PREDIS

Final Conference 2024
Impact Workshop
6.6.2024

MARIA OKSA & ERIKA HOLT, VTT

THE WORKSHOP STARTS AT 9:00 (CET)

PLEASE MUTE YOUR MICROPHONE AND TURN OFF YOUR CAMERA

YOU CAN USE THE TEAMS CHAT FOR QUESTIONS AND COMMENTS

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

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General Reminders

- Please use the PREDIS Event within the Euratom4U App to see the agenda, get announcements, etc. From web or QR code at the right
  https://event.do/fisaeuradwaste
- Convention room WiFi: User =SEMINAIRE / Password : seminaire2021
- No Emergency or Fire Drills planned. Meeting spot front of building
- Emergencies: Helene Nonnet +33 6 31 99 12 54 *(WhatsApp or SMS or phone ok)*
- Catering:
  - Special diets should always inform the waiter
  - Dinner is available at Novotel – please inform hotel receptionist earlier in the day if interested (so the kitchen is prepared)

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REFLECTIONS OF PREDIS 4 YEARS

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3) What do you think (in under 5 words)?

What is your best memory from PREDIS?

Presentation Link

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The PREDIS project

- H2020-Euratom-1 – Indirect action
- NFRP-2018-5 – Developing pre-disposal activities identified in the scope of the European Joint Programme in Radioactive Waste Management
- Research and Innovation Action (RIA)
- 47 Partners from 17 EU countries

⇨ All predisposal activities from the waste generation and prior to its disposal

⇨ A gap analysis identified the main research topics to be investigated

⇨ The work packages address specific waste streams: organics, metallic waste and cemented packages

Project Information

PREDIS

Grant agreement ID: 945098

Status
Ongoing project

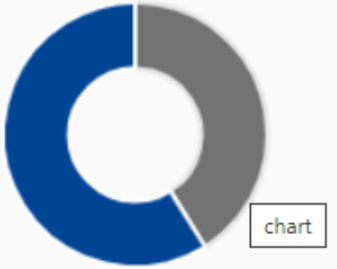
Start date
1 September 2020

End date
31 August 2024

Funded under
H2020-Euratom-1.

Overall budget
€ 23 773 742,75

EU contribution
€ 14 000 000



Coordinated by
TEKNOLOGIAN TUTKIMUSKESKUS VTT OY

Finland

Main conclusion from the EC review

- PREDIS has been a successful, efficient and productive project, which has achieved its objective in the specific areas selected out of a wide landscape of possible activities. Pre-disposal is a wide subject. The overall outcome is impressive. It has delivered even more than expected.
- The areas chosen for research in the different WPs are relevant to many end-users. Value assessment of the results remained to be performed. Life cycle analysis important.
- PREDIS has benefitted from a strong management structure. The efforts to make it function has been successful. This is a great achievement given the large size of the project and the large number of participants. The secretariat and the management structure should be congratulated for this.
- Strong links have been built with IAEA, NEA, SNETP/NUGENIA and EURAD
- The streamlining of many activities with those of the EURAD project augurs for an efficient incorporation of pre-disposal R&D in the up-coming EURAD2. A challenge will remain to also involve the pre-disposal end users in the EURAD2 work

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FISA-EURADWASTE 2025 and SNETP Forum 2025

Under the Polish Presidency of the Council of the EU

Warsaw, 12-16 May 2025 (tbc)

.....

One Plenary room up to 500 persons, **three** parallel rooms 120-150 persons

Sunday evening, YGN ice breaker

Day 1 – Monday Young Generation Network, Awards and Atomic Careers' Day

Day 2 – Tuesday

- AM High-level Opening
- PM Plenary I then 3 parallel sessions

Day 3 – Wednesday

- AM Plenary II then 3 parallel sessions
- PM Plenary III then 3 Parallel sessions

Day 4 – Thursday

- AM Plenary IV then 3 parallel sessions
- PM Plenary V Wrap-up parallel sessions
- PM High-level Closing

Day 5 – Friday Technical tours

Euratom4U iOS Android App. & desktop version

ENS-YGN **High-Level Opening**

+150 participants

Open Call MSc/PhD/R&D Awards Competition,

Nuclear Innovation Prize, Poster Exhibition,

SNETP Forum and ENEN PhD Event & Prize

ENS-YGN Workshops, Meet & Match, **+500** Attendees

3 full days FISA-EURADWASTE 2025 and SNETP Forum 2025

- **High-level** Opening / Closing plenary sessions
- **5** Plenaries (I to V)
- **12** parallel sessions
- **100** students invited (Posters), 100 Euratom projects up to 200 Posters in total

1 day Young Generation Network, Awards and Atomic Careers' Day

1 day Technical tours

Several Prizes Nuclear Innovation Prize, R&D Awards, ENEN PhD Event & Prize

Exhibition Stands and Euratom project posters will be presented

EPJ-N special editions and Proceedings of the conferences in 2025

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Highlights of Project Impacts

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Galson SCIENCES LTD

egis GROUP

Introduction on the Value Assessment Process & Case Studies

6TH JUNE 2024, AVIGNON

JENNY KENT, STEVE WICKHAM, CALLUM ELDRIDGE, SLIMANE DOUDOU, TIM HARRISON, GEORGES DAVAL, DELHIA ALBY, (GSL), PREDIS MT, WP LEADS AND PARTNERS

ISSUE 1.0

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Content

1. Value assessment methodology
2. Scenario definition
3. PREDIS examples and wider applicability

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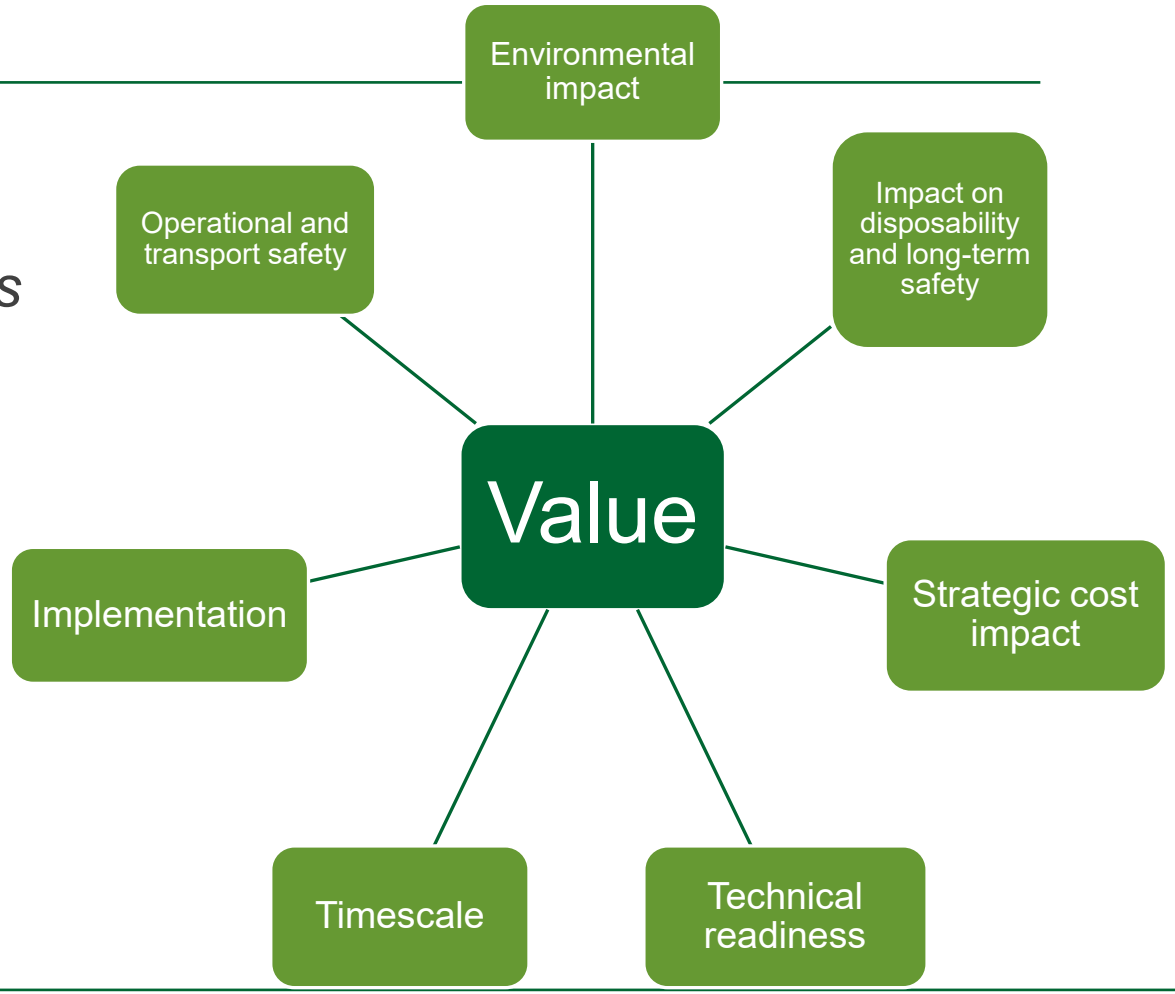
What is Value?

*"the realisable benefit in **safety, monetary and environmental** outcomes that will arise from implementing this technology at a specified time"*

- Stakeholder priorities depend on their perspectives
- Supports engagement and collaborative decision making



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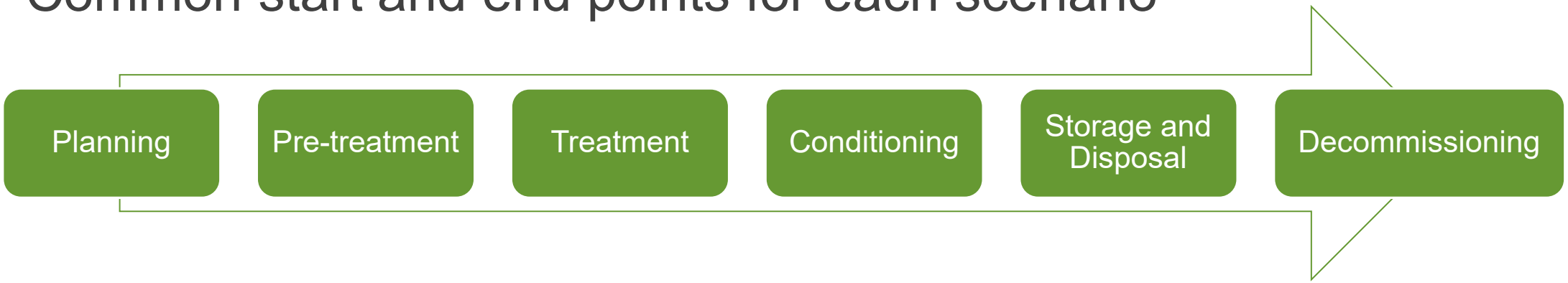
Scope of Assessment

- Value is considered across the full waste management lifecycle
- Common start and end points for each scenario



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Value Assessment Structure

Attribute	Data Category	Assessment considerations					
		Planning	Pre-treatment	Treatment operations	Conditioning	Storage and Disposal	Decommissioning
Operational and Transport Safety	Facility construction and decommissioning						
	Waste pre-treatment requirements (conventional and radiological safety implications)						
	Waste post-treatment requirements (conventional and radiological safety implications)						
	Waste operational safety issues (e.g., ease of providing shielding during operation)						
	Transport safety issues						
Environmental Impact	Material requirements						
	Energy requirements						
	Secondary waste and gaseous/liquid discharges generated						
	Nuisance						
Impact on disposability / long-term safety	Ability to meet waste acceptance criteria						
	Disposability of secondary waste						
Implementation	Indicative lifetime feed						
	Ease of achieving required throughput for process (full-scale facility) (m^3/year)						
	Potential to treat a wide range of waste groups (flexibility) including problematic and orphan wastes						
	Impact on waste management strategy						
Timescale	Design, construction and active commissioning timescale						
	Lifetime operating timescale						
	Decommissioning timescale						
Technical Readiness	Maturity of technology						
Strategic Cost Impact	Costs of construction, operation and decommissioning						
	Impact on disposal costs (total packaged waste volume, disposal route, and required storage and disposal capacity)						

Evaluation process in PREDIS

- **Structured multi-criteria assessment** to inform strategic decision making
- Value Assessment workshops held in early 2024
- Participation by wide range of Partners and End Users

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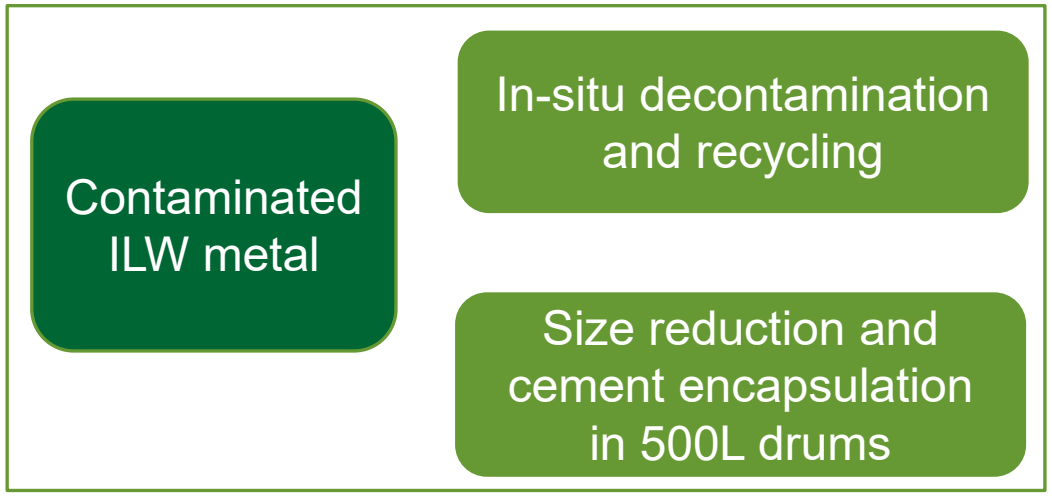
Scenario definition

- Two types of scenarios:
  - **Variant scenarios:** Combination of waste types and treatment approaches / formulations developed in PREDIS
  - **Baseline scenario**: Current waste management practices for a given waste type
- Selection criteria:
  - Realism and relevance to PREDIS R&D
  - Data availability
  - Alignment with Life Cycle Analysis and Life Cycle Costing (LCA/LCC) PREDIS case studies

Example scenario from WP4



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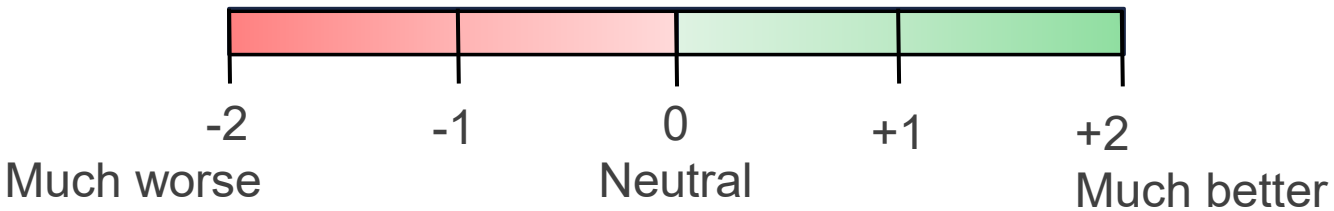
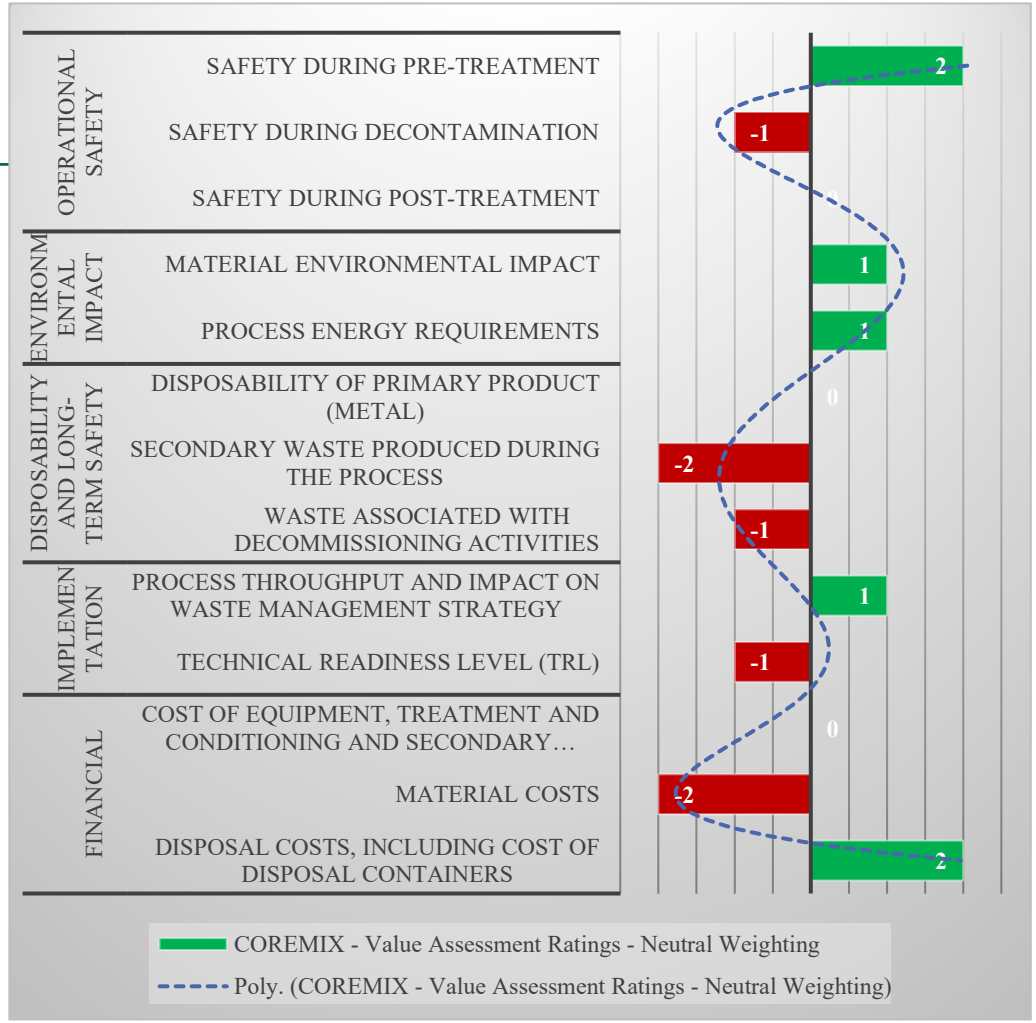
3. Example of an evaluation

- Comparative approach
- Focus on differentiators between the baseline and variant scenarios
- Flexible - qualitative or semi-quantitative, depending on data availability and uncertainties





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Value Assessment in PREDIS

WP	Deliverable or Milestone	Title	Lead	Due
4	MS25 *D4.2*	Value Assessment Workshop *Included in Synthesis Report on Management of Metallic Waste Streams*	GSL *GSL*	M42 *M45*
5	D5.5	Included in Report on Direct conditioning of liquid organic waste route	GSL	M46
6	MS47 *D6.3*	Value Assessment Workshop *Included in Economic, environmental & disposability impacts of novel treatments report*	SCK-CEN *GSL*	M42 *M42*
7	MS54 *D7.9*	Value Assessment Workshop *Included in Economic, environmental, and safety impact report*	BAM *GSL*	M45 *M45*

And providing underpinning data for PREDIS Case Studies

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Geopolymers for Waste Immobilization

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Use of Geopolymer for the Immobilization of Liquid and Solid Organic Waste

Results into practice – PREDIS partner's view

AVIGNON, JUNE 3-7, 2024

QUOC TRI PHUNG

SCK CEN

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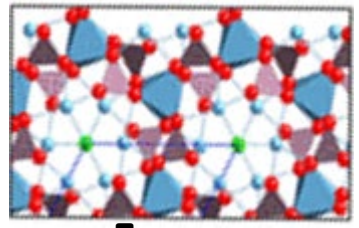
Current conditioning approach

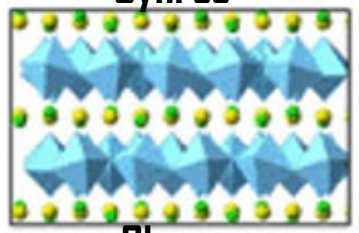
Various waste streams (low/intermediate/high level solid/liquid organic/inorganic)

Alternative?

Ceramic



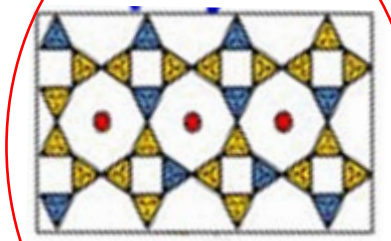
Synroc



Glass

High T

Geopolymer

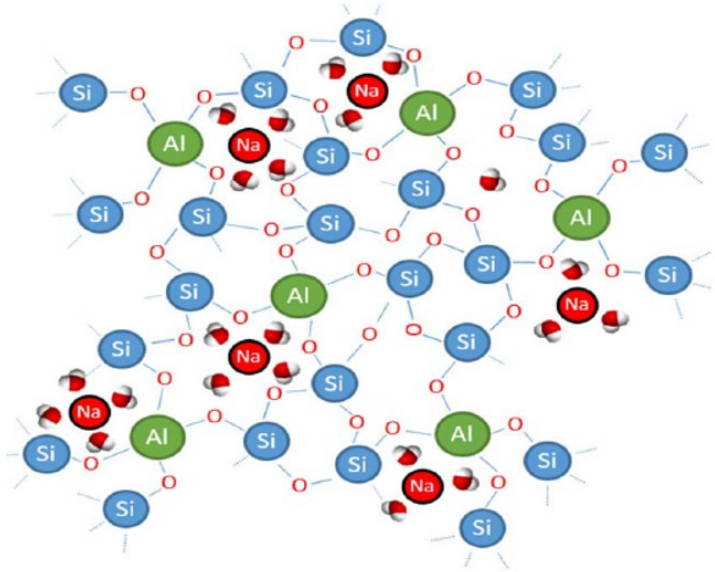


Ambient to slightly increased T

Shortcomings

- Difficult to meet ACRIA w.r.t:
  - ASR/DEF
  - Organic complexation of radionuclides
  - Thermal cracking

Geopolymer = promising matrix



3D network of Si-O-Al bonds

- High strength
- Less free water
- Low permeability
- No EDF, less ASR
- Compactible with organic wastes
- Thermal resistance

High potential to stabilize & solidify various waste streams

PREDIS project

Joint effort:

- **20 partners (liquid wastes)**
- **14 partners (solid wastes)**

Onsite implementation

- Polymerization technology
- Characterization
- Monitoring

Upscaling tests

- Drum scales
- Monitoring stability, T
- Modelling

Recipe design at lab scale

- Precursors
- Waste loading
- ACRIA
- Durability
- Active tests

Waste inventory

- Physicochemical characterization
- Radiology
- Moisture conditioning

Highlights – liquid wastes

Direct conditioning of liquid organic wastes in geopolymers:

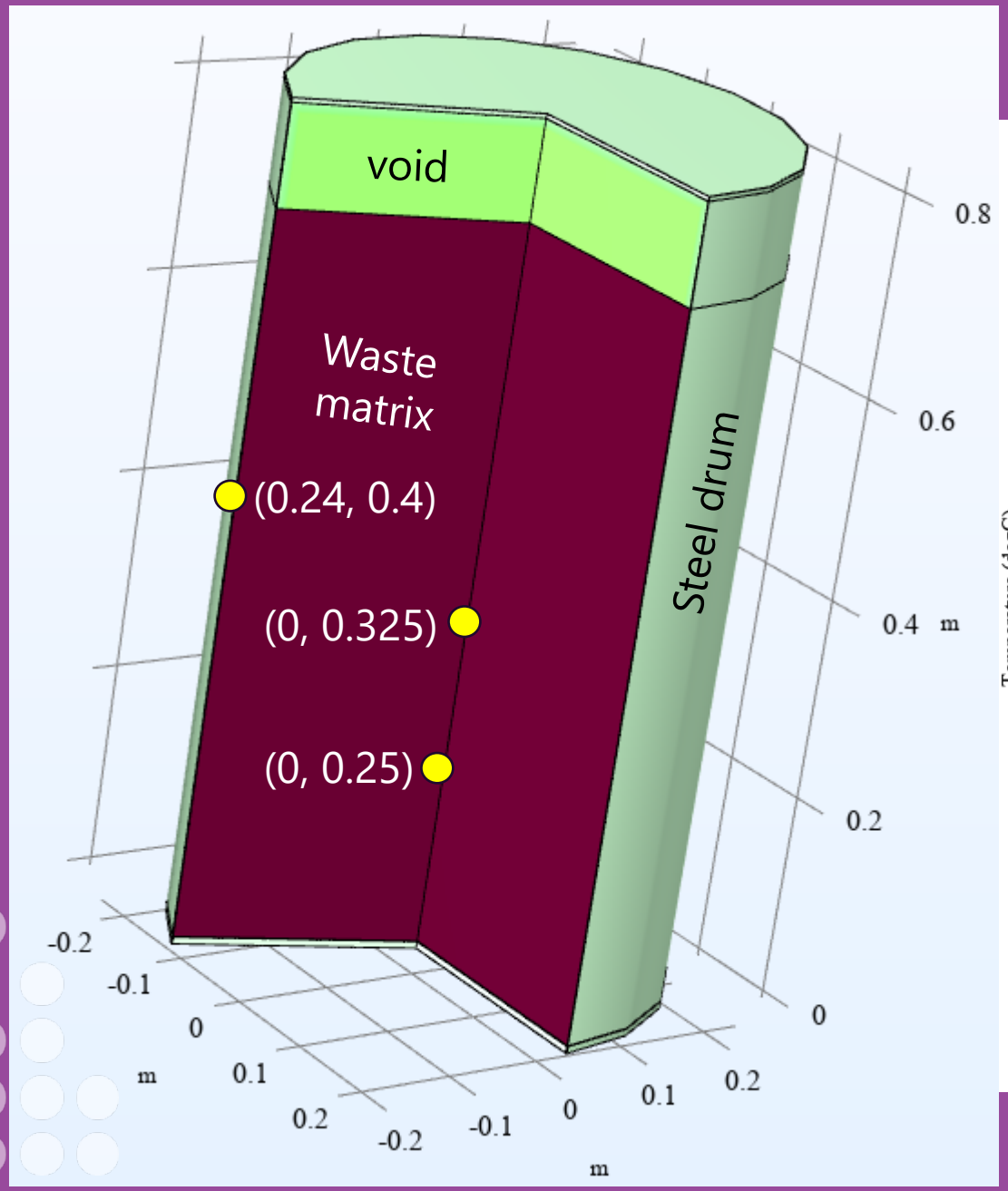
- **Waste types: oils, TBP, ionic liquid, LSC**
- **Waste loading: up to 40%**

Scale up

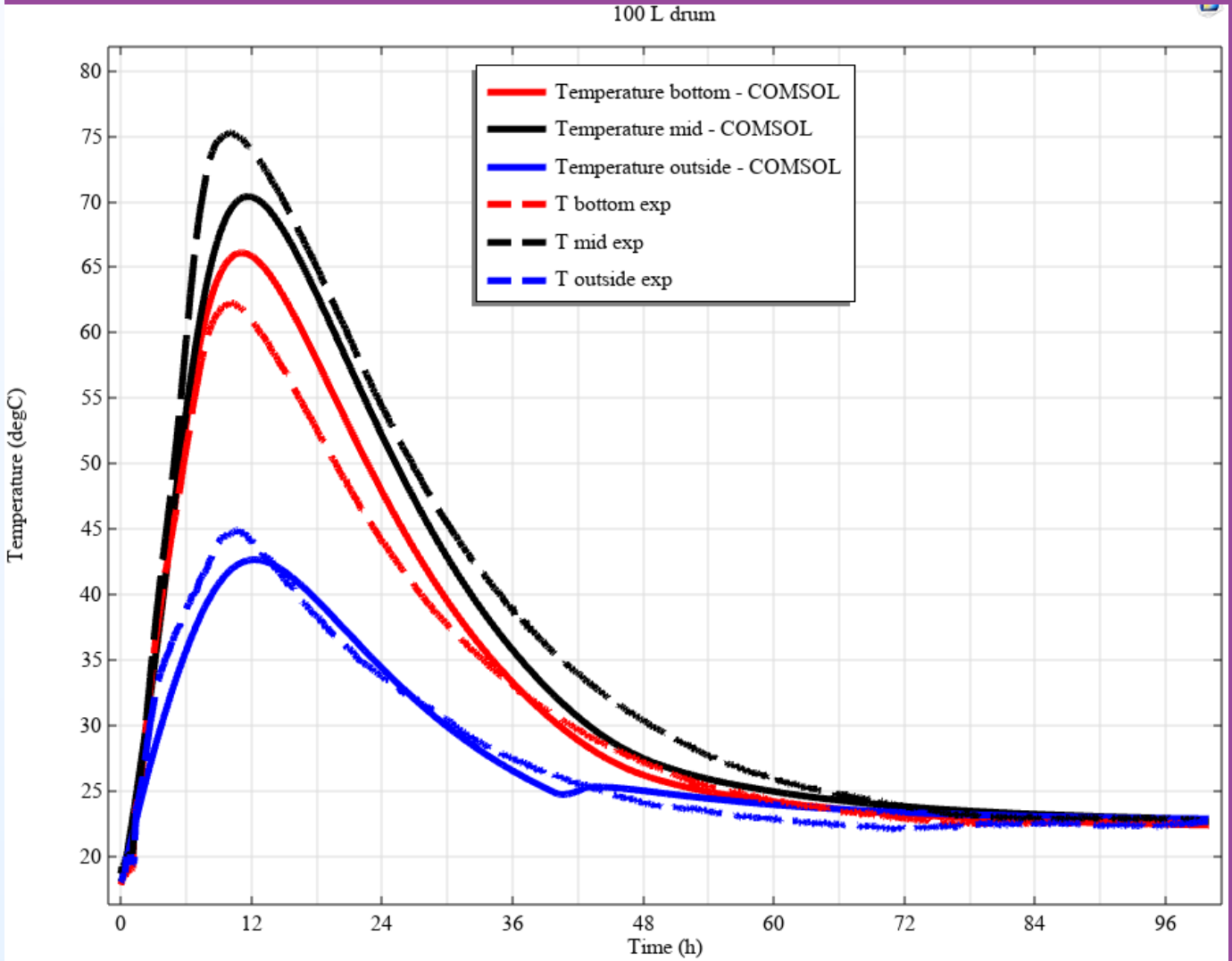
100 L drum @ CVRez

AAS + Lubricating oils

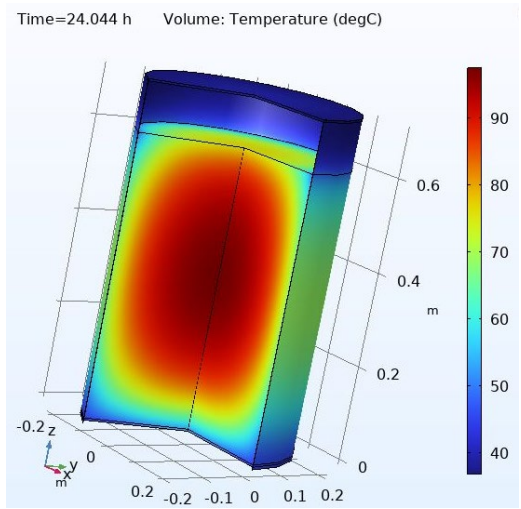
Modelled geometry (100 L)



Preliminary temperature predictions at the sensor locations



Highlights – solid wastes

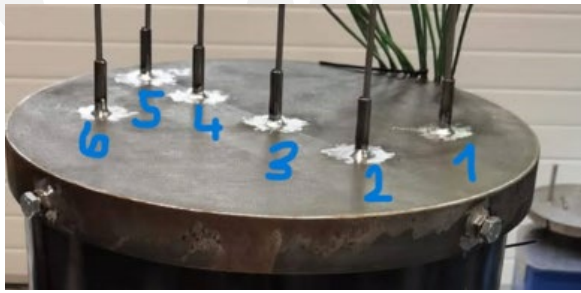


Conditioning of solid organic wastes in geopolymers:

- **Waste types: molten salts, IER**
- **Waste loading: up to 20% (MSO), 30% (IER)**

- CEM I / BFS / Silica fume / lime / limestone
- 10 – 14 wt.% waste loading

- Blast furnace slag precursor
- Activated by $Na_2O.2SiO_2$ and NaOH (from salt)
- 10 – 20 wt.% waste loading



Highlights – solid wastes

Conditioning of solid organic wastes in geopolymers:

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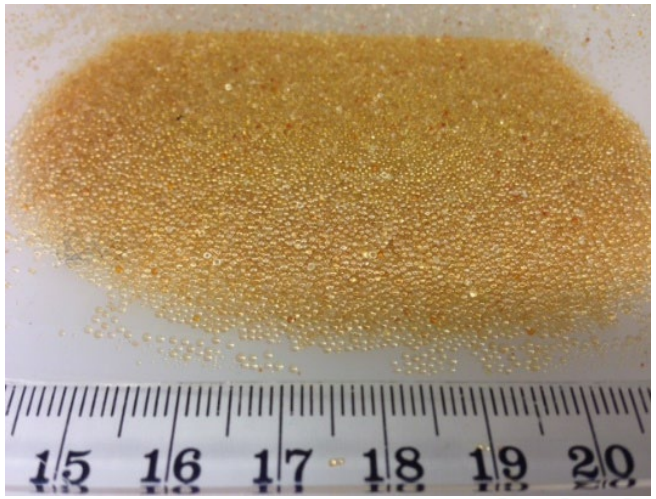
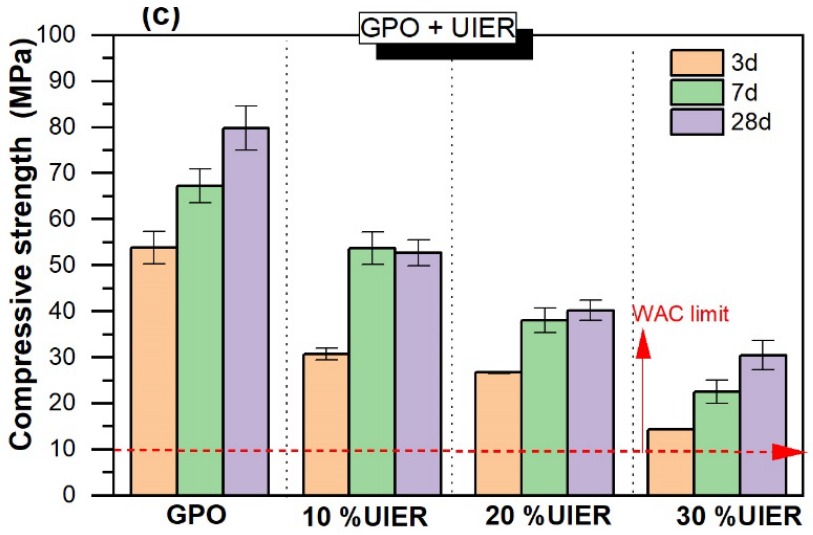
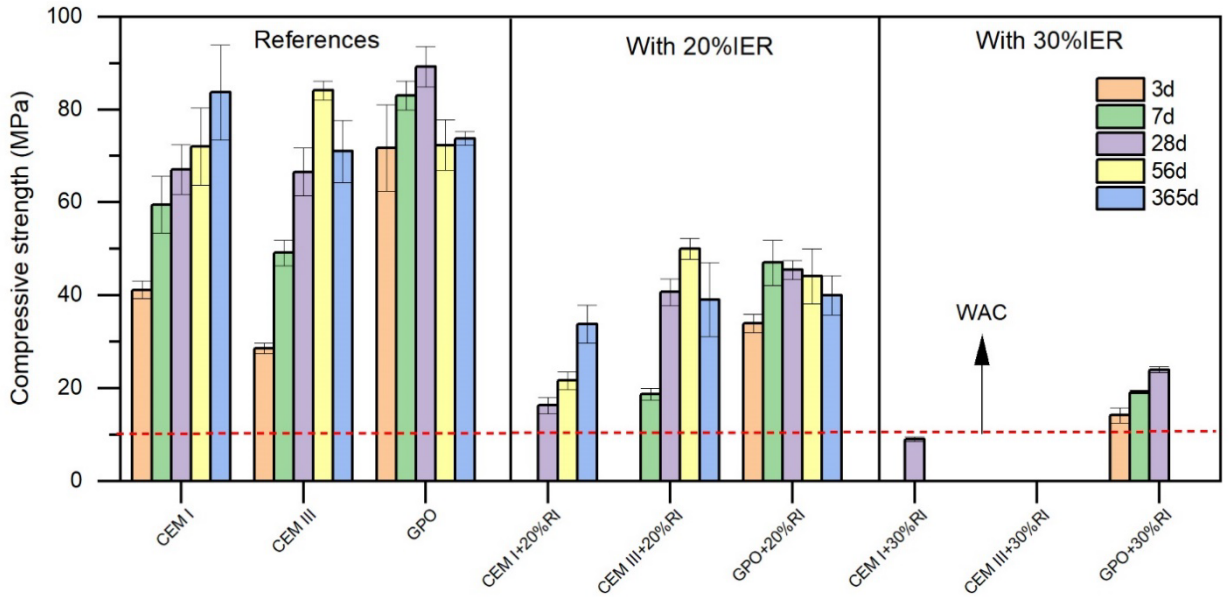


Unreated IER



Treated IER



Highlights – solid wastes

Conditioning of solid organic wastes in geopolymers:

- **Waste types: molten salts, IER**
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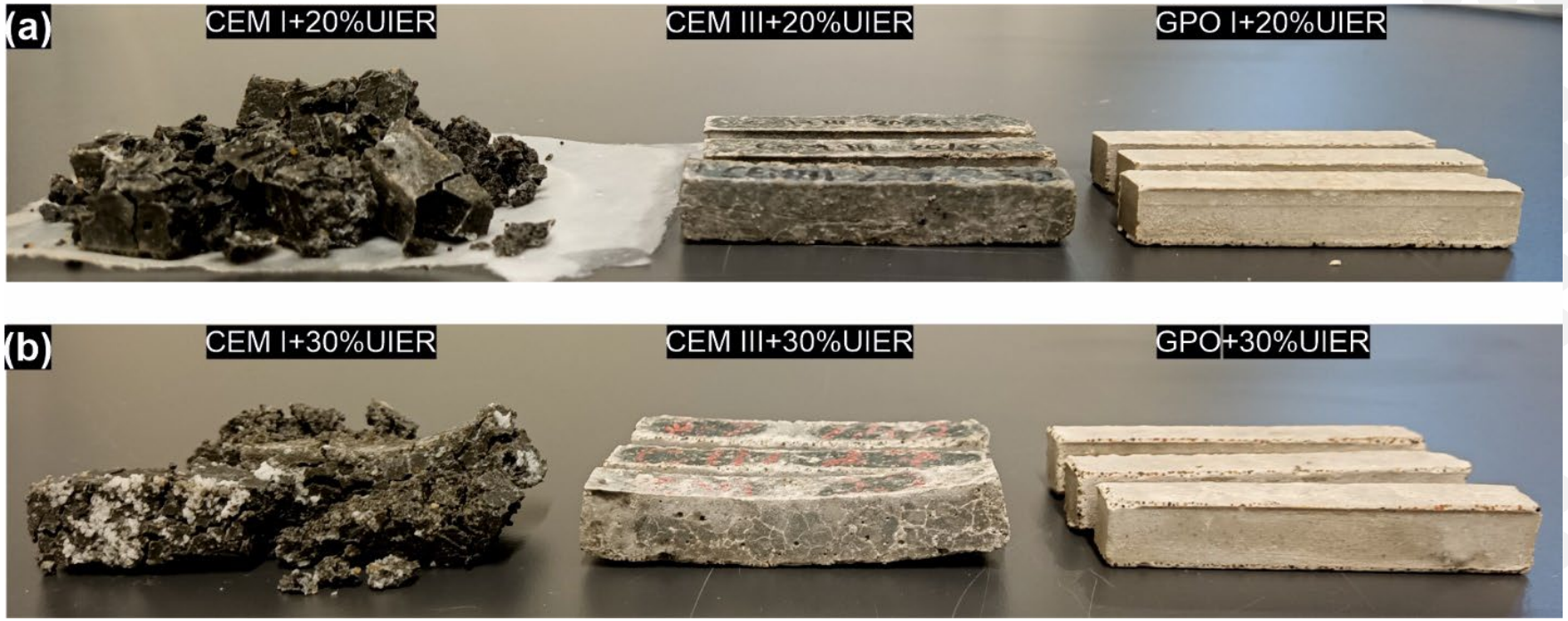


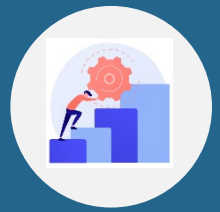
3 months at 21°C and 99% RH

Benefits & Challenges

Benefits

- Solutions for legacy and problematic wastes
- Tailored recipes suitable for various waste types
- High waste loading, no secondary wastes
- High RN binding capacity
- Minimized effort to meet the ACRIA
- Robust, durable and sustainable

Challenges



- No ACRIA available
- Low TRL
- Strict controlled conditioning processes
- Long-term performance

Showcase @ Czech republic

Fresh IER

After mixing

with geopolymer

Pilot installation @ UJV

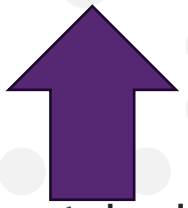
Showcase - SIAL® matrix

- SIAL®
  - Commercial Geopolymer
  - Made from inorganic raw materials (MK →SiO_2 and Al_2O_3)
- Market
  - Licensed in Slovakia, Czech Republic
  - Applied in Japan, Taiwan, France, UK
  - Used for sludge, resins, crystalline borates, residues from thermal treatments and contaminated organic waste

Sludge/resins SIAL matrix [IAEA-TECDOC-CD—1701]

Impacts & Perspectives

1. Promising geopolymer matrices for radwaste immobilization:
   - High potential to comply with ACRIA
   - Suitable for various waste streams with high WL
   - Alternative to cementation
   - Sustainable & environmentally friendly materials
2. Yet challenging:
   - Long-term performance
   - Testing standards
   - Upscaling
3. But having some real scale applications:
   - SIAL matrix: Slovakia, Czech, Japan, Taiwan
   - Others?



Slag from steel production

Ash from coal power plant

Do the project provide helpful inputs to end-users to consider geopolymer as an alternative conditioning matrix?

IMMOBILIZATION OF LIQUID ORGANIC WASTE USING NEW MATRICES - WMO APPROACH

D. Ricard, X. Bourbon, B. Frasca (Andra)

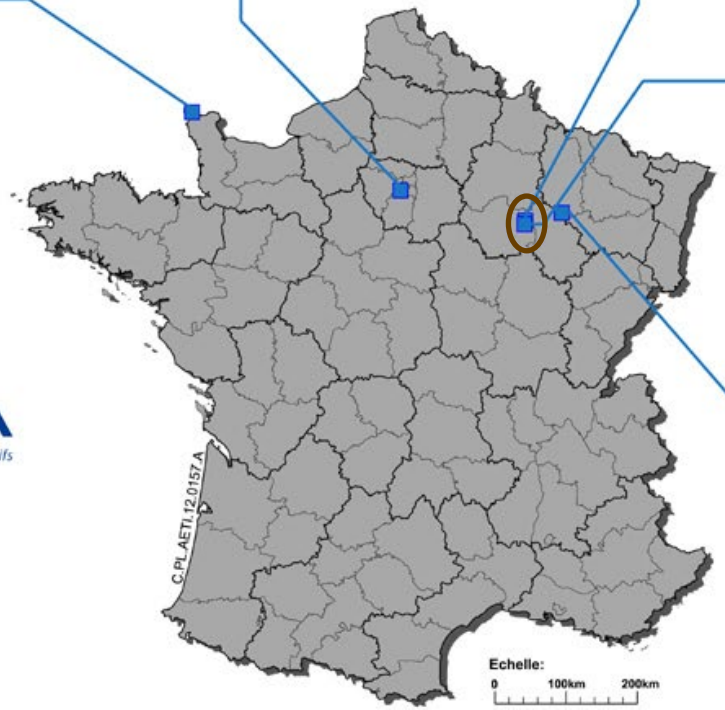
June 5th, 2024, Final PREDIS Workshop

Andra – French Radioactive Waste Management Agency

Head office

CSA
LILW-SL waste repository

CSM
LILW-SL waste repository



VLLW waste repository

Meuse/Haute-Marne site (URL)

ANDRA
La maîtrise des déchets radioactifs

ANDRA

LILW-SL repository – CSA facilities

Surface repository Waste Acceptance Criteria

- Free Organic liquids and oil are not accepted
- No release from the conditioned/encapsulated waste
  - Based on biohazards and environmental impact

Current waste management routes

- Incineration is the common waste management solution
- Depending on the physico-chemical and radiological properties, incineration is not allowed

Alternative to handle this kind of waste

- One concerns the development by waste producers of « new (organic or mineral) matrices » such as geopolymers or polymer materials
  - Knowledge about the properties and behaviour of these materials is less mature
    - Short term behaviour not directly transposable to the long term

R&D needs:

- Understanding of long-term behaviour (physical and chemical behaviour)
  - Prediction over the time

LILW-SL repository – CSA facilities

Perspectives

- In the framework of Eurad II: two WP related to the conditioning and behaviour of new matrices
  - WP6 STREAM– Sustainable treatment and immobilisation of challenging waste
    - Andra participation as End-Users
  - WP7 L'OPERA Long-term performance of waste matrices
    - Andra participation as partner
      - Studies in collaboration with ORANO and PIMM laboratory about Nochar/oil durability and long-term prediction

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Impact of the PREDIS project in relation of use of geopolymers for the immobilization of organic radioactive waste

P. ORMAI

RADIOACTIVE WASTE MANAGEMENT NON-PROFIT COMPANY (PURAM)

Contact: ormai.peter@rhk.hu

CONTACT:

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The Hungarian context

- Formerly considered methods for solidification of ion exchangers and sludge, currently stored in a semi-liquid form in PAKS NPP, were based on cement.
- In recent years, immobilization and/or encapsulation of radioactive waste in a geopolymer matrix has gained global interest as an alternative to standard Portland cement blends.
- PREDIS activities on geopolymer application has further increased our interest in considering this matrix in the future..
- .

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The Hungarian actors involved 1.

- ***Waste generator (NPP)***
  - ✓ The decision on the selection of the conditioning method is up to the waste generator.
  - ✓ Ensure that any waste form (geopolymer), aligns with relevant disposal WAC.

- ***Disposal facility operator (PURAM)***
  - ✓ Establish WAC.
  - ✓ Ensure that (geopolymer) waste form, aligns with relevant disposal WAC, a series of tests are necessary.
    - ✓ These tests establish the durability performance of the waste form over extended time periods, in conditions that simulate representative disposal conditions.
  - ✓ Verify the matrix/package performance according to a set of WAC.

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The Hungarian actors involved 2.

- ***Regulator***
  - ✓ Before regulatory approval of WAC, PURAM has to demonstrate the composite stability under disposal conditions.

- ***TSO***
  - ✓ PURAM rely on the R+D capabilities of specialized institutions.
  - ✓ In PREDIS project Isotoptech Ltd. was the leading company on the subject of state of the art methods for waste form characterisation.
  - ✓ Isotoptech Ltd. is ready to continue both within EURAD-2 or IAEA CRP.
    - ✓ The IAEA has recently proposed CRP which aims to benchmark established cementitious protocols against emerging procedures developed for geopolymer matrix testing.
    - ✓ The goal is to facilitate the establishment of future waste form testing protocols for using geopolymers as matrices for immobilizing radioactive waste.

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Envisaged investigation programme

studies	method
Choosing the samples with appropriate physical and structural properties	NMR relaxometry and microscopic measurements
Measuring the transversal relaxation time of water confined in the pore structure of the hardened geopolymers	taking microscopic images of the samples
Study of the geo-polimerization process for the chosen geopolymers	NMR relaxometry
Leaching studies – Analysis of the leached phases including pH-, conductivity measurement and determination of the leached model ion contents (e.g. Cs-, Ni-, Nb, Nd-, Re-, I-ions) – Analysis of the leached organic molecules	ICP-MS high- field NMR
– Determination of the self- diffusion coefficient of water in the geopolymer samples – Examination of the permeability between the water types in the samples. – Study of the structural changes of the geopolymers during the leaching process	NMR diffusometry NMR relaxometry

studies	method
– Determination of the effective diffusion coefficient, the leaching kinetics and leaching rate of the model ions – Determination of the bound and bulk 133-Cs content of the geopolymers	elemental analysis NMR measurements
Structural characterization Study of the interaction with water Characterisation of the pore structure and water types in the hardened geopolymers	– low- field NMR relaxometry – microscopic images of the solidified samples
– Evaluation of the effect of additives – Study of the hardening process of the geopolymers (geo-polymerisation) Determination of the pore sizes in the hardened binders	NMR relaxometry NMR cryoporometry and relaxometry
Long-range study of the structure of geopolymer	**in situ in the radioactive waste disposal repository**

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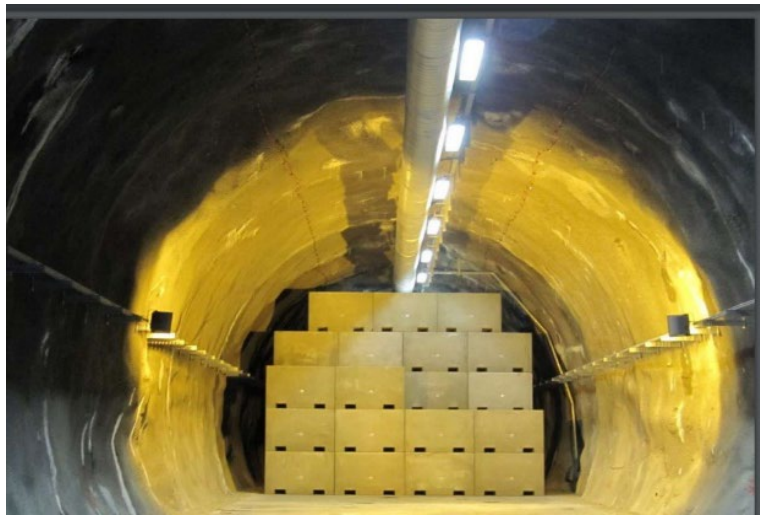
PREDIS

Congratulations to all PREDIS actors for the successful implementation of the project and helping the disposal society.



This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

PREDIS

- Comments and Discussion

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Decontamination & Supporting Waste Hiearchy Principles

Pdf presentation

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

PREDIS

- Comments and Discussion

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Digitalization advancements for monitoring

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

PREDIS

Final Conference
Impact workshop 6.6.2024 - *Digitalization Advancements for Monitoring*

SURESH SEETHARAM

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Key PREDIS Impact - in 4 broad categories

- New monitoring technologies developed within this project
- Validation of the technologies using real scale demonstration tests
- Feasibility of Digital twin deployment
- Innovation in data handling, processing and decision framework

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Key PREDIS Impact – New monitoring technologies

Drum hang-up gamma and neutron sensors, wireless sensor network	External radiological monitoring
NDT such as acoustic emission and ultrasonic test coupled with optical/laser scans	Capture internal defects such as volumetric deformation, cracks, or evolution of waste drums
Embedded sensor technologies – sensor nodes and wireless technology preserving waste drum integrity	Capture evolution of the waste behaviour (T, P, RH, etc.), focus on long term
Muon tomography for large scale waste drums	Capture spatial material heterogeneity

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Key PREDIS Impact – New industrial scale validation

7 industrial scale demonstration tests successfully conducted to validate the monitoring technologies in realistic conditions – surface laboratory/interim storage facilities around Europe

Demonstrated data acquisition from 1000s of km via virtual private network (no internet required)

Demonstrated wireless signal and power transmission across metallic containers (RFID)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Key PREDIS Impact – Digital twin

Digital twin proof of concept developed for a realistic homogeneous cemented waste drum degradation process (lab -> industrial -> digital twin -> integration with PREDIS dashboard)

An alternative Digital twin dashboard developed embedding chemical models to feed into decision analytic framework

Developed a data driven model (machine learning) to address complex degradation processes at the drum scale (artificial neural network based)

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Key PREDIS Impact – Data handling, processing and decision framework

A new customizable data platform developed for sensing and condition monitoring, prediction generation, data integration and management, and decision support

Scalable, layers of digital dashboard for access by different stakeholders (e.g., regulators)

Industrial scale demonstration proved that sensor data can be fed into Microsoft Azure cloud platform, and visualized on the developed decision platform

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Key PREDIS Impact – Challenges, hence opportunities

- No doubt, technical challenges remain with the monitoring technologies, implies TRLs at various degrees of maturity
- Phenomenological understanding and robust model development is key for digital twin deployment
- Heterogenous waste poses even more significant challenges for digital twin deployment
- Challenges with data driven models for decision analytic frameworks yet to be unraveled (training data sets not available if degradation has not kicked in, or the sensor data might not be enough to build a digital twin)

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PREDIS

WP7: Digitalization Advancements for Monitoring

ANDREA CHIERICI

DEPARTMENT OF INDUSTRIAL AND CIVIL ENGINEERING, UNIVERSITY OF PISA

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PREDIS FINAL CONFERENCE, AVIGNON (FR), JUNE 2024

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Introduction

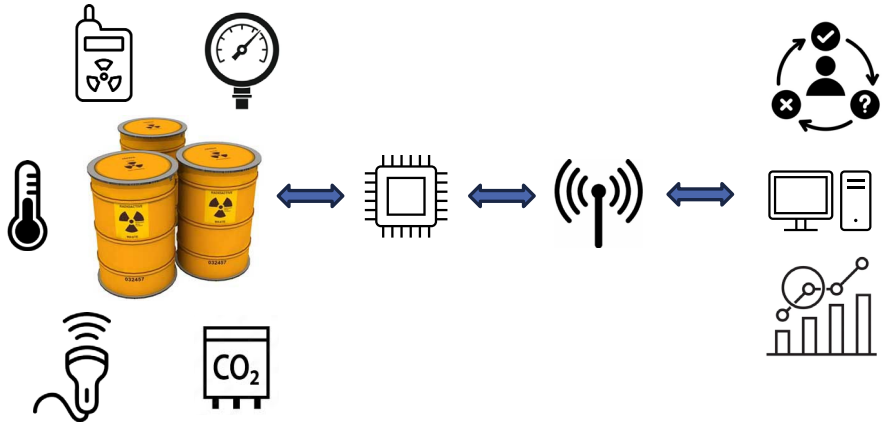
- **Industrial Digitalization?**
  - Novel Sensing Techs
  - IoT
  - Big Data
  - Digital Twins
  - Predictive Analytics
  - AI
  - Etc.

- **Digitalization in PREDIS**
  - Sensing Technologies for Radioactive Waste Drums Monitoring and Characterization
  - Digital Twins for Predictions
  - Data Management Framework for Heterogeneous Information

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Enhancing Waste Management through Advanced Monitoring Technologies

- **Primary Objective:** enhance safety, efficiency, and reliability in radioactive waste management through continuous, real-time monitoring with advanced sensors.
- **Enhanced Monitoring Capabilities:** to facilitate early detection of potential issues.



- **Waste Management Facilities:** better operational decisions, reduced risk of containment failures, and enhanced compliance with safety regulations.

- **Regulatory Bodies:** ensure waste management high safety and environmental standards through detailed, real-time data.

- **Environmental Impact:** protection from potential radioactive contamination, supporting sustainable waste management practices.

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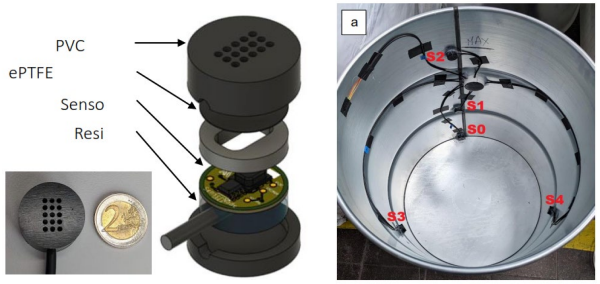
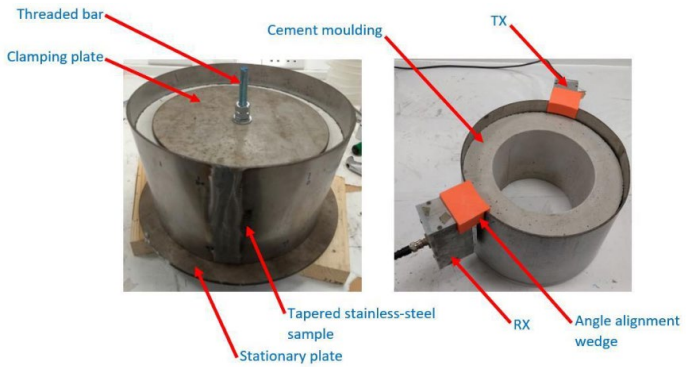
Bridging the Gap: From Development to Deployment

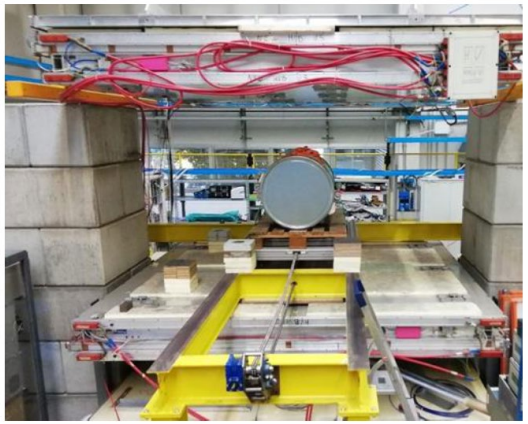


Embedded Sensors



Ultrasonic Inspection

External Radiation Sensors
WiFi/LoRa



Muon Tomography

Acoustic Emission for ASR

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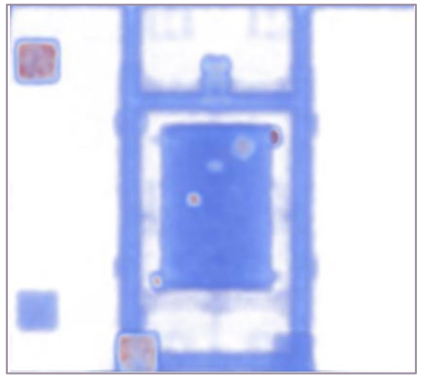
Pathway to Real-World Implementation of Sensor Technologies

Demonstration Tests:

- Conducted in simulated environments that closely mimic actual waste storage conditions to confirm the technologies' operational capabilities.
- **ÚJV Řež demo test:** embedded sensors, SiLiF / SciFi, Sensorised LoRa Network
- **INFN-Padova:** MU-tom demonstrator
- **National Nuclear Laboratory, UK:** ultrasonic inspection
- **Magics Technologies / SCK-CEN:** acoustic monitoring for ASR



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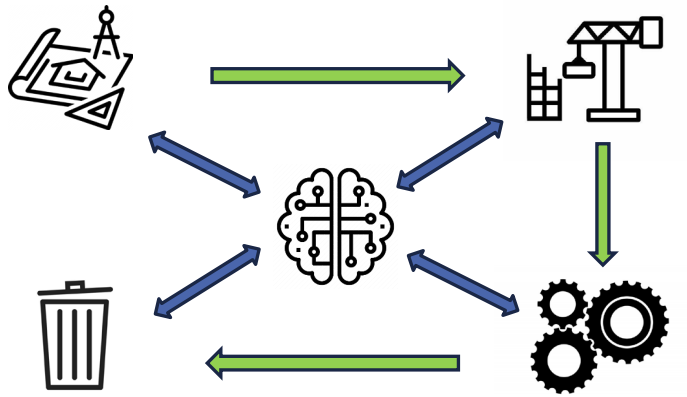
Advancing Radioactive Waste Management with Digital Twins

- **Digital Twins:** capable of managing complex systems across various industries by providing a detailed, real-time view of physical assets throughout their lifecycle.
- Digital Twins track assets through all lifecycle phases: **Create** (design), **Build** (manufacture), **Operate** (use), and **Dispose** (decommission).



Why Digital Twins?

- **Real-Time Monitoring**
- **Predictive Maintenance**
- **Enhanced Decision Making**
- **Regulatory Compliance**

Neural network models to predict chemical reactions in waste packages	Automated control systems that can adjust operations in real-time to prevent critical issues	Bayesian methods to estimate parameters and validate models for regulatory purposes

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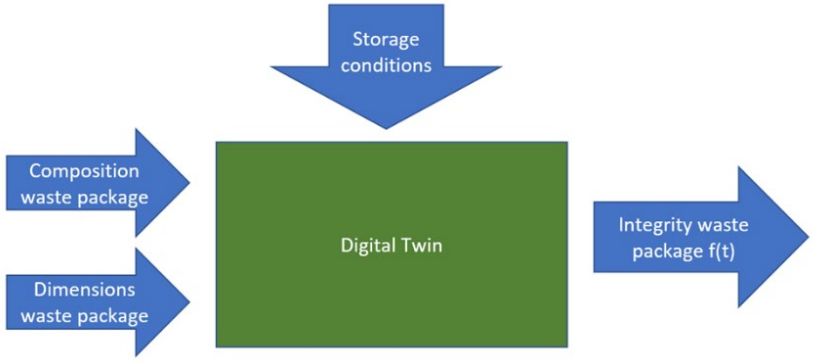
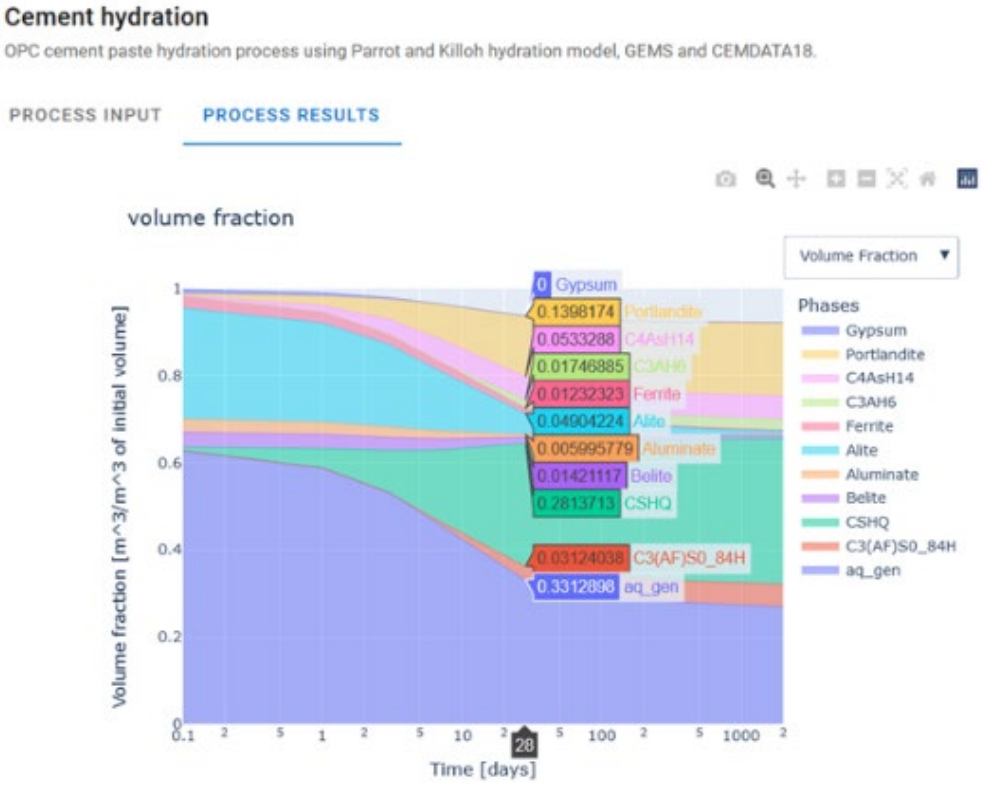
Building the Digital Twin Toolkit for Radioactive Waste Management

- In PREDIS, **a DT toolkit** to model and simulate the behavior of packages was developed.
- It incorporates **multiphysics models** (thermal, hydraulic, chemical, and mechanical processes).
- Based on the input values and evolution submodel(s) the **integrity evolution** can be calculated over time.





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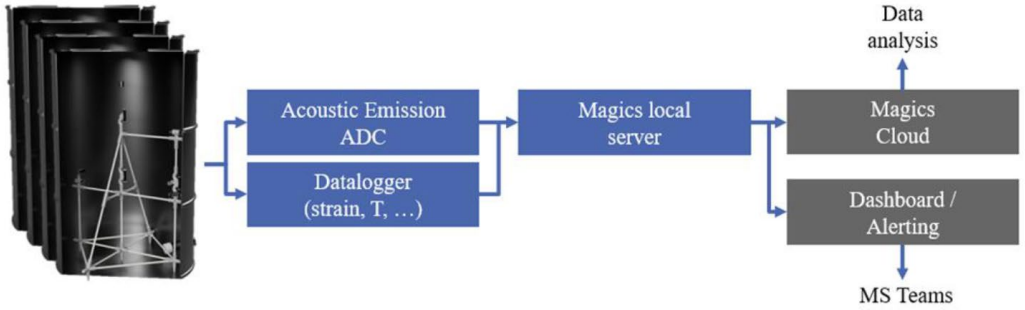
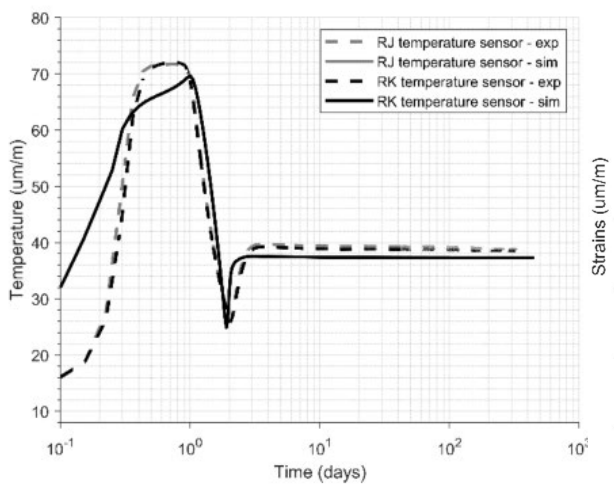
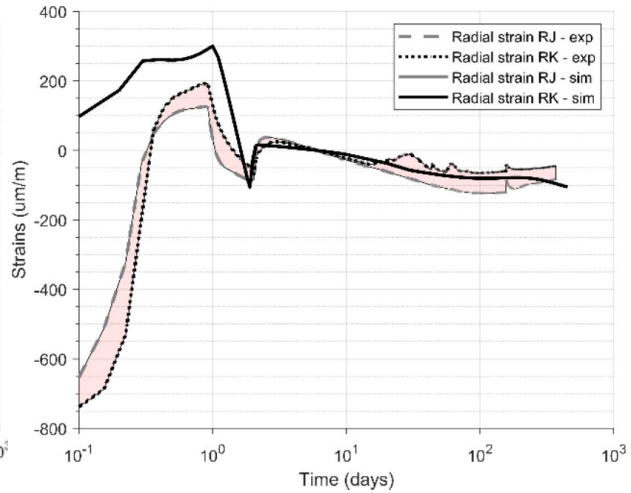
Applying Digital Twin Technologies: Case Study and Future Integration

Case Study: Alkali Silica Reaction (ASR):

- **ASR** can lead to the formation of **expansive gels**, causing **cracking** and **structural damage**.
- **Lab-scale** experiments to **refine the model**, while **drum scale** experiments to **validate it** through blind prediction.
- The experiments were done on **without the radioactive waste** to keep things simpler and more focused on ASR.
- The **model allowed to predict ASR progression**, allowing proactive measures to prevent damage.







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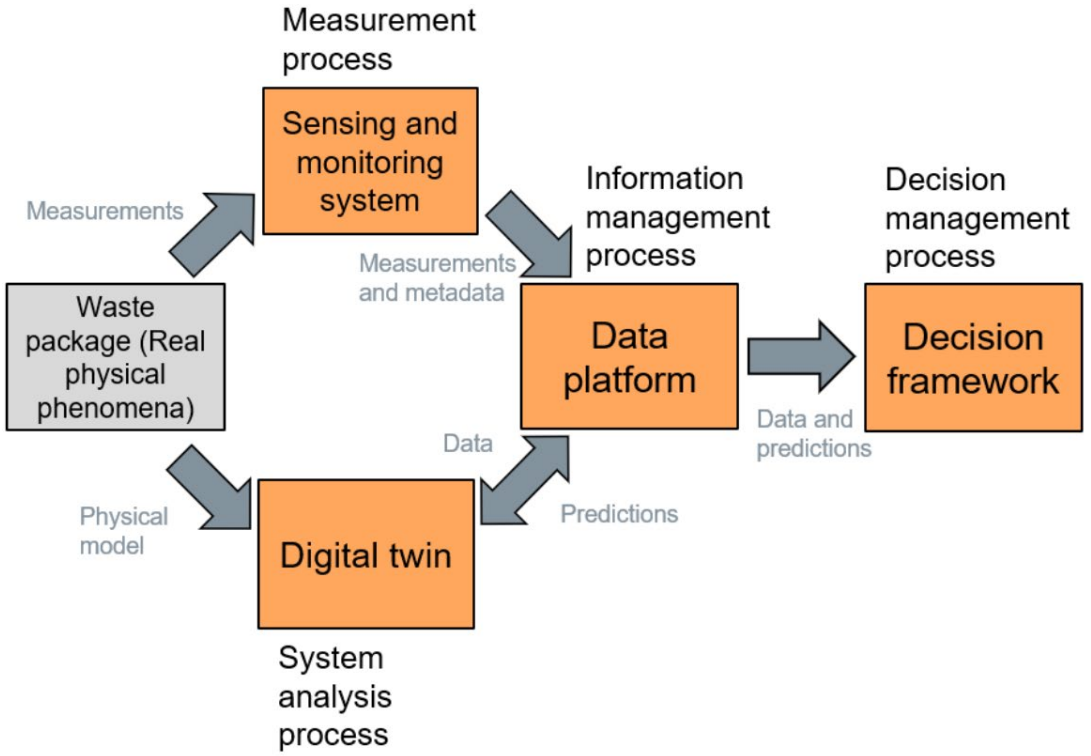
Developing a Comprehensive Data Management Framework

Purpose and Objectives:

- **Goal:** create a secure and efficient data handling and decision-making framework for managing cemented radioactive waste.
- **Objective:** integrate data from various sources to enhance monitoring capabilities and support decision-making processes.



- ❑ Scalability, flexibility, IoT
- ❑ Security, compliance, global reach
- ❑ Good developer tools and ecosystem

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Developing a Comprehensive Data Management Framework

Data Platform

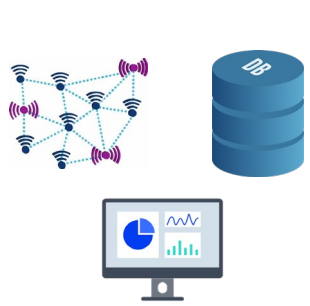
- Device and Sensor Integration
- Configurable Human Machine Interface (HMI)
- Dashboard Concept
- Reference Database

Data Processing

- Data Integration
- Data Cleaning
- Time Series Data Handling
- Data Transformation

Decision framework

- 3D and Dose Analysis
- Online Analytical Processing (OLAP)
- Digital Twin View
- Dashboards



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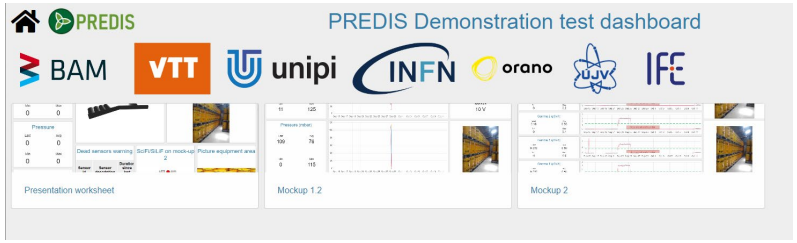
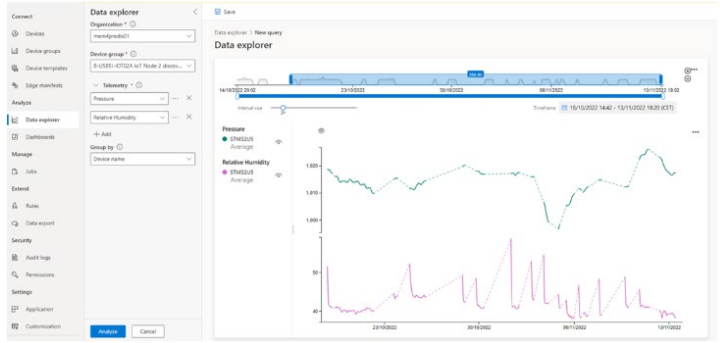
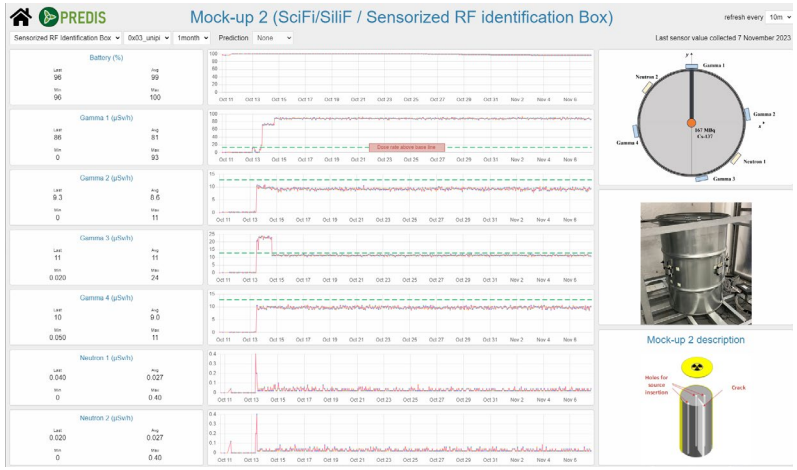
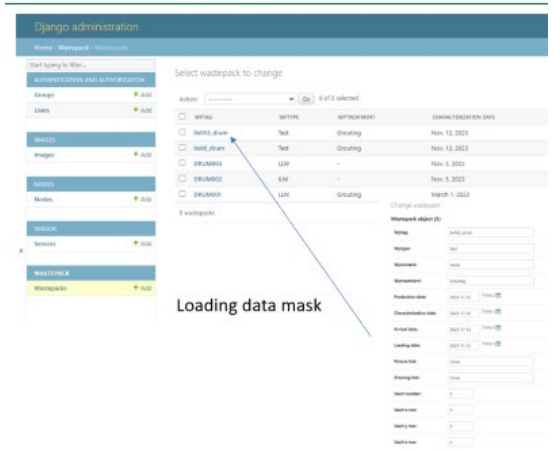
Data Platform Case Studies









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PREDIS

- Comments and Discussion

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PREDIS

Coffee / Stretch Break
Resume at 11.25 CET

Personal slides presentation

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

PREDIS

STAKEHOLDER PANELISTS – Thursday Morning

- **Hélène DENIAU**, Performance & Methods Director at Veolia Nuclear Solutions
- **Henri LE MONIES DE SAGAZAN**, Deputy Head of waste management, EDF
- **Fabrice MOGGIA**, R&D Leader, ORANO
- **Magali SALUDEN**, R&D Manager Decommissioning, CEA
- **Virginie WASSELIN**, Head of Strategy Department, ANDRA





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PREDIS

STAKEHOLDER QUESTIONS

1) What are best practices how R&D and/or Knowledge Management activities in projects have been done together with end users or stakeholders?
2) How can the work done in projects be utilized by the wider community?
3) What type of challenges or limitations are there when utilizing results of such projects?
4) How should the research community best support governmental and industry groups to focus on the most impactful topics in projects?
5) What challenges still remain or should be the focus as we move forward with collaborative RD&D and Knowledge Management activities for the next 5 years (EURAD-2 new programme)?

(audience questions as well)

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PREDIS

Lunch break
Resume at 14.00 CET

Personal slides presentation

This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

PREDIS

STAKEHOLDER PANELISTS – Thursday Afternoon

- **Anthony BANFORD**, SNETP TA5 Chairperson
- **Paul CARBOL**, EURAD cooperation (KM views)
- **Hans FORSSTRÖM**, Senior Adviser SKB International, (EC Evaluator views)
- **Seif Ben Hadj HASSINE**, Program Officer, European Commission
- **Vaidas MATUZAS**, Scientific Officer, JRC
- **Rebecca ROBBINS**, Radioactive Waste Team Leader (Predisposal), IAEA






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PREDIS

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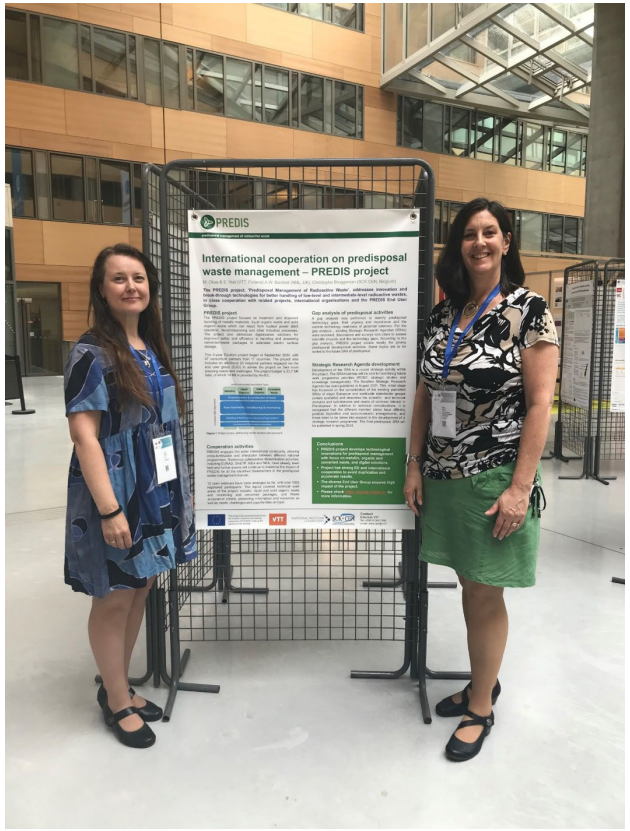
CLOSING WORDS - COORDINATORS



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4) What do you think (in under 5 words)?

What are you most proud of in PREDIS?

Presentation Link

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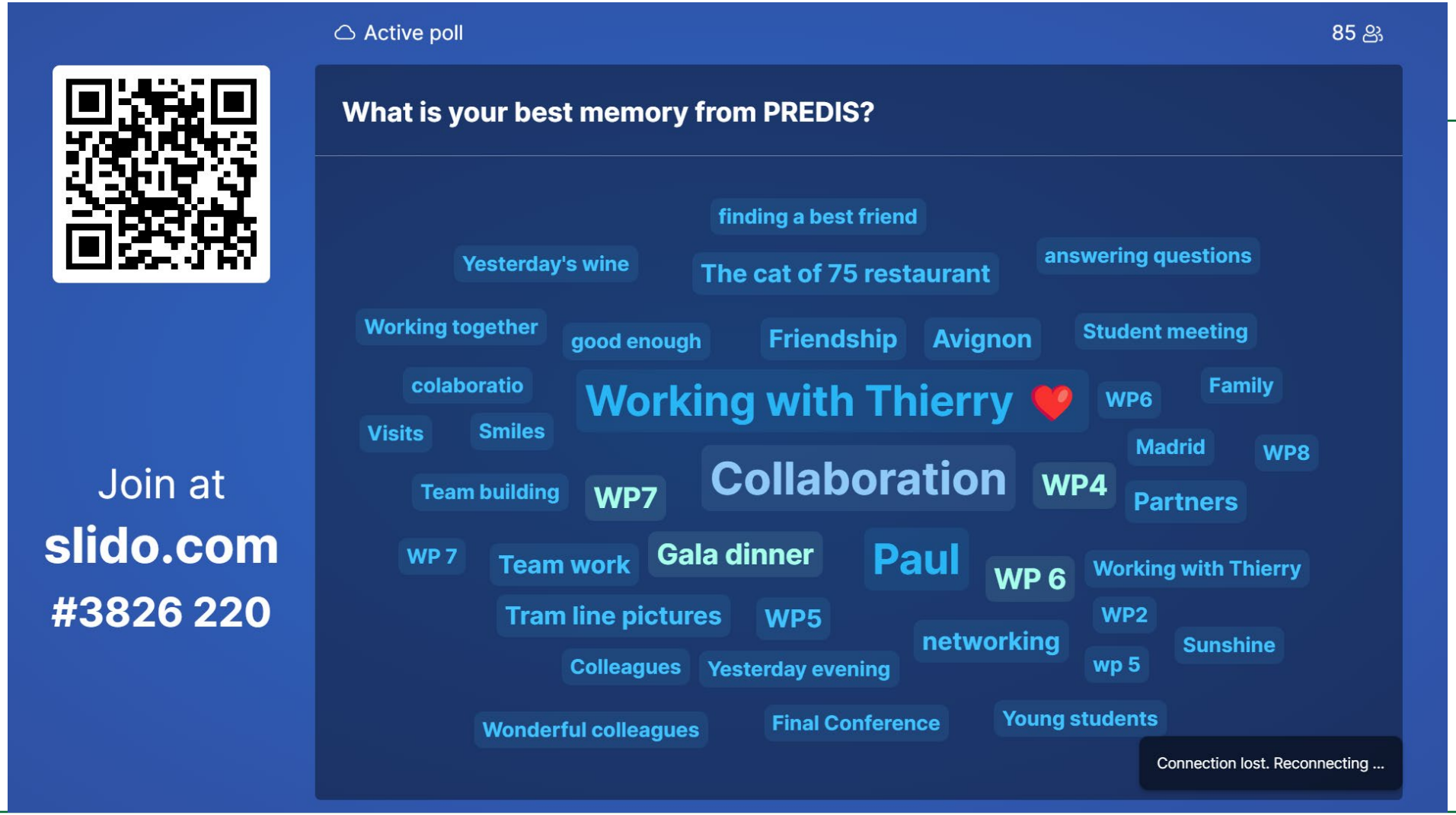
PREDIS



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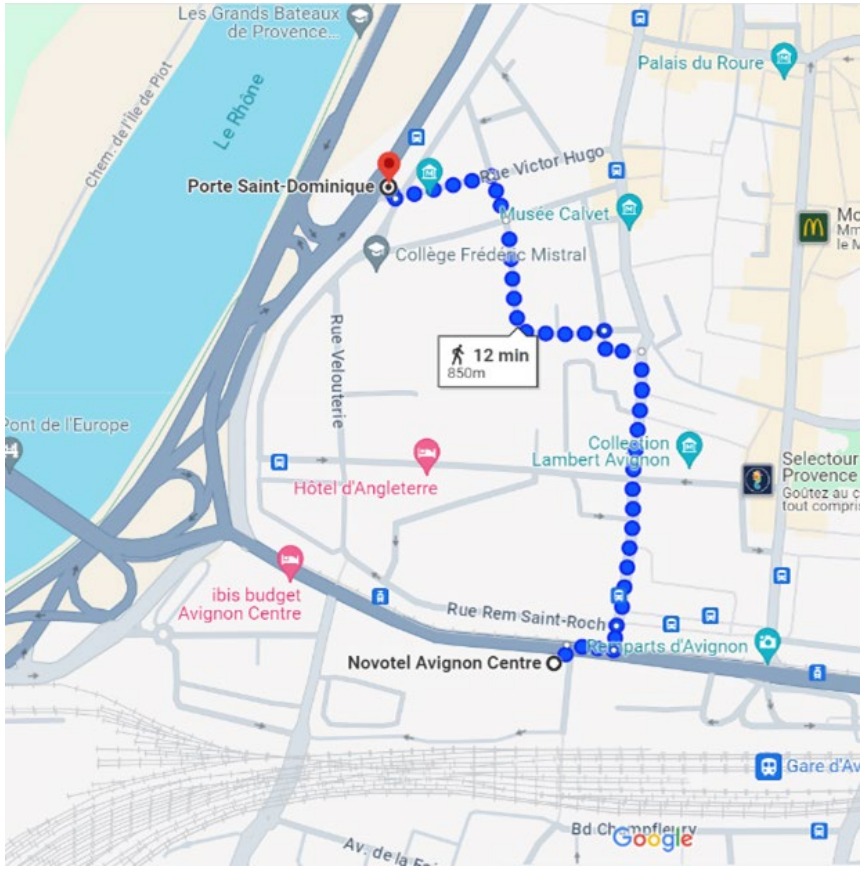
PREDIS

Marcoule tour to CEA tomorrow Friday 7.6.2024

- The bus will **departs at 7h30 in Porte Saint Dominique**, located 850 meters from the Novotel Avignon Centre hotel. (be there a few minutes early)
- Bring your ID!
- No computers!
- Proper clothing (see instructions)!
- **For more information please check the email sent by Hélène NONNET last Tuesday (28/05/2024)**



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PREDIS

OTHER REMINDERS

- EC needs Evaluators who have waste management (predisposal!) competences. Please consider and encourage colleagues to register https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/work-as-an-expert
- Return your nametag badges and lanyards to the box at the Registration table upon departure
- We look forward to seeing you at EURAD-2 (23-25.10.2024, Brussels) and EURADWASTE (13-16.5.2025, Warsaw)
- We appreciate your feedback on the event (or QR code): https://www.lyyti.fi/questions/29bc703243

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THANK YOU TO THE PREDIS FAMILY!
Let’s keep the enthusiasm and momentum