



Council of the
European Union

Brussels, 23 May 2024
(OR. en)

10313/24

ATO 38

COVER NOTE

From:	Secretary-General of the European Commission, signed by Ms Martine DEPREZ, Director
date of receipt:	22 May 2024
To:	Ms Thérèse BLANCHET, Secretary-General of the Council of the European Union
No. Cion doc.:	COM(2024) 197 final
Subject:	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

Delegations will find attached document COM(2024) 197 final.

Encl.: COM(2024) 197 final



EUROPEAN
COMMISSION

Brussels, 22.5.2024
COM(2024) 197 final

**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

{SWD(2024) 123 final} - {SWD(2024) 127 final}

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1 INTRODUCTION

Under Article 14(2) of Council Directive 2011/70/Euratom¹ on the responsible and safe management of spent fuel² and radioactive waste³ ('the Directive') the Commission must submit to the European Parliament and Council:

- progress reports on the implementation of this Directive; and
- an inventory of radioactive waste and spent fuel present in the European Atomic Energy Community's ('the Community') territory and the future prospects, on the basis of Member States' national reports due every 3 years as per Article 14(1) of the Directive⁴.

The Commission presented two progress reports^{5,6} to the EU public in 2017 and 2019, providing a comprehensive overview of the situation. This third report covers the period 2018-2021.

It is based on the Member States' national reports due for submission to the Commission by 23 August 2021 ('the reporting date'). It addresses the overall EU inventory of radioactive waste and spent fuel (Section 2), Member State compliance with the key aspects of the Directive (Section 3) and sets out the Commission's conclusions (Section 4).

The report is accompanied by two staff working documents:

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 Spent fuel is "nuclear fuel that has been irradiated in and permanently removed from a reactor core" (Article 3(11) of the Directive) and that is no longer usable in its current form. It is generated by the operation of nuclear reactors for power generation, research, training and demonstration.

³ Radioactive waste is "radioactive material in gaseous, liquid or solid form for which no further use is foreseen or considered" (Article 3(7) of the Directive) and which has been classified as radioactive waste. Its generation is associated with the production of electricity in nuclear power plants or with non-power-related uses of radioactive materials for medical, research, industrial and agricultural purposes. Please see SWD(2024) 123 on progress of implementation of Council Directive 2011/70/Euratom for the definitions of others important concepts as provided by the Directive, such as storage or disposal.

⁴ The analysis presented in the report is based on the national reports and the newly adopted or updated national programmes as submitted by Member States in August 2021. The United Kingdom did not provide a report. To enable comparison with historical data, the United Kingdom's inventory share was removed from the overall EU inventory in 2013 and 2016.

⁵ 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, 15 May 2017, COM(2017) 236 final, and corresponding SWD(2017) 159 final and SWD(2017) 161 final.

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 – Second report, 17 December 2019, COM(2019) 632 final, and corresponding SWD(2019) 435 final and SWD(2019) 436 final.

- one presents the EU inventory of radioactive waste and spent fuel and its prospects, with a reference date of December 2019; and
- the other presents the overall situation on spent fuel and radioactive waste management in the Community based on the Commission's analyses of the national reports.

Section 2 below provides an overview of radioactive waste and spent fuel inventories in the EU-27, including trends and prospects. Section 3 summarises the assessment of how national frameworks and policies are currently implemented under the Directive, highlighting progress made and challenges, compared to the previous reporting cycles.

2 RADIOACTIVE WASTE AND SPENT FUEL IN THE EUROPEAN UNION

Under the Directive's requirements the Commission periodically provides a transparent and comprehensive overview of the Community-wide inventories of spent fuel and radioactive waste, including prospects. This information is key to see whether Member States have taken reasonable steps in their national policies and programmes to minimise the amounts generated and ensure in good time sufficient storage and disposal capacities to avoid imposing any undue burden on future generations in managing spent fuel and radioactive waste.

2.1 Origin of radioactive waste and spent fuel

All Member States generate radioactive waste through various activities ranging from medical applications to electricity generation. A total of 17 Member States also manage spent nuclear fuel on their territory. Owing to its radiological properties and the potential hazard it poses to workers, the public and the environment, the safe management of such material from its generation to disposal must be ensured. This requires containment and isolation from humans and the living environment over periods of time ranging from several days to several hundreds of thousands of years, depending on the radioactivity content of the material.

Most of the radioactive waste originates from nuclear power plants and associated nuclear fuel cycle activities. Smaller volumes of radioactive waste are generated as a result of non-power uses of radioactive materials, such as the manufacturing of radioisotopes for use in medical and industrial applications, or research facilities such as laboratories and research reactors.

Each Member State defines its own electricity generation mix and as of the reporting date nuclear power plants were in operation in 13 countries⁷. Two other Member States, Lithuania and Italy, had terminated their nuclear power programmes and were decommissioning their nuclear installations. At the end of the reporting period, these 15 Member States with nuclear power programmes⁸ together accounted for 99.5% in volume of the radioactive waste inventory in the EU.

⁷ Belgium, Bulgaria, Czechia, Finland, France, Germany, Hungary, the Netherlands, Romania, Slovakia, Slovenia, Spain and Sweden. In addition, although it has no nuclear power plant within its own national borders, Croatia co-owns the Krsko nuclear power plant with Slovenia.

⁸ 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.

By the reporting date, 103 nuclear power reactors were in operation, with a total capacity of about 101 GWe, 66 nuclear power reactors were permanently shut down and being decommissioned, and 3 nuclear power reactors were fully decommissioned. In addition, there were 30 research reactors in 18 Member States either in operation, long-term shutdown or being decommissioned⁹. Therefore, further spent fuel and long-lived radioactive waste will arise, requiring their safe and long-term management until disposal.

2.2 Inventory estimates and trends

The Commission services collaborated with the International Atomic Energy Agency (IAEA) and the OECD's Nuclear Energy Agency (NEA) on defining a harmonised set of data on the reporting of national inventories and supported the development of an IAEA harmonised reporting tool – the Spent Fuel and Radioactive Waste Information System (SRIS) – to help Member States provide comprehensive and up-to-date inventories.

The Commission also carried out a study on the benchmarking of national inventories¹⁰, followed by another study on radioactive waste classification schemes in the EU¹¹.

The former study concluded that the standardised communication approach used between licensees and authorities appears to be efficient and to suit user needs. It also pointed out that radioactive waste classification may not systematically apply for all reported waste in the national reports, and the approaches, methods and tools that Member States use to develop their inventories were not systematically published.

The latter study confirmed that there are no apparent needs for adopting a harmonised waste classification system across the Member States, although the need for harmonised reporting remains.

The quality of the inventory has not substantially changed compared to the previous reporting cycle. One third of the Member States (mainly those with nuclear programmes) provided detailed inventory information, while most of the others reported incomplete inventory data and in the same format as in the first reporting cycle. Eight Member States introduced their inventory data in SRIS by June 2023. The rest of the Member States are encouraged to take advantage of systematically reporting through this system as well. The Commission will continue to support Member States in addressing quality and harmonisation aspects of reporting, mainly by promoting the use of SRIS.

Most Member States have presented their radioactive waste inventory using the classification scheme as per the IAEA safety guide GSG-1¹² or have provided matrixes enabling data to be converted from their national classification scheme into the classification scheme

⁹ See the IAEA Research Reactor Database: <https://nucleus.iaea.org/RRDB/RR/ReactorSearch.aspx>.

¹⁰ Benchmark Analysis of Member States Approaches to Definition of National Inventories for Radioactive Waste and Spent Fuel - <https://op.europa.eu/en/publication-detail/-/publication/e8d170a2-4016-11eb-b27b-01aa75ed71a1/language-en>.

¹¹ Study on radioactive waste classification schemes in the EU - <https://op.europa.eu/en/publication-detail/-/publication/a3fa58a2-dcce-11ed-a05c-01aa75ed71a1>.

¹² 'Classification of Radioactive Waste', General Safety Guide, IAEA, Vienna, 2009.

recommended by the IAEA.

At the end of 2019 the estimated total inventory of radioactive waste on the EU-27 territory was **2 334 000 m³** (a 5 % increase since the previous reporting period, corresponding to an average yearly production of less than 40 000 m³)¹³.

Approximately 66% of this waste had been disposed of¹⁴ (1 552 000 m³) and 34% (782 000 m³) was in storage¹⁵ and will have to be managed in the future. Data show that in those Member States where disposal routes are open for very-low-level and low-level waste, the process from generation to disposal appears generally flowing; for these classes of waste the amounts in storage fell by 10% (28 000 m³), while the amounts disposed of increased by 8% (122 000 m³). Not surprisingly, the same was not observed for intermediate-level and high-level waste as well as spent fuel, as currently there are no operational disposal facilities to handle these waste classes.

¹³ The yearly average radioactive waste generation per capita was ~90 milliliters; this amount corresponds to less than 0.1% compared to the yearly production of hazardous waste in general.

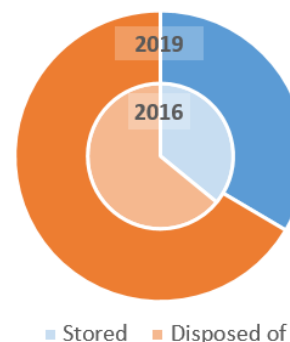
¹⁴ ‘Disposal’ means the emplacement of spent fuel or radioactive waste in a facility without the intention of retrieval.

¹⁵ ‘Storage’ means the holding of spent fuel or of radioactive waste in a facility with the intention of retrieval.

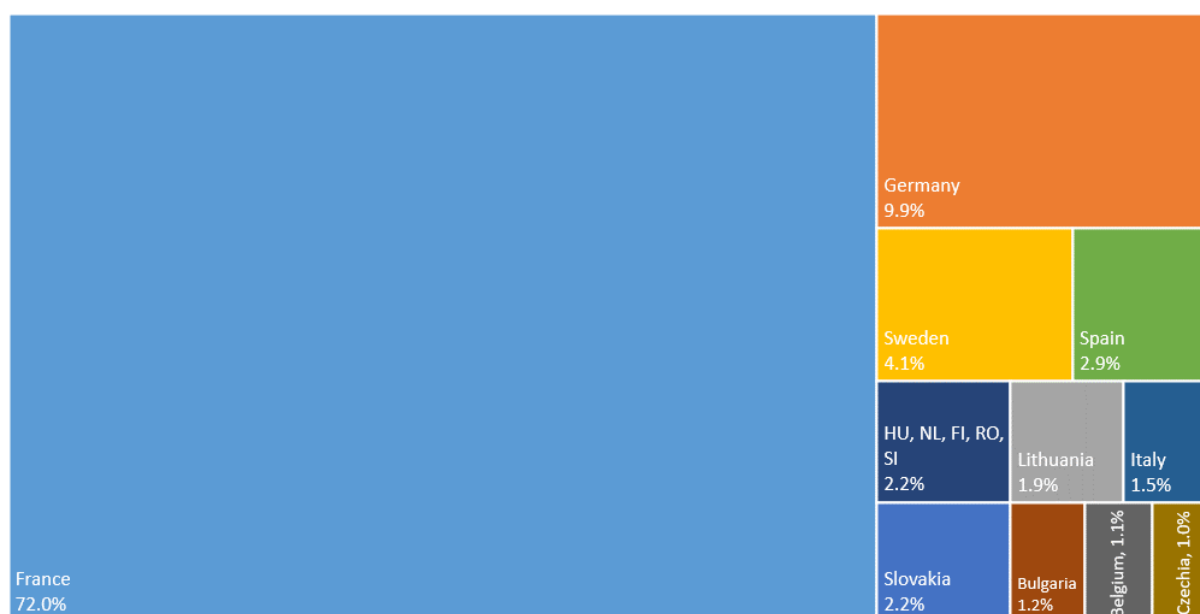
Box 1

Volumes and status of radioactive waste in the European Union, end of 2016 and 2019.

Amounts (thousands m ³)						
Year	Stored		Disposed of		Total	
	2016	2019	2016	2019	2016	2019
VLLW	233	233	369	462	601	695
LLW	381	353	1 039	1 068	1 420	1 421
ILW	178	191	12	22	190	213
HLW	4.5	4.8	0	0	4.5	4.8
Total	796	782	1 420	1 552	2 216	2 334



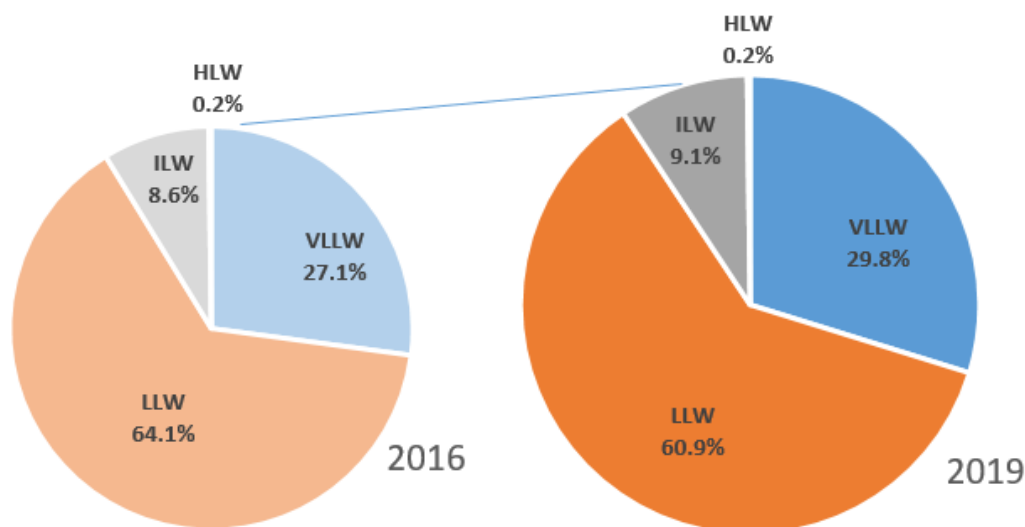
Distribution of total volumes of radioactive waste in Member States with a nuclear power programme, end of 2019.



The distribution of radioactive waste by class remained for the most part unchanged, with the highest share for low-level waste and the second highest for very-low-level waste. A specific point to consider is that some Member States do not have a separate very-low-level waste class, as defined in the IAEA GSG-1 waste classification scheme. Such waste is reported as part of the low-level waste class. The result is that the amounts of very-low-level waste reported are underestimates while the amounts of low-level waste reported are overestimates.

Intermediate-level waste and high-level waste are generated and safely stored predominantly in the Member States with nuclear power programmes.

Box 2 - Distribution of radioactive waste per category.



At the end of 2019¹⁶, approximately **54 700 tHM of spent fuel** were stored in the EU-27, (approximately 5% increase from 2016 and a 12% increase from 2013). About 1.5% of this spent fuel was sent for reprocessing outside the EU with expected returns of the radioactive waste resulting from reprocessing.

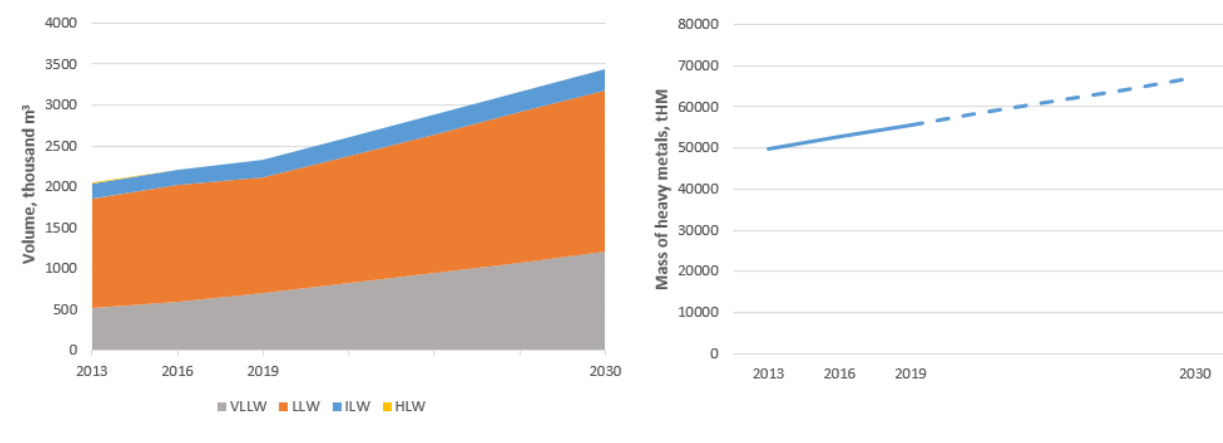
All spent fuel in the EU is currently in storage, as no civil disposal facility for spent fuel is in operation worldwide. Most Member States operating nuclear power plants intend to dispose of their spent fuel in deep geological facilities without reprocessing. However, some are reprocessing their spent fuel, while others keep an option for reprocessing in their policies.

2.3 Future prospects

In the previous report, the inventory data reported by the Member States enabled the Commission to present, for the first time, the prospects for creating an Euratom radioactive waste and spent fuel inventory until 2030. In the current reporting cycle, some Member States provided an updated inventory forecast resulting in an updated forecast until 2030.

¹⁶ The cut-off date for most data is end 2019 in order to reduce reporting burden on the Member States and facilitate joint reporting with the Joint Convention. Please see SWD(2024) 127 on inventory for details.

Box 3 - Evolution of radioactive waste (left) and spent fuel (right) inventories.



The level of detail provided by Member States varied considerably, particularly about the waste that originated from non-power applications and the decommissioning of nuclear installations. Due to limitations of the reported data, the current projection of radioactive waste and spent fuel amounts until 2030 is an estimate. Most Member States provided estimates of their future inventories for 2050. However, due to the unavailability of inventory forecast data for 2050 from some Member States with large inventories, it was not possible to provide an overall EU inventory long-term forecast. Since most national programmes cover periods of over 100 years, Member States are encouraged to work on estimates spanning until 2050 and to reduce as much as possible the level of uncertainty that has been observed by the Commission. Quality of the inventory data is expected to improve due to the use of SRIS. If it is not the case, the Commission may decide to set minimum standards for accurate, complete and transparent reporting.

Due to the planned shutdown and the anticipated decommissioning of several nuclear installations, the amount of waste will increase significantly during the next decade. It is expected that by 2030 very-low-level waste amounts may almost double, while the other waste classes could increase by between 38% and 73%. Therefore, attention should be paid to: i) minimising radioactive waste at the origin; ii) developing and implementing predisposal options to reduce waste volumes; and iii) developing of new storage or disposal facilities.

2.4 Trends and challenges

The current lack of operational deep geological disposal facilities leads to continuously increasing amounts of stored intermediate- and high-level waste, and spent fuel, which creates challenges in terms of ensuring sufficient long-term storage capacity and developing sustainable disposal solutions. Figure 1 shows the Member States' current plans for starting the operation of deep geological facilities.

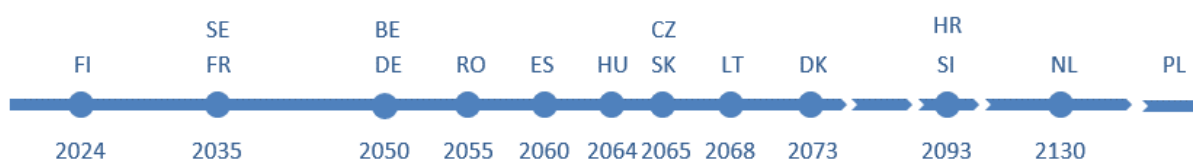


Figure 1. Planned start of operation of deep geological facilities.

The length of these plans combined with pending decisions and lack of concrete steps might jeopardise the timely delivery of such projects. Member States need to increase their engagement as regards developing long-term management solutions for intermediate-level waste, high-level waste, and spent fuel, including research, development and demonstration activities as soon as possible to avoid placing an undue burden on future generations. All necessary measures should be taken to ensure that at policy and technical level no excessive delays in implementing projects are encountered in the future. As such, all Member States should optimise planning, commit sufficient resources, carry out the necessary research and training activities and engage with the public and other stakeholders to accelerate implementation. This shows that Member States have much to gain from aligning with each other's best practices to ensure that the principles of safe and responsible management of spent fuel and radioactive waste that are enshrined in the Directive are sufficiently adhered to.

Most countries are progressing in the construction, modernisation and extension of storage facilities, despite experiencing some delays compared to the original plans.

Decommissioning nuclear power plants is becoming an increasingly important activity for the European nuclear industry. The decommissioning of nuclear sites that were shut down is ongoing in a quarter of the Member States.

3 ENSURING SAFE AND RESPONSIBLE MANAGEMENT OF SPENT FUEL AND RADIOACTIVE WASTE

3.1 National frameworks

In general, the Member States' national frameworks have continued to improve in recent past years, mainly through adopting national legislative measures that addressed residual transposing issues, and which led to the closure of two thirds of infringement procedures on incorrect transposition of the Directive.

Beside the dialogue with the Commission, self-assessments and international peer reviews have proven to be driving forces behind the alignment of national frameworks with the requirements of the Directive.

3.1.1 Competent regulatory authorities

In 2019 the Commission concluded that all Member States had at least one competent regulatory authority. In a few cases, the arrangements are such that local/regional competent authorities deal with radioactive waste management along with national authorities; the related national reports did not provide information on their roles and responsibilities, or on how they interact with each other.

While most Member States devised mechanisms to retain skilled staff within the regulatory authorities, some faced challenges in maintaining adequate human resources in the long term. Outcomes of recent international peer review missions confirmed this trend.

Most national reports provide information on measures for ensuring technical and financial independence of the competent regulatory authorities. A total of 19 Member States provided actual staff numbers; therefore, the information does not cover the full EU-27. The Commission reiterates its call to Member States to provide the relevant information as they already do in the Joint Convention¹⁷ reports, and to submit it under Article 14(1) of the Directive, as required.

3.1.2 Licence holders

In line with the Directive's requirement, licence holders are primarily responsible for the safe management of spent fuel and radioactive waste generated in the Member States' territory. Member States' reports generally provided a summary of the applicable legal requirements without further information on how those requirements are implemented in practice, especially regarding safety assessments and the human and financial resources of license holders.

On periodic safety reviews and safety improvements as well as on safety assessments during the licensing process¹⁸, almost half of the Member States provided information achievements during the reporting period.

Almost no information was provided on the actual human and financial resources of licence holders beyond indicating the related legal requirements. In some cases, generic information was provided on how competence and skills are managed. Member States should cover these aspects in the next reporting cycle.

3.1.3 Expertise and skills

Few changes or developments were reported compared to the situation 3 years prior. Nearly all Member States have established legal requirements to ensure the training and education of staff of all parties involved. However, around one third of the Member States did not include information or did not provide examples on the implementation of such requirements.

Member States with nuclear power programmes have generally more developed formal arrangements for education, training, and research. In general, the training and education received by the regulatory authority is better defined than that of operators and other stakeholders/licensees. International exchange of experience through peer reviews, workshops, conferences, visits, and similar events have been recognised as useful tools for training and educating staff, particularly for Member States without nuclear power programmes.

Research and development activities are reported by slightly less than half of the Member States, and by the rest only in generic terms or not at all.

¹⁷ Joint Convention on the Safety of Spent Fuel management and on the Safety of Radioactive Waste Management.

¹⁸ Articles 7(2), 7(3) of the Directive.

3.1.4 Financial resources

Nearly all Member States¹⁹ provided information on the cost assessment of their national programmes. The estimates vary widely in terms of methodology, assumptions, completeness of data, scope and time frames.

Half of the Member States – mainly those with nuclear power programmes – recently updated their cost estimates. However, those updates were not always complete and did not reflect the cost developments in the recent years. It is important to periodically review and, when necessary, update the cost estimates as they form the basis for providing sufficient funding for implementing the national programmes.

In the first progress report, the estimated total cost of radioactive waste management²⁰ in the EU-27 was around EUR 250 billion, while in the second it was re-estimated at around EUR 300 billion²¹. The current cost estimate is at the same level²².

About half of the Member States provided information on the status of the funds for spent fuel and/or radioactive waste management although the level of detail varied²³. Overall, very little information was reported on the performance of the funds. Member States are encouraged to regularly assess how their funds perform, so as to proactively react to any changes that may occur and ensure the timely adoption of corrective measures, if needed.

Recognising the importance of this subject, in 2020, the Commission carried out a study²⁴ on the methodologies in use for cost assessment, as well as the financing schemes in place and the relationship between them. The study identified common trends, good practices and challenges for all Member States. Furthermore, in 2021, the Commission formally established the group of experts on financial aspects of nuclear decommissioning and spent fuel and radioactive waste management (short name: ‘Nuclear Backend Financial Aspects expert group’)²⁵. Through its work programme, the group of experts will support the Commission and the Member States in financial assessment and modelling. Nonetheless, it is apparent that the Directive has not been effective as regards its rules that aimed to create conditions for fully ensuring the availability of adequate financial resources for spent fuel and radioactive waste management, including radioactive waste from decommissioning activities, when needed.

¹⁹ Only two Member States (having only institutional waste) did not provide any cost assessment.

²⁰ ‘Estimated total cost of radioactive waste management’ means the aggregated total cost of all the EU Member States’ national programmes during their full duration.

²¹ These figures do not include cost estimates for the UK national programme.

²² See details for each Member State in the SWD(2024) 123 on Progress of Implementation of Council Directive 2011/70/Euratom. However, information from ongoing infringement procedures has not been included.

²³ See Table 10 in SWD(2024) 123.

²⁴ European Commission, Directorate-General for Energy, Methodologies of cost assessment for radioactive waste and spent fuel management : an overview of the practices adopted in the EU, Publications Office, 2020, <https://data.europa.eu/doi/10.2833/476584>.

²⁵ <https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?lang=en&groupID=3777> .

3.1.5 Transparency and public participation

No major steps or developments were reported by the Member States, except for France's public debate on the fifth National Programme²⁶. The national reports presented mainly the policy and legal framework regulating the transparency arrangements and provided little or no details regarding actual implementation or practices. The major channels of publicity continued to be web sites, reports, media, etc. Typically, regulatory authorities carry out these activities, though in some Member States national legislation also creates obligations towards the licence holders. Over two thirds of the Member States consult the public as part of the environmental impact assessment as a precondition for issuing licences for nuclear and radioactive waste management installations.

The Commission reiterates the importance of implementing the transparency and public participation requirements effectively, including providing information on the progress of implementation in practice in the next reporting cycle. The importance of appropriate key performance indicators has been largely disregarded in reporting. This indicates that the Directive was not effective in ensuring fully transparent communication on how the national programmes were implemented.

3.1.6 Infringements

In relation to the pending issues described above, the Commission had to initiate several procedures against some Member States on the transposition of the Directive.

By the time of this report, two procedures²⁷ were on-going, while the Commission had closed six²⁸ infringement cases before the end of the reporting cycle.

3.2 National programmes

The Directive sets out a key requirement for Member States to establish and maintain national policies on safe and long-term management of spent fuel and radioactive waste. These policies must abide by general principles²⁹ and should be translated into concrete plans of actions in each Member State's national programme³⁰.

3.2.1 State of progress

The Commission noted continuous progress in developing and adopting national programmes. By now, all 27 Member States have established their national programme and, during the reporting period, one third of them have been updated.

Some Member States have adopted national programmes detailing activities only for a specific timeframe, mostly covering a 5 to 10-year period. However, two such Member States did not adopt updated versions in time. To avoid such situations in the future, Member States

²⁶ <https://www.asn.fr/l-asn-informe/dossiers-pedagogiques/la-gestion-des-dechets-radioactifs#plan-national-de-gestion-des-matieres-et-dechets-radioactifs>

²⁷ Against Croatia, and Latvia.

²⁸ Against Estonia, Hungary, Ireland, Malta, Portugal and the United Kingdom.

²⁹ Article 4 of the Directive.

³⁰ Articles 11 and 12 of the Directive.

are encouraged to optimise planning and adoption processes to ensure continuity of the national programme.

In most cases, updating programmes have resulted in milestones being pushed to a later time. The Commission would like to recall that Member States are required to notify any significant change to the national programmes in line with Article 13(1) of the Directive, including changes to implementation schedules.

Generally, the implementation of most Member States' national programmes was impacted by delays up to 5 years, due in part to lengthier than expected licensing procedures, changes in the policy or political decisions. In some other cases, where no clear timelines were reported or a long-term strategy was not defined, it was difficult to assess the timeliness of the programme's implementation. Such delays may imply a transfer of burden to future generations. However, they were not linked to any safety issues, as currently the national frameworks ensure proper management of radioactive waste and spent fuel.

3.2.2 Main plans and policies

Overall, almost all of the national programmes cover all types of radioactive waste and spent fuel generated in the Member States' territories, but only one third of them indicate concrete plans from generation to disposal. While most of the Member States plan to dispose of radioactive waste and/or spent fuel in their territory, not all of them have made their final decision and some still consider the possibilities of common multinational disposal.

Most Member States without nuclear power programmes and some Member States with nuclear power programmes are considering exporting radioactive waste for disposal. However, the Commission has observed no significant development in practice in recent years towards a shared solution for disposal. It is worth noting that national frameworks prohibit importing radioactive waste in several Member States, including some which are considering shared solutions³¹.

Similarly to the previous reporting cycle, there is still little information on how institutional radioactive waste³² is managed, therefore this report covers that aspect of radioactive waste management in broad terms only.

3.2.3 Monitoring progress towards implementation

According to Article 12(1)(g) of the Directive, national programmes must include key performance indicators (KPIs) to monitor progress towards their implementation. Far from being a mere formal requirement, KPIs are an essential element of the national programme, enabling the monitoring of progress towards its implementation, the implementation of the national policy and, ultimately, towards achieving the Directive's overarching objective of avoiding undue burdens on future generations. Moreover, since Member States, under Article 14 of the Directive, should report them to the Commission every 3 years, KPIs are also a useful tool for ensuring transparency for the public.

³¹ See Table 1 in SWD(2024) 123.

³² Institutional waste is radioactive waste originating from medical and industrial applications, and research institutions.

Since the first progress report the Commission has been identifying the definition of KPIs in line with the above-mentioned requirement as one of the main implementation challenges related to the national programmes. In its second report, the Commission highlighted that further effort was still needed from the Member States to fully comply with the KPI requirement, stressing that over a third of the Member States did not define KPIs in line with the Directive.

To support Member States in addressing this major compliance issue the Commission funded a study³³ on KPIs, which was presented to and discussed with the Member States' regulatory authorities and relevant stakeholders.

Little progress on the KPIs has been observed since the last report. Most of the Member States have reported progress made in implementing the national programmes, mainly by describing what has been achieved since the last report, and many Member States have updated their milestones and timeframes. However, the Member States did not use KPIs to present the status of implementation of their national programmes in their national reports.

Slovenia updated its national programme in January 2023, including bringing KPIs in line with the Directive's requirements and setting a benchmark for good practices.

3.2.4 Research, development and demonstration activities

The situation remained largely unchanged since the last report in this area. The Member States provided minimal information on their research, development and demonstration activities planned to support the implementation of their national programmes. Six Member States, mainly having large- and medium-sized nuclear programmes, provided details and presented the progress made³⁴. Other Member States presented the research and development activities and timeframes for final disposal in very general terms, and many Member States have not reported any details or confirmed that they do not have a specific research programme.

The research programmes are at various stages of implementation, and progress typically correlates with the advancement of the national radioactive waste and spent fuel management programmes.

Many Member States with small inventories rely on participating in, or following the results of international programmes or projects that are in-line with their radioactive waste management needs, with a few of them planning to develop their own research, development and demonstration activities. Member States also generally presented the international activities they participate in, providing lists of projects without a clear or explicit link to the implementation of the national programmes. Therefore, the Commission invites the Member States to provide information on the expected impact those projects have on the implementation of national programmes in their future reporting.

³³ European Commission, Directorate-General for Energy, Study on key performance indicators for monitoring implementation of national programmes on safe and long-term management of spent fuel and radioactive waste: final report, Publications Office of the European Union, 2022, <https://data.europa.eu/doi/10.2833/052078>.

³⁴ Research, development and demonstration activities are usually carried out by the national waste management organisation and by research organisations.

3.2.5 *Infringements*

In relation to the pending issues described above, the Commission had to initiate several procedures against some Member States on the compliance of national programmes with the requirements of the Directive.

In early 2024 18 procedures³⁵ are on-going. The Commission had closed three³⁶ infringement cases before the end of the reporting cycle.

3.3 Self-assessment and international peer reviews

The Member States must arrange self-assessments of their national framework, competent regulatory authority, national programme and its implementation. They also must arrange an international peer review of their national framework, competent regulatory authority and/or national programme at least every 10 years³⁷.

The Member States have generally ensured compliance with this requirement by means of services provided by the IAEA, such as the IRRS (Integrated Regulatory Review Service) and ARTEMIS (Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation), which have been developed with the support of the Commission.

The reporting period coincided with the 2020-2021 COVID-19 pandemic, which has significantly disrupted the ARTEMIS peer-review schedule. Despite this setback, all Member States conducted the ARTEMIS peer-review by the end of 2023 in line with Article 14(3) requirements. The Commission participated in the missions as an observer and followed up the development of the ARTEMIS peer-review service.

Similarly to the first and second reporting cycles, most Member States have provided information on self-assessments and international peer reviews of the regulatory authorities (IRRS). Two IRRS missions and three IRRS follow-up missions were carried out during the reporting period, and to date all EU Member States have carried out or planned IRRS review missions.

The Commission already noted in its previous report that although in most Member States IRRS and ARTEMIS reports are publicly available, Member States need to notify the outcomes of such reviews and their plans to address recommendations and suggestions to the Commission.

4 CONCLUSIONS

The Commission considers that radioactive waste and spent fuel were managed safely in the Member States in the reporting period. National programmes are in place across the EU and generally were established in a transparent and participative manner. For the largest share of radioactive waste safe solutions for management and disposal were pursued, as demonstrated

³⁵ Against Austria, Belgium, Bulgaria, Czechia, Germany, Denmark, Estonia, Greece, Spain, Croatia, Ireland, Italy, Latvia, Lithuania, the Netherlands, Portugal, Romania and Slovenia.

³⁶ Against Poland, Romania and the United Kingdom.

³⁷ Article 14(3) of the Directive.

by increasing amounts of disposed of volumes against decreasing amounts of stored volumes. The system of self-assessments and international peer reviews appeared consistent with the needs and is driving updates and continuous improvement in waste management; it is worth remarking that this is best practice on a global scale, as EU Member States have been the main clients of the IAEA ARTEMIS peer review-mechanism thus far.

However, the rate of addressing key challenges remained generally slow, and few changes can be reported in relation to the previous report (in several cases the national reports were almost identical to the ones submitted in the previous reporting cycle). As the 10th anniversary of the transposition deadline of the Directive into national legislation has passed, overall, a general conclusion can be drawn that the transposition and implementation of the Directive in the Member States have not to date fully achieved the Directive's objectives for all categories of radioactive waste. This calls for a more thorough evaluation of the Directive's effectiveness in ensuring responsible management of spent nuclear fuel and radioactive waste in the EU and avoiding the transfer of any undue burden to future generations.

While Finland, France and Sweden progressed substantially in constructing deep geological repositories and maintained ambitious plans, several Member States still did not further define national policies for the long-term management of all their radioactive waste, particularly intermediate-level waste and high-level waste. Furthermore, the targets set in some national programmes are not sufficiently ambitious and envisage long implementation periods that risk burdening future generations. Several Member States keep an option for shared disposal solutions with other countries. However, this may lead to deferral of decisions rather than acceleration especially because of import bans in numerous Member States.

Main issues to address are programmes' control and funding. The assessment of costs is sometimes out-of-date or not comprehensive, therefore impacting the effectiveness of financing schemes with a risk that they will not be sufficient to cover the costs. The Member States should also improve the use of KPIs in controlling and reporting on the progress made with the implementation.

The Commission considers that Member States should accelerate the review and update of the national programmes, taking into account the outcomes of self-assessments and international peer reviews, and – at the same time – improving the quality of reporting on the programmes' implementation regarding the aspects identified in this report. Member States should address these issues in the next reporting cycle. At the same time, the Commission will carry out a thorough reassessment of the current ENSREG guidelines³⁸ setting out reporting requirements and establish more specific reporting criteria to support the efforts of the Member States.

³⁸ [ENSREG reporting guidelines for Member States](#)