

# Sustainability of Advanced Fuel Cycles

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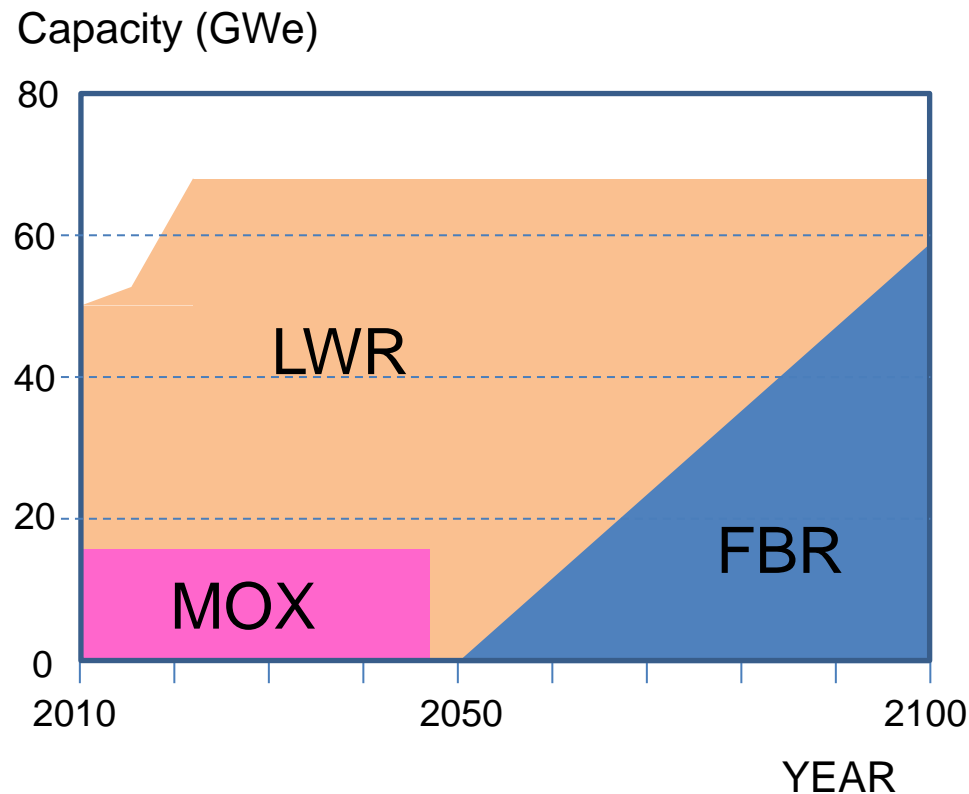
# Introduction

- Before 3.11,
  - Japan had promoted R&D for commercial deployment in the middle of the century.
- Now,
  - Japan is in the course of deliberation of Energy Strategy.
  - Wide variety of scenarios are open in the deliberation.
  - It takes a certain period of time for the deliberation
  - R&D activities has been suspended so far.



# Contribution of FR System to Nuclear Power Generation Scenario Expected before 3.11

- Nuclear plants shares a half of total electricity demand.
- FBR will be introduced in 2050, as replacement of LWR.
- FBR is major source in the next century.

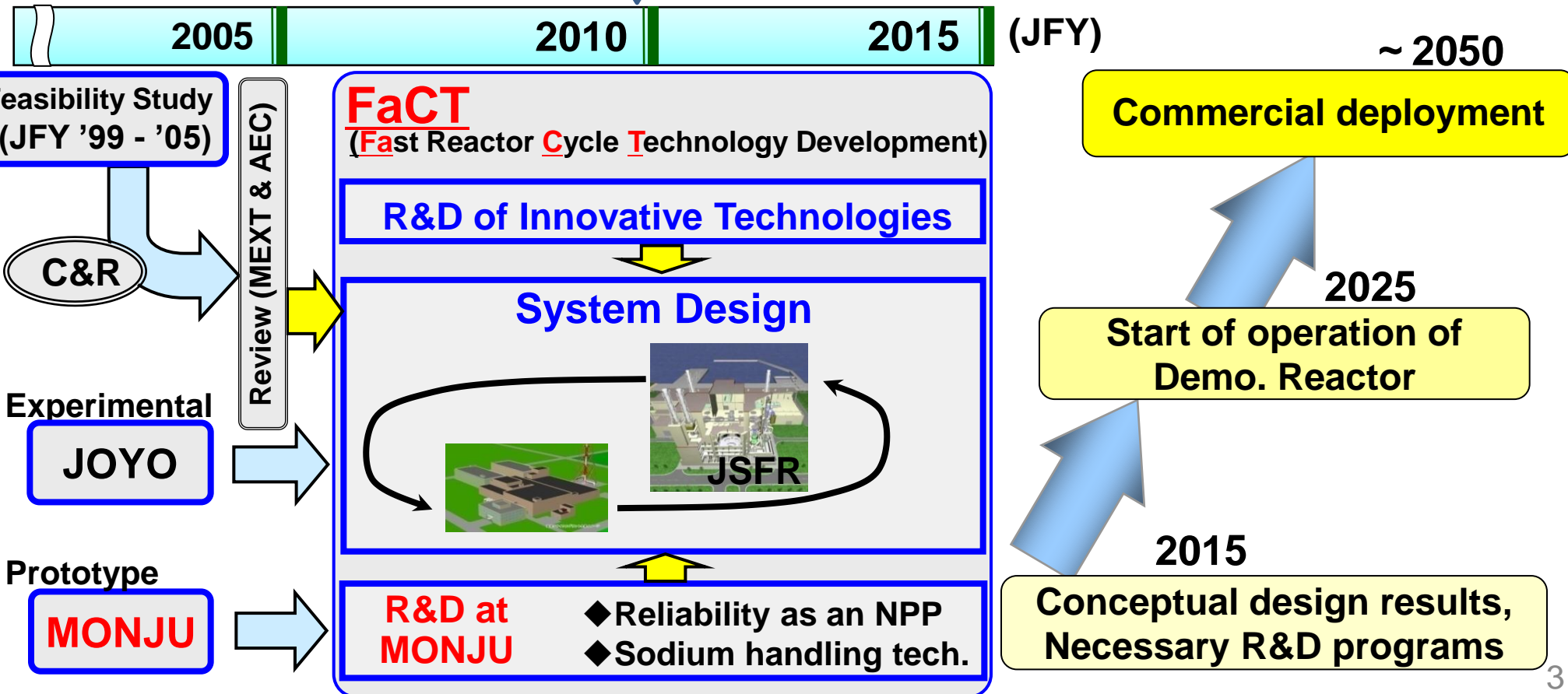




# FR Cycle R&D Program in Japan, before 3.11

- Japan had conducted intensive R&D activities with FaCT and MONJU for commercial deployment in ~2050 to fit with the scenario.

▼ 3.11





# Deployment Goal of FaCT Project

## **Safety and Reliability**

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- SR-1**     *Ensuring safety equal to future LWR and related fuel cycle facilities*
- SR-2**     *Ensuring reliability equal to future LWR and related fuel cycle facilities*

## **Sustainability**

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### **Environment Protection**

- EP-1**     *Radioactive influence through normal operation no more than future LWR cycle*
- EP-2**     *Emission control of environment transfer substances which can restrict in safety limits*

### **Waste Management**

- WM-1**     *Reduction of an amount of radioactive waste compared with future LWR cycle*
- WM-2**     *Improvement of waste manageability equal to or more than future LWR cycle*
- WM-3**     *Reduction of radio-toxicity compared with future LWR cycle*

### **Efficient Utilization of Nuclear Fuel Resources**

- UR-1**     *Breeding performance to enable transition to fast reactor, and its flexibility*

## **Economic Competitiveness**

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- EC-1**     *Electric generation cost which can compete with other power plants*
- EC-2**     *Investment risks no more than future LWR cycle*
- EC-3**     *External costs no more than future LWR cycle*

## **Nuclear Non-Proliferation**

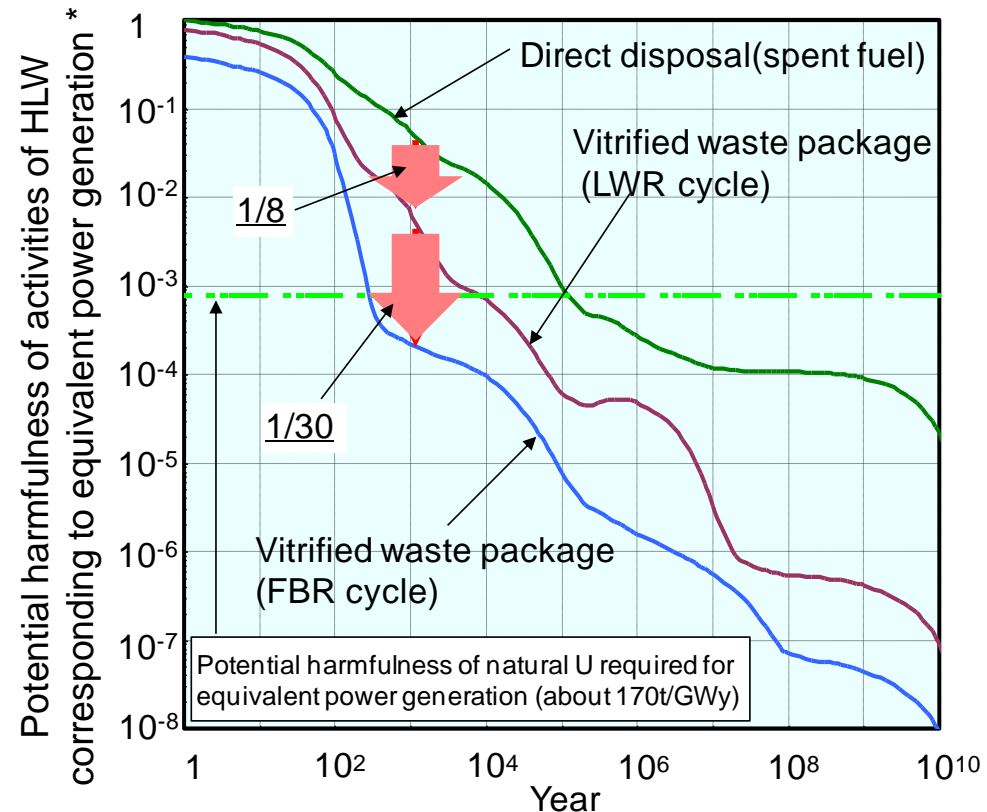
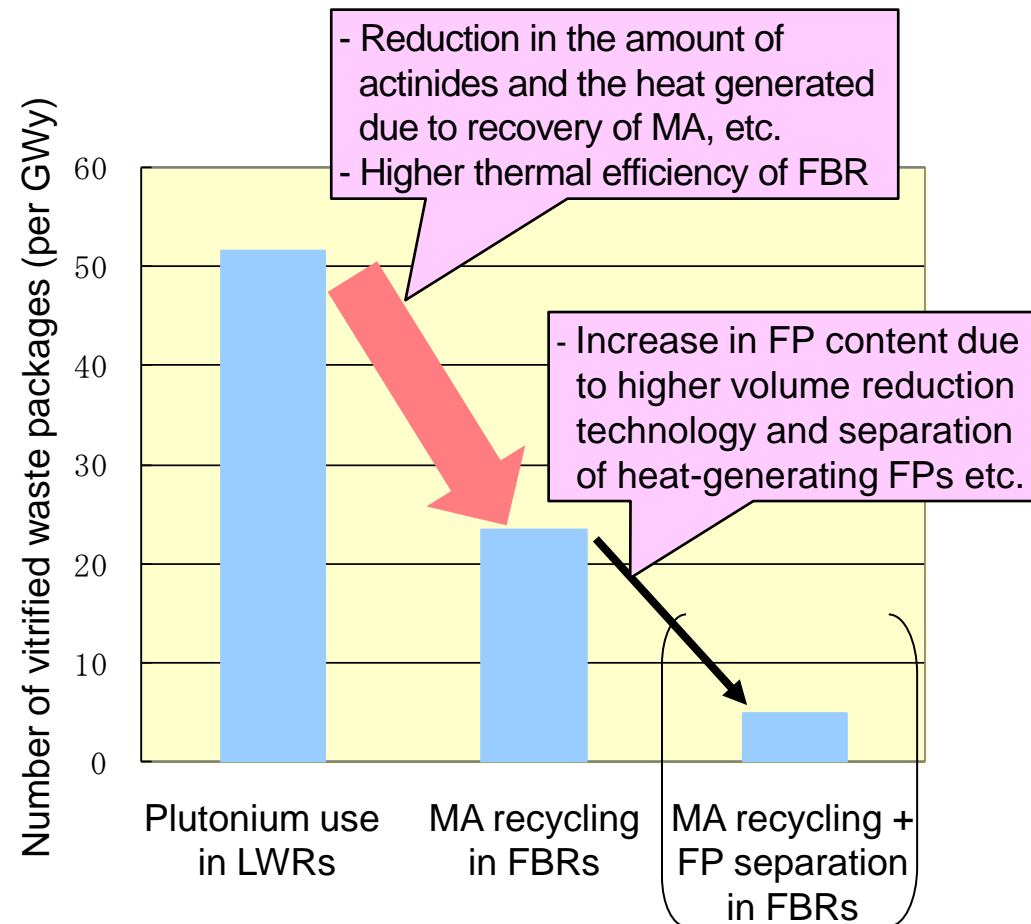
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- NP-1**     *Adoption of institutional measures and application of technical features which can enhance non-proliferation*
- NP-2**     *System design of physical protection and its development to prevent theft of nuclear materials and sabotage*



# Reduction in Volume and Toxicity of HLW estimated in FaCT before 3.11

- Commercialization of the FR cycle is important in terms of reducing environmental burden.

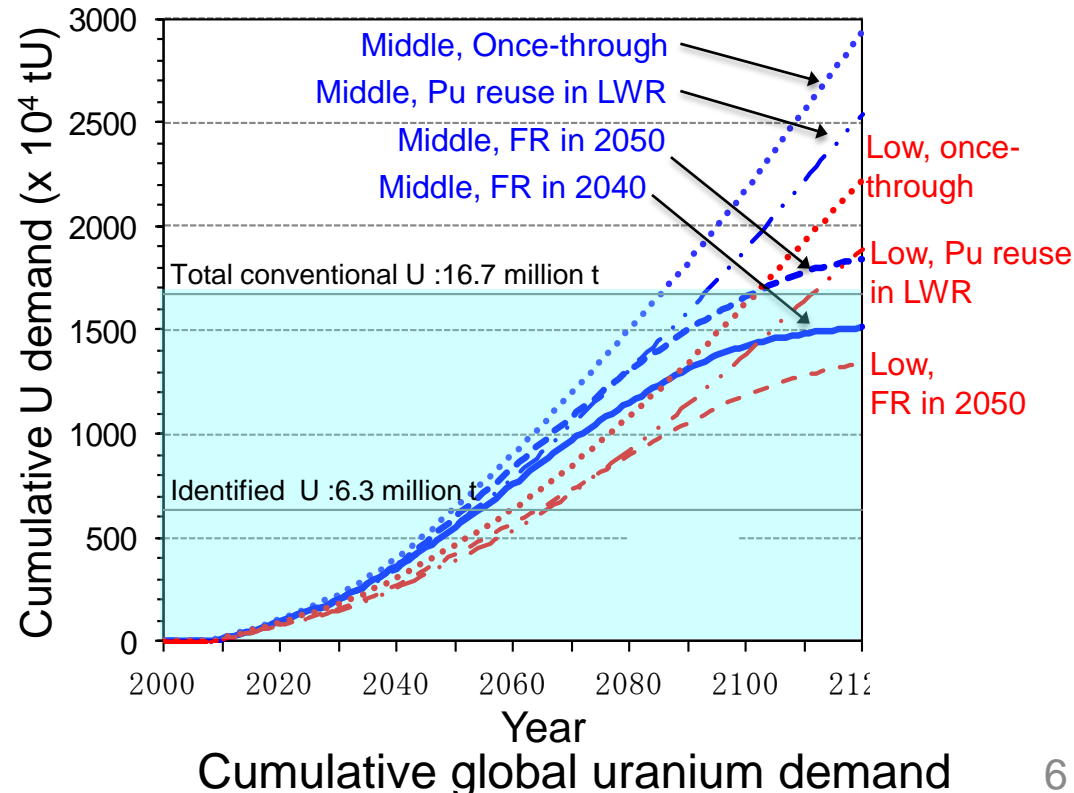
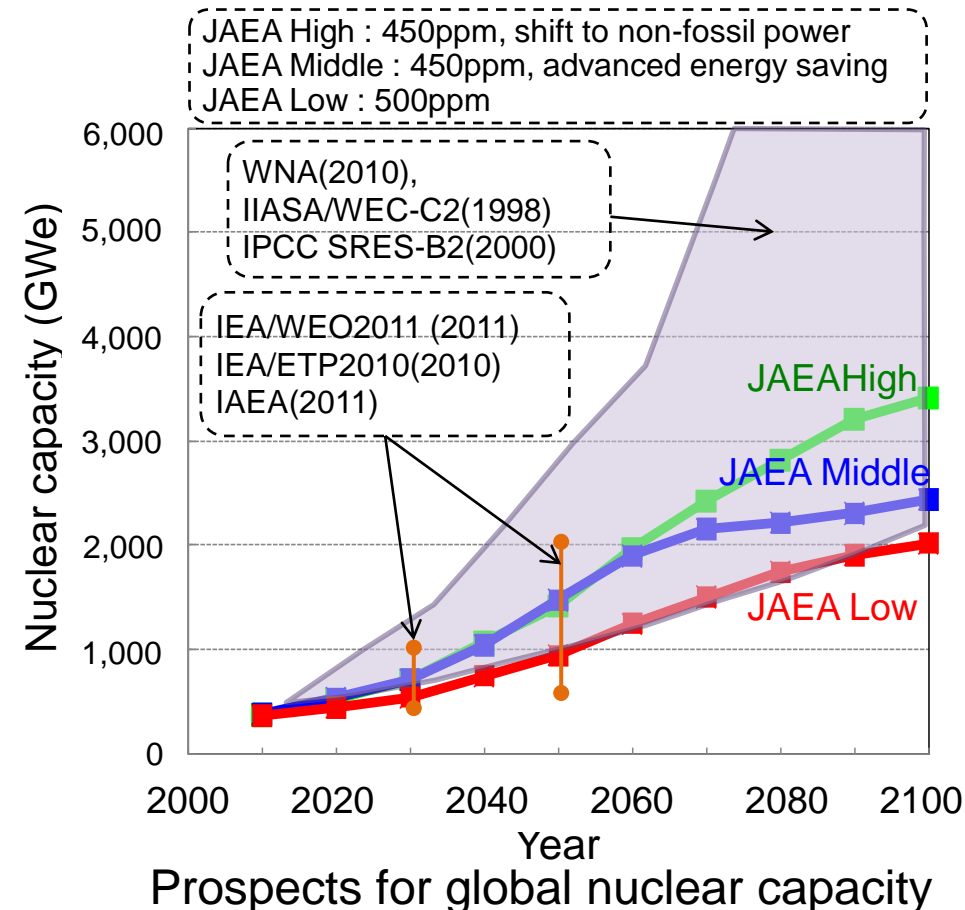


\*) It is a relative value with the potential harmfulness of spent fuel in the first year of disposal being 1.



# Utilization of Uranium Resources estimated in FaCT before 3.11

- Commercialization of the FR cycle is necessary to avoid competition for U resources from a global perspective.

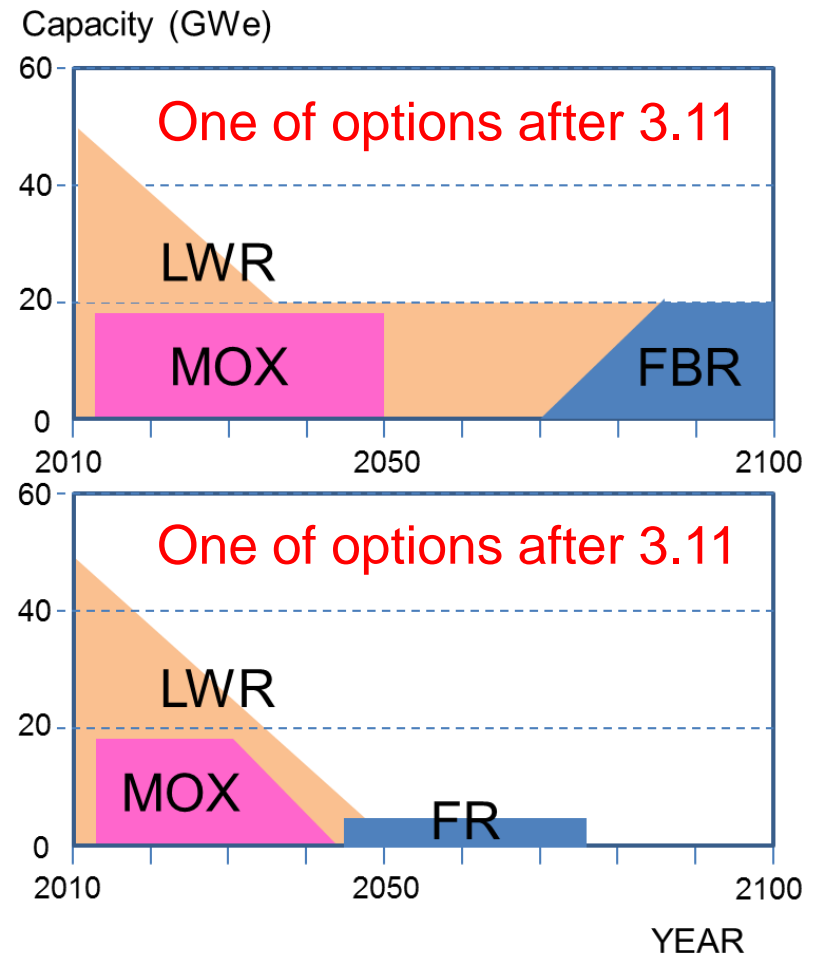
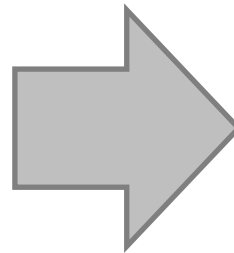
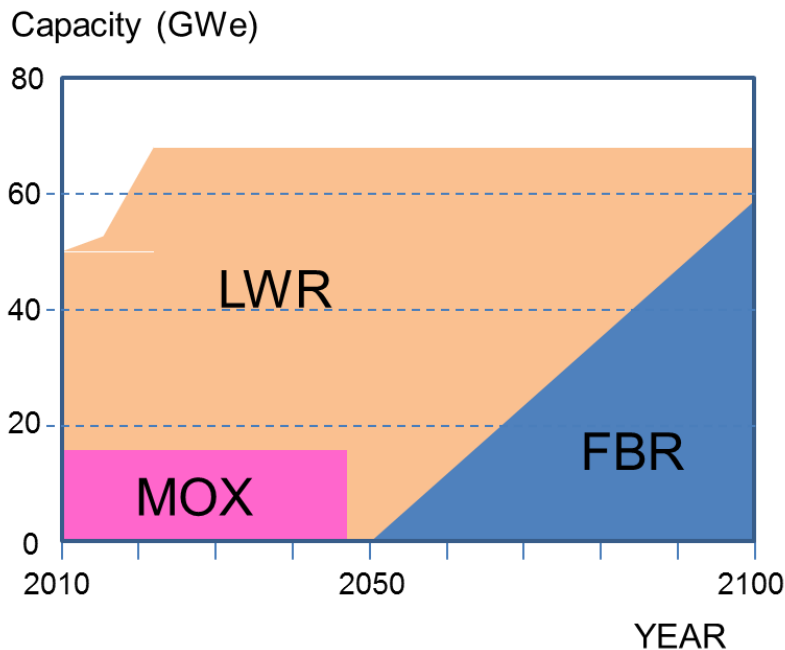




# Change in Nuclear Power Generation Scenario

- The contribution of nuclear power in Japan seems decrease.
- Many options, FBR/FR system, direct disposal are open.

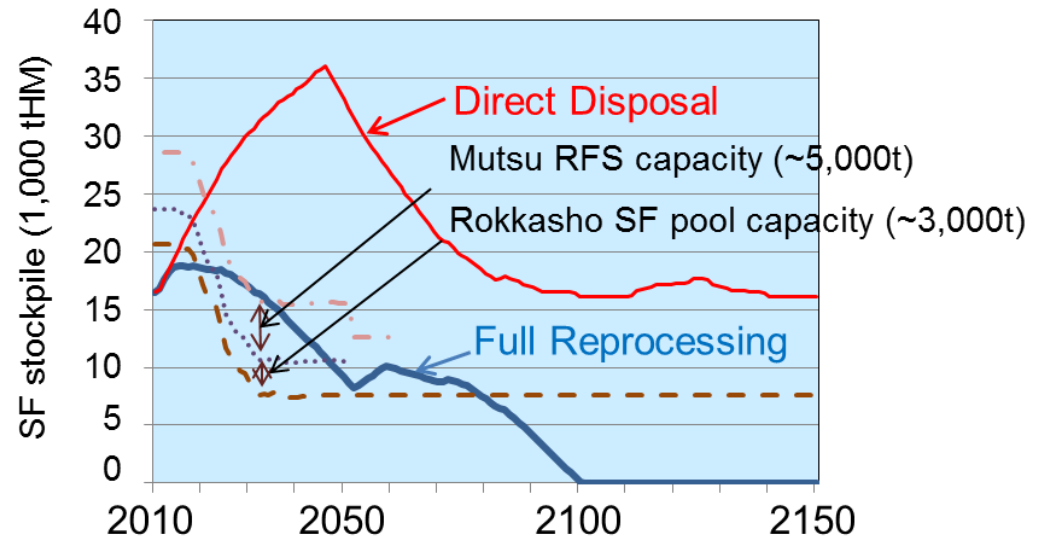
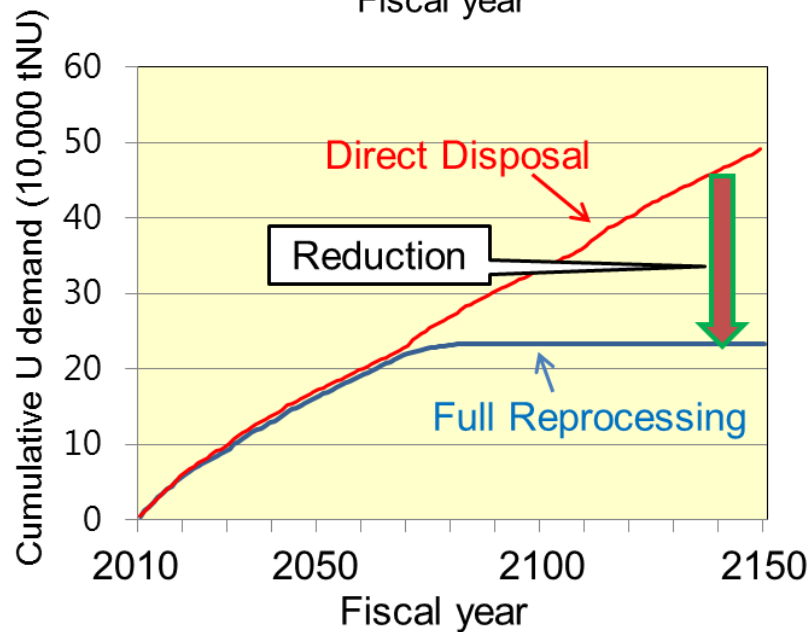
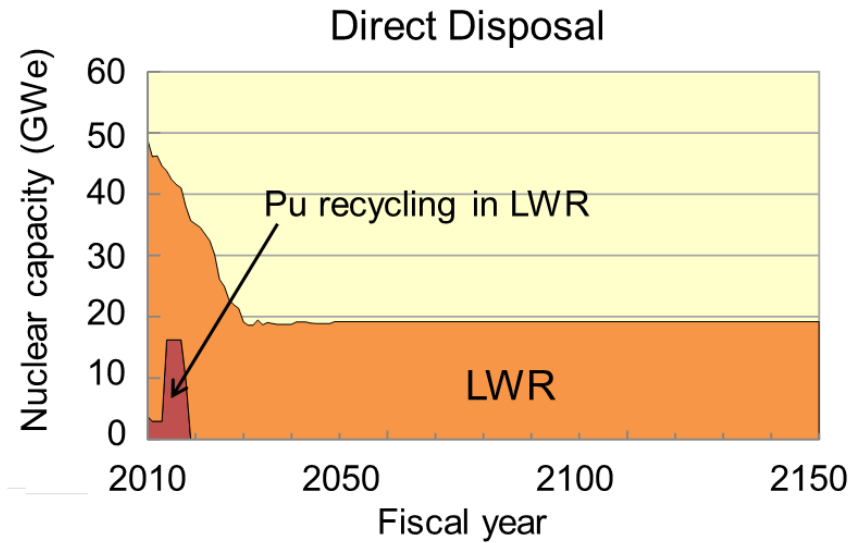
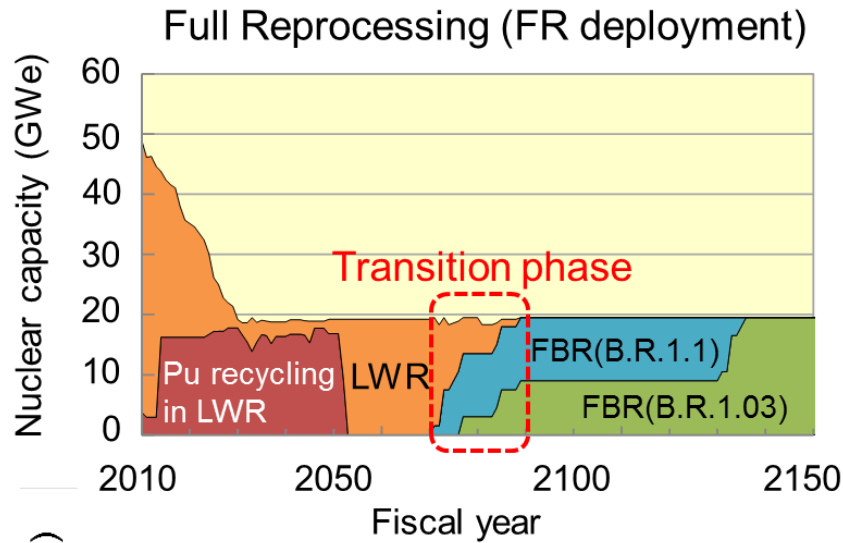
Reference scenario before 3.11







# Scenario Study on new options after 3.11



Note: Each SF occupancy of 5 out of 17 reactor sites in Japan exceeds 70% (Sept. 2011)



# Effect of FR Deployment for New Scenarios with Decreased Nuclear Contribution after 3.11

- Uranium utilization in constant contribution scenario
  - Many countries maintain their nuclear energy program after 3.11.
  - Uranium shortage is still fatal issue of this century.
  - FR system has significant contribution to enhance sustainability in uranium utilization
- Spent Fuel (SF) management in constant contribution scenario
  - Reprocessing of spent fuels will be essential to remain the SF stockpile within the storage capacity.
- Pu/waste management in all scenarios
  - FR systems can provide flexibility to Pu/waste management.



# Immediate priority in R&D activities on SFR system

- MONJU
  - Confirmation of performance by completing system startup tests and accumulation of operation experience/data through full power operation are essential to summarize SFR technology.
- Strengthening of SFR safety
  - TEPCO Fukushima accident reminded importance of prevention/mitigation of severe accident
  - Further effort to strengthen defence-in-depth features is needed.
- Minimization of Radioactive Waste
  - Operation of MONJU will provide various information on Am bearing MOX fuel and core operation.
  - R&D on Pu/MA recycling and burning in SFR will be conducted in MONJU, JOYO and related fuel cycle facilities.



# Immediate priority in R&D activities on SFR system

- Near-term R&D can be conducted in R&D facilities of JAEA
- International cooperation is welcome.

Experimental Fast Reactor "JOYO"    Fast Breeder Prototype Reactor "MONJU"



Plutonium Fuel Production Facility "PFPF"



## Fuel cycle facilities

Fuels Monitoring Facility "FMF"



Plutonium Fuel Development Facility "PFDf"



Chemical Process Facility "CPF"



Alpha-Gamma Facility "AGF"



Advanced Technology Experiment Sodium(Na) Facility "AtheNa"

## Sodium test facilities



Sodium Thermal Hydraulic Test Facility "PLANDTL"



Sodium-Water Reaction Test Facility "SWAT-3R"



**Thank you  
for your kind attention**