



South Korea's Prospects for Nuclear Energy at Home and Abroad

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OUTLINE

- Nuclear Energy in Korea
- First export contract: UAE
- Further export plans
- Relationship with United States

Historical Electricity Trends



ELECTRICITY PRODUCTION, CONSUMPTION AND CAPACITY

	1970	1980	1990	2000	2005	2009	2011	Average annual growth rate (%) 2000 to 2011
Capacity of electrical plants (GW)								
- Thermal	2.18	7.65	11.07	31.59	40.50	49.10	52.35	4.70
- Hydro	0.22	1.16	2.24	3.15	3.88	5.52	6.42	6.69
- Nuclear	-	0.59	7.62	13.72	17.72	17.72	18.72	2.87
- Wind	-	-	-	-	0.09	0.35	0.41	-
- Geothermal	-	-	-	-	-	-	-	-
- other renewable	-	-	-	-	0.07	0.78	1.45	-
- Total	2.51	9.39	21.02	48.45	62.26	73.47	79.34	4.59
Electricity production (TW.h)								
- Thermal	7.95	31.7	48.42	151.83	209.51	278.40	326.75	7.22
- Hydro	1.22	1.98	6.36	5.61	5.19	5.64	7.83	3.08
- Nuclear	-	3.48	52.89	108.96	146.78	147.78	154.72	3.24
- Wind	-	-	-	-	0.13	0.69	0.86	-
- Geothermal	-	-	-	-	-	-	-	-
- other renewable	-	-	-	-	3.87	1.09	6.73	-
- Total (1)	9.17	37.24	107.67	266.40	364.64	433.60	496.89	5.83
Total Electricity consumption (TW.h)	7.74	32.73	94.38	239.54	332.41	394.49	434.16	5.56

(1) Electricity transmission losses are not deducted.

Source: Korea Electric Power Corporation (<http://www.kepco.co.kr/eng>)



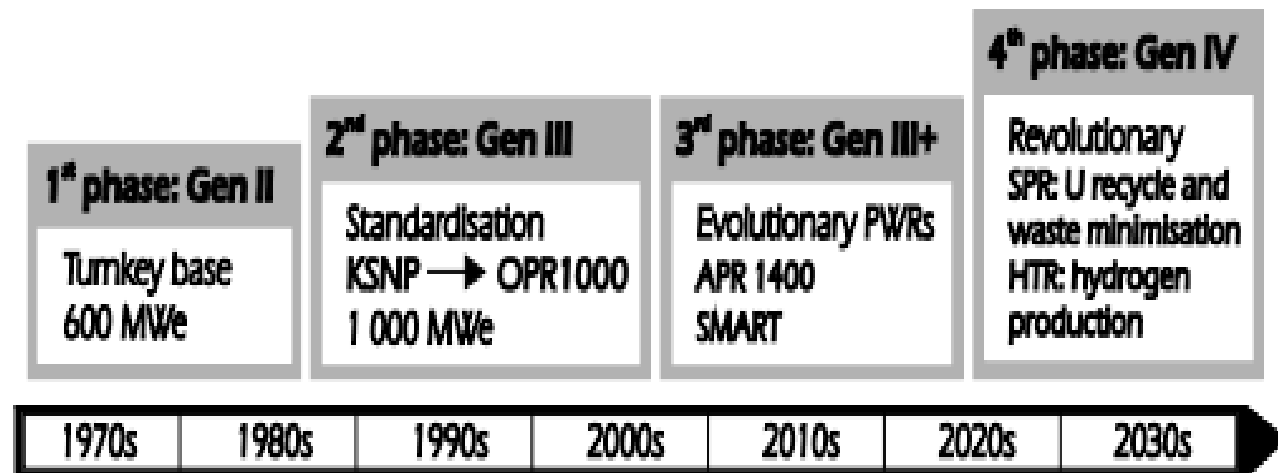
ENERGY RELATED RATIOS

	1970	1980	1990	2000	2005	2009	2010
Energy consumption per capita (GJ/capita)	25.24	48.15	90.85	170.82	198.87	208.92	224.95
Electricity consumption per capita (kW.h/capita)	240	859	2,206	5,067	6,883	8,092	8,883
Electricity production/Energy production (%)	7.68	27.36	99.11	175.47	179.21	232.29	249.44
Nuclear/Total electricity (%)	0.00	9.34	49.12	40.90	40.25	34.08	31.3
Ratio of external dependency (%) (1)	47.56	73.37	87.95	97.15	98.00	96.50	96.50

(1) Net import / Total energy consumption.

Source: Energy Info. Korea 2010 by Korea Energy Economics Institute (<http://www.kses.net/>)

Evolution of Korean nuclear power

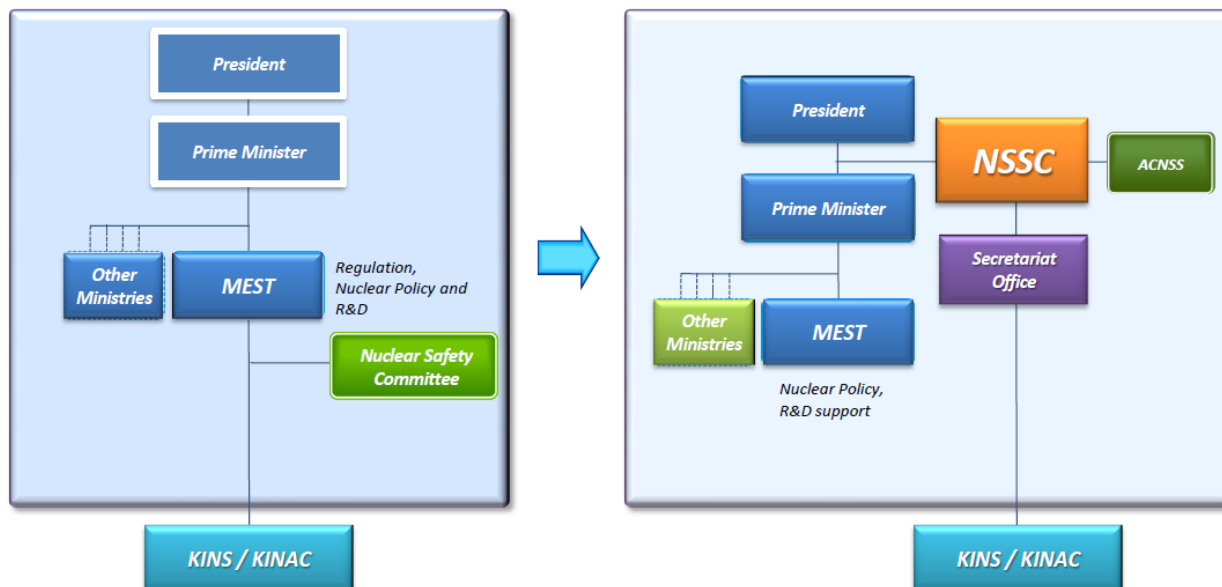


Source: Korean Case Study in: *Trends in Sustainability of the Nuclear Fuel Cycle*, OECD/NEA, Paris, 2011.

Domestic Nuclear Energy Growth

- **Currently, 23 npps operating (19 PWRs, 4 PHWRs)**
- **Plans to build additional 13 PWRs by 2024**
- **Plans unaltered after Fukushima accident**
- **Some reorganization of regulatory infrastructure (still sorting itself out)**
- **Some safety issues**

Post-Fukushima Reorganization*



*Further reorganization will await implementation under the new Park government

Advanced Nuclear Technology State

- **Member of Generation IV Forum (GIF), ITER, INPRO**
- **Sodium fast reactor program. Pyroprocessing R&D**
- **Have all elements of fuel cycle except uranium enrichment, spent fuel reprocessing and final disposal**

UAE Contract

- ~\$20B for 4 APR-1400s; anticipate 10 in total.
- Estimated first operation – 2017.
- KEPCO consortium is prime contractor; partnership include Samsung, Hyundai, Doosan Heavy Industries, Toshiba (Japan) and Westinghouse (USA)
- Financing reportedly not yet settled. Costs appear to be escalating.
- Construction permit filed in 2011.

Drive to Export

KEPCO 2010 annual report:

“As domestic demand for power has begun to plateau, KEPCO must seek out new opportunities in nuclear and conventional energy, transmission and distribution, and resources development beyond Korea’s borders.”

Government officials seek to capture 20% of estimated export market, or about 80 npps by 2030 (MKE estimates \$400 b).

Markets for Korean nuclear industry

- Southeast Asia – Vietnam, Malaysia, Indonesia
- Middle East – Turkey, Jordan
- US – especially fuel
- South Asia?

Importance of US to Korean nuclear power and for nuclear exports

- US supplies conversion, enrichment, some components and instrumentation and control for some reactors
- About 70% of spent fuel is U.S.-origin, requiring consent for reprocessing.
- APR-1400 derived from OPR-1000, derived from Combustion-Engineering design.
- US exports to the UAE project reportedly > \$1.5B. Includes design, technical support services, consulting on licensing, control equipment, major components.

Importance of Korea to U.S. nuclear industry

- **ROK industry in the supply chain for AP-1000s being built in US**
 - Changwon reactor vessels, steam generators
 - Sacheon steam condensers
 - Ansan-City demineralizers and heat exchangers
 - Cheonan valves
- **KNF chosen to develop fuel for Nu-Scale SMRs**

Issues for ROK-US export relationship (I)

- **US-ROK 123 agreement up for renegotiation**
 - March 2014 expiration date of original agreement
 - Does not conform to 1978 NNPA requirements
 - Needs to be presented to Congress in mid-2013
- **Key issue is consent to enrich/reprocess**
- **US policy is not to provide advance (long-term) consent to countries that do not already have enrichment and reprocessing capabilities**
- **Korea has neither**

However,

- **Korea appears to be looking to acquire both.**
- **During negotiations, US agreed to jointly sponsor a 10-year study of the viability of pyroprocessing from economic, technical and nonproliferation perspectives**
- **US itself will never provide enrichment or reprocessing technology to any non-nuclear weapon state**

Role of Nuclear Suppliers Group

- **If Korea seeks enrichment capability, how will NSG respond?**
 - ROK appears to meet new, more specific criteria in paras 6 and 7 of NSG Guidelines
 - But, still significant political issues on the Korean peninsula (including 1992 Joint Declaration)
- **US may still be the key for other suppliers' agreement (a la India)**

Fuel Cycle Capabilities and Exports

- Korea cites “export competitiveness” as rationale for acquiring enrichment and/or pyroprocessing
- Competing with vertically integrated entities like AREVA, Rosatom
- However, it was able to secure the UAE deal without a domestic enrichment capability
- KNF has primary fuel contract, but AREVA, Urenco, Rosatom supplying enriched uranium product to KNF for fuel fabrication.

Key questions for Korean nuclear exports

- Was the UAE price a loss-leader?
- Can Korean skill in project management be duplicated overseas?
- If global demand for nuclear power is significantly less than it was before Fukushima, are there enough contracts to compete for among suppliers?
- Can Korea recover after recent safety scandals?
- Will new regulatory system guarantee independence?

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