Research findings on nuclear waste issues

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commissioned by Rebecca Harms, MEP

THE GREENS/EFA
in the European Parliament

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Overview

- Risks on Health and Environment
- Classification of Wastes
- Waste Management Concepts
- Quantities of Wastes
- Costs and Financing
- Country Examples

Risks on Health and Environment

- health impacts from routine gaseous and liquid waste emissions from nuclear facilities.
- the very large global collective doses from nuclear reprocessing,
- the unsatisfactory and unstable condition of much of the nuclear waste already created.
- High-level waste (HLW) in the form of spent nuclear fuel or vitrified waste from reprocessing contains more than 90 percent of the radioactivity in nuclear wastes.

However, no fully operational HLW final disposal site in the world. Estimates of impacts remain speculative.

To assess risks, it is necessary to have accurate doses, but these are often not estimated in epidemiology studies.

Classification

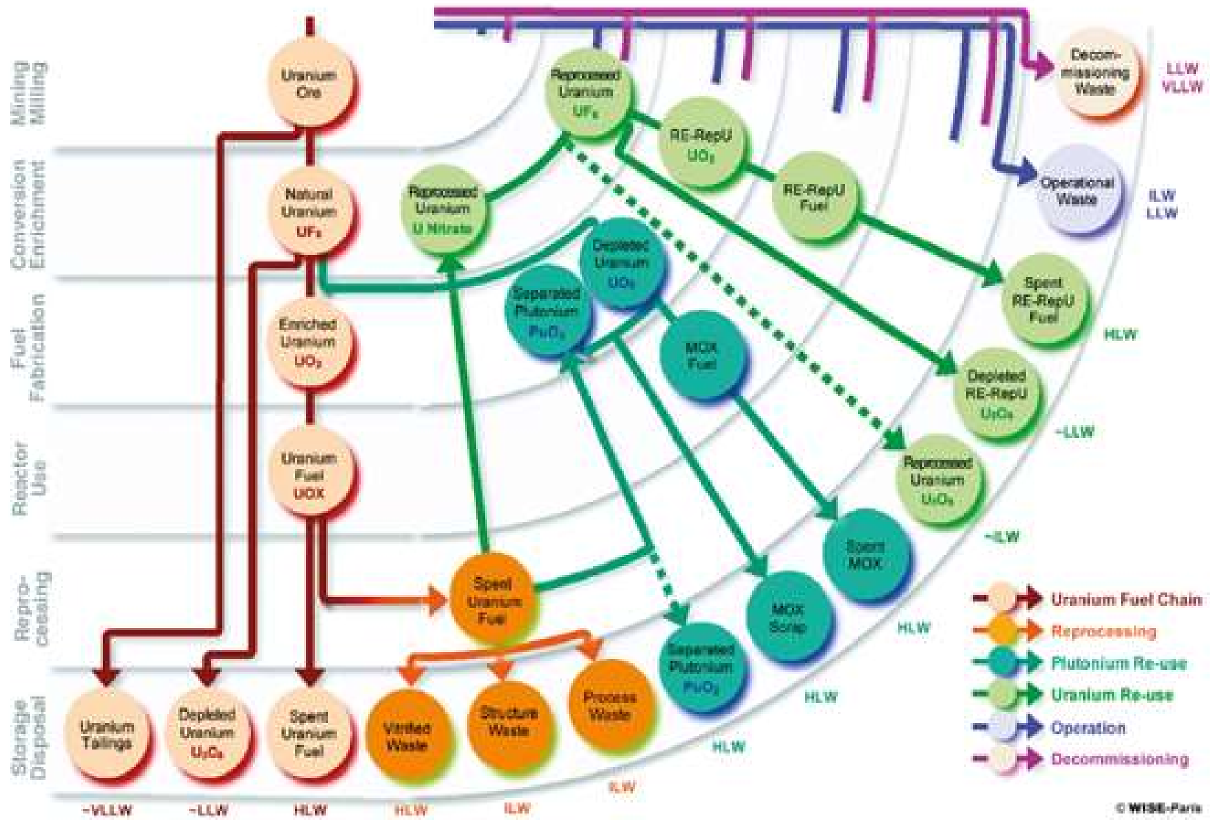


Figure 4.12 | The nuclear fuel chain. Source: WISE-Paris.

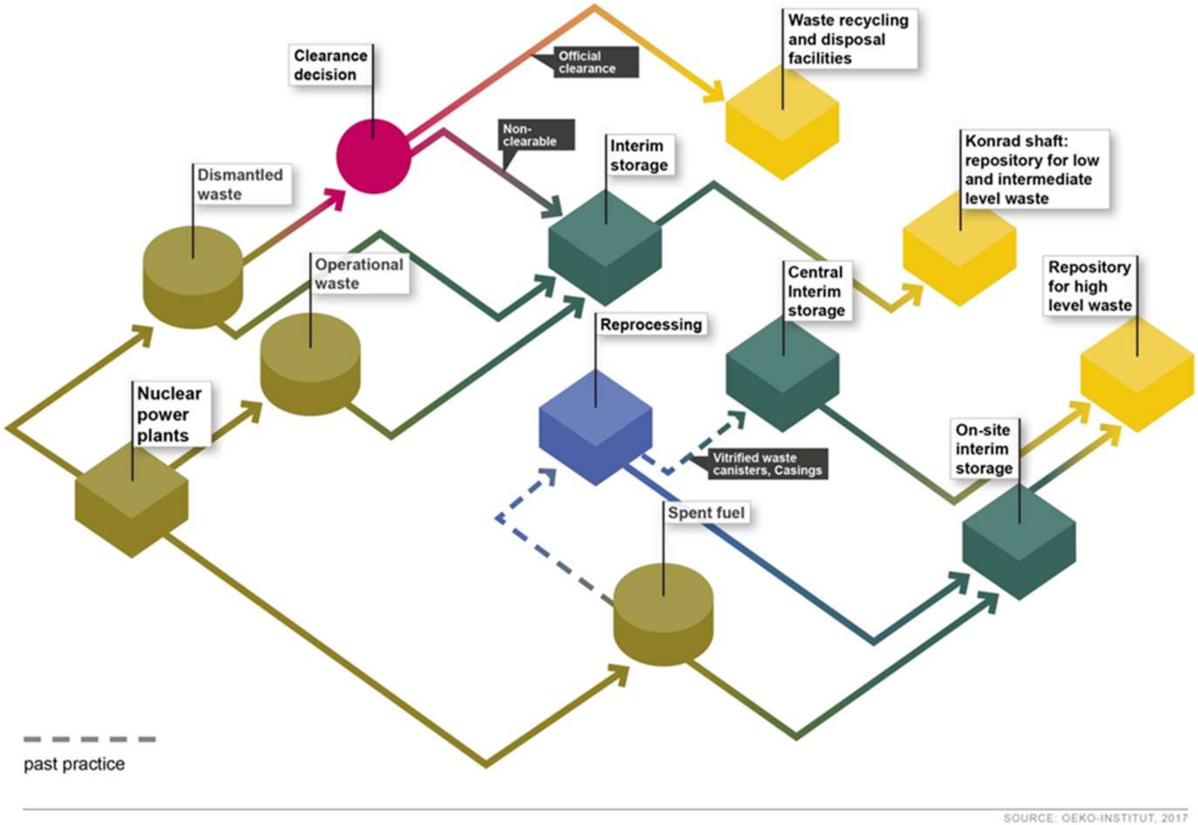
Figure 2.1: The nuclear fuel chain
Source: Wise-Paris

Classification

EU member states differ significantly in their practices on classifying nuclear wastes:

- disagreement about whether spent fuel and some of its potential separated products (plutonium and uranium) are a waste or a resource.
- significant divergences in the categorizations of waste, with no two countries having identical systems. While all agree on the category of heat-generating (high level) wastes, there are many alternative ways of characterizing other nuclear waste streams. These differences signify a lack of transparency in the classification process.
- Despite guidance from the IAEA and EU attempt, there are substantial differences between European classification systems, and even more variety when considering non-EU countries.
- Several countries regard spent fuel as waste, to be disposed directly, while others regard it – once reprocessing separates plutonium and uranium – as a resource. Another common feature in the HLW category is that there is as yet no available long-term management route for HLW.

Waste management Concepts



Waste management Concepts

- Worldwide waste management concepts still face serious challenges, especially for high-level waste. Storage time will be extended to uncertain timeframes with unclear consequences.
- The paths for low-level waste is not fully developed and involve many uncertainties. An additional difficulty is the diversity of waste types and their treatment, which in turn has consequences for storage and disposal.
- Countries’ performance differs. Some have already clear concepts and implement these. Others are back at the beginning after setbacks or have only very vague concepts.
- With international conventions, the objective is to achieve and maintain safe waste management worldwide. The self-commitment of the countries to mutual reporting encourages public discussion and evaluation of country progress internationally.

Quantities of Waste: Overview

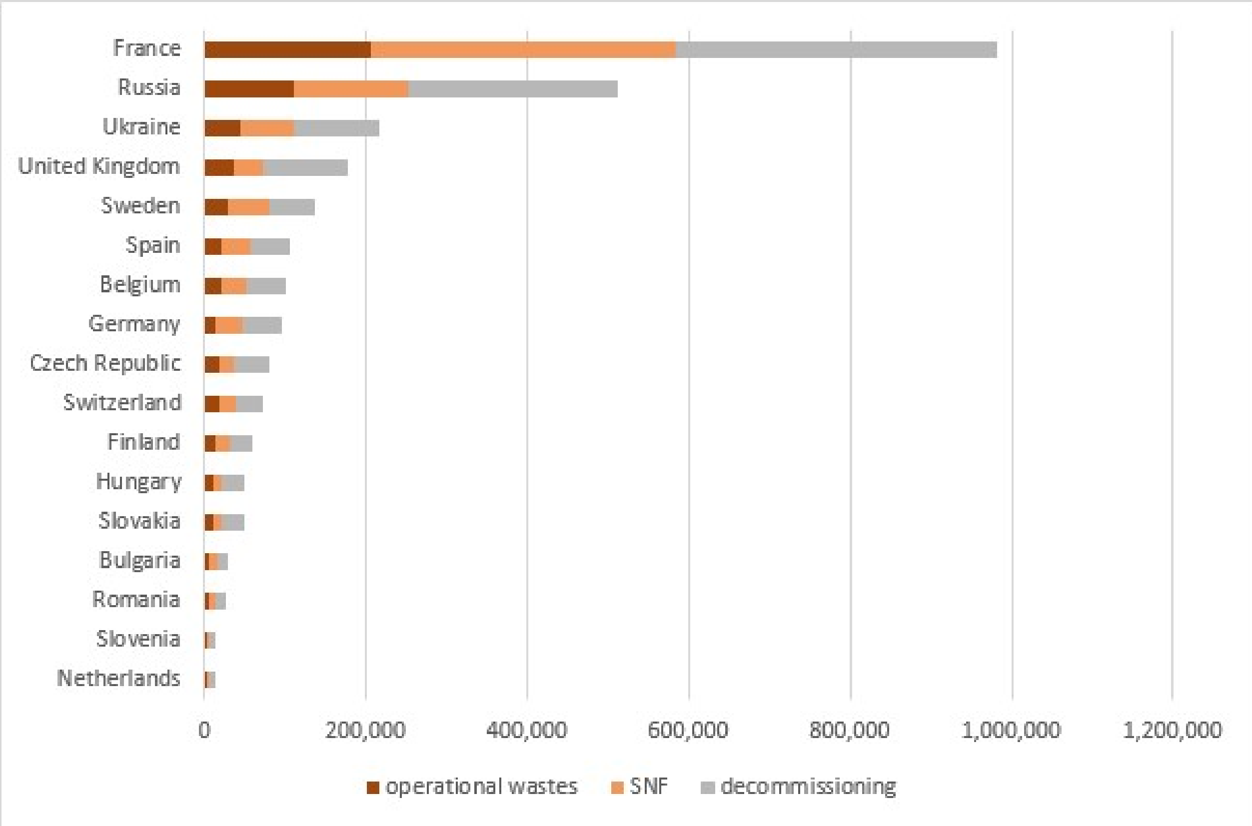


Figure 1: Estimated wastes from operation, SNF management, and decommissioning in Europe in m^3

Source: Own compilation.

Quantities: Uranium Mill Tailings

Country	Million tonnes of uranium mill tailings
Australia	79
Bulgaria	16
Canada	202.13
Czech Republic	89
France	29.318
Germany	174.45
Hungary	29.4
Kazakhstan	165
Kyrgyzstan	32.3
Namibia	350
Russia	56.85
South Africa	700
Ukraine	89.5
USA	235
Uzbekistan	60

Source: www.wise-uranium.org/mdaf.html

Quantities: Spent Fuel

Country	Spent Fuel inventory (tons of heavy metal) end of 2007	Spent fuel policy
Canada	38 400	Direct disposal
Finland	1 600	Direct disposal
France	13 500	Reprocessing, disposal, storage
Germany	5 850	Direct disposal (now)
Japan	19 000	Plan of reprocessing, disposal for now
Russia	13 000	Some reprocessing
South Korea	10 900	Storage, disposal undecided
Sweden	5 400	Direct disposal
United Kingdom	5 850	Reprocessing but future unclear
United States	61 000	Direct disposal

Table 1.2 : Spent fuel inventories in cooling ponds and dry-cast storage as of the end of 2007 for the 10 countries in the present study - except for France and Japan. For the data for France and Japan, see respective chapters

Quantities: Plutonium

Country	Civilian Plutonium (tons)
Russia	57.2
US	7
UK	110.3
France	65.4
China	0.04
India	0.4
Japan & Others	49.3
Total	**290**

Source: http://fissilematerials.org

Costs and Financing

	Czech Republic	France	Germany
Funding system Under control by	Internal segregated and restricted fund operators	Internal segregated and restricted fund operator	Internal non-segregated and unrestricted operators
Accumulation	Levy on electricity price(?)	Levy on electricity price	Provisions by the utilities
Total Cost estimations	Dukovany: CZK22.4 billion (US$1 billion) or $532/kW. Temelín: CZK18.4 billion (US$847 million) or $356/kW	€31.7 billion for decommissioning for its entire fleet or 400 €/kW (operational); 1,200 €/kW for legacy	€19.7 billion or €830/kW for the 23 commercial reactors
Set aside funds	Dukovany: US$276 million or 28%. Temelin: CZK2.8 billion (US$129 million) or 15%.	€18.5 billion or 58% of the estimated costs	€21.5 billion (in 2017, including casks, transport, operational wastes)

Table 1: Overview of funding systems for decommissioning in Czech Republic, France, and Germany.

Source: Own depiction.

Costs and Financing

	France (EDF)	Germany	USA
Financing scheme	Internal segregated and restricted fund, then moved to regulator at construction start	External segregated fund	External segregated fund
Accumulation	levy on electricity price	investment of the funds	Previously levy on electricity price but no longer connected
Total Cost estimations	€31 billion	€8.3 billion (HLW), €3.7 billion (LILW), €5.8 billion for interim storage	US$96 billion
Set aside funds	€9.9 billion	€24.1 billion (including interim storage, LILW and HLW disposal)	US$34.3 billion

Table 2: Overview of funding systems for disposal in France, Germany, and USA.

Source: Own depiction.

Country example: France

La Hague reprocessing plant 2008 pictured in 2008. *Photo by Jean-Marie Taillat.*

THE CIGEO PROJECT

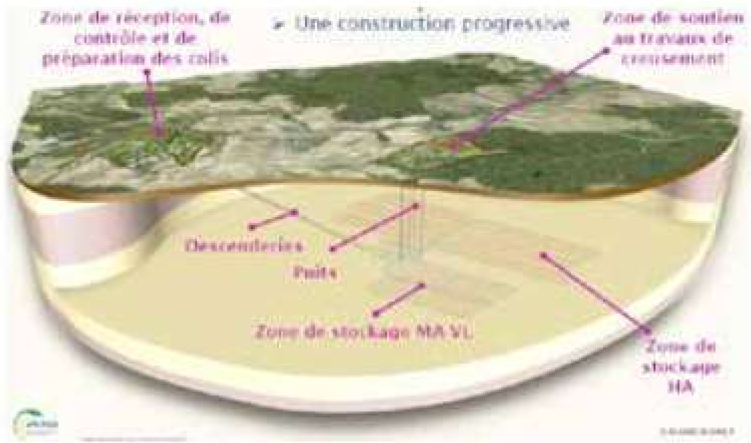
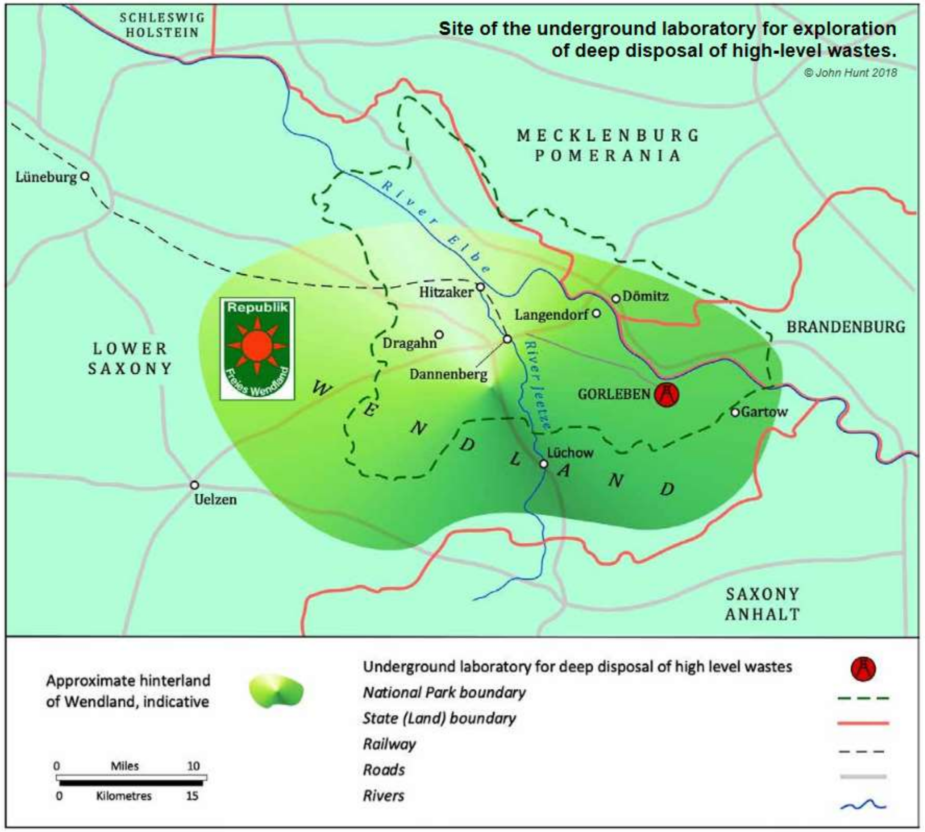


Figure 3 – The CIGEO Storage Project

Country example: Germany

Aerial view of Gorleben and the surrounding area.
Main photo: GNS Gesellschaft für Nuklear-Servic. Inset: Andrew Blowers



Country example: Sweden

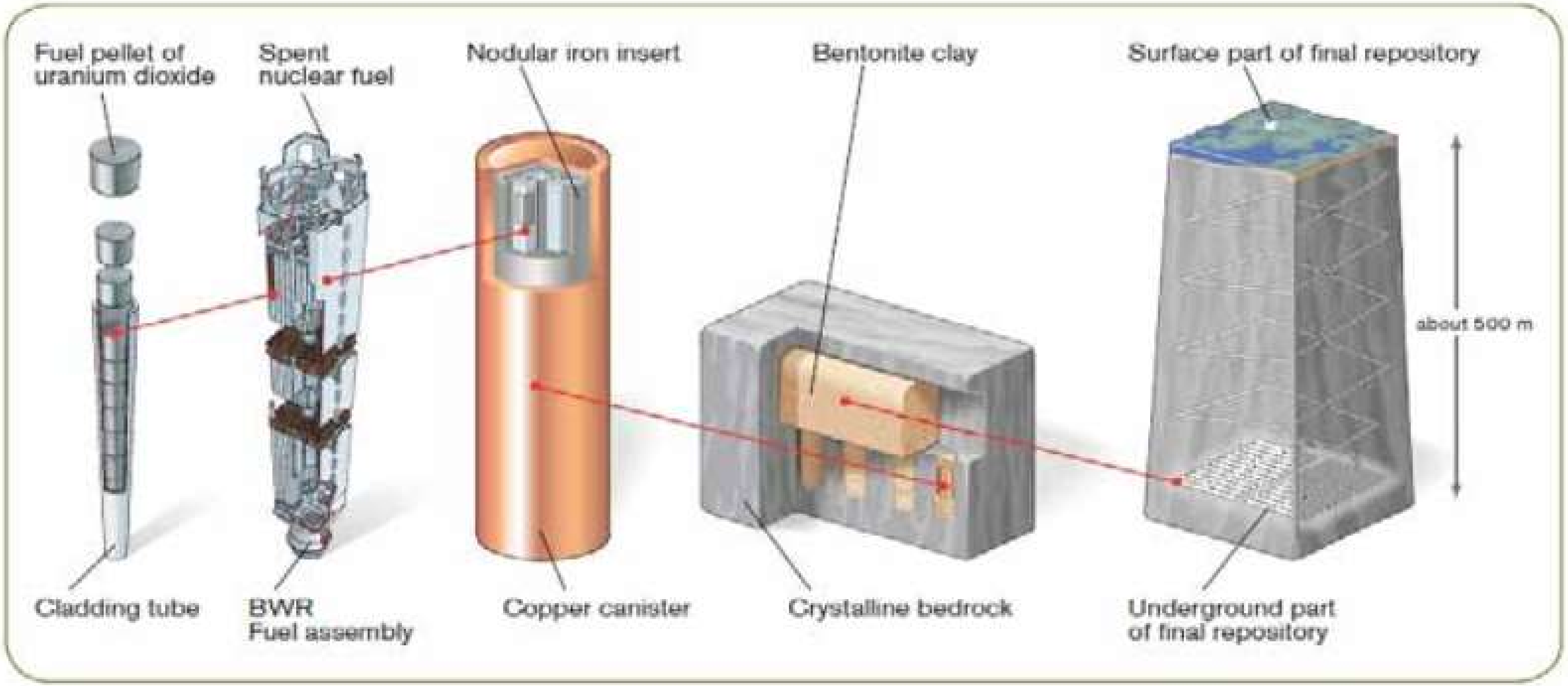


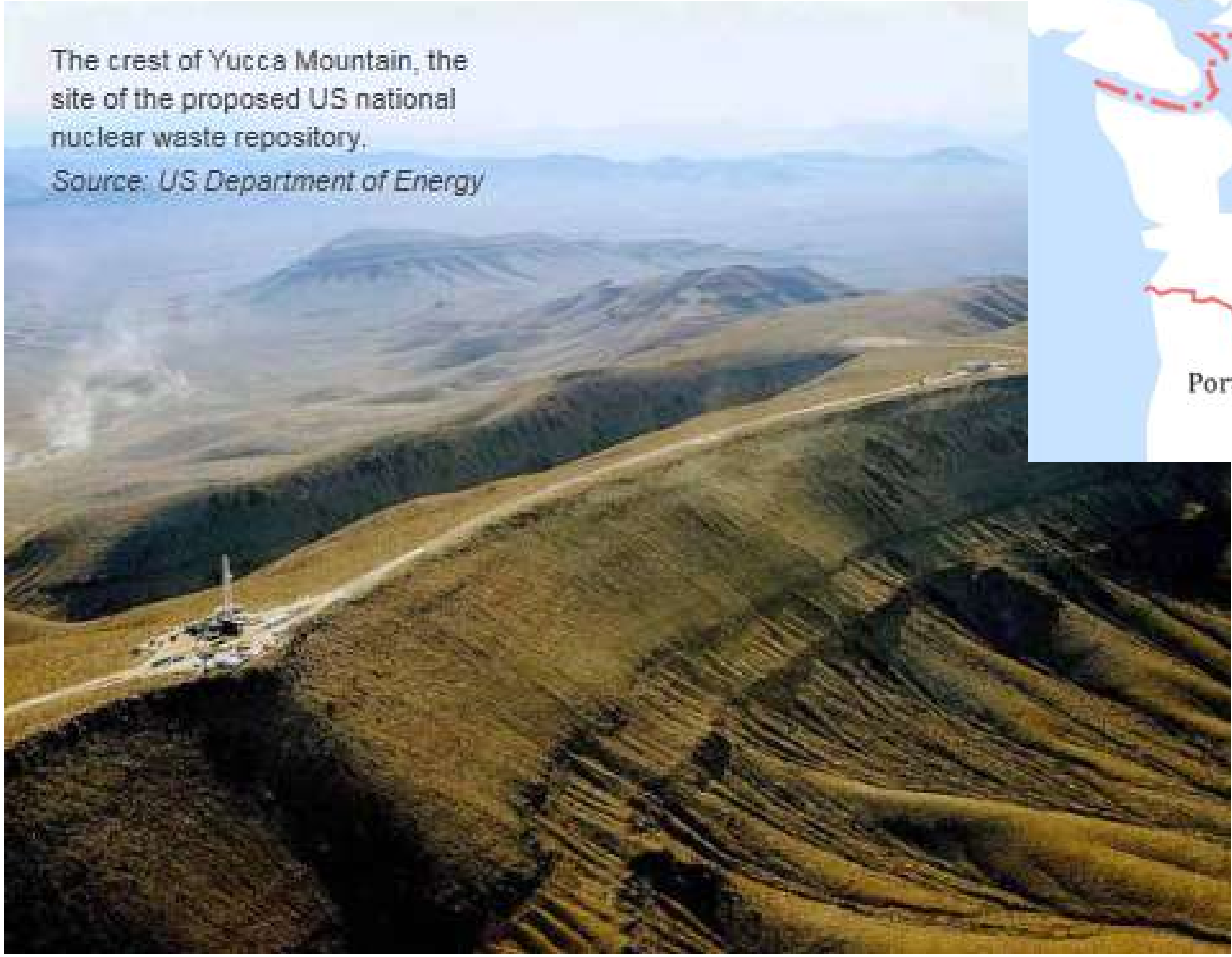
Figure S-2. The KBS-3 method. The method involves encapsulating the spent fuel in copper canisters which are then emplaced, surrounded by a buffer of bentonite clay, in deposition holes in a tunnel system at a depth of about 500 metres in the bedrock.

Country example: UK

Sellafield landscape. *Source: Sellafield Ltd.*

Legacy waste pond at Sellafield.

Country example: USA



The crest of Yucca Mountain, the site of the proposed US national nuclear waste repository.
Source: US Department of Energy

Conclusion

1. Large quantities of nuclear waste have been generated in Europe, for which in most cases still no disposal facility exists. The European countries with the largest quantities of wastes are the United Kingdom and France, followed by Germany.
2. Countries differ significantly in their practices on classifying nuclear waste, with no two countries having identical systems.
3. Worldwide waste management concepts still face serious challenges, especially for high-level waste. Some countries have clear concepts. Others are back at the beginning after setbacks or have only very vague concepts.
4. The financing of radioactive wastes management is a long-term challenge in all nuclear countries. All cost estimations have underlying uncertainties due to long time-scales, cost increases, lacking experiences, and estimated discounting (fund accumulation) rates.

Further guiding questions

1. What is the exact problem, what is the solution?
2. Periphery and inequality?
3. Storage or disposal? (Is that the question?)
4. What future for new build?

Thank you for your kind attention

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