



**Association for Multinational
Radioactive Waste Solutions**

The ERDO Association Roadmap

Routes to Shared Disposal Solutions in Europe

Version 1
September 2021

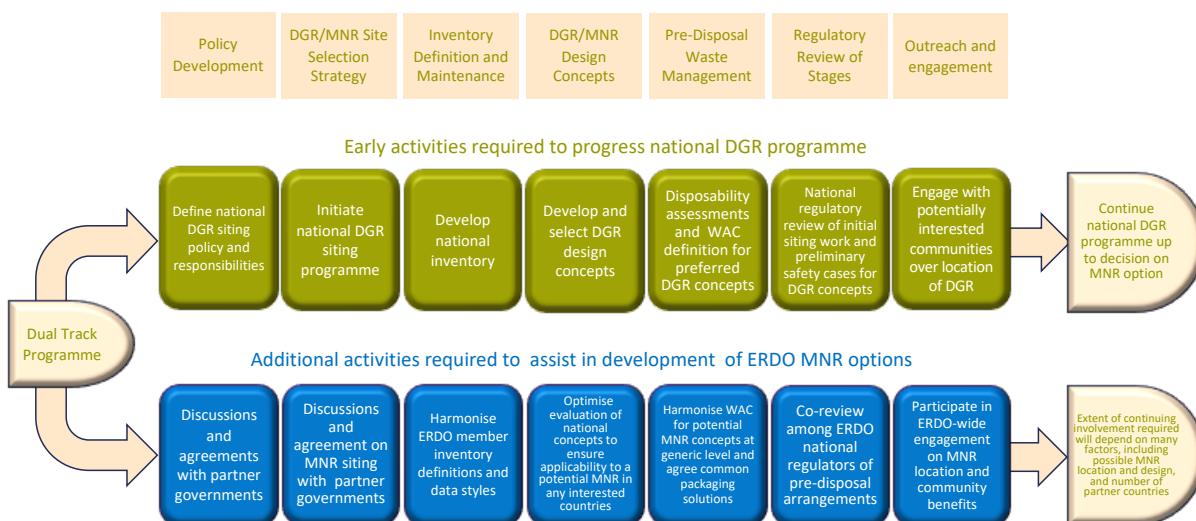
1 The ERDO Mission

The aim of the ERDO Association is to work together to address the common challenges of safely managing the long-lived radioactive wastes in our countries and to carry out the necessary groundwork to enable the establishment of one or more operational, shared multinational waste management solutions.

Our ultimate objective is to implement deep geological disposal in multinational repositories (MNR). A shared MNR might be implemented by ERDO member countries in Europe or an MNR might emerge elsewhere in the world that could be available to ERDO member countries, as a result of global initiatives in the future. Whilst maintaining active interest and links with initiatives outside Europe, the ERDO Association's principal aim and the objective of its work programme is the eventual development of one or more shared MNRs in Europe.

ERDO members follow the 'dual track' approach to geological disposal of their long-lived and higher-activity radioactive wastes. The dual track approach acknowledges that a shared, European MNR might not be achievable, that other MNR solutions might not emerge in a timely manner and that multinational options might eventually not be suitable to meet the specific requirements of a national programme. This means that each country must have its own, active, parallel, national programme that could lead to a deep geological repository (DGR) as an alternative to an MNR solution – hence the term 'dual track'.

In the period up to the point where a specific MNR solution becomes an alternative option, following the dual track approach does not require major additional resources over and above those needed for a purely national DGR programme – indeed, there can be savings made in several areas of pre-disposal management if shared solutions are available. However, it does require additional activities. These are shown schematically for each of the main areas of radioactive waste management activity in the graphic below: the green boxes indicate activities in a national DGR development programme and the blue boxes in the lower part of the graphic the additional activities required in a dual track approach.



2 Why is a roadmap needed?

It is clear that there are many potential routes towards MNRs and that much work of both a technical and strategic nature needs to be done to facilitate such solutions. It is acknowledged that, as with purely national disposal programmes aimed at implementing a DGR, it is likely to take many years to achieve an MNR and there is consequently adequate time to build the ERDO programme.

To facilitate planning and optioneering, a roadmap will act as a guide to develop the requisite activities and scope out the various routes that need to be explored – specifically, towards one or more shared MNRs in Europe.

The roadmap:

- provides a common basis for internal and external discussions;
- shows that there are routes to eventual shared disposal solutions;
- shows that there are alternative pathways to disposal, and different possible starting points;
- illustrates how the dual-track approach meshes activities within a national programme with activities in emerging MNR solutions.

3 Structure of the ERDO Roadmap

The ERDO Roadmap is a living framework to guide and manage our developing programme of work. This initial version of the Roadmap thus contains current activities and routes that are viewed today as being feasible and worth exploring. It is expected that these will all evolve with time.

This first version of the roadmap is consequently a high-level, conceptual framework to guide discussion. It comprises two parts:

- a pathways map, showing how ERDO activities will lie along two parallel paths;
- a series of roadmaps identifying and illustrating the issues, activities, decisions and possible outcomes that a dual track programme within ERDO will encounter, taken from three possible starting situations.

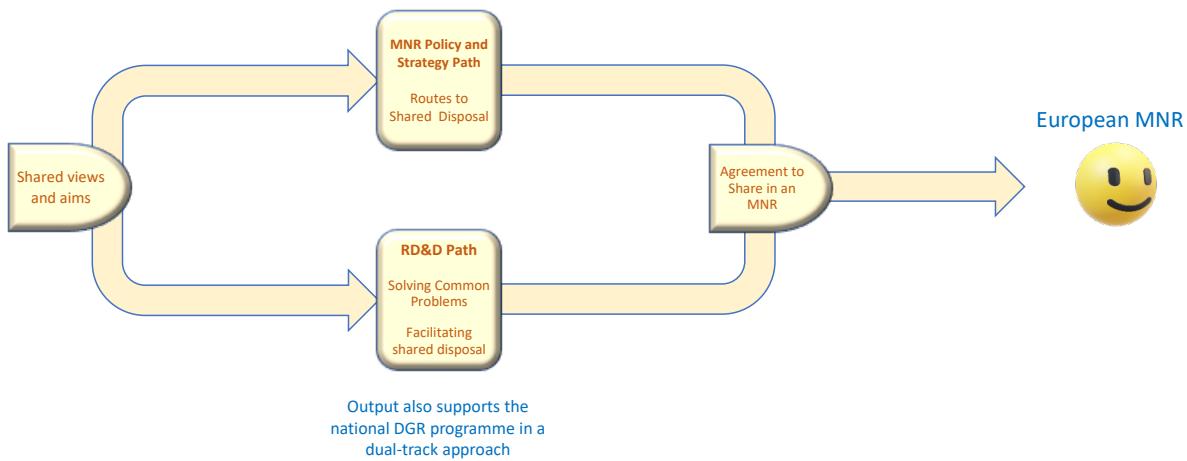
These are described in the following sections.

4 The twin pathway concept

ERDO perceives two main pathways that structure its work:

- Policy and Strategy Path: exploring and developing routes to a shared MNR;
- RD&D Path: solving common problems and thus facilitating shared disposal.

These two paths are illustrated in the graphic on the following page and the activities that are involved in each are then elaborated in more detail.



The **Policy and Strategy Path** aims to inform and bring together decision-makers, the public and concerned stakeholders so as to generate and facilitate the essential discussions that will be required if eventual intergovernmental and inter-stakeholder agreements are to be reached. The path involves activities such as:

- liaison between ERDO and governments or government agencies;
- liaison between ERDO and international organisations such as the IAEA and European Commission;
- facilitating direct government-to-government contacts and discussions;
- public and technical community outreach activities, to make the dual track approach and MNR solutions more commonplace.

It is planned to support these liaison and outreach activities with documentation, covering topics such as:

- Liabilities and responsibilities of MNR participants.
- Organisational structures and governance of a multinational WMO.
- Financing an MNR project.
- Benefits and risks of MNR solutions.
- MNR siting strategies.

The **RD&D Path** involves project work on topics that are of common interest, with the aim of facilitating shared RWM solutions in the shorter term and shared disposal in the longer term.

The concept of the RD&D Path is that there are similar issues facing smaller-inventory programmes where a common approach would improve efficiency and effectiveness, as well as facilitating adoption of shared disposal solutions. These include:

- harmonised WAC for similar facilities;
- a harmonised approach to the nature and level of waste characterisation;
- generic, transferable disposal concepts that could be applied widely without need for adaptation (e.g., a design concept for deep borehole disposal);

- demonstrators of novel disposal concepts;
- common conditioning and packaging technologies and standards.

Developments in these areas could mean that common standardised packaging and characterisation would meet common disposability requirements for a shared MNR.

Currently, ERDO has two active projects within the RD&D Path:

- **LWC Project:** Legacy Waste Characterization for streamlined disposability:
 - Surveying the main Legacy Waste streams in the interested countries and looking for similarities and possible WMF/Knowledge sharing.
 - Identifying the minimum set of WAC (physical-chemical-radiological) to be respected by legacy VLLW-LLW or ILW packages for envisaging possible re-treatment/reconditioning processes and disposability to a National or Multinational Disposal Facility.
 - Evaluating possible methodologies for quantitatively deriving the missing characterization data for the Legacy Waste streams.
- **Deep Borehole Disposal Project:** to describe one or more specific borehole disposal concepts, based on available (drilling) technology and the anticipated waste inventory of participating nations.

5 Different dual track starting points

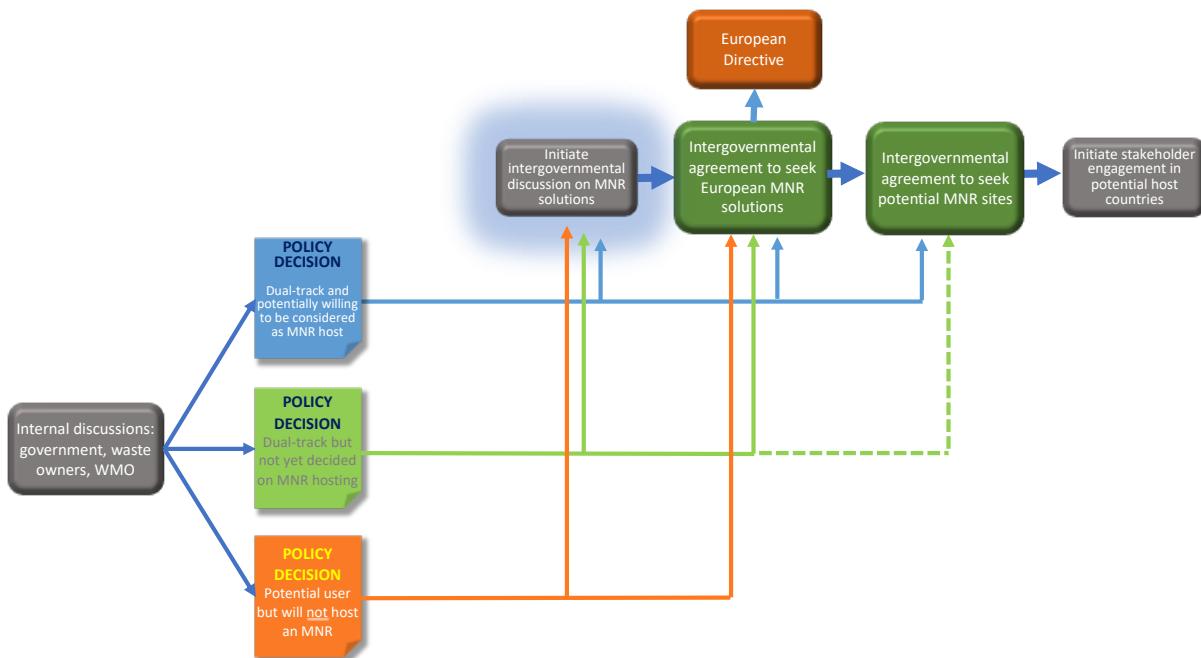
ERDO member countries have adopted different positions on how they will manage the dual track approach in their national programmes. At present, they fall into three broad categories:

1. National programmes that do not currently exclude the option of hosting an MNR.
2. National programmes that are currently undecided as to whether they could be willing to host an MNR.
3. National programmes that are interested in being part of a shared MNR project but have already decided that they do not want to be the host country.

Of course, the stance of any national policy could change in the future, moving member countries from one category to another.

Internal discussions about MNR solutions are required between the waste producers, waste management agencies and the government to define which is the appropriate category for a national programme. In many European countries, these discussions have not yet taken place and one of the ERDO Policy and Strategy Path aims is to help facilitate and inform such discussions in future. Most of the member countries of the pre-cursor ERDO Working Group lie in the second category.

Getting the process started from these different starting positions is one of the most challenging tasks that ERDO will take on in the coming years. The diagram on the following page illustrates the steps that are being evaluated.



The diagram indicates that the key early objective is to enable intergovernmental discussions. This is regarded as a major and essential step, for which the work of ERDO over the last decade has provided a firm foundation. It is expected that such discussions would be most effective if they were held at ministerial levels. All potentially interested countries would enter these discussions.

Two styles of agreement are suggested by ERDO for consideration:

- A general high-level intergovernmental agreement that the parties wish to work together to explore possible establishment of a European MNR. All three categories of country outlined above could enter such an agreement and be willing to support and resource MNR development projects, as potential users of a facility.
- A high-level agreement between two or more countries that they are prepared to initiate a joint programme of work on siting an MNR. Countries that have decided not to act as host would clearly not be expected to enter into this type of agreement.

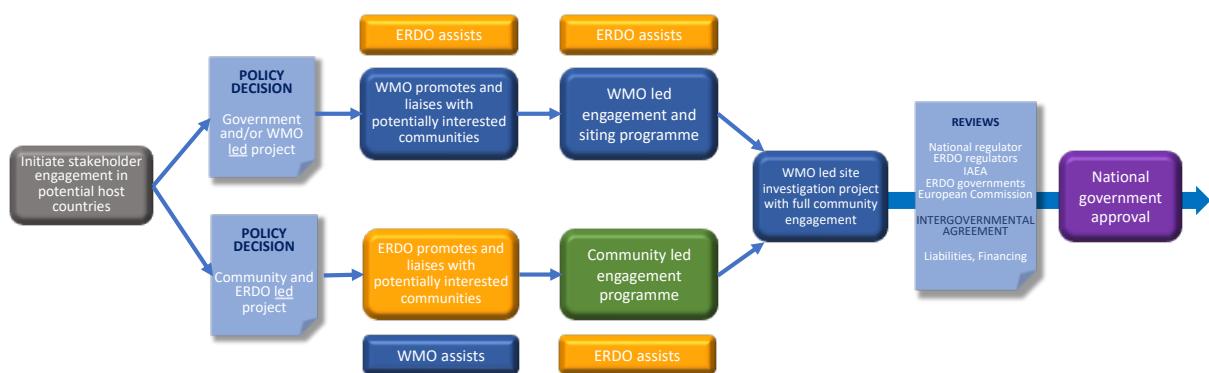
It is likely that these two types of agreement might be sequential – which is clearly a matter to be considered in preliminary intergovernmental discussions.

Following a high-level agreement to start considering MNR siting approaches and options, the next step would be to engage with stakeholders in the countries that are party to the agreement, in order to hear opinions and discuss how to proceed.

The European Waste Directive is indicated on the diagram because any intergovernmental agreements would be made within its framework, would have an influence on national reporting and would have a significant impact on the credibility of the dual track approach that is included within the Directive as an option for Member States.

6 Different MNR champions

At present, ERDO is considering two main models of how the stakeholder engagement mentioned above might lead into an MNR siting programme, once intergovernmental agreement in principle has been reached. The diagram below indicates how the two models might be developed.



In the first model (the upper pathway on the diagram) the process is similar to the approaches adopted by most countries for their national DGR programmes. A country that has agreed to be considered as a possible location for an MNR adapts its DGR siting programme as necessary to include the additional inventory, storage and transport requirements, with the work being led by the national WMO, acting within government policy and national regulatory guidelines.

ERDO (representing potential users, as well as the potential host country or countries) assists the WMO in its engagement programme with potentially interested communities and is involved in the siting programme up to the point of detailed site investigations.

In the second model (the lower pathway on the diagram), the process is led by potentially interested communities. Following an intergovernmental agreement to be considered as a potential location for an MNR, the siting programme is initially led by ERDO, seeking proactive communities that might wish to take an active role in promoting an MNR on the basis of the benefits that it would bring to them. If such communities emerge, they are invited to take a leading role in furthering the project, again up to the point of detailed site investigations. The national WMO assists ERDO and the communities involved and then takes on the site investigation work. At this point, the two models converge, with the WMO managing the detailed site investigations on behalf of ERDO and/or the community.

Clearly, there are many variants to these two models, as well as potential overlaps and crossovers. For example, both models would need to take account of the maturity and state of development of parallel national, dual track DGR projects in potential host countries, as well as the way in which these are designed and managed, especially with respect to community engagement.

In addition, there are several ways in which a shared project group (here, under the umbrella designation of 'ERDO') could be organised at various times along the two paths, which would affect its authority and capacity with respect to making contracts and managing projects. An

obvious matter for discussion is the extent to which, in either model, ERDO either manages or owns the MNR project, and its consequent interface with the national WMO.

The diagram also illustrates another key issue – that of review and regulation. An MNR project is expected to come under more intense scrutiny than a national DGR project – a process that is likely to, or would benefit from, the involvement of additional parties. For example, there is a potential review and oversight role for the IAEA, and it is likely that many aspects of how environmental safety regulation is managed would require agreement between the regulatory authorities in each of the user countries. For a major, first-of-a-kind European project involving several partner countries, it is likely that the European Commission would also take a close interest, in particular with respect to the Waste Directive.

The final point shown on the pathways, after a site is shown to be suitable and meets with approval from the review and regulatory processes, is agreement to go ahead with the project by the government of the country in which the MNR is to be located. This would certainly be done in consultation with the user country governments and is likely to involve a further intergovernmental agreement covering aspects such as liabilities and financial guarantees.

Discussion on all these matters will comprise a large component of work in ERDO's Policy and Strategy Path.

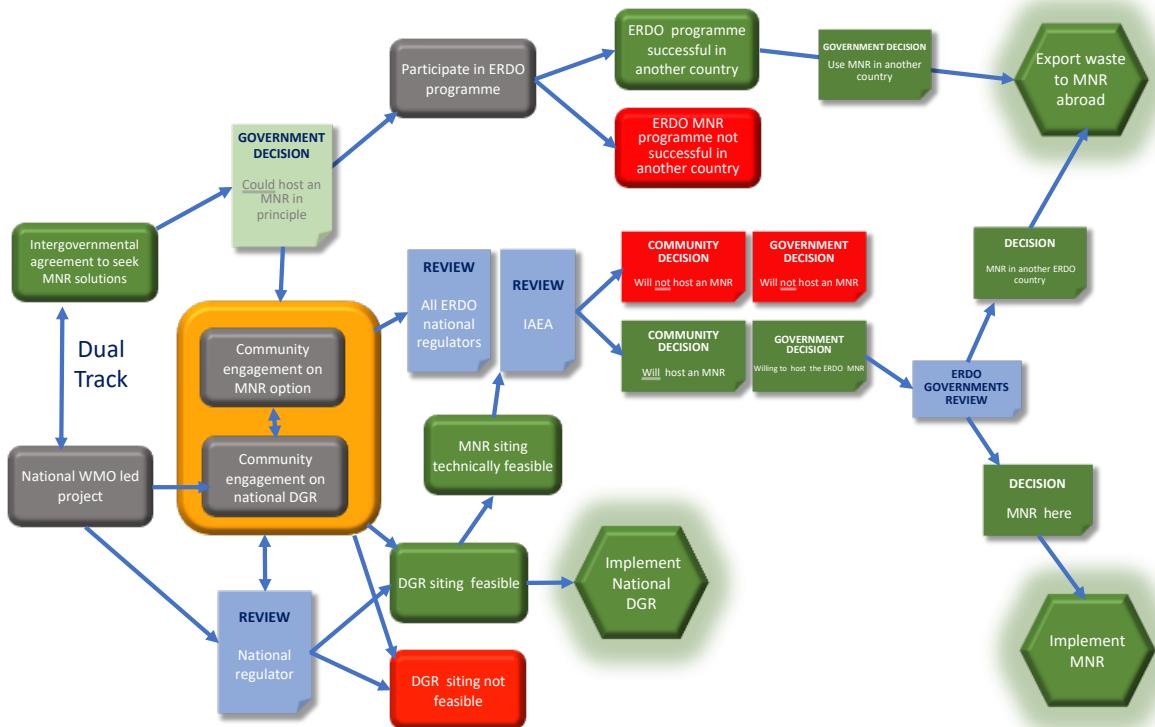
7 Routes to an MNR from different starting points

It is likely to be many years before an MNR in Europe could become operational and there will be many steps along the route. This part of the ERDO Roadmap illustrates some of the activities and decisions that will be needed, and some of the potential outcomes, starting at different points for countries that are at different stage in considering their involvement, as outlined in Section 5.

As will be seen, the role of communities in potential siting areas is a central factor that will control possible paths for a dual track country to reach a satisfactory solution for geological disposal of its higher activity, long-lived wastes – whether in a national DGR or an MNR.

Another overarching factor is the timeframe within which decisions will be required. ERDO considers that there is no urgency to make many of the decisions that will be seen on the example roadmaps in this Section. The only important decision that is needed in the short-term is an agreement between interested governments to co-operate on MNR project development and siting. In other words, for countries that have declared a dual track policy, then the critical step now is to agree to pursue the multinational option actively. This requires the type of high-level intergovernmental agreement discussed in Section 5. At present, ERDO members are agencies and organisations that are managing wastes within national programmes, acting with the knowledge and approval of their governments. Higher-level engagement to achieve intergovernmental agreement is the next key step, and the starting point for the paths through the roadmap.

The figure below shows the relatively well-constrained situation of possible routes to disposal for a country that has not yet decided on whether it would host an MNR but could be willing in principle to do so. The roadmap begins at the point where there has been an intergovernmental agreement to seek MNR solutions and where the country has an active national DGR programme under way. The core involvement of local communities is indicated by the gold lozenge.



The diagram shows three potential successful endpoints for the country's WM programme:

- exporting its wastes to an MNR abroad;
- implementing its own DGR;
- implementing an MNR in its own territory (assumed here to be an extension of what would otherwise be its national DGR).

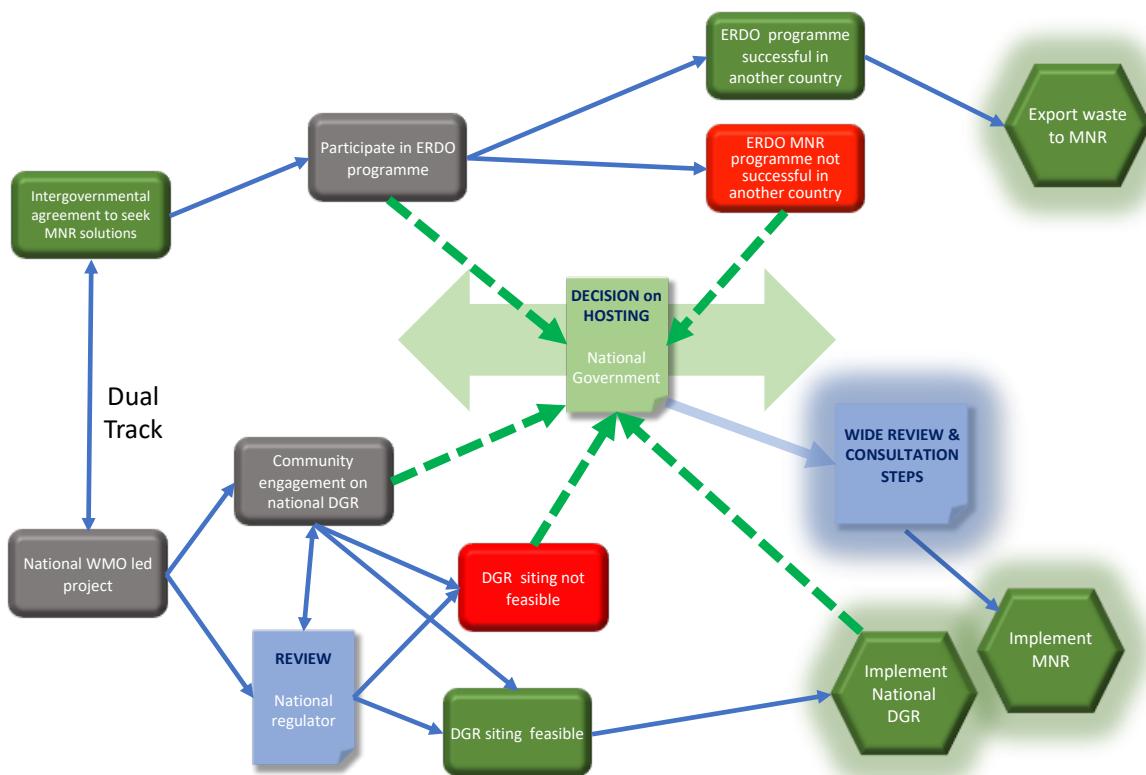
Potential 'dead-ends', requiring taking another route, are indicated in red. For example, should DGR siting not be feasible, for either technical or societal reasons (the lower red box), then this also excludes the possibility of hosting an MNR and leaves only the export route open.

On the other hand, if the national DGR is technically feasible and is agreed by a community, then this opens the possibility of developing it as an MNR. That this would require extensive community discussion, followed by both community and various regulatory agreements and successful reviews, is indicated in the earlier stages of the roadmap.

Somewhat later there would need to be a government decision to go ahead with developing the MNR (as discussed in the previous Section). This would then be followed by a decision from the potential users that they wish to go ahead. The optimistic possibility that there might be more than one European MNR project is indicated – in which case, there would need to be decisions by all parties as to whether to go ahead with more than one project and a decision by the country considered here on which route to take.

Overlain on this (and the following) roadmap, but not indicated, is the possibility that a dual track country might be able to make use of a 'third-party' MNR outside Europe and the ERDO programme, provided as a service by another country.

The second roadmap shows the situation where a country that has not yet reached the point of deciding whether it might be willing to host an MNR. The diagram is essentially a blurred version of the previous roadmap, illustrating the point made earlier, that there is a wide potential window for taking many of the decisions that will be required.

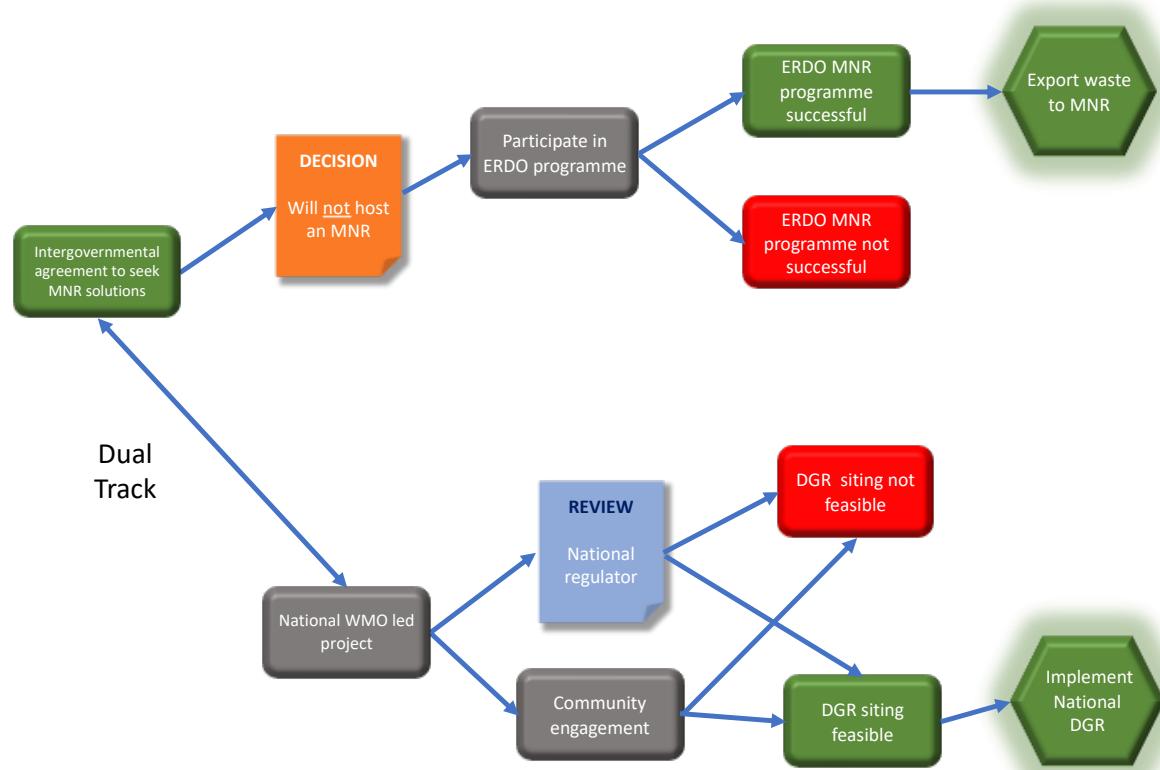


The main point being made by this diagram is that, having made an intergovernmental agreement to seek multinational solutions, a subsequent decision on whether to be considered as a possible MNR location (the green box in the centre of the diagram) can be influenced by many factors (green dashed arrows). These include 'forcing factors', such as no other MNR possibility emerging, leaving the country as perhaps the only option – which could drive a possible decision to act as host – and the situation where the parallel national DGR programme is unsuccessful – meaning that it would not be possible to host an MNR.

On the other hand, if the national DGR programme proves to be successful, then a 'late' decision might be made to offer the facility as an MNR to other partners in the ERDO sharing programme (and, possibly, other users), provided it were technically feasible to extend it and there were to be community agreement. This is indicated by the two endpoints being directly adjacent to each other on the roadmap.

The wide range of review and approval stages that were discussed in the previous roadmap are not elaborated here, but are indicated simply by the right-hand blue box.

The final roadmap shows the more straightforward situation of a country that is interested in being part of a shared MNR project but has already decided that it does not want to be the host country.



A decision point that would be common to all the roadmaps concerns the relationship between the national DGR project and the success of an MNR alternative in another country. With the emergence of a successful MNR option in another country, the question would arise as to when to terminate the national DGR programme and the dual track approach. Deciding when and how to make this decision would be a key strategic matter for any national RWM programme.

It is also clear that any decision to be considered as a host or not could be reversed at any stage in the multiyear process of MNR implementation.