Korea’s Energy Transition

Status and Strategies

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Current Status
Energy Balance

2017

Imports

Overseas Dependency
93.5% (146.0bil.$)

Crude Oil
Middle East (73.5%)
- Saudi (29.0%)
- Kuwait (14.5%)
- Iraq (12.4%)
- Asia (11.0%)
- Africa (3.7%)

Qatar
Australia
USA

Australia
Indonesia
Russia

Russia
Canada

Russia
Australia
China

Domestic Production 6.5%

Primary Energy

307.3 mil. toe (100.0%)

Refining 3.1 mil.b/d

Transformation

69.4 mil. toe
(22.6%)

City Gas
19.8 mil. ton

Heat
2,693.6 thou. toe

Electricity
570.0 bil.KWh

Final Energy

237.9 mil. toe
(77.4%)

Industrial
61.5%

Naphtha etc industrial resource 23.2%

Residential & Commercial
17.5%

Transportation
17.9%

Electricity

Industrial 53.9%

Residential & Commercial 39.4%

Public 6.2%

Transportation 0.6%
Total Primary Energy Supply

Cumulative

Proportion
Final Energy Consumption

Cumulative

Proportion

[Charts showing energy consumption trends and proportions for different sectors (Industry, Res. & Comm., Transport, Public) from 2000 to 2018, with specific values and proportions highlighted.]
Power Generation Mix ('18)

### Generation Capacity

- **Oil**: 3.4%
- **Renewables**: 15.2%
- **Natural Gas**: 25.6%
- **Nuclear**: 18.3%
- **Coal**: 29.7%
- **Others**: 7.7%

- **Total capacity**: 119.1GW (2018)
- **Fossil fuel**: 65.9GW (55.9%)
- **Nuclear reactors in operation**: 25

### Electricity Production

- **Oil**: 1.2%
- **Renewables**: 6.0%
- **Natural Gas**: 20.5%
- **Nuclear**: 23.4%
- **Coal**: 40.6%
- **Others**: 8.3%

- **Total production**: 570.1TWh (2018)
- **Base-load fuel (coal, nuclear)**: 64.0%
National Inventory

Greenhouse Gas Emissions

Nationally Determined Contribution

- Revised in 2018 to enhance domestic GHG reduction
- Additional efforts in power sector & newly accounted LULUCF
- Int'l credit: 11.3% ('15) → 1.9%

 Additional Reduction Potential

LULUCF & Int'l Credit

536 Target

-37% from BAU
Paradigm Shift: Innovation of Consumption Structure
Demand Outlook and Target

**Demand Outlook**

☑️ **Final energy**: 211.0 Mtoe (2040) with annual average of 0.8% ↑

  Energy intensity for final energy consumption: annual average of 1.2% ↓

**Target Demand**

☑️ Reduce **final energy consumption** by 18.6% compared to the BAU demand

  Improve energy intensity for final energy consumption by 38%

[ BAU and Target Demand for Final Energy (draft) ]
**Demand Outlook and Target**

### Target Demand

- **Oil products**: 31.1% decrease against BAU (vehicle fuel efficiency, EVs & FCEVs)
- **Renewables**: 19.9% ↑ from BAU due mainly to distributed generation for self-consumption

### Demand Target for Final Energy: Sources

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Oil</th>
<th>City gas</th>
<th>Renewables</th>
<th>Electricity</th>
<th>Heat</th>
<th>Energy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>33.2</td>
<td>61.4</td>
<td>23.7</td>
<td>11.8</td>
<td>43.7</td>
<td>2.3</td>
<td></td>
<td>176.0</td>
</tr>
<tr>
<td>2030</td>
<td>32.3</td>
<td>47.8</td>
<td>25.4</td>
<td>18.8</td>
<td>49.0</td>
<td>2.0</td>
<td></td>
<td>175.3</td>
</tr>
<tr>
<td>2040</td>
<td>31.2</td>
<td>39.4</td>
<td>26.1</td>
<td>23.8</td>
<td>49.7</td>
<td>1.6</td>
<td></td>
<td>171.8</td>
</tr>
<tr>
<td>(BAU)</td>
<td>39.0</td>
<td>57.1</td>
<td>30.5</td>
<td>19.9</td>
<td>61.8</td>
<td>2.6</td>
<td></td>
<td>211.0</td>
</tr>
</tbody>
</table>

### Demand Target for Final Energy: Sectors

<table>
<thead>
<tr>
<th>Year</th>
<th>Industry</th>
<th>Residential</th>
<th>Commercial</th>
<th>Public</th>
<th>Transport</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>87.4</td>
<td>22.2</td>
<td>17.6</td>
<td>6.4</td>
<td>42.5</td>
<td>176.0</td>
</tr>
<tr>
<td>2030</td>
<td>94.7</td>
<td>19.1</td>
<td>18.4</td>
<td>6.8</td>
<td>36.2</td>
<td>175.3</td>
</tr>
<tr>
<td>2040</td>
<td>96.3</td>
<td>17.7</td>
<td>18.5</td>
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<td>32.7</td>
<td>171.8</td>
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<tr>
<td>(BAU)</td>
<td>113.3</td>
<td>21.9</td>
<td>23.9</td>
<td>8.0</td>
<td>43.8</td>
<td>211.0</td>
</tr>
</tbody>
</table>
Demand Management

### Industry
- Voluntary annual 1% reduction of energy intensity for heavy consumers (2,000 TOE ↑)
- More FEMS installation
- Replacements with high-efficiency equipment (ex. boilers)

### Building
- Mandatory efficiency assessment for public/commercial buildings (3,000 m² ↑)
- Stronger building insulation/installation standards & more BEMS installation
- No fluorescent lights in the market (2028)

### Transportation
- Fuel efficiency target for heavy duty vehicles
- Improved fuel efficiency target for passenger vehicles
- 8.3 million electric vehicles and 2.9 million hydrogen vehicles by 2040
- Intelligent Transportation System (ITS) & efficiency of non-road transportation

**Energy intensity (TOE/$1,000, value-added)**

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry &amp; the public</td>
<td>0.150</td>
<td>0.119</td>
</tr>
</tbody>
</table>

**Energy intensity for industry and the public (TOE/$1,000)**

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry &amp; the public</td>
<td>0.029</td>
<td>0.018</td>
</tr>
</tbody>
</table>

**Average fuel efficiency (km/ℓ)**

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger vehicle</td>
<td>16.8</td>
<td>35.0</td>
</tr>
<tr>
<td>Heavy duty vehicle</td>
<td>5.19</td>
<td>7.5</td>
</tr>
</tbody>
</table>

1.5-2 times
Transition to Clean and Safe Energy Mix
Renewable Energy

**Recent Progress**

- [Power Generation by Renewables](#)

<table>
<thead>
<tr>
<th>Year</th>
<th>Power Generation (GWh)</th>
<th>Power Generation by Renewables (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>20,859</td>
<td>3.84%</td>
</tr>
<tr>
<td>2014</td>
<td>25,939</td>
<td>4.75%</td>
</tr>
<tr>
<td>2015</td>
<td>35,984</td>
<td>6.41%</td>
</tr>
<tr>
<td>2016</td>
<td>39,152</td>
<td>6.97%</td>
</tr>
<tr>
<td>2017</td>
<td>43,868</td>
<td>7.60%</td>
</tr>
<tr>
<td>2018</td>
<td>48,585</td>
<td>8.18%</td>
</tr>
</tbody>
</table>

- [Annual Growth Rate](#)

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual Growth Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>24.4%</td>
</tr>
<tr>
<td>2015</td>
<td>38.7%</td>
</tr>
<tr>
<td>2016</td>
<td>8.8%</td>
</tr>
<tr>
<td>2017</td>
<td>12.0%</td>
</tr>
<tr>
<td>2018</td>
<td>10.8%</td>
</tr>
</tbody>
</table>

**Renewable Portfolio Standard**

- Power generation companies of 500+MW capacity must supply a proportion of their electricity out of renewable energy sources (6.0% this year)
- Target is being raised by 1.0% annually up to 10% (from 4.0% in 2017 to 10.0% in 2023)
Power Generation Mix

2030 Target

<table>
<thead>
<tr>
<th>Capacity (GW)</th>
<th>2017</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>107.8</td>
<td>22.5 (20.9%)</td>
<td>20.4 (16.6%)</td>
</tr>
<tr>
<td></td>
<td>36.1 (33.5%)</td>
<td>38.9 (31.6%)</td>
</tr>
<tr>
<td></td>
<td>37.4 (34.7%)</td>
<td>47.5 (38.6%)</td>
</tr>
<tr>
<td></td>
<td>3.1 (2.9%)</td>
<td>8.8 (7.2%)</td>
</tr>
<tr>
<td></td>
<td>8.7 (8.1%)</td>
<td>7.4</td>
</tr>
</tbody>
</table>

Renewable Energy

2040 Target: 30~35% (range) (range) of Power Generation

Changes possible in the future (ex. technological development, public acceptance)
## Sustainable Energy Mix

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>Phase-out: no new plants &amp; early retirement if necessary</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>↑ role as a source for power generation</td>
</tr>
<tr>
<td></td>
<td>Demand diversification</td>
</tr>
<tr>
<td>Nuclear Power</td>
<td>Phase-out: no lifespan extension &amp; no new plants</td>
</tr>
<tr>
<td>Oil</td>
<td>↓ role as a transportation fuel</td>
</tr>
<tr>
<td></td>
<td>↑ use as a feedstock for petrochemicals</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>Groundwork to develop it as an important source</td>
</tr>
</tbody>
</table>
Energy Security through Global Cooperation

**Energy Import Diversification**
- Continuous diversification of oil import supply & more storage facilities for commercial use
- Natural gas portfolio diversification: source, pricing, contract length, etc.

**Overseas Resources Development Innovation**
- Public enterprises: restructuring of financial structure and decision making process
- Support for private-sector capacity building (ex. financing, R&D, manpower development)

**Northeast Asia Super Grid**
- South Korea-North Korea-Russia: joint study between S. Korea and Russia (~2020)
- Korea-China-Japan interconnector: MOU or joint study in a bilateral manner

**Northeast Asia Cooperation on Natural Gas**
- Less rigid contract conditions, joint stock in case of supply emergency, more swap trade
- Natural gas pipeline connection in Northeast Asia
Expansion of Distributed & Participatory Energy System
Distributed Power System

**Located nearby demand**

- More fuel cells for power generation and CHP power plants

**Electricity Prosumers**

- More independent solar PV and residential/building fuel cells

**Electricity Trading Market**

- Virtual power plants for small distributed power, including solar PV, ESS and V2G
Participatory and Decentralized Governance

**Better Communication · Public Participation**

- Promotion of resident-participation and profit-sharing projects
- Systematic communication & conflict prevention processes (ex: ESTEEM model)

**Role & Responsibility of Regional and Local Governments**

- Zone planning system for renewable energy
- Enhancement of regional energy plans & establishment of regional energy centers

**Energy Welfare**

- Better energy welfare system for cooling in summer
- More efficient support system (ex. restructuring of the agency in charge)
Thank You.