NRE Policy of Korea and Cooperative Proposal

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Korea’s Energy Status

High Dependence on External Sources of Energy (96.5%)

- Very limited supply of indigenous natural resources
- Surge in energy demand driven by high economic growth
  (world's 10th largest energy & 8th oil consuming country)
- Cost of energy imports reached $171.9 billion in 2011 (32.8% of total imports)
  (crude oil $100.8 billion, LNG $24 billion, coal $18.5 billion)

**Energy Imports (Based on total imports)**

- Crude oil imports (million bbl)
  - '07: 874 (26.6%)
  - '08: 865
  - '09: 835
  - '10: 872
  - '11: 927

- Hundred million $:
  - '07: $91.8 billion
  - '08: $1,415 (32.5%)
  - '09: $912 (28.2%)
  - '10: $1,217 (28.6%)
  - '11: $1,719 (32.8%)

**$171.9 billion**
(Energy)

**$91.8 billion**
(Exports of Car + Semiconductor)
National Energy Plan 2030

Low Energy Consumption and Low Carbon Society

- Drastically improve energy intensity in Korean economy (Improving 46% by 2030)

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Intensity (toe/1,000$)</th>
<th>KOREA</th>
<th>OECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>0.335</td>
<td>0.230</td>
<td>0.183</td>
</tr>
<tr>
<td>2030</td>
<td>0.185</td>
<td>0.123</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Fossil Fuel-free Society

- Moving away from a fossil fuel dependent energy system

<table>
<thead>
<tr>
<th>Year</th>
<th>Renewable share</th>
<th>Nuclear share (generating facilities)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>2.4%</td>
<td>26%</td>
</tr>
<tr>
<td>2030</td>
<td>11%</td>
<td>41%</td>
</tr>
</tbody>
</table>

Industrialization for Green Energy

- Promote green energy industry by developing advanced technologies

Competitiveness of core energy technology: 60% → World Best

Energy Independence and Energy Welfare

<table>
<thead>
<tr>
<th>Year</th>
<th>Self-exploitation capacity ratio</th>
<th>Energy poverty ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>4.2%</td>
<td>7.8%</td>
</tr>
<tr>
<td>2030</td>
<td>33%</td>
<td>0%</td>
</tr>
</tbody>
</table>

* Excerpt from the Master Plan for National Energy (MKE 2008)
The 3rd Industrial Revolution - Changing Paradigm of Development

3rd Industrial Revolution

- The Era for Fusion of New & Renewable Energy and ICT
  * Ref : Jeremy Rifkin - The Third Industrial Revolution

  ![Diagram of Industrial Revolutions]

- The 1st Industrial Revolution
  - Steam Engine + Printing

- The 2nd Industrial Revolution
  - Car, Construction + Fossil Fuel

- The 3rd Industrial Revolution
  - ICT (Information & Communication Technology) + New & Renewable Energy

- 5 Main Topics of the 3rd Industrial Revolution
  - Shifting from fossil fuel (oil, coal) to new & renewable energy (PV, Wind etc)
  - Generating electricity from all buildings through new & renewable energy
  - Saving energy effectively from new & renewable energy via Energy Storage System
  - Sharing energy through smart grid system using internet
  - Shifting to Fuel Cell Vehicle and Net Metering
Achievements in NRE

Increasing NRE Share Ratio

Annual Growth Rate: 7.0% (’06~’10)

NRE Share in TPES (%)

- ’06: 2.24%
- ’07: 2.37%
- ’08: 2.43%
- ’09: 2.50%
- ’10: 2.61%

< Breakdown of NRE share (2010) >

NRE Industries Nurturing

- No. of Manufacturers
  - ’07: 101
  - ’09: 193
  - ’11: 215
- No. of Employees
  - ’07: 3,661
  - ’09: 14,408
  - ’11: 14,408
- Sales (bil.USD)
  - ’07: 1.04
  - ’09: 3.97
  - ’11: 6.98
- Investment (bil.USD)
  - ’07: 0.58
  - ’09: 2.49
  - ’11: 3.52

Strong Government Support

Active Participation by Manufacturer, People

Nurturing Industrial Eco-system and Creating Market

Waste 70.9%
Hydro 11.6%
Bio 11%
Wind 2.6%
PV 2.4%
Fuel Cell, etc 1.5%

‘07 ‘09 ‘11
2.1 times
215
2.1 times
3.9 times
14,408
6.7 times
6.98
6.1 times
3.52
Implementing strategies

1. Strategic R&D & Commercialization
2. Market Creation to stimulate Industrialization
3. Facilitating Export-oriented Industrialization
4. Strengthening Growth potential

Investment of 40trillion KRW (36.3 bil USD) will be invested in NRE by public (7tril) and private (33tril) sectors until 2015.

Policy Vision

NRE Vision in Korea

Policy Vision

Dissemination Target (2030)

NRE Shares in TPES by 11% (2.6% in 2010)

Industrialization Target (2015)

To be the world’s top 5 powerhouse in NRE market

<table>
<thead>
<tr>
<th>Year</th>
<th>Sale (unit: bil USD)</th>
<th>Export (unit: 0.1 bil USD)</th>
<th>Employment (unit: 10,000 employees)</th>
<th>Private Investment (unit: 0.1 bil USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>'09</td>
<td>3.9</td>
<td>26</td>
<td>1.2</td>
<td>2.5</td>
</tr>
<tr>
<td>'12</td>
<td>16</td>
<td>107</td>
<td>2.7</td>
<td>5.7</td>
</tr>
<tr>
<td>'15</td>
<td>41</td>
<td>362</td>
<td>11</td>
<td>8.6</td>
</tr>
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</table>
## Major Renewable Energy Policies

### Market Creation Programs through Generation, Heat and Transportation

<table>
<thead>
<tr>
<th>Generation</th>
<th>RPS (Renewable Portfolio Standards, 2012)</th>
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<tbody>
<tr>
<td></td>
<td>To realize national target, 11% of NRE share in TPES, launched in ’12</td>
</tr>
<tr>
<td></td>
<td>13 Mandatory power companies with capacity of more than 500MW</td>
</tr>
<tr>
<td></td>
<td>2% ~ 10% of total power generation must be generated by NRE, expecting market creating about 41 bil USD</td>
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<tr>
<th>Heat</th>
<th>RHO (Renewable Heat Obligation, 2015 ~)</th>
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<tr>
<td></td>
<td>Newly built buildings’ (total floor area more than 10,000 m²) energy demand should be met by renewable heat sources.</td>
</tr>
<tr>
<td></td>
<td>Solar thermal, Geo thermal and Bio etc (Multiple sources are under consideration)</td>
</tr>
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<thead>
<tr>
<th>Transport</th>
<th>RFS (Renewable Fuel Standards, 2014)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Bio fuel mix obligation with gasoline and diesel fuel for transportation</td>
</tr>
<tr>
<td></td>
<td>BD2 is in operation from 2012</td>
</tr>
</tbody>
</table>
Renewable Energy Support Program

- **[One million Green Homes]** Renewable energy supply for domestic housing
- **[General Deployment]** Installation subsidies for new technology and commercialization
- **[Local Deployment]** Establishment of eco-friendly local supply system
- **[Soft Loans]** Support installation and manufacturing companies

- **[Certification]** Renewable equipments certification standards for durability and efficiency
- **[Test-bed]** Providing testing types and infrastructure
- **[Overseas]** Market investigation, project excavation, and training & education

- **[Mandatory Scheme for Public Buildings]**
  Public buildings newly built or renovated (floor area 1,000㎡) should invest in NRE facilities
Energy Fusion Future Plan
Combining the advantages of Nuclear Energy and NRE and mitigating their disadvantages (Creates synergy effect)

What’s the solution to minimize disadvantages?
Technology and Development Research

**Nuclear Power Energy**
- Develop future technology and expand research base
- Technology research to improve safety of nuclear power plants
- Research on nuclear fuel and waste disposal (for low- and intermediate-level waste)

**NRE**
- Research on NRE materials/parts and R&D technologies
- Research on cooperation link between NRE test bed (photovoltaic power / wind power) and demonstration complex

**Energy Fusion**
- Technology research on hydrogen generation and process (fuel cell) of nuclear power by using ultra high-temperature reactor
- Research on nuclear power plant related technologies and energy fusion in various ways (such as NRE, BT, NT, and IT)
- Research on smart grid
International Cooperation

International Cooperation Activity

**Int’l Technology Exchange**
- Promote int’l joint research on improving nuclear power plant safety and reprocessing radioactive soil
- Research on joint certification system in NRE field and Northeast energy network

**Strengthen Manpower**
- Build network to foster professionals in energy fusion
- Foster experts in nuclear power plant and NRE fields

**Promotion of Int’l Cooperation**
- Promote int’l cooperation according to the cooperation agreement on nuclear energy
- Hold conferences with multilateral bodies (e.g. IEA, WB, ADB, UNEP)
- Support peer review of nuclear power plants via international organizations such as the IAEA
“Evolution of civilization depend on cheap energy, so we need to get to net zero CO2, not only low carbon.

- Bill Gates -

Investment renewables for ‘own electricity procurement’

1. Getting To Zero: efficiency of Google Data Centers and offices
2. Beyond Zero: Invest and support to renewable energy
“Renewable energy will get synergistic effect with IT business. So, we need a long term investment for renewable energy.

-Masayoshi Son, CEO of SoftBank -

- Devoting 1 billion yen to establish ‘Natural Energy Foundation’
- 80 billion yen investment plan for national PV plants in Japan
- Mongolia natural energy development business based on Korea-Japan partnership
- Hanwha, entering Japan PV market to supply PV module to SoftBank
Asia Super-Grid
# Necessity for Super Grid Interconnection

Northeast Asia 6 countries would get complementary advantages in economic, financial, and energy resources technology sectors.

- Rich resources (Russia, China) vs. Poor resources (Korea, Japan)
- High demand for electricity (China, Korea) vs. Surplus electricity (Russia)
- New power plants approval issue (Korea, Japan)
- Large-scale energy resources availability (Russia, China)

## Expected Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>Economy</strong></td>
<td>Effective use of natural resources, flexible selected power generation’s location</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>Utilization of eco-friendly resources, new NRE power plants development</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>Mutual power management for blackout and power qualities control</td>
</tr>
<tr>
<td><strong>International Cooperation</strong></td>
<td>Expanding South and North’s exchanges and possible cooperation</td>
</tr>
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</table>
Korea-Japan Grid Connection Project (tentative)

Based on the international undersea cable network, Super Grid project would be able to expand from renewable energy to other resources.

<table>
<thead>
<tr>
<th>Length of Track</th>
<th>220km (Busan ~ Fukuoka)</th>
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<tbody>
<tr>
<td>Operation</td>
<td>500kV, 3GW (about 5 years for construct)</td>
</tr>
<tr>
<td>Investment</td>
<td>200million $ (50 million $ for transfer, 150 million $ for cable)</td>
</tr>
<tr>
<td>Business Promotion</td>
<td>SPC foundation (private investor 60%, Korea-Japan each 20%)</td>
</tr>
</tbody>
</table>

Sharing electricity demand peak, developing HDVC technology, and creating profits by trading electricity power has both advantages and barriers

* Political issues, critical public, financial procurement etc.

Priorities are exchanging opinions and forming consultative group before business promotion
Thank you very much

KOREA ENERGY MANAGEMENT CORPORATION