

# THE WORLD NUCLEAR WASTE REPORT 2019

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ÖKOLOGIE & FRIEDEN

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# APPROACH

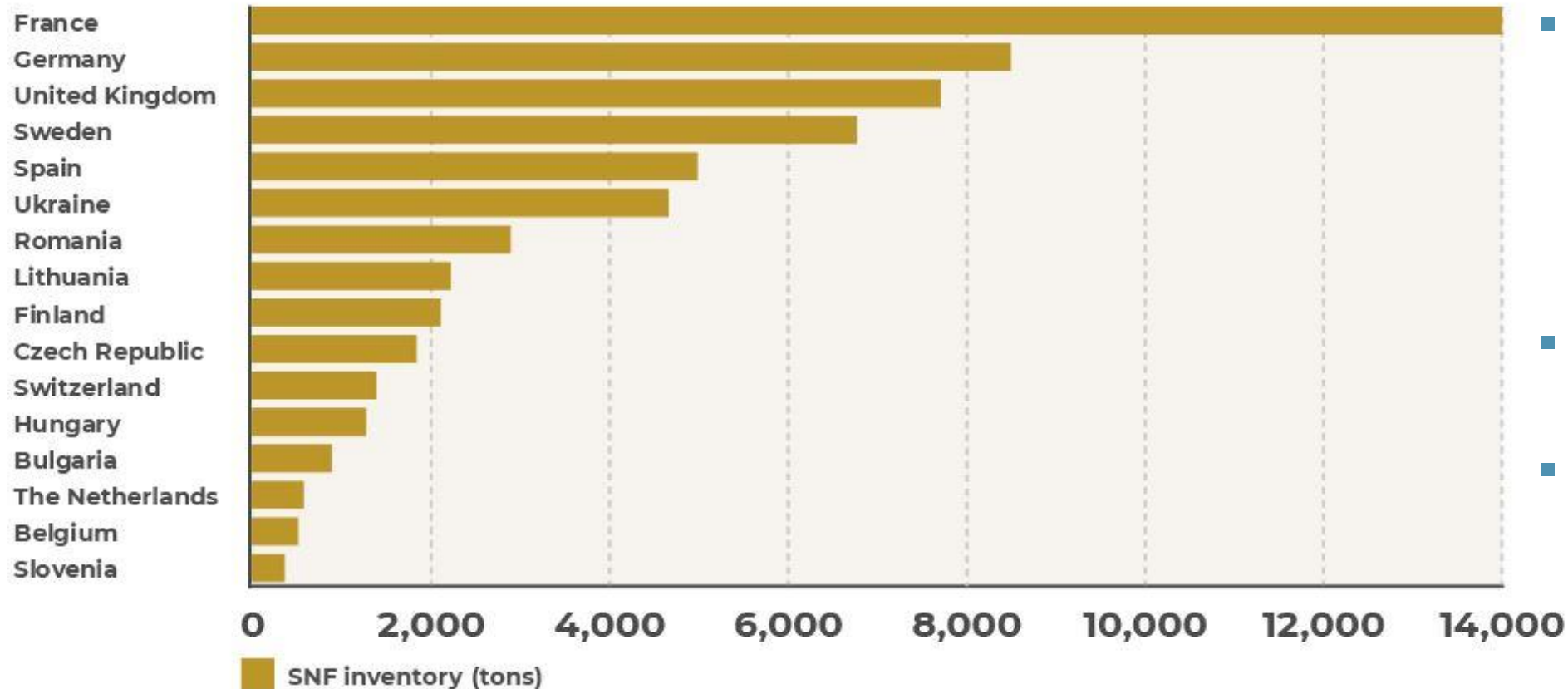


- Geographic focus on Europe
- Thematic focus on nuclear waste from power production
- Diverse group of contributors with strong expertise across scientific disciplines and countries.
- Overall approach: provide data in a descriptive, empirical, and technical overview. Closing research gap. Identifying data inconsistencies. Allowing for comparison. Establishing monitoring over time. No recommendations.
- Main interests: How do countries classify nuclear waste? What risks does nuclear waste pose? How much has been generated (and is expected)? Which concepts do governments pursue for waste management and disposal? How much does it cost and who pays for it?

# OVER 60,000 TONS OF SPENT NUCLEAR FUEL



**FIGURE 3:** Spent nuclear fuel in interim storage in Europe (excluding Russia, and Slovakia)  
in tons as of December 31, 2016



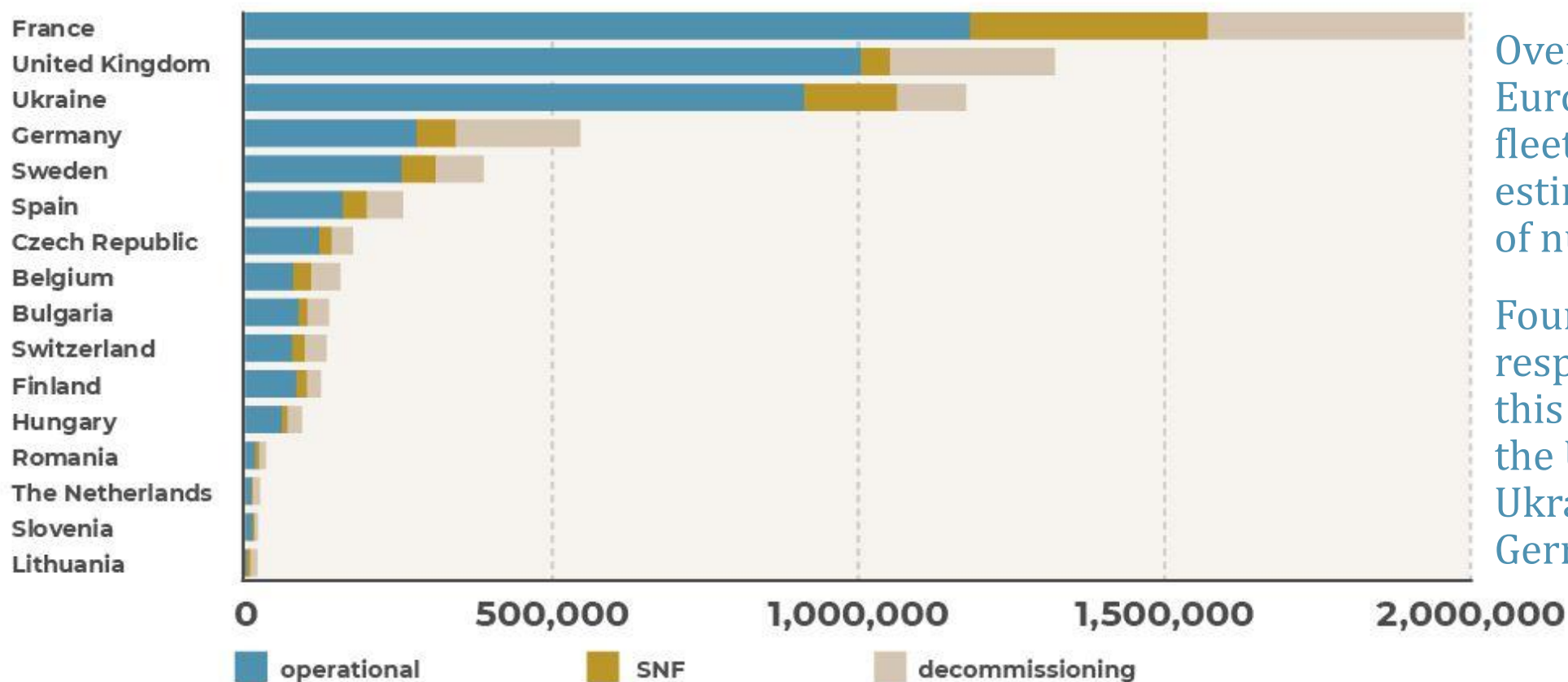
- Over 60,000 tons of spent nuclear fuel (SNF) alone are stored in interim storage facilities across Europe (without Russia and Slovakia).
- 81 percent of this is stored in wet storage.
- SNF accounts for only a smaller volume. But it is most difficult to solve because of its
  - high radioactivity
  - long-lived radioactivity
  - and heat generation.

Source: Own depiction based on reports published under Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management.

# ESTIMATE: 6,6 MIO. M<sup>3</sup> OF NUCLEAR WASTE



**FIGURE 2:** Estimated nuclear waste from operation, spent nuclear fuel management, and decommissioning from European NPP fleet (operational and shut down) in m<sup>3</sup> as of December 31, 2018



Over its lifetime, the European nuclear reactor fleet will produce an estimated 6.6 million m<sup>3</sup> of nuclear waste.

Four countries are responsible for most of this waste: France (30%), the UK (20%), the Ukraine (18%) and Germany (8%).

# COSTS AND FINANCES



**TABLE 6:** Funding systems for decommissioning in the Czech Republic, France, and Germany as of December 2018

	CZECH REPUBLIC	FRANCE*	GERMANY
<b>FUNDING SYSTEM</b>	internal segregated and restricted fund	internal segregated and restricted fund	internal non-segregated and unrestricted
<b>CONTROLLED BY</b>	operators	operator	operators
<b>ACCUMULATED BY</b>	fee on generated electricity	levy on electricity price	provisions by operators
<b>COST ESTIMATES</b>	Temelín: US\$ 847 million Dukovany: US\$ 1 billion  US\$410/kW to US\$530/kW	US\$ 35.7 billion for entire fleet  US\$450/kW for operational; US\$1,350/kW for legacy	US\$ 22.2 billion for 23 commercial reactors**  US\$940/kW
<b>SET ASIDE FUNDS, (IN % OF COST ESTIMATE)</b>	Temelín: US\$ 129 million (15%) Dukovany: US\$ 276 million (28%)	US\$ 20.8 billion (58%)	US\$ 26.7 billion*** (n.a.)

Source: Own depiction.

Notes: \* only applies to EDF

\*\* excluding costs for casks, transport, and conditioning

\*\*\* including provisions for casks, transport, and conditioning (also of operational waste); in 2017

# COSTS AND FINANCES



- **Underestimated costs:** Governments and operators often significantly underestimate the costs of decommissioning, storage, and disposal of nuclear waste. Many cost studies are based on outdated data from the 1970s and 80s (instead of the few existing real-data-cases).
- **Cost-finance-gap:** In many countries the financial resources set aside only cover a smaller part of the estimated costs. In many cases this cost-finance-gap is expected to grow when actual costs outpace the outdated data. Also, final disposal involves incalculable risks, which often lead to delays and enormous cost increases (for example Asse in Germany, €6-8 billion).
- **Polluter-pays-principle failed to apply:** Government claim to pursue the polluter-pays-principle, but fail to apply it consistently. It makes operators liable for the costs of managing, storing, and disposing of nuclear waste. No country in Europe has taken sufficient precautions to finance the costs of the final disposal of nuclear waste. There is a threat that the real, massive costs will ultimately be borne by the taxpayers.

**TABLE 5 | Country programs for repositories for high-level waste as of August 2019**

Country	Waste type	Host rock	Site selection status	Underground Research Laboratory	Construction permit	Time frame to repository license
<b>BELGIUM</b>	SNF, HLW, TRU	clay, unconsolidated	appointed	Hades		not scheduled
<b>CANADA</b>	SNF, HLW, TRU	crystalline	deferred*	none		not scheduled
<b>CHINA</b>	HLW, TRU	crystalline, clay	ongoing?	Beishan		not scheduled
<b>CZECH REPUBLIC</b>	HLW	crystalline	1990-2015 (est.)	none		2065 (est.)
<b>FINLAND</b>	SNF	Crystalline	appointed (1985-2000)	Onkalo RF	2018	2024 (est.)
<b>FRANCE</b>	HLW, TRU	clay, consolidated	appointed	Bure, Tournemire	2020 (est.)	not scheduled
<b>GERMANY</b>	SNF, HLW, TRU	salt, clay, Crystalline	2017-2031 (est.)	none		2050 (est.)
<b>HUNGARY</b>	SNF, TRU	clay	1995-2030 (est.)	Pécs		not scheduled
<b>JAPAN</b>	HLW, TRU	crystalline, sediments	2010-2030 (est.)	Honorobe Mizunami, others		not scheduled
<b>THE NETHERLANDS</b>	SNF, HLW	open	deferred	none		storage >100 years
<b>SPAIN</b>	SNF, HLW	salt, clay, Crystalline	deferred	none		not scheduled
<b>SWEDEN</b>	SNF (HLW)	crystalline	appointed (1980s-2009)	Äspö	ongoing (deposited 2011)	not scheduled
<b>SWITZERLAND</b>	SNF, HLW, TRU	clay, consolidated	2008-2030 (est.)	Mont-Terri		2060 (est.)
<b>UNITED KINGDOM</b>	HLW, TRU	not specified, different UK-country policies	2008	none		not scheduled
<b>USA</b>	TRU-wastes	salt	appointed (1972-1988)	none	repository in operation (1998/2000)	
	SNF, HLW	tuff (other)	deferred	none		not scheduled

**Source:** Own compilation based on official country reports

**Notes:** \*on voluntary basis. est. = estimated; HLW = high-level waste; SNF = spent nuclear fuel; TRU = transuranic waste

# COUNTRY PROGRAMS FOR REPOSITORIES



# WASTE MANAGEMENT AND DISPOSAL



- No country in the world has a deep geological repository for spent nuclear fuel in operation. Finland is the only country currently constructing a permanent repository. Sweden and France selected sites. Most countries are decades away from starting construction or even operation of a final disposal.
- Despite multiple failed selection procedures and abandoned repositories, a preference for deep geological disposal for high-level waste remains. However, there is no guarantee for the feasibility of deep geological disposal.
- Due to the lack of repositories, the risks are increasingly shifting to interim storage facilities. This is problematic, because these facilities have not been designed for such a long-term use. Also, some of these are running out of capacity (example Finland: 93% saturation).



# OVERALL TAKE-AWAY



The final disposal of high-level radioactive waste presents governments worldwide with major challenges that have not yet been addressed. It entails incalculable technical, logistical, and financial risks.

[www.WorldNuclearWasteReport.org](http://www.WorldNuclearWasteReport.org)

