Holistic Consideration of Fuel Cycle Systems for Sustainable Development

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Nuclear Energy : Pioneer for a Recycle-oriented Society

- Holistic concepts started off the peaceful use of nuclear energy
- Why was there a focus on recycling ?
- LWR as the de facto leaving behind the backend cycle as necessary evil
- Sustainability of the nuclear power system : Scapegoat for the nuclear deterrence

Tasks involving the resource and environment

Conventional Concept

Obtaining and using energy resources lavishly

- Transient use of the cheapest energy resources
- Back fitting of environmental countermeasure

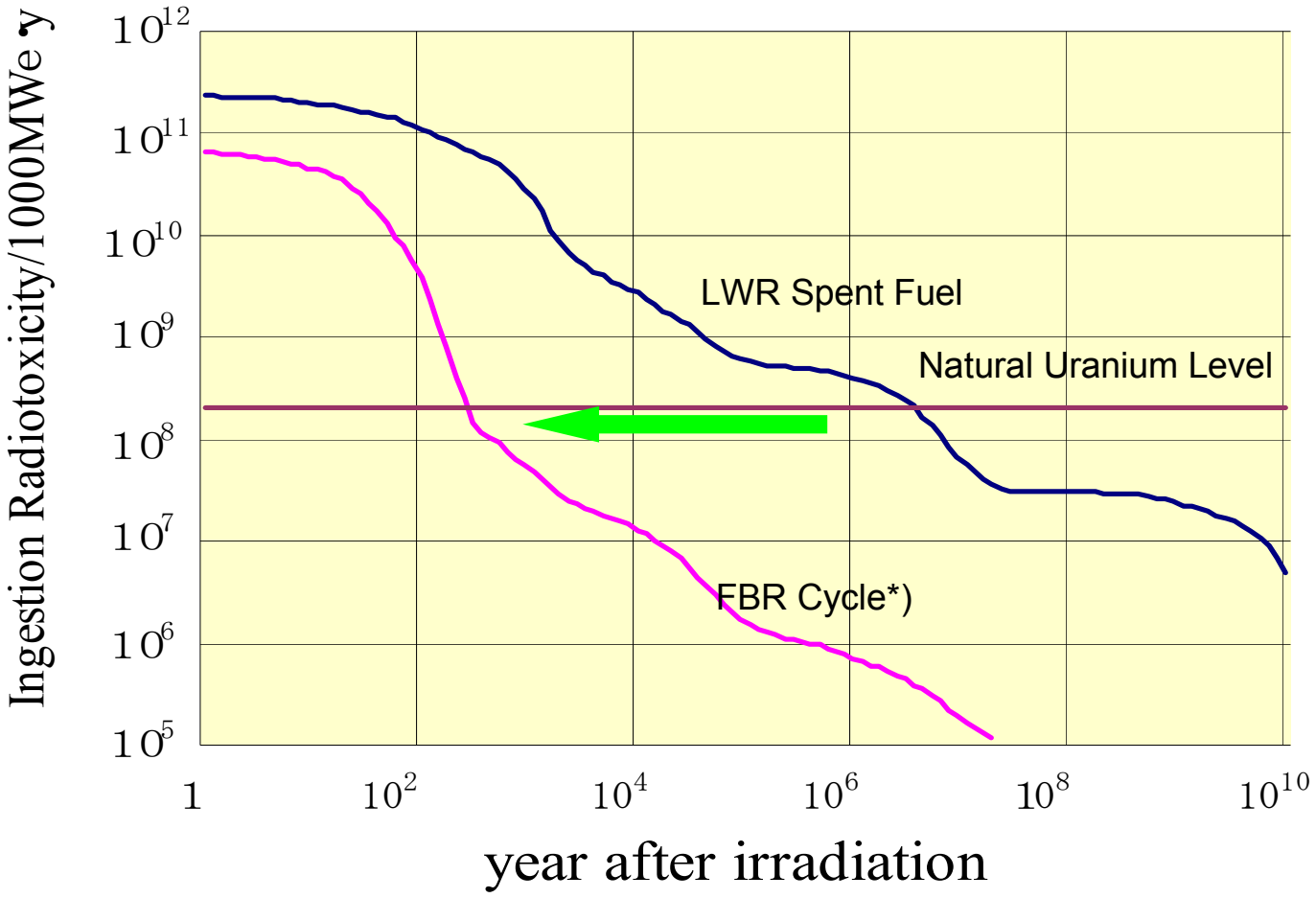
Sustainable Concept

Do not leave the bill for future generations to pay.

- Planned use of limited resources
- Minimizing the environmental impact for developing resources

Development policy of advanced reactor

Conventional Concept	• Priority on the reactor performance • Cost competitiveness with light water reactors • Cycle development as an extrinsic technology to reactor development
Sustainable Concept	• Priority on consistency with the cycle backend • Complement the shortcomings of LWR system • Reactor development as an element of a cycle • Unified development of cycle and reactor



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-Reduction of Radiotoxicity of HLW-

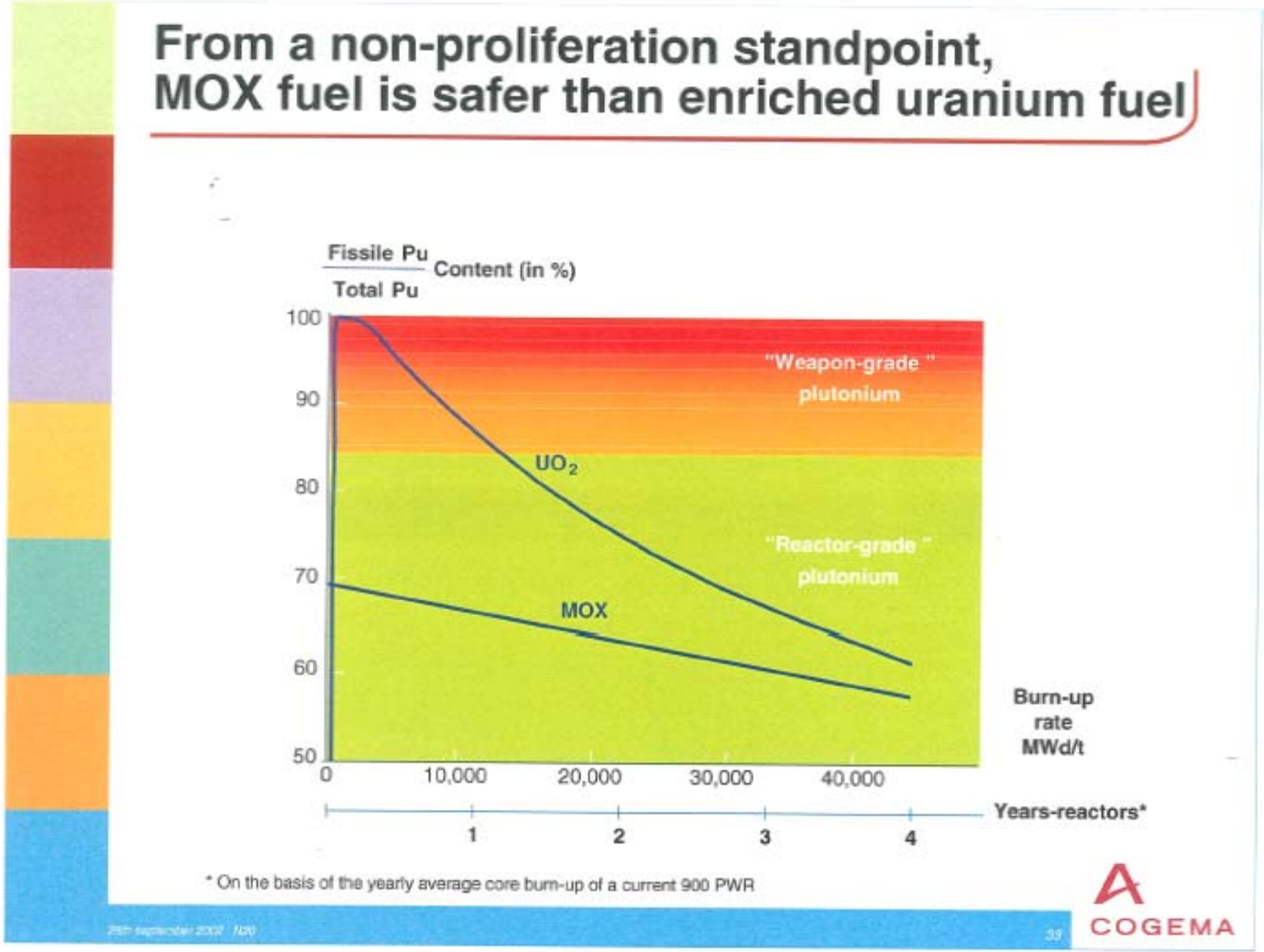
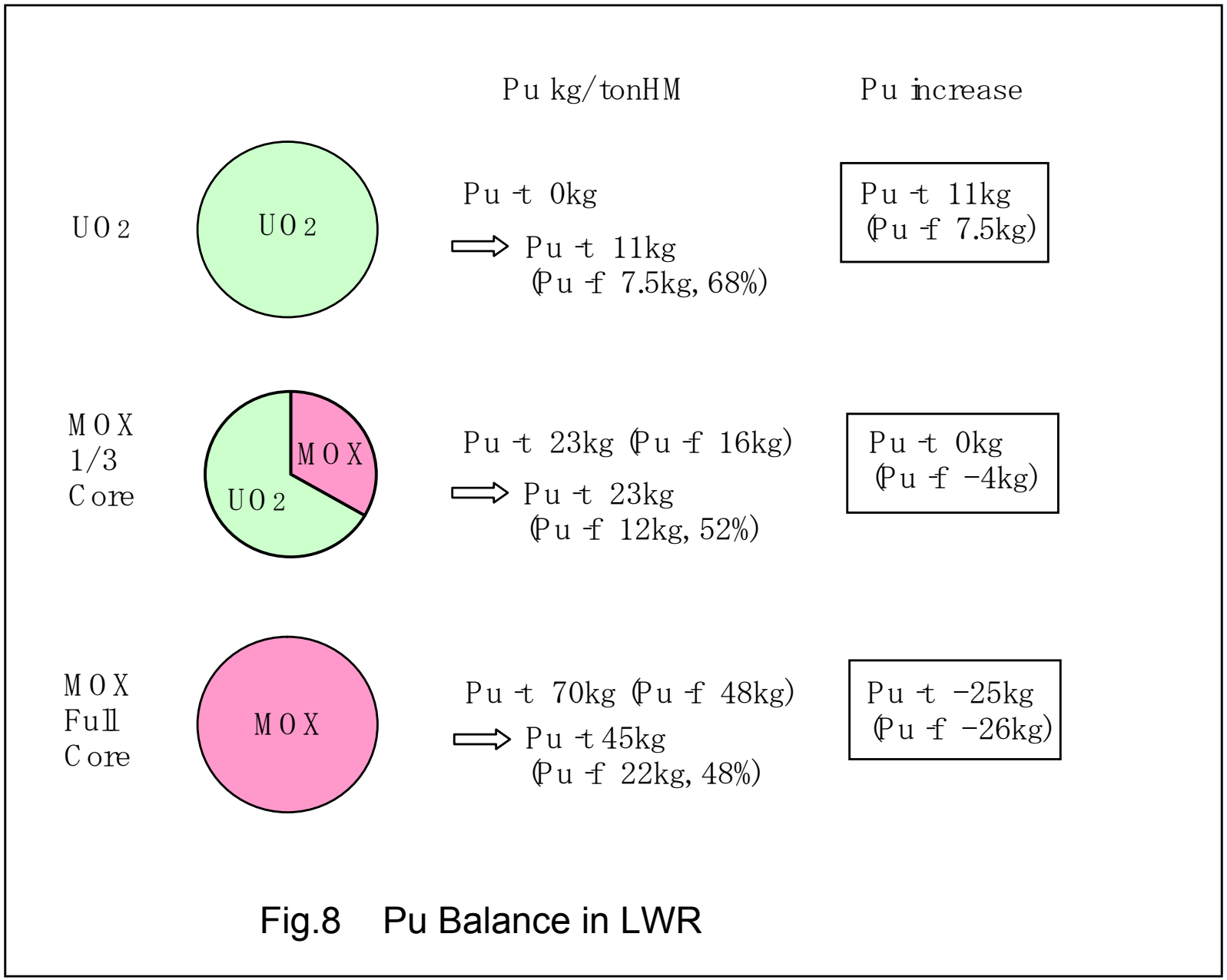


Fig. 7 MOX Fuel from a Non-Proliferation Standpoint



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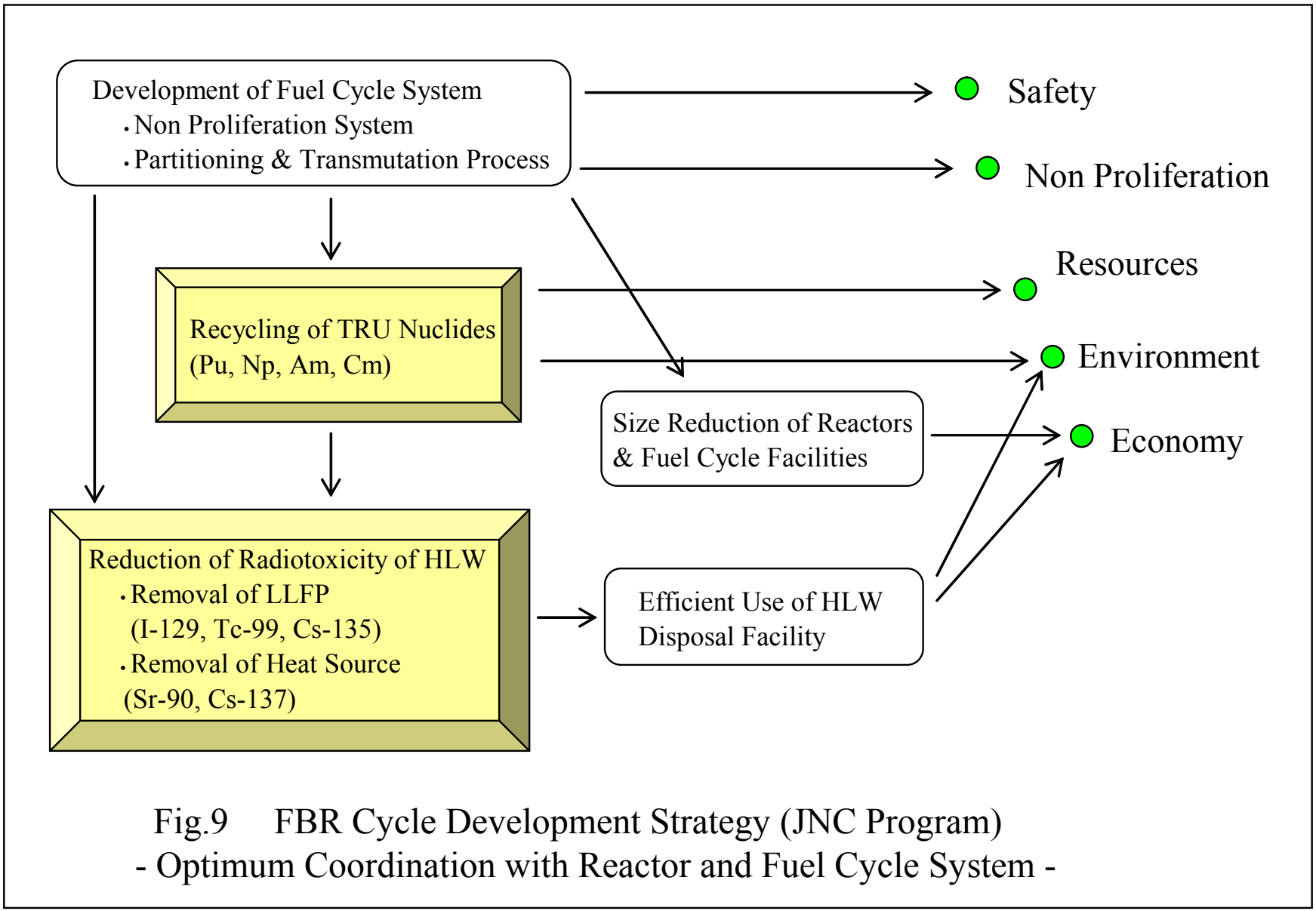


Fig.9 FBR Cycle Development Strategy (JNC Program)
- Optimum Coordination with Reactor and Fuel Cycle System -

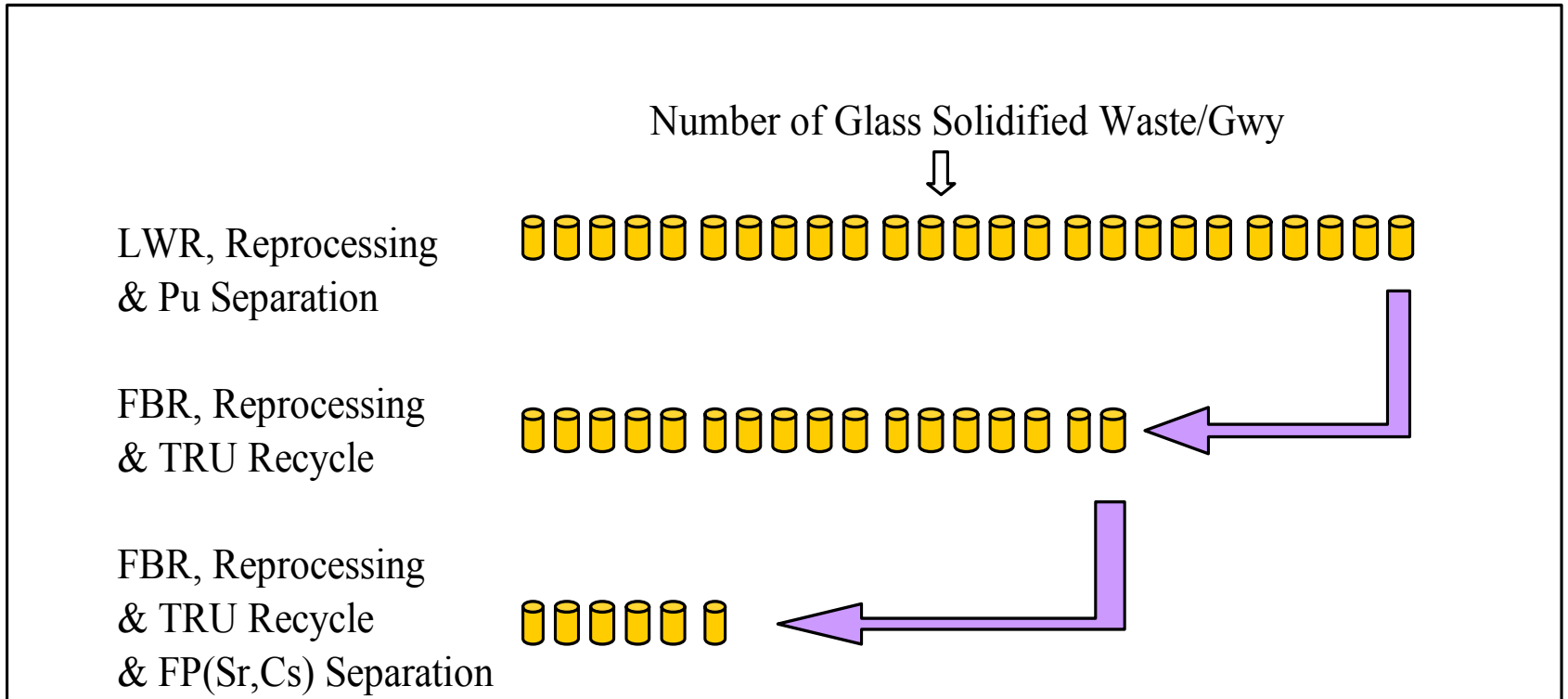


Fig.10 Effect of FBR Recycle System
- Reduction of glass solidified waste -

Example of Transition Scenario from LWR to FR Cycle

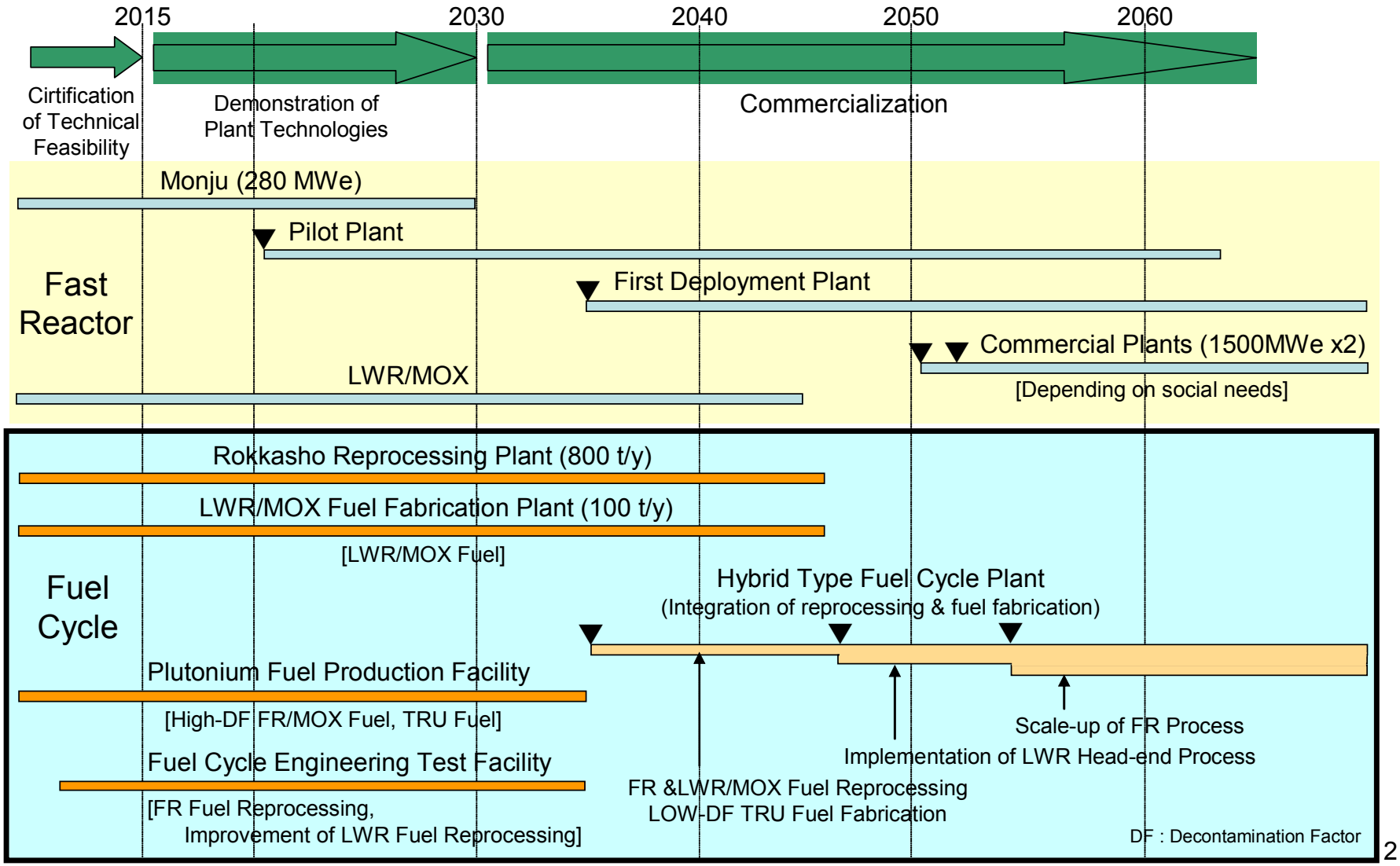
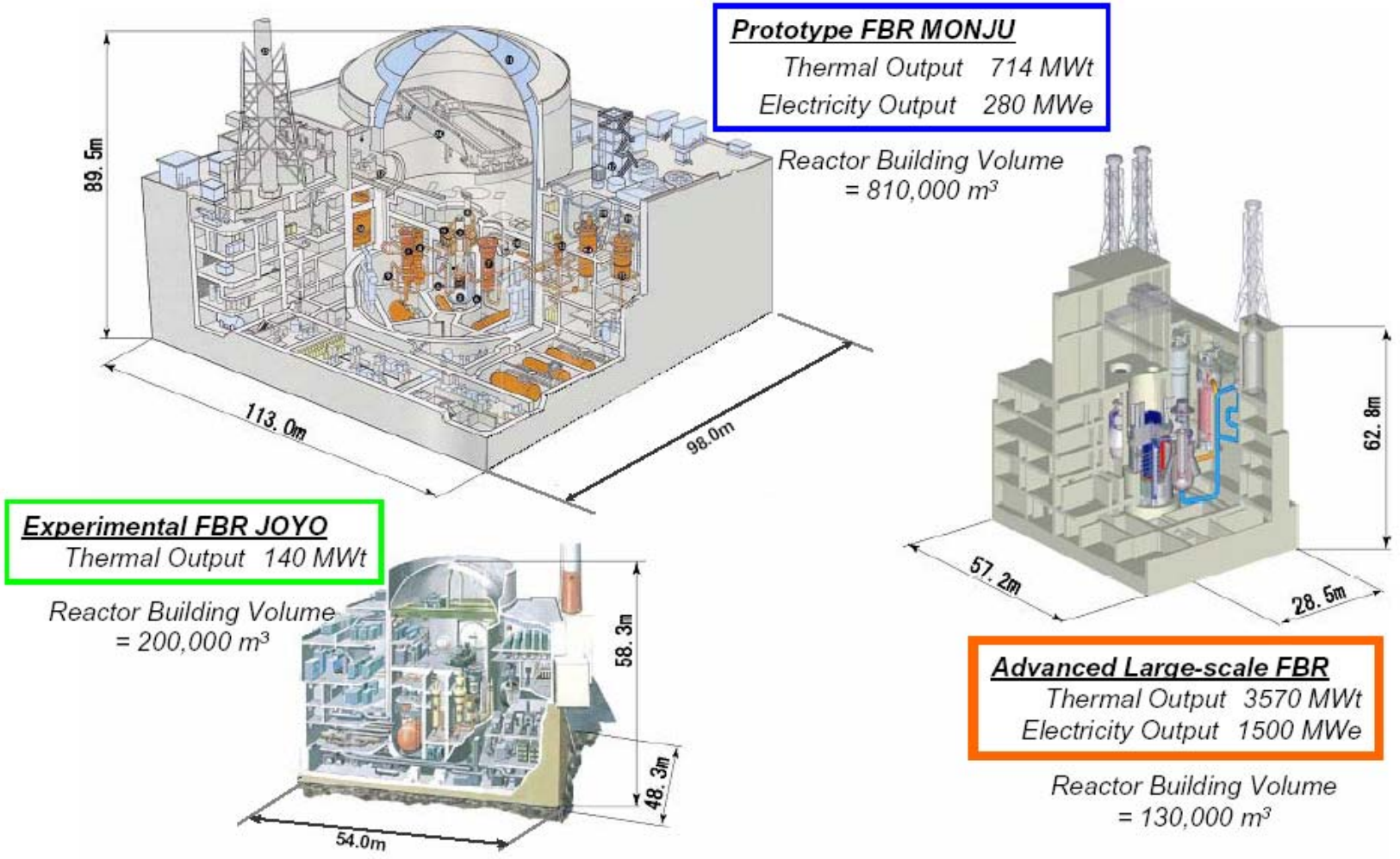


Fig. 11 Example of Transition Scenario from LWR to FR Cycle

Comparison of Reactor Building Volume

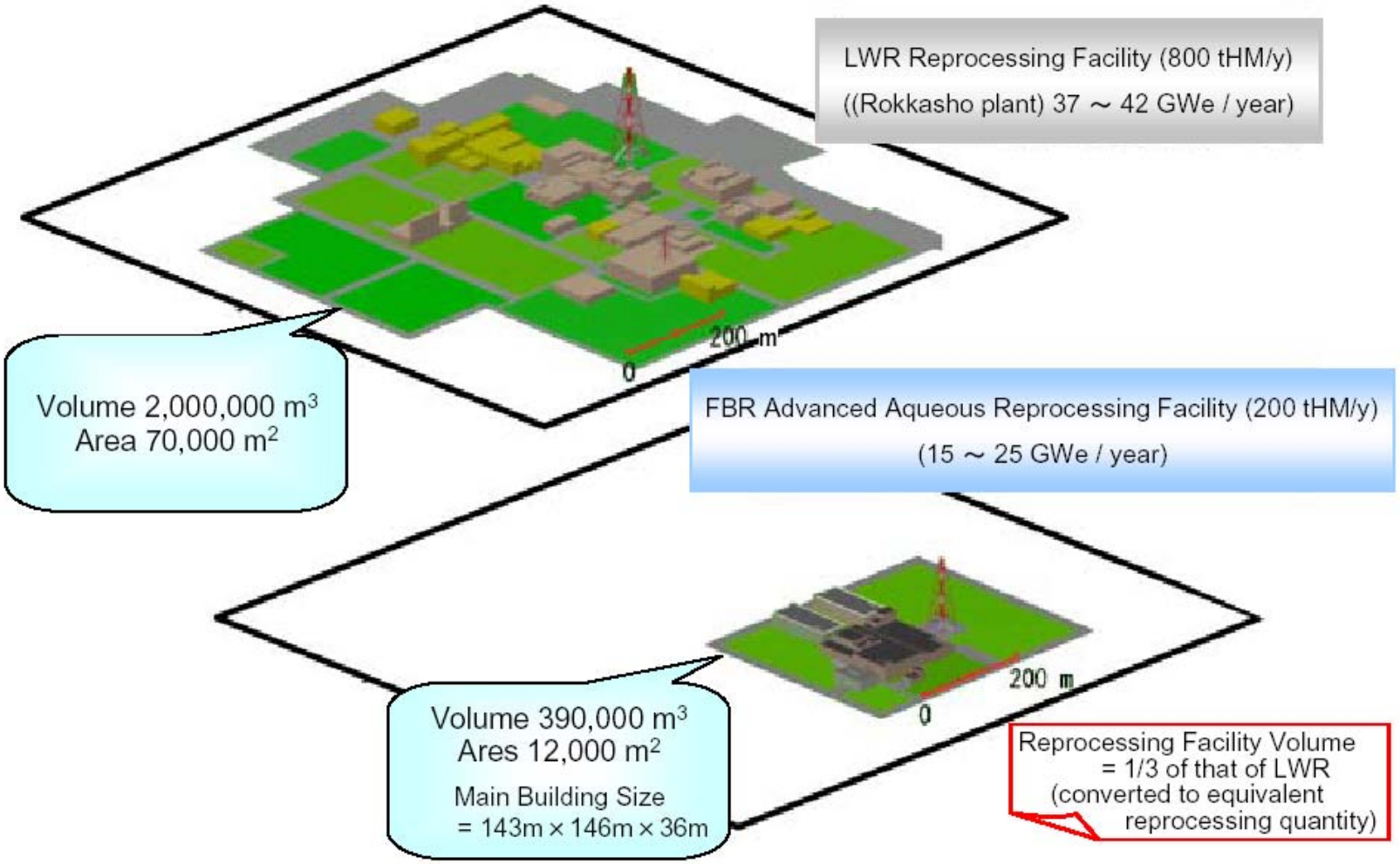
JNC



Ref.(a) Comparison of Reactor Building Volume

Comparison of Nuclear Fuel Cycle Facilities

JNC



Ref.(b) Comparison of Nuclear Fuel Cycle Facilities

International cooperation

Conventional Concept	• Persuit of national interest by monopolizing information • Development of strategies and systems by individual country
Sustainable Concept	• Persuit of mutual interest by sharing information • Cooperative development for increasing speed and reducing costs • Development of strategies and systems through international cooperation

Alien Power into Accustomed Power

- Reaction of 9.11
- Distance of Public
  from Nuclear Society
  from Aviation Society
  from Automobile Society
- Education for Next Generation

“Sleep Peacefully as we Never Repeat the Mislead”

- The first and last nuclear-bombed country : A model of an advanced nuclear power country independent from weaponry world
- No oil , No coal , No choice : The current situation in France and Japan , tomorrow’s situation of the world
- Energy for the short term or energy for supporting the generations to come ?

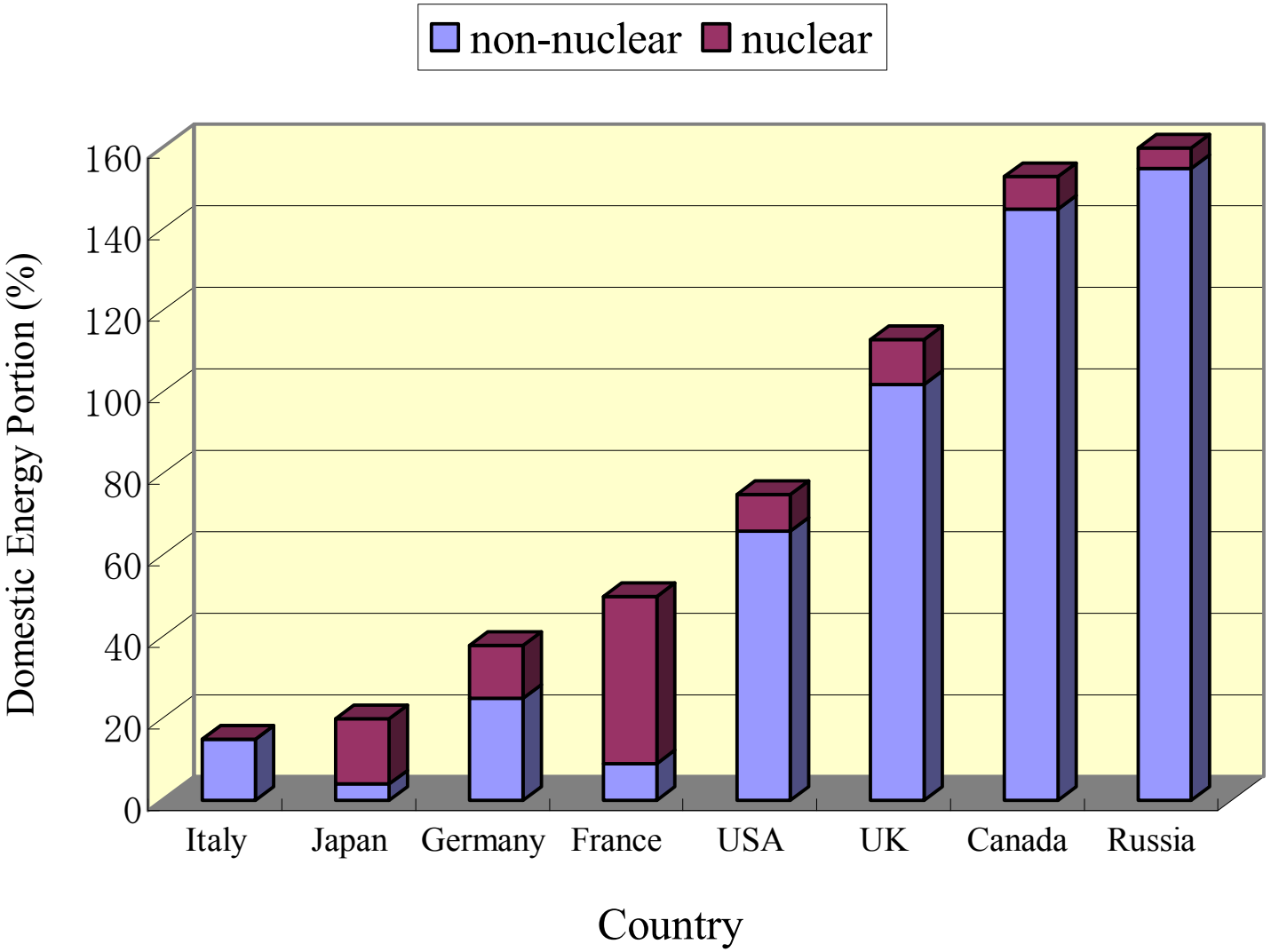


Fig.12 Portion of Domestic & Nuclear Energy

(Source: IEA Energy Balances of OECD/Non OECD Countries, 2000-2001)

Review of the Mission (1)

Purpose of nuclear reactors development

Conventional Concept	Reduction of direct power generation cost by improving reactor perfomance
Sustainable Concept	Improvement of reactor perfomance in accordance with the needs of the cycle and reduction of total power generation costs

Approach of nuclear reactors development

Conventional Concept	Jump up to a fast breeder reactor
Sustainable Concept	Gradual progress from LWR-MOX, Pu/MA burner fast reactor to fast breeder reactor

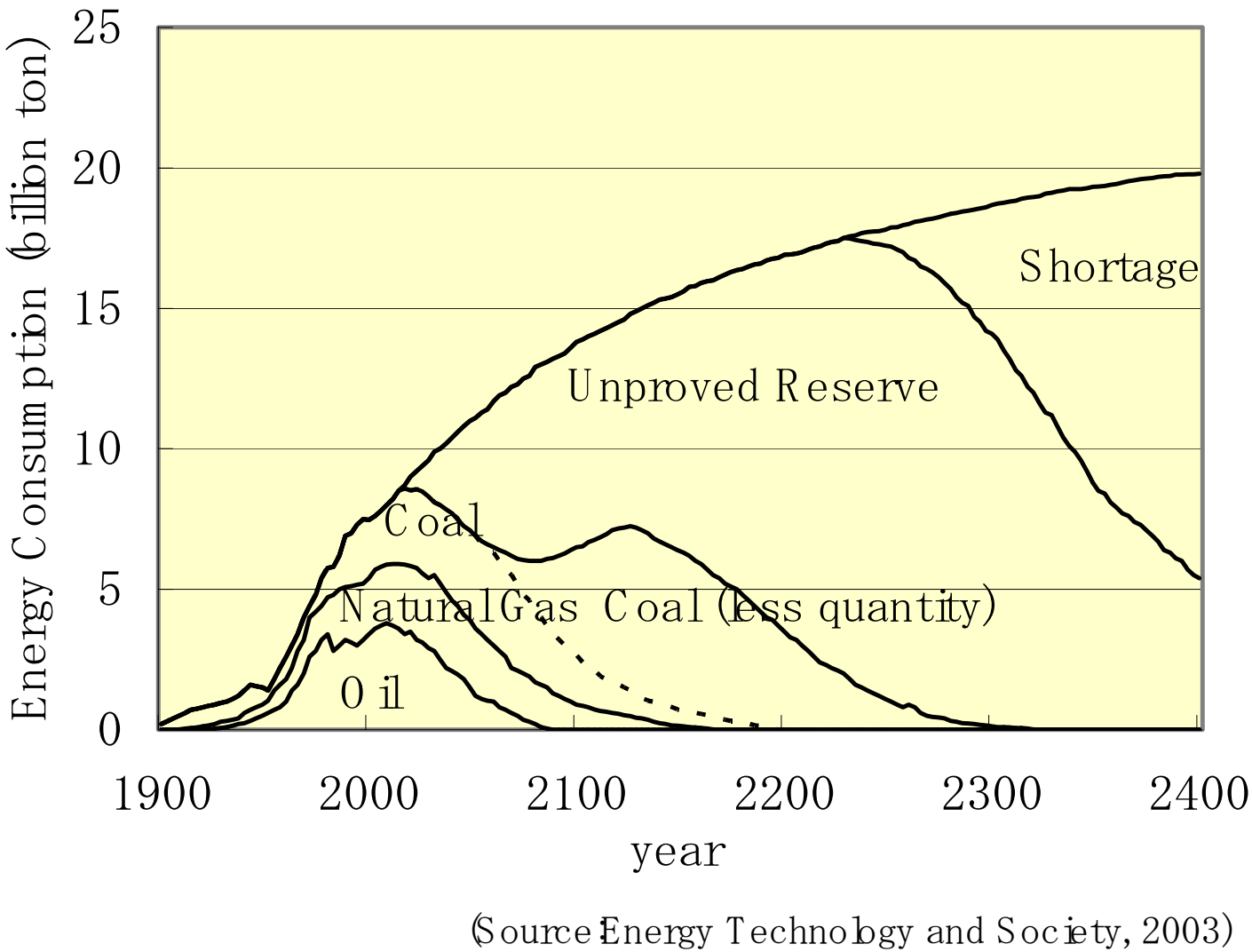
Review of the Mission (2)

Function of Reprocessing

Conventional Concept	Isolation and effective use of nuclear fuel substances
Sustainable Concept	• Waste management acceptable to society • Use of nuclear fuel substances in a manner of proliferation resistance

HLW management

Conventional Concept	Permanent Disposal in accodance with geological time scale
Sustainable Concept	Management and disposal in accordance with societal time scale



(Source: Energy Technology and Society, 2003)

Fig.1 Long Term Energy Demand and Fossil Fuel Supply

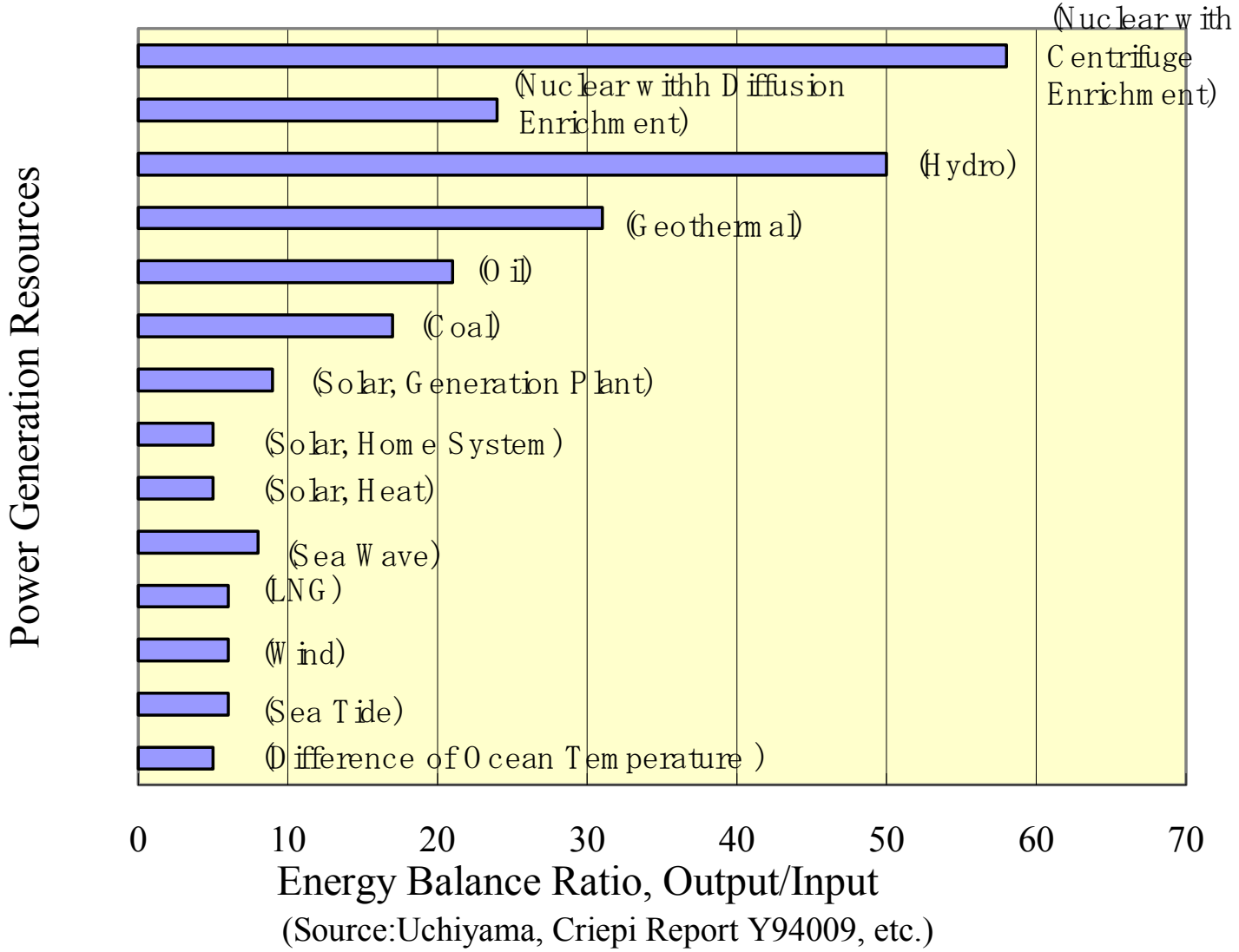


Fig.2 Energy Balance Ratio of Various Generation System in Japan

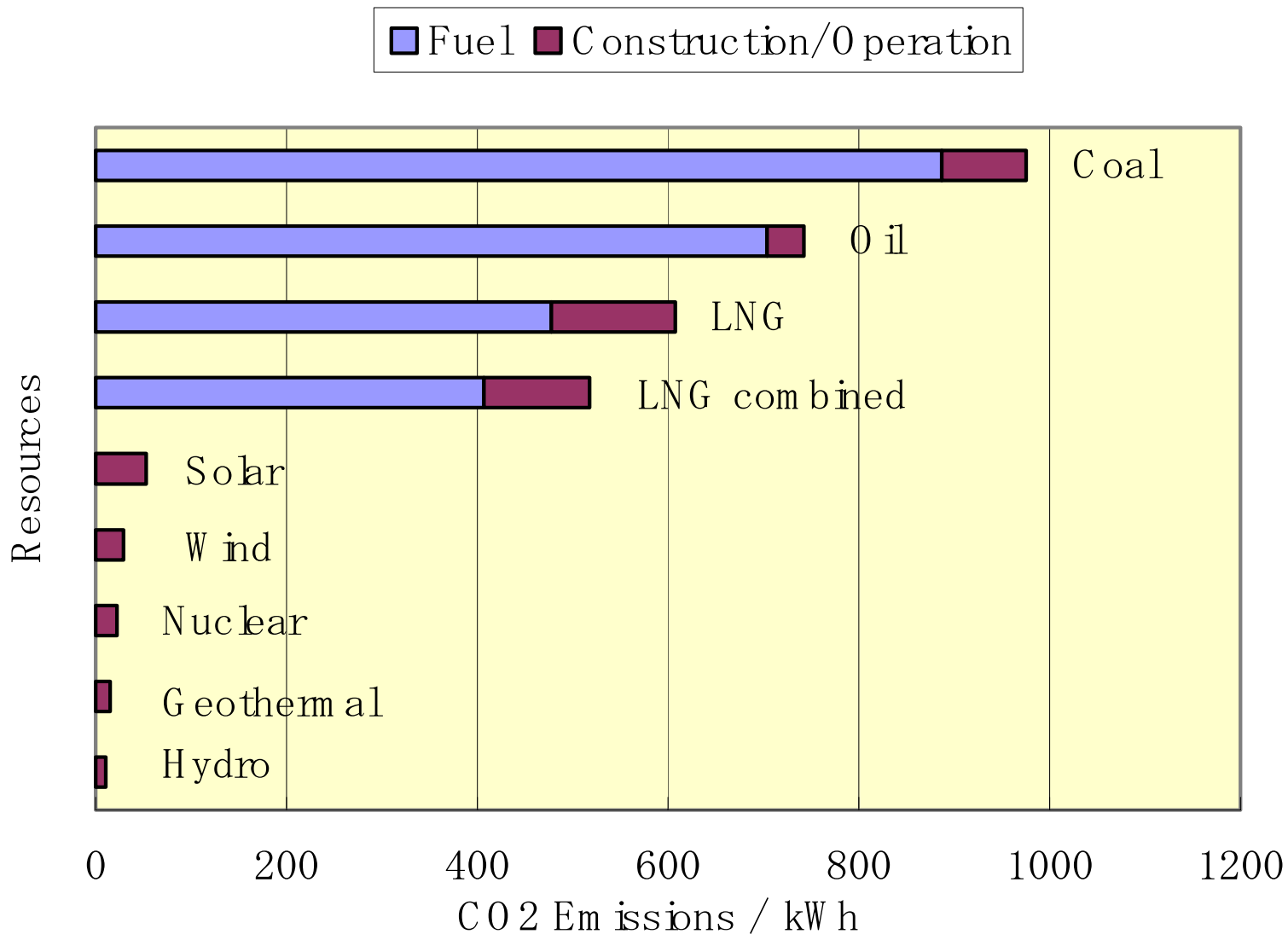


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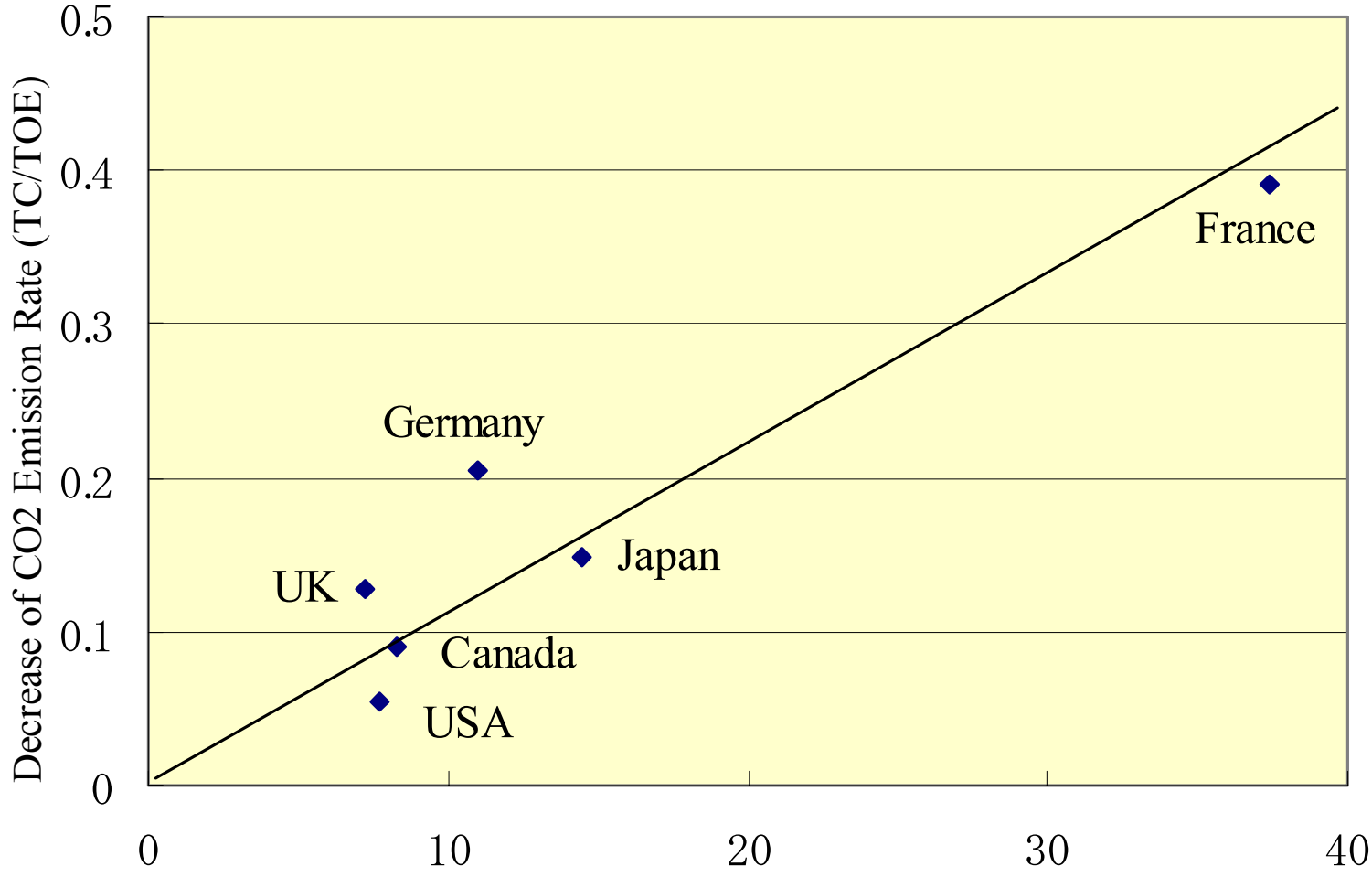
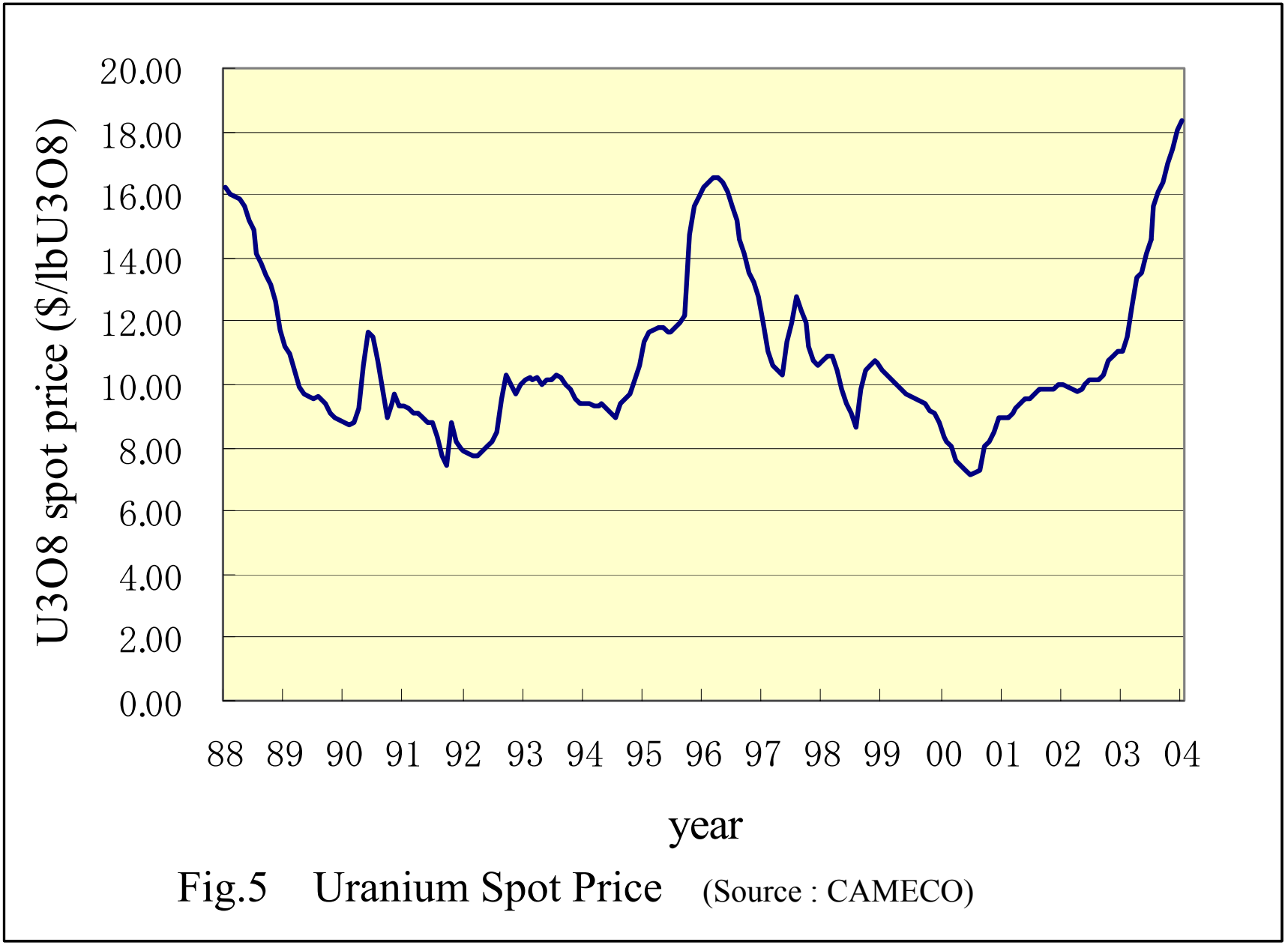
Fig.3 Life Cycle Assessment of CO2 Emissions for Generation Systems



(TPES:Total Primary Energy Supply, TC/TOE:tonof crbon/ton of pwerolium)

Fig.4 Expansion of Nuclear Energy vs. Decrease of CO2Emission Rate in 1973-1995



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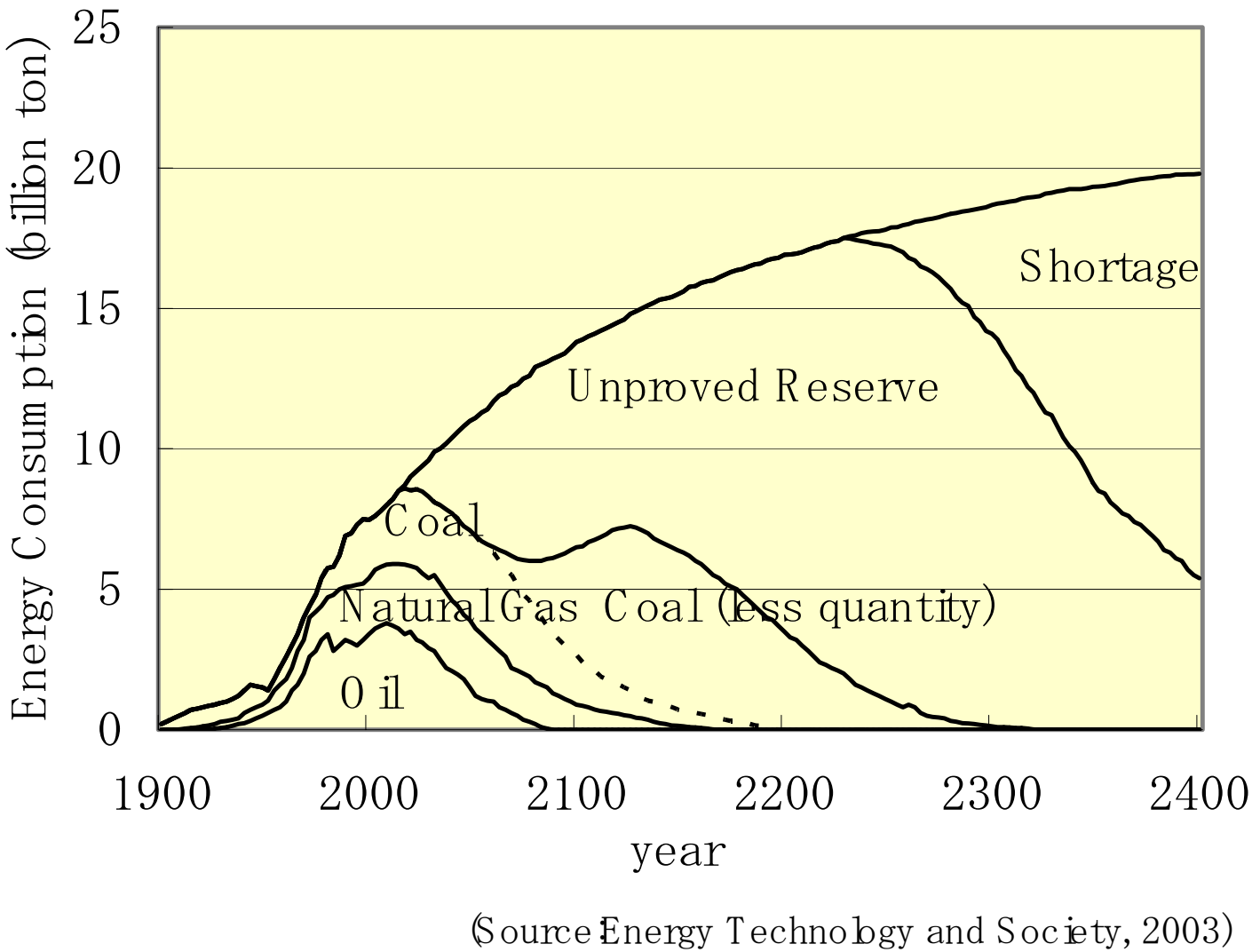

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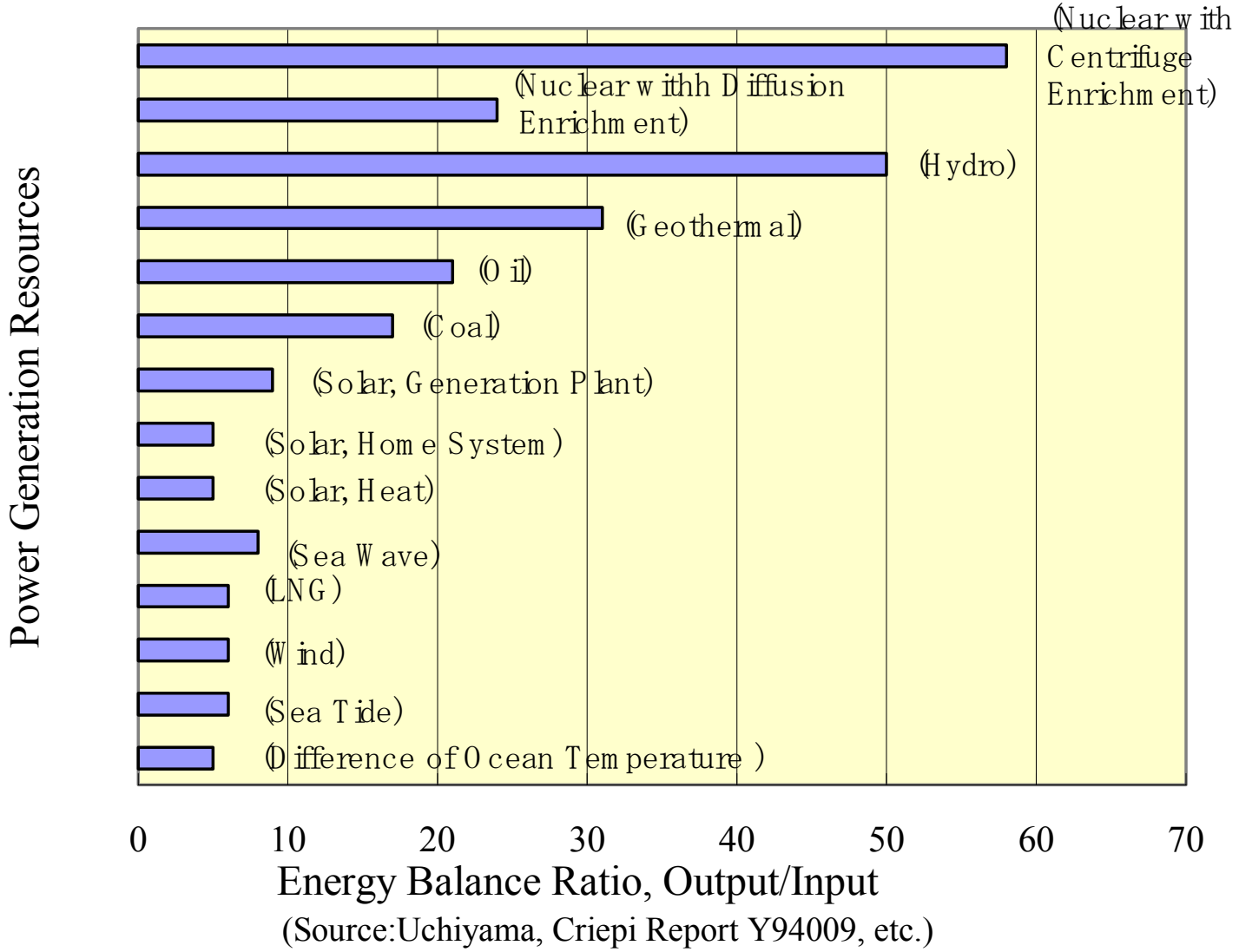

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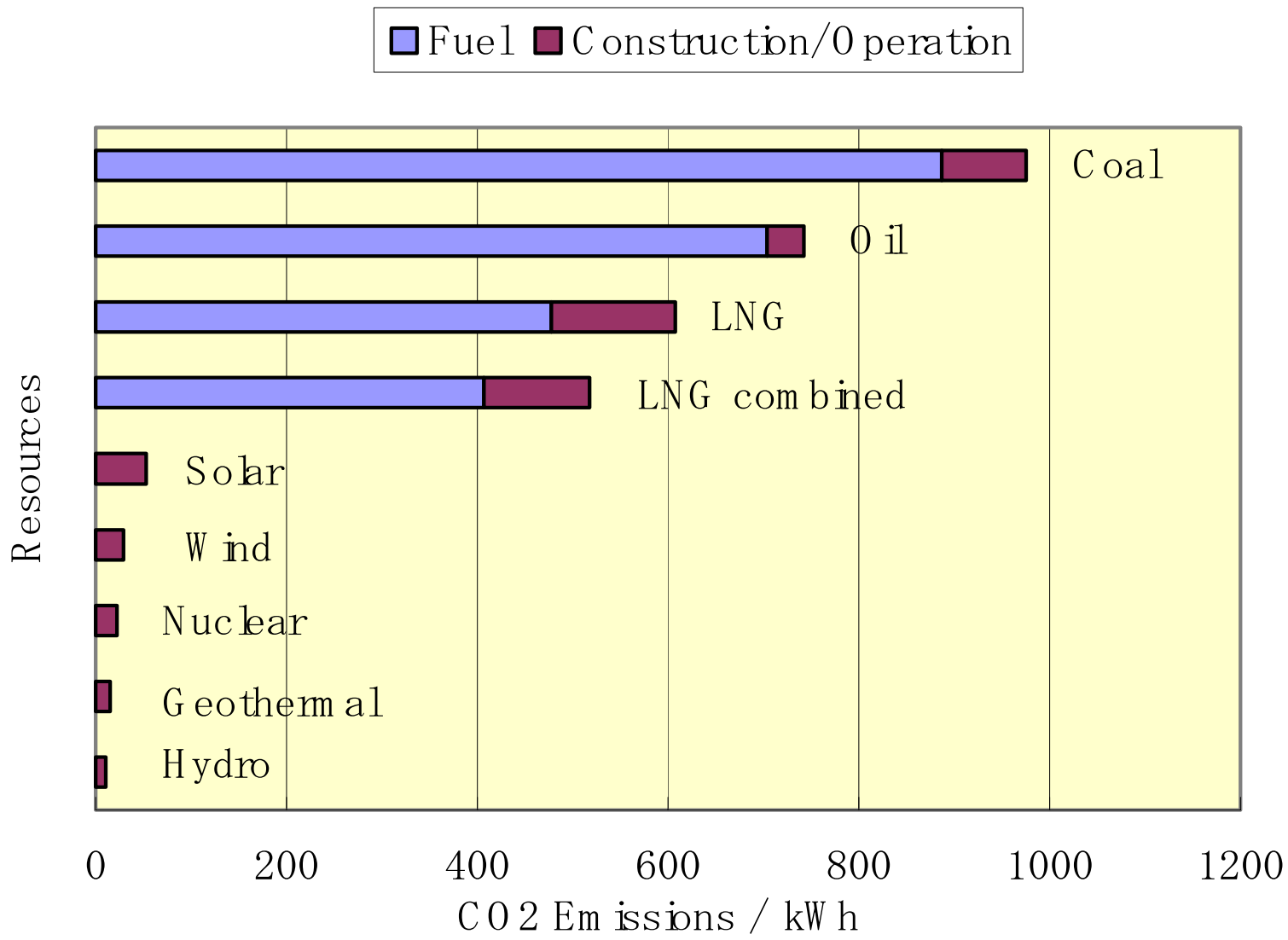

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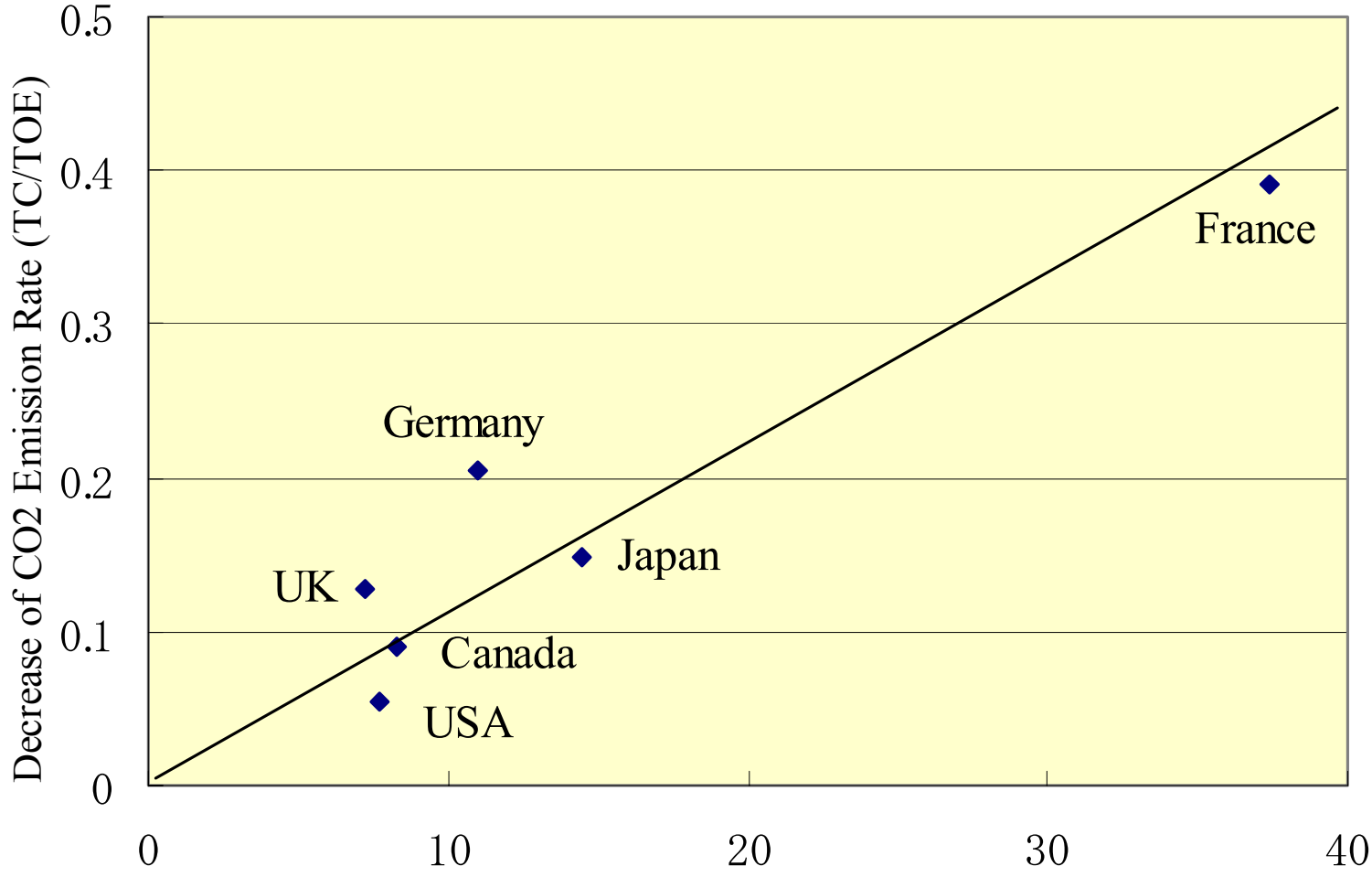

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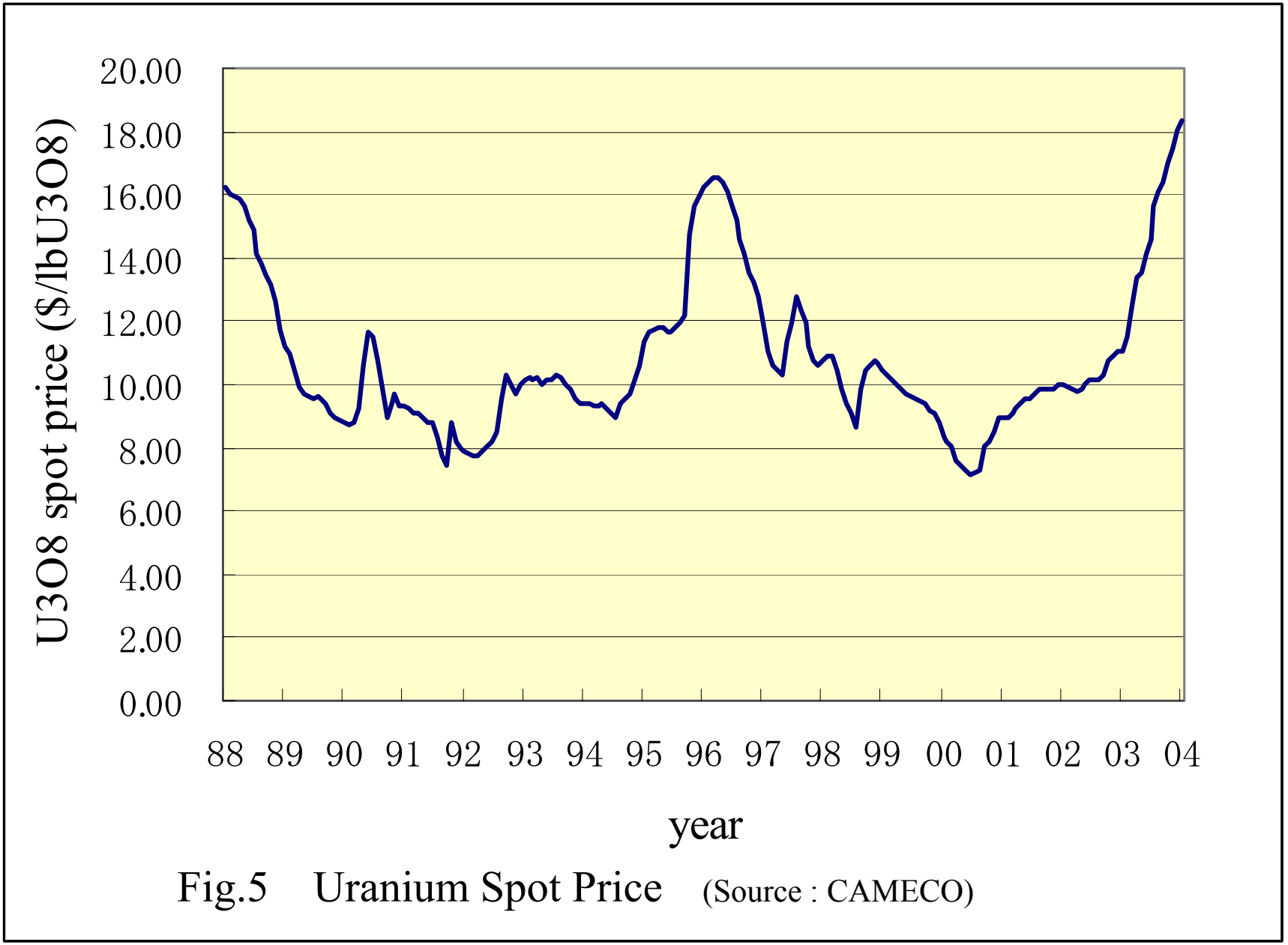

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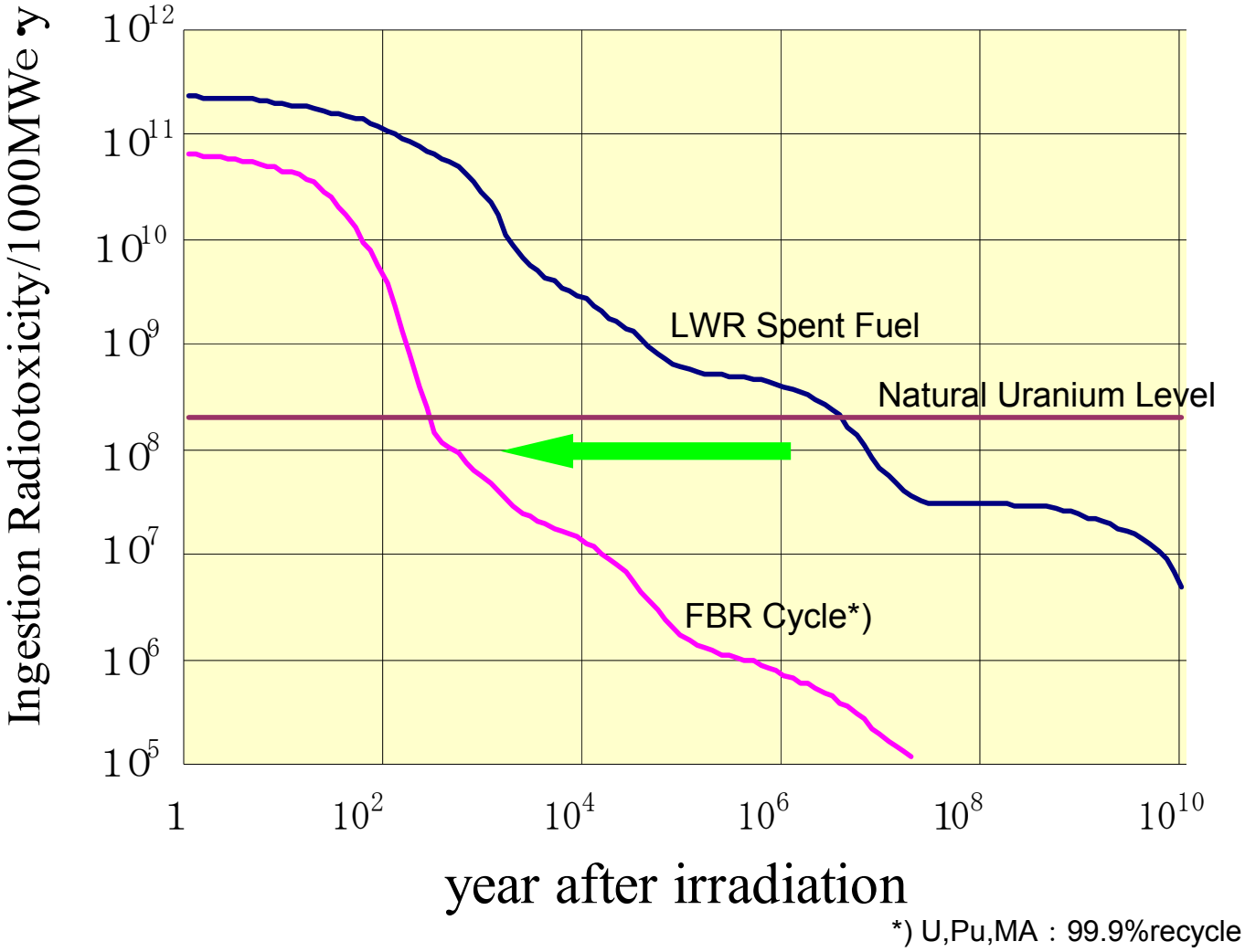

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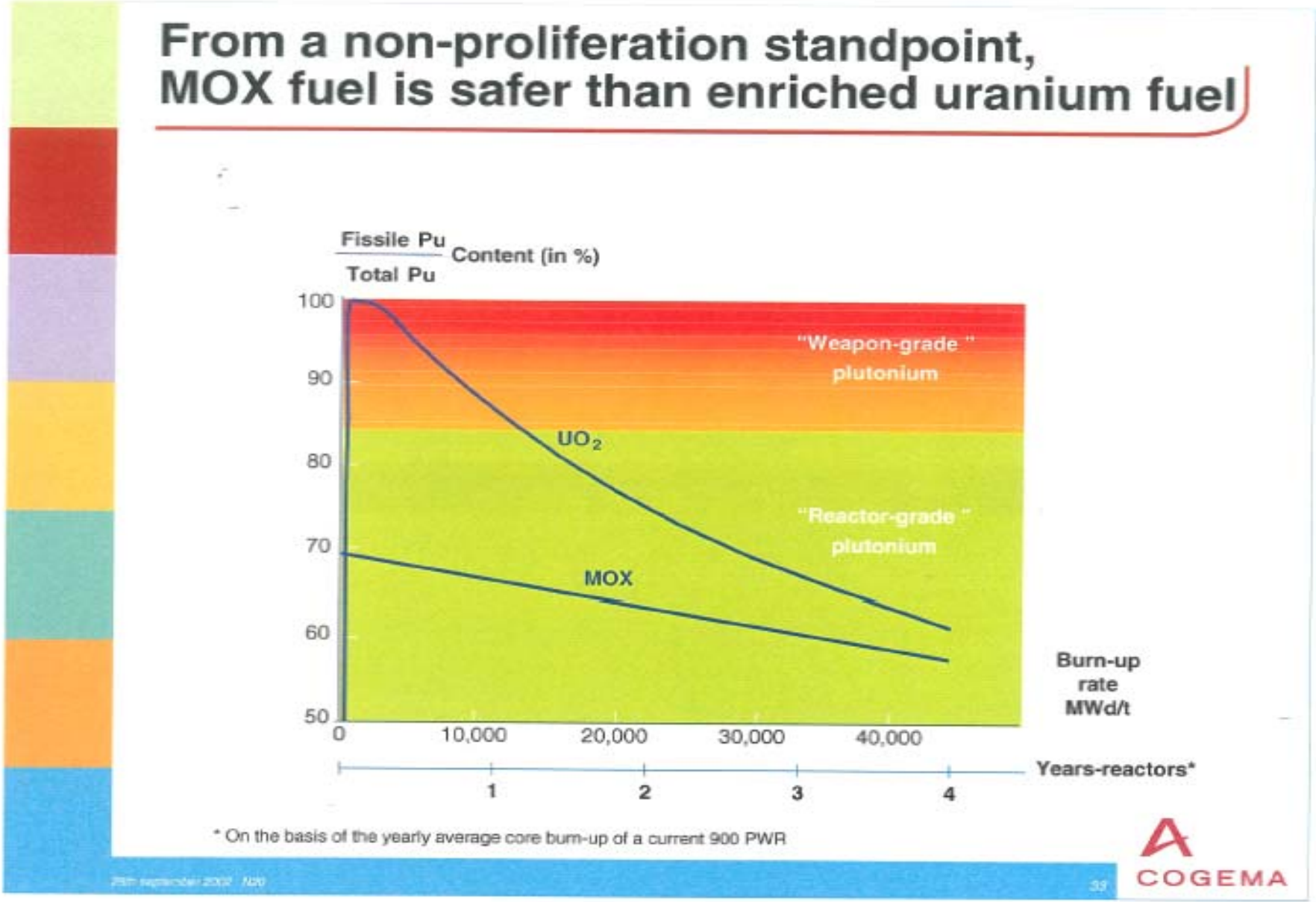

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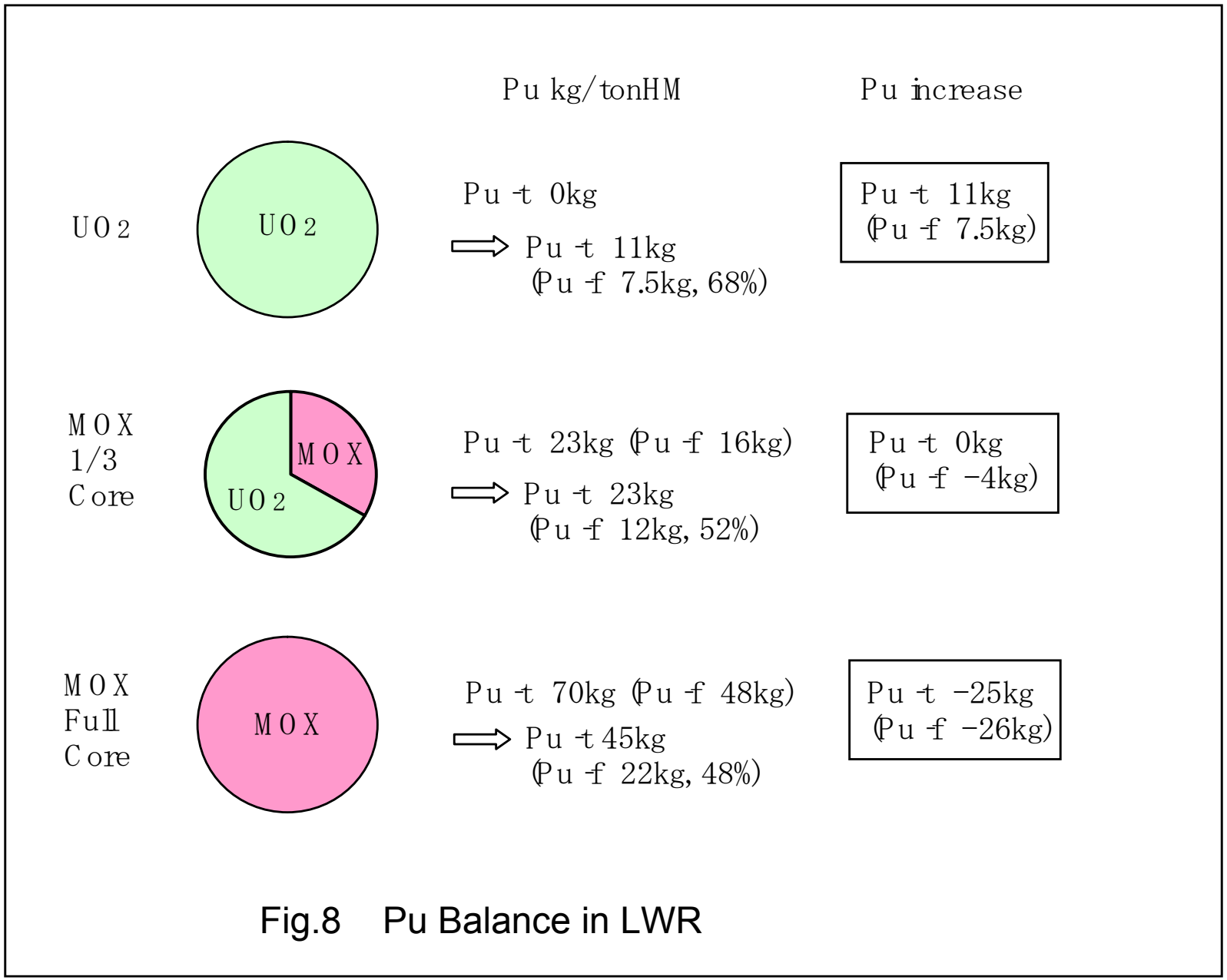

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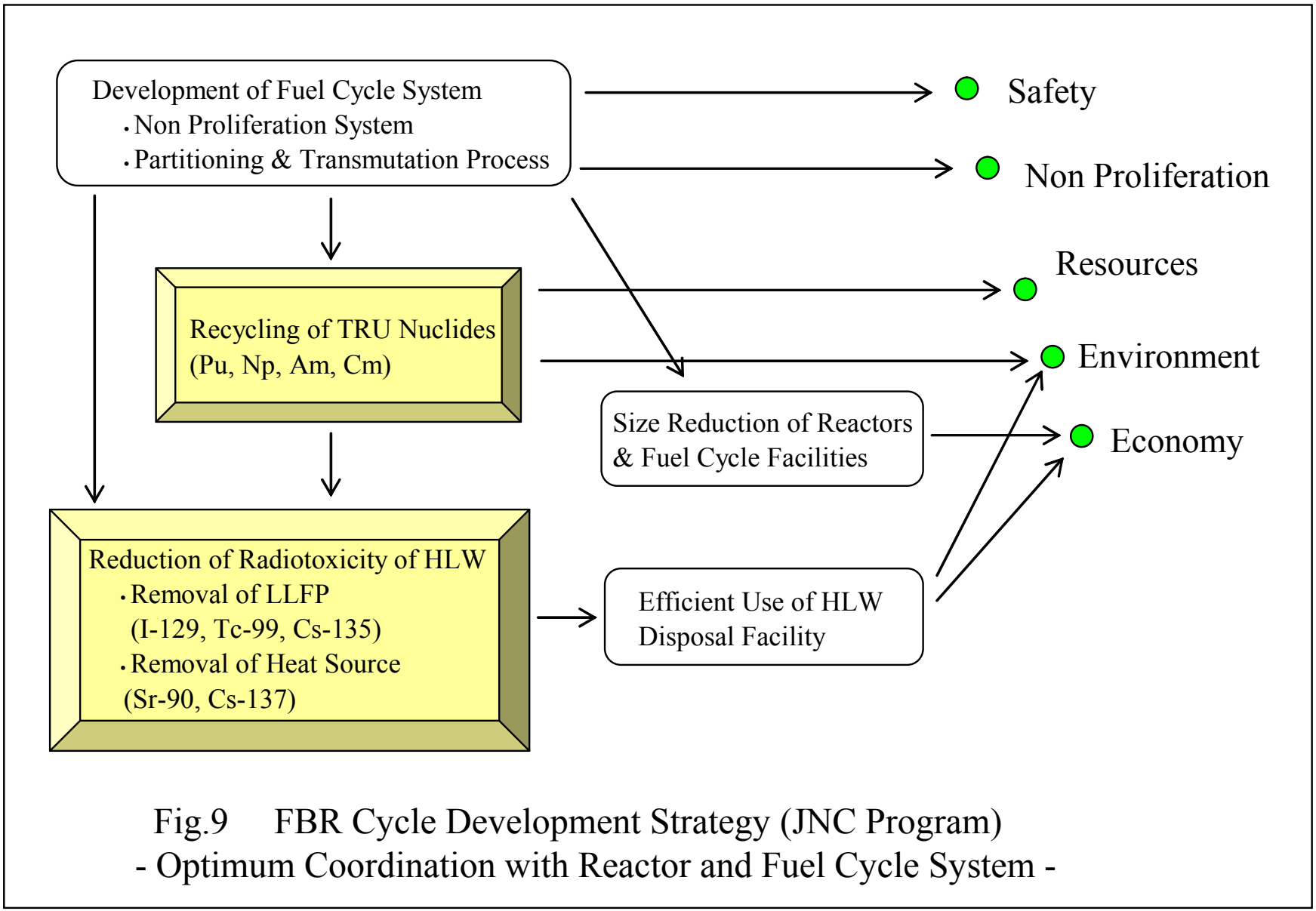

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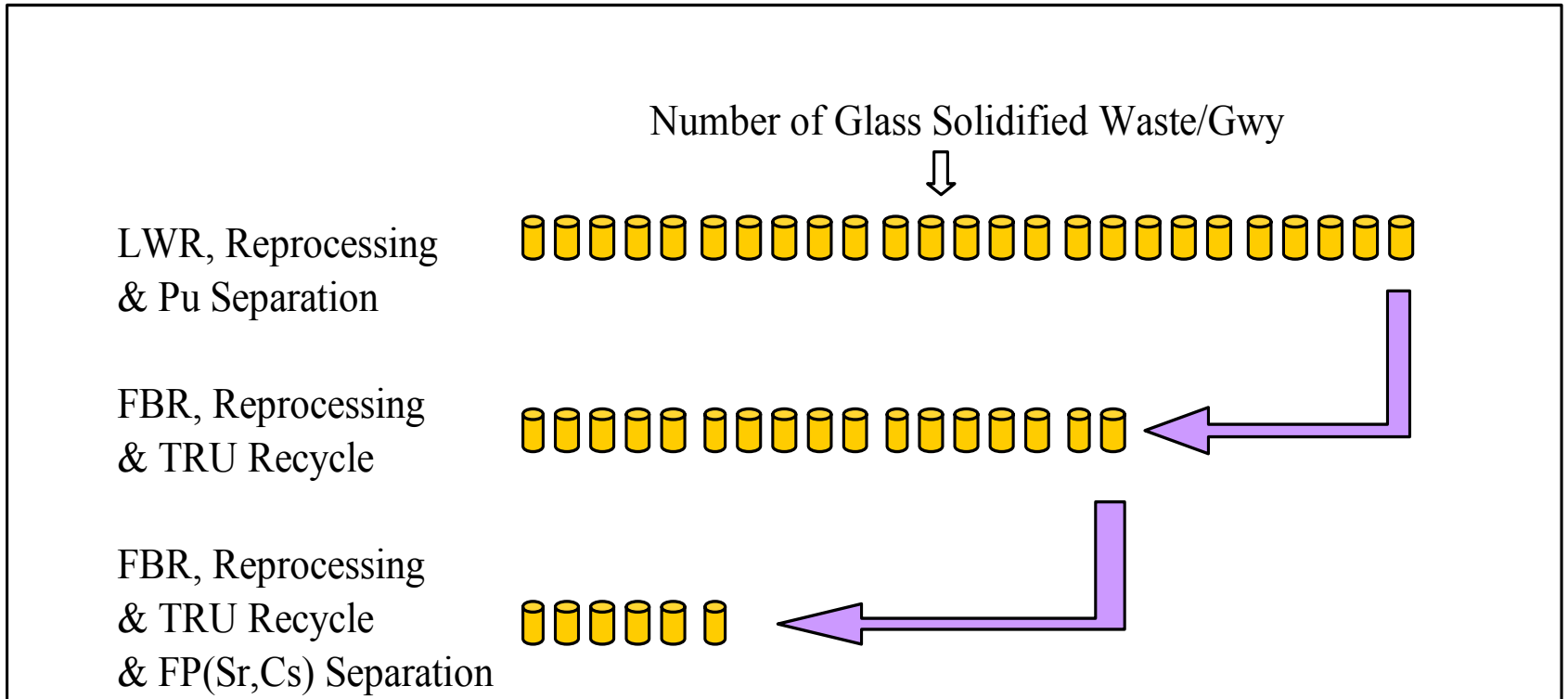

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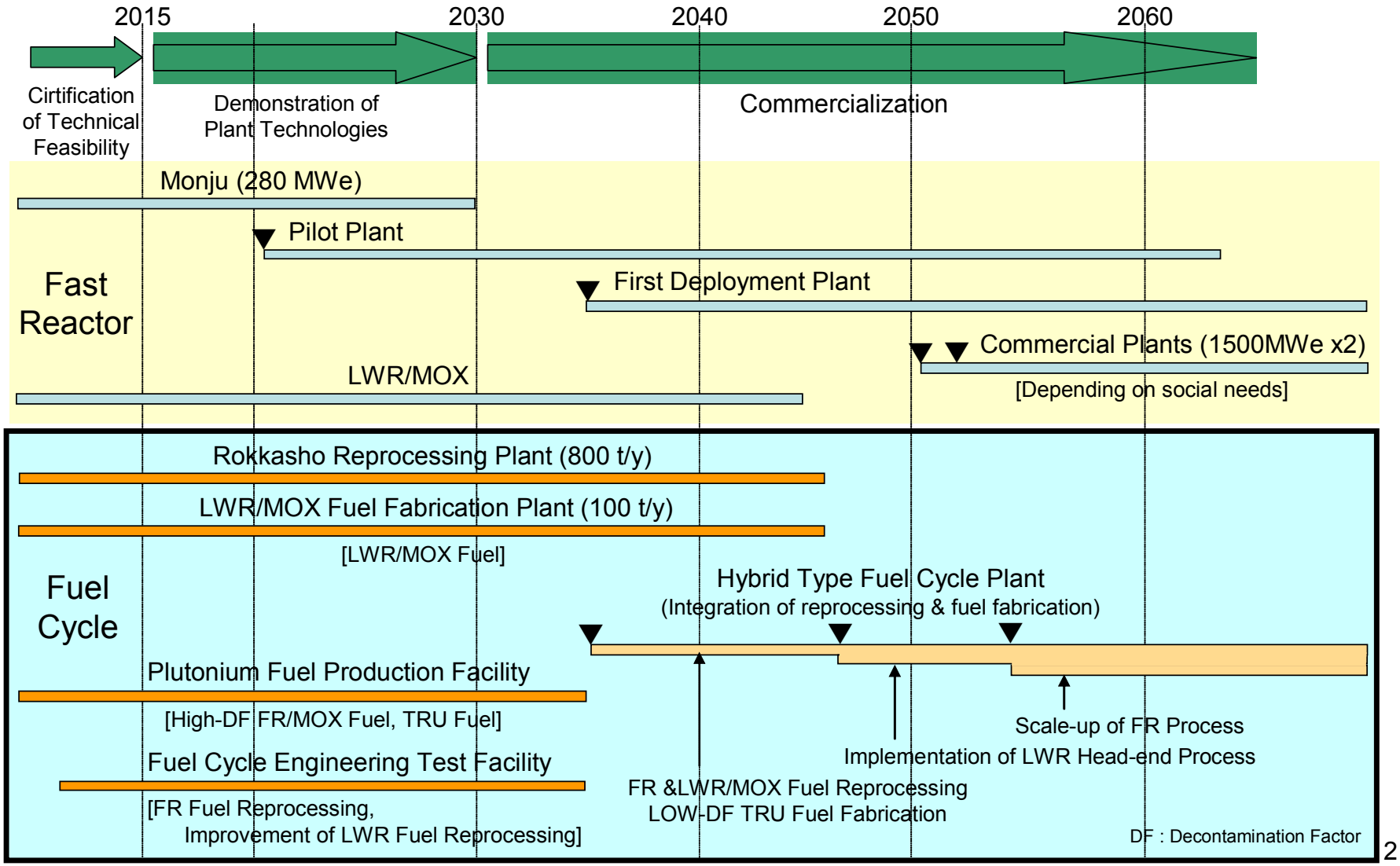

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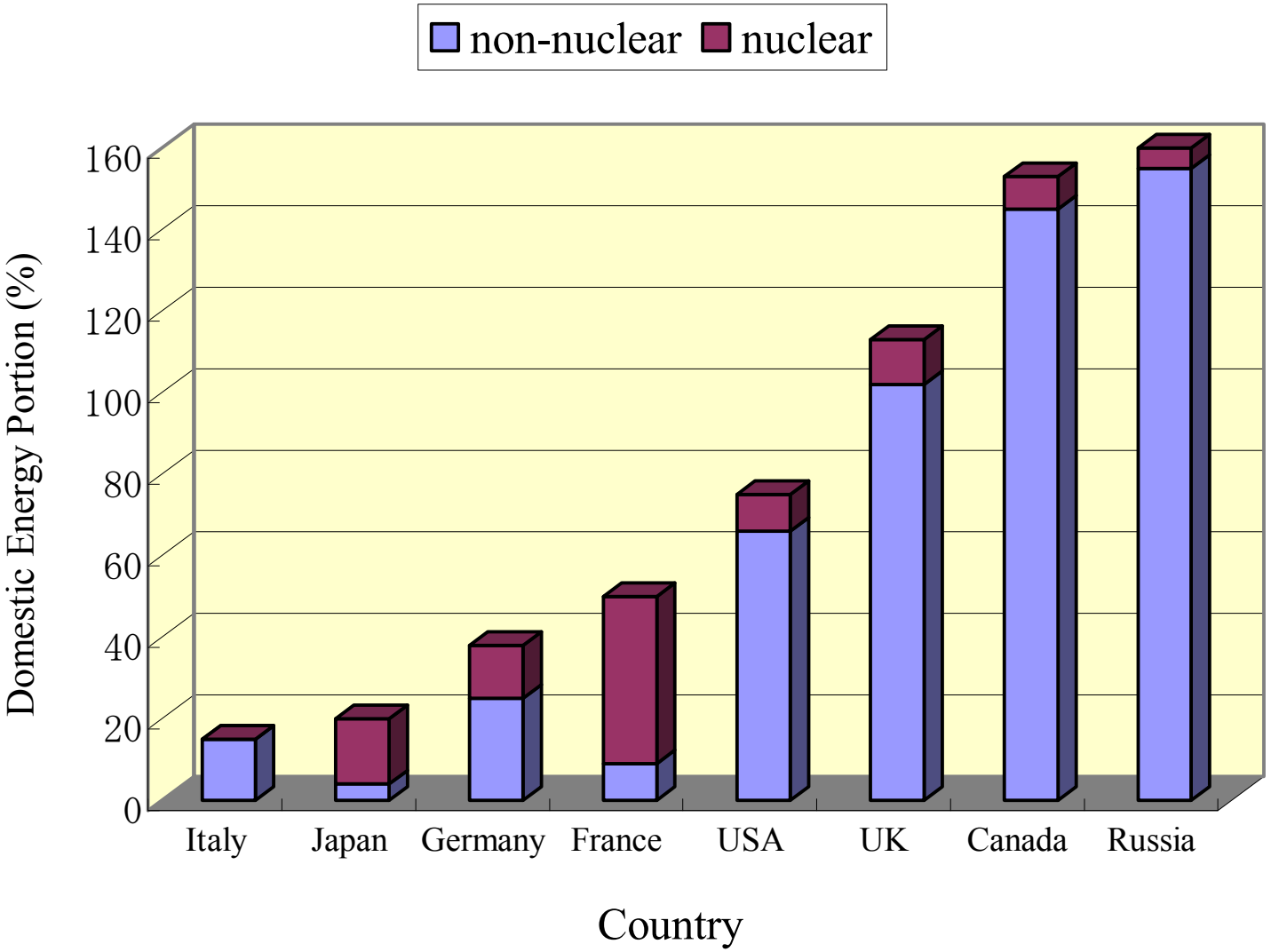

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