World Nuclear Power Generation Markets and Prospects for Nuclear Industry Realignment

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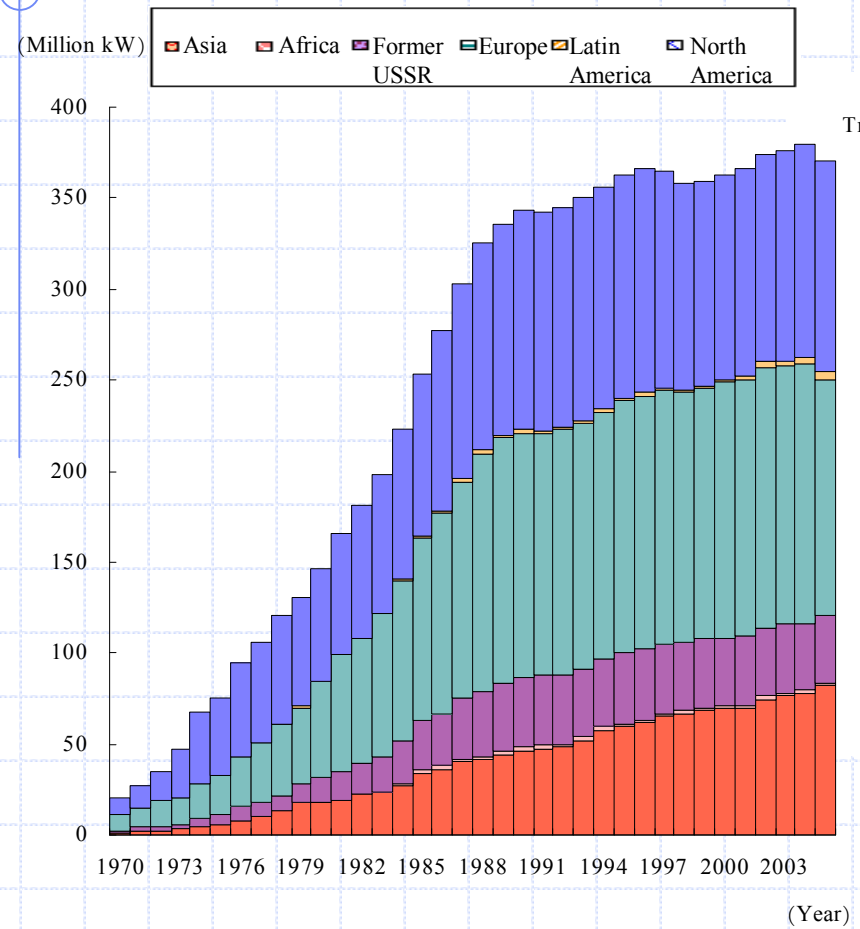
Contents

1. World Nuclear Power Generation Development and Policy Trends

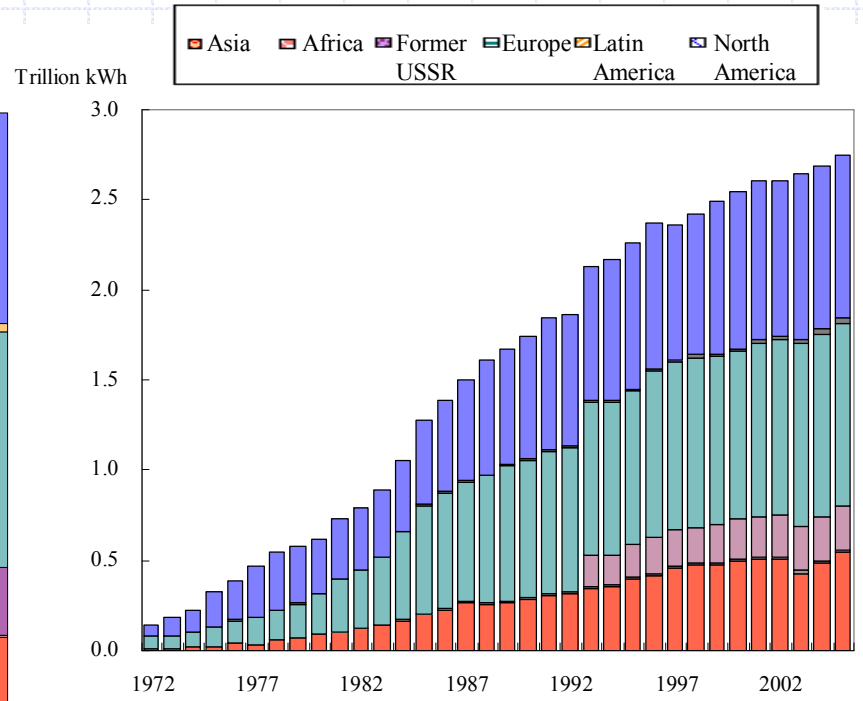
Present State of World Nuclear Power Generation Development －Summary－

- At the end of 2005 in the world,
  - A total of 443 nuclear reactors for a total capacity of 367.8 million kW were in operation in 31 countries.
  - Of the total, 84%, for 308.4 million kW, existed in OECD nations.
  - Nuclear energy accounted for some 6% of primary energy demand, covering about 15% of total electricity supply.
  - Nuclear power generation was at 2,742 billion kWh.
- Power generators (power utilities)
  - 86 companies in the world (including 26 in the U.S.)
  - France's EDF was the largest nuclear power generator with capacity at 65.8 million kW
- Nuclear plant makers
  - A large number of nuclear plant makers have been consolidated.

Changes in World Nuclear Power Generation Capacity and Generation



Changes in World Nuclear Power Generation Capacity

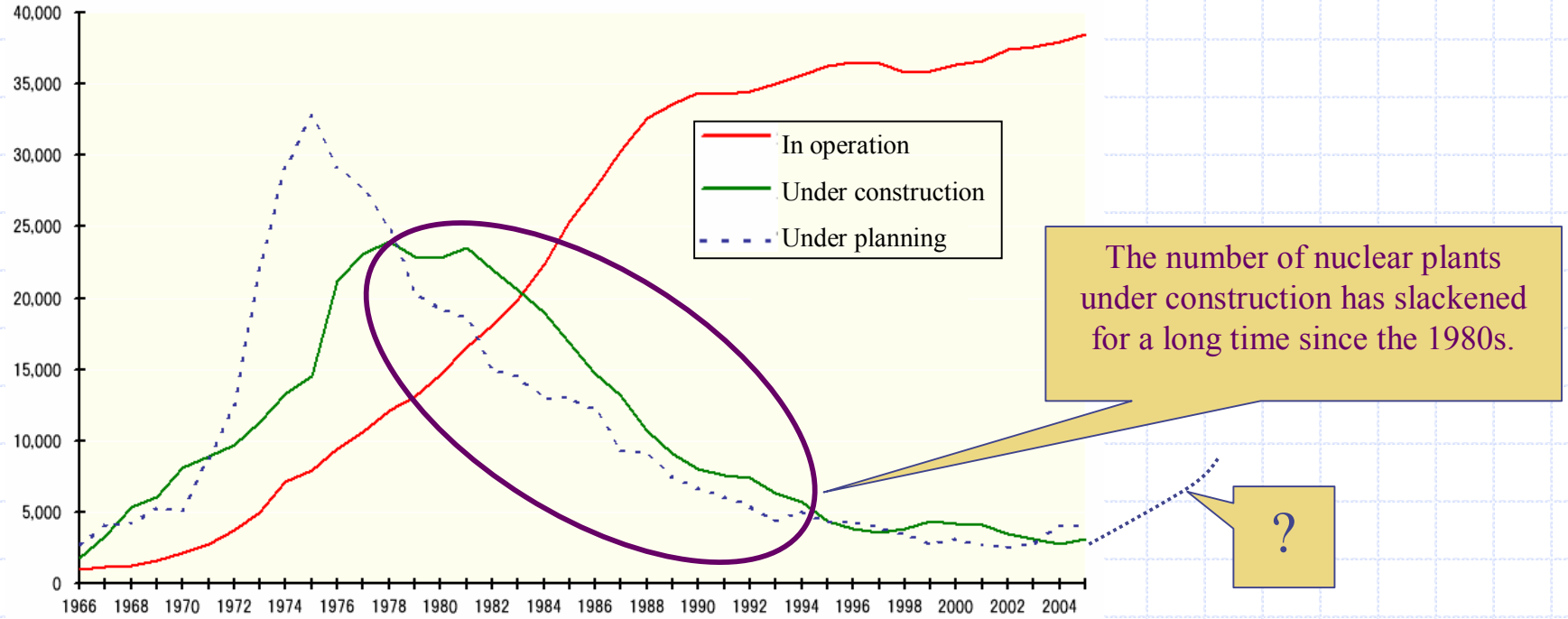


Changes in World Nuclear Power Generation

Sources: "World Nuclear Power Generation Development Trends 2006," Japan Atomic Industrial Forum, Inc.; "World Energy Outlook 2006," IEA

Changes in Capacity of Nuclear Reactors under Construction

- Nuclear power plant construction has slackened since the 1980s.
- In recent years, however, the United States and some other countries have seen government moves to promote nuclear energy.
- Nuclear power generation plans have made steady progress in China and India.
- Demand will begin to emerge for replacement of outdated nuclear plants in Europe and the United States in 2020.



(Notes)
1. Reactors with capacity at 10,000 kW or more are covered for 1973 and earlier years.
2. Reactors with capacity at 30,000 kW or more are covered for 1974 and later years
3. Figures for 1996 are equal to those in February 1967.
The source is specified below.

Figure 2 Changes in World Nuclear Power Generation Capacity

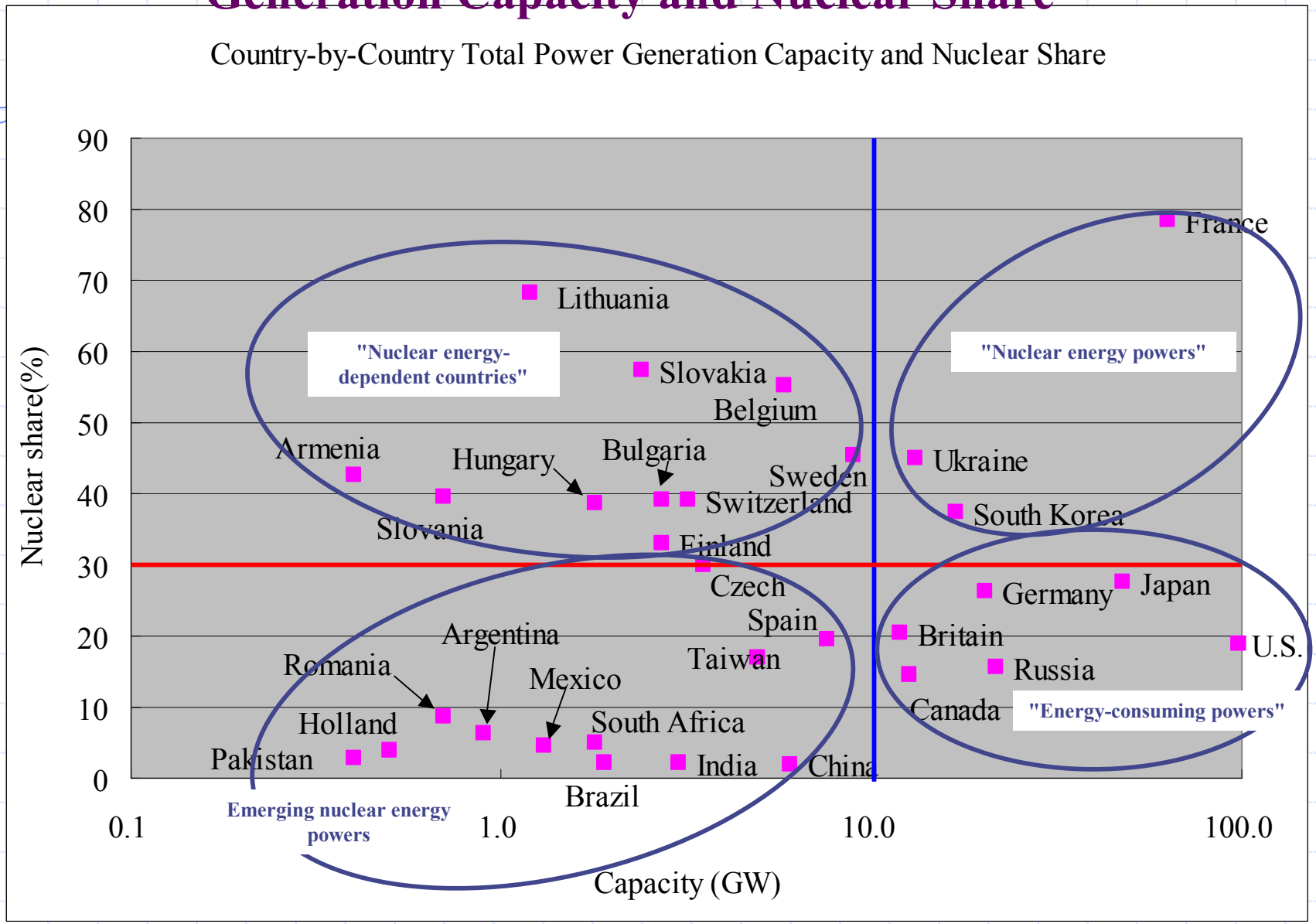
Source: "World Nuclear Power Generation Development Trends 2005 (May 2006)," Japan Atomic Industrial Forum, Inc. p.64, p.88-129

Source: Nuclear Encyclopedia ATOMICA（01-07-05-01）

Country	Number of reactors in operation	Capacity of reactors in operation (gW)	Number of reactors under construction or planning	Capacity of reactors under construction or planning (gW)	Power generation (TWh)	Nuclear power share (%)	Number of nuclear power generation firms
Belgium	7	5.8	0	0.0	48	55.2	1
Canada	18	12.6	0	0.0	92	14.6	4
The Czech Republic	6	3.5	0	0.0	25	29.9	1
Finland	4	2.7	1	1.7	23	33.0	2
France	59	63.1	1	1.6	452	78.5	1
Germany	17	20.3	0	0.0	163	26.3	4
Hungary	4	1.8	0	0.0	14	38.7	1
Japan	56	47.8	13	17.2	293	27.7	10
South Korea	20	16.8	8	9.6	147	37.4	1
Mexico	2	1.3	0	0.0	11	4.6	1
Holland	1	0.5	0	0.0	4	4.0	1
Slovakia	6	2.4	0	0.0	18	57.5	2
Spain	9	7.6	0	0.0	58	19.5	5
Sweden	10	8.9	0	0.0	72	45.4	3
Switzerland	5	3.2	0	0.0	23	39.1	4
Britain	23	11.9	0	0.0	82	20.4	2
U.S.	104	98.3	0	0.0	809	18.9	26
OECD total	**351**	**308.4**	**23**	**30.1**	**2,333**	**22.4**	**68**
Armenia	1	0.4	0	0.0	3	42.7	1
Bulgaria	4	2.7	2	2.0	17	39.2	1
Lithuania	1	1.2	0	0.0	10	68.2	1
Romania	1	0.7	4	2.8	5	8.6	1
Russia	31	21.7	5	4.1	149	15.7	1
Slovenia	1	0.7	0	0.0	6	39.6	1
Ukraine	15	13.1	3	3.0	84	45.1	1
Transition Economies total	**54**	**40.5**	**14**	**11.9**	**274**	**17.0**	**7**
Argentina	2	0.9	1	0.7	6	6.3	1
Brazil	2	1.9	1	1.3	10	2.2	1
China	9	6.0	10	9.3	50	2.0	5
India	15	3.0	8	3.9	16	2.2	1
Pakistan	2	0.4	1	0.3	2	2.8	1
South Africa	2	1.8	1	0.1	12	5.0	1
Taiwan	6	4.9	2	2.7	38	16.9	1
Developing countries total	38	18.9	24	18.4	135	2.1	11
Grant total	**443**	**367.8**	**61**	**60.4**	**2,742**	**14.9**	**86**

Sources: "World Nuclear Power Generation Development Trends 2006," Japan Atomic Industrial Forum, Inc.; "World Energy Outlook 2006," IEA

National Characteristics as Seen from Total Power Generation Capacity and Nuclear Share



Source: World Energy Outlook 2006.

National Nuclear Policy (1)
U.S. Policy Developments①

- In May 2001, President Bush announced the National Energy Policy (NEP) that supports expanded use of nuclear energy and called for promoting development of nuclear fuel cycle and next-generation nuclear energy technologies.
- In May 2005, the Department of Energy announced the "Report to Congress on Advanced Fuel Cycle Initiative:Objectives, Approach and Technology Summary" .
- In August 2005, The U.S. Energy Policy Act of 2005 was enacted.
- In February 2006, the DOE announced the Global Nuclear Energy Partnership, or GNEP.
- In August 2006, the U.S.-India nuclear agreement was established to increase the possibility of European-American light water reactors being provided to India.

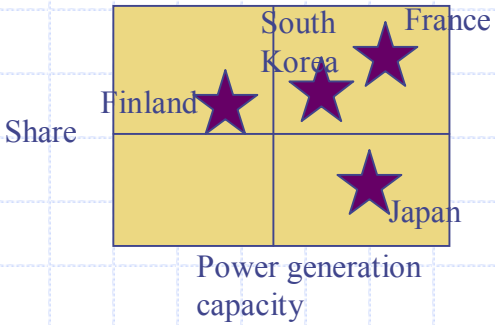
National Nuclear Policy (2) U.S. Policy Developments ②
2005 Omnibus Energy Act

- The Price-Anderson Act for nuclear liability is extended for 20 years. Upon the extension, the "hold-harmless provision*" that had substantially increased the potential liability of businesses is repealed.
- The government guarantees up to 80% of loans for projects adopting new energy technologies to curb greenhouse gas emissions (including advanced nuclear power plants, renewable energy-powered generators and integrated gasification combined cycle power generation systems).
- The act provides a production tax credit of 1.8 cents per kilowatt-hour, or up to $125 million per year, for up to 6,000 megawatts of generating capacity from new nuclear power plants for the first eight years of operation.
- A standby risk insurance is provided for up to $500 million per reactor in protection to cover the cost of licensing process delays. The first six new reactors are subject to the insurance. Up to $500 million (100% of the cost of delays) in protection is provided for the first two new units, and up to $250 million (50%) is provided for the remaining four units.

*Hold-harmless provision: The government pays damages for nuclear facility accidents in principle (as provided by the Price-Anderson nuclear liability act). But there was a provision that if accidents were caused by significant negligence or deliberate acts of DOE constructors, or those commissioned by the Department of Energy to operate and manage nuclear facilities, the Department of Justice might request the DOE constructors to pay back unjustifiable profit. This disadvantageous provision for DOE constructors had been called the "hold-harmless provision." DOE constructors had long lobbied to repeal the provision.

National Nuclear Policy (3)
Other Countries Promoting Construction of New Nuclear Plants Positively

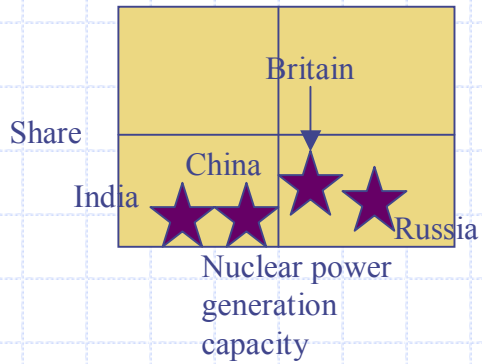
- Finland: A new nuclear power plant is under construction for operation starting in 2010 (some delay is expected).
- France: Construction of the 60th plant is scheduled to start as early as 2007.
- Japan: The new national energy strategy specifies a goal to boost nuclear energy's share to a 30-40% or higher range in and after 2030.
- South Korea: A goal has been specified for expanding nuclear power generation capacity to 27 million kW by 2017.



National Nuclear Policy (4)
Countries Positive on Construction of New Nuclear Plants

- Russia: In June 2006, the Federal Target Program, "Development of the Nuclear Power Complex of Russia in 2007-2015" was created, calling for raising the nuclear share from the present 17% to 25% by 2030.
- China: A goal is set to boost nuclear power generation capacity to 40 million kW by 2020*.
- India: In May 2003, a goal was officially announced to increase nuclear power generation capacity to 40 million kW by 2030.
- Britain: In July 2006, the Energy Review described nuclear power generation as important.

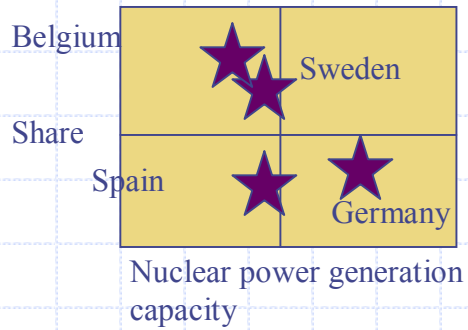
*"2005-2020 Nuclear Power Development Plan," CNNC (China National Nuclear Corporation), 2005



National Nuclear Policy (5)
Countries with Legal Bans or Restrictions on Nuclear Power Development

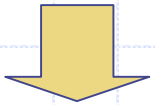
- Italy: Nuclear power generation and nuclear fuel cycle development have been suspended since a halt to nuclear power generation in 1990.
- Denmark: Nuclear power generation development has been suspended since 1999.
- Norway: A government whitepaper in the early 1980s pledged not to implement nuclear power development for the immediate future.
- Austria: No nuclear power development has been made since a nuclear power prohibition law was created in 1978.
- Poland: Nuclear power generation development has been suspended since 1990.
- Australia: A 1999 environmental conservation law has restricted nuclear power generation development projects other than those for nuclear waste disposal technologies.

- Spain: In 1994, a decision was made to freeze new nuclear plant construction plans. No new plans have been made since then.
- Belgium: An anti-nuclear law was created in 2003 to phase out nuclear power.
- Germany: An anti-nuclear law was created in 2002 to phase out nuclear power.
- Sweden: A policy has been implemented since 1998 to phase out nuclear power.



World Nuclear Nonproliferation Policy Developments (1)

- As people in the world have grown conscious of fossil fuel limits and global environmental problems over recent years, the world is likely to expand nuclear power generation.
- As Iranian and North Korean nuclear problems have grown serious, limits of the present NPT (Treaty on the Non-Proliferation of Nuclear Weapons)regime have been cited. A new framework is required to refrain from leading to nuclear proliferation concerns and from impeding peaceful use of nuclear energy unnecessarily.



- The United States and others have submitted various nuclear nonproliferation proposals to achieve both nuclear nonproliferation and expanded peaceful use of nuclear energy.

World Nuclear Nonproliferation Policy Developments (2)

- In September 2003, IAEA Director-General Mohammad ElBaradei proposed his Multilateral Nuclear Approach, or MNA, calling for multilateral management of uranium enrichment and reprocessing, international reprocessing of spent nuclear fuels and international disposal of radioactive wastes.
- In February 2004, U.S. President George W. Bush proposed prevention of proliferation of uranium enrichment and reprocessing technologies in his address on nonproliferation of weapons of mass destruction (Bush Proposal).
- In February 2005, the IAEA announced a recommendation including five approaches for realizing the ElBaradei proposal. The recommendation stated that nuclear fuel cycle facilities in nuclear or non-nuclear countries in NPT or non-NPT nations should be put under international management for development of a multilateral nuclear management regime.

World Nuclear Nonproliferation Policy Developments (3)

- In January 2006, Russian President Vladimir Putin announced an international nuclear fuel center concept. This aims to avoid proliferation of nuclear weapons and establish a nuclear fuel cycle, allowing all peaceful users of nuclear energy to receive uranium enrichment and reprocessing services indispensable for the nuclear fuel cycle.

- In February 2006, the U.S. Department of Energy released the Global Nuclear Energy Partnership, or GNEP, initiative.
  - "Nuclear fuel cycle (partnership) countries" would guarantee fuel supply to "nuclear power generating countries" while "nuclear power generating countries" would give up nuclear fuel cycle technologies.
  - Development should be promoted of advanced nuclear fuel reprocessing technologies resistant to proliferation and of fast reactors using plutonium.

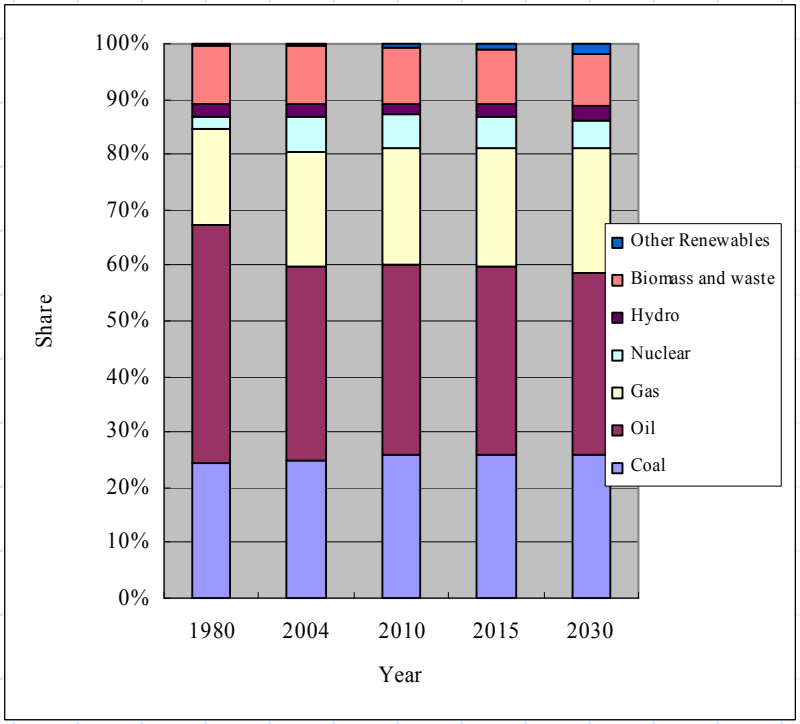
- In December 2006, the United Nations Security Council unanimously adopted a resolution for sanctions regarding the Iranian nuclear problem.

2. Future Prospects for Nuclear Power Generation Development

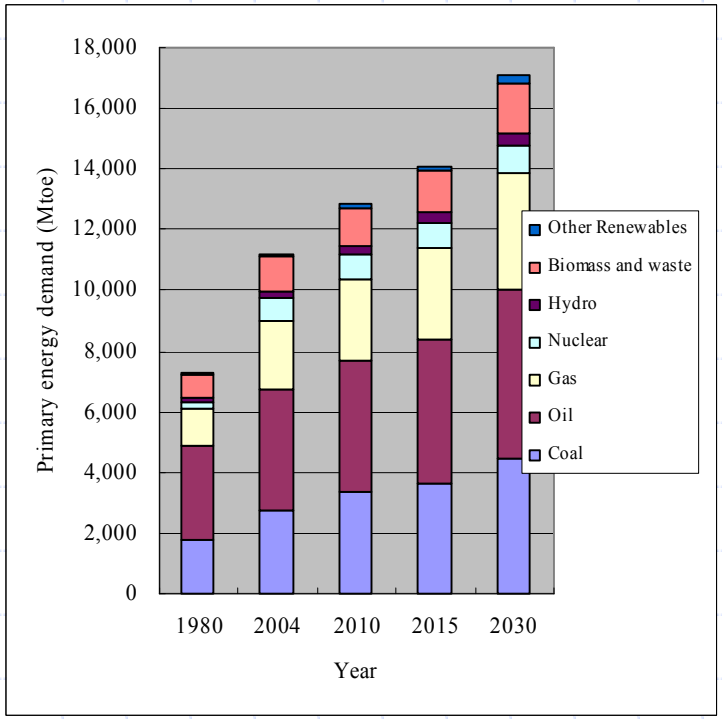
Prospects under World Energy Outlook 2006: (1) Reference Scenario

- The reference scenario, which gives no considerations to any new measures against global warming, indicates that nuclear energy's share of primary energy demand may decline from 6% in 2004 to some 5% in 2030.
- Although Asian and other developing countries are expected to expand nuclear power generation, Europe and the United States are presumed to close outdated nuclear plants.

World Primary Energy Demand Outlook
(reference scenario)



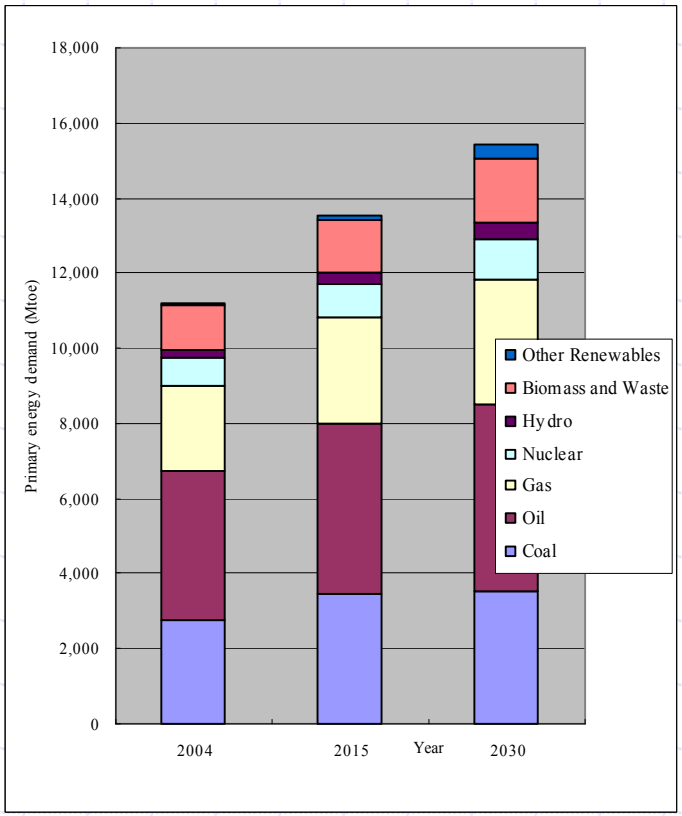
World Primary Energy Demand Outlook
(reference scenario)



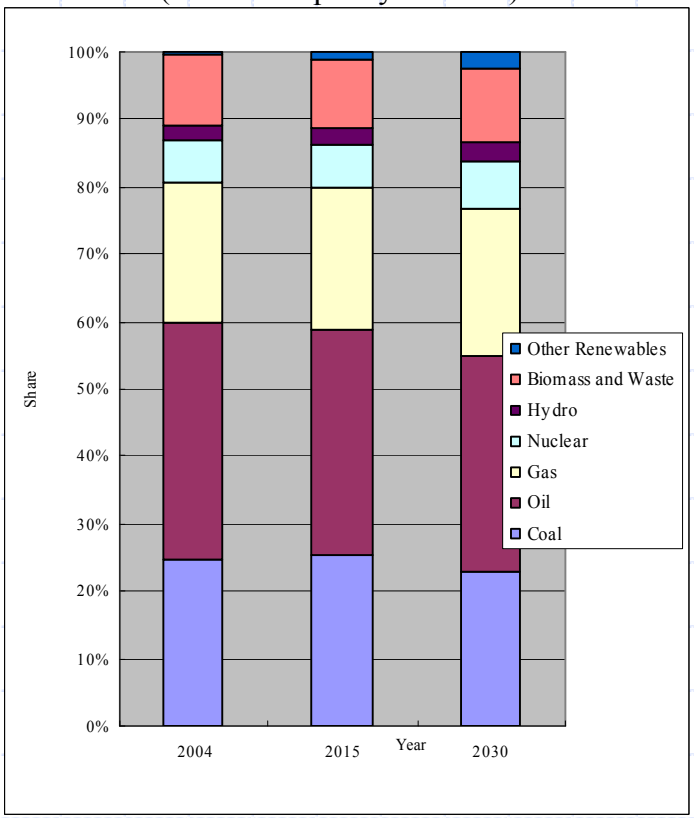
Prospects under World Energy Outlook 2006: (2) Alternative Policy Scenario

- The alternative policy scenario, which takes more measures against global warming into account, indicates nuclear energy's share of primary energy demand may slightly rise.
- Primary energy demand growth in the alternative policy scenario is lower than in the reference scenario due to energy-saving effects.

World Primary Energy Demand Outlook
(alternative policy scenario)

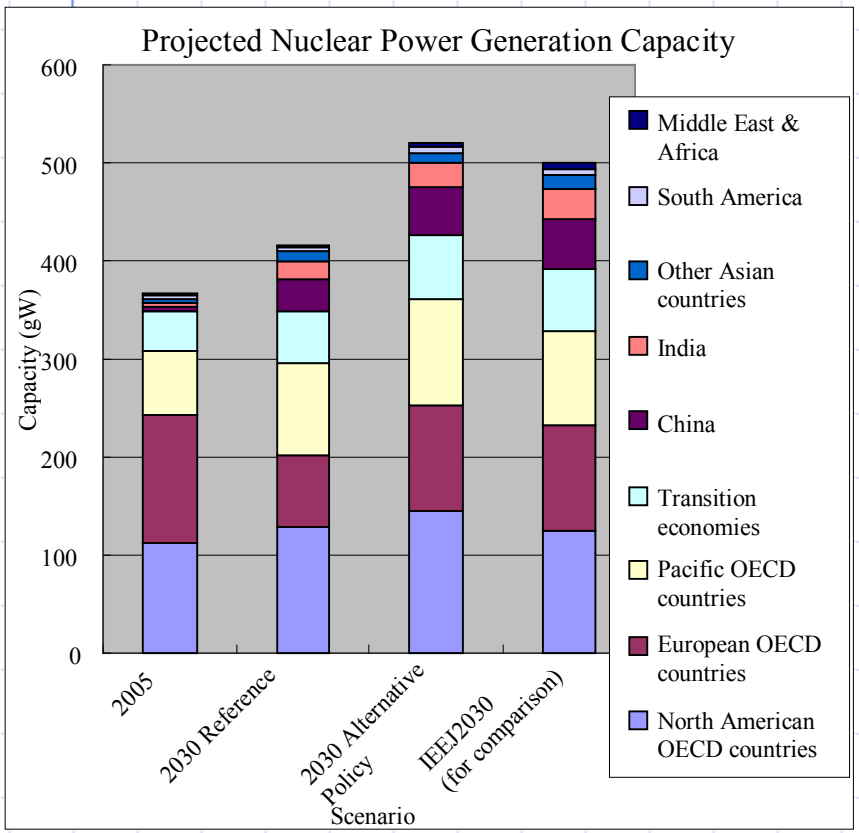


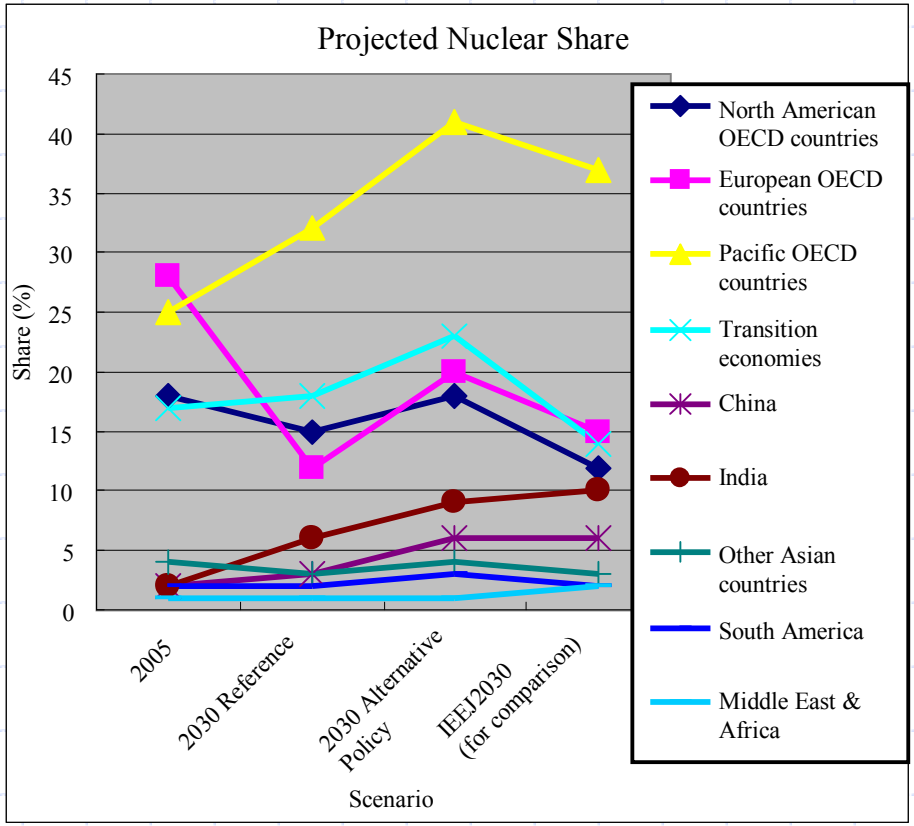
World Primary Energy Demand Outlook
(alternative policy scenario)



Prospects under World Energy Outlook 2006: (3) Nuclear Power Generation Capacity and Nuclear Share

- Nuclear power generation capacity would rise by 13% from the present level (368 GW) to 416 GW even in the reference scenario and by 40% to 519 GW in the alternative policy scenario.
- If nuclear reactors now under construction and planning are completed, total capacity may exceed the reference scenario estimate (416 GW) (see p.7).
- In reality, however, various impediments may emerge.





Source: IEEJ2003 from IEEJ Asia/World Energy Outlook 2006.

Factors for and against Nuclear Development Promotion

- Excellent economic efficiency in the market
  - Gas and coal prices are high enough.
  - CO2 emission credit prices are high enough.
  - Construction and operation costs are low.

If so, → Nuclear power generation has competitive advantages in the market

- Initial investment risks (including delays of plans)
- Interests in global environmental problems
- Interests in energy security (energy supply stability)
- Public's and local residents' interests in and understanding about safety and disposal of radioactive wastes
- Nuclear proliferation concerns

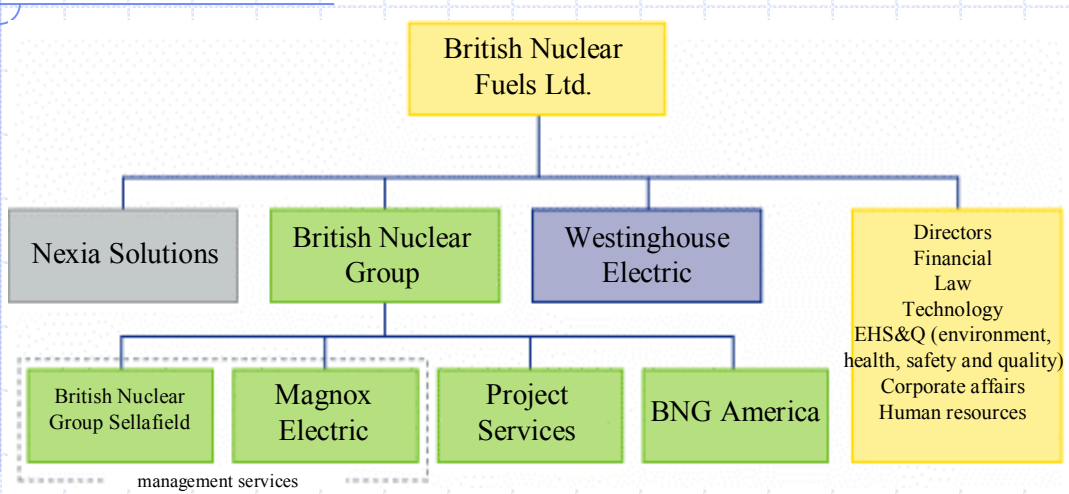
3. Global Nuclear Industry Developments and Future Japanese Industry

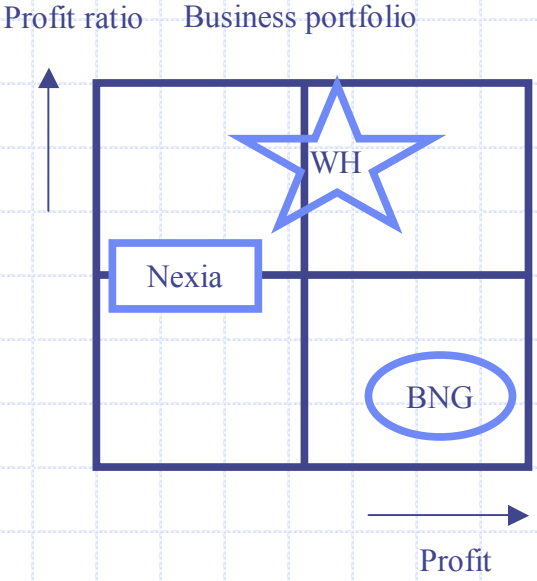
Global Nuclear Industry Developments Review

- In the 1960s, which represented the initial phase of nuclear power generation, nuclear plant makers, nuclear fuel producers and nuclear-related engineering companies prospered.
- As demand declined for construction of nuclear power plants in the 1970s, many nuclear industry participants implemented cross-border realignment and consolidation.

- The global nuclear power plant market was oligopolized by a few companies having excellent plant concepts and engineering know-how in terms of economy and reliability.
  - General Electric (GE) (U.S.)
  - Westinghouse Electric (WH) (U.S.)
  - Areva (France)
  - Mitsubishi, Toshiba, Hitachi (Japan)

WH's Position in BNFL Group (Upon June 2005 decision to sell WH)





Source: BNFL/Westinghouse Japan Website (downloaded in March 2006)

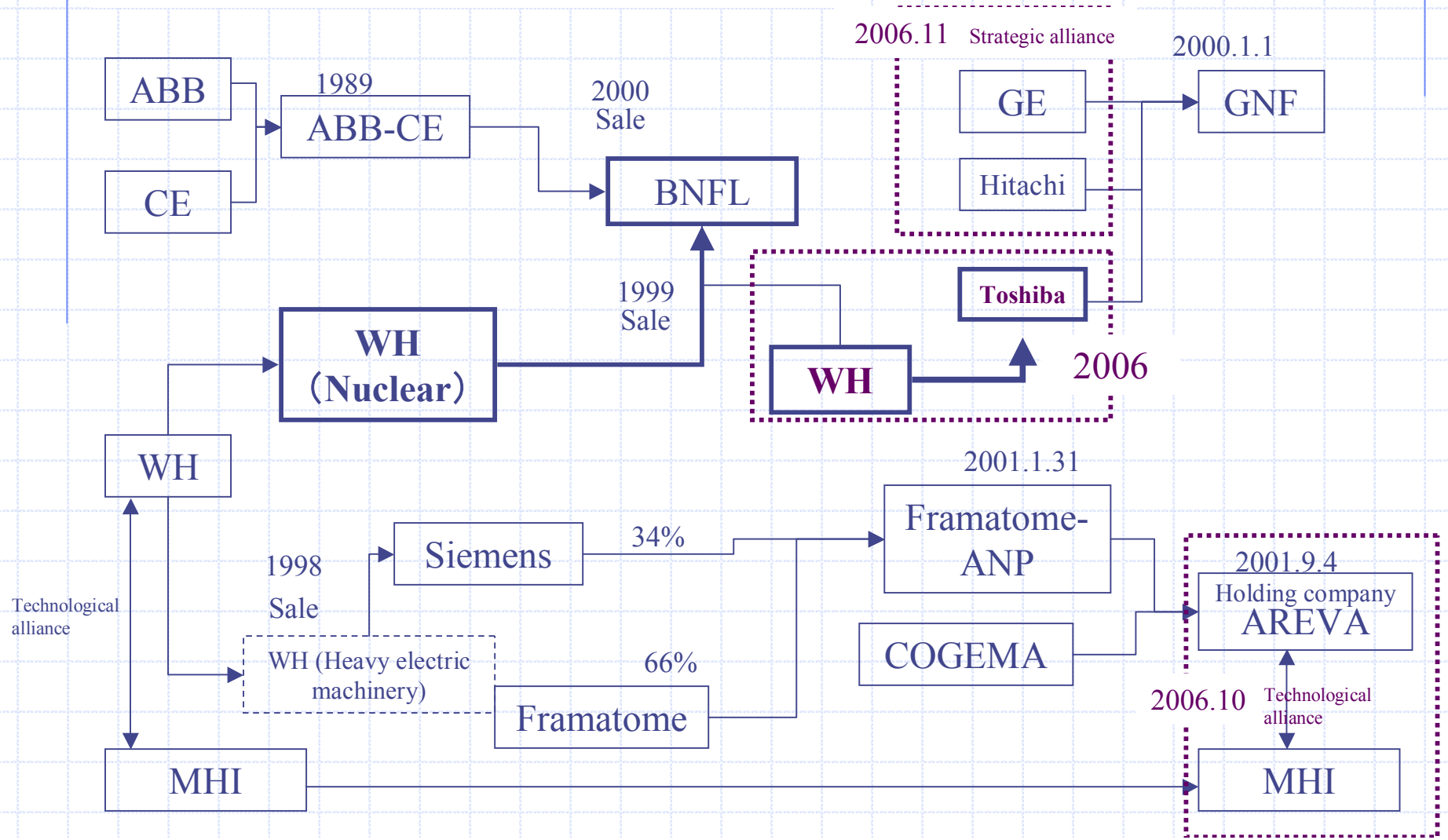
(Unit: £M)	BNG	WH	Nexia
Total sales	2,016	1,144	113
Pretax profit	101	83	6
Profit ratio	5.0%	7.3%	5.3%

Source: BNFL Annual Report 2005

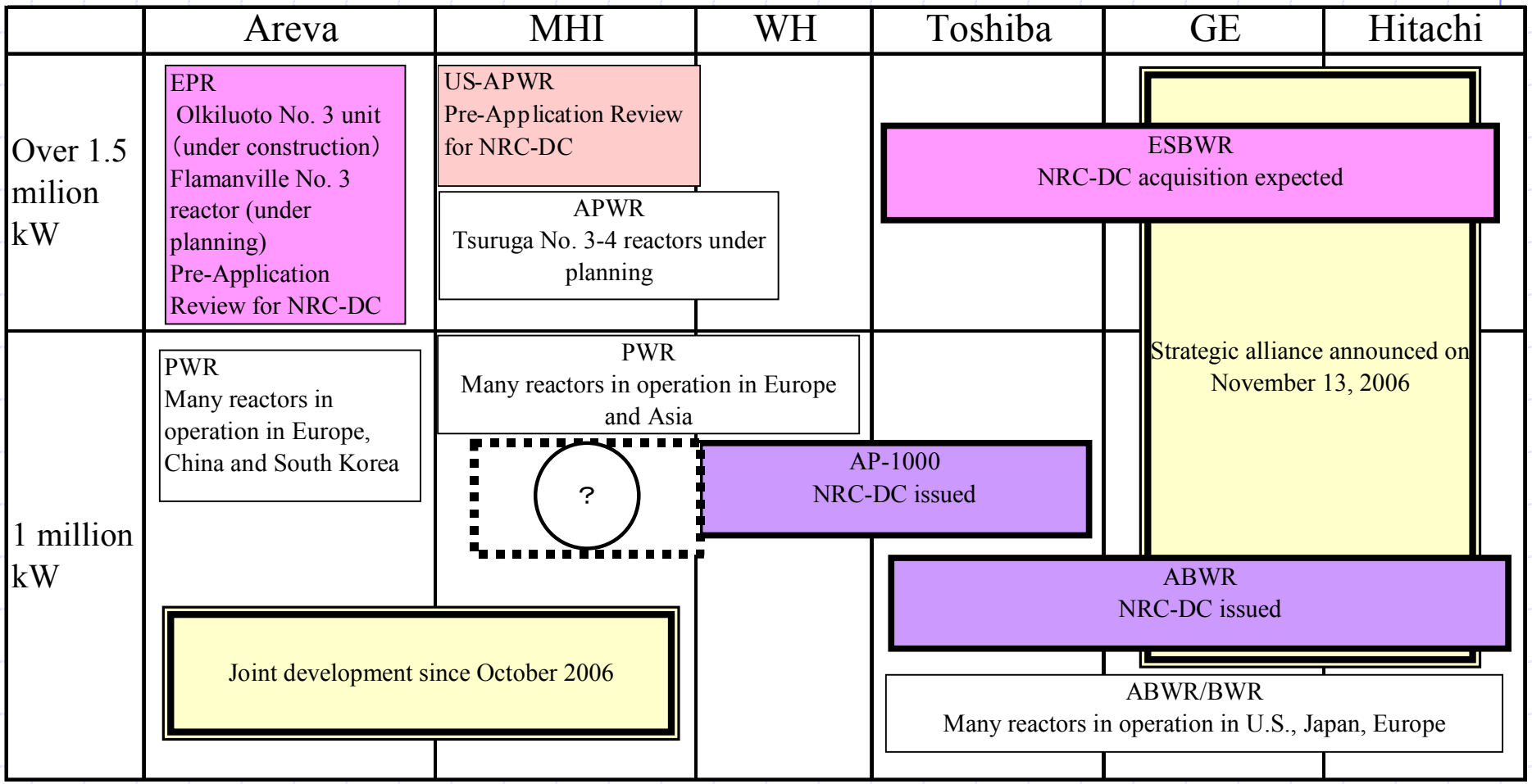
- WH was a crown jewel in the BNFL group.
- This is cited by some people as the reason for the decision to sell WH.

Developments since 2006

- February 2006: Toshiba announces its acquisition of WH
- July 2006: MHI announces advancement in the United States
- October 2006: MHI announces an alliance with Areva
- November 2006: GE and Hitachi announce a strategic alliance



Nuclear Plant Makers and Their Reactor Types (as of January 2007)



*) NRC-DC: The design certification as provided by the U.S. Nuclear Regulatory Commission

Note: The figure is based on public releases of relevant companies and does not necessarily reflect the realities.

Comparison of Nuclear Plant Makers' Reactor Specifications

Reactor type	ABWR	ESBWR	EPR	AP-1000	US-APWR
Maker	GE/Hitachi/Toshiba	GE/Hitachi/Toshiba	Areva	WH	MHI
Output (10,000 kW)	1,400	1,550	1,650	1,200	1,700
Construction	Kashiwazaki - Kariwa No. 6 and 7 Hamaoka No. 5 Shika No. 2	None	Olkiluoto No. 3 (under construction)	None	None
U.S. NRC-DC	Issued	Under Review	Under Pre-Application Review	Issued	Under Pre-Application Review
Unit construction cost ($/kW)	2,000~ 2,400	<~1,500	~2,300	<~1,500	~2,000

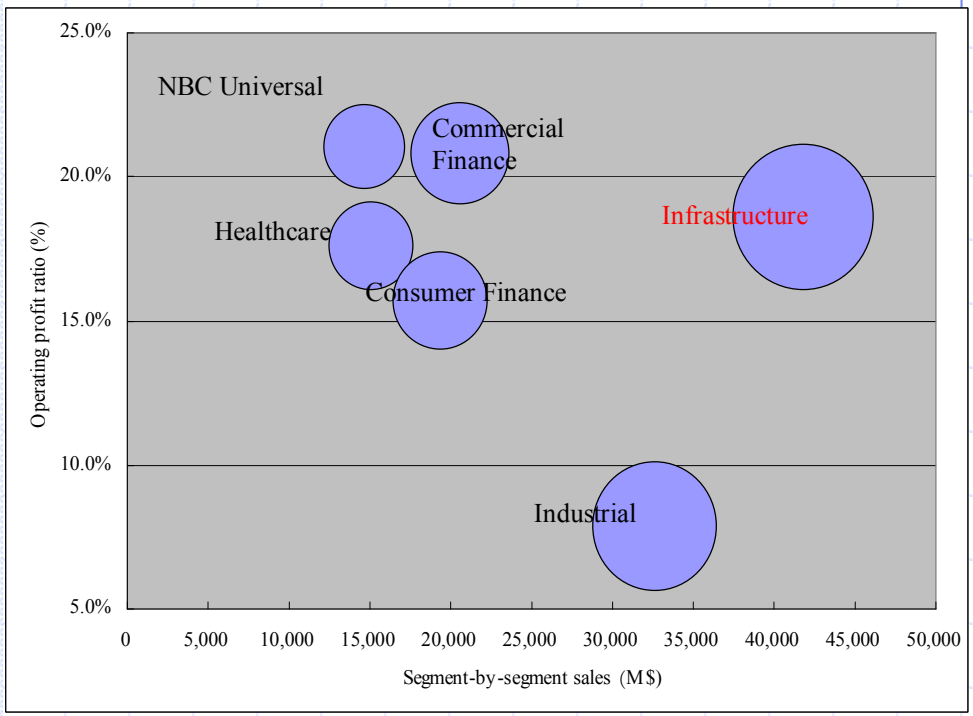
Sources for unit construction cost: Estimates in the WNA "The New Economics of Nuclear Power (2005/12/1)" for the ESBWR and AP-1000. Estimated real cost for the ABWR and EPR. Published cost of Japan's Tsuruga No. 3 and 4 reactors for the US-APWR.

The next ABWR for construction is projected to cost $1,600-1,800/kW (for the TVA Bellefone project as estimated by GE).

Background and Company-by-Company Reasons for Nuclear Industry Realignment
(1) Analysis of GE's Business Portfolio

- GE's corporate culture has pursued higher value added and higher profitability while liquidating less profitable businesses.
- GE's business model means that GE "sells excellent concepts, undertakes engineering as prime contractor and orders equipment form other firms."
- The "Infrastructure" segment including nuclear operations is a core of the GE group.

GE's Segment-wise Performances (2005)

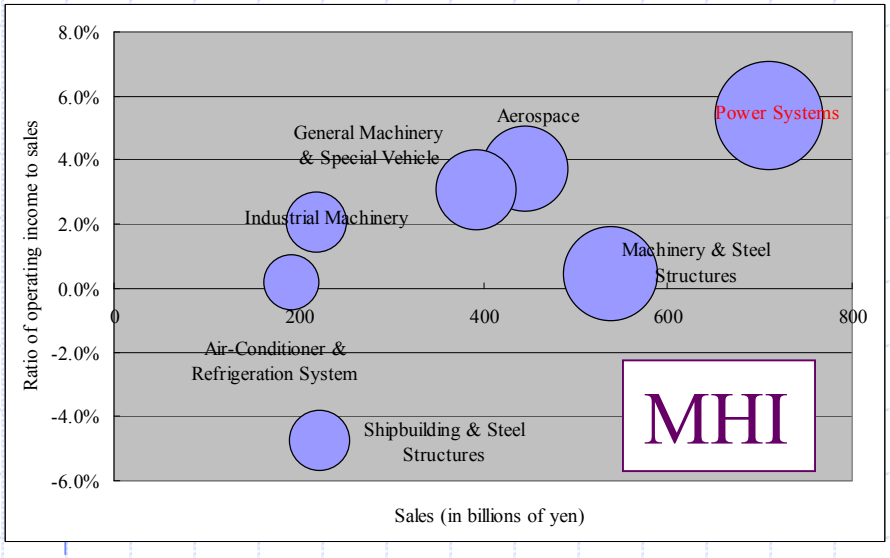


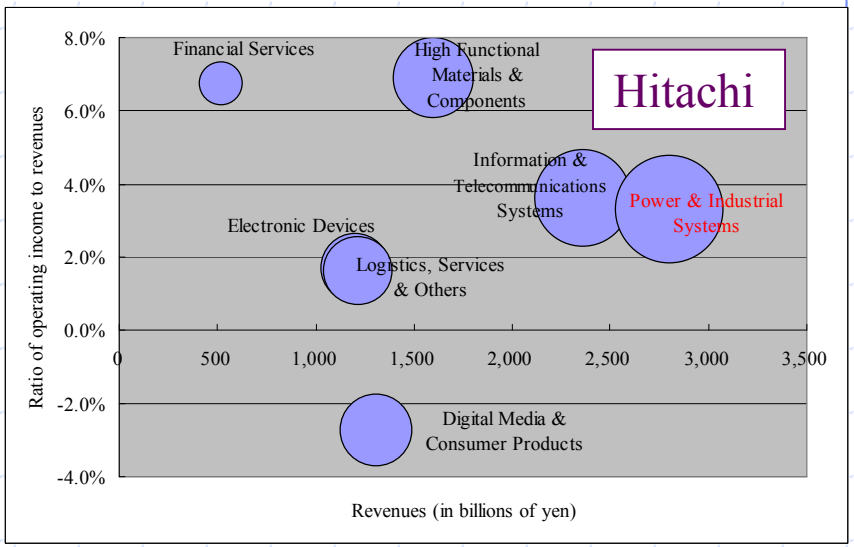
GE features a higher profit ratio than Japanese firms.

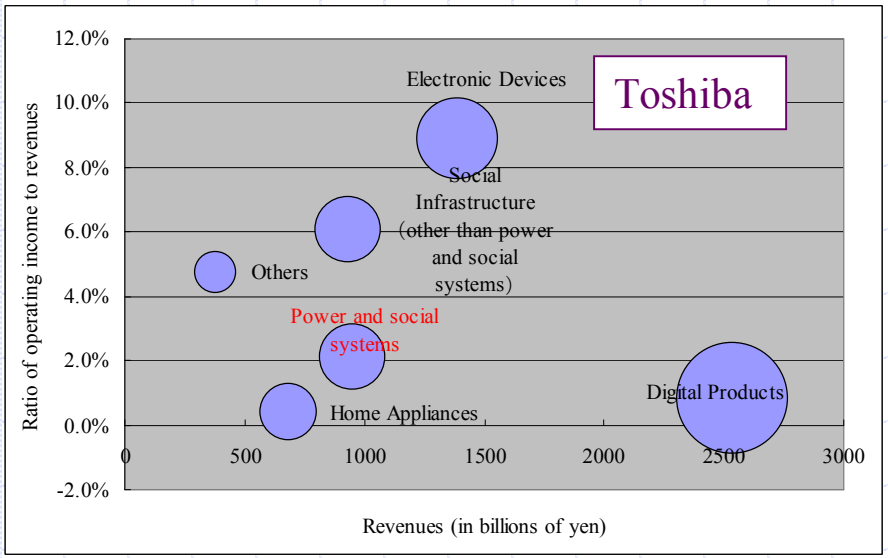
Source 2005 GE annual report

http://www.ge.com/files/usa/company/investor/secreport/pdfs/ge_10Ka_2005.pdf

Background and Company-by-Company Reasons for Nuclear Industry Realignment
(2) Analysis of Three Japanese Firms' Business Portfolios (in the year to March 2006)







- The Power Systems segment is a core for MHI.
- Toshiba's future challenge is to increase sales and profitability through the WH acquisition.
- Hitachi's challenge may be to raise profitability rather than sales.

Sources: Segment data are from these firms' respective annual reports for fiscal 2005.

Direction Japanese Nuclear Industry Should Pursue in Global Nuclear Market

Basic policies given in the Nuclear Energy National Plan
(as reported at the Electricity Industry Committee of the Advisory Committee for Natural Resources and Energy on September 4, 2006)

- Realize a greater nuclear energy share over a medium to long term
- Promote a nuclear fuel cycle steadily and enhance the nuclear fuel cycle industry strategically
- Commercialize a fast breeder reactor cycle at an early date
- Promote the project to develop a next-generation light-water reactor
- Support the Japanese nuclear industry's international expansion
- Engage positively in creating an international framework to achieve both expansion of nuclear power generation and nuclear nonproliferation

Goals of Japan's Nuclear Industry

Enhance quality of the nuclear industry for its development of a globally workable size and competitiveness

Develop a basic design concept to become a global standard

Challenges Regarding Japan's Next-generation Light-Water Reactor Development and International Expansion

Policy Goals

- Nuclear Energy National Plan's Points on Japanese Next-generation light-water reactor
  - The government, power utilities and nuclear plant makers should be united for a national project to develop a Japanese next-generation light-water reactor.
  - Nuclear plant makers should take leadership.
  - Standard reactors for development should be limited to two.
- Nuclear Energy National Plan's Points on Realization of Nuclear Plant Industry with Globally Workable Size and Competitiveness
  - The policy goal is to enhance the quality of Japanese nuclear plant makers to have globally workable sizes and competitiveness.
  - Stakeholders should specify nuclear reactor concepts for Japanese nuclear plant makers' competition in the global market and their target markets and should make strategic efforts to achieve their international expansion.
  - Nuclear plant makers should develop their marketing strategies at home and abroad, should strategically consider domestic and overseas partners, areas and forms for alliances, and should try to keep frank communications.
  - Nuclear plant makers may have difficulties in expanding into overseas markets on their own. The government should pledge efforts and support measures such as official financing to pave the way for their international expansion. At the same time, power utilities should form partnerships as necessary.

Challenges

Japanese nuclear plant makers could lead their foreign alliance partners to take part in the project.

Optimizing concepts.

Looking into reactor types for specific regions or countries and for specific development timeframes

Maintaining organized technological capabilities and human resources even amid changes in capital equity relations.

Japanese government efforts to improve presence of Japanese nuclear plant makers.

4. Conclusion

Key Points of Nuclear Power Generation Development (1)

- Nuclear power generation will grow more important for addressing energy security and global warming.
- Government support is a key to promotion of nuclear power generation development.
- Deregulation and nuclear power: Can nuclear power generation keep its competitive advantage in the market?
- Given huge initial investment, the government should create some mechanism to disperse fund-raising risks in a bid to promote private enterprises' investment.
- The government should pave the way for Japanese nuclear plant makers to take advantage of their alliances with overseas partners for demonstrating their technological capabilities.

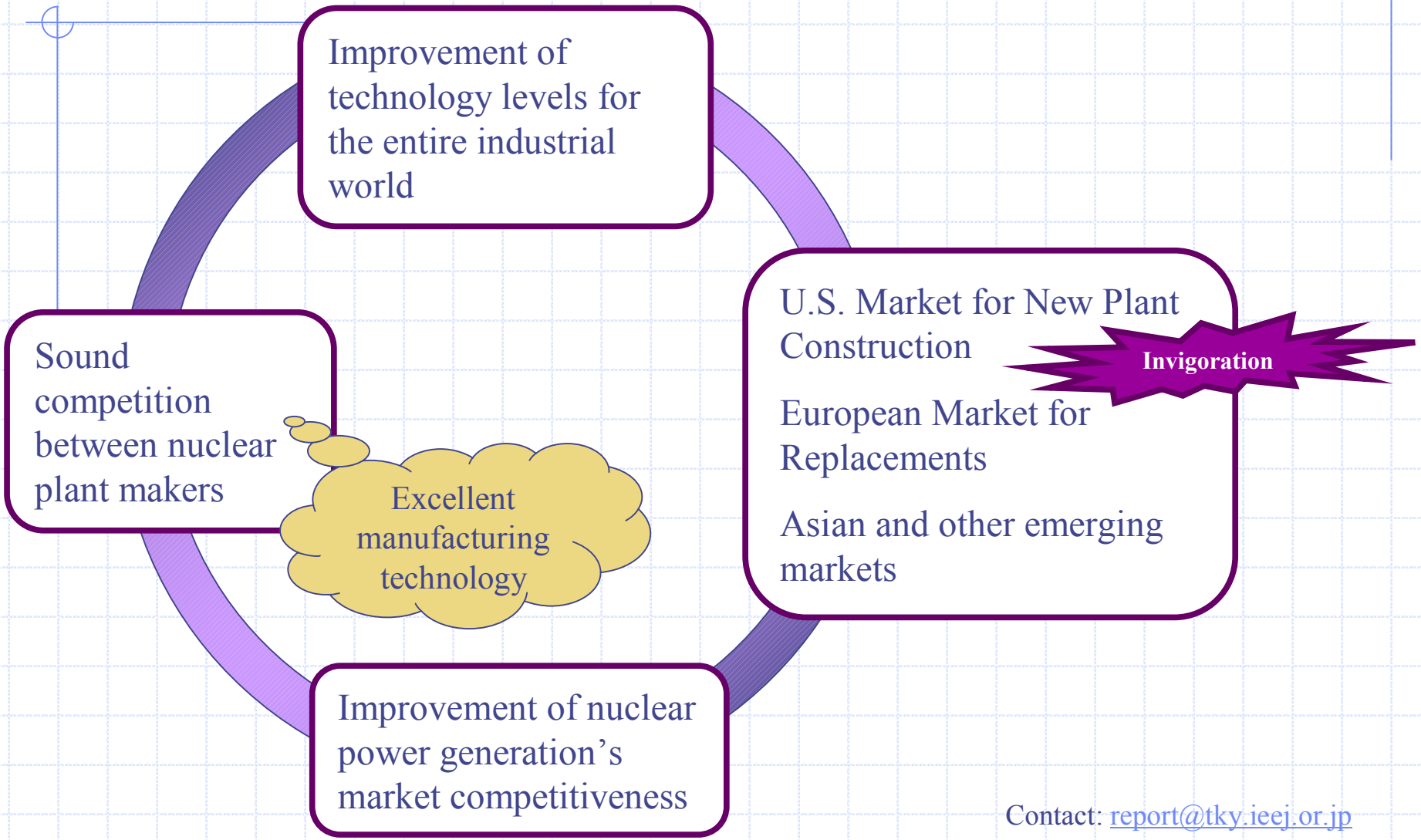
Key Points of Nuclear Power Generation Development (2)

- Smooth permission, licensing and construction processes will also be an important factor for promotion of nuclear power generation. Every country should reduce uncertainties about costs and permission and licensing procedures as much as possible.
- Surveillance is required on safety, waste management and nuclear nonproliferation.
  - Creation of safety regulations in "emerging nuclear power generation countries" is particularly important.
  - Relevant countries should make early decisions on how to treat spent nuclear fuels and dispose nuclear wastes.
  - The world should try to implement GNEP, MNA and other effective mechanisms to achieve both international expansion of nuclear energy utilization and nuclear nonproliferation.
    - Guaranteeing nuclear fuel supply
    - Multilateral management of nuclear fuel cycle facilities, etc.

Key Points of Industry Developments

- How would nuclear plant makers judge country-by-country reactor needs and risks for their selection and concentration?
  - Any group that receives first orders in the United States may obtain an advantageous position.
  - Becoming the world's top runners will be companies that fully appreciate country or regional risks, have clear visions and make best investment decisions.
- How would nuclear plant makers maintain organized technological capabilities and human resources as their capital equity relations change even across national borders?
- Would any synergy effect of the BWR and PWR be realized to invigorate the nuclear industry?
  - Expectations are placed on the Toshiba-WH team with both types, as well as the GE-Hitachi and Areva-MHI alliances that have made achievements with their respective single reactor types.

Industry Developments' Effects on Market



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