KEPCO’s Future Plans of Northeast Asia Supergrid

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1. General Status of KEPCO
AT a Glance

KEPCO since 1898

(As of June 2013)

- **Generation**
  - Total of Nation: 84.3GW
  - KEPCO & 6 GENCOs: 69.3GW (82%)

- **Transmission**
  - Line Length: 32,017c-km
  - Substation Capacity: 272,253MVA

- **Distribution**
  - Line Length: 446,113c-km

**Assets**
- USD 140 billion

**Sales (2012)**
- USD 47 billion

**Gov. Share**
- 51%

**Employees**
- 19,445 (person)
Peak demand occurred in the summer. But, it caused in the winter since 2009.
- Peak Demand of 2013 : 76 GW  (Jan 3, 2013)

Installed generating capacity is 84 GW in June 2013
- Nuclear power and Coal power are responsible for 54% of load as base load
Minimize new power plant constructions through active demand management
Maintain at least 22% power reserve ratio
More than 20% share of renewable in total generation capacity
2. Overview of Supergrid
KEPCO’s thinking on Supergrid

- Broad continental grid for high capacity power transmission
- Integration diverse energy sources including renewable energy
- Power trading between nations (Peak share → Biz model)
- Advanced grid to overcome power shortage
Supergrid Market Volume (~2050)

Nord-Eu (500GW)  Sud EU–Marghabreb (470GW)  Grand Inga (100GW)

Supergrid Investment

B [US$]

Billion [US$]

1,200

1,000

800

600

400

200

0

Nord-EU Super Grid  Sud EU-Maghreb  Grand Inga Project  Gross Investment

1'st(2020)  2’nd(2030)  3’rd(2050)
### Status of NEA Supergrid

<table>
<thead>
<tr>
<th>Nations</th>
<th>Generation Capacity (MW)</th>
<th>Volume of Consume (million kWh)</th>
<th>Transmission Voltage (kV)</th>
<th>Frequency (Hz)</th>
<th>Load Features (Peak)</th>
<th>Energy Resource</th>
<th>Energy Consumption</th>
<th>Price Index (Korea=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Republic of Korea</td>
<td>83,212 ('12)</td>
<td>394,474 ('09)</td>
<td>765 345 154</td>
<td>60</td>
<td>summer winter</td>
<td>Poor</td>
<td>Large</td>
<td>100</td>
</tr>
<tr>
<td>Russia Federation</td>
<td>225,508</td>
<td>913,600 ('08)</td>
<td>1,150 750 500, 330</td>
<td>50</td>
<td>winter</td>
<td>Abundant</td>
<td>Small</td>
<td>50~70</td>
</tr>
<tr>
<td>Japan</td>
<td>282,315 ('12)</td>
<td>896,668 ('09)</td>
<td>500 275 220</td>
<td>50</td>
<td>summer winter</td>
<td>Poor</td>
<td>Large</td>
<td>250~300</td>
</tr>
<tr>
<td>China</td>
<td>1,0600,000 ('12)</td>
<td>3,437,919 ('08)</td>
<td>1,000 750 500, 330</td>
<td>50</td>
<td>winter</td>
<td>Abundant</td>
<td>Large</td>
<td>100</td>
</tr>
</tbody>
</table>

#### The North–East Asia region has sufficient conditions to make the SuperGrid.

- Emerging as a world best market (20% of area, population, GDP, trade in the world)
- The price gap, natural energy resource imbalance between nations
  - Important factor for the valuation of NorthEast Asia SuperGrid
Technical Feasibility

**Technically Feasible !!!**

**Technical side**

- HVDC Transmission Line: 1,900 km (China)
  - Capacity: 6.4 GW, Operation Start: 2010

- Submarine HVDC Transmission Line: 580 km (Europe)
  - Capacity: 0.6 GW, Operation Start: 2008

Source: Blank map of Europe.svg by Maix

**Constructive side (Submarine)**

- Maximum Water Level
  - Korea (Jeju Island): 110m
  - Japan: 260m, Europe: 540m

Source: KEPCO
Jeju #1 HVDC Project
Capacity: 300MW (150MW X 2 lines)
Voltage: DC ± 180 kV
Commercial Operation: 1998. 3

Jeju #2 HVDC Project
Capacity: 400MW (200MW X 2 lines)
Voltage: DC ± 250 kV
Commercial Operation: 2013. 9

Jeju #3 HVDC Project
Capacity: 200MW (200MW X 1 line)
* Considering HVDC or Gas Plants
8 circuits of telecommunication cable between Korea - Japan.
- Connection Point: Busan-Fukuoka, Kitakyushu, Hamada City

6 circuits between Korea - China.
- Connection Point: Taean-Qingdao
The first option, Big Loop, includes Russia, Mongolia, China, Japan, and Korea Jeju.

The second option, Small Loop, includes Russia, North and South Korea, and Japan.

Russia En+ came up with 2 options of NEA Supergrid in Apec 2012.
China State Grid’s Proposal

REF : State Grid of China

**China want to sell natural gas and renewable energy power to Europe**

- State grid of China set forth a plan to export electric power from China to Europe - about 5,000km, HVDC line (at the CIGRE conference in 2012)
Biz Model of Supergrid

SuperGrid can Creates Various Biz Models

- HVDC
- Peak Sharing
- Hub of SuperGrid
- ESS
- Price Gap
- Power Trade
3. KEPCO’s NEA Supergrid
1. Solution to grid problems by Peak share (power supply securing, Green energy developing) ⇒ Korea is isolated grid like Japan = Island grid

2. A fair cooperation model by electric power with North East Nations

3. Creating various types of business model

Why KEPCO is interested in Supergrid?
KEPCO`s Plan

1. Korea-Russia Interconnection
   - Abundant Resources of Russia

2. Korea-Japan Interconnection
   - The Nearest Distance to Connect

3. Korea-China Interconnection
   - Various Routes to link
Plan for the North-East Supergrid

- Consideration long-term period and uncertainty of business
  - Phased and practical Approach

- Promotion after constructing Energy council between nations
  - Government and electric company

- Essential to attend a expert group
  - Technique, economy and policy
4. Kepco’s progress
Korea–Russia Interconnection

Project Outline
- Expected Path: Vladivostok~ North-Gyeonggido (through North Korea)
  - Distance: 1,000km
- Connection System: HVDC 500~800kV

Progress
- On-Going Feasibility Study for Korea-Russia Grid Interconnection from 2012

Consideration
- Uncertainty of pass through the special territory
- Agreement by 3 parties
Korea–Japan Interconnection

Project Outline

- Expected Path: Southern Korea – Fukuoka, kitakyushu
  - Distance: 250km
- Connection System: HVDC 500kV

Progress

- On-Going pre-feasibility Study for Korea-Japan Grid Interconnection from 2012

Consideration

- Commercial based project propel
- Pay attention to protect fishery area of both sides
Korea-China Interconnection

**Project Outline**
- Expected Path: Qingdao~Inchon
  - Distance: 350km (submarine)
- Connection System: HVDC 500kV

**Progress**
- Meeting between KEPCO CEO & SGCC Chairman (Liu Zhenya)
  - WEC 2013: emphasis on northeast Asia energy cooperation
- On-going pre-feasibility study

**Consideration**
- Detail investigation of fishery area
5. conclusion & suggestion
Conclusion & Suggestion

- Benchmark similar overseas cases
- Risk analysis and mutual benefits review
- Consider many obstacles (regional characteristics)
- No technical problem for construction, operation experience
- Project financing
- Expert council among Northeast Asia countries
- Mutual understanding between both governments