

30 May - 3 June 2022  
Lyon, France

# SHARE: STAKEHOLDER BASED ANALYSIS OF RESEARCH FOR DECOMMISSIONING

JUNE 1<sup>ST</sup> 2022

**Robert Winkler (CEA, France)**, Laura Aldave de las Heras (JRC, Germany), Emilio Garcia Neri (ENRESA, Spain), Anthony Banford (NNL, UK), Kurt van den Dungen (SCK CEN, Belgium) Pierre Joly (IE, France), Rékà Szőke (IFE, Norway), Federica Pancott (SOGIN, Italy), Anumaija Leskinen (VTT, Finland), Gintautas Poškas (LEI, Lithuania), Angelika Bohnstedt (KIT, Germany)



10<sup>th</sup> European Commission Conference on EURATOM Research and Training in Safety of Reactor Systems  
30 May - 3 June 2022 | Lyon, France

## Project Overview

### SHARE – StakeHolder based Analysis of REsearch for Decommissioning

Consortium of 11 European Stakeholders :

- CEA, France (Coordinator)
- ENRESA, Spain
- IFE, Norway
- KIT, Germany
- LEI, Lithuania
- NNL, United Kingdom
- SCK CEN, Belgium
- SOGIN, Italy
- VTT, Finland
- JRC, Karlsruhe
- EI, France

Timeline

Start, 1/6/2019

End, 28/3/2022

Extension, July 2021

Budget : 1.4 M€ (EU Grant NFRP-2018-5 847626)

Contact (CEA): Robert Winkler (robert.winkler@cea.fr) & Anne Fornier (anne.fornier@cea.fr)



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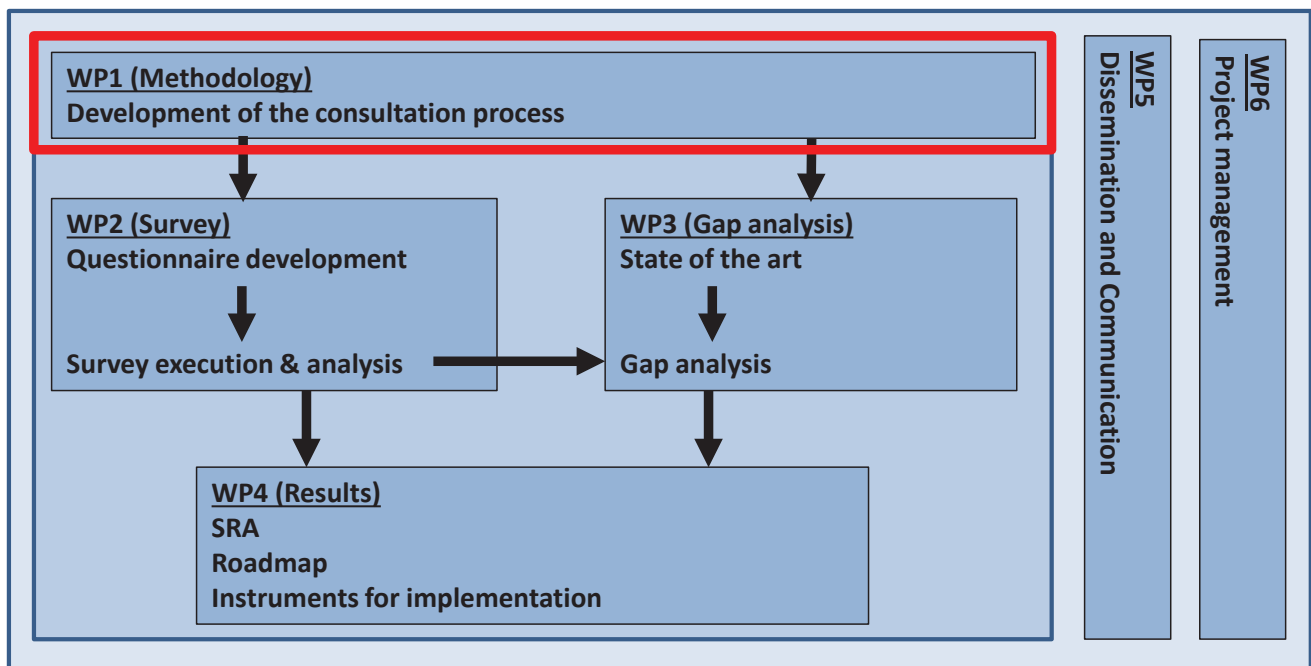
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## The main objectives

Main SHARE objective was to provide an **inclusive roadmap** for future research collaboration, for **Stakeholders** to jointly improve safety, reduce costs and minimize environmental impact **in the decommissioning of nuclear facilities**.

- Determine the **research needs** based on the opinions collected from Stakeholders in an inclusive process
- **Review the state of the art** in collaboration with the Stakeholders to **identify the gaps**
- Construct a **Strategic Research Agenda (SRA)** to fill the gaps with **activities** consolidated together with the Stakeholders that will feed a **roadmap of activities** for the next 10-15 years and will allow to propose **instruments for implementation** for the activities using identified mechanisms

## The work packages



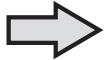
# WP1: Methodology

## Objectives

- Elaboration of a list of Stakeholders that is representative of the decommissioning industry



Consortium members established a list based on contacts and publicly available information (650 contacts)



Stakeholders' type (Industry, regulator...) and country are observed for representativity

- Development of a methodology of evaluation for the questionnaire



Work towards a weighting procedure for the items in the questionnaire

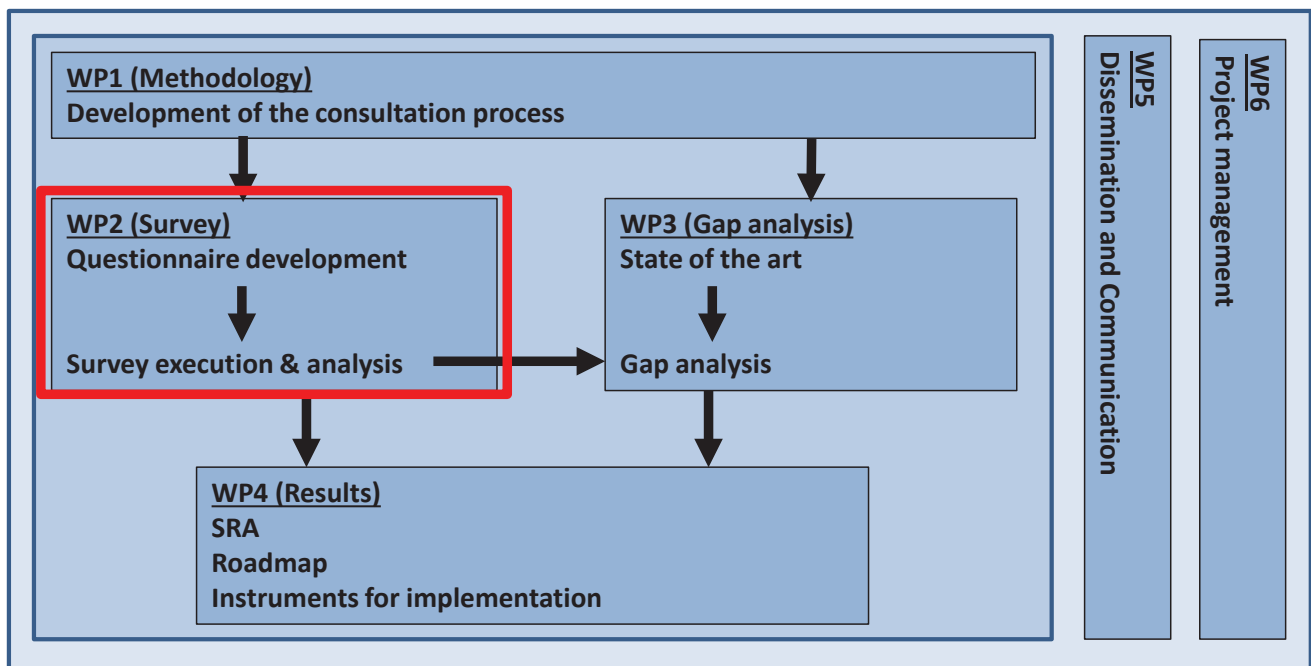
- Overall structure of the project



Work towards defining the interactions between deliverables



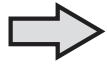
## The work packages



## WP2: Survey

### Objectives

- Development of the questionnaire survey



Consortium developed a questionnaire that is endorsed by the Expert Review Panel



## WP2: Survey

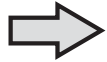
### Objectives

- Development of the questionnaire survey

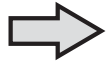


Consortium developed a questionnaire that is endorsed by the Expert Review Panel

- Survey execution



Online survey from March 2020 to July 2020



224 filled out questionnaires from the 650 contacted stakeholder and additional comments in open section

- ✓ Predefined questions in thematic areas with ratings on importance and urgency
- ✓ Additional comments in open section



# Representativity of responding stakeholders

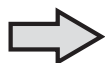
## Percentage of Stakeholders in the survey



## WP2: Survey

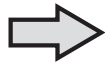
### Objectives

- Development of the questionnaire survey



Consortium developed a questionnaire that is endorsed by the Expert Review Panel

- Survey execution



Online survey from March 2020 to July 2020



224 filled out questionnaires from the 650 contacted stakeholder and additional comments in open section

- Survey analysis



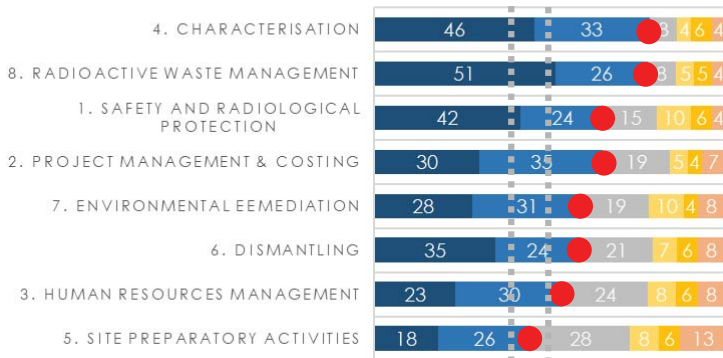
Weighting of the ranking by (I) matching the contacted population and (II) type of stakeholder, status of the decommissioning project and region



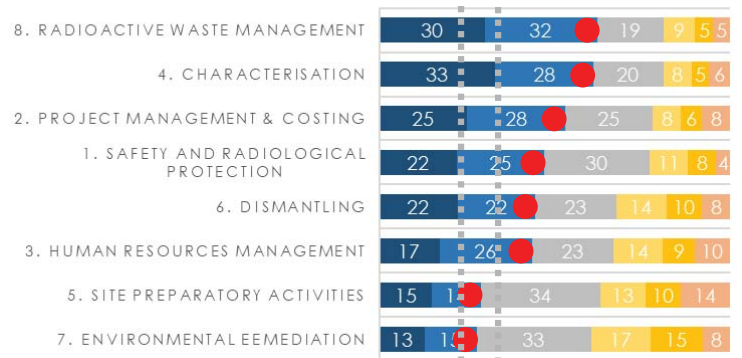
# Main outcome: Urgency and Importance ranking

**Top 2 ranking was found most relevant (ex. Thematic areas) indicated by a ●**

## IMPORTANCE



## URGENCY



➤ Generally Importance > Urgency

➤ Slight difference in prioritisation but Q4, Q8, Q1 & Q2 more important than Q6, Q3, Q5 & Q7

➤ Three categories:

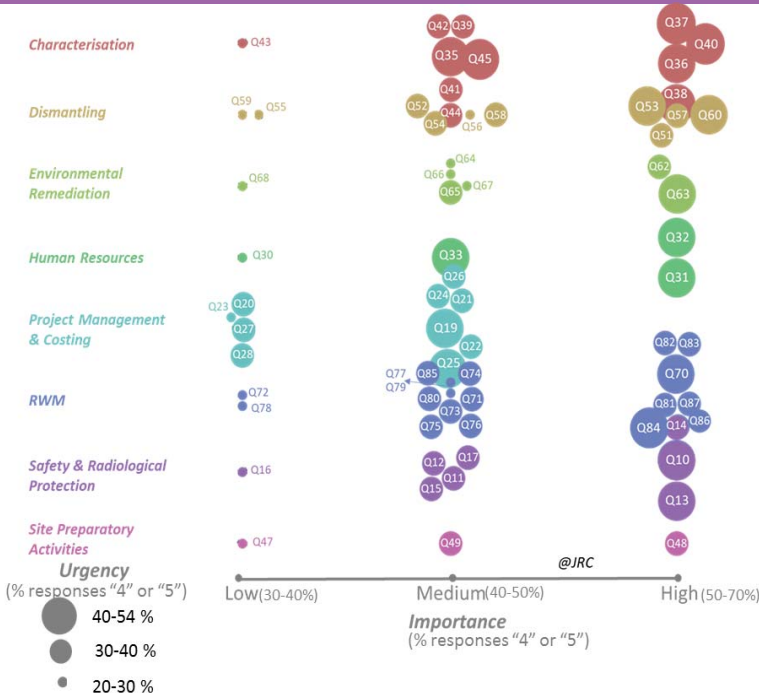
	High	Medium	Low
Importance	>50	50-40	<40
Urgency	>40	40-30	<30



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## For the sub-thematic areas



### Interpretation:

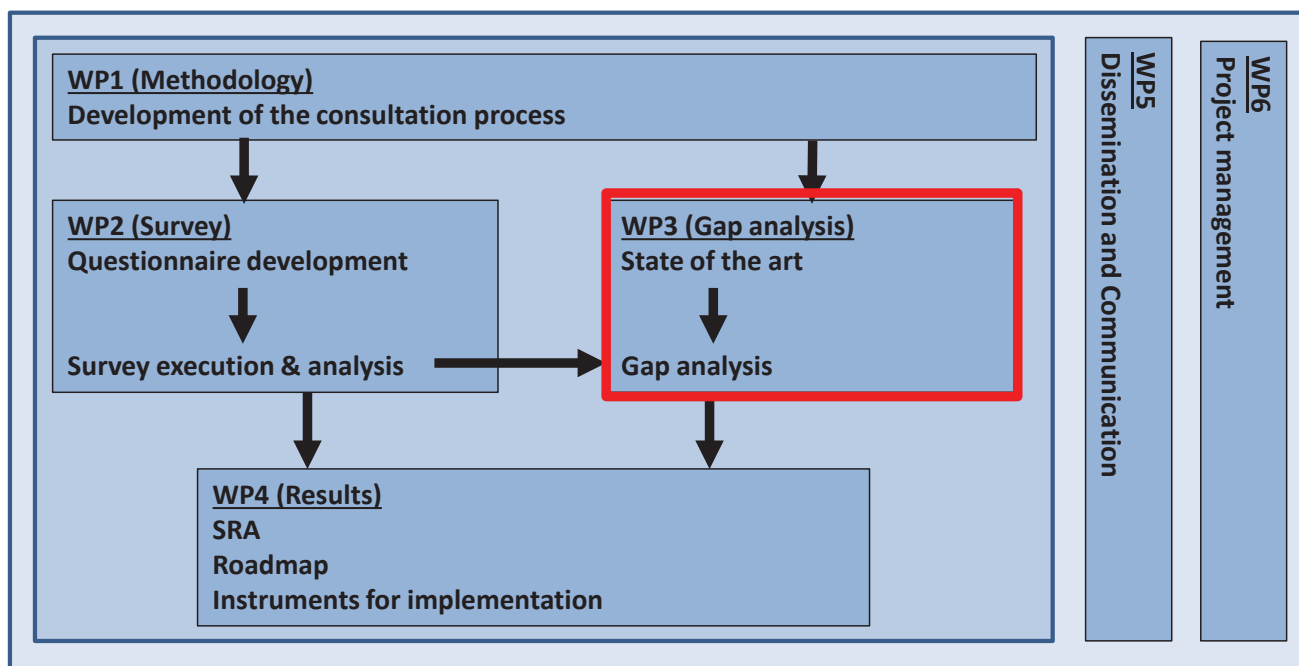
- Each colour corresponds to a thematic area
- Each circle correspond to a sub-thematic area (Q10-Q84)
- Bigger circles = higher urgency rating
- Circles further to the right = higher Importance rating
- Most of the time, for a given sub-thematic areas, importance and urgency have similar tendencies

Place	Importance		Urgency	
	Number	Title	Number	Title
1	Q36	Inventory assessment (Radiological and non-radiological)	Q36	*
2	Q53	In situ Radioactive Waste characterization and segregation	Q53	*
3	Q60	Robots and remote controlled tools for dismantling	Q32	General education for decommissioning
4	Q38	Characterization of activated components and areas (Concrete)	Q13	*
5	Q40	Technologies for hard to access areas (high walls, embedded components, harsh environment...)	Q38	*
6	Q37	Characterization of activated components and areas (Metal)	Q70	*
7	Q70	Management routes for materials including radioactive waste streams	Q37	*
8	Q13	Development for National regulatory guidance for Decommissioning (Clearance of structures and materials)	Q40	*
9	Q62	Clearance of surfaces and structures (interiors and exteriors)	Q60	*
10	Q63	Characterization methods and technologies to identify subsurface	Q84	Material clearance (methodology and procedures)



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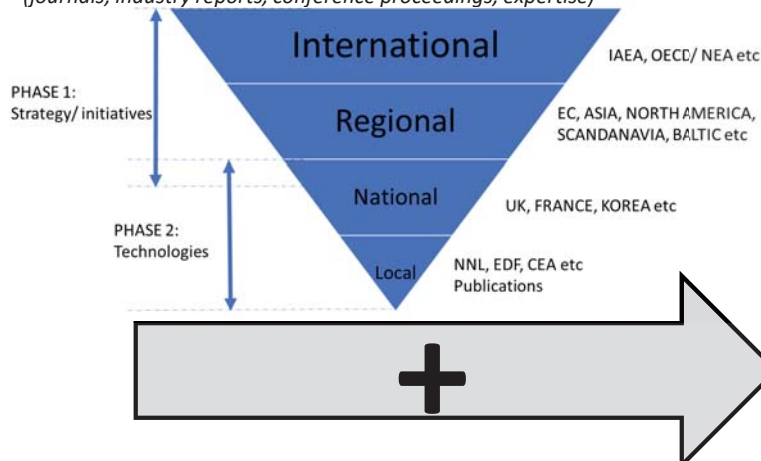
# The work packages



## WP3: Outcomes

### Consortium literature review

*(journals, industry reports, conference proceedings, expertise)*



Stakeholder workshop in October 2020

### Extensive review on the existing practices and on-going developments in the 8 thematic areas



## SHARE

H2020 NFRP-2018 CSA: Coordination and Support Action

Grant Agreement n° 847626

### D3.1: Report detailing applicable technologies/ methodologies

Author: Federica Pancotti, [SOGIN]

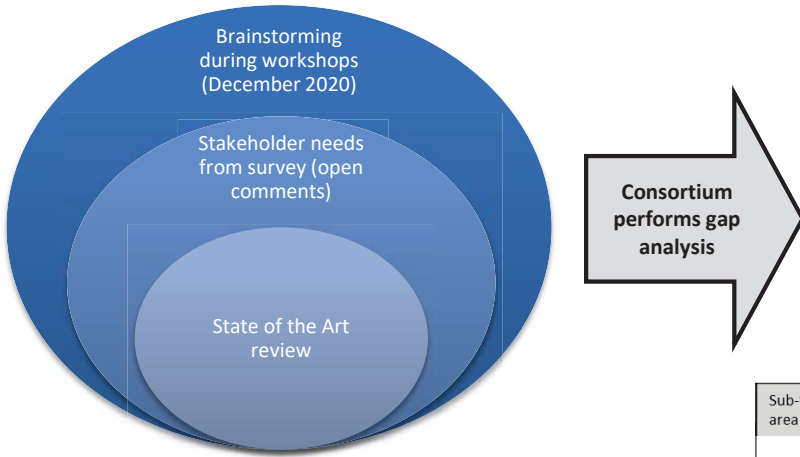
With contributions from: Fanny Fert [CEA], Ludovic Vaillant [CEA/CEPN], Jorge Borque Liñán, Emilio Garcia Neri [ENRESA], Istvan Szöke, Lucas Stephane [IFE], Angelika Bohnstedt, Simone Müller [KIT], Gintautas Poškas, Povilas Poskas, Egidijus Babilas [LEI], Samantha Ree, James Dewar, Ed Butcher [NNL], Kurt Van Den Dungen, Luc Noynaert [SCK-CEN], Alessandro Mattioli, Domenico Lisi, Rossella Sciacqua, Valerio Maturo, Gianpaolo Di Bartolomeo, Carlo Rusconi [SOGIN], Markus Airila, Raimo Launonen, Rafael Popper, Antti Rätty, Anumaija Leskinen, Uro Auterinen, Jaakko Leppänen, Petri Kotiluoto [VTI]

Reviewers: Christine Georges [CEA], Réka Szöke [IFE], Laura Aldave de las Heras [JRC], Muhammad Junaid Ejaz Chaudhry [KIT], Anthony Banford [NNL]





# WP3 Main Outcome



## 250 proposed actions for the 71 sub-thematic areas

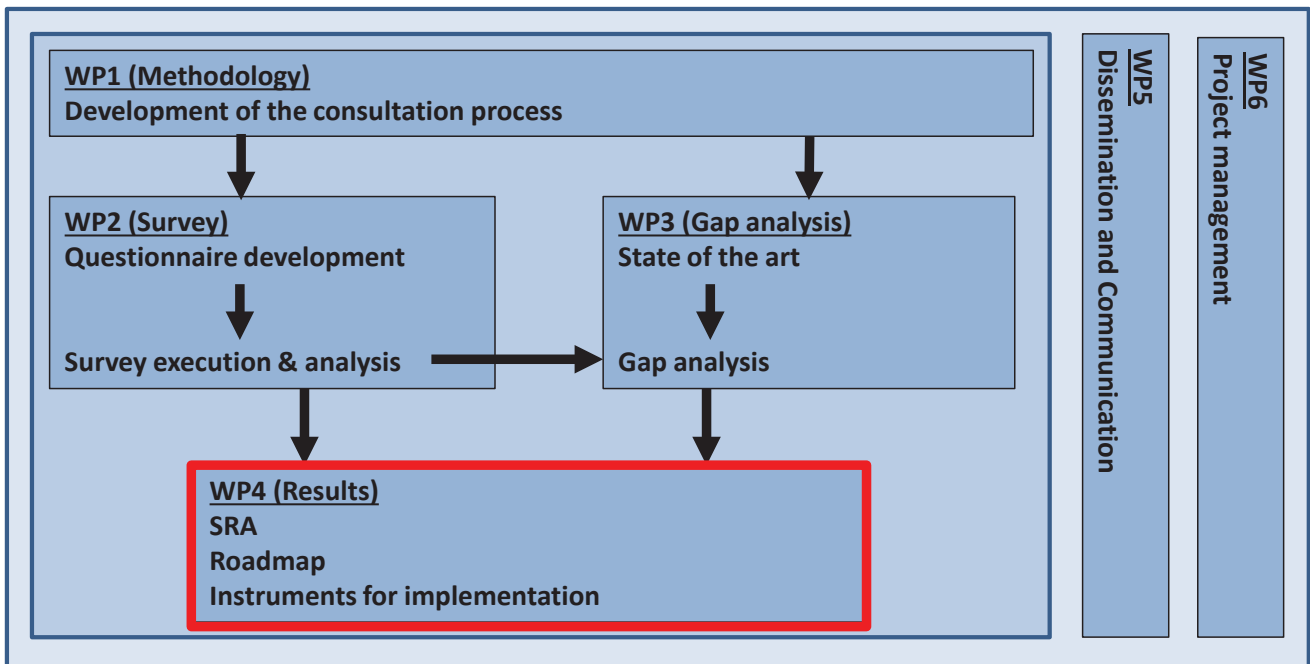
- consolidated with the help of the stakeholders at DigiDecom 2021



Sub-thematic area	Needs or opportunities	Actions proposed		Type
Q59. Demolition of large, reinforced concrete structures	Safety reference	Benchmarking	for the safer techniques for demolition of large structures with reinforced concrete.	Guidance
		Guidance	for using remote demolition that provides worker safety.	Guidance
	Innovation and improvements in Laser technology	Benchmarking	for laser technology considering secondary waste minimisation and efficiency	Development
		Development	in laser technology by considering micro melting phenomenon	



# The work packages





# WP4: Strategic Research Agenda

## Four Action Types

Implementation of RD&D	<ul style="list-style-type: none"> <li>Includes research, development, demonstration and deployment activities.</li> <li>Includes underpinning activities such as benchmarking</li> <li>Knowledge creation across all TRL levels</li> </ul>
Knowledge Sharing	<ul style="list-style-type: none"> <li>Focuses on knowledge exchange ranging from knowledge management to dissemination activities</li> <li>Includes best practices and networking</li> </ul>
Education and Training	<ul style="list-style-type: none"> <li>Activities that aim to develop capabilities, skills and competences for the nuclear workforce</li> </ul>
Harmonisation of Practices	<ul style="list-style-type: none"> <li>Opportunities and benefits of harmonisation in the areas of regulatory frameworks and technology development</li> <li>Achieved by mutual agreement and consolidated by recommendations, directives and guidelines</li> </ul>

### Non-technological areas (Safety, project management, human resources)

- Mainly cross-cutting activities (KS, HP, E&T)
- Education and recruitment of the next generation work force
- Development of adequate digital tools
- Development of cost estimation methodologies

### Characterisation and Radioactive Waste Management

- Most important thematic areas
- Measurement optimisation (Difficult to measure RN, in-situ)
- Waste treatment and conditioning techniques
- Harmonisation of waste criteria

### Dismantling, Decontamination and Environmental remediation

- Waste minimisation
- Improvement of efficiency, mobility and automation
- Sharing best practices and development of guidance



# ROADMAP

## SHARE TIMELINE

SHARE roadmap, based on the SHARE Strategic Research Agenda, compiles the various activities by activity bundles. These bundles are prioritised to establish visibility of the necessary action in 5, 10 and 15 years from the stakeholder perspective.

### TYPE OF ACTIVITY

- RD&D
- Knowledge Sharing
- Harmonisation of Practices
- Education & Training

Enhance **international cooperation and coordination** (IAEA, NEA, WNA, WENRA, ENSREG) on **harmonisation of WAC**.  
Strategy and promotion for international **sharing of facilities** (treatment and/or storage of waste from decommissioning).  
Enhance harmonisation of practices in **VLLW management** (metal, concrete etc.) regarding clearance and acceptance criteria.  
Enhance international harmonisation of **clearance criteria for Solid/Liquid/Gaseous** radioactive materials from decommissioning.  
Enhance harmonisation of practices in **packaging** (transport, storage, disposal).

New **cost effective** and more general purpose **modular and mobile systems** and robotic solutions.  
Technologies and methodologies for **hard to access areas** (tele-operated remote arms).  
**Testing methodologies in mock-ups**.

Easy to access **database for robotics**.  
Sharing of experiences and **best practices** for efficient remote cutting technologies.

Harmonisation of practices, development of **standards** for robotic verification and demonstration.



### DIGITALISATION, MODELLING & SIMULATION

Best practices and guidelines on the implementation of digital technologies to improve key tasks in the decommissioning. **BIM and Digital twins** to add value and accelerate the decommissioning programmes.

### in situ WASTE CHARACTERISATION & SEGREGATION

Remote, integrated and automatic technologies for in situ waste characterisation and segregation (improvement of existing technologies, active demonstration to increase the **technology readiness and demonstrate maturity**).

### EDUCATION FOR DECOMMISSIONING

Harmonisation of **education levels** required for decommissioning (i.e., certificates for specific skill sets).  
E&T at **international level and cooperation** between different stakeholders by internships and certifications for attracting young workforce.  
Enhance the use of **immersive training methods (VR)** for task specific training through certificates and standards.  
Implementation of **E&T programmes** to ensure sufficient and skilled staff are available for the sector with a special focus on the use of **new technologies**.

### INTERNATIONAL STANDARDISATION & HARMONISATION

### DIFFICULT TO MEASURE RADIONUCLIDES (DTM)

Fast, cheap and straightforward methods for difficult to measure (DTM) radionuclides, in situ alpha and beta measurements and automation.

### ROBOTICS & REMOTE SYSTEMS FOR D&D

### SRA THEMATIC AREAS

- 01 Safety, Radiological Protection & Resources Management
- 02 Characterisation
- 03 Material & Waste management
- 04 Site Preparatory Activities, Dismantling, Decontamination & Demolition
- 05 Environmental Remediation
- 06 Final Release

## Outlook

- On-going projects on some of the issues

**PLEIADES**  
Smarter Plant Decommissioning



**eurad**  
European Joint Programme  
on Radioactive Waste Management



**PREDIS**

- Encouraging stakeholders to initiate collaborative projects to provide solutions



## Thank you



**Initiator and founder of SHARE**  
**Christine Georges**

Anne Fornier  
Ludovic Vaillant  
Fanny Fert



Pierre Joly  
Romain Tricon-Duez



Emilio Garcia Neri  
Jorge Borque Liñán



Rékà Szőke  
Istvan Szőke  
Lucas Stephane



Laura Aldave de las Heras  
Karin Casteleyn



Angelika Bohnstedt  
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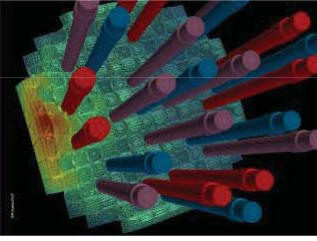


Federica Pancotti  
Rossella Sciacqua  
Alessandro Mattioli



Anumaija Leskinen  
Rafael Popper  
Iiro Auterinen





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**Thank you for your attention!**



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