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Inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects

Accompanying the document

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

on progress of implementation of Council Directive 2011/70/EURATOM and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects - THIRD REPORT

{COM(2024) 197 final} - {SWD(2024) 123 final}

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List of abbreviations

DSRS	Disused sealed radioactive sources
EU	European Union
HLW	High Level Waste
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Waste
LLW	Low Level Waste
NORM	Naturally Occurring Radioactive Material
OECD-NEA	Nuclear Energy Agency of Organisation for Economic Co-operation and Development
RAW	Radioactive waste
SF	Spent fuel
SRIS	Spent Fuel and Radioactive Waste Information System
tHM	Tons of heavy metal
VLLW	Very Low Level Waste
VSLW	Very Short Lived waste

1. Introduction

According to Article 14(2)(b) of Council Directive 2011/70/EURATOM[1] establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (further "Directive"), the European Commission (further "Commission"), on the basis of the Member States' reports, shall submit to the European Parliament and the Council an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects.

This Staff Working Document (SWD) presents **an overview of spent fuel and radioactive waste inventory in the European Union and the future prospects** and provides background information to the inventory data presented in the Third Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/EURATOM and an inventory of radioactive waste and spent fuel present in the Community's territory and future prospects (COM(2024) 197).

This is the third Staff Working Document providing an updated overview of spent fuel and radioactive waste inventory in the European Union and the future prospects. The inventory reference date is end of 2019, although more than half of the Member States reported inventory as of end of 2020 or 2021 (more information on the inventory dates are provided in chapter 2 – sources of information). This document is based on the information provided in the third national reports of EU Member States on the implementation of the Directive and it builds on the second SWD document (SWD(2019)435 final[2]) with inventory data from 2016. This document provides an overview of:

- The total spent fuel and radioactive waste inventory on the EU-27 territory as of 2019;
- Forecast of national and EU inventory in 2030 based on available information reported by Member States;
- Updated trends of radioactive waste and spent fuel in the EU.

Previously the European Commission had published a series of "Situation Reports"[3] which were developed in order to analyse and inform stakeholders about the situation of spent fuel and radioactive waste management in the European Union. Since the Directive entered into force, situation reports were discontinued and replaced by the Commission report on implementation of the Directive and accompanying Staff Working Documents.

Updated information about the Member States' installations generating radioactive waste and spent fuel, national policies, programmes, concepts, plans and financing mechanisms is summarised in the Staff Working Document SWD(2024) 123 on progress of implementation of Council Directive 2011/70/Euratom.

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1 Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste; OJ L 199, 2.8.2011, p. 48.

2 Commission Staff Working Document, Inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects; SWD(2019)435 final, 17.12.2019.

3 The last one of the series was "Commission staff working paper, Seventh situation report, radioactive waste and spent fuel management in the European Union; SEC(2011) 1007 final, 22.8.2011".

2. Sources of information

The European Union spent fuel and radioactive waste inventory data presented in this document is based on the **third national reports** submitted by all Member States in 2021.

To support Member States in reporting radioactive waste and spent fuel inventory to the international organisations, the Commission services in collaboration with the International Atomic Energy Agency (IAEA) and the OECD's Nuclear Energy Agency (NEA) defined a harmonised set of data on reporting of national inventories and supported the corresponding inventory reporting system SRIS[4] operated by the IAEA (SRIS – Spent Fuel and Radioactive Waste Information System). By mid-2023 eight[5] Member States have introduced their inventory data in SRIS. For the next reporting period (ending in August 2024), the use of SRIS for inventory reporting to the international organisations is strongly encouraged by the Commission.

Although Article 14(1) of the Directive indicates that Member States can take advantage of the review and reporting under the Joint Convention, less than half of the Member States did so. Those Member States used inventory data reported in the last Joint Convention reporting cycle (using 2019 as a reference date for their inventories for the 7th Joint Convention meeting in June 2022). The remaining Member States reported newer inventory data. To summarize, the inventory situation was reported as of year-end 2019 by 12 Member States, as of year-end 2020 by 8 Member States and the remaining 7 Member States reported the newest inventory information dated 2021. Looking at the size of the programmes it is clear that mainly Member States having small inventories reported newer data, while for larger inventories it takes more time to collect and process inventory data. As for radioactive waste volumes distribution by reporting year – inventory with the reference date as of 2019 makes up 91% of the overall volume, and inventories with the reference dates of 2020 and 2021 make 5% and 4% of the overall radioactive waste volume in the EU, respectively.

As the dominating volume of radioactive waste is reported with 2019 as the reference date, 2019 is chosen in this document as the reference date for the overall EU radioactive waste and spent fuel inventory in order to simplify data presentation.

For the trend analysis only inventory data from the first[6] and second[7] Commission reports is used. It has to be noted that inventory data provided in the previous Commission reports included inventory information from the United Kingdom. As the United Kingdom has left the European Union on 31 January 2020, all the historical inventory data used for

4 https://sris.iaea.org/

5 Estonia, Finland, France, Greece, Italy, Latvia, Lithuania, Spain.

6 Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/Euratom and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects - COM(2017) 236 final.

7 Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/Euratom and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects – Second report – COM(2019) 632 final.

identification of trends have been adjusted, i.e. historical inventory data from 2013 and 2016 presented in this report were adjusted to represent inventory of the 27 European Union Member States.

Most of the national inventory summaries presented in this document have been verified (fact-checked) by the respective Member States in 2022.

In preparation of this report, most of the **sources of uncertainty,** identified in the document SWD(2017)161 final, remained valid, i.e.

- Member States are using different radioactive waste classification schemes. For EU inventory aggregation purposes conversion to a common reporting basis is necessary (IAEA GSG-1 classification[8]; see Chapter 4 below). However, a transition from one classification scheme to another often introduces uncertainties, as the radioactive waste classes in different national classification schemes sometimes cannot be directly matched. In such situations, transformation is carried out on a "best approximation" basis. In the third national reports most Member States reported their radioactive waste inventory using IAEA GSG-1 classification scheme or provided transformation matrix allowing transformation of waste inventory from their national classification scheme to IAEA GSG-1.
- Member States use **different units** (volume, mass, etc.) for unconditioned waste. Conversion from mass to volume without detailed information of the used treatment/conditioning methods used can result in significant uncertainties[9].

  Reporting of disused sealed radioactive sources varies from country to country. Countries with large nuclear programmes generally integrate disused sealed radioactive sources into other large radioactive waste streams and do not report them separately. Countries where the disused sealed radioactive sources make significant part of the national inventory report them separately from the other radioactive waste streams. In such cases, disused sealed radioactive sources are reported only as number of sources.
- Member States report differently volumes of unconditioned radioactive waste – **some report actual volumes in storage, while others report estimated volumes after conditioning to be emplaced in disposal.**

  For inventory aggregation purposes, the estimated volumes of radioactive waste to be placed in disposal are preferred since this represents the final step in management of radioactive waste. Use of actual radioactive waste volumes in storage can lead to significant uncertainties, especially when estimating the need for disposal capacities. Usually, most significant volume changes (reduction) occur as a result of liquid radioactive waste and sludge treatment and conditioning for disposal. The same is true for combustible and compactible radioactive waste.

  In the third national reports, most of the Member States reported estimated disposal volumes for unconditioned waste. This allows to reduce uncertainties and to improve consistency and comparability of the data.

8 Classification of Radioactive Waste. IAEA Safety Standards No. GSG-1, 2009, Vienna.

9 Simple approach is to use 1 t ≡ 1 m^3 equivalence.

- **Knowledge of radioactive contamination** of facilities subject to decommissioning plays important role in predicting amounts of decommissioning waste**.** The detailed characterization of a facility subject to decommissioning increases the precision in forecasting the amount of radioactive waste, however, only when decommissioning is well progressed will the actual categories and amounts of waste be fully known. This is also valid for the limited knowledge of characteristics of some legacy wastes.
- Future radioactive waste inventories highly depend on **various decisions** introducing additional uncertainties in the projection of future radioactive waste inventories**,** e.g.:
    - **Technological decisions,** such as the selection of treatment and conditioning options, the choice between immediate or deferred decommissioning, the decision to retrieve disposed radioactive waste, might have significant impact on the projection of future radioactive waste inventories (e.g. volumes, classes);
    - **Political decisions and changes in the legal/regulatory framework,** such as the development of new nuclear facilities, changes to the fuel cycle or introduction of new radioactive waste classes.

During the **assessment of the evolution of Member States inventories with time**, the following additional sources of **uncertainties remained**:

- **Differences in the reference dates of Member States' inventories** – for the current reporting period, less than half of all Member States (12, see above) reported inventories as of the end of 2019 and more than a half have chosen to report more recent inventories with dates ranging from 2020 to 2021.
- **Change in radioactive waste status** – during the reporting period no retrievals of previously disposed radioactive waste were reported. However, some Member States plan in the future to recover previously disposed of radioactive waste, process and re-dispose of it in existing and/or newly constructed disposal facilities. Re-disposal activities might affect the overall radioactive waste inventory as a result of subsequent retreatment and final disposal. There are already a few Member States which took the decision on remediation of disposal sites, thus their radioactive waste is considered as stored whilst awaiting retrieval.

3. Sources of spent fuel and radioactive waste

Radioactive waste is generated in all Member States of the European Union even though the quantities are very small in non-nuclear power Member States compared to those Member States operating nuclear power plants. Radioactive waste inventory in small countries usually consists of disused sealed radioactive sources or small amounts of orphan/legacy radioactive materials. Small volumes of radioactive waste are generated as a result of non-power uses of radioactive materials, such as the manufacturing of radioactive materials for use in medical and industrial applications, or research facilities such as laboratories, and research reactors. Most of the Member States operating research reactors have an agreement in place to send back spent fuel to the suppliers.

Most of the radioactive waste come from nuclear power plants and associated nuclear fuel cycle activities, i.e., from conversion of uranium to fuel fabrication, to its use for electricity generation, and the subsequent reprocessing of spent fuel. In the third national report 17 Member States have declared spent fuel. Some of those Member States have chosen to reprocess spent fuel, some Member States have chosen the once-through fuel cycle option when spent fuel will be directly disposed of in deep geological disposal. A few Member States applied both approaches – part of their spent fuel was reprocessed and the remaining part will be directly disposed of. Currently, spent fuel is stored in specialised storage facilities until final disposal facilities will be available. Most of the radioactive waste, in terms of activity is generated during operation of nuclear facilities. However, in terms of volume, most of the waste comes from decommissioning of nuclear power plants and other nuclear facilities at the end of their useful lifetime, and it is mainly low-level waste.

In some Member States waste from mining and milling of uranium is declared as radioactive waste. Usually, those activities generate significant amounts of waste. Some Member States report such material as part of radioactive waste inventory, whereas others do not. Therefore, an aggregate estimate and comparison of inventories of waste containing naturally occurring radioactive material between Member States or compilation of an overall European Union inventory (including NORM waste) is currently not possible and therefore outside the scope of this report.

4. Classification of spent fuel and radioactive waste

In line with Article 12(1)(c) of the Directive, Member States need to develop, as part of their national programmes, and notify to the Commission, spent fuel and radioactive waste inventories in accordance with an appropriate classification. Correspondingly, Member States have notified their national programmes and third national reports on their spent fuel and radioactive waste inventories based on radioactive waste classifications that may differ from one Member State to another.

As in the previous report, in order to make spent fuel and radioactive waste inventories comparable among different Member States and in order to aggregate the overall inventory on the territory of the European Union, Member States' inventories have been translated into a common classification. The IAEA GSG-1 classification system has been chosen for that purpose in order to facilitate Member States reporting to various international organisations (e.g. IAEA) and instruments (e.g. Joint Convention).

The categories of radioactive waste used for data aggregation are as follows:

- **Very Low Level Waste** (VLLW): waste that does not need a high level of containment and isolation and, therefore, is suitable for disposal in near surface landfill type facilities with limited regulatory control.

- **Low Level Waste** (LLW)**:** waste that is above clearance levels, but with limited amounts of long-lived radionuclides. Such waste requires robust isolation and containment for periods of up to a few hundred years and is suitable for disposal in engineered near surface facilities. This class covers a very broad range of waste. LLW may include short-lived radionuclides at higher levels of activity concentration, and also long-lived radionuclides, but only at relatively low levels of activity concentration.
- **Intermediate Level Waste** (ILW): waste that, because of its content, particularly of long-lived radionuclides, requires a greater degree of containment and isolation than that provided by near surface disposal. However, ILW needs no provision, or only limited provision, for heat dissipation during its storage and disposal. ILW may contain long-lived radionuclides, in particular, alpha emitting radionuclides that will not decay to a level of activity concentration acceptable for near surface disposal during the time for which institutional controls can be relied upon. Therefore, waste in this class requires disposal at greater depths, of the order of tens of metres to a few hundred metres.
- **High Level Waste** (HLW): waste with levels of activity concentration high enough to generate significant quantities of heat by the radioactive decay process or waste with large amounts of long-lived radionuclides that need to be considered in the design of a disposal facility for such waste. Disposal in deep, stable geological formations, usually several hundred metres or more, below the surface is the generally recognized option for disposal of HLW.

Spent fuel (SF) is also considered in its entirety, whether it might be intended for reprocessing or awaiting decision for future long-term management (reprocessing or disposal).

In addition to the above-mentioned waste classes, IAEA GSG-1 classification system defines:

- **Exempt waste** with concentrations of radionuclides small enough to not require provisions for radiation protection. Such material can be cleared from regulatory control and does not require any further consideration from a regulatory control perspective.
- **Very short-lived waste** containing only very short half-life radionuclides, thus such waste can be stored until the activity has fallen beneath the levels of clearance, allowing for the cleared waste to be managed as conventional waste.

The latter two waste classes do not require future long-term management or disposal as radioactive waste due to their short-lifetime and/or levels allowing the exemption or clearance from regulatory control. Accordingly, exempt waste and very short-lived waste are in most cases not reported by Member States. Thus, these waste classes have not been used for data aggregation in the present document.

Several Member States combine VLLW and LLW, or do not have a separate VLLW class. In the latter case, such material could be subject to clearance in accordance with the respective national legislation. Reflecting the disposal routes, several Member States also use a combined waste class “low and intermediate level waste” (LILW). Where other than the IAEA GSG-1 classification system is used for reporting by Member States, a conversion

provided by the Member States is applied in this Report in order to achieve the transformation from the national to the IAEA classification systems.

5. Current radioactive waste and spent fuel inventory in the European Union

This section is dedicated to the presentation and analysis of the radioactive waste and spent fuel inventory present in the Community's territory and the future prospects as required by Article 14(2)(b) of the Directive. The information used to compile this section was primarily collected from the third national reports and national programmes. The details on the national inventories are given in Annex I of this document. The first Commission report contained information on the radioactive waste disposed of at sea (Table I.8 of the Staff Working Document SWD(2017)161 final). As such disposal practices were prohibited by the London Convention that entered into force in 1975 and no new information emerged since publication of the first Commission report – information on radioactive waste disposed of at sea is excluded from this document.

The section is composed of two parts – the first part deals with the radioactive waste inventory and the second part is dedicated to the spent fuel inventory.

Overall, inventory data reported in the third national reports are generally consistent with the data provided in national programmes and second national reports. In most of the cases, national reports provided sufficient information to explain non-typical changes in the inventories (e.g. successful volume reduction programmes resulting in reduction of waste amounts without presence of disposal activities). However, the number of sources of uncertainties previously listed in Section 2 of this document still remains an obstacle for the most complete and comprehensive reporting of national and EU inventory.

The future prospects of the radioactive waste and spent fuel inventory present in the Community's territory are presented in Section 6.

EU radioactive waste inventory

The estimated total inventory of radioactive waste on the European Union territory at the end of 2019 was 2 334 000 m^3. Approximately 66% of this waste was already disposed of (1 552 000 m^3) and 34% (782 000 m^3) was still in storage and will have to be managed in the future. Compared to the 2016 radioactive waste inventory there is a 5% increase of total radioactive waste volumes, compared to an 8.5% total radioactive waste inventory increase from 2013 to 2016.

Table 1 summarizes the overall amounts of radioactive waste in the European Union with comparison to previous reporting (i.e. evolution since 2016).

Table 1. Volumes of radioactive waste in the European Union, end 2019.

Waste Category	EU RAW Amounts (m^3, rounded to thousands[10])					
	Stored		Disposed		Total	
Year	2016*	2019	2016*	2019	2016*	2019
VLLW	233 000	233 000	369 000	462 000	601 000	695 000
LLW	381 000	353 000	1 039 000	1 068 000	1 420 000	1 421 000
ILW	178 000	191 000	12 000	22 000	190 000	213 000
HLW	4 500	4 800	0	0	4 500	4 800
Total (m^3)	**796 000**	**782 000**	**1 420 000**	**1 552 000**	**2 216 000**	**2 334 000**

* Inventory 2016 refers to 27 Member States without United Kingdom.

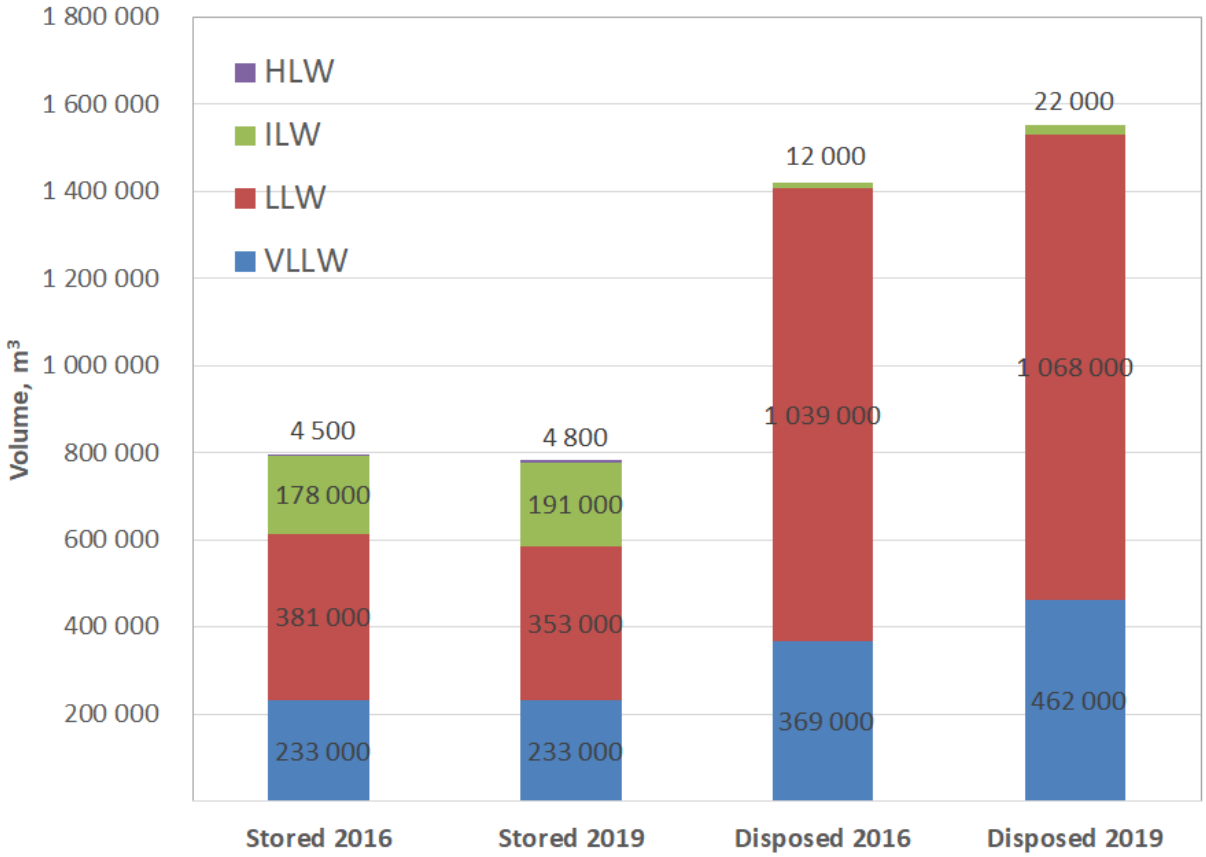


Figure 1. Distribution of the RAW in the EU between stored and disposed of by waste class at the end of 2016 and 2019.

Figure 1 and Figure 2 provide information on the distribution of radioactive waste in the European Union by waste class and by management phase. As it can be seen from those figures, the distribution of radioactive waste by class has not changed significantly compared

[10] Except for HLW, which is rounded to hundreds.

to 2016. As in previous reporting, LLW still remains as the dominating waste class making 60.9% of the overall waste amount, while VLLW and ILW is estimated at a 29.8% and 9.1% share respectively (see Figure 3). HLW makes by far the smallest fraction of the overall waste volume, accounting for less than 0.2% (all HLW is kept in storage).

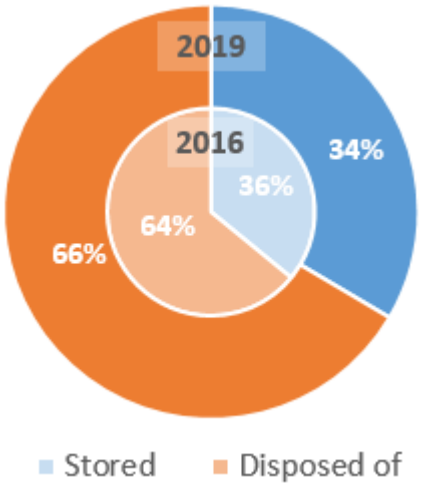


Figure 2. Distribution of the total RAW in the EU between stored and disposed of at the end of 2016 and 2019.

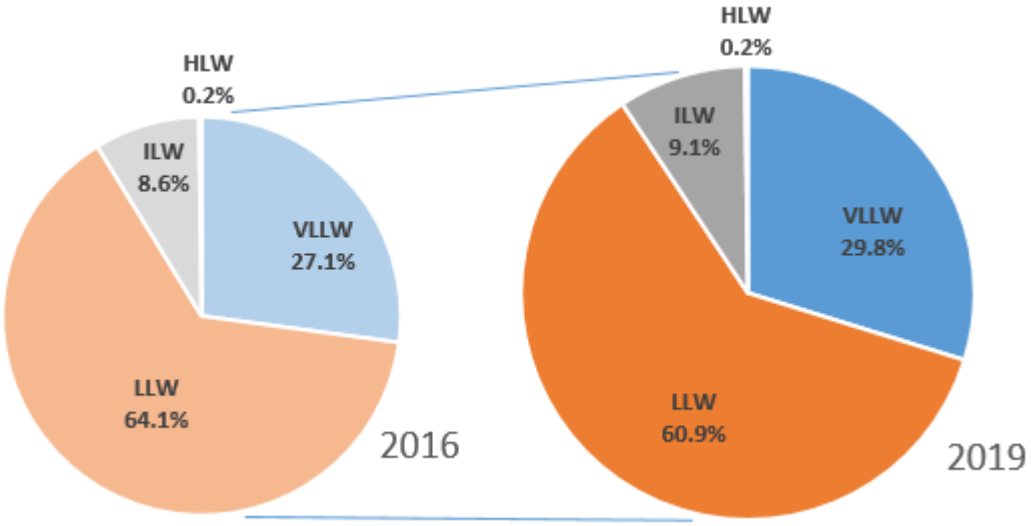


Figure 3. Distribution of the total RAW in the EU by waste category at the end of 2016 and 2019.

Even though LLW dominates radioactive waste inventory, two specific points should be taken into consideration:

- some Member States do not have separate VLLW class as defined in IAEA GSG-1 waste classification scheme. In such cases all the VLLW is reported as part of LLW waste class;

- some Member States do not register (partially or completely) VLLW amounts in their national inventory.

Both above-mentioned issues lead to a situation where VLLW amounts are underestimated and LLW overestimated.

The total quantity of the **disposed radioactive waste** as of end 2019 equals to 1 552 000 m^3. This is approximately 66% of total RAW and it consists mainly of LLW, i.e. 69% of the disposed of radioactive waste is LLW. However, due to the non-inclusion of VLLW disposals to the national inventories (i.e. this waste is classified and disposed as LLW) of some Member States the actual fraction of disposed of LLW volumes could be significantly lower. At the end of 2019, 66% of the total VLLW volume was reported as disposed of and the amount of VLLW disposed of had steadily increased. At the same time, 75% of LLW was reported as disposed of. Few Member States reported small amounts of ILW disposed of (1.4% of the total disposed of waste). In most of the cases ILW was disposed of as a result of past practices. Some Member States due to safety concerns are planning to retrieve ILW and re-dispose of it in new disposal facilities.

The total volume of **stored radioactive waste** in 2019 was 782 000 m^3. LLW makes almost half of this amount (45.1%), while VLLW and ILW make 29.8% and 24.4%, respectively. HLW fraction in the overall radioactive waste in storage is 0.6% and it remains unchanged since the previous reporting. Distribution of stored RAW by class for 2019 is shown in Figure 4 together with 2016 values for comparison. As in the previous cases, the change between two periods is fairly small.

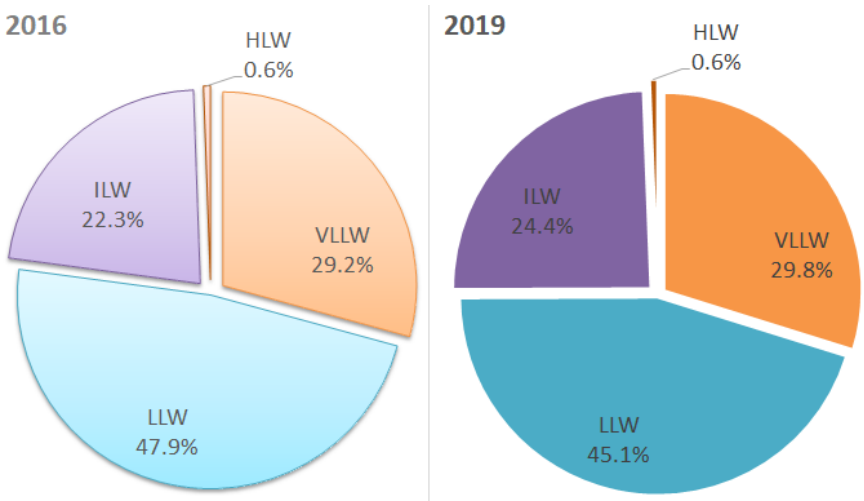


Figure 4. Distribution of stored radioactive waste in the European Union by class, end of 2016 (796 000 m^3) and 2019 (782 000 m^3).

There are significant differences in the amounts of stored radioactive waste between Member States with and without nuclear power programmes[11]. Figure 5 presents this at aggregated level for all RAW classes. At aggregate level, 15 EU Member States with nuclear power programme have accounted for 99.5% of the total radioactive waste volume generated in the EU compared to 0.5% generated by 12 Member States without nuclear power programme. It can be clearly seen that Member States without nuclear power programmes (even with research reactors) are contributing very little to the overall European Union radioactive waste inventory. Figure 5 shows volumes of radioactive waste in storage by class in Member States with and without nuclear power programme.

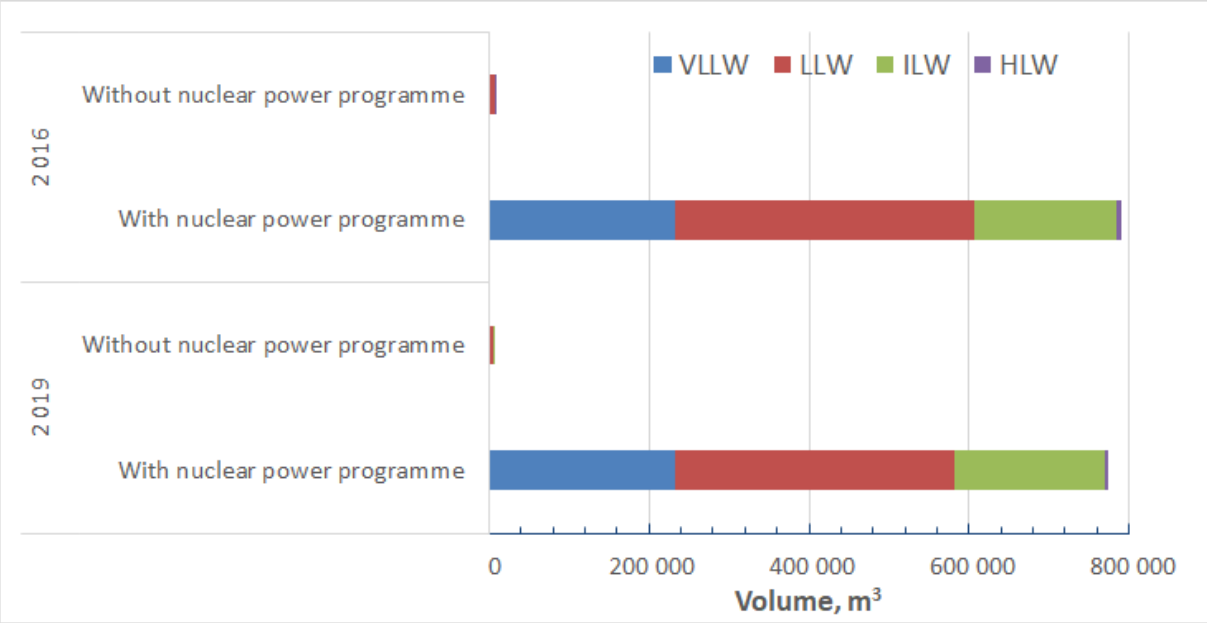


Figure 5. Volumes of stored radioactive waste by class in Member States with and without a nuclear power programme, end of 2016 and 2019.

Radioactive waste inventory - trends in the EU

Evolution of the total amount of radioactive waste (Table 2), radioactive waste in storage (Table 3) and radioactive waste which has been disposed of (Table 4) is based on the data from the previous Commission reports published in 2017 (inventory data from 2013), 2019 (inventory data 2016) and on the current data from the third national reports (inventory data 2019).

[11] For the purposes of this report, those Member States that have nuclear power reactors on their territory either operational or shut down are indicated as Member States with a nuclear power programme.

Table 2. Evolution of total radioactive waste inventory since 2013.

Waste Category	Total amount (m^3, rounded to thousands[12])		
	2013*	2016*	2019
VLLW	515 000	601 000	696 000
LLW	1 345 000	1 420 000	1 420 000
ILW	185 000	190 000	213 000
HLW	4 300	4 500	4 800
Total	**2 049 000**	**2 216 000**	**2 334 000**

* Inventory from 2013 and 2016 refers to 27 Member States without United Kingdom.

Figure 6 presents radioactive waste inventory evolution for the period 2013-2019. There are no significant changes since the first Commission report. VLLW volume as well as a fraction of disposed of waste steadily increased. LLW still remains dominant waste class in terms of total volume and disposal rate.

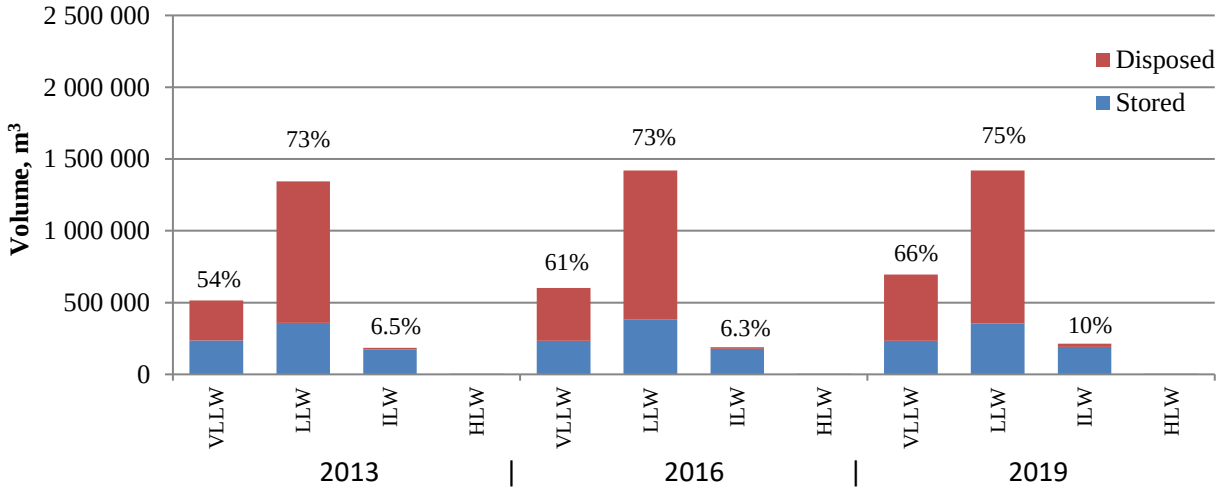


Figure 6. Evolution of total radioactive waste volumes since the end of 2013 (with the percentage of waste disposed of indicated).

Normalized RAW amounts from tables are also presented in figures to allow easier trend observation (see Figure 7, Figure 8 and Figure 9). Normalization allows to better present together RAW categories with huge differences in values but it also removes information about relative share. In all RAW categories steady increase of total volume over time is noticeable.

[12] Except for HLW, which is rounded to hundreds.

The overall evolution of radioactive waste generated in the European Union (normalized sum of radioactive waste both stored and disposed) until the end of 2019 is shown in Figure 7.

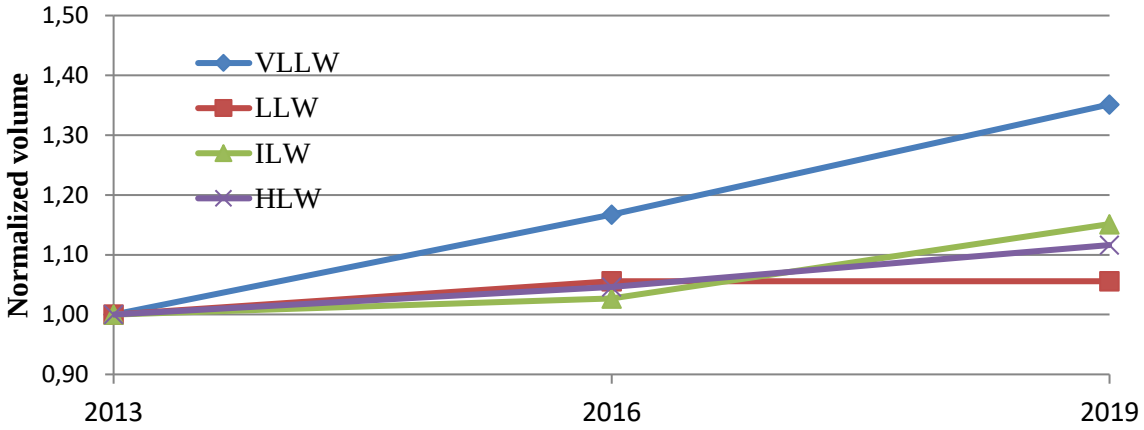


Figure 7. Normalized[13] evolution of RAW volumes in the EU (both stored and disposed).

The evolution of the stored radioactive waste volumes (per waste category) is presented in Table 3.

Table 3. Evolution of stored radioactive waste in the 2013-2019 period.

Waste Category	Stored amount (m^3, rounded to thousands[14])		
	2013*	2016*	2019
VLLW	236 000	233 000	233 000
LLW	358 000	381 000	353 000
ILW	173 000	178 000	191 000
HLW	4 300	4 500	4 800
Total	**771 000**	**797 000**	**782 000**

* Inventory from 2013 and 2016 refers to 27 Member States without United Kingdom.

There are currently no operational deep geological disposal facilities for ILW and HLW. Consequently, the amounts of stored ILW and HLW are steadily increasing over time. The amounts of VLLW and LLW in storage are affected by differences in generation and disposal rates. During different time periods, their respective amounts in storage may therefore increase or decrease. The volume of stored VLLW and LLW is rather stable and has not changed significantly since 2013. This shows that the disposal rate of VLLW and LLW is

13 The chart shows relative change of radioactive waste volumes over the time since 2013.
14 Except for HLW, which is rounded to hundreds.

aligned with the generation rate of the radioactive waste. Figure 8 presents graphically normalised stored RAW categories for all reporting periods.

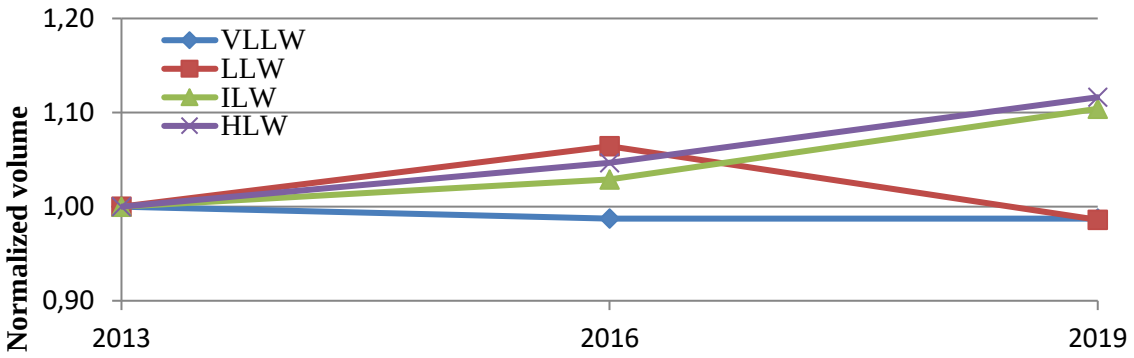


Figure 8. Normalised[15] evolution of stored RAW amounts in EU since 2013.

Table 4 shows the evolution of radioactive waste disposal over time. Steady increase of disposed VLLW and LLW since 2013 can be seen, confirming proper functioning and capacities of disposal systems.

Table 4. Evolution of radioactive waste disposals in the 2013-2019 period

Waste Category	Disposed of amount (m^3, rounded to thousands)		
	2013*	2016*	2019
VLLW	279 000	369 000	462 000
LLW	987 000	1 039 000	1 068 000
ILW	12 000	12 000	22 000
HLW	0	0	0
Total	**1 279 000**	**1 420 000**	**1 552 000**

* Inventory from 2013 and 2016 refers to 27 Member States without United Kingdom.

From Table 4 it can be also seen that some Member States are disposing of ILW. However, this is not yet widespread practice. These disposals, in accordance with the IAEA classification, consist mainly of highly active disused radioactive sealed sources containing short-lived radionuclides. Approximately 95% of ILW is still kept in storage and pending proper disposal facilities. Figure 9 presents graphically normalised disposal of VLLW and LLW waste since 2013.

[15] The chart shows relative change of radioactive waste volumes over the time in comparison to the 2013 volumes.

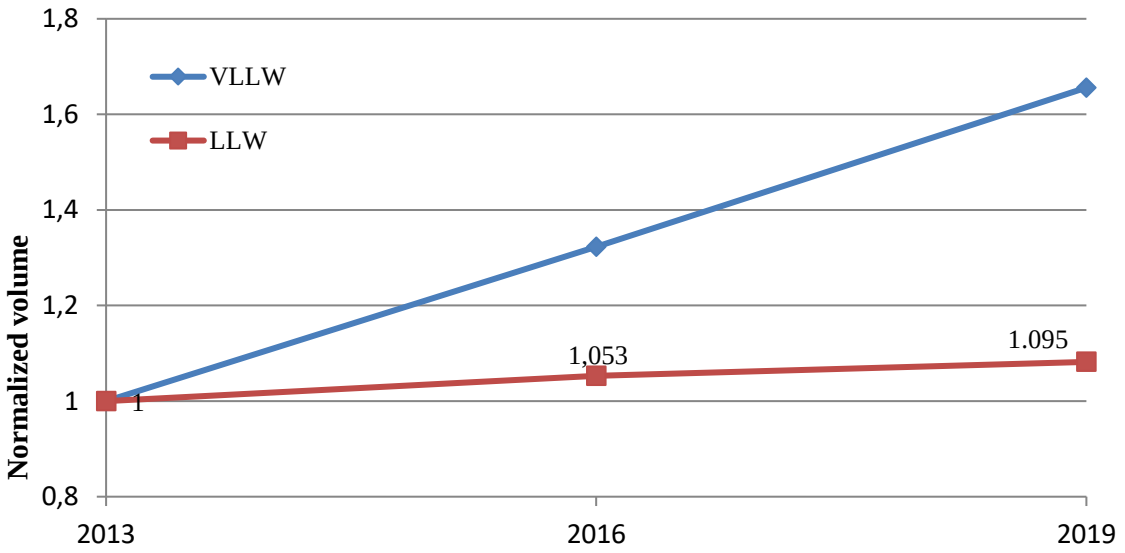


Figure 9. Normalised[16] evolution of VLLW and LLW disposal amounts in EU since 2013.

Overall, the situation remains broadly unchanged compared to the one described in the 1st and 2nd Commission reports. Approximately 25% of the LLW amount generated is kept in storage. There is no systematic increase in the amounts in storage between 2013 and 2019 and the overall LLW amount of waste generated and disposed of is generally in equilibrium. LLW disposal is dominated by Member States with large LLW inventories (primarily France), whereas several Member States with smaller inventories do not yet dispose of their LLW. For ILW the situation is very different. In 2019, approximately 10% of the total ILW volume was disposed of as reported, and in some cases such ILW will be retrieved as current disposal facilities do not meet present safety requirements. There is a steady increase in ILW in storage.

For HLW and spent fuel declared as waste, the first facility for disposal of such material is expected around 2024 in Finland, with other facilities in France (around 2035) and Sweden (around 2030). Therefore, one should expect that the amounts of HLW and spent fuel in storage will increase steadily in line with their generation.

Currently, twelve Member States have radioactive waste disposal facilities either in operation or closed (nuclear power programme countries: Czech Republic, Finland, France, Germany, Hungary, Romania, Slovakia, Spain, Sweden; non-nuclear programme countries: Latvia, Poland and Portugal). Based on the information from the national programmes and reports it is expected that more repositories will be built in the coming years.

A number of Member States (both with and without nuclear power plants) have dedicated disposal sites for institutional radioactive waste. In some cases, the disposal of waste

[16] The chart shows relative change factors of radioactive waste volumes over the time in comparison to the 2013 (VLLW and LLW).

undertaken in the past at several sites is now being reconsidered and there are plans for the retrieval of the waste disposed of several decades ago. Consequently, a change of radioactive waste inventories can be expected after retrieval for processing and subsequent storage and/or disposal.

The reports since 2013 present the status of RAW inventory for all Member States. The amounts of RAW are presented according to their management phase and four RAW classes. Because of the mentioned difference in scale, the presentation is separate for Member States with and without nuclear power programme.

There are fifteen European Union Member States that operate or have operated nuclear power plants. Member states with nuclear power programmes together account for 99.5 % of the radioactive waste inventory in the European Union. The share of the total RAW in 2019 between Member States with nuclear power programme is presented in Figure 10.

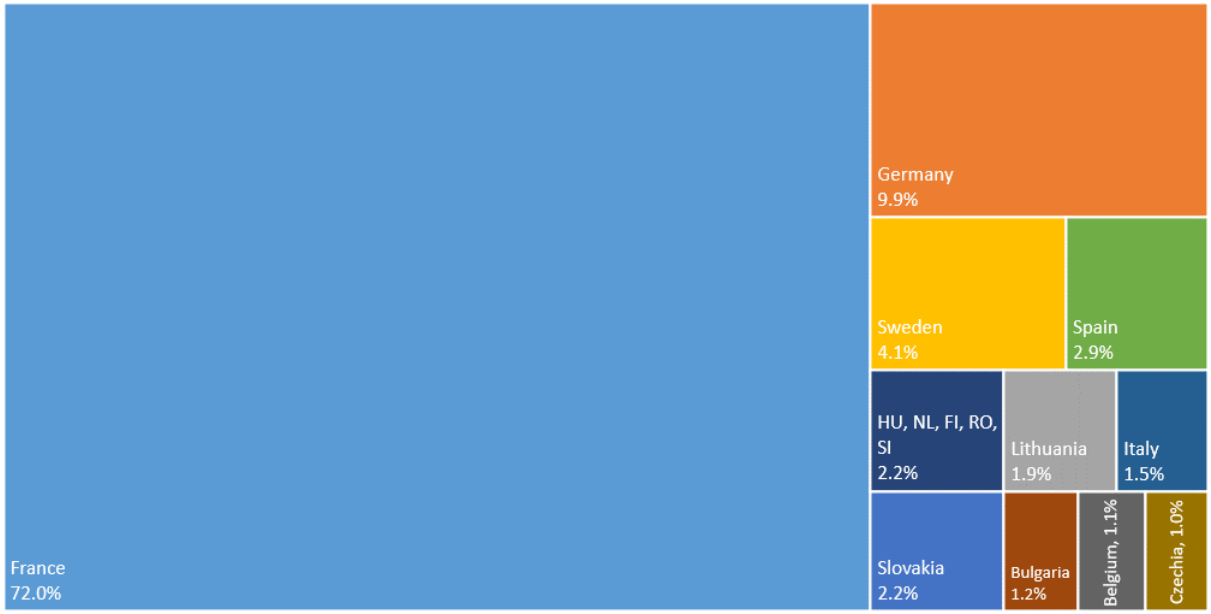


Figure 10. Distribution of total volumes of radioactive waste (2 334 000 m^3) **in Member States with nuclear power programme, end of 2019[17].**

Overating the largest fleet of nuclear power plants, France is clearly dominating with the largest volumes of radioactive waste (72% of the total radioactive waste in Member States with nuclear power programme). The Member State with the next highest share is Germany with 9.9%. The total volume of radioactive waste in those Member States is shown individually in Figure 11 (with indicated stored and disposed of amounts in 2016 and 2019).

[17] Member States' (MS) abbreviations in this report are as follows: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), Cyprus (CY), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), Malta (MT), The Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), Slovakia (SK), Slovenia (SI), Spain (ES) and Sweden (SE).

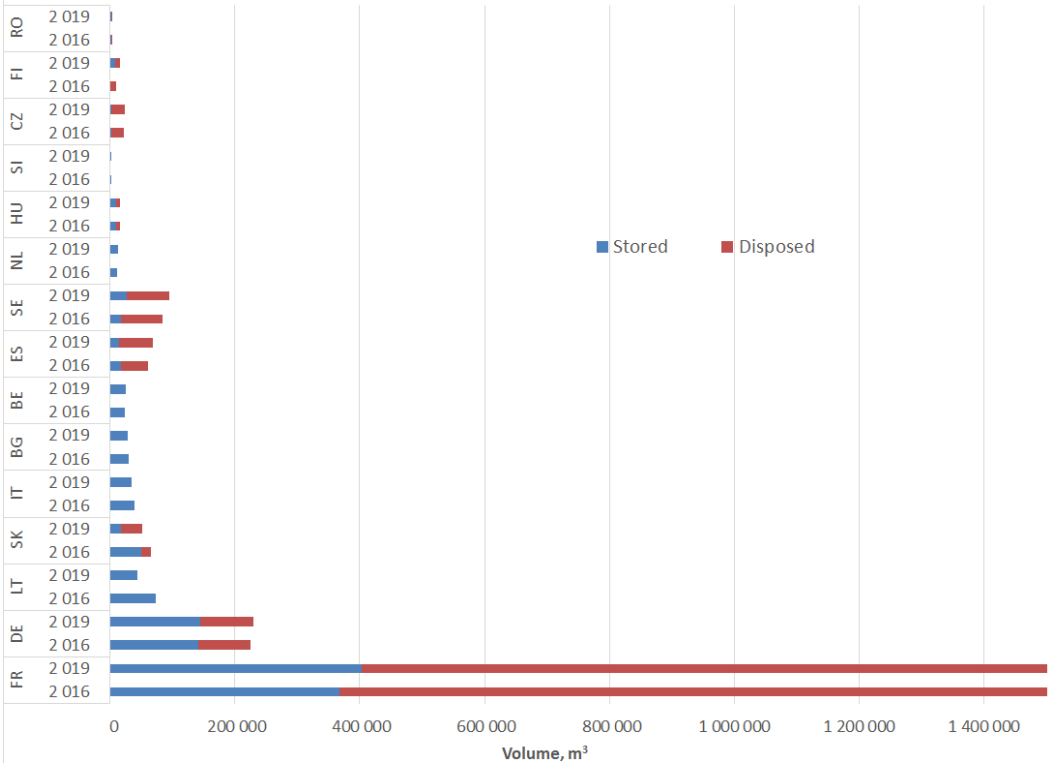


Figure 11. Volumes of RAW in the 15 Member States with nuclear power programme, end of 2016 and 2019.

Twelve Member States have no nuclear power programme, although six of them are operating or have operated research, training or demonstration nuclear reactors. The distribution of the total volume of radioactive waste among the Member States without nuclear power programme is shown in Figure 12 and Figure 13 with information on stored and disposed of amounts for 2016 and 2019.

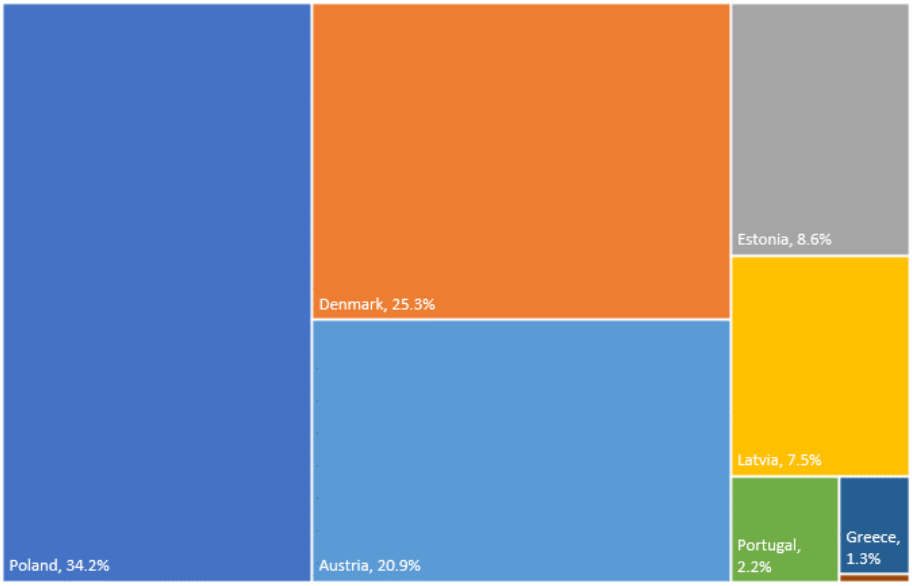


Figure 12. Distribution of total volumes of RAW in Member States without nuclear power programme, end of 2019 (HR, LU, CY, IE and MT have together 0.1%).

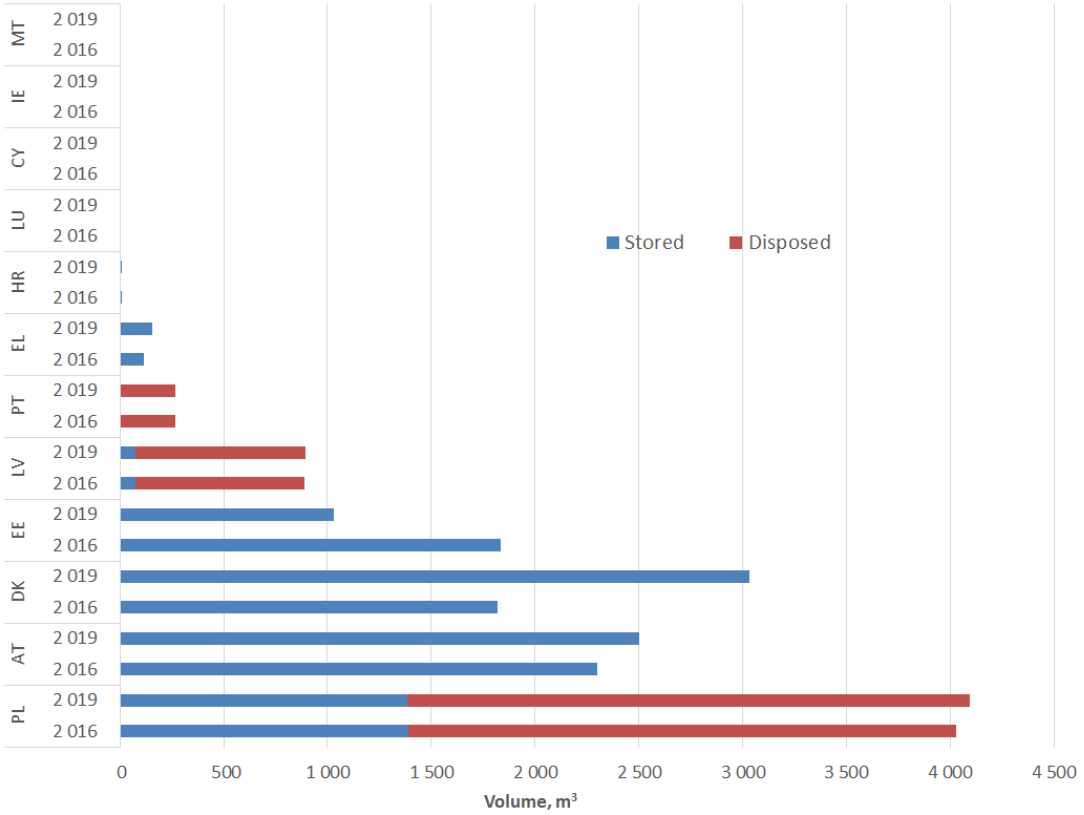


Figure 13. Volume of RAW in Member States without nuclear power programme, end of 2016 and 2019.

Member States with nuclear power programmes are primary contributors to the overall radioactive waste inventory of the European Union. The radioactive waste amounts are in line with the extent of the respective nuclear programmes. Amounts of stored radioactive waste in Member States with nuclear power programmes are shown in Figure 14 for 2016 and 2019 with information on amounts of all RAW classes.

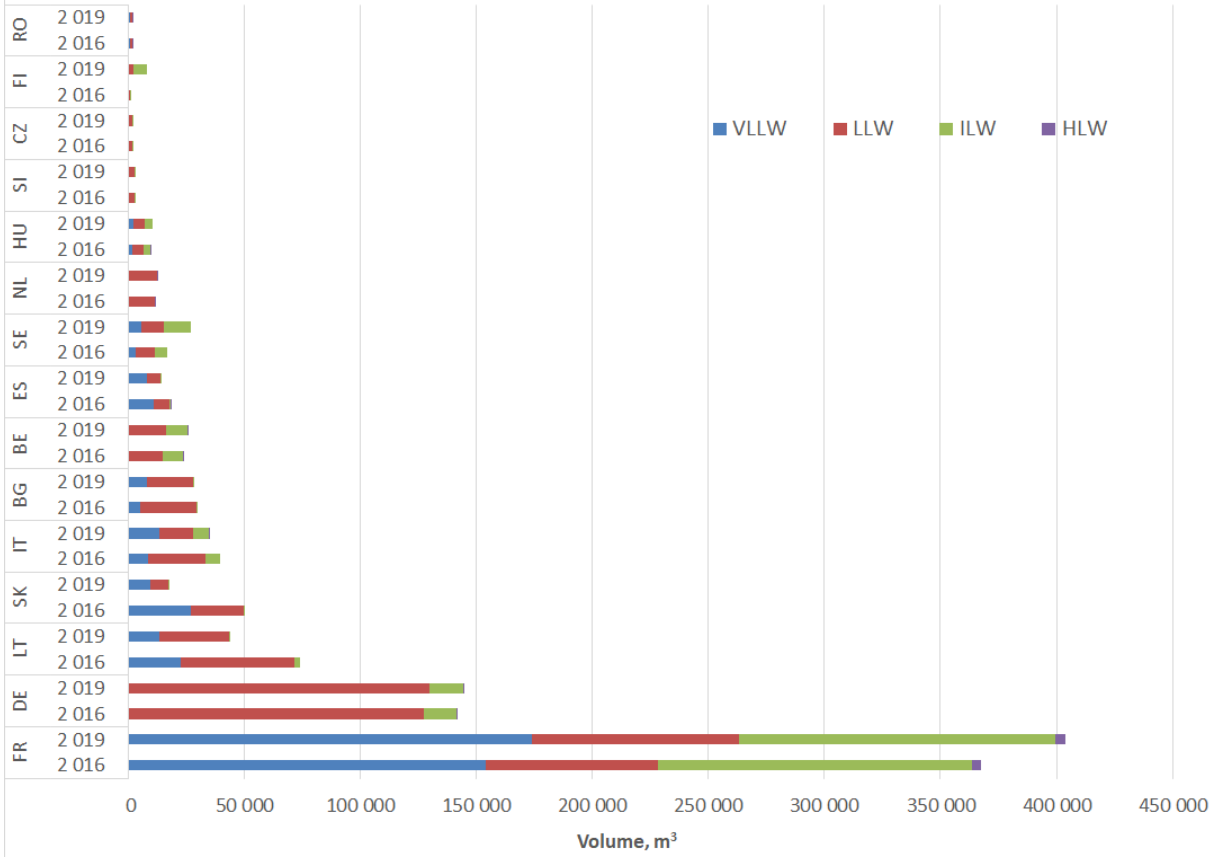


Figure 14. Volumes of stored RAW by class in Member States with nuclear power programmes, end of 2016 and 2019.

The amounts of stored radioactive waste for Member States which are without nuclear power programme are shown in Figure 15 for 2016 and 2019 with information on amounts of all RAW classes.

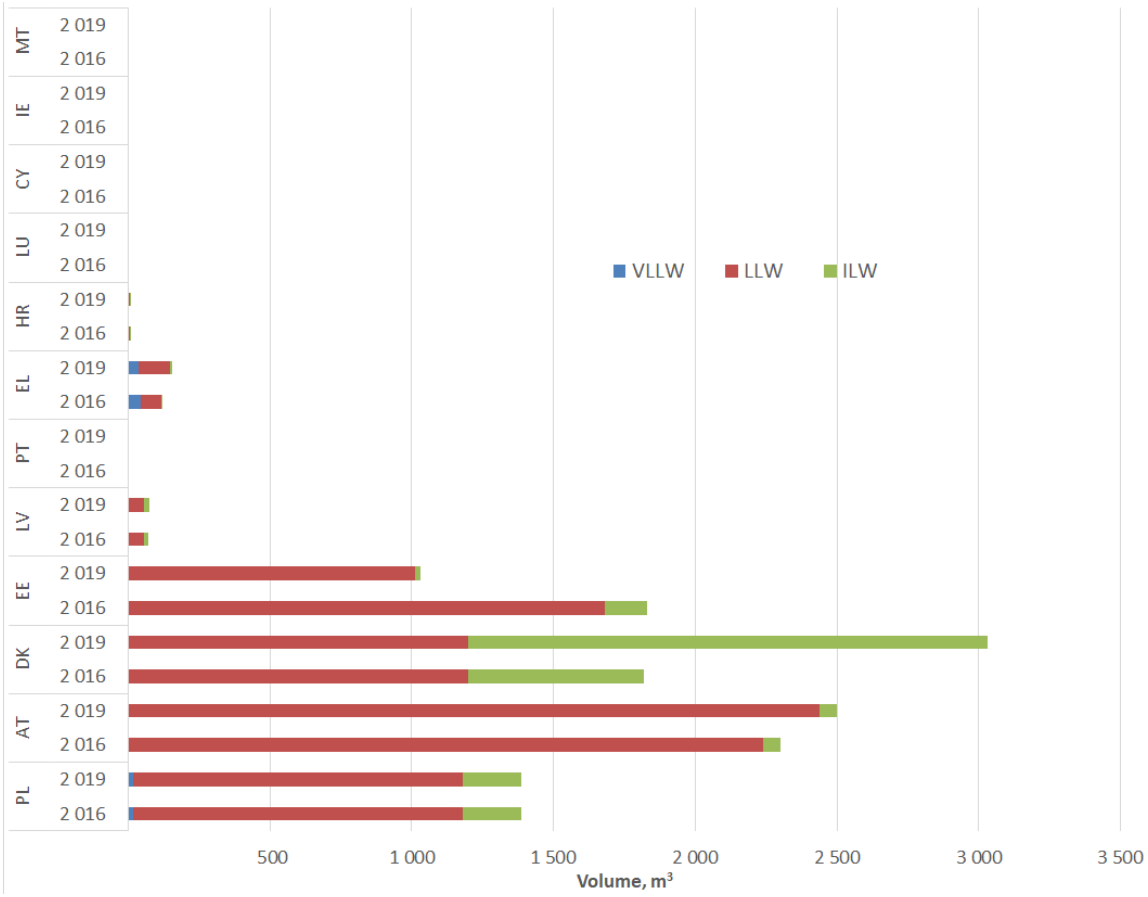


Figure 15. Volumes of stored RAW by class in MSs without nuclear power programme, end of 2016 and 2019.

The distribution of the disposed of radioactive waste is presented in Figure 16 for all 27 Member States regardless of whether or not they have a nuclear power programme with information on amounts of all RAW classes for 2016 and 2019 for comparison. None of HLW waste was disposed of in any Member State until this reporting period.

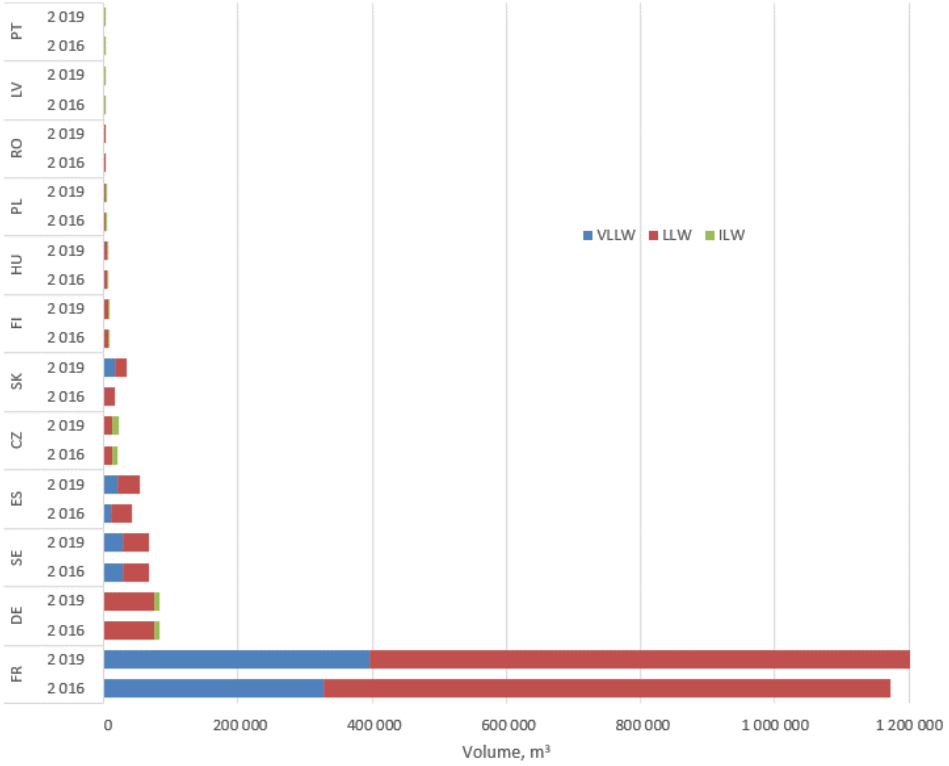


Figure 16. Volumes of radioactive waste disposed of in the European Union, end of 2016 and 2019.

Spent fuel inventory

Based on the Member State strategy, spent fuel is stored pending either disposal or reprocessing. During reprocessing, uranium and plutonium are recovered, with additional generation of radioactive waste (mainly HLW and ILW). As there are no operational disposal facilities for this kind of radioactive waste, it is currently stored until disposal facilities become available.

At the end of 2019 approximately 54 700 tHM of spent fuel were stored in the European Union territory (about 5% increase from 2016 and 12% increase since 2013) and about 900 tHM of spent fuel (about 1.5%) were shipped for reprocessing outside the European Union with the expected returns of resulting radioactive waste from reprocessing. In total this results in approximately 55 600 tHM of spent fuel. These amounts include both spent fuel coming from power and non-power (e.g. research, medical isotope production) reactors.

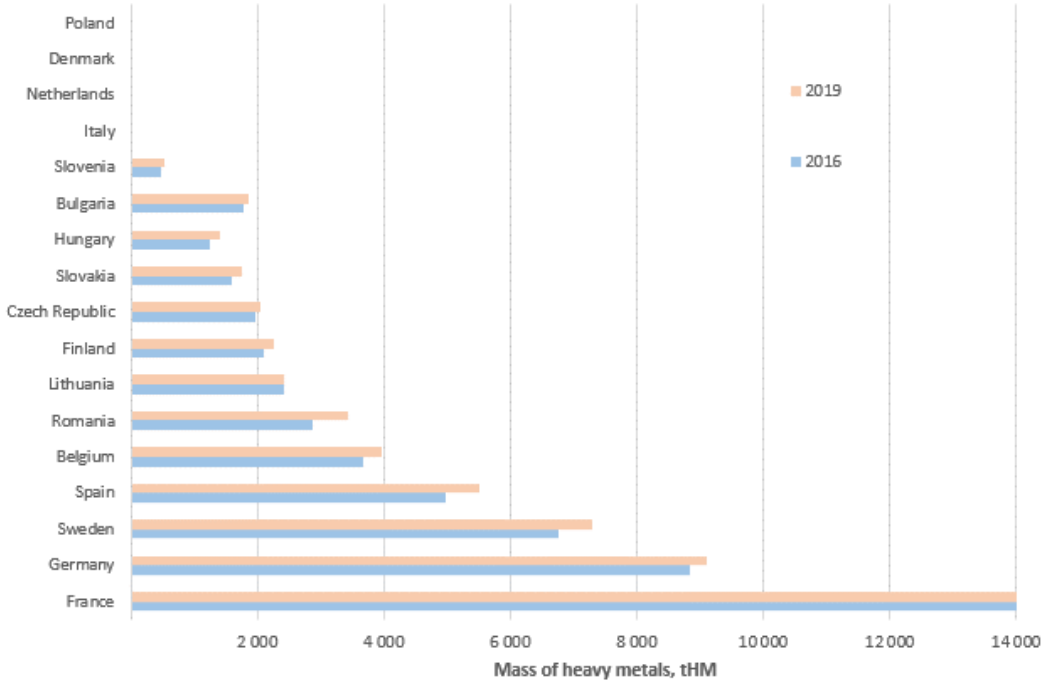


Figure 17. Spent fuel in storage at the end of 2016 and 2019.

Most recent reported amounts of spent fuel stored at each Member States are shown in Figure 17 together with values from 2016 for comparison. Some Member States have smaller inventories of spent fuel (or none) in storage than that generated by the nuclear power plants because part of it or all of it has been reprocessed. Countries with neither past nor current reprocessing have however comparably high spent fuel inventories. An increase of the spent fuel mass is visible in all Member States. The percentage share of spent fuel between Member States is presented in Figure 18.

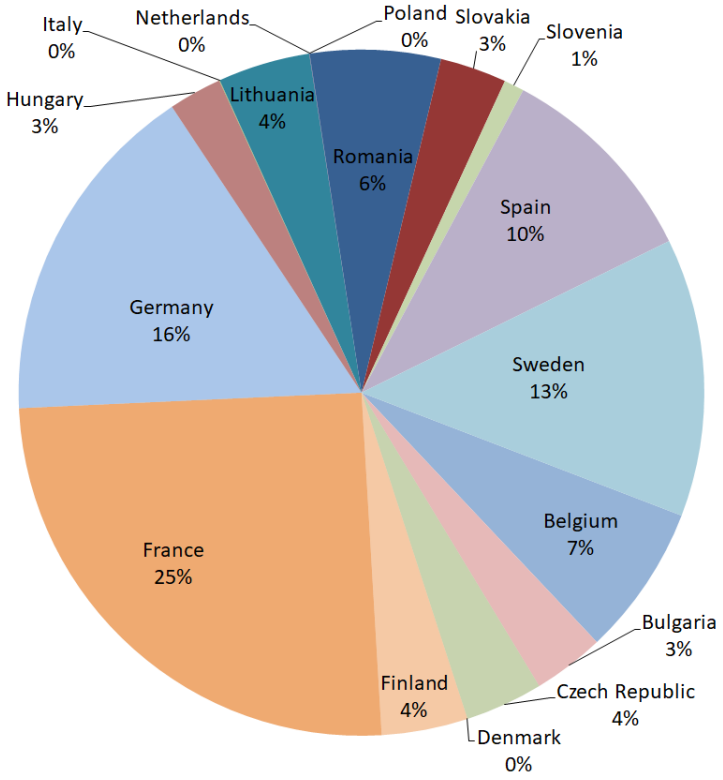


Figure 18. Member States' share of the overall spent fuel inventory in the European Union at the end of 2019.

Given that today there is no disposal route yet available for spent fuel (first disposal facility to become operational in 2025) and that not all Member States have their spent fuel reprocessed, a continual increase of spent fuel in storage is observed (see Table 5 and Figure 19).

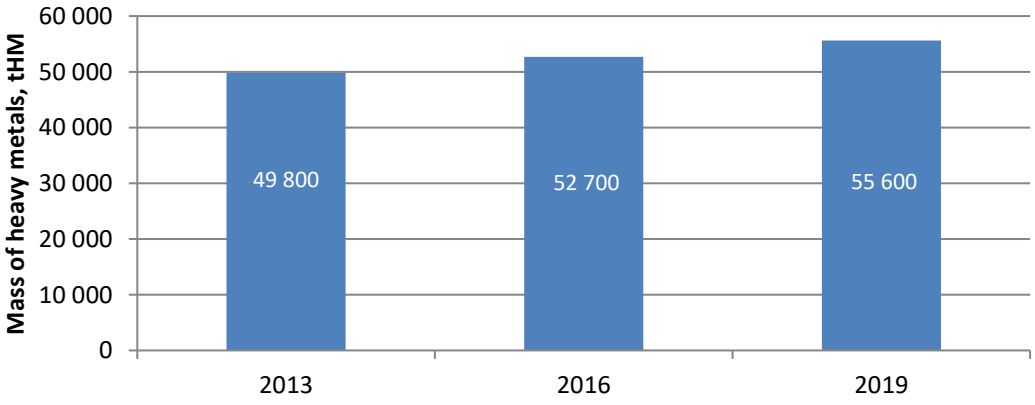


Figure 19. Evolution of spent fuel in storage in Member States since 2013.

6. Projections of radioactive waste and spent fuel

The Staff Working Document on the EU Inventory (SWD(2017)161) informed that projections of radioactive waste inventories in Member States differed in the level of detail and time frames provided and several Member States had not provided any or sufficiently detailed estimates of their future inventory of spent fuel and/or radioactive waste, particularly regarding new builds and decommissioning. Therefore, at that time it was not possible for the Commission to forecast future total EU inventories. In the second national reports Member States improved reporting of the future projections compared to the first national reports and this allowed for the first time to prepare an EU forecast for 2030. In the third national reports some Member States provided updated inventory forecasts.

It has to be stressed that all uncertainties previously mentioned in Section 2 are significantly larger for future predictions. Due to limitations of the reported inventory data only an estimation of short-term radioactive waste and spent fuel projection for 2030 was possible. The majority of Member States provided estimates of their future inventories for 2050. However, due to the unavailability of such inventory forecast data from some large Member States, it was still not possible to establish an overall EU inventory long-term forecast.

The majority of Member States reported their inventory projections for 2030 and 2050. In addition to the inventory projections for specific dates few Member States reported long-term estimations of overall radioactive waste and spent fuel generation from the existing nuclear facilities (including decommissioning of those facilities).

Estimated EU radioactive waste and spent fuel inventory for 2030 is presented in Table 5. Data reported by individual Member States are given in Annex I of this document.

The decommissioning of nuclear power plants is becoming an increasingly important activity for the European nuclear industry due to the ageing of the reactor fleet. This has an important impact on the amounts of radioactive waste generated, especially on very low level waste and low level waste, and should therefore be taken into account when planning disposal and storage facilities. As it can be seen from Figure 20 it is expected that the total VLLW volumes will almost double by 2030 compared to the current amounts and that a significant increase of LLW is expected as well. The current amounts of LLW make up 72% of the expected LLW amounts in 2030 (or a 38% increase from the current level). The main contributors to this increase are Member States with large nuclear power programmes.

For ILW and HLW, safe and responsible management is challenging in terms of the availability of sufficient long-term storage capacity and the development of sustainable disposal solutions. It is expected that by 2030 ILW will increase by approximately 21%. The biggest part of this increase will come from decommissioning activities. An HLW increase by about 67% will result from the reprocessing of spent fuel (mostly in France).

Table 5. Estimated future amounts of RAW in the EU MSs for 2030

	Future RAW and SF amount estimates (m^3, rounded to thousands[18])				
	VLLW	LLW	ILW	HLW	SF
2019	695 000	1 421 000	213 000	4 800	55 600
2030	1 204 000	1 971 000	258 000	8 000	67 100

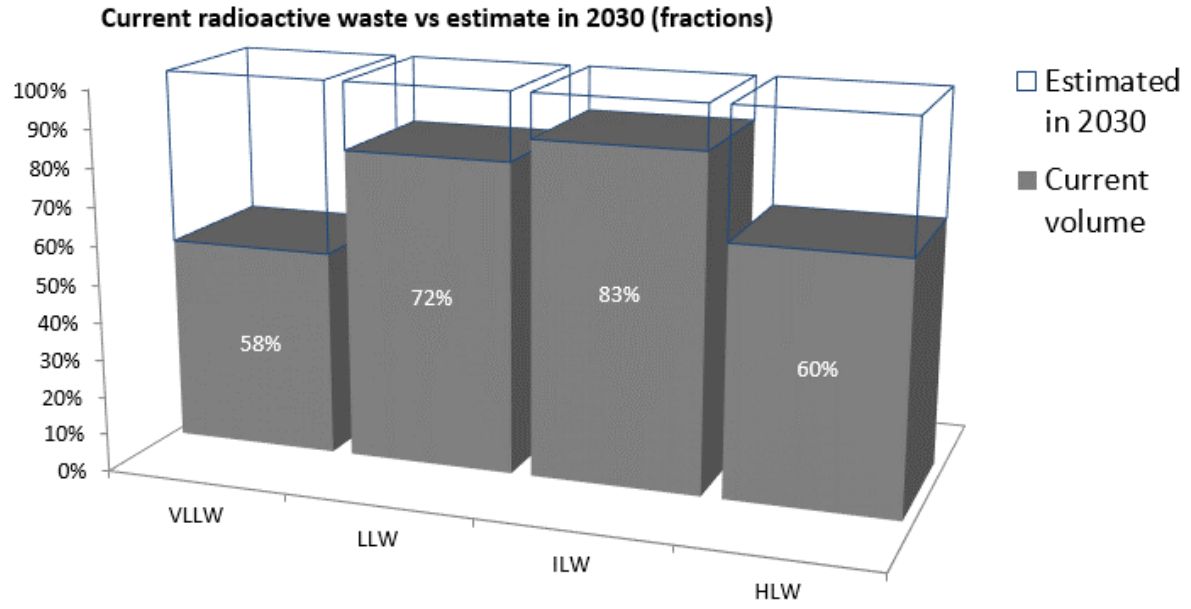


Figure 20. Estimation of radioactive waste generation by 2030 compared to current inventory

[18] Except for HLW and spent fuel, which is rounded to hundreds.

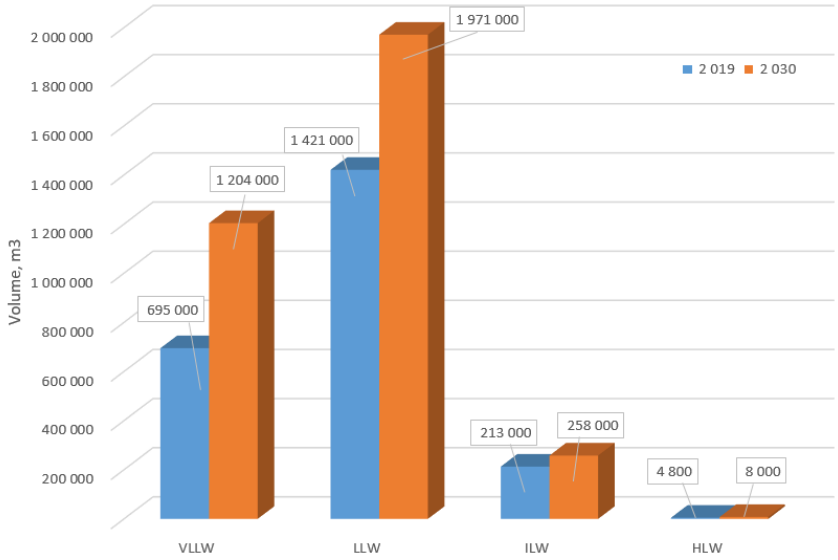


Figure 21. Volumes of total radioactive waste in the European Union, end of 2019 and 2030

With regards to **spent fuel**, an increase from the current volume of 55 600 tHM to 67 100 tHM in 2030 is estimated. It has to be noted that the majority of Member States have not reported inventories from the new build. It is expected that by 2030 the spent fuel inventory will increase by approximately 10%. As some Member States proceed with spent fuel reprocessing – the actual increase does not represent the actual amount of spent fuel removed from the reactors. Part of the spent fuel is sent for reprocessing outside the European Union and it is expected that around 1100 m^3 of radioactive waste from spent fuel reprocesing will be returned to the EU by 2030.

Annex I: Spent fuel and radioactive waste inventory data

"-" in the tables below means no data was received from the Member State or no such practice exists

"0" in the table means that the data with value "0" was received from the Member State

Table I.1. Overall European Union radioactive waste inventory and future prospects as of the end of 2019

Total RAW		2019		2030		2050		Other	date
MS	Category	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3 [Date, year]	Decom. Share, m^3
Austria	VLLW	-	-	-	-	-	-	-	-
	LLW	2 440	1 030	3 050	1 930	3 620	2 390	3600 [2045]	2390 [2045]
	ILW	60	30	60	30	60	30	60 [2045]	30 [2045]
	HLW	-	-	-	-	-	-	-	-
Belgium	VLLW	-	-	-	-	-	-	-	-
	LLW	16 076	-	31 100	-	53 600	-	53 500 [2130]	-
	ILW	9 288	-	7 500	-	9 200	-	8 700 [2130]	-
	HLW	70	-	70	-	137	-	140 [2130]	-
Bulgaria	VLLW	7 894	-	42 000	-	-	-	-	-
	LLW	20 110	-	90 200	-	-	-	-	-
	ILW	10	-	10	-	-	-	-	-
	HLW	0	-	1 100	-	-	-	-	-
Croatia	VLLW	-	-	-	-	-	-	-	-
	LLW	7.53	0	-	-	-	-	1237 [2023] 1510 [2043] 2930 [2058]	0 [2023] 0 [2043] 1421 [2058]
	ILW	3.81	0	-	-	-	-	-	-
	HLW	0	0	-	-	-	-	70 [2058]	70 [2058]
Cyprus	VLLW	-	-	-	-	-	-	-	-
	LLW	-	-	<1	-	<1	-	-	-
	ILW	-	-	-	-	-	-	-	-
	HLW	-	-	-	-	-	-	-	-
Czech Republic	VLLW	-	-	-	-	-	-	-	-
	LLW	14 355.7	-	17 600	11 000	32 800	23 200	146 000 [2085]-	83 000 [2085]-
	ILW	9 290	-	2 850	1 500	2 500	150	7 253 [2085]	2 829 t [2085]
	HLW	0	-	4 200 t	4 200 t	41	0	0 [2085]	0 [2085]
Denmark	VLLW	-	-	-	-	-	-	-	-
	LLW	1 200	-	1 926	-	3 162	-	-	-

Total RAW		2019		2030		2050		Other	date
MS	**Category**	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3 [Date, year]	Decom. Share, m^3
	ILW	1 831	-	9 949	-	9 949	-	-	-
	HLW	-	-	-	-	-	-	-	-
Estonia	VLLW	-	-	-	-	-	-	-	-
	LLW	1 012.1	-	1 112.2	28	2 024	-	-	-
	ILW	19.5	-	65.45	0	801.6	650	-	-
	HLW	-	-	-	-	-	-	-	-
Finland	VLLW	204	0	-	-	-	-	-	-
	LLW	8 232	0	-	-	-	-	-	-
	ILW	4 087	0	-	-	-	-	-	-
	HLW	0	0	-	-	-	-	-	-
France	VLLW	570 351	-	970 000	-	-	-	1 600 000 [2040]	930 000 [2040]
	LLW	961 389	-	1 200 000	-	-	-	1 500 000 [2040]	420 000 [2040]
	ILW	136 327	-	160 000	-	-	-	170 000 [2040]	31 000 [2040]
	HLW	4 086	-	5 700	-	-	-	6 900 [2040]	0 [2040]
Germany	VLLW	-	-	-	-	-	-	-	-
	LLW	205 718*	-	300 816.9	-	345 816.9	-	350 316.9 [2080]	-
	ILW	22 858*	-	33 424	-	38 424	-	38 924 [2080]	-
	HLW	570	-	700	-	700	-	700 [2080]	-
Greece	VLLW	94	-	-	-	-	-	-	-
	LLW	15.08	-	-	-	-	-	-	-
	ILW	0.93	-	-	-	-	-	-	-
	HLW	-	-	-	-	-	-	-	-
Hungary	VLLW	3 215	-	3 671	-	4 650	-	-	-
	LLW	8 038	-	9 178	-	11 625	-	-	-
	ILW	5 273	-	6 073	-	7 715	-	-	-
	HLW	-	-	-	-	-	-	-	-
Ireland	VLLW	-	-	-	-	-	-	-	-
	LLW	-	-	-	-	-	-	-	-
	ILW	-	-	-	-	-	-	-	-
	HLW	-	-	-	-	-	-	-	-
Italy	VLLW	13 388	1 160	31 152	17 807	37 727	24 381	37 727 [2065]	24 381 [2065]
	LLW	15 279	980	31 435	15 466	35 773	18 651	36 639 [2065]	18 651 [2065]
	ILW	7 172	380	12 073	4 356	14 425	6 708	14 425 [2065]	6 708 [2065]
	HLW	34.4	-	273	-	273	-	273 [2065]	-
Latvia	VLLW	0	0	-	-	-	-	-	-
	LLW	840.64	0	-	-	-	-	-	-
	ILW	52.97	0	-	-	-	-	-	-
	HLW	0	0	-	-	-	-	-	-

Total RAW		2019		2030		2050		Other	date
MS	Category	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3 [Date, year]	Decom. Share, m^3
Lithuania	VLLW	7 000	-	25 400	-	53 500	-	-	-
	LLW	27 000	-	54 267	-	74 232	-	-	-
	ILW	180	-	3 750	-	7 500	-	-	-
	HLW	-	-	-	-	-	-	-	-
Luxem-bourg	VLLW	-	-	-	-	-	-	-	-
	LLW	0.1	-	-	-	0.1	-	-	-
	ILW	-	-	-	-	-	-	-	-
	HLW	-	-	-	-	-	-	-	-
Malta	VLLW	-	-	-	-	-	-	-	-
	LLW	-	-	-	-	-	-	-	-
	ILW	-	-	-	-	-	-	-	-
	HLW	-	-	-	-	-	-	-	-
The Netherlands	VLLW	-	-	-	-	-	-	-	-
	LLW	12 236	-	-	-	-	-	70 000 [2130]	-
	ILW	-	-	-	-	-	-	267 [2130]	-
	HLW	100.2	-	-	-	-	-	133 [2130]	-
Poland	VLLW	1 091	-	1 280	0	30 000	0	-	-
	LLW	2 785	-	4 800	0	15 000	0	-	-
	ILW	218	-	491	0	2543	0	-	-
	HLW	-	-	-	-	-	-	-	-
Portugal **	VLLW	-	-	-	-	-	-	-	-
	LLW	-	-	-	-	-	-	-	-
	ILW	-	-	-	-	-	-	-	-
	HLW	-	-	-	-	-	-	-	-
Romania	VLLW	437	0	100	-	225	-	-	-
	LLW	3 542.1	0	3 948.1	-	8 002.3	1 500	-	-
	ILW	70.07	0	218.9	-	490	10	-	-
	HLW	0.12	0	0.02	-	0.05	0.05	-	-
Slovakia	VLLW	9 351.4	-	29 000	29 000	29 000	29 000	29 000 [2040]	29 000 [2040]
	LLW	26 831.3	-	38 512	24 648	44 644	25 136	41 894 [2040]	25 136 [2040]
	ILW	187.8	-	1 200	1 187	1 900	1 887	1 900 [2040]	1 887 [2040]
	HLW	-	-	-	-	-	-	-	-
Slovenia	VLLW	-	-	-	-	-	-	-	-
	LLW	2 382	-	2 972	-	-	-	3 342 [2040]	-
	ILW	35	-	-	-	-	-	-	-
	HLW	-	-	-	-	-	-	-	-
Spain	VLLW	27 094	13 987	45 000	25 000	121 300	94 100	126 200 [2090]	94 500 [2090]
	LLW	41 017	3 969	56 000	10 000	93 900	46 700	95 100 [2090]	46 700 [2090]
	ILW	200	185	300	200	2 700	700	6 100 [2090]	1 350 [2090]

Total RAW		2019		2030		2050		Other	date
MS	**Category**	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3	Decom. Share, m^3	Volume, m^3 [Date, year]	Decom. Share, m^3
	HLW	13	0	13	0	13	0	13 [2090]	0 [2090]
Sweden	VLLW	33 150	-	54 000	-	54 000	-	-	-
	LLW	49 650	-	90 000	-	145 000	-	-	-
	ILW	11 750	-	12 000	-	15 000	-	-	-
	HLW	0	-	-	-	-	-	-	-

* Indicated LLW and ILW amounts include 19 401t of unconditioned non-heat generating waste. For aggregation purposes Commission Services assumed 1t = $1m^3$ (numbers not verified by Germany).

** Information reported in the 3rd national report insufficient to establish national inventory.

Table I.2. Spent fuel stored on Member States' territory

	SF in Storage on a MS territory, tHM			
Country	**2019**	**2030**	**2050**	**Other date (Mass/date)**
Austria	-	-	-	-
Belgium	3 958	4100	4100	4 100 [2130]
Bulgaria*	955.7	1 486	-	-
Croatia**	-	-	-	-
Cyprus	-	-	-	-
Czech Republic	2 042	2913	5268	9910 [>2085]
Denmark	0.233	-	-	-
Estonia	-	-	-	-
Finland	2 261	3 154	4 169	-
France	14 018	15 457	-	16 956 [2040]
Germany	9 115	10 110	10 110	-
Greece	0	-	-	-
Hungary	1 397	2 137	3 342	-
Ireland	-	-	-	-
Italy	15.837	2.95	2.95	2.95 [2065]
Latvia	-	-	-	-
Lithuania	2 416	2 416	2 416	-
Luxembourg	-	-	-	-
Malta	-	-	-	-
The Netherlands	10 m^3	-	-	-
Poland	0.228	1	1 500	-
Portugal	0	-	-	-
Romania	3 420.1	5 795	14 383	-
Slovakia	1 744	1 919	2 991	2 439 [2040]
Slovenia**	529	685	-	842 [2040]
Spain	5 502	7 445	7 445	7 445 [2090]
Sweden	7 291	9 500	12 000	-

* Amounts do not include 917 tHM of spent fuel shipped for reprocessing to the Russian Federation.

** Spent fuel reported by Slovenia to be shared equally by Croatia and Slovenia.

Table I.3. Conditioned radioactive waste stored on Member States' territory

Stored conditioned RAW (Estimated volume for disposal, m^3)					
Country	**RAW**	**2019**	**2030**	**2050**	**Volume [Date]**
Austria	VLLW	-	-	-	-
	LLW	2 440	3 050	3 620	3600 [2045]
	ILW	60	60	60	60 [2045]
	HLW	-	-	-	-
Belgium	VLLW	-	-	-	-
	LLW	16 076	-	-	53 500 [2130]
	ILW	9 288	-	-	8 700 [2130]
	HLW	70	-	-	140 [2130]
Bulgaria	VLLW	3 572	-	-	-
	LLW	12 642	-	-	-
	ILW	0	-	-	-
	HLW	0	-	-	-
Croatia	VLLW	-	-	-	-
	LLW	7.5	-	-	-
	ILW	3.8	-	-	-
	HLW	0	-	-	-
Cyprus	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Czech Republic	VLLW	-	-	-	-
	LLW	-	3 600	3 600	-
	ILW	-	350	350	-
	HLW	-	-	-	-
Denmark	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Estonia	VLLW	-	-	-	-
	LLW	1 012.1	-	-	-
	ILW	19.5	-	-	-
	HLW	-	-	-	-
Finland	VLLW	204	-	-	-
	LLW	1 691	-	-	-
	ILW	1 970	-	-	-
	HLW	-	-	-	-
France	VLLW	173 997	-	-	-
	LLW	89 246	-	-	-
	ILW	136 327	-	-	-
	HLW	4 086	-	-	-

Stored conditioned RAW (Estimated volume for disposal, m^3)					
Country	**RAW**	**2019**	**2030**	**2050**	**Volume [Date]**
Germany	VLLW	-	-	-	-
	LLW	112 441	198 000	-	-
	ILW	12 493	22 740	-	-
	HLW	570	700	700	-
Greece	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Hungary	VLLW	-	118	131	-
	LLW	-	295	328	-
	ILW	-	182	222	-
	HLW	-	-	-	-
Ireland	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Italy	VLLW	3 144	28 322	3 039	0 [2065]
	LLW	3 434	28 665	2 085	0 [2065]
	ILW	1 252	12 073	14 425	14 425 [2065]
	HLW	-	273	273	273 [2065]
Latvia	VLLW	0	0	0	-
	LLW	53	64	64	-
	ILW	5	5	5	-
	HLW	0	0	0	-
Lithuania	VLLW	13 100	-	-	-
	LLW	380	-	-	-
	ILW	180	-	-	-
	HLW	0	-	-	-
Luxembourg	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Malta	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
The Netherlands	VLLW	-	-	-	-
	LLW	12 236	-	-	70 000 [2130]
	ILW	-	-	-	267 [2130]
	HLW	100.2	-	-	133 [2130]
Poland	VLLW	19	50	45 000	-
	LLW	1 161	900	15 000	-

Stored conditioned RAW (Estimated volume for disposal, m^3)					
Country	**RAW**	**2019**	**2030**	**2050**	**Volume [Date]**
	ILW	206	480	2 543	-
	HLW	-	-	-	-
Portugal*	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Romania	VLLW	-	-	-	-
	LLW	-	2 000	1 600	-
	ILW	-	285	1 075	-
	HLW	-	0	0	-
Slovakia	VLLW	-	0	0	-
	LLW	48.62	1 600	1 000	1 400 [2040]
	ILW	0.826	1 200	1 900	1 900 [2040]
	HLW	-	-	-	-
Slovenia	VLLW	-	-	-	-
	LLW	2 311	-	-	-
	ILW	18	-	-	-
	HLW	-	-	-	-
Spain	VLLW	7 700	6 000	4 000	0 [2100]
	LLW	6 100	10 000	1 200	0 [2100]
	ILW	200	300	2 700	0 [2100]
	HLW	13	13	13	0 [2100]
Sweden	VLLW	5 250	2 000	0	-
	LLW	9 750	30 000	5 000	-
	ILW	11 750	12 000	10 000	-
	HLW	0	0	-	-

* All waste declared as disposed of.

Table I.4. Unconditioned radioactive waste stored on Member States' territory

Stored unconditioned RAW (volume, m^3 / or mass, t)						
Country	**Volume RAW**	**2019**	Estimated disposal volume	**2030**	**2050**	**Volume [Date]**
Austria	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Belgium	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Bulgaria	VLLW	4 322	4 322	-	-	-
	LLW	7 468	7 468	-	-	-
	ILW	3	10	-	-	-
	HLW	0	0	-	-	-
Croatia	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Cyprus	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Czech Republic	VLLW	-	-	-	-	-
	LLW	322t, 1 138.7	-	-	-	63 000 [2085]
	ILW	134.9	-	-	-	4 424 [2085]
	HLW	-	-	-	-	-
Denmark	VLLW	-	-	-	-	-
	LLW	1 200	-	-	-	-
	ILW	1 831	-	-	-	-
	HLW	-	-	-	-	-
Estonia	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Finland	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
France	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-

Stored unconditioned RAW (volume, m^3 / or mass, t)						
Country	**Volume RAW**	**2019**	Estimated disposal volume	**2030**	**2050**	**Volume [Date]**
	HLW	-	-	-	-	-
Germany	VLLW	-	-	-	-	-
	LLW	17 460t	-	-	-	-
	ILW	1 940t	-	-	-	-
	HLW	-	-	-	-	-
Greece	VLLW	93.84**	-	-	-	-
	LLW	14.08***	-	-	-	-
	ILW	0.93	-	-	-	-
	HLW	-	-	-	-	-
Hungary	VLLW	2 020	1 974	849	0	-
	LLW	5 051	4 935	2 122	0	-
	ILW	3 334	3 411	1 432	218	-
	HLW	-	-	-	-	-
Ireland	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Italy	VLLW	10 928	10 243	-	-	-
	LLW	9 087	10 845	-	-	-
	ILW	1 817	5 962	-	-	-
	HLW	-	-	-	-	-
Latvia	VLLW	-	-	0	0	-
	LLW	4.64	4.64	18	48	-
	ILW	12.97	12.97	26.95	31.95	-
	HLW	-	-	0	0	-
Lithuania	VLLW	-	-	-	-	-
	LLW	14 422	-	-	-	-
	ILW	15 440	-	-	-	-
	HLW	-	-	-	-	-
Luxembourg	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Malta	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
The Netherlands	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-

Stored unconditioned RAW (volume, m^3 / or mass, t)						
Country	**Volume RAW**	**2019**	Estimated disposal volume	**2030**	**2050**	**Volume [Date]**
	HLW	-	-	-	-	-
Poland	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Portugal*	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Romania	VLLW	447	447	-	-	-
	LLW	1 257.1	-	2 951	7 425	-
	ILW	76.7	-	216.2	494.58	-
	HLW	0.12	850	-	-	-
Slovakia	VLLW	9351.4	9352	-	-	-
	LLW	9887.63	7580	2765	1400	-
	ILW	177.144	109	1368	2096	-
	HLW	-	-	-	-	-
Slovenia	VLLW	-	-	-	-	-
	LLW	104.6	-	-	-	-
	ILW	17	-	-	-	-
	HLW	-	-	-	-	-
Spain	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-
Sweden	VLLW	-	-	-	-	-
	LLW	-	-	-	-	-
	ILW	-	-	-	-	-
	HLW	-	-	-	-	-

* All waste declared as disposed of.

** Including legacy waste.

*** Including graphite waste.

Table I.5. Radioactive waste disposed of on Member States' territory

Disposed RAW (Volume as disposed, m^3)					
Country	**RAW**	**2019**	**2030**	**2050**	**Other date**
Austria	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Belgium	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Bulgaria	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Croatia	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Cyprus	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Czech Republic	VLLW	-	-	-	-
	LLW	12 895	14 000	29 200	-
	ILW	9 155	2 500	2 000	-
	HLW	-	-	-	-
Denmark	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Estonia	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Finland	VLLW	0	2 300	6 900	-
	LLW	6 541	8 761	10 661	-
	ILW	2 117	8 278	9 078	-
	HLW	0	-	-	-
France	VLLW	396 354	-	-	-
	LLW	872 143	-	-	-

Disposed RAW (Volume as disposed, m^3)					
Country	**RAW**	**2019**	**2030**	**2050**	**Other date**
	ILW	0	-	-	-
	HLW	0	-	-	-
Germany	VLLW	-	-	-	-
	LLW	75 817	102 817	345 817	350 317 [2080]
	ILW	8 424	10 684	38 424	38 924 [2080]
	HLW	-	-	-	-
Greece	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Hungary	VLLW	1 241	2 704	4 519	-
	LLW	3 103	6 641	11 128	-
	ILW	1 862	4 056	6 779	-
	HLW	0	0	0	-
Ireland	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Italy	VLLW	-	2 830	34 688	37 727 [2065]
	LLW	-	2 770	33 689	36 639 [2065]
	ILW	-	-	-	-
	HLW	-	-	-	-
Latvia	VLLW	0	0	0	-
	LLW	783	1 774	1 774	-
	ILW	35	35	35	-
	HLW	0	0	0	-
Lithuania	VLLW	0	21 000	53 500	-
	LLW	0	36 422	74 232	-
	ILW	0	0	0	
	HLW	-	0	0	-
Luxembourg	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Malta	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-

Disposed RAW (Volume as disposed, m^3)					
Country	**RAW**	**2019**	**2030**	**2050**	**Other date**
The Netherlands	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Poland	VLLW	1 072	1230	45 000	200 000 [2152]
	LLW	1 624	3 900	15 000	138 500 [2152]
	ILW	11	11	2 543	15 000 [2152]
	HLW	-	-	-	-
Portugal*	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Romania	VLLW	-	-	-	-
	LLW	2 286	1 270	8 300	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Slovakia	VLLW	16403.3	29 000	29 000	29 000 [2040]
	LLW	17304.2	36 912	43 644	40 494 [2040]
	ILW	-	-	-	-
	HLW	-	-	-	-
Slovenia	VLLW	-	-	-	-
	LLW	-	-	-	-
	ILW	-	-	-	-
	HLW	-	-	-	-
Spain	VLLW	19 397	39 000	117 300	126 200 [2100]
	LLW	34 927	46 000	92 700	95 100 [2100]
	ILW	-	-	-	6 100 [2100]
	HLW	-	-	-	13 [2100]
Sweden	VLLW	27 900	52 000	54 000	-
	LLW	39 900	60 000	140 000	
	ILW	0	0	5 000	
	HLW	0			

* Information reported in the 3rd national report insufficient to establish national inventory

Table I.6. Other radioactive waste on Member States' territory

Country	Waste type	**Amount** (number, volume, mass or activity)		
		2019	**2030**	**2050**
Austria	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Belgium	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Bulgaria	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Croatia	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Cyprus	DSRS (number)	708	-	-
	NORM (m^3)	-	-	-
Czech Republic	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Denmark	DSRS (number)	-	-	-
	NORM (t)	600	1 050	2 050
	Tailings and ore (t)	4 800	-	-
Estonia	DSRS (number)	-	-	-
	NORM	29	-	-
Finland	DSRS (number)	12 100	13 000	155 000
	NORM (m^3)	-	-	-
France	DSRS (number)	-	-	-
	NORM (t)	-	-	-
Germany	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Greece	DSRS (number)	659	-	-
	NORM (m^3)	100	-	-
Hungary	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Ireland	DSRS (number)	37	-	-
	NORM (m^3)	-	-	-
Italy	DSRS (GBq)	909 233	-	-
	NORM (m^3)	-	-	-
Latvia	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Lithuania	DSRS (number)	40 m^3	100 m^3	100 m^3
	NORM (m^3)	67	-	-
Luxembourg	DSRS (m^3)	-	-	< 2

Country	Waste type	Amount (number, volume, mass or activity)		
		2019	2030	2050
	Contaminated material (m^3)	-	-	-
Malta	DSRS (number)	89	-	-
	NORM (m^3)	-	-	-
	Uranium salts (kg)	2.23	-	-
	Thorium salts (kg)	0.125	-	-
The Netherlands	DSRS (number)	-	-	-
	NORM (m^3)	23 066	-	158 000*
Poland	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Portugal**	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Romania	DSRS (number)	459	-	-
	NORM (m^3)	2 739 085	-	-
	Other (m^3)	25 920	-	-
	Sterile and radioactive rock (m^3)	7 087 054	-	-
Slovakia	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Slovenia	DSRS (number)	-	-	-
	NORM (m^3)	1 614 443	1 614 443	-
Spain	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-
Sweden	DSRS (number)	-	-	-
	NORM (m^3)	-	-	-

* NORM estimate for The Netherlands in 2130.

** Information reported in the 3rd national report is insufficient to establish national inventory.

Table I.7. Evolution of global European Union radioactive wastes in disposal (m^3, rounded to thousands)

Disposed of	2013	2016	2019	2030*
Total waste	**1 279 000***	**1 420 000**	**1 552 000**	**-**
VLLW	279 000	369 000	462 000	-
LLW	987 000	1 039 000	1 067 000	-
ILW	12 000	12 000	22 000	-
HLW	0	0	0	-

* Information reported in the 3rd national report is insufficient to establish future disposal volumes.

Table I.8. Evolution of global European Union spent fuel and radioactive wastes in storage (m^3, rounded to thousands)

Stored	**2013**	**2016**	**2019**	**2030**
Total SF	49 800	52 700	55 600	67 100
Total waste	**771 000**	**796 000**	**783 000**	**-***
VLLW	236 000	233 000	233 000	-*
LLW	358 000	381 000	353 000	-*
ILW	173 000	178 000	191 000	-*
HLW	4 300	4 500	4 800	-*

* Information reported in the 3rd national report is insufficient to establish future radioactive waste volumes in storage.

Table I.9. Evolution of global European Union spent fuel and radioactive wastes – Total (m^3, rounded to thousands)

Total	**2013**	**2016**	**2019**	**2030***
Total SF	49 800	52 700	55 600	67 100
Total waste	**2 050 000**	**2 216 000**	**2 334 000**	**3 441 000**
VLLW	515 000	601 000	695 000	1 204 000
LLW	1 345 000	1 420 000	1 421 000	1 971 000
ILW	185 000	190 000	213 000	258 000
HLW	4 300	4 500	4 800	8 000

* Commission estimates primarily based on the information reported by Member States and on the other sources when information was not available in 3rd national reports.