Nuclear Power and Renewable Energy in Asia: Future Prospects for International Cooperation

Asia Energy Forum 2005, Tokyo, Japan

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Status of Nuclear Power Development in Japan and Asia(1)

- Japan's nuclear power programs are now entering "new era."
  - Lower growth expected (8~17 units by 2030), while maintaining its share in total electricity at 30~40%
  - Start up of large reprocessing facility and plutonium recycling
- Institutional and policy reforms are now underway to reduce financial and political risks
  - New JAEC's Long Term Policy has been published (Oct. 2005)
  - New law enacted to cover 40-year reprocessing costs (May 2005)

Status of Nuclear Power Development in Japan and Asia(2)

- In Asia, especially China(12 to 14 units by 2020) and India(20 units in 20 years), high nuclear power growth is expected although its share is still limited (less than 5%).
- South Korea is expecting steady growth(16 units by 2015) , and facing uncertainties in back-end of fuel cycle.
- Vietnam and Indonesia are planning to introduce nuclear power in 2020 or beyond.

Prospects for nuclear power growth in APEC countries

Table 3 Nuclear reactors planned in APEC economies up to 2020, as of April 2004

Economy	Planned reactors	Comments
China	6 units by 2010	China Atomic Energy Authority plans the construction of 6 units by 2005. China National Nuclear Corporation expects the construction of 6 to 8 units by 2010.[6]
Japan	12 units by 2020	12 units planned by the major electric power companies of Japan.
Korea	8 units by 2015	8 additional units by 2015 according to the 1st Basic Plan of Long Term Electricity Supply and Demand (2002-2015).[7]
Russia	4 units by 2010	4 new units by 2010, and 25 additional reactors between 2010 and 2020 according to the Russian Energy Strategy[8]
United States	2 units by 2010	At least one by 2010 according to the USDOE's Nuclear Power 2010 Initiative; but awards to two utilities, Dominion and Exelon, have been announced to conduct Early Site Permit Scoping Studies.[9]
Vietnam	2-4 units by 2020	2 to 4 units by 2020 are being analysed in pre-feasibility studies of nuclear power in Vietnam.[10]
Total	32 reactors	By 2020

Source: APERC, "Nuclear Power Generation in the APEC region," 2004.

Status of Renewable Energy Development in Japan and Asia(1)

- Japan's renewable energies, especially PV and Wind Power, are experiencing rapid-growth
  - Government subsidies and policies have been helpful
- But their share is relatively low and need additional measures for further developments
  - Renewable Portfolio Standards (RPS) and direct subsidies to PV owners are now under review
  - Integration with electric grid
  - Emerging Siting issues for Wind Farm
  - Cost reduction (through advanced R&D)

Status of Renewable Energy Development in Japan and Asia(2)

- Some countries, like China and Japan, have relatively high-growth, but not others
- Despite apparent large potential of renewable energy in the region, many areas are still under-developed.
  - Lack of resource data
  - Lack of financial sources and policies
- Need international assistance to increase renewable energy production in the region
  - Resource data
  - Financial incentives and policy measures
  - Technology transfer

Major Policy Issues(1)- Ideological conflicts

- Nuclear and renewable energy are both essential options for improving energy security and reducing greenhouse gases
- However, ideological conflicts between “nuclear” vs “renewable” debate remain strong
- Both energy sources are needed and should be recognized as essential options for future energy needs
  - Need to understand characteristics of both energy sources

Major Policy Issues (2)

	Nuclear	Renewable
Technology	Large, Complex Centralized Stable base load	Distributed, small scale, simple Unstable
Economics	Large capital cost, competitive but uncertainty remains (backend)	Smaller capital cost Many are not competitive yet
Politics	Proliferation risk Public acceptance (NIMBY) issue	Well accepted but emerging siting (NIMBY) issue

Major Policy Issues (3)
Economics and Financial Risk

- Nuclear power
  - Can be competitive in 40-year life time
  - But investment risks are still high
  - Need policy framework to secure continuous investment
    - US Energy Policy Act of 2005 provide measures to reduce financial risks (~1.8cent/kWh over 8 years, up to $125 million, licensing delay assurance, loan guarantee)
  - Need innovative technology (ex. small, modular)
  - Need solid back-end programs in dealing with waste and spent fuel

Newly Established Reprocessing Fund in Japan

- Rokkasho reprocessing plant will start operation from 2007.
- Its life time costs, including operation, decommissioning, disposal of TRU waste, are estimated to be at ~¥12.7 trillion (~$110 billion over 40 years).
- New Law to establish a “Reprocessing Fund” to recover the cost has been passed (May 2005)
  - Surcharge on electricity cost would be at ~¥0.4/kWh
  - All electricity customers will be charged
- This Fund is expected to reduce financial uncertainties in back-end of fuel cycle in Japan.

Major Policy Issues (4)
Economics and Financial Risk (continued)

- Renewable Energy
  - Except wind power in some regions, renewable energies are not yet competitive
  - But rapid growth can be realized through financial and policy scheme
    - Renewable Portfolio Standards (RPS): US, Japan
    - Feed-in-Tariff: Germany
    - Direct subsidies to homeowners of PV: Japan
    - Tax-incentives: US

Cost trends of renewable energy sources

Table 1 NRE Technology Investment and Generation Cost Trend

	$/kW		Cents/kWh (low)		Cents/kWh (high)	
NRE Technology	2002	2010	2002	2010	2002	2010
Wind	850-1700	700-1300	3-5	2-4	10-12	6-9
PV	4500-7000	3000-4500	18-20	10-15	25-80	18-40
Small hydro	1000-5000	950-4500	2-3	2	9-15	8-13
Geothermal	1200-5000	1000-3500	2-5	2-3	6-12	5-10
Biomass	500-4000	400-3000	2-3	2	10-15	8-12

Source : IEA (2003) citing NET Ltd. Switzerland

Source: APERC, "New and Renewable Energy in the APEC region; Prospects for Electricity Generation," 2004.

Major Policy Issues (4)
Geopolitical Risks of Nuclear Power

- Differences in Development Stages
  - Japan is the only one country with complete fuel cycle facilities.
  - ASEAN countries has no commercial nuclear programs.
- Some countries in the region have either nuclear weapons or had intentions to possess nuclear weapons.
- Historical and Potential Conflicts among Nations

Prospects for International Cooperation-nuclear energy (1)

- In the last few years, there have been number of proposals calling for a regional nuclear cooperation scheme for the Asia-Pacific region.
  - Referring to the EURATOM as a possible model.
- But due to unique conditions in East Asia and lack of coherent needs, no scheme has not been realized
- Recent trends suggest security and geo-political concern are becoming stronger in nuclear cooperation

Prospects for International Cooperation-nuclear energy (2)

- Most proposals address generic needs and schemes, and only a few proposal discusses specific international scheme or arrangement.
- All proposals address nuclear safety and spent fuel management as important issues to be addressed regionally.
- Differences in emphasis among various proposals exist.
- Step by step approach is preferred by most proposals, including flexibility in membership.
- Regional nuclear fuel cycle concept can be potential area of cooperation or a source of conflict depending on the emphasis of proposal.

Possible Regional Cooperation on HLW and Spent Fuel Management
proposed by PNC (December 2003)*

- Potential Advantage
  - Economy of Scale
  - Saving efforts (for planning to completion)
  - More options (in particular for smaller nations)
  - Enhance transparency
  - Non-proliferation and security advantage
    - Avoid unnecessary reprocessing
  - Sharing technical knowledge and concern

*Pacific Nuclear Council Steering Group on HLW/SNF, "The International Cooperation on High Level Nuclear Waste (HLW) and Spent Nuclear Fuel (SNF) Management," Interim Report, December 2004

Possible Regional Cooperation on HLW and Spent Fuel Management
proposed by PNC (December 2003)*

- Potential Disadvantage
  - Need for complex negotiation
    - "NIMBY" politics for international scale?
  - Possible negative impacts on domestic programs
  - Increase transportation requirements
  - Raising ethical and fairness issues

Possible Regional Cooperation on HLW and Spent Fuel Management
proposed by PNC (December 2003)*

- Policy Issues
  - What service to be offered?
    - joint R&D? storage? reprocessing? disposal?
  - Who bears responsibility?
    - Ownership and liability of HLW/SNF?
  - How would the host state be chosen?
    - What are the necessary conditions for host country?
  - What institutional arrangements?
    - Private? National government? Consortium of private companies? Multinational institutions?
  - Who are the customers?
  - Where does the revenue go?

Prospects for International Cooperation-nuclear energy (3)- new trends

- Generation IV International Forum (GIF)
  - Established in Jan. 2000, under the leadership of US, and has 11 members
    - *Argentina, Brazil, Canada*, Euratom, France, Japan, South Africa, *South Korea, Switzerland*, United Kingdom, and United States
  - To investigate innovative nuclear energy systems meeting new energy policy criteria
    - Sustainability, Economics, Safety, Proliferation-resistant
    - 6 types are selected out of 100 concepts, aiming at commercialization by 2030
- International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)
  - Initiated by IAEA in September 2000 and has now 16 members
    - *Argentina*, *Brazil*, Bulgaria, *Canada*, China, Germany, India, Indonesia, *the Republic of Korea*, Pakistan, the Russian Federation, Spain, *Switzerland*, The Netherlands, Turkey and the European Commission**.**

Note: ***Italic countries are members of both GIF and INPRO***

Prospects for International Cooperation-nuclear energy (3)- new trends

- Recent proposals call for more stringent regulations toward nuclear fuel cycle activities, esp. “sensitive” parts (enrichment and reprocessing) of nuclear fuel cycle activities (2004~2005)
  - From “moratorium” to “multilateral approaches”
- Most recent proposal from the US calls for establishment of “International Fuel Assurance (stock)” scheme (September 2005)
  - US provides 17 tons of Highly Enriched Uranium for International Stock supervised by IAEA
  - Stock can be released to countries in case of uranium fuel shortage who give up national reprocessing/enrichment programs
- METI recently announced that Japan is willing to contibute to multilateral approaches (October 2005)

Prospects for International Cooperation –Renewable Energy

Asia-Pacific Partnership for Clean Development and Climate (1)

- Announced July 28, 2005, at an Association of AESAN Regional Forum Meeting.
- Members include: US, Australia, China, India, Japan and South Korea, which account for ~50% of GHG emission in the world.
- Objectives
  - develop, deploy and transfer existing and emerging clean technology;
  - meet increased energy needs and explore ways to reduce the greenhouse gas intensity of economies;
  - build human and institutional capacity to strengthen cooperative efforts; and
  - seek ways to engage the private sector

Prospects for International Cooperation – Asia-Pacific Partnership for Clean Development and Climate (2)

- Clean energy technologies
  - Renewable Energy (Wind, Solar, Biomass, etc.)
  - Nuclear Energy (next generation of reactors)
  - Carbon Capture and Storage
  - Hydrogen Energy
  - Biotechnology and Nanotechnology
- It is important to cover wide range of technology options, including nuclear energy

Prospects for International Cooperation – Asia-Pacific Partnership for Clean Development and Climate (3)

- Possible Hurdles
  - Policies toward Kyoto Protocol are different
  - Inclusion of nuclear technologies
    - India is not a member of Nuclear Non-Proliferation Treaty (NPT)
    - Recent India-US agreement on nuclear technology could be controversial
  - Not so useful for short term deployment of emerging technologies

Conclusions (1)

- Both nuclear power and renewable energy should be considered as viable and important energy options for the future
- Nuclear power is geopolitically sensitive and thus its cooperation need careful arrangements, especially involving nuclear fuel cycle
- Developing countries could learn much from experiences of programs and measures in advanced countries to promote nuclear and renewable energy sources
- Long term needs (such as development of advanced technologies) and short term needs to address current problems require different approaches

Conclusions (2)

- Already many bi-lateral and multilateral cooperative agreements are either proposed or underway
  - Experiences should be shared
  - Careful analysis is needed to learn from past experience as well as for future proposal to be implemented
- Potential conflicts could arise from differences in energy policies and nuclear policies
- Dialogue to establish regional cooperation would be useful to reduce such concern through better transparency and information sharing.

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