[International Symposium on Nuclear Non-Proliferation and Peaceful Use of Nuclear Energy]

Role of Nuclear Energy in the 21st century

Yohji UCHIYAMA University of Tsukuba Oct. 4, 2007

Risk Factor of Energy Supply

Basic Requirements for Energy Supply	Risk Factor
Energy Security	Volatility of Fuel Prices Stoppage of Fuel Supply (Middle East, Sea Lane, etc.) Uneven Distribution of Energy Sources Depletion of Fuel Sources [long term]
Development of Energy Supply infrastructures	Economical Risk (huge investment) R&D Risk Lack of Universal Service Lack of Ancillary Service Blackouts
Public Acceptance (Safety and Environment Protection)	 Accident and Incident (coal-mine explosion, stranding of oil tanker, explosion of gas, Breach of Dum, Nuclear accident, etc.) Environmental Pollution (Air, Water, ground) Radioactive Wastes Global Warming Damage Caused by Rumors Terrorism, Nuclear Proliferation

The Status of Nuclear Power in Japan's Energy Policies

Goal of the Energy Policy

(Basic Law on Energy Policy (June 14, 2002)]

- Ensuring stable energy supplies (energy security, etc.)
- Environmental soundness (prevention of global warming, etc.)
- Making use of market mechanism (deregulation etc.) while giving due consideration to the two goals mentioned above

Basic Energy Plan in Japan

(Approved by the Cabinet in October 2003)

- Nuclear electric power generation should be given quasi-national status as an energy source
- ★ As it does not expel CO₂ in the process of electrical generation, it contributes to deterring global warming
- With securing safety as the top priority, nuclear electric power generation shall continue to be regarded as a primary energy source and promoted accordingly.

Status of Worldwide Nuclear Development

Country	Status	Country	Status
USA	Over 30 Plants (estimation)	Japan	3 Plants (under construction)
Canada	Improvement Work of 4 plants	China	40GW up to 2020 (plan) (8GW in 2006)
France	EPR Plan (Oct.2004)	India	8 Plants (under construction) 20GW up to 2020 (plan)
Britain	Need of Plant Construction (2006 Energy Policy)	Indonesia	First Plant in 2015-16 (plan) 4 plants up to 2025 (plan)
Finland	Under Construction of EPR	Vietnam	2-4GW up to 2017-20 (plan)
Sweden	Review of Nuclear Power Escape	Thailand	4GW up to 2011-21 (plan)
Russia	Annual Construction Plan Over 2GW from 2013	S. Africa	36 Plants up to 2030 (plan)

Trend of Per Capita GDP vs. Per Capita Energy Consumption



Distribution of Worldwide Per Capita Energy Consumption



(U/ L / C) ... POULAL ...

Fossil Fuel Resources and Production Cost

Resources (GDOE)							
Subdivision of Resources	1(A)	2(B)	3(C)	4(D)	5(E)	6	total
Oil	111	45	62	102	33	246	602
Natural gas	95	83	113	41	102	190	624
Coal	330	220	411	154	2926		4620

Decources (Chao)

Production cost (\$/boe)

Subdivision of Resources	1(A)	2(B)	3(C)	4(D)	5(E)	6
Oil	3-12	12-19	19–25	25-35	35-38	38–52
Natural gas	3-10	10-16	16-25	25–29	29-34	34-42
Coal	3-9	9-11	11-16	16-24	24-36	

Sources: Hans-Holger Rogner "IIASA An Assessment of World Hydrocarbon"

Production Curve of Oil Resources



Supply Curve of Fossil Fuel Resource ~Scenario A~



Fossil Fuel Supply : 90% of Total Energy Demand

Supply Curve of Fossil Fuel Resource ~Scenario B~



Gross Energy Output of Different Power Generation Systems [1,000MW, life:30 year]



Life Cycle CO₂ Emission of Power Generating System



Electricity Generating Costs



Discount rate:2%, capacity factor:80%,45%(hydro)

Source: Federation of Electric power companies(2004)

Source: Advisory council for resources and energy(2001)

Trend of Casualties Caused by Natural Disaster and Man-made Disaster



出典:EU" Externalities of Energy: Methodology 2005"

Curve of Casualties Caused by Different Power Generating Systems (OECD)



Curve of Casualties Caused by Different Power Generating Systems (non-OECD)



Perspectives of Nuclear Energy

- Recent trend of nuclear plant construction, especially in Asia
- Economical competitiveness of nuclear power plant against fossil fuels fired plants
- Ensuring nuclear safety, radioactive waste management and public understanding of nuclear power needs
- Development of new nuclear technologies such as desalination and heat supply as well as power generation
- Prospect of worldwide nuclear development from 2030 onward (depletion of fossil fuel, global warming)