Chemical
- EcoPro
- Daejung Chemical
- ENF

OVERSEAS
- Japan/Australia/China

**Electrolyte Additive**
DOMESTIC
- Lichem

OVERSEAS
- Ube Industries
- Mitsubishi Chem
- Tomiyama
Factors shaping the Korea’s ESS: PPP

Joint Domestic Industrial-Academic Research on Separators
Prospect

- Demand
- Gov’t subsidy
- Infrastructure
- Technology
  - Battery density
  - Intense competition among major battery vendors in Korea

Figure 4. Korea’s ESS Market Outlook (value)

Challenges

- Land space for Renewables
  - Landslides due to rash renewables development
- Facility fire accidents
  - Lack of standards and interoperability
- Waste issue
  - Recycling of used batteries