

International Conference on  
**The Safety of Radioactive  
Waste Management,  
Decommissioning,  
Environmental Protection  
and Remediation**

**6-10 November 2023  
Vienna, Austria**



**Ensuring Safety and  
Enabling Sustainability**





HARMONISED BEST PRACTICES, REGULATIONS  
AND STANDARDS IN WASTE MANAGEMENT AND  
DECOMMISSIONING

# EURATOM HARPERS PROJECT PHASE 1 OVERVIEW

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This project has received funding from the Euratom research and training programme 2021-27  
under grant agreement No 101060028

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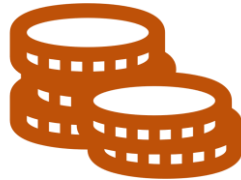
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**What`s next, where to find us?**

Response to EURATOM call HORIZON-EURATOM-2021-NRT-01-08:  
*Towards a harmonised application of the international regulatory framework in  
waste management and decommissioning*



2022-2025



2,4M€ EC

0,9M€ NO/UK/JRC



**26 partners, 13 countries**

# Specific needs that inspired the project

- **Different national regulations** in decommissioning and waste management hinder establishing broader markets for services (e.g., cross-border treatment and processing) → limits job and business growth opportunities.
- **Implementation** of advanced or breakthrough technologies **is slow** due to regulatory uncertainties or variations.
- Valuable **repository volumes are occupied** by wastes which could otherwise be recycled or freely released.
- **Risk of negative public perception** of the nuclear sector if environmental and sustainability issues regarding waste streams are not handled efficiently.
- (...)

# Overall goals & objectives

**Establish & clarify** the benefits & added value of aligned practices and methodologies in decommissioning and RWM.



**Identify** the obstacles & issues preventing implementation of a more common regulatory approach, covering e.g. nuclear, industrial safety, occupational health, environmental, ... aspects.

Realisation of the aims of the project will contribute to enhance the overall safety & economics of the nuclear sector.

# Expected outcomes / Impacts / Target groups

## IMPACTS

**Increase number of companies** offering international services

**Wider deployment** of advanced technologies

**More effective & efficient** decommissioning and RWM

**Reduction of radioactive waste into repositories**

**Implementation of circular economy principles**

**Faster procurement processes for services**

**Faster implementation of solutions** based on improved public confidence in safety from regulatory harmony.

## TARGET GROUPS

*Who could use or further up-take the results of the project? Who could benefit from the results of the project?*

Waste Owners

Commercial Service Providers

Public, civil society & NGO

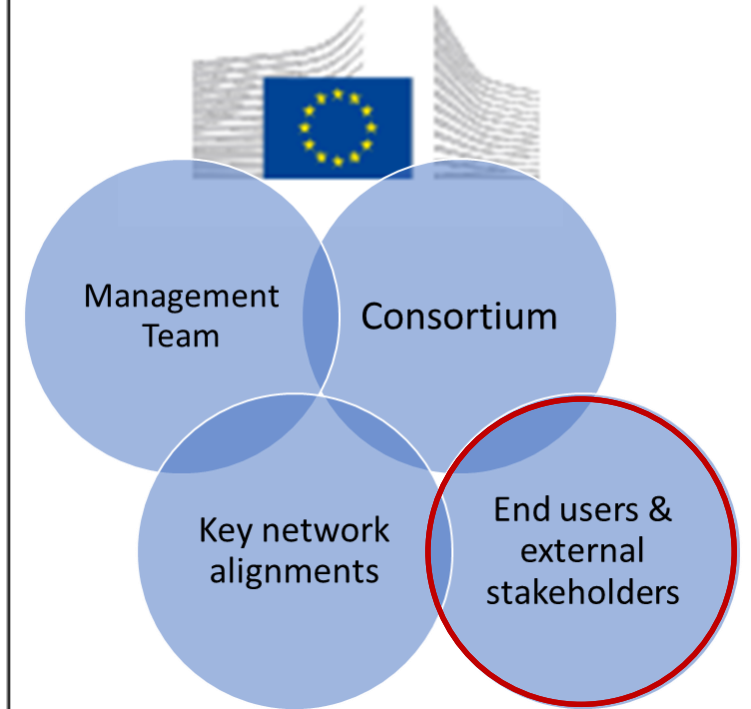
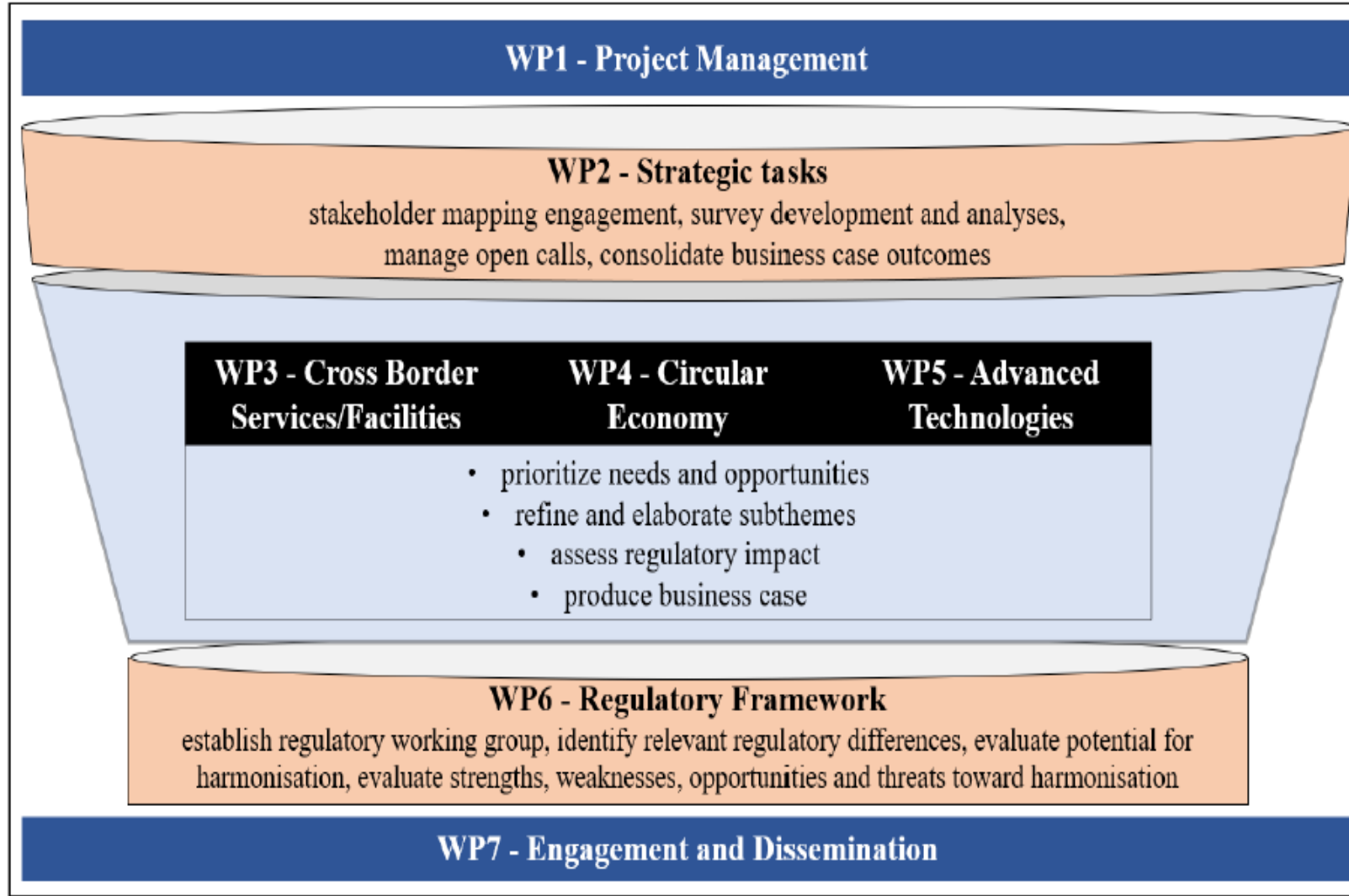
MS governmental bodies

EC, policy makers, R&D strategy

Regulatory Authorities

A greater convergence of methodologies and approaches will support international cooperation, will decrease the fragmentation of the European market, therefore will contribute to cross-European mobility of industry & services, **shared facilities**, acceptance of **advanced technologies** and encourage implementation of **circular economy principles**.

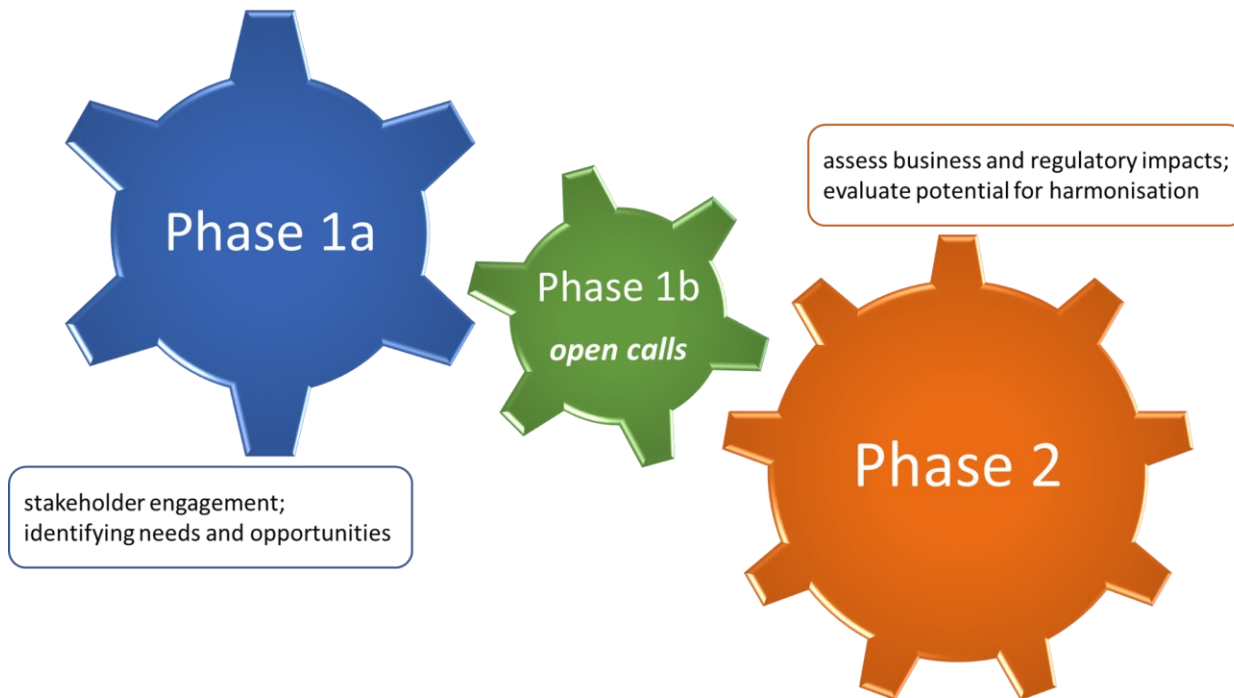
# Project structure





# Work plan

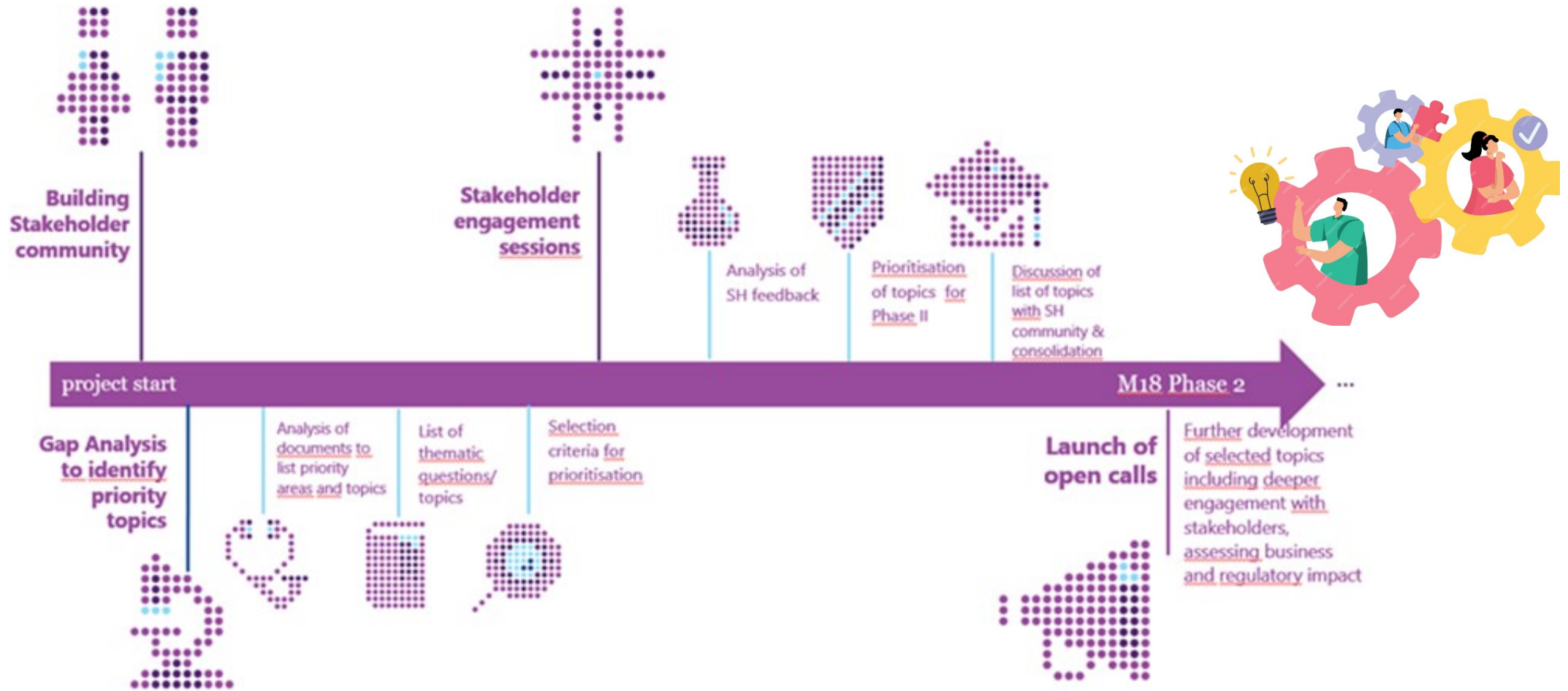
HARPERS aims to reinforce the activities of the European Joint Programme EURAD, EURATOM PREDIS and SHARE projects; international cooperation is encouraged.



**Phase 1a:** establishing a wide MS stakeholder community + associated engagement → define priority areas for Phase 2.

**Phase 1b:** open calls for expert contributions on defined priority areas, includes possibility for 3<sup>rd</sup> parties to contribute.

**Phase 2:** further development of priority topics including deeper engagement with the stakeholder community; assessing business and regulatory impacts.



# What was expected from Stakeholders in Phase 1?

**Ensure highest prioritisation in project focus and greatest impact of the project outcomes**

**Cross border services/facilities**

4

- **Pre-defined list of topics developed** within HARPERS project based on the input of the different partners and on the review conducted on the existing literatures (including SRA, position papers, past and on-going projects).

**Circular Economy**

7

- **2 on-line workshop sessions/WP** to discuss & consolidate a list of priority topics to be further analysed during the HARPERS project

**Advanced Technologies**

3

⇒ **The input received during the webinar was further analysed to arrive to a prioritisation of the top 3/4 topics to move from Phase 1 to Phase 2 and to define the work to be performed in the last 2 years of the project.**

The work performed allowed the identification of the top priority areas in a transparent and effective way.





## WP4 Circular Economy

The **IAEA-CN-318-310 poster** gives a detailed description of workshop results, the Topic Prioritization Process and discusses the top three identified priority areas to be further analyzed in Phase 2.



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# Circular Economy- Nuclear Sector

**REDUCE**  
REDUCTION OF WASTE VOLUMES  
IMPROVED REACTOR DESIGN  
REACTOR OPERATION & FUEL PRODUCTION

**REUSE**

SEVERAL TECHNOLOGIES  
ENABLE REUSE OF SNF

**Decommissioning as  
an  
opportunity**

**RECYCLE**

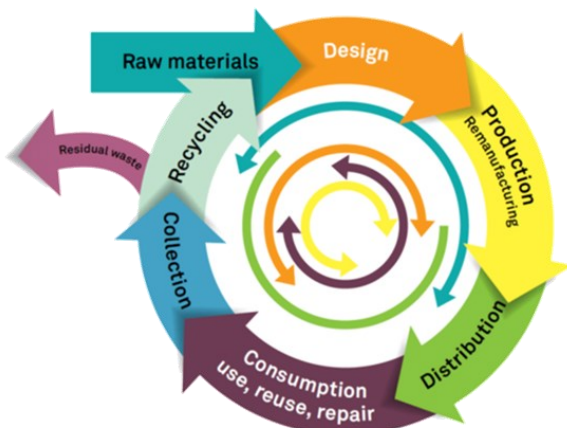
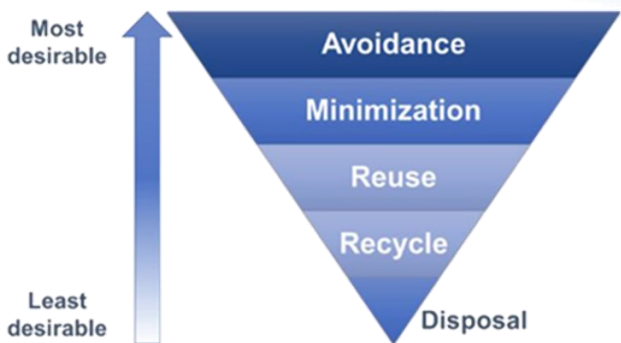
CONSTRUCTION MATERIALS, METALS, ...  
RECYCLED RADIONUCLIDES FOR SPACE, MEDICAL & OTHERS APPS

TEMPORARY STORAGE  
(RETRIEVAL & REUSE SNF)

**RESIDUAL**

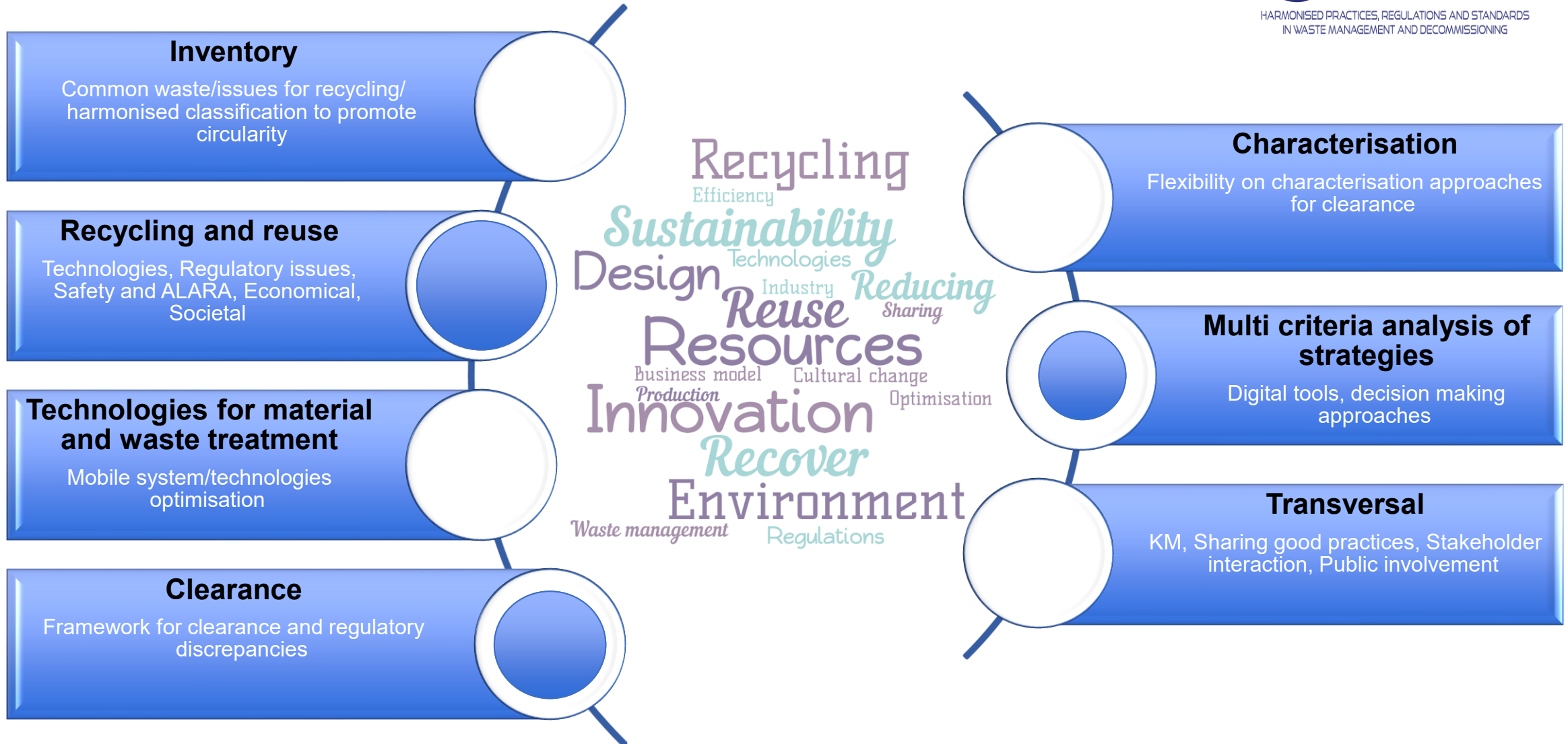
**CIRCULAR ECONOMY  
IN THE  
NUCLEAR SECTOR**

LONG TERM DISPOSAL  
(DGR))



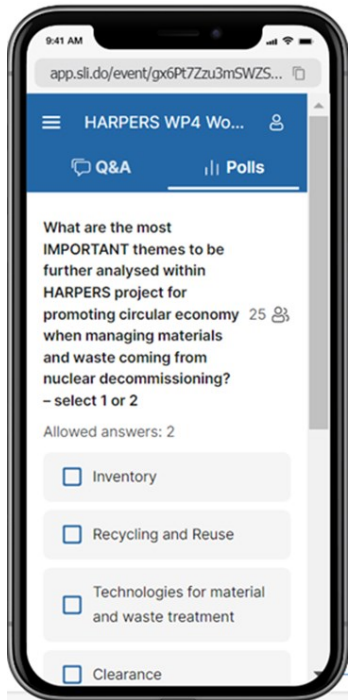
*\* based on nucleareurope*

# Main Categories



# WP4 Circular Economy - Workshops output

## slido polls to understand stakeholder views on the topics and the main challenges



- Each workshop involved around 35-36 participants (4-7 External Stakeholders)
- Sustainability and waste minimization indicated as main reasons why CE is important for decommissioning and radioactive waste management (RWM)
- Protection of citizens and environment, economic renewal and growth and public trust and confidence as the top 3 drivers for implementing CE in RWM
- Recycling and Reuse and Clearance as the most important topics. No strong expectations were highlighted with regards to Inventory or Characterisation.
- Regulatory discrepancies and regulatory constraints as the main challenges for clearance and material recycling.
- Societal aspects were indicated as a dominant theme and sharing of current/good practices could help in building trust in the recycling of materials



# Methodology for prioritisation of topics

Semi-quantitative approach based on:

- ✓ Identification and assignment of **Weighting Factors** to:
  - Categories
  - Drivers
  - Challenges

} Starting from the Workshop outcomes and further consolidated within HARPERS Partners
- ✓ Analysis of the **impact of the topics on the top drivers**
- ✓ **Qualitative evaluation** of the the top priority topics in terms of **Importance, Urgency and Achievability**
- ✓ Final identification of the **3 priority topics** to be further analysed in **Phase 2**

# Priority Topics

Priority	Description of the topic	Main challenges	Main needs
1	<p><b><u>National Regulations and Criteria for Clearance</u></b></p> <p>Analysis of the differences between national regulations and on the release criteria (unconditional and conditional)</p>	Different national regulations and criteria	Identify the advantages and weaknesses of the different national approaches, as well as the points that could be improved in order to optimize the reuse and recycling of waste
2	<p><b><u>Benchmarking of Circular Economy Approaches and Technologies</u></b></p> <p>Sharing of best practices and information and lessons learned from Circular Economy approaches and technologies already implemented in nuclear and non-nuclear fields</p>	Different approaches/regulations (e.g., for non-nuclear into nuclear)	Support decision makers ability to make strategies and decisions for more sustainable decommissioning and for minimizing waste and recovering and reusing valuable materials
3	<p><b><u>Sustainability Assessment</u></b></p> <p>Sustainability of the Circular Economy strategy needs to be analyzed in comparison to the linear approach to assess the main benefits and identify the main barriers preventing the implementation of reuse and recycling in nuclear sector</p>	Societal and Economical	An assessment of the economic, environmental and societal benefits can facilitate decision making and promote the use of recycled materials and create or expand the European market for recycled materials



## WP5

# Advanced Technologies

The **IAEA-CN-318-331 poster** gives a detailed description of workshop results, the Topic Prioritization Process and discusses the top three identified priority areas to be further analyzed in Phase 2.



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**Waste treatment**  
Advanced technologies for decontamination, waste treatment and characterisation

**Automation and Robotics**  
Automation and robotics in decommissioning, decontamination, waste management

**Digitalisation**  
Standardisation, protocols, digital twins, building information management systems, digital architecture, 3D modelling

semi-quantitative approach based on the use of weighting factors

New technologies for decontamination of buildings and environmental restoration	● 1.9
Adoption of advanced manufacturing techniques including additive manufacturing	● 1.0
New waste treatment and immobilisation technologies	● 1.9
Harmonised waste-form assessment protocols	● 1.2
Remote in-situ characterisation / non contact or non-destructive evaluation	● 0.7
Standards for mobile treatment systems	● 0.6

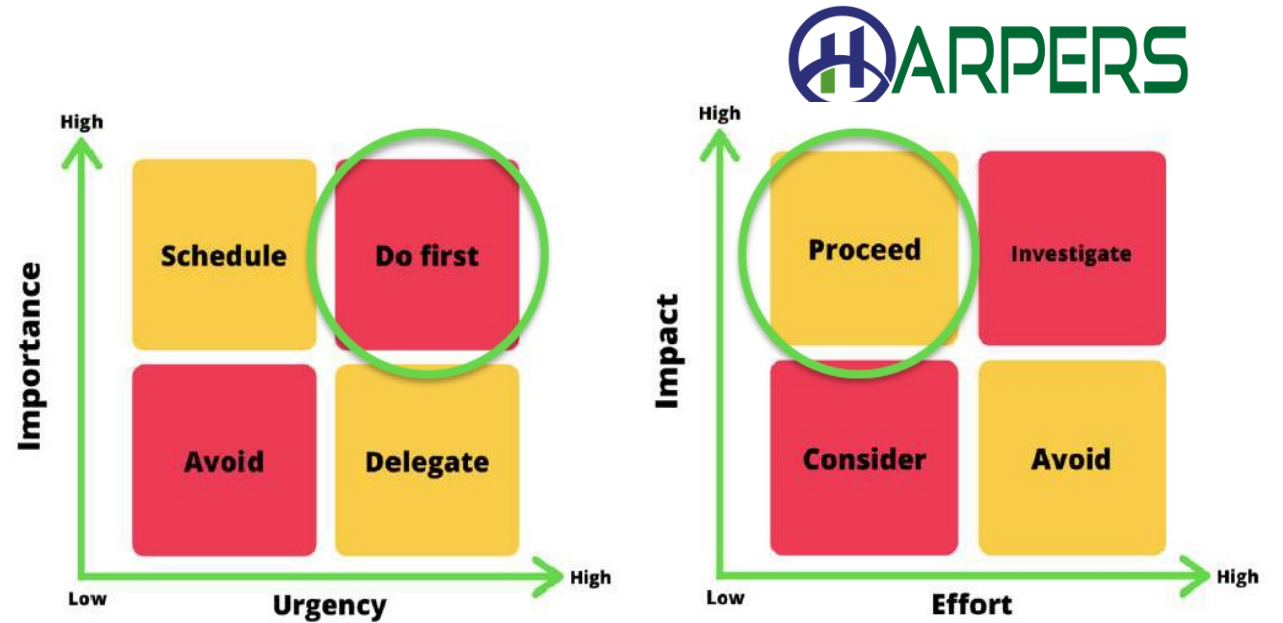
Adoption of robotics in decommissioning planning, dismantling and waste management – new technology in nuclear environments e.g. (semi) autonomous systems, AI focused technologies, exoskeletons, wearable technology, augmented reality.	● 2.4
Automation of waste sorting, segregation, sentencing and packaging.	● 1.9
Automation of waste stores, learning from advanced digital logistics practice.	● 1.9
Smart decontamination techniques - targeting contamination through sensing, local decontamination and removal of the hazard from the system.	● 2.4

'Standardised' DTW and advanced BIM technology and their application.	● 2.2
Standardisation of protocols for security of data and data transfer, including cyber security and segregation	● 2.4
Standardisation of digital architecture and frameworks - common human machine interface (HMI)	● 2.2
Automation of site mapping – coupling the use of sensors, Geographical Information Systems (GIS) and deployment methods (UAV, land based automated vehicles etc).	● 2.3
Standardisation of 3D modelling protocols	● 1.3



This project has received funding from under grant agreement No 101060028

# Down-selection: one topic per thematic category



- ✓ **Waste Treatment:** *Standardising approaches to technology assessment and qualification for decontamination, environmental restoration, waste treatment and immobilization*
- ✓ **Automation and Robotics:** *Standardising protocols and systems to support adoption of robotics and automation in decommissioning, dismantling and waste management*
- ✓ **Digitalisation:** *Standardising digital twin and advanced Building Information Management (BIM) technology and their application*

# NEXT step

The selected **topics will be studied in more detail in Phase-2**, by performing deeper engagement with stakeholders and further evaluate issues associated with the topics:

- surveys
- 1 to 1 discussion
- workshops

The **outcome of Phase 2** will be a **series of position papers**, each based on the relevant task data and the detailed feedback from the stakeholders engaged with a series of **recommendations using the TECOP** (technical, economical, commercial, organizational and political) approach.

# Stakeholder Engagement - Harpers-h2020

The screenshot shows the HARPERS website with a navigation bar and a main content area. The 'STAKEHOLDER ENGAGEMENT' section is highlighted with a blue box. Below it, there is a 'NEWS & EVENTS' section with several articles. At the bottom, a grid of logos for partner organizations is displayed, including sck cen, IFE, Studsvik, SOGIN, NATIONAL NUCLEAR LABORATORY, VTT, ENEA, SÚRO, BELV, UJV, GRS, AMPHOS<sup>21</sup>, merience, ANDRA, CEPN, IRSN, CAEN, NUCLECO, IRE, RATEN ICN PITEȘTI, javys, Galson, orano, cyclife, and the European Commission logo.

Are you part of the stakeholder community? Would you like to be informed or actively involved in the HARPERS project?

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6 Tweets

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**HARPERS EURATOM**  
@Harpers\_Euratom

HARmonised PracticEs, Regulations and Standards in waste management and decommissioning (Horizon-Euratom funded project)

Joined July 2022

65 Following 9 Followers

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