Shared solutions for the management of spent fuel and radioactive waste – status, advantages, and disadvantages

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1 Summary

Shared solutions are an umbrella term over all activities and projects in the management of spent fuel and radioactive waste that could be shared on a bilateral or multinational level. These activities include steps from predisposal of radioactive waste to final disposal of all types of radioactive material (like spent fuel) and radioactive waste.

More than half of EU member states included the option of a shared disposal in their national waste management programs under Directive 2011/70/Euratom. In its last two implementation reports of 2019 and 2024, the European Commission complained that keeping an option for a shared disposal might lead to deferral of the national disposal program. And EC also pointed out that many member states have banned import of radioactive waste, which makes it impossible to host a site for a shared facility.

There are not many examples of sharing yet, most of them are described in this report:

- Luxembourg exports all of its radioactive waste to Belgium für treatment and disposal. This bilateral activity seems to be working well, but it has to be considered that the amounts of radioactive waste involved are very small.
- The Republics of Slovenia and Croatia co-own NPP Krško. While this co-ownership after initial political difficulties functions well, the collaborative management of spent fuel and radioactive waste does not. The management is characterized by lack of transparency and participation, and inefficiency of the installed Intergovernmental Committee whose members change after every election.
- The use of the Bohunice RAW Treatment Centre in Slovakia for foreign low- and very low-level waste is an example of a commercial activity in radioactive waste treatment where the waste is first shipped to a country to be treated and transported back afterwards. What went wrong in this example was the misinformation of the public: company JAVYS constructed a second incinerator on the Bohunice site but did not inform the public that this will be mainly used for treatment of the foreign waste. The public found out and protested. This led to a bill in 2021 by the Slovak Parliament banning future contracts for incineration of foreign radioactive waste.
- The European Repository Development Organisation ERDO was set up in 2009 to develop first studies and later implement one or more shared geological repositories in Europe. Not all EU member states that have shared repositories as an option in their national waste management programs under Directive 2011/70/Euratom are members of ERDO. There do not seem to be many ERDO activities ongoing, efforts to raise funds for extensive projects were obviously not successful; parallel activities from MIRA or the EC's Pilot Project are resulting in a waiting position for ERDO. In the activities of ERDO until now, transparency and public participation play only a marginal role.
- Based on a recommendation from the European Parliament, the European Commission (DG ENER) decided in 2023 to carry out a Pilot Project on shared solutions. Public information is very scare. A DG ENER representative said in 2025 that the biggest political barrier to a shared repository was public resistance. But nevertheless, the Pilot Project does not seem to have a plan for transparency and public participation already in the early steps; on the contrary, it is not even clear yet whether the results of the Pilot Project would be published at all.

- OECD/NEA started in 2023 the Multinational Infrastructure for Managing Radioactive Waste project MIRA. Also, for MIRA, public information is scarce. Last information was that an expert group was set up.
- The Australian company Tellus is offering its Chandler project as the first multinational geological repository of the World in Australia; it shall be built in a salt rock south of Alice Springs. The repository has not been fully licensed yet. It is approved for hazardous waste but now should be opened also for radioactive waste. While Tellus informs that they have the consent of the indigenous community, critical media see economic pressure and misleading information when it comes to radioactive waste. This confirms a major concern of critical NGOs working on nuclear issues, that nuclear waste repositories will be constructed in marginalized areas with high economic pressure and low democratic standards, if the public is not alert and careful to prevent agreements under economic pressure.

In these examples of shared solutions or projects lots of unsolved issues become visible.

No country has stepped forward yet to offer hosting a shared repository.

One of the most important unsolved issues is the **lack of transparency and public participation in shared solutions projects and concepts**. Not only the disposal of spent fuel and radioactive waste, but also treatment and transports have impacts. The risk of negative impacts on people and environment of all of these management activities will burden uncountable future generations. If the public is not informed correctly, and if there is no adequate and effective public participation, trust will be lost.

Directive 2011/70/Euratom defines that member states have to ensure that countries where they ship their radioactive waste to, have to have a high level of safety. But even EU member states do have different safety criteria; it is therefore **up to interpretation what "high level of safety" means**. For civil society it is important that the **highest level of safety** will be chosen for shared disposal facilities. This approach would best recognize the precautionary principle.

Future generations might advertently or inadvertently try to intrude repositories by drilling activities. Also, here the **highest level of security** needs to be implemented for shared disposals which includes a program to keep the memory of the site alive.

Questions of **ultimate responsibility** remain open, if the political situations change like for example if a country where radioactive waste has been exported to engages in a war. How long will the ultimate responsibility be with the exporting member state?

Many EU member states have legally forbidden import of radioactive waste, among them many countries interested in shared disposals.

Another open question is what will happen in case of an accident in a shared facility, who will be liable for the consequences? This has to be clarified.

These unsolved questions need to be solved first, especially when shared final repositories ae envisaged.

Shared solutions could have some **advantages**. Member states with **small inventories (SIMS)** often do not have the know-how and the resources of member states with large inventories (LIMS), especially compared to LIMS with an advanced nuclear waste management program accompanied by a dedicated research program. Such benefits can include predisposal and disposal sharing activities. This will be especially true for countries with very small inventory.

Costs are sometimes highlighted as advantage due to the economies of scale argument: bigger repositories can reduce unit costs. But it can be expected that the first deep geological repositories will all be first-of-a-kind as they might be built in different host rock and using different technologies. Nuclear projects are characterized nowadays by cost overruns, this might also be true for shared repositories, especially deep geological ones. It will be necessary to establish agreements on who will pay for cost overruns in a multinational collaboration.

Recommendations for civil society work on shared solutions:

- Differentiation in the discussion on shared solutions between predisposal and disposal activities: sharing predisposal technologies and facilities could bring benefits contributing to safer radioactive waste management if a state that is advanced in its radioactive waste management can offer support to a state that does not have sufficient resources for a safe management.
- Development of national strategies for final disposal should be prioritized over waiting for shared disposal solutions as they are far from being advanced yet; long-term interim storage as the main alternative for final disposal, especially for high-level waste, comes with an increase of risk due to ageing materials, outdated designs and lower security features, and therefore is not the best option in the long-term.
- Projects like ERDO and the EC Pilot Project need to become transparent and engage in public participation from the beginning; interaction with civil society needs to be established on a robust level-
- Avoiding social and environmental dumping for multinational repositories is key. The promises of projects like Chandler in Australia need to be carefully monitored for possibly taking advantage of an economic weak region or population group.
- Engagement for phase-out of nuclear energy: the more spent fuel and radioactive waste is produced, the more repositories are needed, which increases the risk for people and environment for countless future generations.

2 Zusammenfassung

Gemeinsame Lösungen sind ein Oberbegriff für alle Aktivitäten und Projekte im Bereich der Entsorgung abgebrannter Brennelemente und radioaktiver Abfälle, die bilateral oder multinational durchgeführt werden können. Diese Aktivitäten umfassen alle Schritte von der Behandlung[1] radioaktiver Abfälle bis zur endgültigen Lagerung aller Arten radioaktiver Materialien (wie abgebrannter Brennelemente) und radioaktiver Abfälle.

Mehr als die Hälfte der EU-Mitgliedstaaten haben die Option einer gemeinsamen Endlagerung in ihre nationalen Entsorgungsprogramme gemäß Richtlinie 2011/70/Euratom aufgenommen. In ihren beiden letzten Umsetzungsberichten von 2019 und 2024 bemängelte die Europäische Kommission, dass die Beibehaltung dieser Option zu einer Verzögerung der nationalen Endlagerprogramme führen könnte. Die Kommission wies zudem darauf hin, dass viele Mitgliedstaaten die Einfuhr radioaktiver Abfälle verboten haben, was die Errichtung eines Standorts für eine gemeinsam genutzte Anlage unmöglich macht.

Es gibt noch nicht viele Beispiele für gemeinsame Lösungen in der Entsorgung, die meisten davon werden in diesem Bericht beschrieben:

- Luxemburg exportiert seinen gesamten radioaktiven Abfall zur Behandlung und Entsorgung nach Belgien. Diese bilaterale Zusammenarbeit scheint gut zu funktionieren, allerdings muss berücksichtigt werden, dass die Mengen an radioaktivem Abfall sehr gering sind.
- Die Republiken Slowenien und Kroatien sind Co-Eigentümer des Kernkraftwerks Krško. Während diese geteilte Eigentümerschaft nach anfänglichen politischen Schwierigkeiten gut funktioniert, gilt das nicht für die gemeinsame Entsorgung der abgebrannten Brennelemente und radioaktiven Abfälle. Die Entsorgung ist gekennzeichnet durch mangelnde Transparenz und fehlende Beteiligung der Öffentlichkeit, ebenso wie durch die Ineffizienz des eingesetzten zwischenstaatlichen Komitees, dessen Mitglieder nach jeder Wahl wechseln.
- Die Nutzung des Behandlungszentrums für radioaktive Abfälle in Bohunice (Slowakei) für ausländische schwach- und sehr schwach radioaktive Abfälle ist ein Beispiel für eine kommerzielle Tätigkeit in der radioaktiven Abfallbehandlung, bei der die Abfälle zunächst in ein anderes Land transportiert, dort behandelt und anschließend wieder zurückgebracht werden. Problematisch war in diesem Fall die Fehlinformation der Öffentlichkeit: Das Unternehmen JAVYS errichtete auf dem Gelände in Bohunice eine zweite Verbrennungsanlage, ohne die Öffentlichkeit darüber zu informieren, dass diese hauptsächlich zur Behandlung ausländischer Abfälle genutzt werden sollte. Die Öffentlichkeit erfuhr davon und protestierte. Dies führte 2021 zu einem Gesetzentwurf des slowakischen Parlaments, der künftige Verträge zur Verbrennung ausländischer radioaktiver Abfälle verbietet.
- Die European Repository Development Organisation (ERDO) wurde 2009 gegründet, um zunächst Studien durchzuführen und später ein oder mehrere gemeinsame geologische Endlager in Europa zu realisieren. Nicht alle EU-Mitgliedstaaten, die gemeinsame Endlager als Option in ihren nationalen Entsorgungsprogrammen gemäß Richtlinie 2011/70/Euratom in Betracht ziehen, sind Mitglieder der ERDO. Derzeit scheinen nur

[1] Der englische Begriff predisposal management hat keine exakte deutsche Entsprechung, hier wird Behandlung als Übersetzung verwendet.

wenige Aktivitäten der ERDO stattzufinden; die Bemühungen zur Mittelbeschaffung für umfangreiche Projekte waren offensichtlich nicht erfolgreich. Parallele Aktivitäten von MIRA oder dem Pilotprojekt der EU-Kommission führen dazu, dass die ERDO auf der Stelle tritt. Transparenz und Beteiligung der Öffentlichkeit spielen in den bisherigen Aktivitäten der ERDO nur eine untergeordnete Rolle.

- Auf Empfehlung des Europäischen Parlaments beschloss die Europäische Kommission (DG ENER) 2023 die Durchführung eines Pilotprojekts zu gemeinsamen Lösungen. Öffentliche Informationen sind rar. Ein Vertreter der DG ENER erklärte 2025, die größte politische Hürde für ein gemeinsames Endlager sei der Widerstand der Öffentlichkeit. Dennoch scheint das Pilotprojekt bereits in der Anfangsphase keinen Plan für Transparenz und Beteiligung der Öffentlichkeit vorzusehen; im Gegenteil, es ist noch nicht einmal klar, ob die Ergebnisse des Pilotprojekts überhaupt veröffentlicht werden.
- OECD/NEA starteten 2023 das Projekt MIRA (Multinational Infrastructure for Managing Radioactive Waste). Auch zu MIRA sind die öffentlichen Informationen spärlich. Zuletzt wurde die Einrichtung einer Expertengruppe bekanntgegeben.
- Das australische Unternehmen Tellus bietet sein Chandler-Projekt als weltweit erstes multinationales geologisches Endlager in Australien an. Es soll in einem Salzgestein südlich von Alice Springs errichtet werden. Das Endlager ist noch nicht vollständig genehmigt. Es ist zwar für gefährliche Abfälle zugelassen, soll aber nun auch für radioaktive Abfälle geöffnet werden. Tellus gibt an, die Zustimmung der indigenen Community zu haben, doch kritische Medien vermuten wirtschaftlichen Druck und irreführende Informationen im Zusammenhang mit radioaktiven Abfällen. Dies bestätigt eine zentrale Befürchtung kritischer NGOs im Atombereich: Atommülllager werden in benachteiligten Gebieten mit hohem wirtschaftlichem Druck und niedrigen demokratischen Standards gebaut, falls die Öffentlichkeit nicht wachsam ist und Vereinbarungen unter wirtschaftlichem Druck verhindert.

In diesen Beispielen gemeinsamer Lösungen oder Projekte werden viele ungelöste Probleme sichtbar.

Bislang hat sich noch kein Land bereit erklärt, ein gemeinsames Endlager zu hosten.

Eines der wichtigsten ungelösten Probleme ist der **Mangel an Transparenz und Beteiligung der Öffentlichkeit bei gemeinsamen Lösungsprojekten und -konzepten** . Nicht nur die Endlagerung abgebrannter Brennelemente und radioaktiver Abfälle, sondern auch deren Behandlung und Transport haben Auswirkungen. Das Risiko negativer Folgen für Mensch und Umwelt durch all diese Maßnahmen wird unzählige zukünftige Generationen belasten. Wird die Öffentlichkeit nicht ausreichend informiert und findet keine angemessene und wirksame Beteiligung statt, geht Vertrauen verloren.

Die Richtlinie 2011/70/Euratom legt fest, dass die Mitgliedstaaten sicherstellen müssen, dass die Länder, in die sie ihre radioaktiven Abfälle verbringen, ein hohes Sicherheitsniveau gewährleisten. Allerdings unterscheiden sich die Sicherheitskriterien selbst innerhalb der EU; daher ist die **Bedeutung von „hohem Sicherheitsniveau“ auslegungsbedürftig** . Für die Zivilgesellschaft ist es wichtig, dass für gemeinsame Endlagerstätten das **höchste Sicherheitsniveau** gewählt wird. Dieser Ansatz würde dem Vorsorgeprinzip am besten gerecht werden.

Zukünftige Generationen könnten absichtlich oder unabsichtlich versuchen, durch Bohrarbeiten in die Endlager einzudringen. Daher muss für die gemeinsame Entsorgung ein

Höchstmaß an Sicherung (security) gewährleistet sein, einschließlich eines Programms zum Wissenserhalt des Endlagerstandortes.

Die Frage der **abschließenden Verantwortung** bleibt offen, falls sich die politischen Gegebenheiten ändern, beispielsweise wenn ein Land, in das radioaktive Abfälle exportiert wurden, in einen Krieg verwickelt wird. Wie lange wird die abschließende Verantwortung beim exportierenden Mitgliedstaat liegen?

Viele EU-Mitgliedstaaten haben die Einfuhr radioaktiver Abfälle gesetzlich verboten, darunter auch viele Länder, die an einer gemeinsamen Entsorgung interessiert sind.

Eine weitere offene Frage ist, was im Falle eines Unfalls in einer gemeinsam genutzten Anlage geschieht und wer für die Folgen haftet. Dies muss geklärt werden.

Diese ungelösten Fragen müssen zuerst geklärt werden, insbesondere wenn gemeinsame Endlager vorgesehen sind.

Gemeinsame Lösungen könnten **Vorteile bieten**. Mitgliedstaaten mit **geringem Inventar an radioaktiven Abfällen** verfügen oft nicht über das Know-how und die Ressourcen von Mitgliedstaaten mit großem Inventar, insbesondere im Vergleich zu solchen mit einem fortschrittlichen Programm zur Entsorgung radioaktiver Abfälle und einem entsprechenden fortgeschrittenen Forschungsprogramm. Zu diesen Vorteilen können gemeinsame Aktivitäten im Bereich der Behandlung und Endlagerung gehören. Dies gilt insbesondere für Länder mit sehr geringen Mengen an radioaktiven Abfällen.

Kosten werden aufgrund von Skaleneffekten mitunter als Vorteil hervorgehoben: Größere Endlager können die Stückkosten senken. Es ist jedoch zu erwarten, dass die ersten tiefengeologischen Endlager allesamt einzigartig sein werden (first-of-a-kind), da sie in unterschiedlichem Wirtsgestein und mit verschiedenen Technologien errichtet werden. Nuklearprojekte sind heutzutage durch Kostenüberschreitungen gekennzeichnet; dies dürfte auch für gemeinsame Endlager, insbesondere tiefengeologische, gelten. Es wird notwendig sein, Vereinbarungen darüber zu treffen, wer in einer multinationalen Zusammenarbeit die Kosten für Kostenüberschreitungen trägt.

Empfehlungen für NGOs zu gemeinsamen Lösungen:

- Differenzierung in der Diskussion über gemeinsame Lösungen zwischen Behandlungs- und Entsorgungsaktivitäten: Die gemeinsame Nutzung von Abfallbehandlungstechnologien und -anlagen könnte Vorteile bringen und zu einer sichereren Entsorgung radioaktiver Abfälle beitragen, wenn ein Staat, der in seiner Entsorgung radioaktiver Abfälle fortgeschritten ist, einem Staat, der nicht über ausreichende Ressourcen für eine sichere Entsorgung verfügt, Unterstützung anbieten kann.
- Die Entwicklung nationaler Strategien für die Endlagerung sollte Vorrang vor dem Abwarten auf gemeinsame Endlager haben, da diese noch lange nicht ausgereift sind. Die langfristige Zwischenlagerung als wichtigste Alternative für die Endlagerung, insbesondere für hochradioaktive Abfälle birgt aufgrund alternder Materialien, veralteten Designs und geringerer Sicherungsmerkmale ein erhöhtes Risiko und ist daher langfristig nicht die beste Option.

- Projekte wie ERDO und das EU-Pilotprojekt müssen transparent werden und von Anfang an die Öffentlichkeit einbeziehen; die Interaktion mit der Zivilgesellschaft muss auf einem robusten Niveau etabliert werden.
- Die Vermeidung sozialen und ökologischen Dumpings durch multinationale Endlager ist von zentraler Bedeutung. Die Versprechen von Projekten wie Chandler in Australien müssen sorgfältig geprüft werden, um festzustellen, ob sie möglicherweise eine wirtschaftlich schwache Region oder Bevölkerungsgruppe ausnutzen.
- Engagement für den Ausstieg aus der Kernenergie: Je mehr abgebrannte Brennelemente und radioaktive Abfälle produziert werden, desto mehr Endlager werden benötigt, was das Risiko für Mensch und Umwelt für unzählige zukünftige Generationen erhöht.

3 Introduction

The management of spent fuel and radioactive waste[2] still faces a number of unresolved issues. A main problem is that there is still no operational final repository for spent fuel and high-level radioactive waste in Europe. Final repositories for low- and medium-level radioactive waste that were built in the second half of the last century do not meet today's standards, and their remediation or decommissioning poses major challenges in some cases (see, for example, Asse II in Germany). But it is not only final disposal that poses difficulties; the conditioning of radioactive waste also raises problems, especially for contaminated sites and challenging waste that have been inadequately managed.

There is often hope that shared solutions, i.e. joint, bilateral or multinational solutions, could remedy this situation by allowing countries with more advanced radioactive waste management programmes to support other countries, either in the form of joint conditioning activities or joint final disposal projects. Shared solutions cover a wide range of possible measures.

The national waste management programmes of EU Member States (based on Directive 2011/70/Euratom) show that a number of countries are seeking shared final disposal solutions. However, not only civil society organisations but also the European Commission have criticised this as a possible excuse for not having to push ahead with national final disposal plans. Many countries have import and export bans, and there are a number of unresolved issues such as liability and financing. Following a recommendation by the European Parliament at the end of 2023, the European Commission (DG ENER) has now decided to carry out a pilot project on shared solutions (‘Proposal for a Joint European Approach towards Radioactive Waste’). This pilot project is already underway. Furthermore, the ASTRA work package (subtask 5.2) within EURAD-2 deals with shared solutions.

This report identifies which activities fall under shared solutions and which projects are being carried out. Particular attention will be paid to possible advantages and disadvantages, as well as assessments of feasibility.

The results of the report provide a basis for a well-founded opinion on shared solutions and recommendations on what needs to be considered from civil society’s view for implementation.

[2] In some countries, spent fuel from NPPs is not defined as radioactive waste but as material (for example in France). Therefore, when talking about “radioactive waste management”, the correct term is “management of spent fuel and radioactive waste”.

4 What are shared solutions?

Radioactive waste management comprises a lot of steps before final disposal, as the following figure shows.

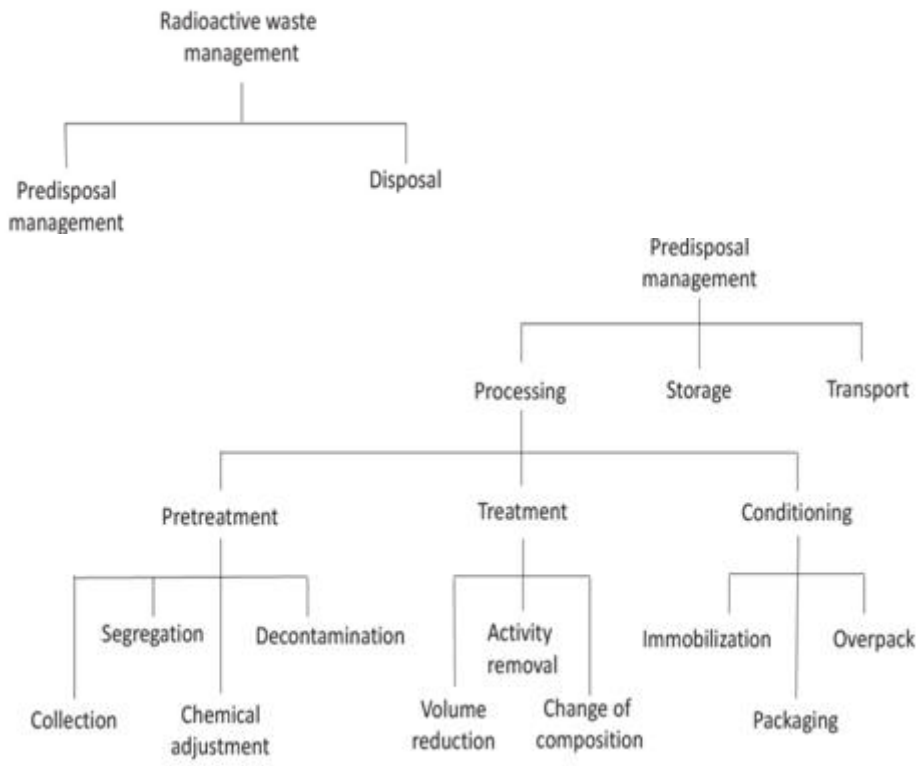


Figure 1: Steps of radioactive waste management, based on IAEA (2006)

Disposal means final disposal in final repositories. Even if there are no final repositories for spent fuel and high-level radioactive waste in operation in Europe yet, this is the final step of management that is defined in the Nuclear Waste Directive 2011/70/Euratom, Art 11 (1): 1. Each Member State shall ensure the implementation of its national programme for the management of spent fuel and radioactive waste ('national programme'), covering all types of spent fuel and radioactive waste under its jurisdiction and all stages of spent fuel and radioactive waste management from generation to disposal.

Predisposal activities include all steps from collection of the radioactive waste, through treating and conditioning to storage.

Storage means interim or temporary or transfer storage. Especially for high-level radioactive waste and some long-lived intermediate-level waste interim storage is increasingly becoming long-term storage (with operation times up to or longer than 100 years) due to lack of final repositories for these types of radioactive waste.

Basically all of these steps could be shared.

Already in 2006, the IAEA published a TECDOC on "innovative waste treatment and conditioning technologies at nuclear power plants" (IAEA 2006). These innovative strategies included the use of centralized processing facilities and the use of mobile treatment plants. Centralized processing facilities, esp. for high temperature treatment, were described as being technically advanced and therefore would require not only a high level of expertise among the personnel but also high financial investments, which would make it very difficult for small inventory countries (SIMS) to operate such facilities. The IAEA stated that its publication was not a source of new, previously unheard of technologies, but a review of what was already available.

Besides shared use of predisposal facilities and technologies, some countries show interest in sharing of final repositories for different types of radioactive waste.

In 2017, the Joint Project[3] conducted a survey among some EU member states that are or were formerly interested in a multinational disposal. The following states were contacted: Austria, Bulgaria, Czech Republic, Hungary, Poland, Romania, Italy, Slovenia, Denmark and the Netherlands (Mraz and Lorenz 2023).

The most important results were:

- Member states are looking for different types of multinational repositories. For example, Slovenia is only interested in a multinational repository for its spent fuel and high-level waste, while Austria hopes that a shared disposal for low and Intermediate level waste might be realized somewhere abroad.
- To some countries, not only shared repositories but also shared conditioning facilities would be of interest.

The national waste management programmes of EU Member States (based on Directive 2011/70/Euratom) show that a number of countries are seeking shared final disposal solutions.

In its implementation report of 2019, EC reported that from those who declared interest in shared solutions, "[h]owever, none of the Member States has reported concrete plans or activities towards implementation of the shared disposal solution. Moreover, discussions on the shared disposal solution are jeopardized due to the fact that most Member States have forbidden by law import of radioactive waste into their territory" (EC 2019a, p 35).

The last sentence deserves particular attention, since countries are trying to find a solution which is legally impossible(!).

Five years later, the EC Report of 2024 states: "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." (EC 2024a, p. 16) "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 Members States, including some which are considering shared solutions." (EC 2024a, p. 13)

[3] https://www.joint-project.org/

The following table shows the policies for radioactive waste import and shared disposals.

Table 1: Policies for radioactive waste import and shared disposals (EC 2024b)

	Import for disposal	Shared solution for disposal
AT	Not prohibited nor authorised	Option
BE	Decided[10]	Not considered/ discarded
BG	Prohibited	Option
CY	Prohibited	Option
CZ	Prohibited	Option
DE	Not indicated	Not considered/ discarded
DK	Not indicated	Option
EE	Prohibited	Not considered/ discarded
EL	Prohibited	Not considered/ discarded
ES	Not indicated	Not considered/ discarded
FI	Prohibited	Prohibited
FR	Prohibited	Not considered/ discarded
HR	Prohibited	Option
HU	Not indicated	Not considered/ discarded
IE	Prohibited	Not applicable
IT	Not indicated	Option
LT	Prohibited	Not considered/ discarded
LU	Not prohibited nor authorised	Decided[9]
LV	Prohibited	Option
MT	Prohibited	Option
NL	Not prohibited nor authorised	Not considered/ discarded
PL	Prohibited	Option
PT	Prohibited	Not considered/ discarded
RO	Prohibited	Not considered/ discarded
SE	Not prohibited nor authorised	Not considered/ discarded
SI	Not indicated	Option
SK	Prohibited	Option

Out of 27 EU member states, Luxembourg already operates a shared solution with Belgium (see chapter 4.2). 12 other countries see shared solutions as an option in their national waste management programs.

Interesting is that, according to this EC report, the Netherlands do not see shared disposal as an option, while the waste management organization of the Netherlands, COVRA, manages the ERDO Association; and another organization from the Netherlands, TNO, is a member of ERDO.

When the two quotes of the EC reports form 2019 and 2024 are compared, it seems that nothing has changed in the last years. Summarizing, many states in Europe are setting their hopes on a multinational repository rather than starting their own reliable national plans. But so far, the multinational repository might serve as a loophole at best, but not as a serious option.

5 Status of activities and projects

This chapter offers an overview of already ongoing sharing of activities, and of shared solution projects that are being developed.

5.1 Shared responsibility between Slovenia and Croatia for spent fuel and radioactive waste from NPP Krško

The NPP Krško was built as a joint venture of Slovenia and Croatia and went into operation in 1981. After the breakup of the former Yugoslavia and after some legal dispute, both republics now hold 50% of the ownership. And with this comes a shared responsibility for all spent fuel and radioactive waste from NPP Krško. This is also recognised in Directive 2011/70/Euratom, where the waste and spent fuel of the existing Krško nuclear power plant is not in the scope of Art 4(4)[4], when it concerns shipments between Slovenia and Croatia.

In the EURAD programme, work package ROUTES, this shared responsibility was researched in a case study. (Železnik et al. 2021) An intergovernmental agreement was adopted in 2001 and came into force after ratification of both Parliaments in 2003. An Intergovernmental Commission was installed as main body for decision-making. A part of the intergovernmental agreement concerns decommissioning and waste management:

- Parties agree to provide an effective joint solution for the decommissioning and disposal of spent fuel and radioactive waste from an economic and environmental point of view.
- Two programmes were set up: First, a programme for spent fuel and radioactive waste disposal, including proposals for the possible division and takeover, acceptance criteria for the disposal and assessment of the necessary financial resources, and deadlines for implementation and revised at least every five years. Second, a decommissioning programme which includes the management of all waste generated during the decommissioning, until their removal from the Krško site, an estimate of the necessary financial resources and deadlines for its implementation, revised at least every five years.
- The location of Krško may be used for temporary storage of spent fuel and radioactive waste for the rest of its lifetime.
- If parties do not agree on a common solution for the disposal by the end of its regular lifetime, they shall undertake removal of radioactive waste and spent fuel from the Krško site no later than two years thereafter, each half.
- Financing of the costs of the preparation of the decommissioning programme, the costs of its implementation, as well as the costs for the radioactive waste and spent fuel disposal programme shall be shared in equal parts. (Železnik et al. 2021)

[4] Directive 2011/70/Euratom Art 4(4): Radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement, taking into account the criteria established by the Commission in accordance with Article 16(2) of Directive 2006/117/Euratom, has entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them.
Art 2(3): Article 4(4) of this Directive shall not apply to: (c): he waste and spent fuel of the existing Krško nuclear power plant, when it concerns shipments between Slovenia and Croatia.

An evaluation of the history of this shared NPP (Tomšić 2021) shows a long list of topics that need to be addressed and settled; these topics would also be of relevance in case of shared disposal facilities:

- What has to be included in the costs that need to be shared? For example: Does this include costs for compensation of host community?
- Should economic benefits for the host region be accounted for? And if yes, how?

Železnik (2021) analyzed hat the co-ownership of the NPP Krško in general functions well. But she criticises shortcomings of transparency and participation in the management of radioactive waste. The Intergovernmental Commission did not function well because after each election its members changed; it would be better to professionalize the responsible body.

5.2 Luxembourg's radioactive waste is managed by Belgium

Luxembourg produces a very small amount of radioactive waste. The volume of conditioned waste transferred to Belgium so far amounts to a total of 0.51 m^3. On the basis of a conservative estimate, the volume of conditioned waste is expected to be less than 2 m^3 in the next 30 years. (ARTEMIS 2018)

According to the national waste management programs of Luxembourg and Belgium, in 1990, the two countries made an agreement for the treatment of Luxembourg's radioactive waste in Belgium. (Direction de la Santé 2015,Kingdom of Belgium 2015) This agreement was renewed in 1992 and 1994. Since 1994, the Belgium waste management organization ONDRAF/NIRAS was allowed to take over every year the radioactive waste from Luxembourg but only up to a limit of 0.1 m^3.

After Directive 2011/70/Euratom came into force, this agreement had to be renewed; it was set up in 2016 (Belgium and Luxembourg 2016). The new agreement regulates all steps of management of radioactive waste from Luxembourg in Belgium, including final disposal. Between 1995 and 2010, about 0.5 m^3 of radioactive waste were shipped to Belgium; this waste was also included in the agreement. The agreement entered into force in 2019, after both Luxembourg and Belgium had each approved a respective law[5]. In its last Joint Convention report, Luxembourg informed that negotiations are still ongoing on the practical modalities. (Direction de Santé 2025)

The agreement reserves in Art. 3 the right of Belgium to refuse any radioactive waste from Luxembourg for final disposal. In total not more than 30 m^3 of radioactive waste from Luxembourg will be managed in Belgium (Art. 5). Luxembourg has to pay all present and future costs (Art. 7). (Belgium and Luxembourg 2016)

[5] Law of 6th June 2018 approving the Agreement between the Grand Duchy of Luxembourg and the Kingdom of Belgium on the management and final disposal of radioactive waste from the Grand Duchy of Luxembourg on the territory of the Kingdom of Belgium (Direction de la Santé 2025)
Law of 10 March 2019 giving assent to the Agreement between the Kingdom of Belgium and the Grand Duchy of Luxembourg on the management and final disposal of radioactive waste from the Grand Duchy of Luxembourg on the territory of the Kingdom of Belgium, done at Luxembourg on 4 July 2016 (Kingdom of Belgium 2020)

5.3 Slovakia: Treatment of foreign waste in the Bohunice RAW Treatment Centre

Since 2013, foreign low- and very low-level waste has been treated in the Bohunice RAW Treatment Centre operated by state-owned company JAVYS, a.s.., amongst others the waste was incinerated there. The waste came from Czech Republic, Germany and Italy.

Michal Daniška from the Slovak Civic Initiative Chceme zdravú krajinu (We want a healthy country) informed about this case in the EURAD and EURAD-2 programme. (Daniška 2021, 2026) The main problem with this treatment of foreign waste was the lack of transparency and participation: the facility had been allegedly installed as a purely national facility when starting operation in 2000.

The contract of JAVYS with the Italian company SOGIN from 2015 covered 800 tons of resins and 65 tons of sludges from the shut-down Caorso NPP. In 2018, during a corresponding Environmental Impact Assessment (EIA), JAVYS justified construction of a second incinerator by citing an expected increase in Slovak combustible radioactive waste production, with no mention of the foreign waste as the key factor, this information being absent from public EIA documents. Municipalities approved the second incinerator on condition that no foreign waste would be incinerated there, a condition JAVYS accepted in this EIA process. (Daniška 2026)

The public only found out by then on the incineration of foreign waste and protested.

Documents obtained later proved the preconditioning line and second incinerator (with a rotary kiln, unlike the first incinerator with the shaft furnace) had been built specifically for the Caorso waste. In 2021, the Slovak Parliament approved a bill[6] banning future contracts for incinerating foreign waste, but this did not affect the contracts made before. In May 2022, after commissioning of the second incinerator, following another EIA process the restriction forbidding foreign waste incineration in the second incinerator expired, and the incineration limit doubled to 480 tons/year. Slovak domestic incineration dropped by approx. 50% in 2021-2022, resuming at higher volumes only once all Italian waste was incinerated by mid-2023. (Daniška 2026)

In December 2023, all four transports of the products resulting from processing the Caorso waste have been re-shipped to Italy according to JAVYS.[7]

By the way: first, the Caorso waste was treated from 1990 bis 1997 in Austria by the waste management organisation NES. About 800 tons were incinerated. After an intervention of the Austrian Government, the rest was sent back to Italy. (Daniška 2026)

This case study is an example of a commercial activity in radioactive waste treatment where the waste is first shipped to a country to be treated and transported back afterwards. Each shipping of radioactive waste to another country has impacts caused by transports and treatment activities. Even if these impacts are low, the risk of accidents is increased. And if the public is not informed correctly about this activity, and if there is no adequate public participation, trust will be lost. This will also have impacts on other nuclear project in this country. Especially for

[6] https://www.nuclear-transparency-watch.eu/activities/radioactive-waste-management/slovak-parliament-approved-a-bill-to-ban-future-contracts-for-incineration-of-foreign-radioactive-waste-according-to-the-slovak-ntw-members-some-concerns-still-remain.html

[7] https://www.javys.sk/en/information-service/news-press-release/press-releases/2078-processed-italian-radioactive-waste-transported-back-to-italy, seen 06.07.2026

the site selection for a final repository, public trust is a prerequisite. If trust is lost, it might not be possible to restore it.

5.4 ERDO - Association for Multinational Radioactive Waste Solutions

The Working Group of the European Repository Development Organisation (ERDO-WG) was founded in 2009. The ERDO-WG was, according to its description on the website[8], a multinational working group, whose members were nominated by the respective governments, established to study the feasibility of setting up a Development Organisation (ERDO) that would implement one or more shared geological repositories in Europe. Additional goals were defined as exchanging information, building up competence and promoting the concept of shared repository development as a complement to the national facilities being developed. The ERDO-WG was managed by the national waste agency of the Netherlands, COVRA, and the Arius Association

While the ERDO-WG a few years before 2017 had ten members (organizations from Austria, Ireland, Netherlands, Poland, Slovakia, Bulgaria, Italy, Lithuania, Romania, Slovenia) this list shrank to eight participants after 2017: Austria, Croatia, Denmark, Italy, Netherlands, Norway Poland and Slovenia[9]. According to information from the Polish Ministry of Energy in 2018, Poland has left the ERDO-WG "due to lack of progress of its work". Romania was a founding member, but it switched to observer status arguing that the ERDO-WG was not operated by a relevant international organization. (Mraz and Lorenz 2023)

In 2021, the ERDO-WG was transformed into the ERDO association[10]. The following waste management organisations are members of the ERDO association:

- ARAO, Slovenia
- COVRA, the Netherlands
- Dekom – Danish Decommissioning, Denmark
- ENEA, Italy
- Fond-NEK, Croatia
- NES, Austria
- NND, Norway
- ONDRAF-NIRAS, Belgium
- TNO, The Netherlands

One goal of both ERDO-WG and ERDO Association is the acquisition of funding for projects. In its 2024 annual report, two ERDO projects are listed: an ERDO-USDOE SMR Study and the MIRA project. The SMR study was funded by US Department of Energy (DOE). The ERDO website informs about this study as follows: "Using credible SMR designs and hypothetical, but representative, countries, the study explores the potential impact of SMR deployment on opportunities for realizing multinational RWM and DGR collaboration."[11] ERDO wants to

[8] http://www.erdo-wg.com/
[9] http://www.erdo-wg.com/
[10] https://www.erdo.org/
[11] https://www.erdo.org/could-a-multinational-approach-to-radioactive-waste-disposal-accelerate-smr-deployment-and-facilitate-a-nuclear-renaissance/; MR = multinational repository, RWM = radioactive waste management, DGR = deep geological repository, SMR = small modular reactor

encourage SMR vendors to develop relationships with potential providers of multinational repositories – a highly theoretical partnership idea, as there are no licensed SMRs in the EU yet, and ERDO as the only organization who wants to establish multinational repositories still has a very long way to go. And the MIRA project was reported as being slowed down due to possible overlaps with other projects.

In conclusion, there do not seem to be many ERDO activities ongoing. The website of the ERDO Association mainly provides outlooks on possible future activities or informs about pending projects. The last meeting that is reported was in 2022. Efforts to raise funds for extensive projects were obviously not successful; parallel activities from MIRA or the EC's pilot project result in a waiting position for ERDO

In the activities of ERDO-WG and ERDO Association until now, transparency and public participation play only a marginal role. In an ERDO-WG strategy document only one sentence on this issue is included: "The essence of any successful siting programme is that it is consensual and inclusive from the outset and all aspects of the repository project are transparent. The process must allow for active inclusion of local communities at all stages." (ERDO-WG n.d.) ERDO does not have any concept how to design active inclusion, or how to reach a consensus.

5.5 European Commission's Pilot Project

Based on a recommendation from the European Parliament, the European Commission (DG ENER) decided in 2023 to carry out a pilot project on shared solutions ("Proposal for a Joint European Approach toward Radioactive Waste," or "Pilot Project").

Publicly available information about this project is scarce. In a 2023 presentation, Gianfranco Brunetti of DG ENER described the pilot project as a first step; if it is successful, it is intended to lead to a "preparatory action." The project is to be carried out in the form of a feasibility study for a deep geological repository for joint European use.

During a EURAD Lunch & Learn session on September 4, 2025, Máté Kukovecz of DG ENER gave a brief presentation on the project[12]. Lunch & Learn is a one-hour online event organized as part of the EURAD and EURAD-2 programs, which is open to anyone interested. This is what Mr. Kukovecz reported:

In the first phase, which is the Pilot Project, two subprojects were put out for bid simultaneously in 2024:

1. Knowledge Compendium
2. Consultation Process

The project budget totals 1 million euros. The projects will last 18 months and are expected to be completed by the end of 2025.

The "Knowledge Compendium" component has already been formally completed in autumn 2025. All results were promised to be accompanied by reader-friendly explanations and published on the EC's website. Member states will be encouraged to publish these findings as

[12] https://www.ejp-eurad.eu/events/lunch-and-learn-session-pilot-project-joint-european-approach-towards-radioactive-waste

well as part of their national waste management programs; also, EC non-member states Norway and Switzerland are involved in this effort.

The “Consultation Process” section is more extensive than the “Knowledge Compendium” section. The first phase until March 2025 was used for preparatory work, including surveys sent to EU member states. Member states were invited to participate or observe.

During an initial workshop held on March 3–4, 2025, a position paper was discussed, a stakeholder group and a steering committee were established, and four work packages were defined. Phase 2 was held in 2025, during which these four work packages were being carried out:

- A forum for policymakers from EU member states to explore joint options for radioactive waste disposal
- Transparent communication and effective participation by the public and civil society
- Removal of political and administrative barriers to create a fully functional and efficient European market
- Structures for multinational radioactive waste management systems

A second workshop on this topic was held in November 2025.

During his presentation at the EURAD Lunch & Learn webinar, Máté Kukovecz said that the biggest political barrier to a shared repository was public resistance. When asked about ideas proposed so far to reduce public resistance, his answer focused exclusively on raising awareness and disseminating information and possibly conducting surveys as well. When asked whether civil society would be invited to the second workshop in November 2025, he declined. He also noted that it had not yet been decided whether the results of the “consultation process” component of the pilot project would be published at all.

During the ASTRA work package in EURAD-2, further information was given[13] that a Forum on Joint Approaches to Radioactive Waste Management (FoJARM) was founded as a discussion platform for policy makers. This should ensure the continuation of the Pilot Project. This Forum will strive to get a DG ENER funded secretariat while the main work should be done by member states as in-kind contribution; case by case project funding should be possible.

No further outcomes of the Pilot Project are known as of yet (June 2026).

One of the problems that have plagued this shared solutions initiative from the very beginning is a substantial lack of transparency and insufficient public participation. Time will tell which ideas were developed by the work package on “transparent communication and effective participation by the public and civil society”, and – more important – time will tell if the implementation of interaction with civil society will fulfill the Aarhus Convention and will start soon enough to enable effective participation at all.

5.6 OECD/NEA project MIRA

MIRA is short for Multinational Infrastructure for Managing Radioactive Waste. The MIRA project aims to identify countries that have specialized facilities for pre-disposal and/or disposal and

[13] Information from Leon Kegel 26.09.2025

have the capacity to handle more than their own national waste volumes. (McCombie and Chapman 2025)

The following information on the MIRA project was provided during EURAD-2[14]: This project by OECD/NEA started in 2023. Its goals are collaboration to explore the creation of multinational repositories and to optimize countries' capacities and facilities for the safe disposal of radioactive waste. Members of MIRA should be the members of the ERDO association and waste management organizations. In Sept 2025 it was not clear how the Pilot Project (see chapter 4.6) and MIRA could cooperate. A NEA expert working group was proposed to make a project proposal with a planned start in April 2026.

There is no new information available as of yet (June 2026).

5.7 Chandler project by company Tellus

The Australian company Tellus makes a big promise on its website: "The Chandler facility will be a world first multi-national geological repository, located 120 km south of Alice Springs in the Titjikala region."[15] This planned final repository shall be built in an 800 m deep salt deposit.

Nate Smith, CEO of Tellus, introduced the project in an EURAD-2 ASTRA workshop in 2025. He made a key point of highlighting that the indigenous community owning the land agrees to the project. This is also mentioned on the Tellus website: "In October 2023, the project gained the support of the Native Title Party and the NT Central Land Council."

Tellus does not have the necessary licenses yet.

According to media reports, the project has been given approval to receive up to 400,000 tons per year of hazardous material over 25 years, from both Australia and "strategic Pacific partners" overseas. This would include low-level radioactive waste and naturally occurring radioactive materials.[16]

Declassified Australia, an investigative Australian media project, criticised in 2025 that Tellus in the 2017 Environmental Impact Assessment only mentioned plans for the final disposal of NORM waste up to exemption level. But Tellus later describes the facility as suitable for low-level waste.[17] Declassified Australia further informed: "Native title holders entered into an agreement under circumstances where the median weekly personal income in Titjikala is just $273, compared to $936 for the NT as a whole, and where successive racist government policies such as compulsory income management make many Indigenous communities heavily dependent on mining royalties."[18]

This confirms a major concern of critical NGOs working on nuclear issues, that nuclear waste repositories will be constructed in marginalized areas with high economic pressure and low democratic standards, if the public is not alert and careful to prevent agreements under economic pressure.

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[14] Information from Leon Kegel 26.09.2025
[15] https://tellus.com.au/project/chandler/
[16] https://www.abc.net.au/news/2023-11-04/native-title-holders-support-toxic-waste-facility-alice-springs/103048570
[17] https://declassifiedaus.org/2025/07/08/disruption-pathway-to-nuclear-dump/
[18] https://declassifiedaus.org/2025/07/08/disruption-pathway-to-nuclear-dump/; NT = Native Title

6 Possible advantages and unsolved issues of shared solutions

There are not many shared solutions projects ongoing in the European Union as of yet. Most have been described in chapter 4.

The examples from chapter 4 give a first highlight on problems that are plaguing shared solutions project and plans: Lack of transparency, wrong information of the public, lack of public participation, political differences between countries complicating their cooperation, legal restrictions like import and export bans for radioactive waste and lack of knowledge, experience and resources which is especially of relevance for countries with small inventory.

This chapter analyses unsolved issues but also possible advantages of shared solutions in more depth.

6.1 Unsolved issues

Safety and security standards

The Nuclear Waste Directive 2011/70/Euratom defines in Article 4 (4) that member states have to assure prior to any shipment that the country of destination have a radioactive waste management program and respective disposal facilities that are managed representing a high level of safety equivalent to those established by the Directive itself. But EU member states do have different safety criteria, for example different dose limits for members of the public from final repositories (10 µSv/a to 300 µSv/a). It is therefore up to interpretation, what "high level of safety" exactly means. For civil society it is important that the highest level of safety will be chosen for shared disposal facilities. This approach would best recognize the precautionary principle. Moreover, different legally established limits might result in obstacles for export of radioactive waste, if the receiving country has lower safety standards.

This will also be true for the highest security standard. It is a known problem for final repositories that future generations might advertently or inadvertently intrude the repository by drilling activities. Some countries like Finland chose not to mark their final repository, while other countries are still considering marking the site and keeping memory to hinder inadvertent intrusion. The question remains which concept will be taken upon for a shared repository and who will decide about this. There are no guidelines for long-term security in Directive 2011/70/Euratom.

In this context, the question of whether a shared final repository will allow for retrievability and recoverability also needs to be solved. National final repository concepts deal differently with this question; it will be important to find a common approach for a shared facility.

Transparency and effective public participation in decision-making

Both transparency and public participation are key in the management of spent fuel and radioactive waste. Legal instruments were established on international, EU and national level. On the concept level, national waste management programs under Directive 2011/70/Euratom have to undergo a Strategic Environmental Assessment (SEA), also transboundary, as they fall in the scope of both the UNECE SEA Protocol (UNECE 2003) and the EU SEA Directive 2001/42/EU. The instrument of SEA has been introduced to assess environmental impacts and to allow for legally secured public participation already at the early stage of concept level. But only a little

more than half of EU member states conducted a SEA for their national waste management programs (EC 2019b). Shared solutions are already included as an option in many national programs; a missing SEA therefore is a significant shortcoming in public participation. The next legal participation possibility would be an Environmental Impact Assessment (EIA), which needs to be conducted for a concrete project. There are no plans yet, how an effective transboundary participation of all stakeholders and the public in the case of a multinational shared disposal could be designed, especially when third countries outside EU might be involved.

In the EC's Pilot Project, transparency and participation of the public are missing altogether, and it is not sure if and when civil society and the public will receive information and will be involved in the debates. This is a serious shortcoming and does not fulfil current good practice standards of transparency and participation.

Radioactive waste disposal in times of War

Plans for sharing of final repositories can include bilateral, multinational and supranational options, involving only member states of European Union or also third countries. According to Directive 2011/70/Euratom, all of these options are open in principle when obligations of Article 4 are fulfilled. This would also include countries like Russia because it fulfils the condition to be a member of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The Joint Convention is an instrument of international law which is based on a peer system but does not foresee any penalties or sanctions. This is problematic. Directive 2011/70/Euratom does not foresee any types of political reasons for restrictions of shipments of radioactive waste and shared solutions. If radioactive waste has been exported to Russia for final disposal under certain conditions, these conditions might be no longer be intact in times of War.

Ultimate responsibility

Directive 2011/70/Euratom assigns the ultimate responsibility for spent fuel and radioactive waste to the member state where it is produced. The Directive regulates for shipments of waste to be processed or reprocessed in another country that the ultimate responsibility remains with the member state from where the waste was shipped. But it is not so clear when it comes to export with the intention of disposal in another country. How long will the ultimate responsibility lie with the exporting member state?

Legal issues of import and export

Many countries have forbidden the import of radioactive waste (see table 1 in chapter 3), some also have forbidden exports. Without changing these legal conditions, it will not be possible to either host a shared repository or to use a shared repository in another country.

Transport

Shared solutions will increase the transport of spent fuel and radioactive waste and by this will increase environmental burdens for the affected regions.

Compensations

If a municipality or region agrees to host a nuclear facility, it is customary to pay compensation. In case of a shared facility, new mechanisms have to be established for such compensation approaches; regions with higher transport burden will also have to be included.

Liability

Another open question is what will happen in case of an accident in a shared facility (including post-operation), who will be liable for the consequences? This has to be clarified.

Who wants to host a shared repository?

No country has stepped forward to offer to host a shared repository as of yet.

6.2 Possible advantages

Benefits of bilateral agreements for countries with very small inventories

The example of Luxembourg shows that it would need a disproportionate amount of resources (not only financial but personnel resources, contribution to research etc.) to manage its own radioactive waste, while on the other hand Belgium already has advanced infrastructure for waste management; Luxembourg can save resources by the arrangement the two countries have concluded. Such an arrangement might only work well for countries with a very small volume of radioactive waste, as this will not cause additional burdens on the public in the country that offers to treat and dispose of this waste. There are other EU member states (Cyprus, Malta, Ireland) with a very low inventory of radioactive waste comparable to Luxembourg.

SIMS can benefit from LIMS

Member states with small inventories (SIMS) often do not have the know-how and the resources of member states with large inventories (LIMS), especially compared to LIMS with an advanced nuclear waste management program accompanied by a dedicated research program. Such benefits can include predisposal and disposal sharing activities.

Costs

The ERDO Association argues that larger repositories will be cheaper, as economies of scale might reduce the unit costs for disposing of waste. Furthermore, ERDO expects host countries to have a significant income from the operation of a shared repository.[19] This is a speculative argument as of yet, because no final repository for high-level waste has started operation yet in Europe; therefore, the final costs are not known. It can be expected that the first deep geological repositories will all be first-of-a-kind as they might be built in different host rock and using different technologies. Nuclear projects are characterized nowadays by cost overruns, this might also be true for shared repositories, especially deep geological ones. It will be necessary to establish agreements on who will pay for cost overruns in a multinational collaboration.

[19] https://www.erdo.org/discover-the-benefits/

7 Conclusions and recommendations

Shared solutions are an umbrella term over all activities and projects in the management of spent fuel and radioactive waste that could be shared on a bilateral or multinational level. These activities include steps from predisposal of radioactive waste to final disposal of all types of radioactive material (like spent fuel) and radioactive waste.

There are not many examples of sharing yet. In the examples of shared solutions or projects describes in this report lots of unsolved issues become visible.

No country has stepped forward yet to offer to host a shared repository.

One of the most important unsolved issues is the **lack of transparency and public participation in shared solutions projects and concepts**. Not only the disposal of spent fuel and radioactive waste, but also treatment and transports have impacts. The risk of negative impacts on people and environment of all of these management activities will burden uncountable future generations. If the public is not informed correctly, and if there is no adequate and effective public participation, trust will be lost.

Directive 2011/70/Euratom defines that member states have to ensure that countries where they ship their radioactive waste to, have to have a high level of safety. But even EU member states do have different safety criteria; it is therefore **up to interpretation what "high level of safety" means**. For civil society it is important that the **highest level of safety** will be chosen for shared disposal facilities. This approach would best recognize the precautionary principle.

Future generations might advertently or inadvertently try to intrude repositories by drilling activities. Also, here the **highest level of security** needs to be implemented for shared disposals which includes a program to keep the memory of the site alive.

Questions of **ultimate responsibility** remain open, if the political situations change like for example if a country where radioactive waste has been exported to engages in a war. How long will the ultimate responsibility be with the exporting member state?

Many EU member states have legally forbidden import of radioactive waste, among them many countries interested in shared disposals.

Another open question is what will happen in case of an accident in a shared facility, who will be liable for the consequences? This has to be clarified.

These unsolved questions need to be solved first, especially when shared final repositories ae envisaged.

Shared solutions could have some **advantages**. Member states with **small inventories (SIMS)** often do not have the know-how and the resources of member states with large inventories (LIMS), especially compared to LIMS with an advanced nuclear waste management program accompanied by a dedicated research program. Such benefits can include predisposal and disposal sharing activities. This will be especially true for countries with very small inventory.

Costs are sometimes highlighted as advantage due to the economies of scale argument: bigger repositories can reduce unit costs. But it can be expected that the first deep geological repositories will all be first-of-a-kind as they might be built in different host rock and using

different technologies. Nuclear projects are characterized nowadays by cost overruns, this might also be true for shared repositories, especially deep geological ones. It will be necessary to establish agreements on who will pay for cost overruns in a multinational collaboration.

Recommendations for civil society work on shared solutions:

- Differentiation in the discussion on shared solutions between predisposal and disposal activities: sharing predisposal technologies and facilities could bring benefits contributing to safer radioactive waste management if a state that is advanced in its radioactive waste management can offer support to a state that does not have sufficient resources for a safe management.
- Development of national strategies for final disposal should be prioritized over waiting for shared disposal solutions as they are far from being advanced yet; long-term interim storage as the main alternative for final disposal, especially for high-level waste, comes with an increase of risk due to ageing materials, outdated designs and lower security features, and therefore is not the best option in the long-term.
- Projects like ERDO and the EC Pilot Project need to become transparent and engage in public participation from the beginning; interaction with civil society needs to be established on a robust level-
- Avoiding social and environmental dumping for multinational repositories is key. The promises of projects like Chandler in Australia need to be carefully monitored for possibly taking advantage of an economic weak region or population group.
- Engagement for phase-out of nuclear energy: the more spent fuel and radioactive waste is produced, the more repositories are needed, which increases the risk for people and environment for countless future generations.

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9 Glossary

EC	European Commission
EIA	Environmental Impact Assessment
EP	European Parliament
ERDO	Association for Multinational Radioactive Waste Solutions
EU	European Union
HLW	High level radioactive waste
IAEA	International Atomic Energy Agency
LILW	Low- and intermediate-level radioactive waste
LLW	Low-level radioactive waste
NEA	Nuclear Energy Agency
NPP	Nuclear power plant
RWM	Radioactive waste management
SEA	Strategic Environmental Assessment

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