

IGD-TP Member Experience of the Relationship between Early Programme Stages and Site Selection and R&D Programmes



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The IGD-TP

- ▶ Dedicated to initiating and carrying out European strategic initiatives to facilitate the stepwise implementation of safe, deep geological disposal of SF, HLW and other long-lived radioactive waste
- ▶ Launched on 12 November 2009 by the European Commission and Waste Management Organisations (WMOs)
- ▶ Now solely funded by the 12 WMOs and organisations responsible for implementation-related RD&D who form the Executive Group (EG)
- ▶ The IGD-TP welcomes membership from all interested parties endorsing the IGD-TP Vision and willing to contribute positively and constructively to the group's goals
 - Currently 142 member organisations across 29 countries



Implementer Progress

- ▶ Our first vision:
'to have the first geological disposal facilities (GDF) for spent fuel, high-level waste and other long-lived radioactive waste in operation by 2025' (Vision 2025)
- ▶ Major progress has been made towards achieving our Vision 2025:
 - POSIVA has a construction licence and plans to submit its operation licence application in 2020/21
 - SKB submitted its construction licence application in 2011
 - ANDRA expects to follow in 2021



Moving closer to realising our Vision 2025!

Vision 2040

- ▶ In order to meet the challenges of the next phase we have updated the group's vision
 - Announced at our 10 year anniversary in November 2019
 - Vision has a slightly broader remit, reflecting the needs of small inventory member states who may be considering shared repositories and/or mined borehole disposal

2040 – Towards industrialisation of radioactive waste disposal in Europe

Safely operate

the first geological
disposal facilities
in Europe

Optimise & industrialise

planning, construction
and disposal
operations

Tailor solutions

for disposal of
the diverse waste
inventories in Europe

IGD-TP objectives and how to meet them

▶ What:

- A forum for discussion of RD&D issues and priorities
- A means for sharing RD&D information and results, including information and experience on RD&D planning and management
- A mechanism for co-ordinating RD&D on topics of shared interest between programmes and groups of organisations

▶ How:

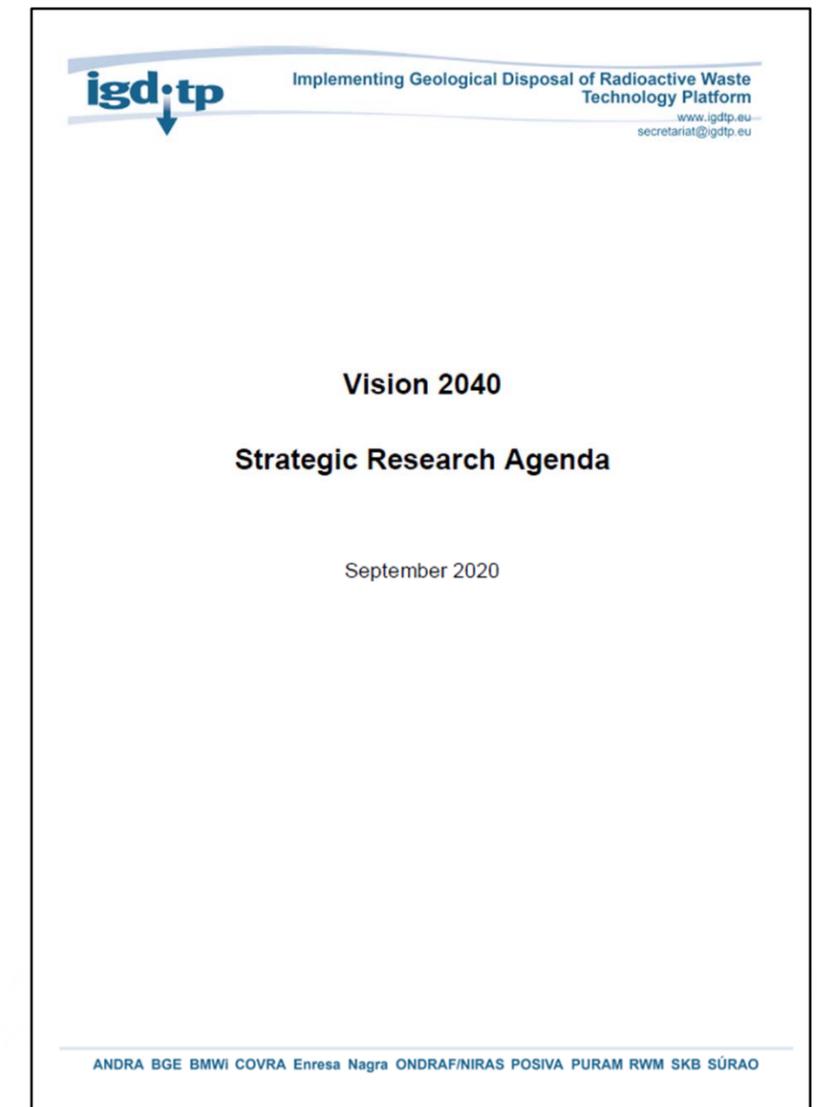
- Pooling of critical European resources and preparing co-ordination of future projects
- Secure finances for implementation of the agreed strategic initiatives
- Foster knowledge management / development and transfer
- Contribute to the availability and maintenance of critical masses of resources for RD&D of technology as well as networks for knowledge management, education and training
- Identify areas in strategic knowledge or know-how that can be covered by concerted actions
- Create synergies with other international organisations and European initiatives

Benefits

- ▶ Competence building
- ▶ Joint work and use of resources
- ▶ Joint work on strategies
- ▶ Knowledge transfer

Shared research interests – our Strategic Research Agenda

- ▶ Considerable scientific and technological knowledge base
- ▶ Sufficient and appropriate robust knowledge base to facilitate licensing and construction of geological disposal facilities
- ▶ Vitally important to maintain, enhance and increase knowledge throughout incremental development, operation and eventual closure of disposal facilities, which will be spread over many decades
 - Underpinning knowledge base
 - Human resources and infrastructure
 - Flexibility to address arising stakeholder concerns
 - Continuous improvement



2020 Strategic Research Agenda

- ▶ 2020 SRA highlights main RD&D needs common to multiple WMOs
- ▶ Identifies main RD&D issues that needed a co-ordinated effort in order to realise our ‘Vision 2040’
- ▶ Also provides valuable input to identifying topics for future EURATOM calls
- ▶ Comprises 9 key topics and various cross-cutting activities

Stages of repository development

	Generic studies and concept development	Selection of host rock and site	Technology development and repository design	Technology development and repository construction	Industrial-scale manufacturing and repository operation
Safety strategy and methodology	Development of safety assessment methodology	Application of methodology in safety case and improvement of methods	Application of methodology in safety case and improvement of methods	Application of methodology in safety case	Application of methodology in safety case
Long-term safety: Scientific and technical basis	Broad-based research	Research narrowed to deal with host rock-specific aspects and specific aspects associated with the selected EBS	In situ experiments and improvement of data bases and understanding	Scientific work sharply focused on small number of residual issues, large-scale in situ experiments and component tests	Confirmation studies on components under site conditions incl. monitoring
Facility and component design	Concept variant studies	Repository design concepts adapted to specific rock type	Component design and layout design Operational safety studies	Full-scale prototypes constructed Industrial scheme developed	Full-scale production and operation
Site-related characteristics	Surveys of potential host rocks and their characteristics based on available information	Host rock characterization and site-specific studies	Detailed site characterization Excavation	Construction of main underground facilities Confirmation of rock properties for final design	Construction, confirmation, monitoring

Generic stages of repository development as derived from international experience. The stated RD&D activities reflect today’s state-of-the-art in geological disposal

SRA 2020 – the way forward

- ▶ The topics are good candidates for future research effort and funds, due to the commonalities and shared priorities with the WMOs
- ▶ This is not an exhaustive list of RD&D topics, as each WMO will have additional research topics of national importance
- ▶ Prioritisation is based on consensus between WMOs assessing importance and urgency of each research topic to their national waste disposal programme

The priorities of RD&D depend upon the national radioactive waste inventory, host rock geology, national context and/or legislation, and the stage of the programme's lifecycle - and these priorities change as the programme progresses.

Overview of European DGR Maturity and Associated RD&D

	Generic	Site selection	Site specific	Construction	Operations	Closure
				2028/2029	2038	2145-2150
						
			2031		2050	
		2120			2130	
	2025	2035	2055	2073	2088	2093
			2024	2050	2060	
						
					2024	
			2055	2064	2079	
						
				2023	2031	2065
			2025			
	Generic safety case RD&D Focus: General science & technology development Lots of options available	Site specific safety case(s) RD&D Focus: Validation of understanding and adaptation of concept Options within programme reducing	Pre-construction safety case RD&D Focus: Disposal concept(s) selected and mature Validation of understanding continues	Pre-operational safety case RD&D Focus: Optimisation and industrialisation of facility and disposal concept(s)	Operational safety case RD&D Focus: Reassurance and competence maintenance	Final safety case
			Construction licence		Operational licence	Closure licence

Way of Working – EURAD and multi-lateral projects

- ▶ Despite significant steps forward, sustained RD&D is needed to ensure that all countries (at various stages of advancement) continue to progress towards implementation
- ▶ The IGD-TP is a technical/scientific group focused on deep geological disposal, but has added wider RWM interests to expand WMO coverage
- ▶ We have broadened our remit to include both EURATOM and non-EURATOM RD&D activities

Two key IGD-TP foci:

- 1) Collaborative work on WMO interests multi-laterally
- 2) Co-ordinating WMO interests within EURAD



Looking forward...

- ▶ The IGD-TP aims at inclusivity of all (European) WMOs to promote collaboration and knowledge transfer within the geological disposal community
- ▶ Has a strong focus on Europe, but the IGD-TP supports international collaboration with many other platforms to avoid duplication and identify synergies
- ▶ Acts as a key instrument in ensuring continuity throughout the long timescales over which development, operation and closure of a GDF take place, in terms of scientific and technological advancements and knowledge transfer of good practice and lessons learned within the community
- ▶ Provides a strong implementer voice and collaborative action to ensure necessary expertise and facilities are maintained and are state-of-the-art
- ▶ Vision 2040 and the SRA are intended to guide the focus of activities and resource allocation over the next decade by highlighting research areas that are of common interest

Short “Lessons Learned” on generic disposal RD&D programmes and the transition to siting a repository

Participating IGD-TP Executive Group members

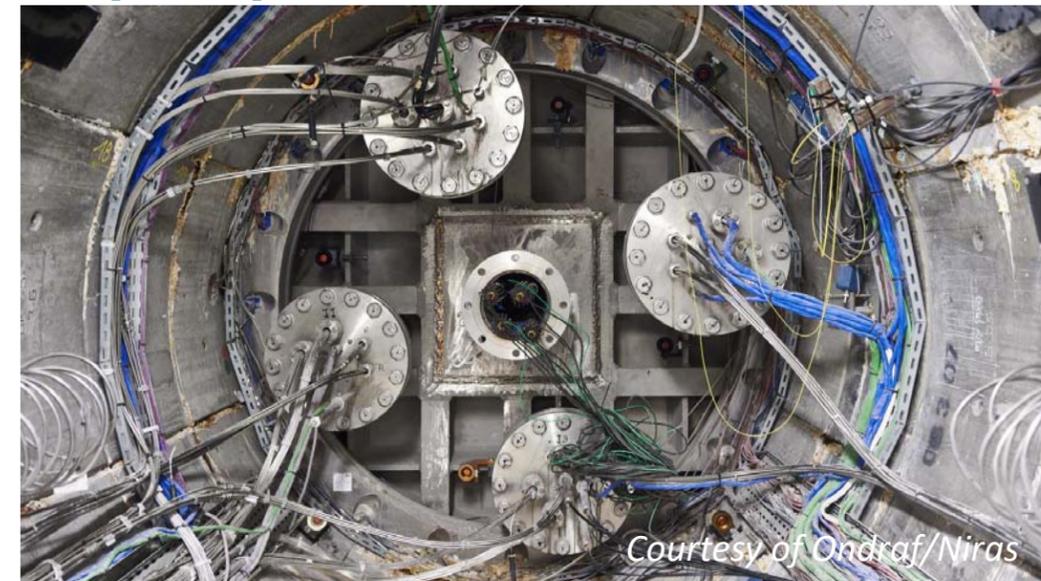
Ondraf/Niras (Belgium)
BGE (Germany)
COVRA (the Netherlands)
Enresa (Spain)
Puram (Hungary)
RWM (U.K.)
Nagra (Switzerland, Chair)

Short “Lessons Learned” from Executive Group members

- ▶ Several of the EG Members are currently in a programme stage similar to the US
 - **Spain:** Restarting site selection after >15 years politically determined hold phase
 - **The Netherlands:** Generic stage with a long period of intermediate storage
 - **Belgium:** After a multi-decade strong focus on clay host-rock, now required to evaluate other rocks
 - **Hungary:** Initial focus on clay host; after a wider evaluation, the clay host rock was confirmed
 - **Germany:** After a strong focus on salt, now country-wide site-selection process
 - **U.K:** After a step back and a long generic stage, now entering site selection → next presentation (L. Bailey)
- ▶ The IGD-TP organised a meeting with representatives of these countries on 23 Nov 2020 to discuss “Key observations for an RD&D programme in the generic or early site selection stage” → next 5 slides

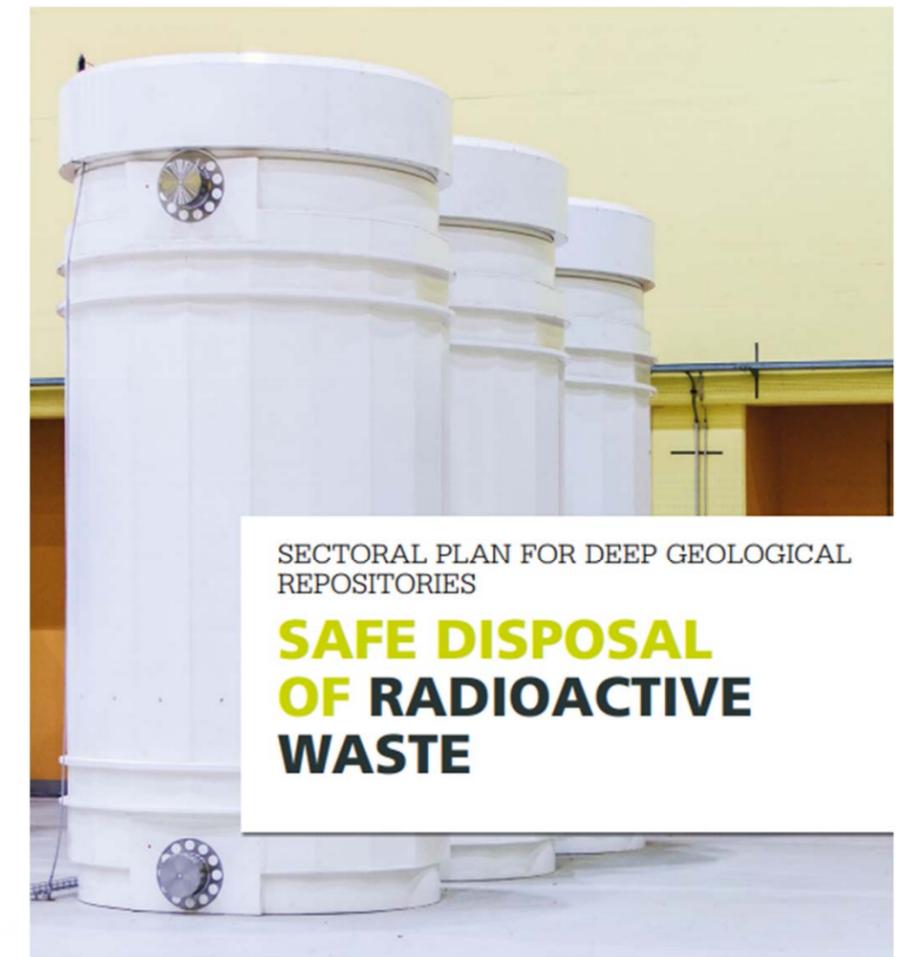
Key messages to ensure and execute an adequate RD&D programme at an early stage (1/2)

- Successful repository implementation needs the legal framework with the roles of each party clearly described (implementer, regulator, society)
- How to implement the repository programme and conduct the site selection needs to be set out and accepted by all parties
- A long-term political commitment is required - without this it has proven extremely difficult to develop and maintain a needs-driven and focussed, well-funded RD&D programme
- Where the above conditions have not been fulfilled, several programmes have gone to a “hold” or even “restart” phase
→ This challenges the RD&D programme and setting priorities
- International collaboration is an instrument to bridge this, but loss of knowledge is almost inevitable



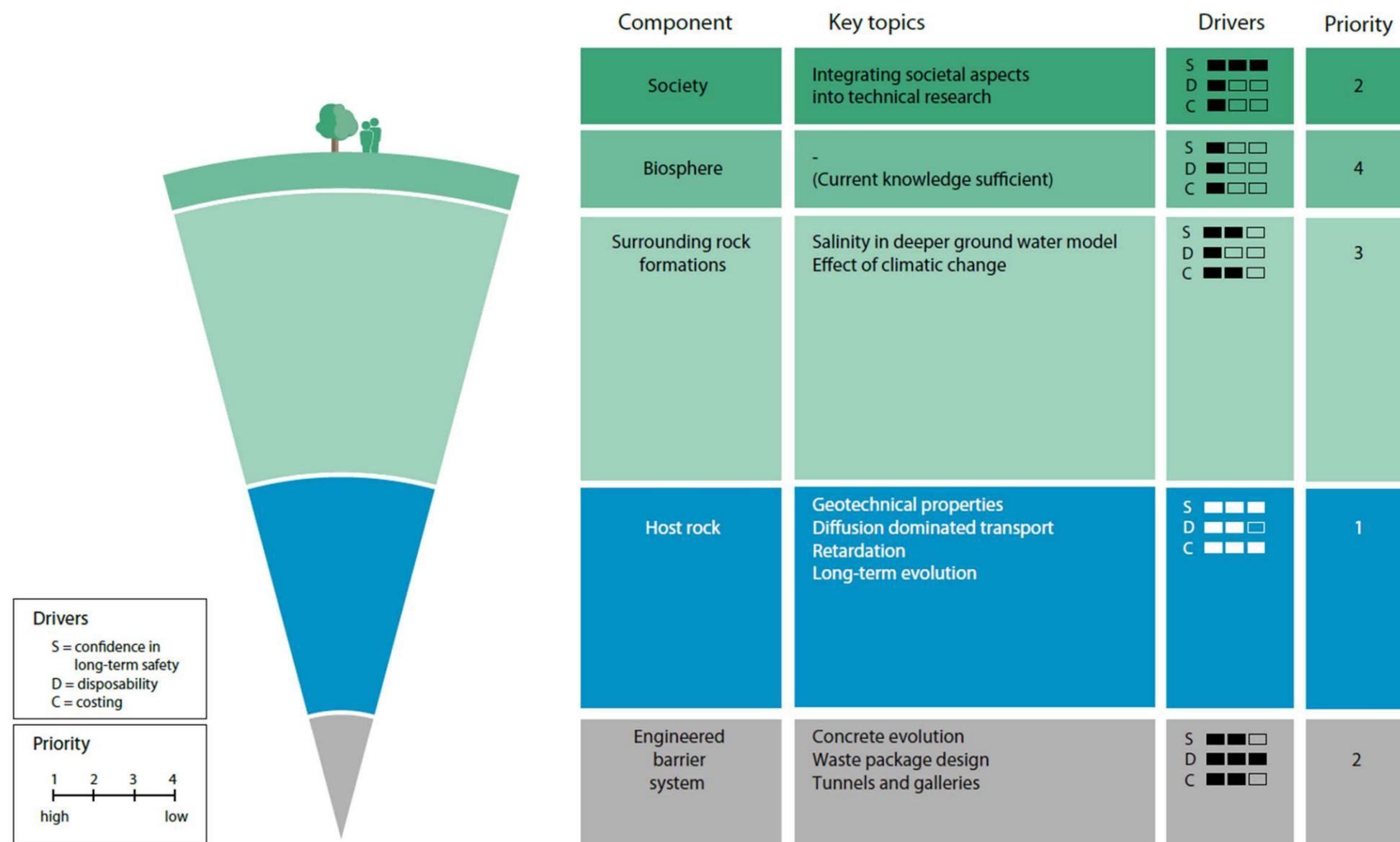
Key messages to ensure and execute an adequate RD&D programme at an early stage (2/2)

- While RD&D is an important part of the repository programme, it is widely felt that the challenges for repository implementation do not lie in the technical aspects (although optimisation will always remain a driver), but rather in the success of mastering the societal challenges
- The role of the implementer is to bring focus to the RD&D programme, in the generic stage based on generic safety cases
→ Focus is needed as RD&D topics mature and going in more detail might no longer be the best way to support the programme



Lessons learned - Aspects of priority setting at an early stage

- ▶ R&D programme is generally revised after safety cases - the results are assessed against programme drivers and the new R&D programme prioritisation is defined
- ▶ Focus on early-stage aspects (geology, waste conditioning) rather than late-stage aspects (technology development)
- ▶ Avoid repeating work done elsewhere – take advantage of scientific topics addressed by advanced programs
- ▶ Some aspects that go into the safety case can be tackled conclusively in an early stage (e.g. packaging strategies, spent fuel integrity)
- ▶ Ensuring competence is one of the main drivers of having an RD&D programme in the generic stage - “generalist competence” (implementer) and “expert competence” (supply chain)
- ▶ Cost optimisation has also gained significance in the early stages
- ▶ Important to consider the role of social and economic RD&D developments, and who is responsible for this in the process → absence of it can be a shortcoming and impact programme success



(COVRA, 2020)

Figure 10: Prioritisation of components of the geological disposal system based on drivers for research (Verhoef et al. 2017)

How important is international collaboration and why?

- ▶ Especially in the early stages international collaboration with programmes in a more advanced stage is key (→ see objectives of the IGD-TP)
- ▶ Collaboration at the strategic, programme level, as well as technical, is beneficial
 - Some disposal programmes are making good progress – important to learn from the success stories
- ▶ Several aspects are highly specialised (e.g. bentonite expertise) → pooling of expertise is essential, which also contributes to maintaining competence and networks
- ▶ Efficient use of available budget through facility sharing (e.g. HotBENT in the GTS)
- ▶ Increased confidence with international consensus → increases stakeholder buy-in
- ▶ Especially when gearing up to site selection, there is strong reliance on international developments and links with academia to build up a full RD&D programme (e.g. recent start in Germany)

What are the challenges of programmes in an early stage?

- ▶ Finding the balance between keeping the focus in the RD&D programme and being broad enough (within specified budgets)
- ▶ Generational changes combined with stops in the programme can lead to loss of knowledge
- ▶ Agility and long-term collaboration with academia: need to be able to prioritise relevant topics, not only those already under investigation → a good safety case focusses the RD&D programme
- ▶ Recruiting excellent staff can be an issue in some locations → keeping the momentum is essential and it works if given attention (e.g. through international collaboration (Spain, Hungary))
- ▶ Keeping the expertise of the previous focus (e.g. Boom clay, Belgium) can be challenging when widening the host-rocks for site selection
- ▶ Once specific geological environments are selected, a strong refocus will occur → need to anticipate this transition

Impact of excavations on clay characteristics



Thermo-hydromechanical behaviour of clay





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Thank you for your attention