Visions for the Next Nuclear Era

For Significant Growth in Global Use of Nuclear Energy

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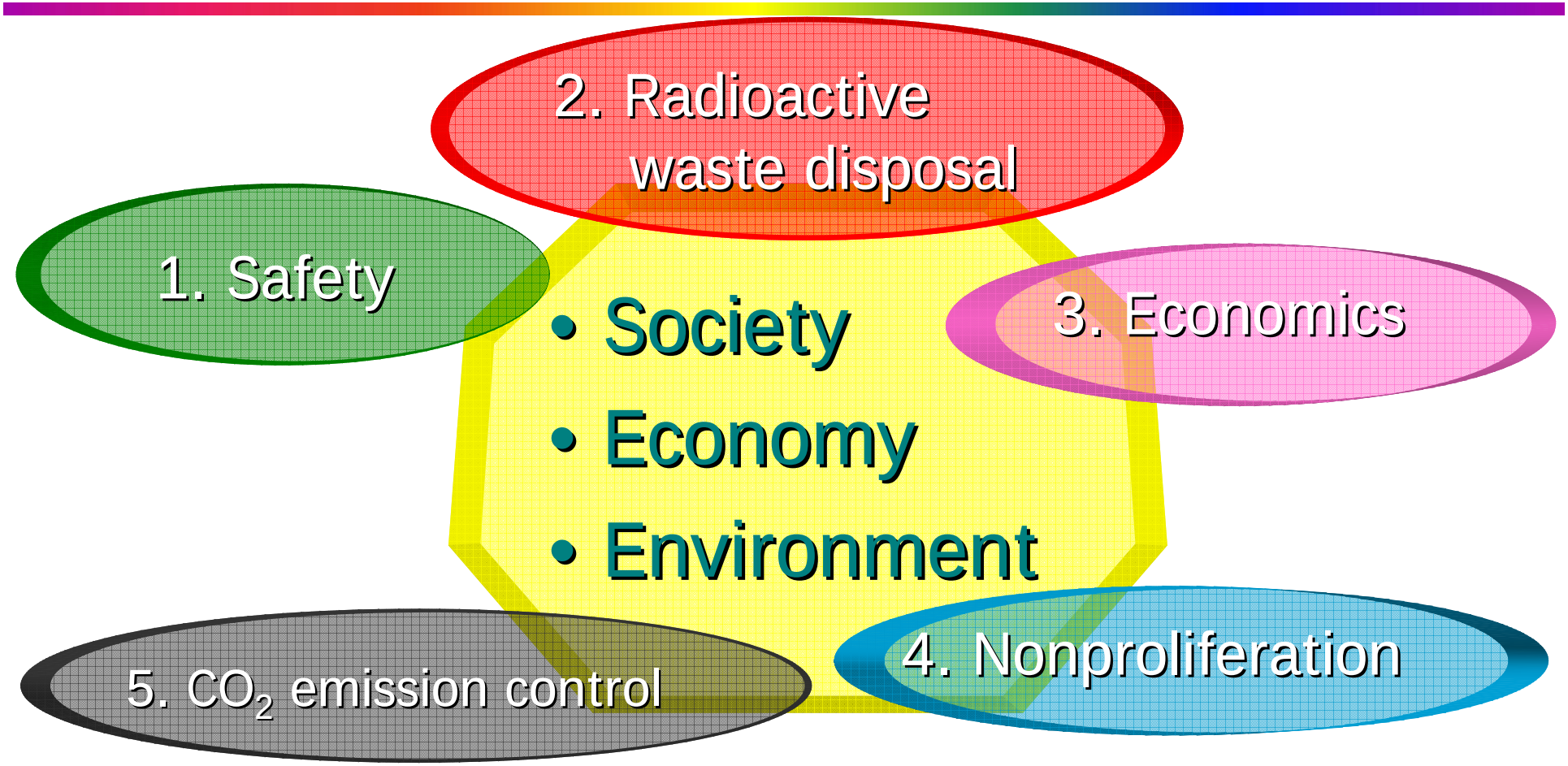
Dimensions of Global Use of Nuclear Energy



Conditions and characteristics for significant growth in Global use of nuclear energy

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1. Safety
2. Radioactive waste disposal
3. Economics
4. Nonproliferation
5. CO_2 emission control

Safety

- Maintain the safety of nuclear power plants and related nuclear facilities
- Highest reliability of the safety
  - Peace of mind, freedom from anxiety for the public
  - Risk information
- Public acceptance
  - Open information on troubles, incidents and accidents as well as advantages and disadvantages of nuclear energy

Conditions and characteristics for significant growth in Global use of nuclear energy

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2. ⇨ Radioactive waste disposal
3. Economics
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Radioactive waste disposal

- Establishment of a safe and reliable geological disposal of high-level radioactive waste
  - Direct disposal: Spent fuel
  - Reprocessing: Vitrified waste
  - Establishment of common scientific database
- Reservation of final repository
- Interim storage
- Transmutation of long-lived minor actinides

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Economics: Power generation cost in Japan

	Power generation cost at a fixed operational lifetime of 40 years (fraction of fuel cost %) and fuel cost			
	yen/kWh			
Nuclear	5.3			
Oil fired	10.7	(50)	27.41	$/b
Gas fired	6.2	(60)	255.36	$/t
Coal fired	5.7	(40)	35.5	$/t
Hydraulic	11.9			

Capacity factor: 80 % (Hydraulic: 45 %)

Discount rate: 3%

(By the Federation of Electric Power Companies, 2003)

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Nonproliferation

- All of the countries have to accept:
  - technical and institutional measures for safeguards and nonproliferation
  - regular inspection for all of the nuclear facilities
- How proliferation-resistant is enough proliferation-resistant ?

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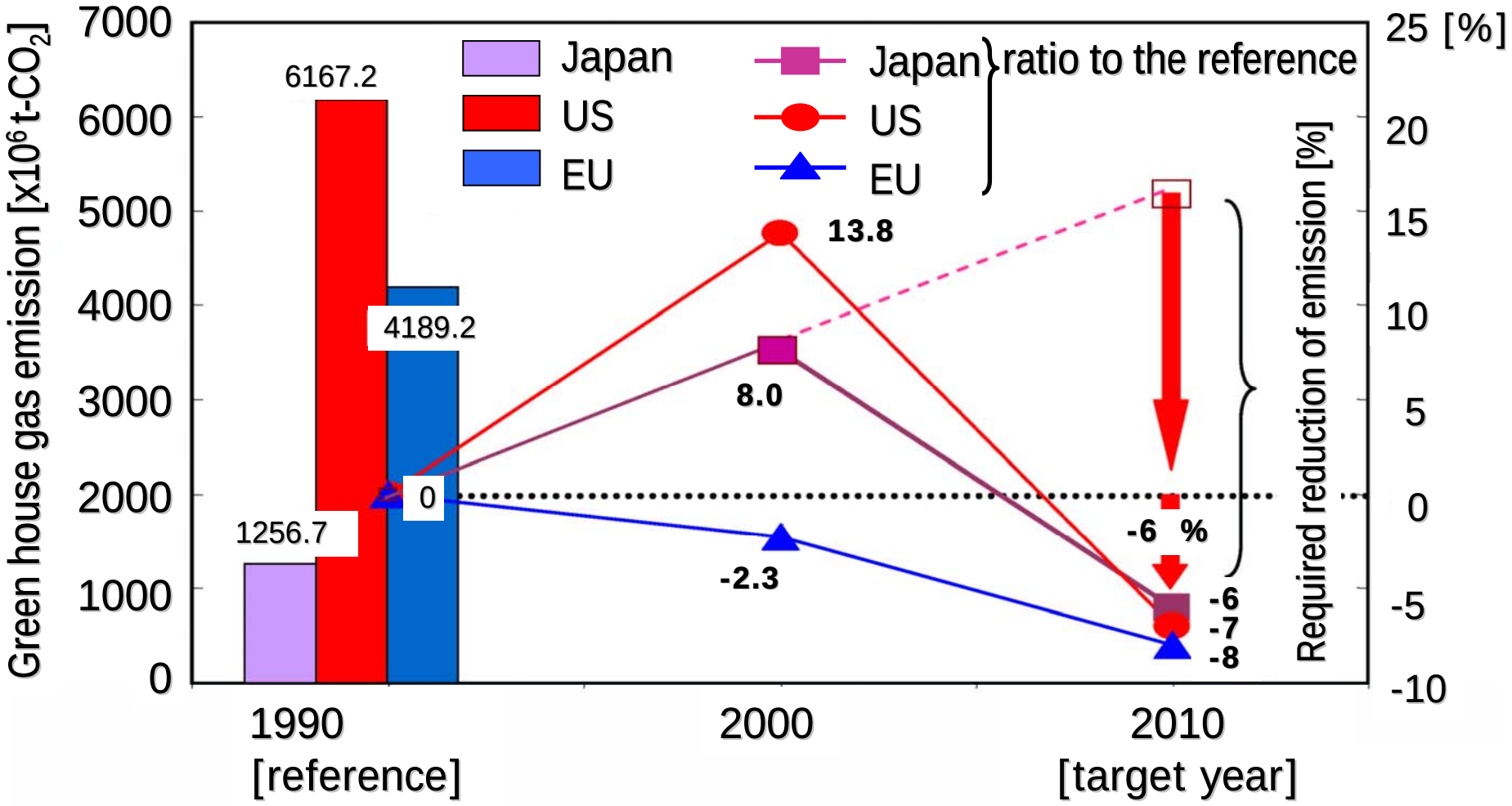
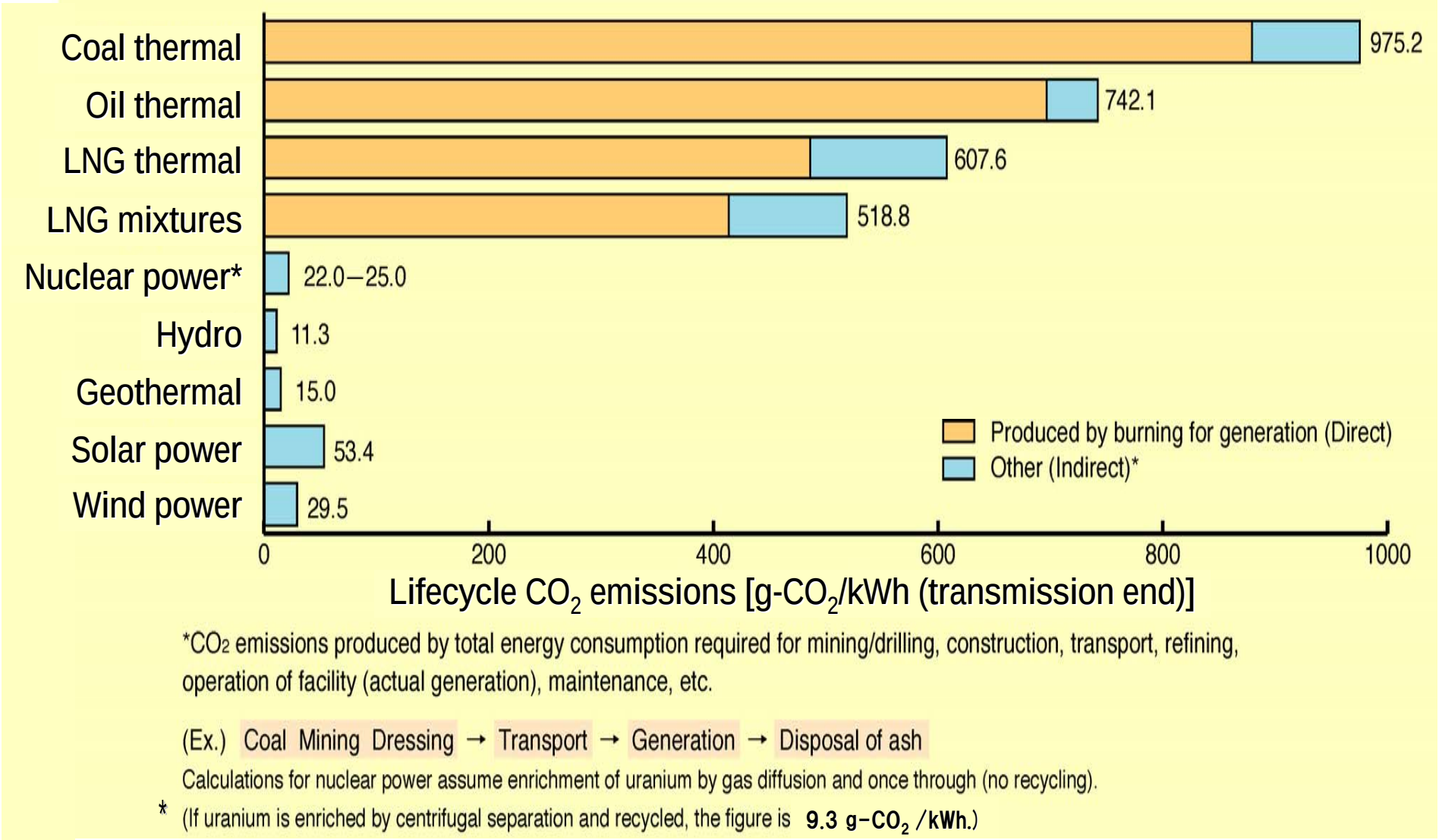
Reduction of CO_2 emission required by Kyoto Protocol

1 NPP(1 MkWe) can reduce 0.6 % of total CO_2 emission in Japan.



(By Ministry of Economy, Trade and Industry, 2003)

CO_2 emissions from different energy sources



*CO_2 emissions produced by total energy consumption required for mining/drilling, construction, transport, refining, operation of facility (actual generation), maintenance, etc.

(Ex.) Coal Mining Dressing → Transport → Generation → Disposal of ash

Calculations for nuclear power assume enrichment of uranium by gas diffusion and once through (no recycling).

* (If uranium is enriched by centrifugal separation and recycled, the figure is **9.3 g-CO_2 /kWh.**)

(By Central Research Institute of Electric Power Industry)

Conditions and characteristics for significant growth in Global use of nuclear energy

1. Safety: Nuclear power plants and related nuclear facilities are safe enough to the public.
2. Radioactive waste disposal: The sites are reserved for safe and reliable geological disposal of high-level radioactive waste.
3. Economics: Nuclear energy is economically competitive with other energy sources even under liberalization of electricity market.
4. Nonproliferation: Nonproliferation regime is strictly observed by all the countries.
5. CO_2 emission control: Every country keeps the limit of CO_2 emission agreed upon internationally to prevent global warming.

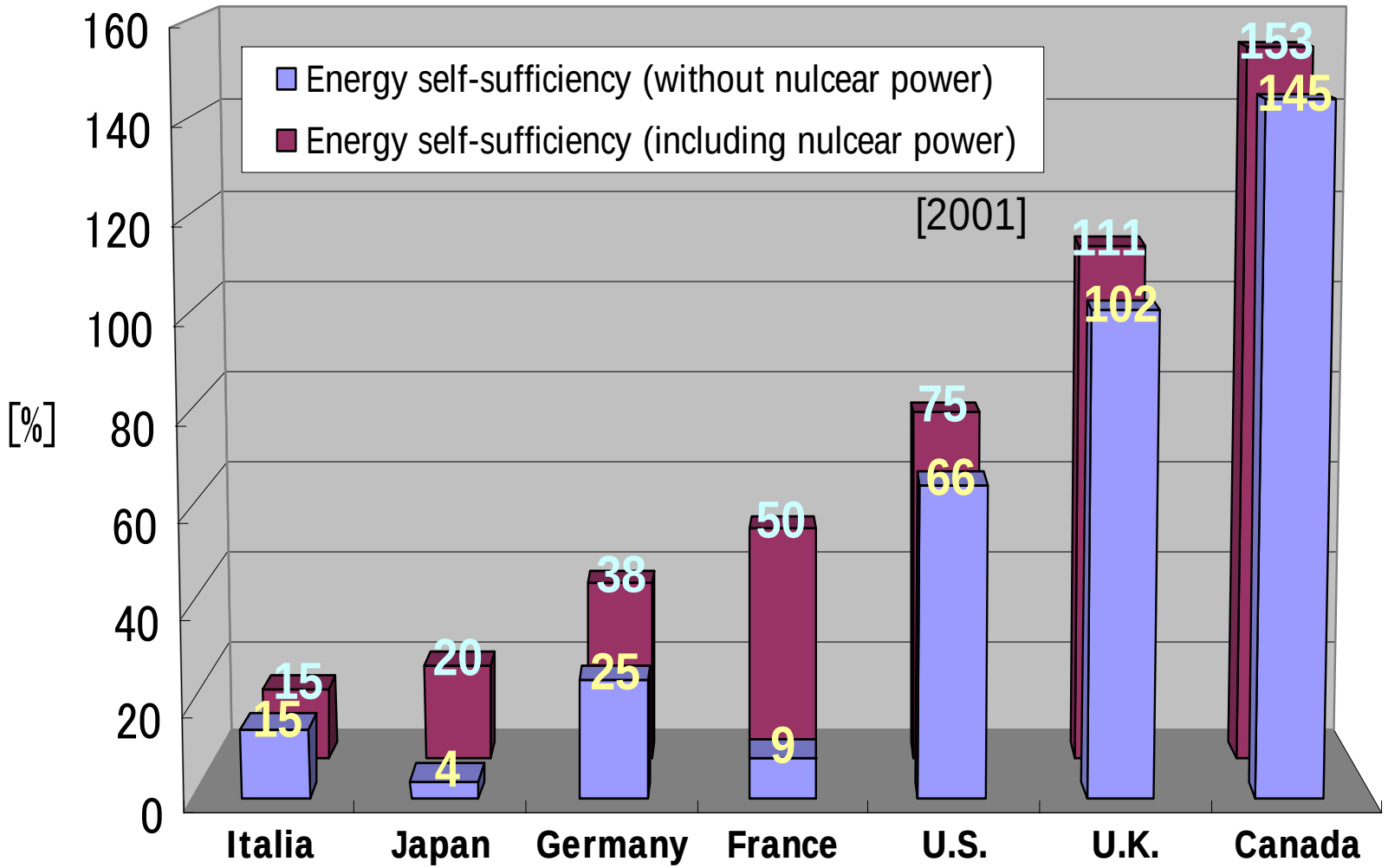
Complementary vision for promotion of use of nuclear energy

1. Fuel recycling
2. Non-electricity use
3. Cooperation in the peaceful use of nuclear energy in Asia

Fuel recycling

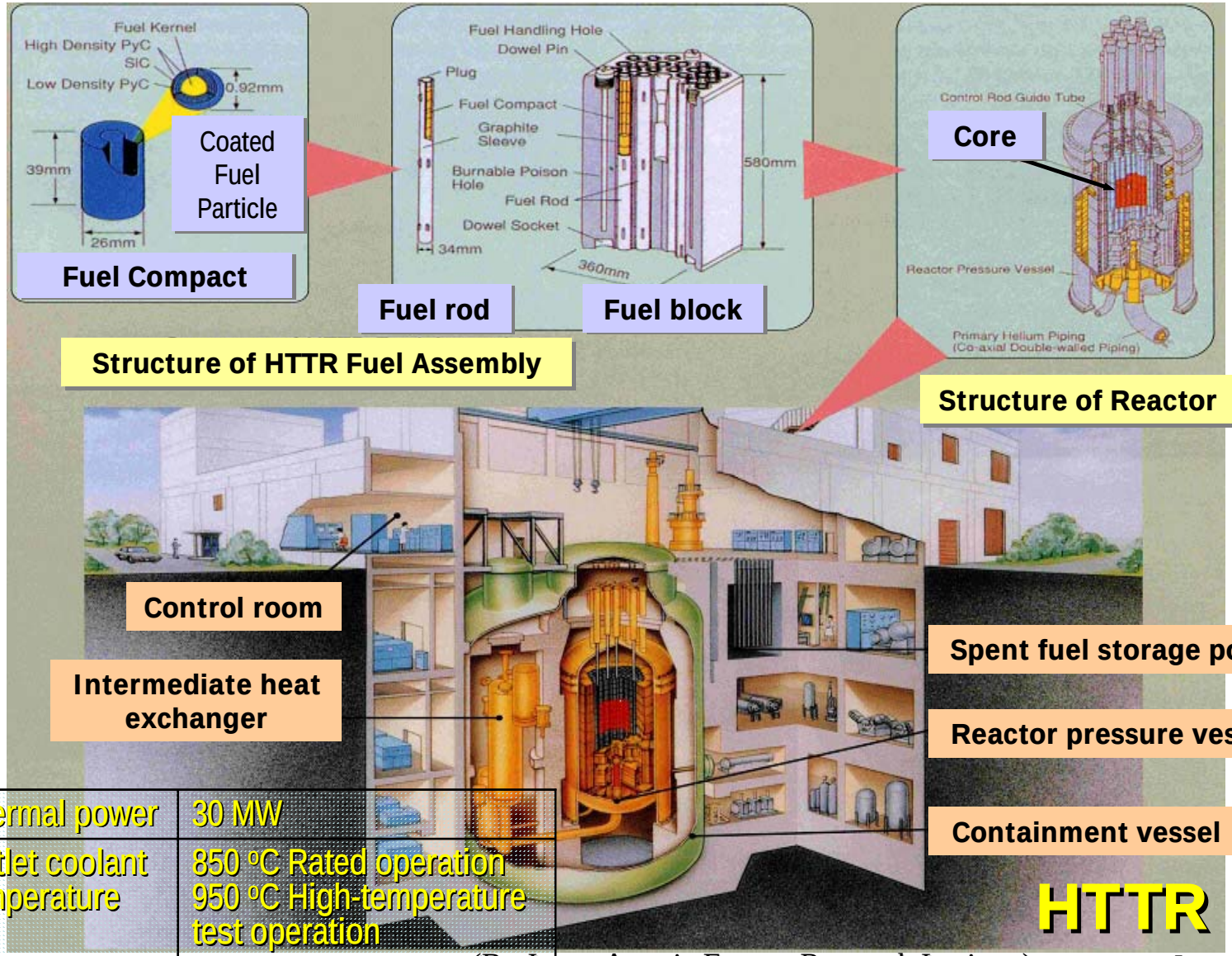
- Some people and some groups advocate or insist that there is a plenty of uranium resources in the world. Then, fuel recycling is not necessary for the coming 50 years.
- No guarantee for the countries, with no uranium resource, to be able to obtain necessary amounts of uranium at appropriate price in anytime.
- This is critical matter to the countries with very low self-sufficiency of energy.

Self sufficiency of energy



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

High-temperature Gas-cooled Engineering Test Reactor (HTTR) in JAERI



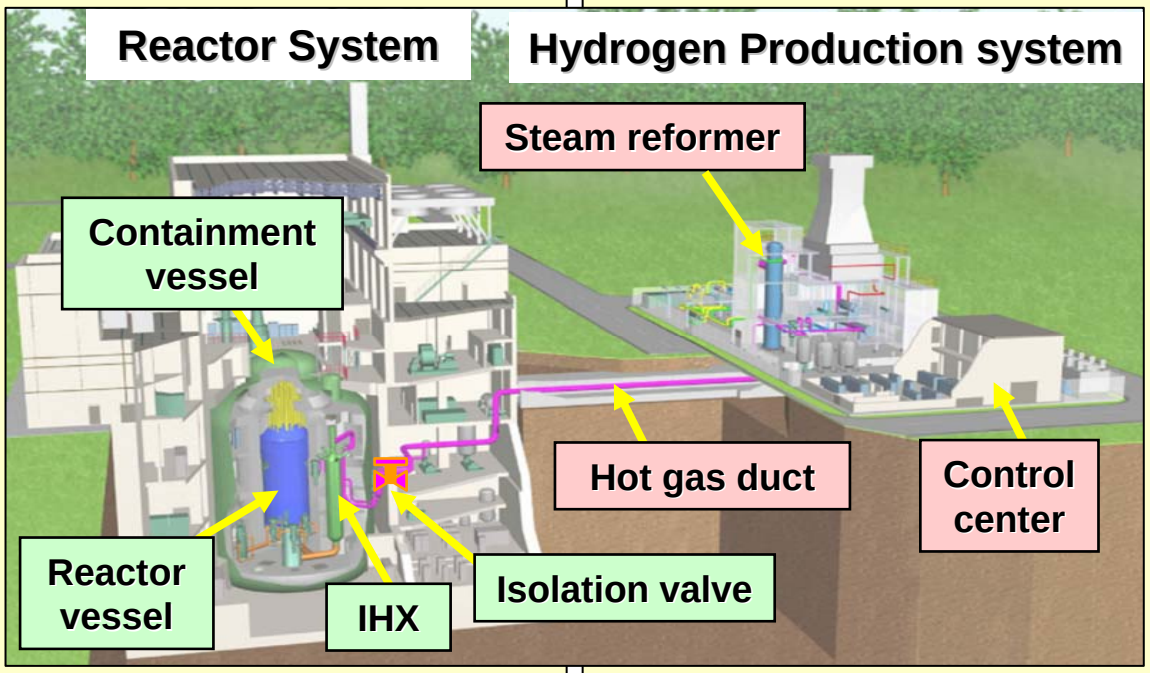
Thermal power	30 MW
Outlet coolant temperature	850 °C Rated operation 950 °C High-temperature test operation

(By Japan Atomic Energy Research Institute)

HTTR-Hydrogen Production Demonstration Project

(By Japan Atomic Energy Research Institute)

Reactor Technology (HTTR)

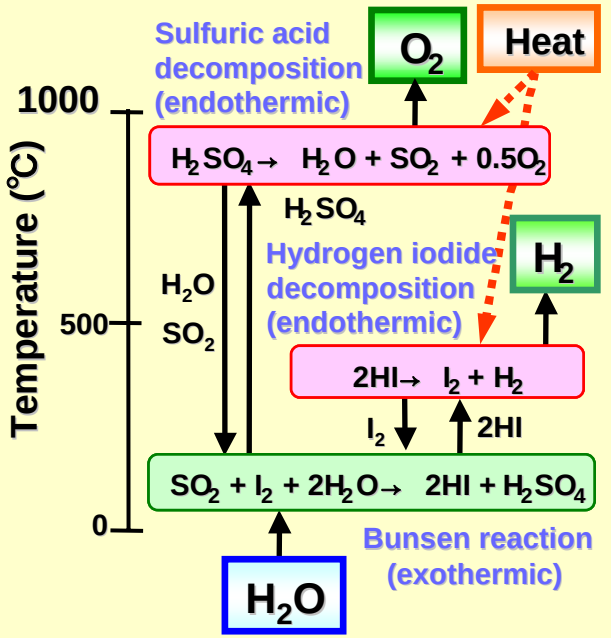


- 1998: First criticality
- 2001: 30 MW, 850 ºC
- 2004: Outlet temp.950 ºC

Hydrogen Production (Steam reforming)

- Simulation test : underway
- Isolation valve test : underway

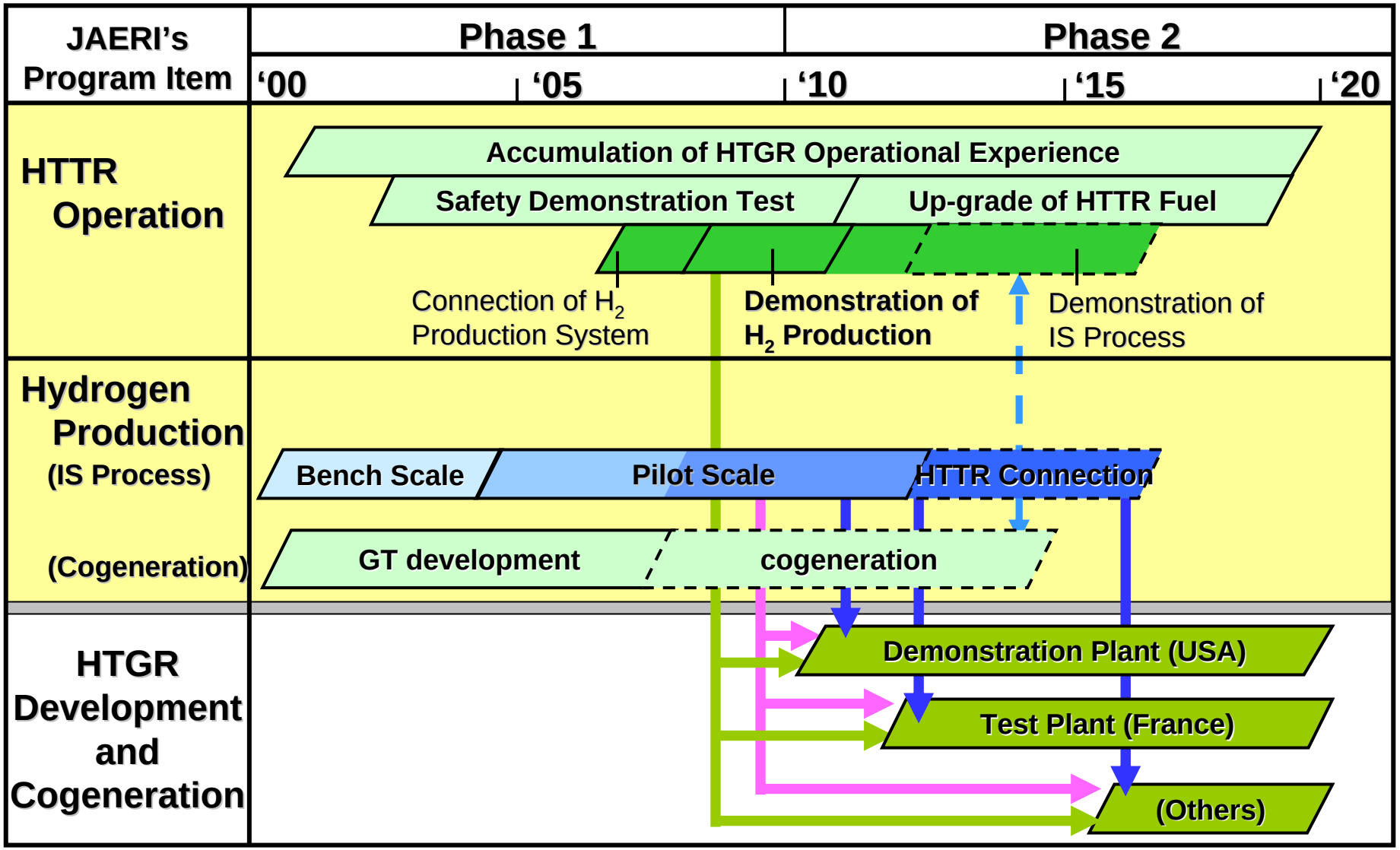
Hydrogen Production (IS process)



- Step1: Laboratory scale : completed
- Step2: Bench scale : underway
- Step3: Pilot scale: planned
- Step4: Connects with HTTR : planned

HTTR system integration test: planned

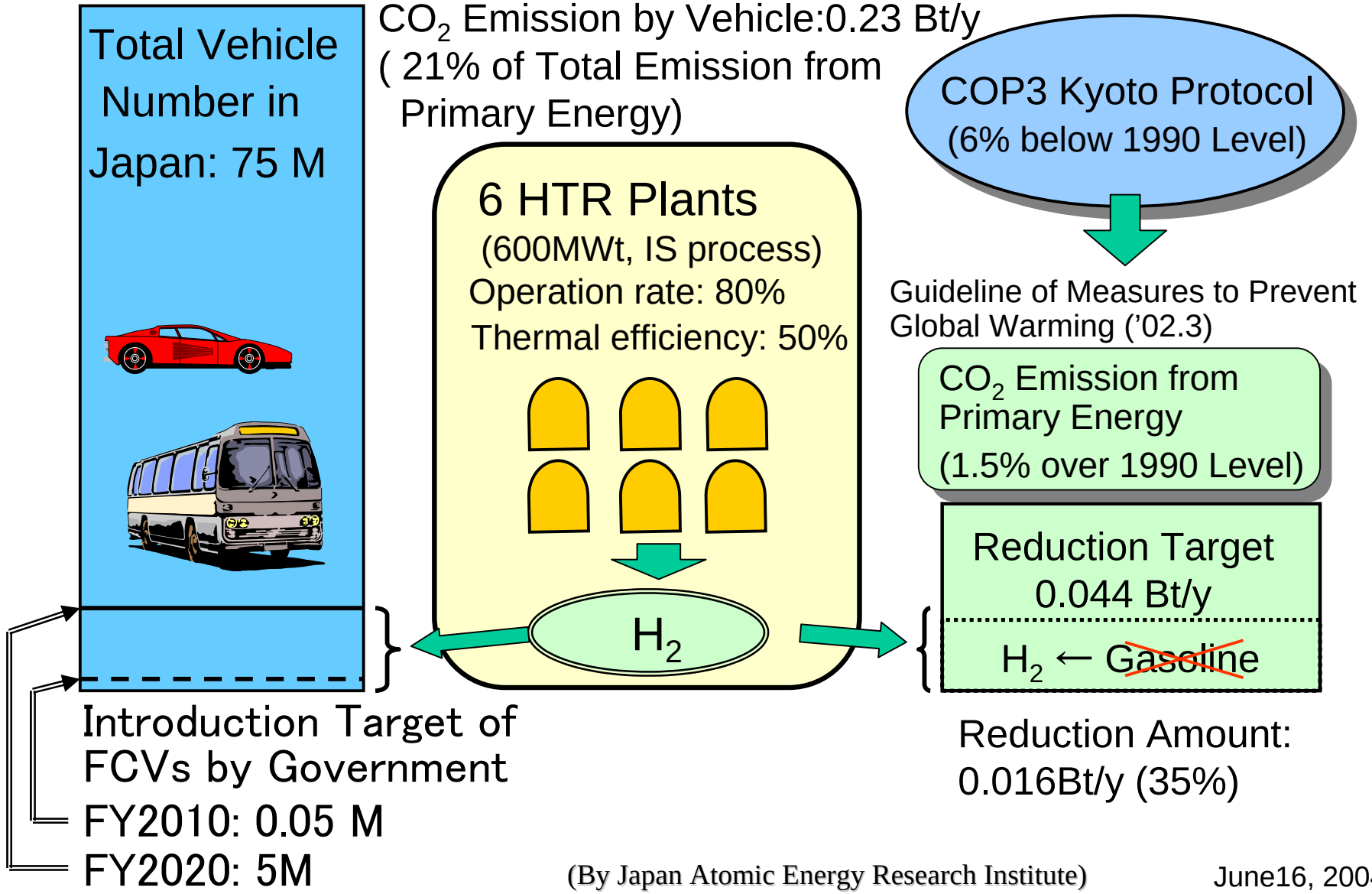
International Collaboration on Development of HTGR and Hydrogen Production Technologies Proposed by JAERI



(By Japan Atomic Energy Research Institute)

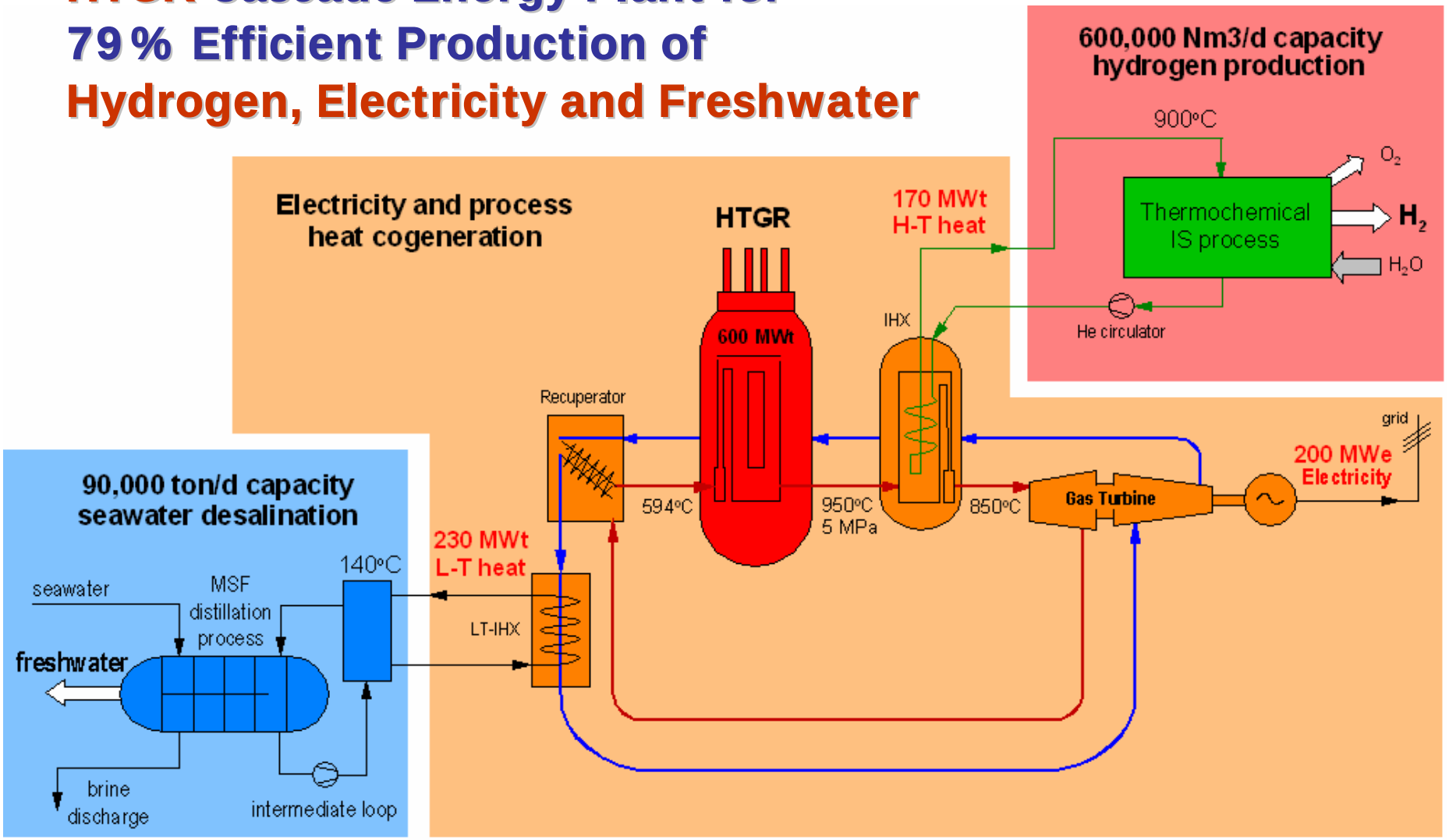
June16, 2004-20

Hydrogen utilization - Reduction of CO_2 Emission



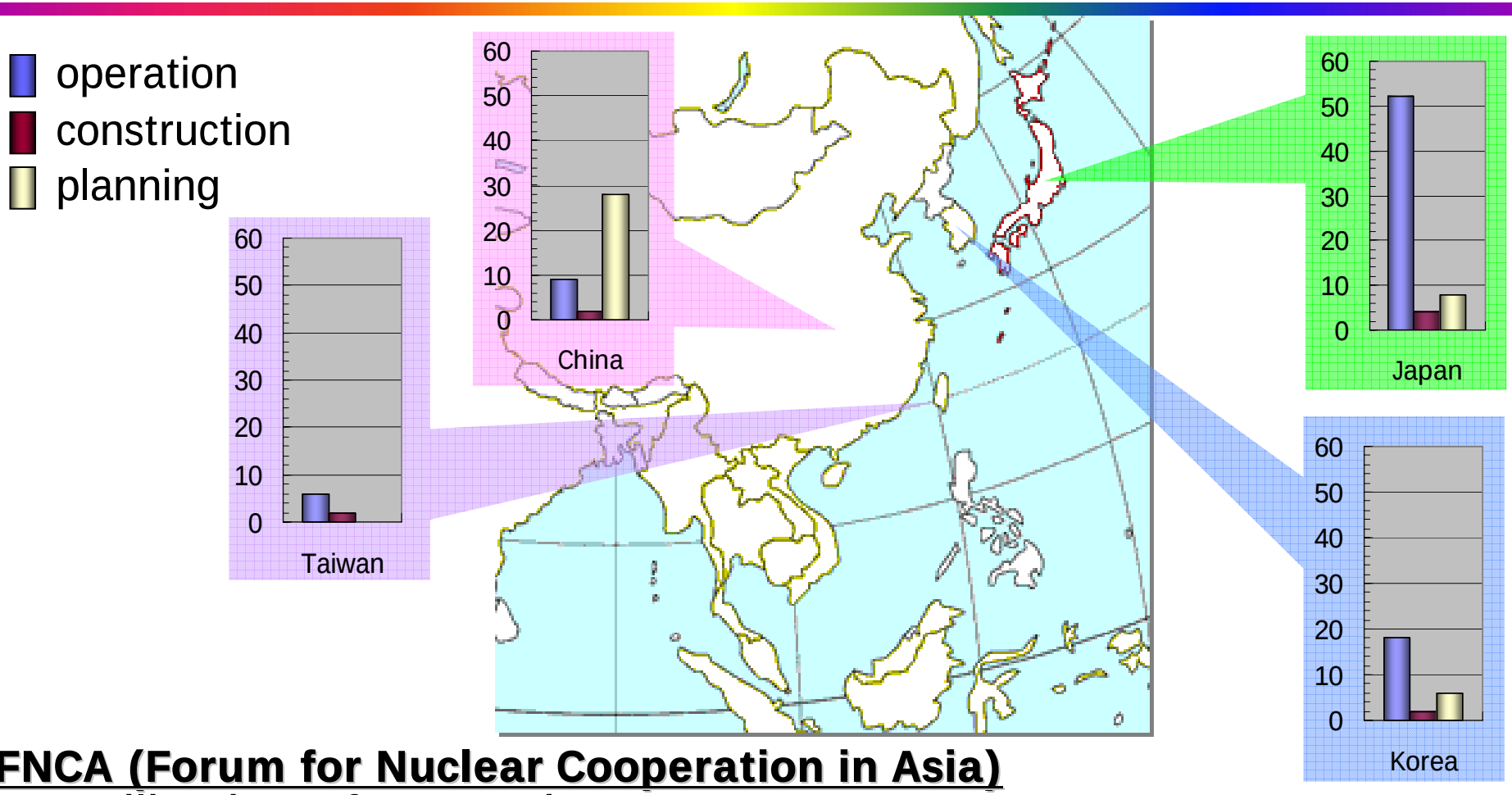
Advantage of High Temperature Gas-cooled Reactor

HTGR Cascade Energy Plant for 79% Efficient Production of Hydrogen, Electricity and Freshwater



(By Japan Atomic Energy Research Institute)

Status and prospects of nuclear power plants in east Asia



FNCA (Forum for Nuclear Cooperation in Asia)

- Utilization of research reactors
- RI, Irradiation (agriculture, medical)
- Information on nuclear energy
- Radioactive waste management
- Safety culture
- Education

Summary

- Five elements, safety, radioactive waste disposal, economics, nonproliferation and CO_2 emission control are essential factors for significant growth in global use of nuclear energy.
- Fuel recycling is indispensable particularly for countries with very low self-efficiency of energy.
- The enlargement of nuclear energy use to non-electricity field such as hydrogen production and co-generation is very important for production of clean secondary energy and reduction of CO_2 emissions as well as improvement of total thermal efficiency.
- The regional cooperation in Asia is indispensable for the peaceful and safe use of nuclear energy.