Nuclear Waste Management in Japan

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Content

Background information

- Legal Framework
- Technology
- Financial framework
- Site selection process

Newly added process

Further consideration

-The direction of nuclear energy policy

-What is “HLW?”

-Public anxiety and the low level of awareness

-The ambiguous principle of the liability of generators

Conclusion

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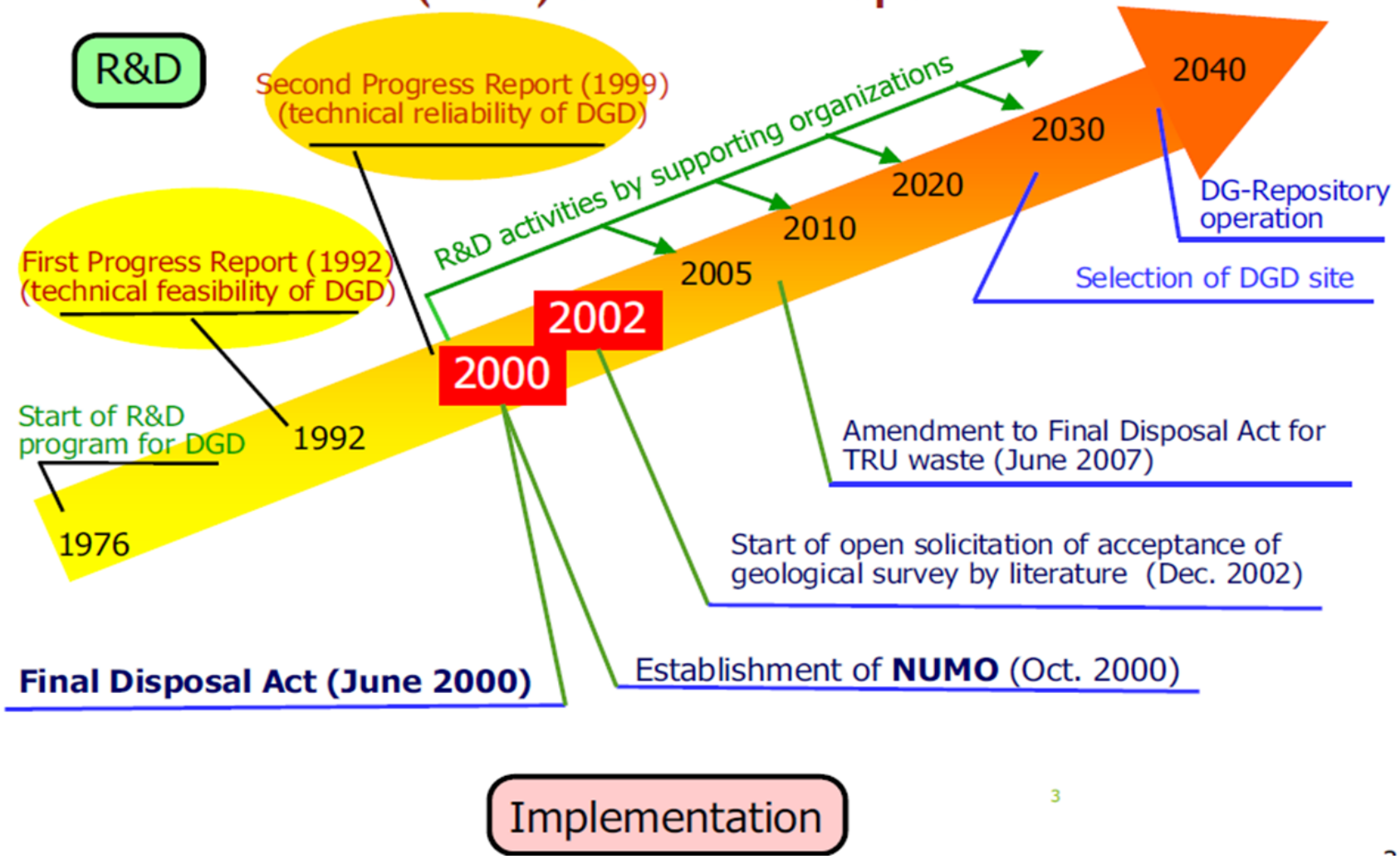
Timeline of Program for Deep Geological Disposal (DGD) of HLW in Japan



Source: JAEA

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Legal framework

2000

Specified Radioactive Waste Final Disposal Act (Final Disposal Act)

2005

Framework for Nuclear Energy Policy

Final Disposal Act (2000)

- HLW -> geological disposal
- Establishment of implementing body
- Contribution-based system for the funds for final disposal
- Three steps for selecting disposal sites

Geological disposal

- **HLW = vitrified waste**
  from the reprocessing of spent fuel
  used in the nuclear power plants

- **TRU (Trans-Uranic) waste**:
  generated by the operation and
  dismantling of reprocessing plants

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The current status of radioactive waste

25,000 tons of spent fuel

2,167 vitrified packages

2,200 vitrified packages
from Areva and Sellafield

17,000 tons => 20,000 vitrified packages

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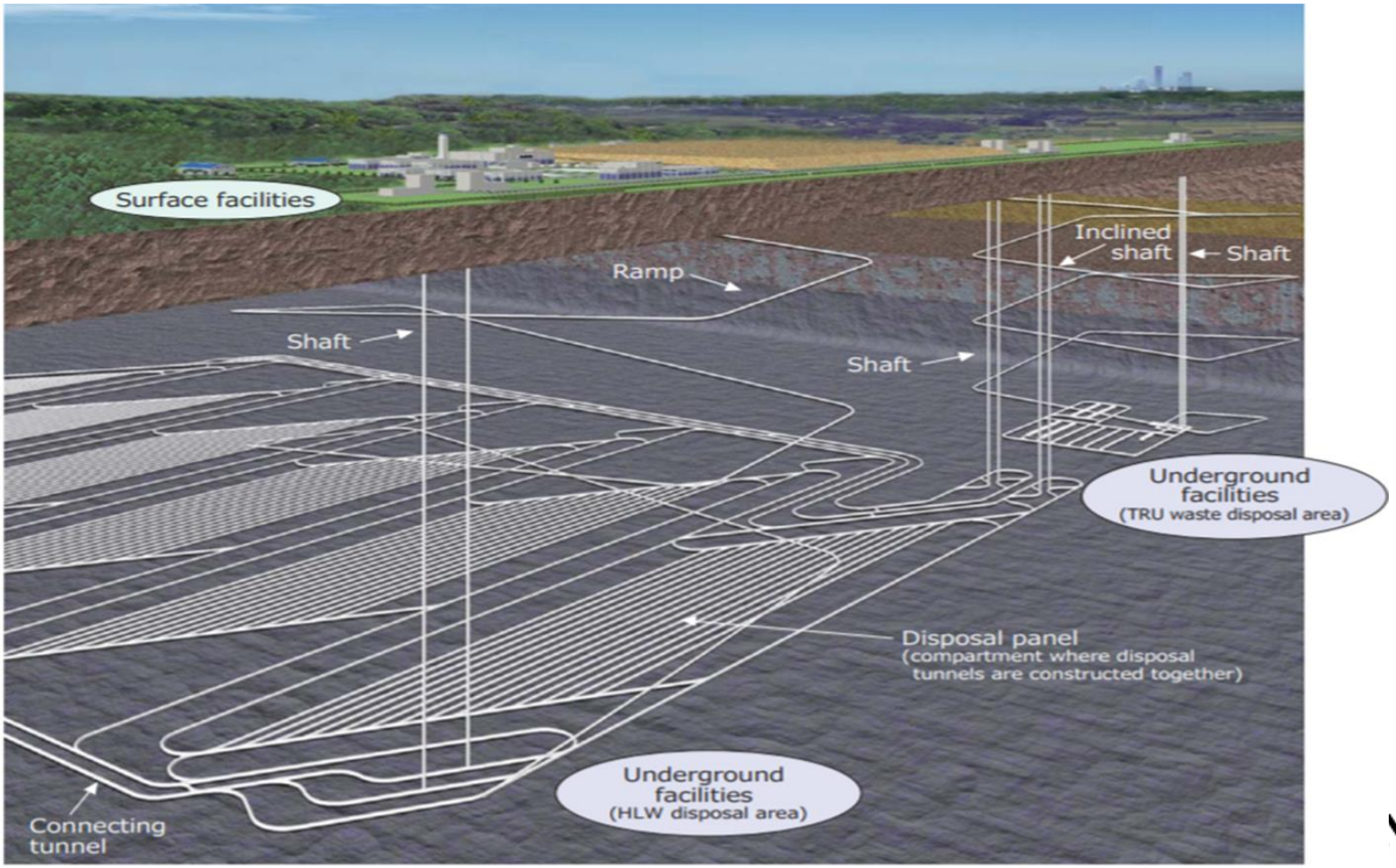
Example of repository layout

Planed only one facility



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Example of repository layout

Surface facilities:

1-2 km^2

Underground facilities :

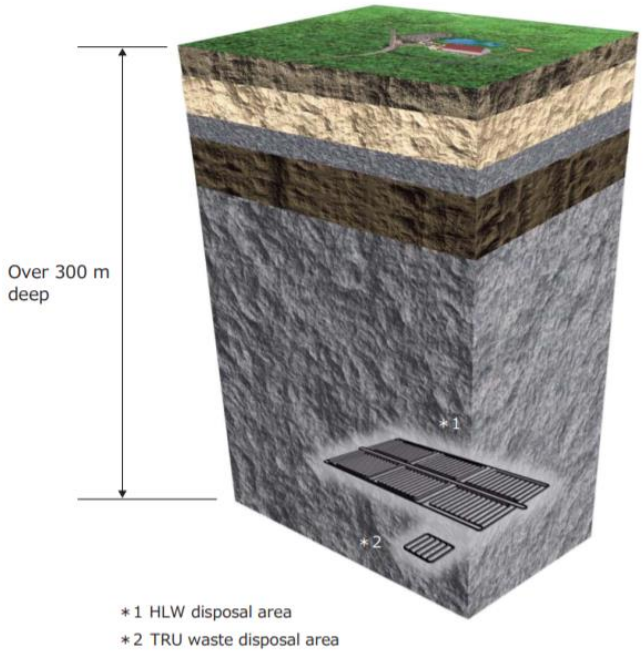
6~10 km^2

HLW disposal area:

around 3 km X 2 km

TRU waste disposal area:

around 0.5 km X 0.3 km



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Final disposal

HLW＝vitrified waste
from reprocessing spent fuel

HLW/TRU⇒ geological disposal
- only one facility
- more than 300m deep
- safe for 100,000 years

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Final Disposal Act (2000)

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- Three steps for selecting disposal sites

An implementing body

Keywords:

Safety & the principle of generator liability

→ A private sector body

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The Nuclear Waste Management Organization of Japan **(NUMO)**

Since October 2000 authorized by METI

- the selection of disposal sites
- the construction and management of disposal facilities, final disposal, the sealing of disposal facilities
- their management thereafter
- disposal operations in general

Bodies involved in geological disposal

Government: supervisor

NUMO: implementing body

JAEA: Research and Development

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Final Disposal Act (2000)

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Burden of final disposal costs

1. SF reprocessing costs
2. reactor decommissioning costs
3. geological disposal costs
4. development and siting costs

Burden of final disposal costs

1. SF reprocessing costs

financial resources:

electricity charges

the Spent Nuclear Fuel Reprocessing Fund Act 2005

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Burden of final disposal costs

2. reactor decommissioning costs

financial resources:

electricity charges since 1989

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Burden of final disposal costs

3. geological disposal costs
(ca. 22,5 billion euro)

financial resources:

annual contribution from power companies to NUMO

= electricity charges since 2000

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Burden of final disposal costs

4. development and siting costs

financial resources:

"Grants for areas hosting power facilities"

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Final Disposal Act (2000)

- HLW -> geological disposal
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The repository site selection process

Three-Stage Process

1. The literature survey

the selection of preliminary investigation areas

2. The preliminary investigation stage

the selection of detailed investigation areas

3. The detailed investigations

the selection of a repository construction site

The repository site selection process

selection of a repository site :

three-stage process

with public participation

and the support of local government

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The repository site selection process

three-stage process

with voluntary system by municipalities

1. The literature survey

ca. 7.5 million euro per year to both the municipal and prefectural governments of the area

2. The preliminary investigation stage

ca. 15 million euro per year to both the municipal and prefectural governments of the area

3. The detailed investigations

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The repository site selection process

three-stage process

with voluntary system by municipalities

Grants are

for the purpose of regional development,

don’t have to be paid back, even if the municipalities don’t go to the next stage.

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The repository site selection process

The literature survey

ca. 7.5 million euro per year

The preliminary investigation stage

ca. 15 million euro per year

Confirmed as a host area

Ca. 20 million euro per year in fixed asset tax

for 60 years = ca. 1.2 billion euro

Final disposal

Legal framework ✓

Technology ✓

Financial framework ✓

Site selection process ✓

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Toyo-machi in Kochi Prefecture

Applied for a literature survey in 2007

ca. 3,000 inhabitants
Located on the Pacific coast

Toyo-machi in Kochi Prefecture

01/2007 Applied for a literature survey
decision by the town's mayor

04/2007 election
the opposition candidate won

23.04.2007 application withdrawn

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Shift in policy on site selection methods

May 2015

revision of the government's Basic Policy

based on the Final Disposal Act

The key point: from the system of voluntary application by local governments to a ***government-led selection system***

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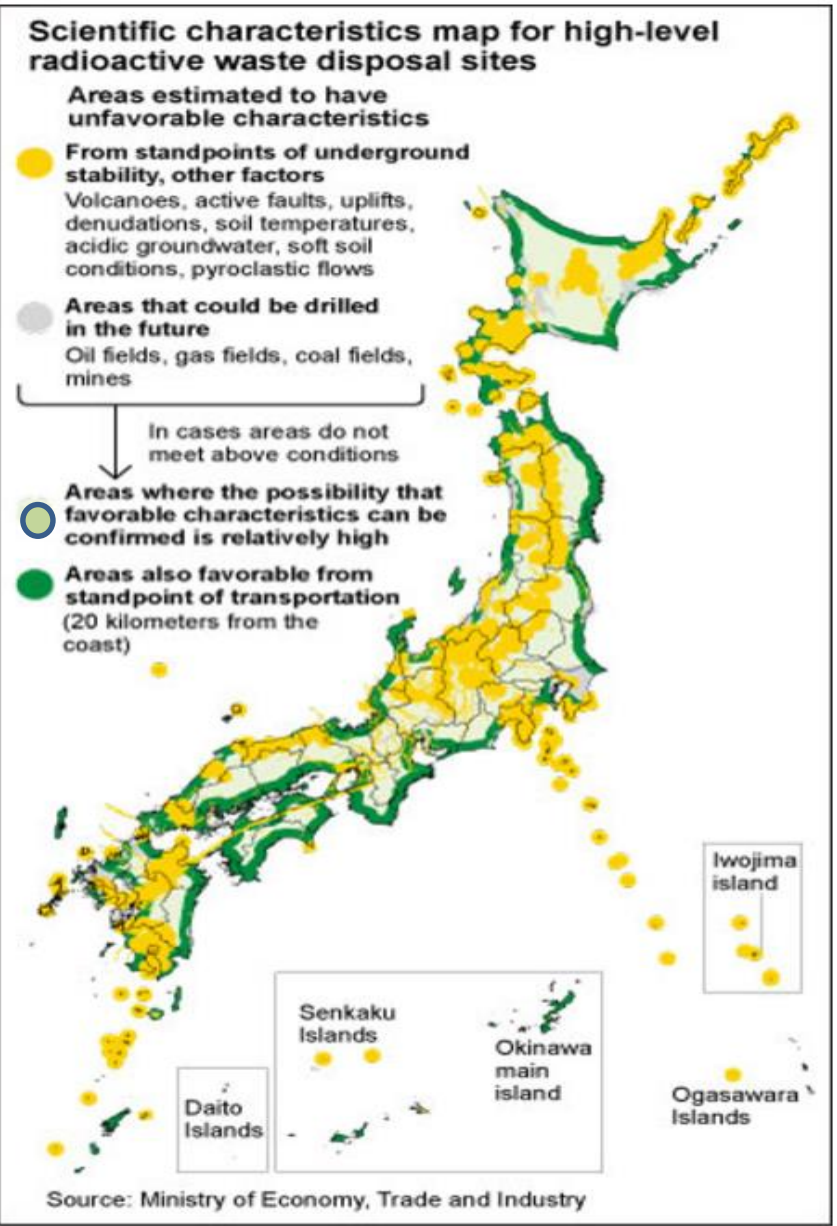
Scientific characteristics map



- Nearby volcanoes or active faults
- Possible drilling in the future
- Relatively appropriate for disposal
- Most appropriate for disposal

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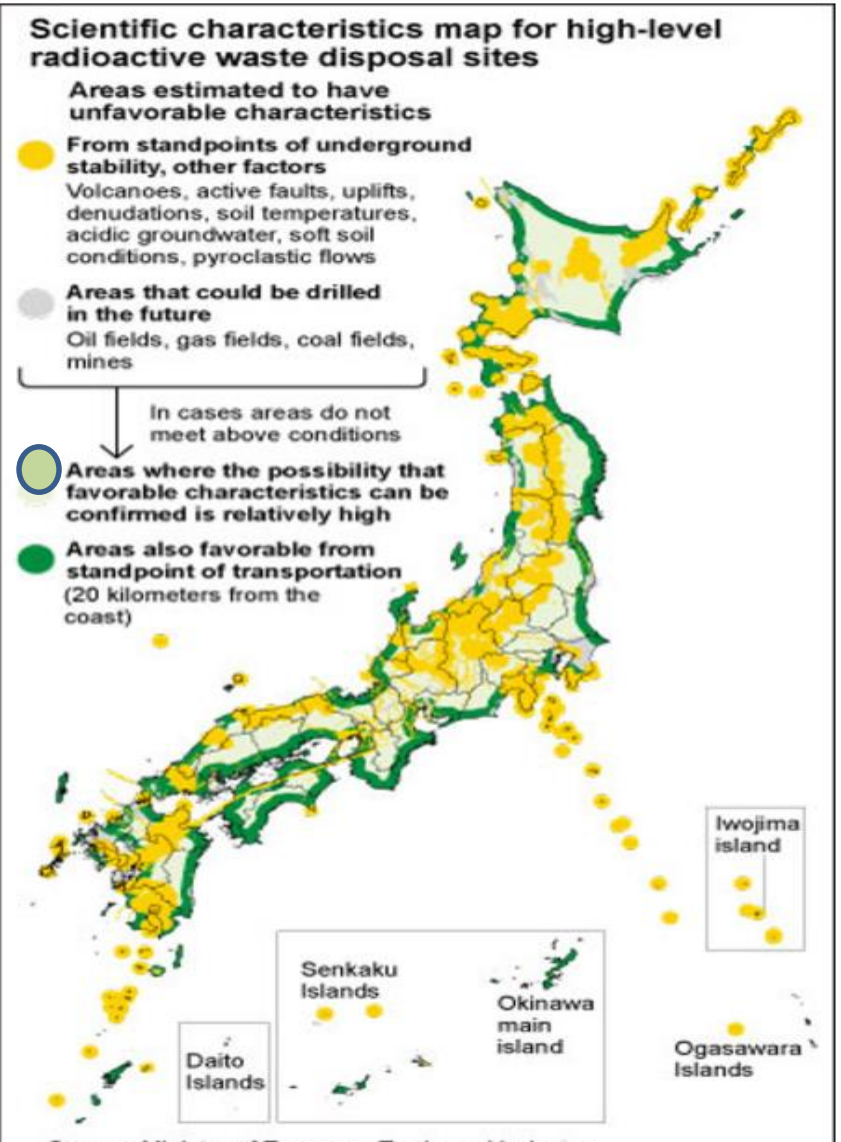
Scientific characteristics map



Relatively appropriate for disposal

Most appropriate for disposal

- 30% of the country's total land
- 900/1750 municipalities in Japan

+ = 65 %

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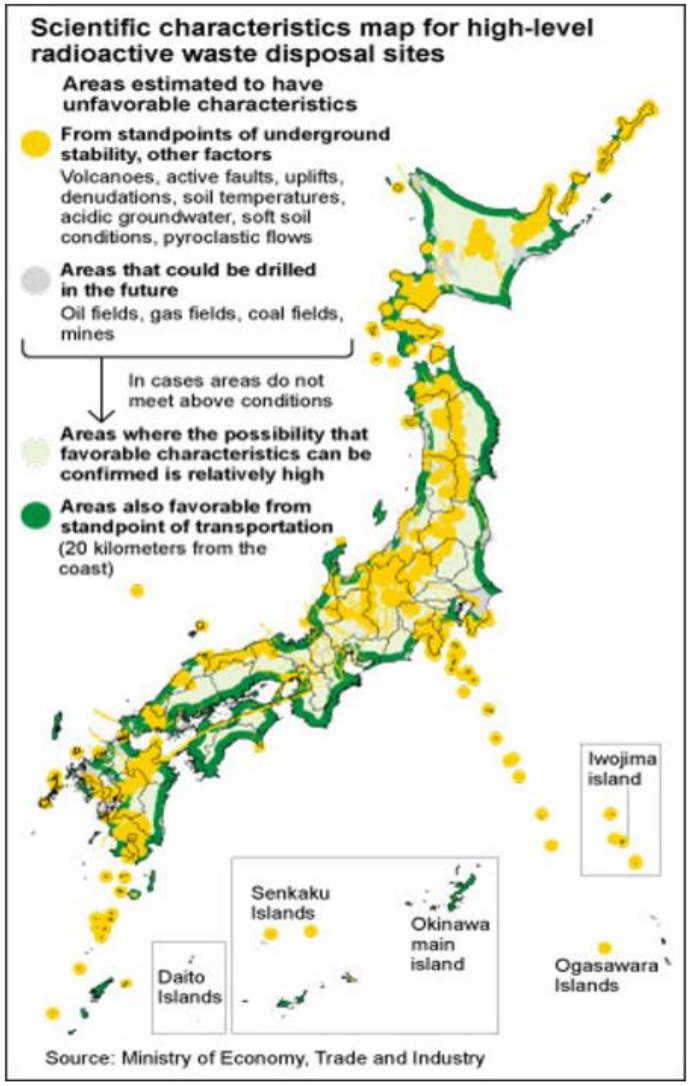
Scientific characteristics map



＋

Awaken the public's attention

－

Entirely from the point of view of earth sciences

－>

Population density and difficulty of land acquisition aren't considered

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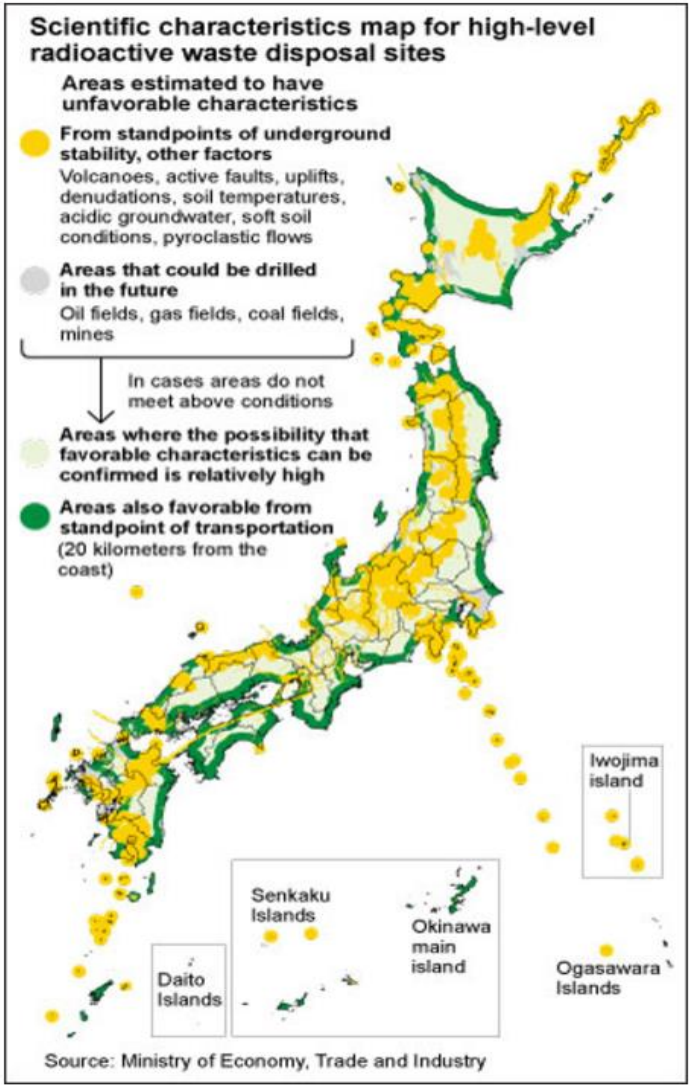
Newly added process under the new cabinet decision

Nationwide scientific screening by government (mapping)

Implementation of dialogue activities (organisation of meeting, etc.)

- Applications by municipalities
- **Proposals by the national government for multiple areas**



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Further consideration

- The direction of nuclear energy policy
- What is “high-level radioactive waste?”
- The ambiguous principle of the liability of generators
- Public anxiety and the low level of awareness

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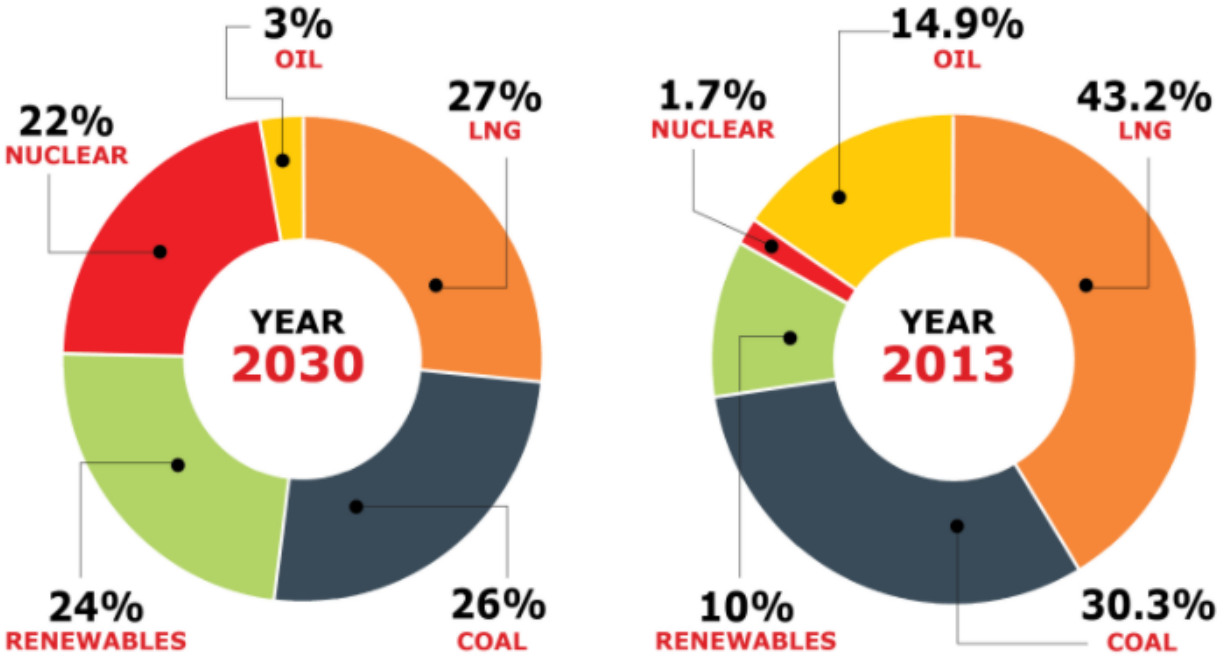
uncertainties

- The direction of nuclear energy policy

After 2030???



Source: METI

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uncertainties

Nuclear power after 2030

1. Abandoning → zero flow waste

1. Continuation with a clear deadline for abandoning
   → flow waste calculable

3. Continuation without a clear deadline
   → ????????

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Nuclear energy policy

- Nuclear power 20-22 % by 2030
- Nuclear fuel cycle &
  commercializing fast breeder reactors

NuRO

Nuclear Reprocessing Organization of Japan

established as an authorized company
on 3 October 2016

The organization aims to advance steady and efficient reprocessing of spent nuclear fuel, among other efforts.

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Final disposal

HLW＝vitrified waste
from reprocessing spent fuel

HLW/TRU⇒ geological disposal
- only one facility
- more than 300m deep
- safety for 100,000 years

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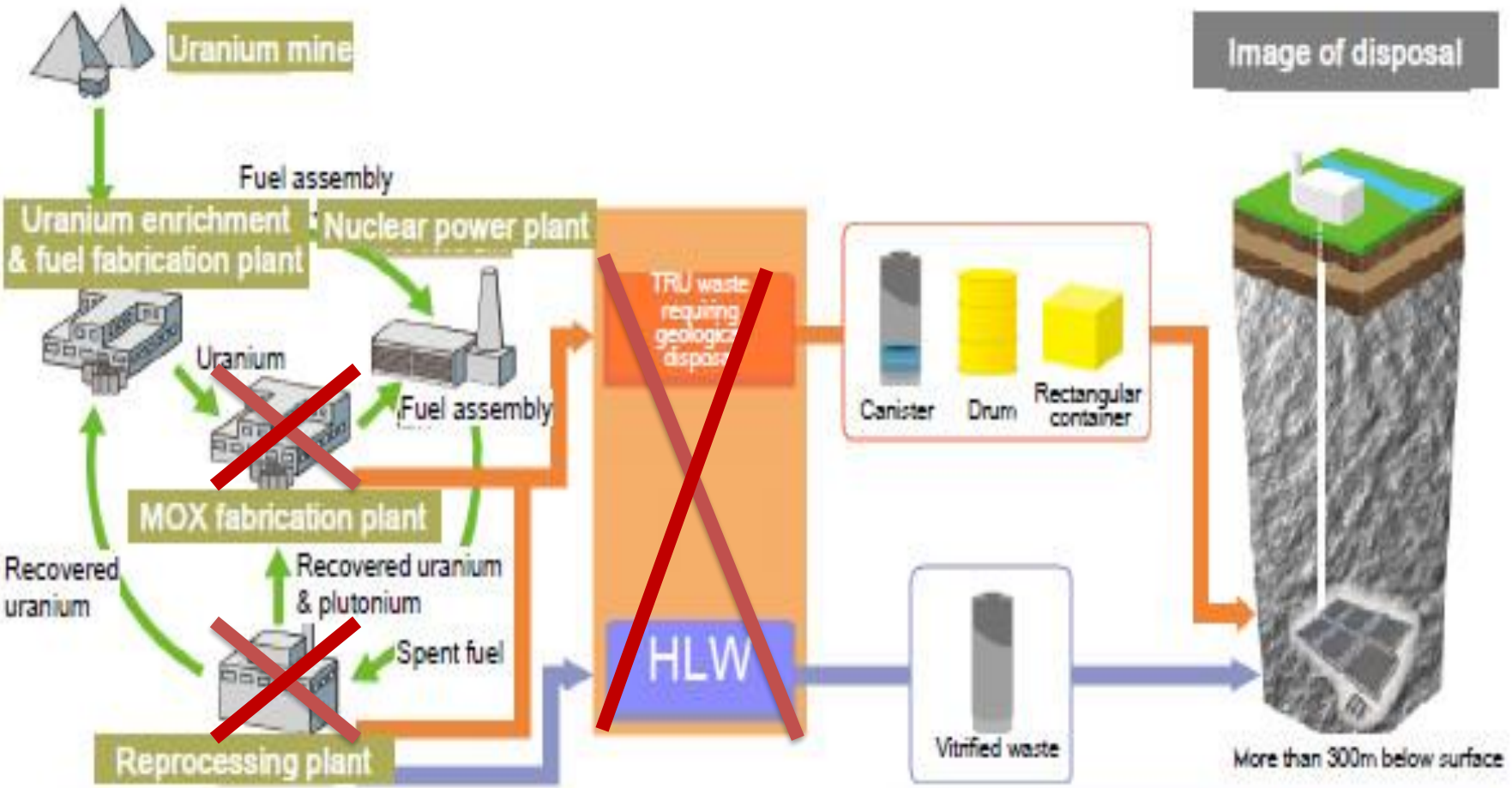
Uranium mine
Fuel assembly
Uranium enrichment & fuel fabrication plant
Nuclear power plant
Uranium
Fuel assembly
MOX fabrication plant
Recovered uranium
Recovered uranium & plutonium
Spent fuel
Reprocessing plant
TRU waste requiring geological disposal
HLW
Canister
Drum
Rectangular container
Vitrified waste
Image of disposal
More than 300m below surface
Nuclear fuel cycle
Geological disposal of high-level & TRU waste

The waste management strategy

Spent fuel

× reprocessing plant
× fast breeder

--→ spent fuel stored
at each nuclear power plant

Quantity of spent fuel stored at each NPP in tons (March 2014)

Electric Power Company/ NPP		Quantity of Waste Stored	Available Capacity	Remaining Available Capacity	Remaining Operation Time (years)
Hokkaido	Tomari	400	1,020	620	16.5
Tohoku	Onagawa	420	790	370	8.2
	Higashidohri	100	400	340	15.1
Tokyo	Fukushima Daiichi	1,960	2,270	n/a	n/a
	Fukushima Daini	1,120	1,360	n/a	n/a
	Kashiwazaki Kariwa	2,370	2,910	540	3.1
Chubu	Hamaoka	1,140	1,740	600	8.0
Hokuriku	Shiga	150	690	540	14.4
Kansai	Mihama	390	670	280	7.5
	Takahama	1,160	1,730	570	7.6
	Ohi	1,420	2,020	600	7.3
Chugoku	Shimane	390	600	210	7.0
Shikoku	Ikata	610	940	330	8.8
Kyushu	Genkai	870	1,070	200	3.0
	Sendai	890	1,290	400	10.7
JAPC	Tsuruga	680	860	280	9.3
	Tokai Daini	370	440	70	3.1
Amount		14,330	20,810	5,950	

The waste management strategy

× reprocessing plant

× fast breeder

→ reprocessing or direct disposal?

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Nuclear fuel recycling cost (Comparison in kWh)

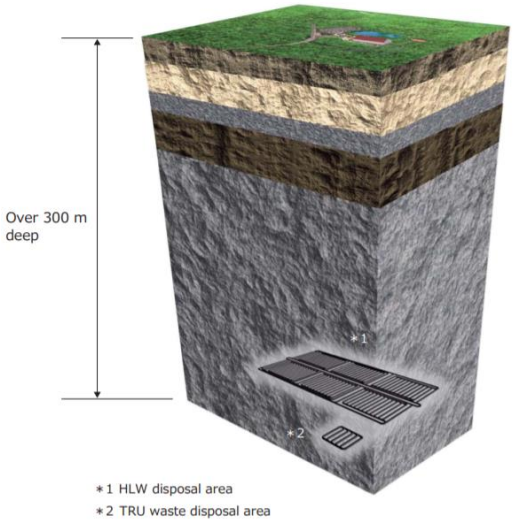
	2011 Estimate	2004 Estimate
all reprocessing	1.98 yen (ca. 1.48 cent)*	ca. 1.6 yen (ca. 1.2 cent)
half reprocessing/ half intermediate treatment	1.39 yen (ca. 1.04 cent)	ca. 1.4-1.5 yen (ca. 1.05-1.12 cent)
all direct disposal	1-1.02 yen (ca. 0.75-0.76 cent)	ca. 0.9-1.1 yen (ca. 0.67-0.82 cent)

Further consideration

- What is “high-level radioactive waste?”

Spent fuel -> reprocessing
for 100,000 years

Spent fuel -> direct disposal
for one million years,
needs more space



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Bodies involved in geological disposal

Government: supervisor

NUMO: implementing body

JAEA: Research and development

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Further consideration

The ambiguous principle of the liability of generators

--->

separate discussion

about nuclear power policy and

nuclear waste management

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Further consideration

- The direction of nuclear energy policy
- What is “high-level radioactive waste?”
- The ambiguous principle of the liability of generators
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HLW→ geological disposal

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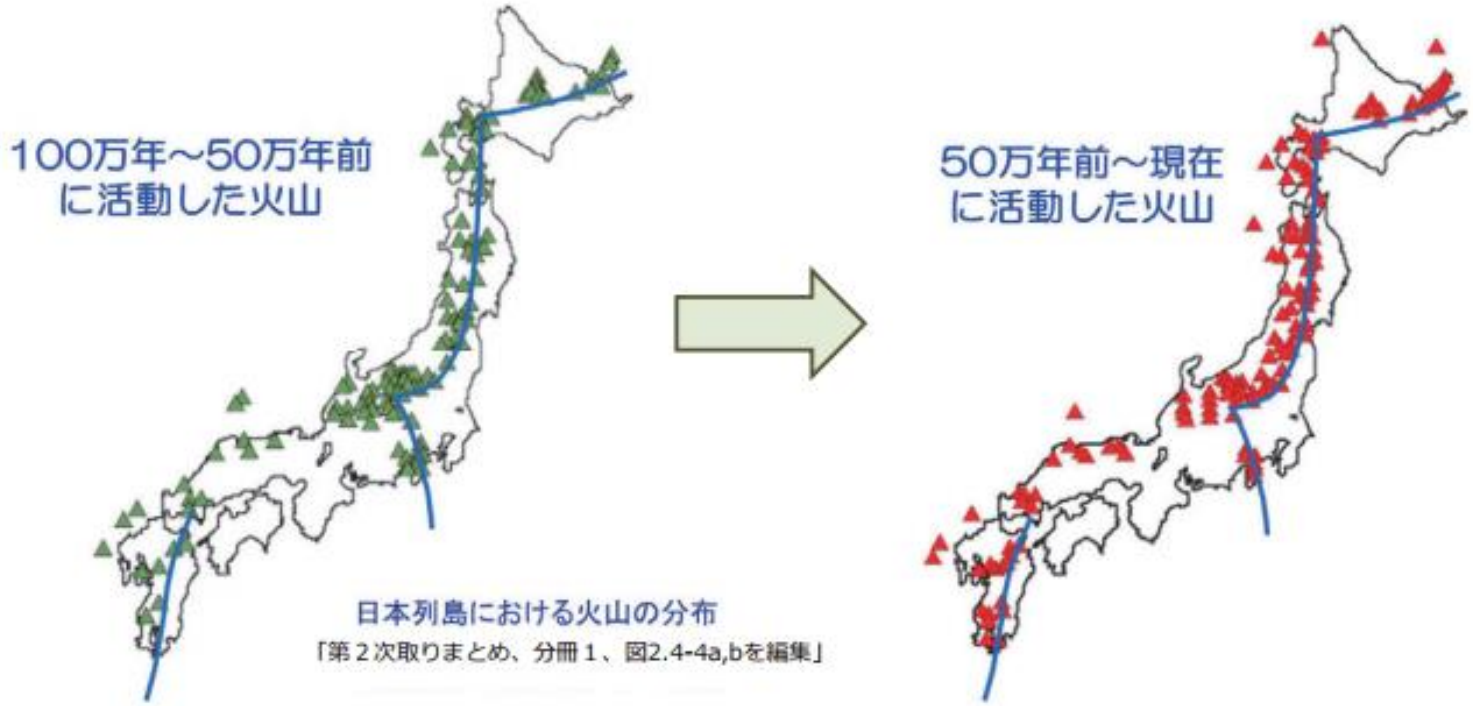
Volcanoes

②実際、数百万年程度の期間、火山ができる位置はほとんど変わっていません。このため、**詳細な調査により火山を避けることができます。**



日本列島における火山の分布
「第２次取りまとめ、分冊１、図2.4-4a,bを編集」

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HLW→ geological disposal

Geological disposal

→ cause of anxiety

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Public anxiety

Nuclear power

Survey by Asahi newspaper in 2016

Opposed to restarting nuclear power 57%

Phasing out of nuclear power 73%

Immediate shutdown of nuclear power 14%

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the low level of awareness

Final disposal

Survey by JAERO (Japan Atomic Energy Relation Organisation)

6.9% knew difference between HLW and LLW

70% knew ***nothing*** about geological disposal

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Further consideration

Public anxiety and

the low level of awareness

⇒

- difficult to gain trust of people
- difficult to make citizens' initiative

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Final disposal

Legal framework ✓

Technology ✓

Financial framework ✓

Site selection process ✓

Final disposal

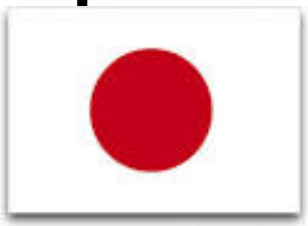
・Candidate site ×
・nuclear power ✓
・fuel cycle ✓

——>

HLW

Total amount /

disposal method ✓



・Candidate site ×
・nuclear power ? ?
・fuel cycle ? ? ?

——>

HLW

Total amount /

disposal method ???

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Final disposal

HLW＝vitrified waste

from reprocessing spent fuel ??

HLW/TRU⇒ geological disposal

- **only one facility** ??
- 300m deep
- **safety for 100,000 years** ??

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Final disposal

Candidate site:Gorleben

——>

National debate

Candidate site: none

——>

Low level of awareness

Fukushima accident

——> greater anxiety

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Final disposal

Public anxiety and the low level of awareness

-→

- more difficult to gain trust of locals
- more difficult to make citizens' initiative

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HLW in Fukushima

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LLW in Fukushima

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Final disposal

Because of Fukushima

additional Problems

⇒

More difficult and complicated than in other countries

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Six Suggestions from SCJ

1. **Drastic review of policies** on disposal of high-level radioactive waste
2. Recognize **the limitation of scientific and technological capability** and secure scientific autonomy for scientific deliberation;
3. Rebuild a framework of policy on the premise of **temporary storage** of HLW and **the control of total amount** thereof;
4. Explore socially acceptable procedures such as those in which fair burden-sharing among people is ensured;
5. Pursue multi-step procedures to build consensus among the public by establishing venues for discussion among them;
6. Recognize the need for long-term tenacious efforts to solve the problems.

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Final disposal

very difficult and

very complex problem

⇒

Necessity of drastic review of nuclear waste policy

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Thank you for your attention!

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