Growing Public Opinion Against the Nuclear Power Phase-Out Policy of Korea

以核養綠
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- Electricity and Nuclear Energy Status of Korea
- Onset of Nuclear Power Phase Out Policy
- Protest Against Phase-Out Policy and SKN 5,6 Deliberation Process
- Problems of Phase-Out Policy
- Counter Arguments Against Phase Out Policy
- Anti Phase Out Organizations and Activities
- Improved Public Opinion
- Summary
Korea and Energy at a Glance

<table>
<thead>
<tr>
<th>Indicator</th>
<th>S. Korea</th>
<th>Taiwan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area, km²</td>
<td>100,363 (107)</td>
<td>36,197</td>
</tr>
<tr>
<td>Population, Million</td>
<td>51.5 (27)</td>
<td>23.6</td>
</tr>
<tr>
<td>Density, per km²</td>
<td>507 (23)</td>
<td>650</td>
</tr>
<tr>
<td>GDP, Billion $</td>
<td>1,693 (12)</td>
<td>603</td>
</tr>
<tr>
<td>PPP GDP/Cap, $</td>
<td>41,338 (32)</td>
<td>52,960</td>
</tr>
</tbody>
</table>

- Overseas Dependence: 95%
- Energy Consumption: 9th in the World
- Island with no Grid Connection
- Avg. Electricity Generation: 63.2 GW
  - 1.1 kW/capita (1.2 for Taiwan)
  - Industry 55%, Residential 13%
- Total Gen. Capacity: 116.4 GW
- Nuclear Capacity: 22.5 GW (24 Units)
  - Producing ~30% of 554 TWh
Design Technology Transfer from Combustion Engineering in 1987-1990
Self-sustaining Korean Nuclear Industry with Full Technology Independence

- Contract
- Planning
- Overseas Business

- Utility Project Management
- Commissioning
- O&M

- Licensing
- Nuclear Safety
- Inspection

Design and Engineering
Nuclear Fuel
Maintenance and Services
Equipment Manufacturing
Construction
International Competitiveness of Korean Electricity Price and NPP Construction

<table>
<thead>
<tr>
<th>Country</th>
<th>Industry</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea</td>
<td>95</td>
<td>103</td>
</tr>
<tr>
<td>Japan</td>
<td>162</td>
<td>225</td>
</tr>
<tr>
<td>Germany</td>
<td>145</td>
<td>327</td>
</tr>
<tr>
<td>USA</td>
<td>127</td>
<td>69</td>
</tr>
<tr>
<td>UK</td>
<td>145</td>
<td>235</td>
</tr>
<tr>
<td>France</td>
<td>110</td>
<td>181</td>
</tr>
</tbody>
</table>

NPP Construction Cost $/kW

- **France**: 7809
- **USA**: 11638
- **Russia**: 5271
- **China**: 4364
- **Korea**: 3717
In December 2009, the contract to build four APR1400 units at Barakha of the United Arab Emirates (UAE) by 2020. Overall, the construction is about 85% complete.
Strong Anti-Nuke: Buan Struggle Experienced during Spent Fuel Disposal Site Selection in 2003

Local governor hospitalized after assault
Growing Anti-Nuke Sentiment after Fukushima

- **Fukushima and Subsequent KHNP Ethical Failure**
  - TV Broadcast of the Fukushima accidents
  - KHNP scandals involving
    - Counterfeit test certificates of NPP supplies such as signal cables
    - Hiding the malfunction of emergency diesel generator leading to station blackout for 12 min

- **Various Anti-Nuke Groups**
  - Environmentalists
  - Professors and medical doctors
  - Lawyers and national assembly members (33)

- **Strong Anti-Nuke Public Activities from 2011**
  - Seoul City: One Less NPP campaign
    - One less NPP with energy saving
  - Anti-nuke schools
    - Regular teaching program for general public and mid to high school students
    - Slow but very effective process
  - Diversified anti-nuke movements to hinder NPP licensing renewals, transmission tower construction, interim rad-waste storage site preparation...
Public Opinion Change before 2014

Changes of Public Opinion on NPP Construction

- PRO
- Fukushima
- Ethical Failure
- ANTI
Record-High Earthquake in Gyeonju

- Strongest-ever earthquake hits Korea, tremors felt nationwide
  - 5.8-magnitude shock stroke Gyeongju on Sep. 12, 2016
  - Danger exaggerated by the anti nukes (even no casualty)
  - Only KHNP responded to the issue
  - Affect the presidential election pledge on May 9, 2017
Movie Pandora

- Unrealistic Fiction Movie Exaggerating the Danger of an Earthquake Induced NPP Accident

The film "Pandora," the first local film dealing with a nuclear disaster here, is striking in that it bears much on what is happening in Korea now. - The Korea Times
- Criticizing the bureaucracy as well
- ~4.5 million people watched
Nuclear Power Phase-Out Policy (NPPOP)

- **Majority Campaign Promise to Phase-Out Nuclear Power During the May 2017 Presidential Election**
  - 4 out of 5 candidates chose Nuclear Power Phase-out Policy as campaign promise

- **President Moon declared NPPOP at Kori-1 retirement ceremony on June 19, 2017**

- **Phase-out Nuclear, Phase-out Coal** declared together as the evil source of electricity
Protests by Group of Professors

- Trials to terminate the construction of Shin Kori Nuclear Units 5&6 (29% complete as of June 2017)
  - Made by the regime transition team

- First Press Conference to Announce the Objection Statement on June 1, 2017
  - Joined by 230 professors nationwide
  - Halt of the construction postponed as a result

- President Moon Ordered Temporary Stop of the Construction after 3 weeks

- Second Press Conference to Announce Another Objection Statement on July 5, 2017 (National Assembly)
Shin Kori 5&6 Public Deliberation Process

- **Overview**
  - Purpose: make a public decision on SKN 5&6 construction
  - Formed a citizen jury consisting of 471 ordinary people
  - Go through the deliberation process involving information delivery and discussions for 3 months from July 15, 2017 (Ended on October 20)

- **Deliberation Process to Rectify the Misunderstanding and Fear about Nuclear Power**
  - The pro-nuclear group consisting of mostly professors and a few KNHP engineers prepared materials to provide right information about the safety and benefits of nuclear power
  - Actively involved in publishing newspaper articles, TV debates, and lectures

- **Change in Public Opinion**
  - Continuation: Termination Ratio changed from 3:7 to 5:5
  - Final Decision by the Citizen Jury 59.5:40.5

- **SKN 5&6 Construction Resumed**

- **Energy transition roadmap was issued right after the decision of resuming construction**
Execution of Nuclear Power Phase-Out Policy
- Cancellation of 6 planned new NPPs (of the 7-th plan)
- No licensing renewal of 11 NPPs of which the initial license expires before 2030

Significant Reduction in the Expected Base Electricity Demand in 2030

Increase of Renewable Share to 20% by 2030

<table>
<thead>
<tr>
<th>Year</th>
<th>Nuclear</th>
<th>Coal</th>
<th>LNG</th>
<th>Ren.</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘17</td>
<td>30.3</td>
<td>45.3</td>
<td>16.9</td>
<td>6.2</td>
<td>1.3</td>
</tr>
<tr>
<td>‘30</td>
<td>23.9</td>
<td>36.1</td>
<td>18.8</td>
<td>20.0</td>
<td>1.1</td>
</tr>
</tbody>
</table>
Mis-prediction Revealed for the First 2 Years

IAEA Forecast of Electrification
2017 18.5%, 2030 21%, 2050 26.6%
Reduced Nuclear Power Generation for Last 2 Yrs

Coal and LNG shares increased significantly to cause

1. More CO₂ by 20 MT ton in 2017

2. Deficit in KEPCO and KHNP Finance
   (Finance Balance in Trillion KRW)

<table>
<thead>
<tr>
<th>Company</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEPCO</td>
<td>12.2</td>
<td>4.95</td>
<td>-0.88</td>
</tr>
<tr>
<td>KHNP</td>
<td>3.85</td>
<td>1.30</td>
<td>-0.40</td>
</tr>
</tbody>
</table>

*Generation during Nov. 1 through Oct. 31 next year
Counter Arguments Against the Phase Out Policy

- **Safety of NPPs Demonstrated by Operation Histories**
  - Only one fatal accident involving casualty for about 18,100 reactor operation years for more than 50 year operation of 620 NPPs worldwide
    - Chernobyl with fewer than 50 casualties)
  - Fukushima accident induced by Tsunami, not by earthquakes
    - Onagawa NPP was safe even with stronger earthquake and higher Tsunami because it is located at a higher site to avoid inundation
  - No fatal accident ever due to earthquake. Instead many cases noted that withstood earthquakes stronger than the seismic design
Safe Spent Nuclear Fuel Storage Possible

- **Absolutely Less Generation of Spent Nuclear Fuel (SNF)**
  - Absolute amount of spent fuel is very little so that on-site storage of spent fuels for the lifetime is possible (SNFs Generated for 20 Yrs in a 1 GW NPP can be stored with area of ~100 m²)

- **Dry interim storage is also possible for safe storage**

Zwilag Interim SNF Storage Facility, 2800m² (~70mx40m) to store SNFs generated for 50 years from two 1 GW NPPs
Safe Disposal Possible with Current Technology

- **Proven Disposal Technology**
  - Thick (~5cm) corrosion resistant copper container
  - Bentonite filler which shields water penetration and prevent migration of radioactive elements
  - Proved safe storage of SNF for 10,000 years

- **More effective technology can be developed**
  - More economical methods are under development
Increasing Needs for NPPs to Combat Climate Change


454 NPPs in Operation in 31 Countries

- Accumulated reactor years of 18,100
- Major countries generating **71.1% of world GDP** use NPPs
- **60.8% of the world population** benefit from NPPs
Expanding Use of NPPs

- **Countries Building First NPP (4)**
  - UAE, Belarus, Bangladesh, Turkey

- **Countries Considering First Building of NPP (6)**
  - Saudi Arabia, Jordan, Indonesia, Lithuania, Kazakhstan, Egypt

- **Other NPP Policies**
  - Japan exit from NPP Zero to reach 20% nuclear share by 2030
  - UK to build 13 NPPs
  - China, India, Russia to actively expand NPPs
  - 160 NPPs expected to be built by 2030

### Yearly Operating and Under Construction NPPs

<table>
<thead>
<tr>
<th>Year</th>
<th>Operating NPPs</th>
<th>NPPs under Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>438</td>
<td>81</td>
</tr>
<tr>
<td>2015</td>
<td>441</td>
<td>67</td>
</tr>
<tr>
<td>2016</td>
<td>447</td>
<td>74</td>
</tr>
<tr>
<td>2017</td>
<td>448</td>
<td>60</td>
</tr>
<tr>
<td>2018</td>
<td>454</td>
<td>50</td>
</tr>
</tbody>
</table>

### Increase in World NPPs

- **Year Operating NPPs NPPs under Construction**

  - 2014 438 81
  - 2015 441 67
  - 2016 447 74
  - 2017 448 60
  - 2018 454 50
Cheap Nuclear Generation Cost which can be used to Pay for Renewable Subsidies

Electricity Prices (KRW/kWh) and Subsidies for Renewables

- Solar Price
- Wind Price
- Solar SMP
- LNG SMP
- Solar Subsidy
- Nuclear SMP
- Nuclear SMP
Energy Security and Semi-Domestic Energy Source

- **Nuclear Fuel Requiring Very Small Amount of Fuel**
  - 22 tons of nuclear fuel which would be sufficient for two truck loads
  - cf. 2.2 million ton for coals (11 loads of 200,000 ton ships)
  - Storage of 25 year fuel for 1 GW plant is possible with an area of an apartment (100 m²)

- **Beneficial for Trade Surplus**
  - 162 B USD for energy imports for past 5 years in Korea
  - Only 0.8 B USD (0.5%) for uranium import, 30% electricity generation with 0.5% expense
  - If Uranium is replaced with LNG, 19 B USD should be spent more which increase the trade deficit significantly
Need for Maintain NPP Supply System

- **No Domestic Build to Cause Rapid Collapse of Korean Nuclear Industry that has Complete NPP Construction and Supply Chains**
  - Big economic loss by discarding world top class nuclear technology
    - No more generation of ~10 Billion USD induced production
  - Loss of employment (~18,000)

- **NPP Export Effect**
  - Direct gain of foreign money
    - Construction 20 Billion USD for the UAE Project
    - Operation 50 Billion USD for 60 years
  - Indirect gain
    - 20 Billion USD by collaboration in other industrial areas such as energy, medical, and semiconductor

- **Difficulty in Export of NPP**
  - Loss of credit and trust
  - Even though a contract can be made, the cost and construction time will increase due to the collapse of many small companies
Organizations to Generate Pro-Nuke Information

- **Nuclear Energy Collective Intelligence (NECI)**
  - Online discussion group consisting of ~30 passionate people who can provide expert knowledge and generate right information regarding the safety and benefit of nuclear energy

- **Nuclear Experts Forum (NEXFO)**
  - Task force groups consisting of about 50 experts to work on specific subjects
  - Generates fact check reports on anti-nuke textbooks and materials

- **Professor Association for Rational Energy Policies (PAREP)**
  - Association of volunteered professors to resolve unreasonable problems in national energy policies
  - Offers seminars and debates and issue position statements

- **Nuclear Energy Policy Coalition (NEPC)**
  - Coalition of nuclear energy sector labor union and professors
  - Execute offline activities and seminars with National Assembly

- **Nuclear Engineering Students Union (NESU)**
  - Union of college students majoring nuclear engineering (14 colleges)
Ways to Spread Right Information

- Articles in Newspaper Opinion Sections
- Media News Interview (Newspaper, TV) – Frequent News Articles
- Issuing Position Statements, Hosting Seminars and Debates
- Operating Atomic wiki (atomic.snu.ac.kr), SNS (FaceBook)
- Signature Movements for Petition
Street Activities (Rally on April 21, 2018)
Public Opinion Favoring Nuclear Power

- Opinion on Desired Share of Nuclear Power in the Future

![Bar Chart]

- Maintain or increase (+)

SKN5,6 Deliberation (2017.09 ~ 10)
Consistent Results in two Recent Polls (Aug. & Nov.)

1) Yes or No on NPP utilization

<table>
<thead>
<tr>
<th>Poll</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUG</td>
<td>71.6</td>
<td>26.0</td>
</tr>
<tr>
<td>NOV</td>
<td>69.5</td>
<td>25.0</td>
</tr>
</tbody>
</table>

2) Future share of NPP

<table>
<thead>
<tr>
<th>Poll</th>
<th>Increase or Keep the present level</th>
<th>Reduce</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUG</td>
<td>69.3</td>
<td>28.9</td>
</tr>
<tr>
<td>NOV</td>
<td>67.9</td>
<td>28.5</td>
</tr>
</tbody>
</table>

3) NPP Safety

<table>
<thead>
<tr>
<th>Poll</th>
<th>Safe</th>
<th>Not Safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUG</td>
<td>55.5</td>
<td>40.7</td>
</tr>
<tr>
<td>NOV</td>
<td>57.6</td>
<td>36.8</td>
</tr>
</tbody>
</table>
- Results indicating that people do not support phase-out

<table>
<thead>
<tr>
<th></th>
<th>Aug</th>
<th>Keep the present level</th>
<th>Reduce to around 20%</th>
<th>Reduce to around 10%</th>
<th>Reduce to less than 10%</th>
<th>Reduce to 0%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>37.7</td>
<td>31.6</td>
<td>6.1</td>
<td>10.6</td>
<td>4.3</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td>35.4</td>
<td>32.5</td>
<td>7.6</td>
<td>8.9</td>
<td>4.2</td>
<td>6.7</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19~29</td>
<td>29.7</td>
<td>39.7</td>
<td>8.8</td>
<td>8.6</td>
<td>7.4</td>
<td>2.9</td>
</tr>
<tr>
<td>30~39</td>
<td>23.2</td>
<td>33.9</td>
<td>7.0</td>
<td>17.2</td>
<td>7.4</td>
<td>8.6</td>
</tr>
<tr>
<td>40~49</td>
<td>24.7</td>
<td>29.8</td>
<td>11.7</td>
<td>12.6</td>
<td>5.6</td>
<td>13.2</td>
</tr>
<tr>
<td>50~59</td>
<td>39.4</td>
<td>31.6</td>
<td>7.4</td>
<td>7.4</td>
<td>1.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Over 60</td>
<td>52.5</td>
<td>29.5</td>
<td>4.3</td>
<td>1.8</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Ideology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressive</td>
<td>20.0</td>
<td>30.7</td>
<td>11.5</td>
<td>16.0</td>
<td>5.9</td>
<td>11.9</td>
</tr>
<tr>
<td>Middle</td>
<td>32.7</td>
<td>39.2</td>
<td>8.6</td>
<td>9.1</td>
<td>3.7</td>
<td>4.7</td>
</tr>
<tr>
<td>Conservative</td>
<td>57.1</td>
<td>28.5</td>
<td>2.6</td>
<td>3.3</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Recognition on NPP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advantage Dominant</td>
<td>65.3</td>
<td>27.0</td>
<td>3.7</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal Tendency</td>
<td>33.9</td>
<td>41.9</td>
<td>9.3</td>
<td>6.3</td>
<td>1.4</td>
<td>2.7</td>
</tr>
<tr>
<td>Disadvantage Dominant</td>
<td>12.1</td>
<td>31.3</td>
<td>9.9</td>
<td>17.3</td>
<td>9.1</td>
<td>14.3</td>
</tr>
</tbody>
</table>
Anti Phase-Out Signature Movement

☐ **Purpose**

- Get people’s consent to change the nuclear power phase out policy also to request to resume the construction of Shin Hanul 3&4 for which the site are made and major devices were already manufactured

☐ **Goals**

- First get 200,000 consents by mid Jan (Started officially on Dec 13, 2018)
- Continue to 1 million people

☐ **Methods**

- Online signature using an SNS
- Offline signature on the streets
- Cooperation between concerned national assembly members and nuclear sector people
Trend of Signee Increase

Days after Initiation (Dec. 12 for SHW 3,4)

SHW3,4
SKN5,6
Summary

- **Korea should exit from the nuclear power phase-out policy to keep**
  - World class NPP construction industry which generates big revenues and employments
  - Affordable electricity prices
  - Reduction of green house gas generation and fine particulate matters
  - Energy security and trade surplus
  - Stable supply of electricity in the future where electrification increases

- **Generating and spreading right Information are crucial to gain public acceptance of nuclear energy**
  - Exaggeration of the possible danger of nuclear power should be rectified
  - Should criticize false claims of the anti-nuke people with fact checks and make the corrections be spread widely
  - Need to approach to the people with friendlier contents and more easily accessible tools such as YouTube or instagram

- **Cooperation with Korean and Taiwanese myth busters would be beneficial to each other.**
Thank You!

Happy Newyear

행복한 설,
에너지 백년대계를 위한 범국민서명에 참여하여 즐겨주세요.

okatom.org에
원자력으로 밝아지는 대한민국을 위한
여러분의 의사를 밝혀주세요

인터넷 주소창이나 휴대폰 메시지창에 okatom.org를 입력해 주세요

새해 복 많이 받으세요
Energy Balance (2016)

Consumption: 497 TWh (=42.7 MTOE)
Fraction: 18.9%

Imports
- Overseas Dependence: 94.7% (80.9 bil. $)
- Crude Oil: 1,078.1 mil. bbl
  - Middle East (85.9%)
    - Saudi (30.1%)
    - Iraq (12.8%)
    - Kuwait (14.8%)
  - Asia (6.7%)
  - Africa (2.8%)
- Qatar, Australia, Indonesia: 33.5 mil. ton
- Australia, Russia, Indonesia: 113.5 mil. ton
- Russia, Canada, Australia: 752.1 ton U
- China, Australia, Russia: 9.4 mil. ton
- Domestic Production: 5.3%

Primary Energy
- Oil: 40.1%
- LNG: 15.4%
- Bituminous: 25.7%
- Nuclear: 11.6%
- Anthracite: 2.1%
- Hydro, Renewable: 5.1%

Transformation
- Refining: 3.1 mil. b/d
- City Gas: 17.4 mil. ton
- Heat: 1.709.5 thou. toe
- Electricity: 5,404.4 bil. Kwh
  - Nuclear: 30.0%
  - Bituminous: 38.5%
  - LNG: 22.4%
  - Oil: 2.6%
  - Anthracite: 1.1%
  - Hydro: 1.2%
  - Renewable: 4.2%

Final Energy
- Industrial: 61.4%
  - Naphtha etc Industrial resource: 23.4%
- Residential & Commercial: 17.0%
- Transportation: 18.9%
- Public: 2.8%
- Electricity: 56.3%
  - Residential & Commercial: 39.0%
  - Public: 6.2%
  - Transportation: 0.5%
Per Capita Electricity Consumption (kW/Person)

- **Taiwan**: 1.2 kW
- **Korea**: 1.1 kW

**Consumption Fraction by Sector**
- Industry: 55%
- Commercial/Public: 32%
- Residential: 13%

**Consumption**
- 56.0 GW

**Production**
- 66.3 GW

*2017 Data*
Electricity Generation Trend

554 TWh in 2017 and 2~3% Steady Increase

~30% Electricity from Nuclear Power
~5% from New & Renewables in 2017
Electricity Market Prices (KRW/kWh)
Reduced of NPP Operation due to Phase-out
### Recognition of NPP advantage and disadvantage

<table>
<thead>
<tr>
<th></th>
<th>AUG</th>
<th>NOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity bill can be lowered because NPP generation cost is relatively low.</td>
<td>73.2%</td>
<td>77.3%</td>
</tr>
<tr>
<td>NPP does not emit green house gas and fine dust.</td>
<td>60.7%</td>
<td>61.7%</td>
</tr>
<tr>
<td>NPP has better energy security because of long term fuel storage.</td>
<td>60.3%</td>
<td>63.6%</td>
</tr>
<tr>
<td>Severe accident can happen at NPP, which gives high risk on people’s life and property</td>
<td>75.9%</td>
<td>78.3%</td>
</tr>
<tr>
<td>It is not easy to safely manage the rad-waste such as spent fuel</td>
<td>82.4%</td>
<td>82.6%</td>
</tr>
<tr>
<td>The electricity generation cost of NPP might be expensive if the cost of accident and decommissioning considered.</td>
<td>63.4%</td>
<td>61.6%</td>
</tr>
</tbody>
</table>

[unit: %, Aug.(n=1,000), Nov.(n=1,006)]

**Advantages**

**Disadvantages**