Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

EURAD

European Joint Programme on Radioactive Waste Management

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ENEA - FUSION AND TECHNOLOGY FOR NUCLEAR SAFETY AND SECURITY DEPARTMENT

EURAD Programme

EURAD - European Joint program on Radioactive Waste Management

Initial **preparatory work of the EC JOPRAD** project.
Goal: to prepare the conditions for the **setting up of a Joint Programme on Radioactive Waste Disposal**, so to identify remaining research priorities of common interest across Europe.

EURAD supports the **implementation of the Directive 2011/70/Euratom Directive** (Waste Directive) in EU Member-States, taking into account the various stages of advancement of national programmes.

EURAD main goals:

- implement a **joint Strategic Programme of research and knowledge management** activities at the European level;
- **support Member-States in developing and implementing their national RD&D programmes** for the safe long-term management of their full range of different types of radioactive w aste through participation in the RWM Joint Programme;
- **develop and consolidate existing knowledge** for the operation of the first geological disposal facilities for spent fuel, high-level waste, and other long-lived radioactive waste, and supporting optimization linked with the stepwise **implementation of geological disposal**;
- enhance **knowledge management and transfer** between organizations, Member States and generations.

EURAD-1: 2019-2024
EURAD-2: 2024-2029

eurad
European Joint Programme on Radioactive Waste Management
www.ejp-eurad.eu

EURAD Programme

EURAD Founding Documents

EURAD Vision: a step change in European collaboration towards safe radioactive waste management (RWM), including disposal, through the development of a robust and sustained science, technology and knowledge management programme that supports timely implementation of RWM activities and serves to foster mutual understanding and trust between Joint Programme participants.

Strategic Research Agenda, Roadmap, Deployment Plan define the terms in which the Programme operates.

- **Strategic Research Agenda**
  Description of **scientific and technical domains and sub-domains** and knowledge management needs of common interest between EURAD participants.

- **Roadmap**
  Representation of a **generic radioactive waste management programme**.

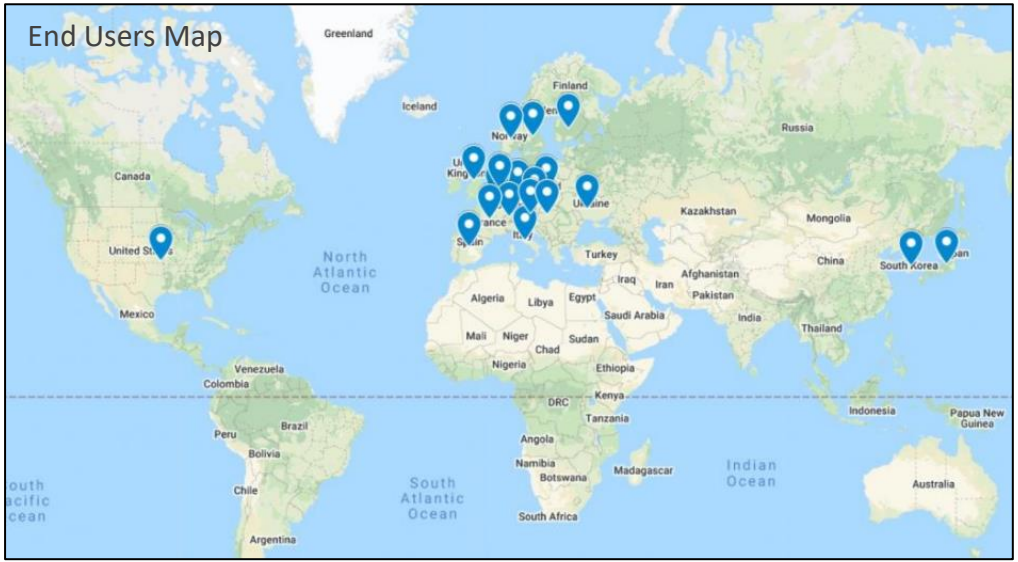
- **Deployment Plan**
  Type of activities that will be implemented during the first 5-year implementation phase : Research, Development & Demonstration, Strategic Studies, Knowledge Management, Interactions with Civil Society and Management).

EURAD-1 Programme

EURAD-1 Participants

- 51 Mandated Organizations
- 61 Linked Third Parties
- 23 Participant Countries (20 EU)
- 3 international Partners

Italy not included in EURAD-1 participants.



EURAD-1 End-Users

- 112 registered end-users (March, 2023)
- 22 countries represented
- 67 end-users whose organism is external to EURAD

EURAD-1 Programme

EURAD-1 Colleges

- **Waste Management Organizations** (*WMO College*) form a core part of the Joint Programme and provide a driving force for what is needed for successful and practical implementation from an industrial perspective. WMOs have established a network and coordination framework for RD&D needs of the implementers of geological disposal at the European level via the **Implementing Geological Disposal Technology Platform (IGD-TP)**.

- **Research Entities** (*RE College*) work to different degrees on the challenges of RWM including disposal (and sometime in direct support to implementers or WMOs or TSOs), under the responsibility of Member States.

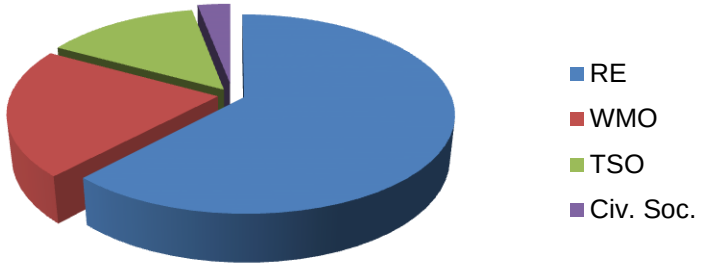
- **Technical Support Operators** (*TSO College*) carry out activities aimed at providing the technical and scientific basis for supporting the work and decisions made by a national regulatory body (Several TSOs, together with other organisations fulfilling a regulatory expertise function and Civil Society Organisations have established the **SITEX network** to support independent technical expertise in the field of safety of geological disposal of radioactive waste).

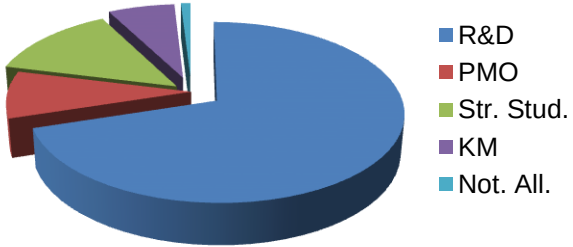
EURAD-1 Programme

EURAD-1 Funding distribution

Distribution of EC contribution in EURAD-1:

- **62 % for REs,**
- 21% for WMOs,
- 14% for TSOs,
- 3% for Civil Society Oorganisations.





Distribution of EC contribution per type of activity:

- **73 % R&D,**
- 10% PMO,
- **9% Strategic Studies,**
- 7 % KM,
- 1 % Not allocated.

EURAD programme is a co-funded partnership: every organisation intending to participate, agrees to provide **co-funding to the action (50%)**.

EURAD-2 Programme

EURAD-2 MANAGEMENT

EURAD-2 (2024-2029) as **merge of EURAD-1 and PREDIS EU project.**

The **Core Group** has been established in August 2022 based on nominations of candidates from the Colleges.

The final composition of the Core Group :

- ❑ Ingo Blechschmidt (NAGRA – Switzerland) — WMO
- ❑ Astrid Göbel (BGE – Germany) — WMO
- ❑ Christophe Bruggeman (SCK-CEN – Belgium) — RE
- ❑ Lara Duro (AMPHOS 21 – Spain) — RE
- ❑ Erika Holt (VTT – Finland) — TSO
- ❑ Nadja Železnik (EIMV – Slovenia) — TSO
- ❑ **Louise Théodon (ANDRA – France) – Coordination**

ANDRA (France) has volunteered to coordinate the work of the Core Group and thus be the coordinator of the EURAD-2 partnership.

The Core Group strives to **ensure inclusiveness**, either as mandated actors or affiliated entities (earlier labelled as “linked third parties”).

EURAD-2 Programme

EURAD-2 Colleges and type of activities

WMO College - via IGD-TP (Johanna Hansen).

RE College - **via EuradScience network**, which also includes supply chains and companies (Christophe Bruggeman).

TSO College - via SITEX-Network; which also includes civil society and regulator views (Valéry Detilleux).

EURAD-2 activities:

- **Collaborative RD&D WPs** (50% funding), aiming at **developing and consolidating scientific and technical knowledge**.
- **Strategic Studies WPs** (100% funding), consisting of enabling experts and specialists to network on **methodological/strategical issues** and advance significant challenges that **are common to various National Programmes** and that are in direct link with scientific and technical issues (EURAD-1 UMAN, ROUTES).
- **Knowledge Management WPs**, consisting of **developing State of Knowledge** (training modules, mobility measure, …).
- **Programme Management Office WP**, for day-to-day administrative, financial and legal management, reporting exercises, interactions with EC, communication and dissemination activities, …

EURAD-2 Programme

EURAD-2 Actors

Beneficiaries: Mandated actors (Italy, ENEA for the RE College).

Affiliated Entities: earlier (EURAD-1) Linked Third Parties. **Legal document as link to the Beneficiaries** broader in scope and duration than just EURAD-2; that is a pre-existing legal relationship (options are: Memorandum of understanding, agreement, contract, affiliation, joint research unit…; not based on a contract for the purchase of goods works or services).

Associated Partners: Only EU – having signature agreement with EC already, **participating at own cost** (no EC funding), do not need a link to any Beneficiary, can provide contribution (i.e. deliverable author, Task leader).

Third Parties: providing **in-kind contribution** (**no EC funding**). Do not report anything to the EC (budget/euros or PM effort). Beneficiaries can call for Linked Third Parties (LTP) to carry out part of the work plan in the WP.

Subcontractors: limited scope, cannot be core task. Must prove **no other partner can do the work**. Need to purchase them at 100% cost (because they have no vested interest in the work they are providing). If for R&D, that means a partner (who has only 50% funding) would need to pay the subcontractor at 100%.

EURAD-2 Programme

EURAD-2 POSSIBLE FUNDING DISTRIBUTION

Core Group recommends that a **possible distribution of the activities (and funding)** could be (November 2022):

- ❑ 66% R&D,
- ❑ 12% Strategic Studies,
- ❑ 12% KM,
- ❑ 10% PMO (incl. Bureau and WP management).

Considering 50% financing for R&D and 100 % for the other activities, this could mean approximately:

- ❑ 16 R&D WPs at 5 M€ each (now 21 WPs!),
- ❑ 3 Strategic Studies at 2 M€ each and 1 at 1 M€,
- ❑ 7 M€ for KM,
- ❑ 6 M€ for PMO,

over the whole 5 years programme duration.

EURAD-2 Programme

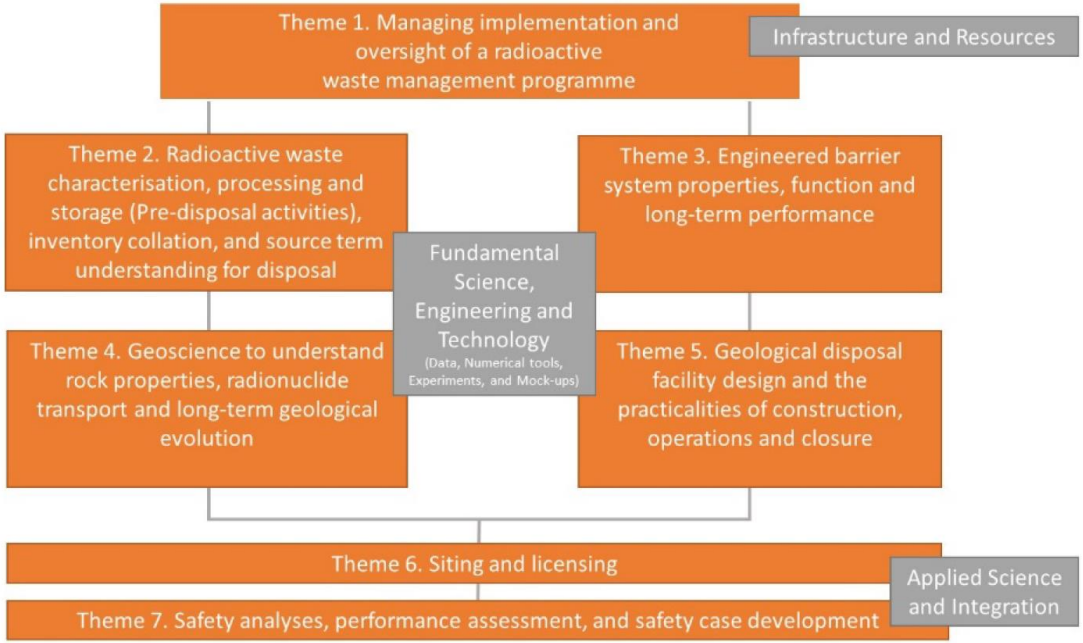
EURAD 2 THEMES

7 EURAD Themes (as EURAD-1) regard the scientific and technical **domains and sub-domains** and knowledge management needs of common interest between EURAD participants (developed within the EC JOPRAD Project).

EURAD **avoids grouping scientific and technical** scope

- ❑ by rock type (e.g. clay, hard-rock, or salt systems),
- ❑ by disposal concept and design (e.g. vertical borehole, horizontal tunnel, …).

EURAD considers **integration** of scope across programmes **with varying rock types and concept designs** as highly beneficial.



EURAD-2 Programme

EURAD 2 SCHEDULE

Activity	Due date	Responsible
Position Papers on feedback regarding Governance issues	End November 2022	Colleges and PREDIS, to Core Group
Template and instructions for solicitation of future Work Packages (WPs) via Colleges	End December 2022	Core Group
Public Webinar #1 on EURAD-2 preparations	**19 January 2023,** morning	Core Group hosts, public attendance (all stakeholders)
EURAD Strategic Research Agenda finalised *	**End of January 2023**	Colleges
Nomination of potential work packages, linked to SRA and drivers	Early February 2023	Colleges
PREDIS Strategic Research Agenda finalised *	March 2023	PREDIS WP2
Guidance on EURAD-2 governance and budgeting expectations	April 2023	Core Group
Selection of WPs having synergy between Colleges	April 2023	Core Group provides recommendations to colleges
Public Webinar #2 on EURAD-2 status	**11 July 2023,** afternoon	Core Group hosts, public attendance (all stakeholders)
Refining WP descriptions (scope, impact, budget, partners, milestones, deliverables)	Summer 2023 (starting from May 2023)	WP steering groups (nominated lead contact, per WP, per College)
Submission of proposal	Sept-Nov 2023	Coordinator
Evaluation/feedback	Spring 2024	EC
Start of EURAD-2	Autumn 2024	N/A

3 Templates to elaborate each proposal activity (template 1) and then to define each Work Package (Template 2, 3).

Template 1 development

- ❑ WP leaders/coordinators nomination
- ❑ Template 2 development (May, 2023)
- ❑ Template 2 evaluation (June 2023)
- ❑ Template 3 development (July 2023)
- ❑ Template 3 refining (end-summer 2023)

EURAD-2 Programme

EURAD-2 Work Packages	Oroginal proposed activities
WP 1 - Alternative RWM Strategies (Theme 1)	1.1 Alternative RWM Strategies 1.2 Deep Borehole Disposal / Sealing - Increasing the TRL (DEEPBORE)
WP 2 - Sustainability (Theme 1)	1.3 Sustainability aspects in RWM: Strategies for environmental, economical und social challenges 1.4 Recycling of radioactive matters
WP 3 - WM for SMRs and future fuels (Theme 1)	1.5 Waste Management for SMRs
WP 4 - Spent fuel A (Theme 1)	1.6 Advanced Spent Fuel Characterization / Innovative Characterization for Pre-disposal SF management
WP 5 - Waste Characterization (Theme 2)	2.2 Characterization of specific problematic waste streams / PRe-dispOsal of Challenging wastE StreamS (PROCESS) 2.5 Characterization issues LILW
WP 6 - Treatment/Immobilization (Theme 2)	2.1 COnditioning of Radioactive wastes in INnovative mAtrices / New matrices for immobilization LLW-ILW 2.3 Long-Term Performance of novel waste matrices / Challenging geopolymer matrices for waste conditioning 2.4 Sustainable ceMentitious mAterials foR wasTe managemENT (SMARTENT) Some issues of 2.6 Managing challenging wastes from both technical and socio-technical perspectives
WP 7 - Long-term performance (Theme 2)	2.3 Long-Term Performance of novel waste matrices 5.1 Durability of cementitious EBS materials Some issues of 2.6 Managing challenging wastes from both technical and socio-technical perspectives
WP 8 - Graphite handling (Theme 2)	2.1 COnditioning of Radioactive wastes in INnovative mAtrices / New matrices for immobilization LLW-ILW 2.2 Characterization of specific problematic waste streams / PRe-dispOsal of Challenging wastE StreamS (PROCESS) Some issues of 2.6 Managing challenging wastes from both technical and socio-technical perspectives
WP 9 - Spent Fuel B (Theme 3)	3.1 Release safety relevant radionuclides from SNF under DGR conditions / Optimization of the understanding of SNF under disposal conditions
WP 10 - Glass (Theme 3)	3.2 Dissolution of waste forms under near-field conditions
WP 11 - Containers/Canisters (Theme 3)	3.4 Development of innovative solutions for HLW containers in geological disposal facilities / Surface processes influencing metallic components long-term performance
WP 12 - Bentonite / Buffers / Backfills (Theme 3)	3.5 Optimised buffer and backfill characterisation 3.6 Development of new composites and forms of buffer&backfill material (characterization and THMC modelling) 3.10 Performance of Engineered Barriers - Long-term Evaluation Scenario 4.3 THMCG challenges (Coupled process capability development) / Understanding dispersion and coupling across THMC properties in host rock formations
WP 13 - Closure (Theme 3)	3.9 Conditions for Closure / Backfill and closure optimisation and role in safety case
WP 14 - Climate change (Theme 4)	4.1 Impact of climate change on site evolution / Impact of climate change on radwaste facility safety
WP 15 - Radionuclides (Theme 4)	4.2 RN mobility under perturbated conditions / Development of a generalized database of RN retention/transport parameters / Targeting key issues for RN migration
WP 16 - Repository Optimisation (Theme 5)	5.1 Durability of cementitious EBS materials 5.2 Behaviour of Gallery support structures in clayey formations in perspective of the design optimisation of geological disposal systems 5.7 Optimization of surface disposal and design of repository (LILW)
WP 17 - Digital Twins (Theme 5)	5.3 Enabling Digital Twins / Towards trusted digital twin powered holistic approach to safety cases
WP 18 - High fidelity numerical simulations (Theme 5)	5.4 High fidelity numerical simulations of strongly coupled processes for repository systems and design optimisation with physical models and machine learning
WP 19 - Criticality Safety (Theme 7)	7.1 Criticality Safety for Final Disposal
WP 20 - Thermodynamic (Theme 7)	7.2 Development and Improvement of Quality Assured Thermodynamic Understanding for use in Nuclear Waste Disposal Safety Case (DITUSC)
WP 21 - Natural analogues (Theme 7)	7.3 Natural analogues and long-term evolution: upscaling towards relevant space and time scales / Natural analogues: understanding long-term evolution and supporting performance and safety assessments Geological and tectonic evolution

Thanks for your attention

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