PREDIS extended user community – SRA Development Overview May 5th 2022

ALAN WAREING (NNL)

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

Topics / Drivers Matrix (example output)

			DRIVER											
			Societal			Actor Specific				Scientific		Financial		
	Technical Topic	Priority Topics (1 - 5)	Economic renewal & growth	Protect citizens & environment	Public trust & confidence	Processes, products & services	Improved performance	Contributes to competences and skills	Improve networks	Science quality and TRL	Innovation	Revenue, turnover	Investment	Sub-areas of key interest
Planning	Inventory	5		X	X		X							Understanding waste inventories from new fuel types.
	Waste Acceptance Criteria			X	X		X							
	Technology Selection					X	X				X			
	Cost Estimating		X									X	X	
	Funding		X									X	X	
	Waste Hierarchy	2		X	X		X							Waste tracking strategies. Waste segregation techniques.
Implementation	Characterisation	1			X		X				X			Remote characterisation. Physico-chemical characteristics
	Treatment Processing	4		X		X				X				Decontamination best practice.
	Conditioning & Packaging			X		X				X				
	Storage			X			X						X	
	Transport				X	X			X					
	Deployment Options		X	X				X						
Operations	Quality & Management Systems				X		X			X				
	Commissioning			X			X	X						
	Optimisation	3				X	X					X		Synergy between new and existing technologies
	Secondary Waste Management			X	X		X							
	R&D		X								X		X	
	Knowledge Management							X	X	X				
	Stakeholder Engagement				X		X		X					

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

EUG by Country and Organisation Type

Country	Company	Role	WP interest areas
Belgium	Belgoprocess	Operator, waste processing	WP7
Belgium	ENGIE SA	Operator	WP4-7
Belgium	NIRAS/ONDRAF	WMO	WP4-6
Bulgaria	SERAW	WMO	WP2-7
Czech Republic	SURAO	WMO	WP4, all
Finland	Fennovoima	Operator	WP4, WP5, WP6
Finland	Fortum	Operator	WP4, WP7
Finland	Posiva	WMO	WP4-7
Finland	TVO	Operator	WP6, WP7
France	Andra	WMO	WP3, WP4, WP5, WP6
France	EDF	Operator	WP2, WP4, WP7
France	ITER	Operator	WP2, WP4-7
Hungary	PURAM	WMO	WP2, WP5, WP6
Italy	Campoverde srl	Waste owner, producer	WP4-7
Netherlands	COVRA	WMO	WP5, WP6
Slovenia	ARAO	WMO	WP2, WP4-6
Sweden	SKB	WMO	WP4, WP5, WP6, WP7
Sweden	Studsvik	Waste owner	WP3-6
Sweden	SVAFO	Waste owner	all
Sweden	Vattenfall	Operator	WP1-4, WP7
Switzerland	Nagra	WMO	WP1-2, WP4, WP7
Ukraine	Chornobyl NPP	Operator	WP4, WP5, WP7
United Kingdom	LLW Repository Ltd	WMO	WP3-7
United Kingdom	URENCO Ltd	Waste owner	WP4, WP5, all
United States	Idaho National Laboratory	Operator	WP1-4, WP6

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

EUG Organisations that have input into the survey

- Waste Management Organisations

Nagra Nuclear Waste Services NWS LLWR ORANO

NIRAS/ONDRAF Andra COVRA ENRESA TVO

- Research

VTT Idaho National Laboratory CV Rez

- Other

ITER Organization

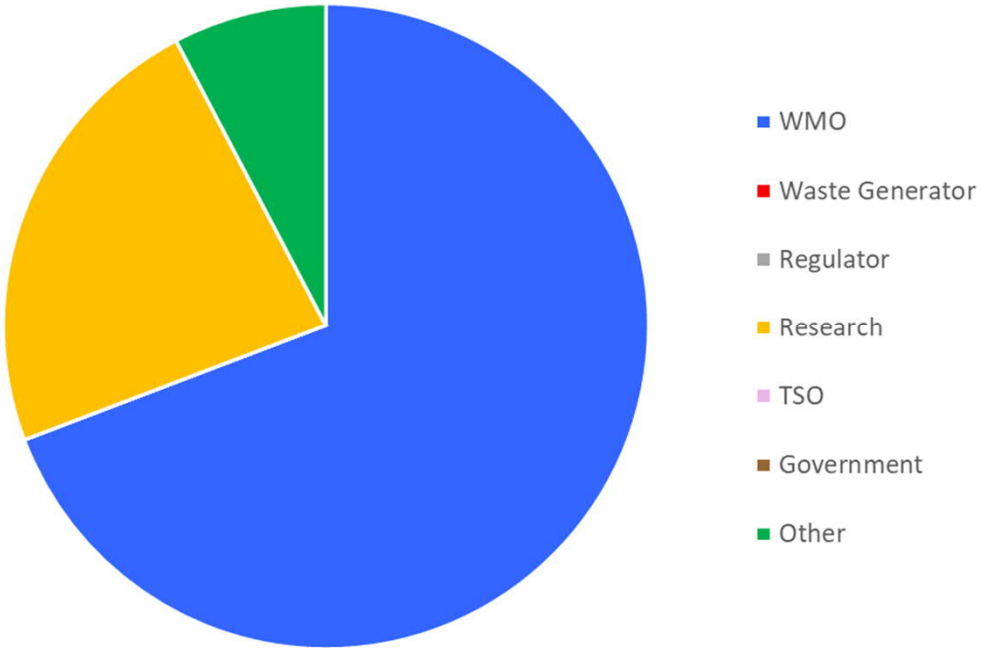
This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Response

- 13 respondents (9 WMOs, 3 Research and 1 Other). 25 PREDIS external EUG from 14 countries plus 16 PREDIS project partners who are EUG qualified from 9 countries – Total cohort of 41 organisations (32% response rate so far)
- Priority topics will provide the areas of focus in the coming engagements and when drafting the updated SRA over the summer
- Sub-areas captured will provide the content and detailed examples in the SRA
- Drivers heatmap will provide the context and reasoning or 'why' each topic is important

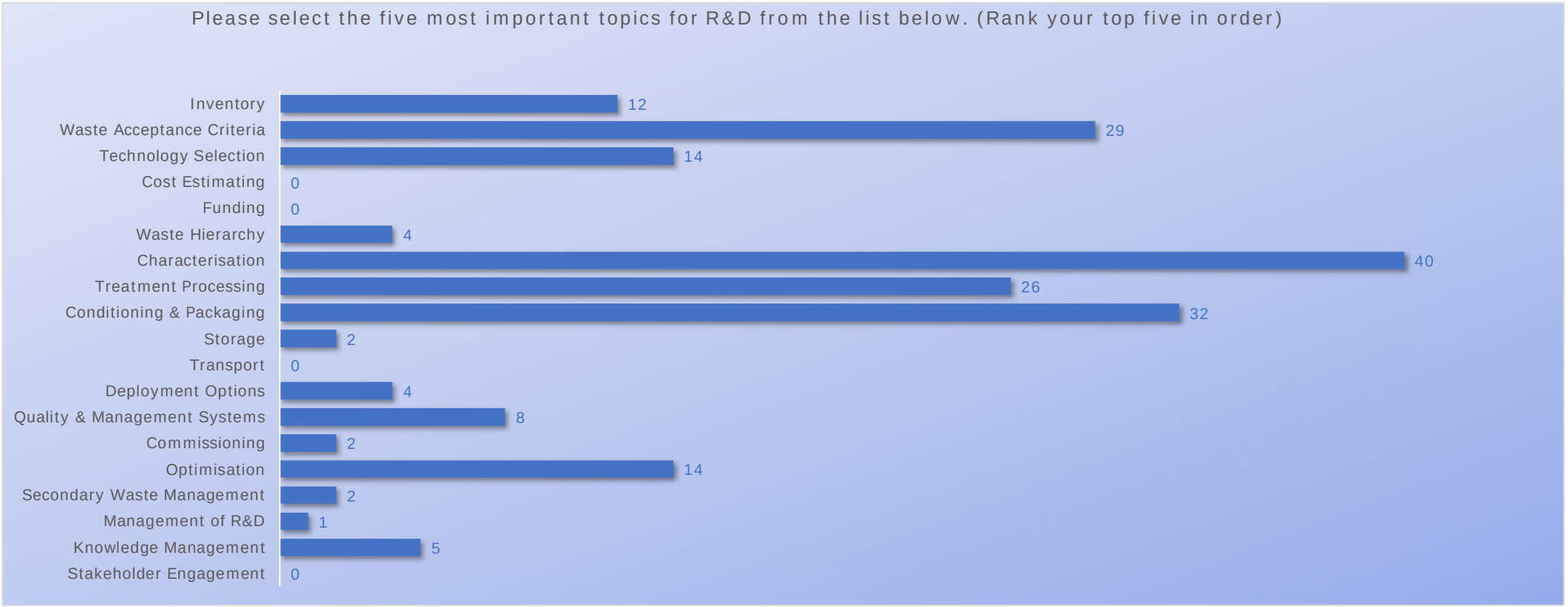
This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Respondents by Organisation Type



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

Results and Emerging Priorities



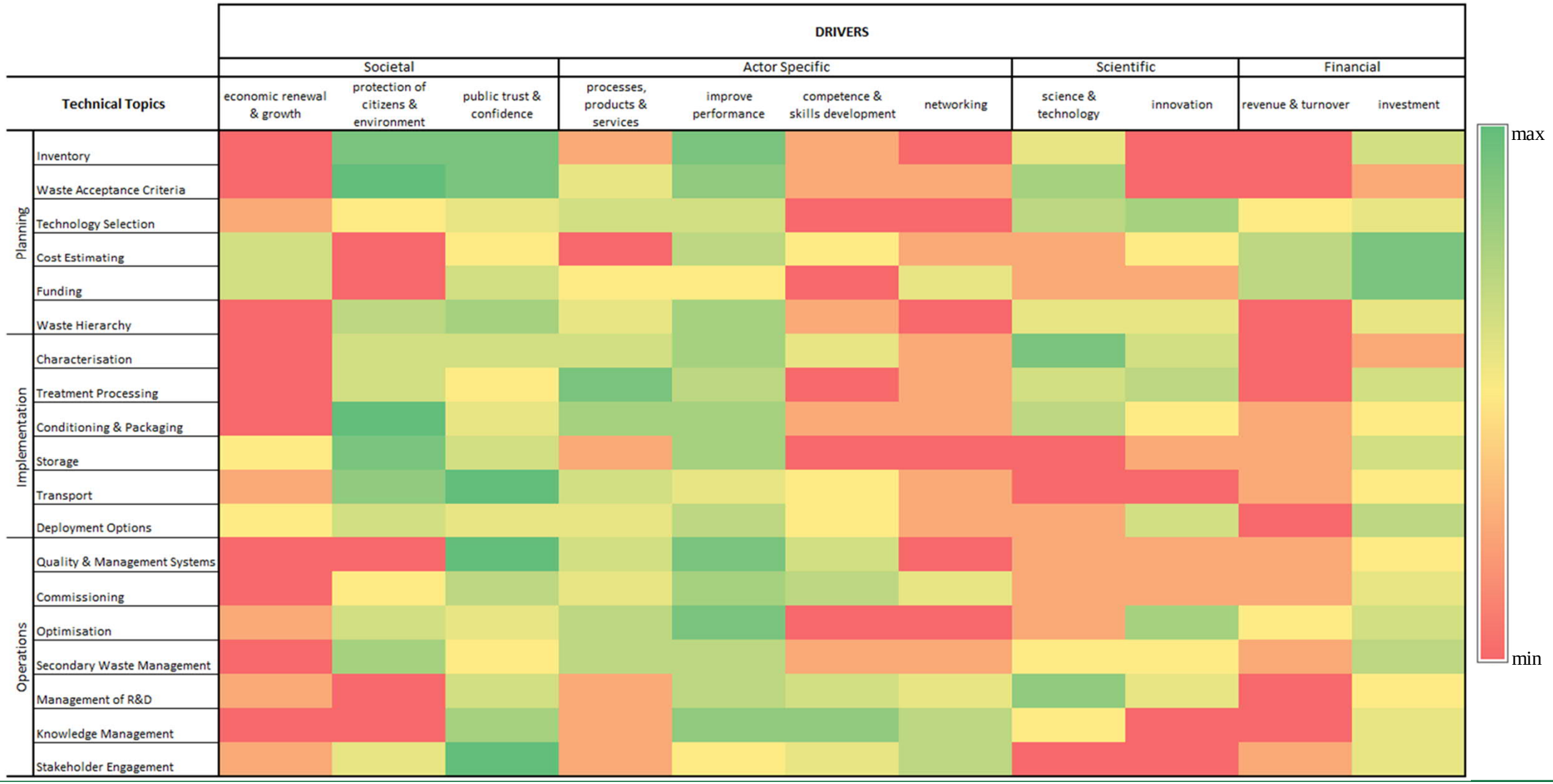
This project has received funding from the Euratom research and training programme 2019-2020 under grant agreement No 945098.

Primary Topic	Sub-Areas
Characterisation	material/chemical characterisation, data handling handling of uncertainties; assuring method fitness for purpose; defining optimised threshold values standards, new radiological characterisation approaches, non-rad characterisation approaches graphite characterisation, non-radiological characterisation simplification of some radioactive characterization processes in order to optimize cost/time on key measures : optimization the number of sampling (statistical methods approach), representativeness, result precisions physico-chemical characteristics, characterize nuclides in the waste industrial and robust characterization in D&D projects economically viable approaches
Waste Acceptance Criteria	harmonising/adapting WAC established for specific disposal route for specific waste stream to different wastes; source term impact on transport/exposure modelling (i.e., WAC as input to long-term safety assessments); incorporating optimised threshold values modelling, reactive metals management, heavy metals management waste evolution, gas generation during operations and post repository closure long-term safety on innovative matrices determining boundaries for existing buildings for new types of wastes generic criteria (without a disposal facility), waste form qualification process
Conditioning & Packaging	reversible packaging, cement materials, package development finding better alternative options (e.g., geopolymers), reconditioning of problematic bitumised and concretised wastes cementitious encapsulation techniques optimize incorporation rates (concrete / waste ratio); new matrices; new packages, durability (e.g., reduced corrosion), lower manufacturing costs by using green packaging resins, PVC, aluminum, organic liquids new waste streams volume reduction
Treatment Processing	new treatment technologies and approaches development of technologies for complex wastes (organic, reactive waste etc…); waste decategorization or recycling waste volume optimization as main aspect to control in D&D volume reduction, new decontamination technologies, long-term safety
Inventory	models, decay models, digitalisation non-radiological contaminants, hazardous wastes, chemotoxic materials

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

Primary Topic	Sub-Areas
Optimisation	heuristic life-time evaluations, digital twins site modelling, calculation approaches, grout development, new packaging development implementing new technologies in existing processes with old ones cost reduction
Waste Hierarchy	assessing (conservativeness of) waste classification relative to minimisation/segregation strategies in terms of direct release, release after treatment and release after storage
Storage	measure/monitor time evolution, corrosion, gas release… development of predictive tools
Deployment Options	remote/automated radiation protection measures, logistics tools, link BIM and radiation protection technology application to dismantling/decommissioning (e.g., robotics, technology transfer from the construction industry (e.g., heavy lifting equipment), extended reality (VR, AR, MR), in-situ measurements)
Secondary Waste Management	asbestos, mercury, persistent organic pollutants volume reduction
Knowledge Management	automated documentation, intelligent record keeping development of a knowledge management system to preserve existing knowledge + data and to add new knowledge + data
Quality & Management Systems	devices/tools for quick quality control of processes
Technology Selection	analysis of technologies in new D&D projects optimal technology for existing and planned waste streams cost reduction
Commissioning	proper timing of facility commisioning

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



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

Top 4 Technical Topic Sub Area examples

Topic	Key themes from questionnaire responses	Key themes in Baseline SRA
Characterisation	• Material/physical/chemical/non-radiological characterisation • Economic aspects - economically viable approaches, simplification of processes to optimise cost/time, optimise number of samples • Radiological characterisation - New radiological characterisation approaches, characterise nuclides in the waste • Assurance - Robustness and fitness for purpose of characterisation methods, representativeness • Data handling, statistical methods (sampling), dealing with uncertainties	• Characterisation of chemical components of waste inventory and associated wasteforms (chemotoxic, physico-chemical properties, including organics) • Characterisation of wastes from advanced fuels and fuel cycles • Effective plant characterisation and tools for analysis and visualisation • Characterisation of legacy and problematic wastes • Cost-effective technologies for radiological characterisation of wastes for countries with small amounts of waste
Waste Acceptance Criteria	• Implications for long-term safety - input to long-term safety assessments, waste evolution, gas generation, long-term safety of innovative matrices • Specific waste types - reactive metals, heavy metals • Establishing WAC - generic criteria without a facility, adapting existing WAC for different/new types of wastes	• Good practice guides for derivation of WAC • WAC for thermally treated products (characterisation requirements, context-specific criteria)
Conditioning & Packaging	• New and alternative options - new matrices, package development, new waste streams, reversible packaging, green packaging, re-conditioning • Cement materials and encapsulation techniques • Resins, PVC, aluminium, organic liquids	• Novel conditioning technologies to address problematic wastes (ion exchange resins, tritiated wastes, I-129, sealed sources, Pu residues, bitumen sludges) • New materials as conditioning matrices (e.g. geopolymers) • New materials and components for containers • Optimisation of containers (safety, handling, costs, robustness) • Demonstration of container fabrication and operation at full-scale/industrial scale • Long-term performance of container materials • Knowledge exchange regarding management of damaged or degraded waste packages
Treatment Processing	•New treatment technologies •Technologies for complex wastes (e.g. organic, reactive wastes) • Decategorisation, recycling •Waste volume optimisation	•Need for a variety of treatment processes (flexibility/adaptability) •Understanding best practice in decontamination technologies •Alternative and novel treatment technologies •Optimisation of treatment processes •Knowledge exchange and transfer

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

PREDIS Workshop Approach

Waste Acceptance Criteria	Identifying the parameters and metrics (radiological, mechanical, physical, chemical and biological characteristics) for waste acceptance criteria through the whole life cycle, accounting for national policy and regulations. Includes understanding the suitability and safety of a waste form/package for storage and disposal and its behaviour within these environments, to determine the implications for treatment, conditioning and packaging designs prior to disposal.
Characterisation	Identifying the characteristics of the wastes (physical, mechanical, chemical, radiological and biological properties) in order to sort, classify and quantify radioactive waste in accordance with the requirements established or approved by the regulatory body. Characterisation of wastes applies throughout the life cycle (e.g. for processing, storage, transport and disposal). .
Treatment Processing	Minimising waste quantities and volumes and/or changing the characteristics of the waste to improve safety and/or economy. This includes pre-treatment (e.g. collection, segregation, chemical adjustment and decontamination) and treatment (e.g. volume reduction, removal of radionuclides from the waste, change of composition).
Conditioning and Packaging	Stabilising the waste by conditioning it (e.g. conversion of the waste into a solid waste form). Preparing the waste/waste form for safe handling, transport, storage and disposal by packaging it in a suitable container.

- 4 topics influenced by responses to the questionnaire
- A number of in-person and virtual break-out areas focussed on ‘sub areas’ for the top 4 topic areas (*detail and priority/timeframe*)

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

PREDIS Workshop Approach

- Helsinki 6 stations where groups cycle through 3 to 4 topic areas - Characterisation, WAC, Conditioning & Packaging and Treatment Processing
- Virtual 2 Issues in each group

Group	To chair/facilitate	Supporter
Group 1	Tara Beattie (WAC and Conditioning & Packaging)	tbc
Group 2	Matt Randall (Characterisation and Conditioning & Packaging)	Linda Fowler
Group 3	Alan Wareing (Characterisation and Treatment Processing)	Aaron Ellis

- Sessions and inputs were recorded
- House rules please state name and organisation before you provide any input

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

PREDIS Workshop Approach

- What is the key research issue beneath the main topic area that is of high interest and importance?
- Why is it important/what is it's impact?
- When does this need to happen (urgency)?

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

PREDIS

Breakout Session - Urgency

Immediate 4-5 years

What solutions could be progressed by a 4-5 year project or programme of work i.e. instrument for implementation – internal/external funding from industry and other entities (e.g. EC)

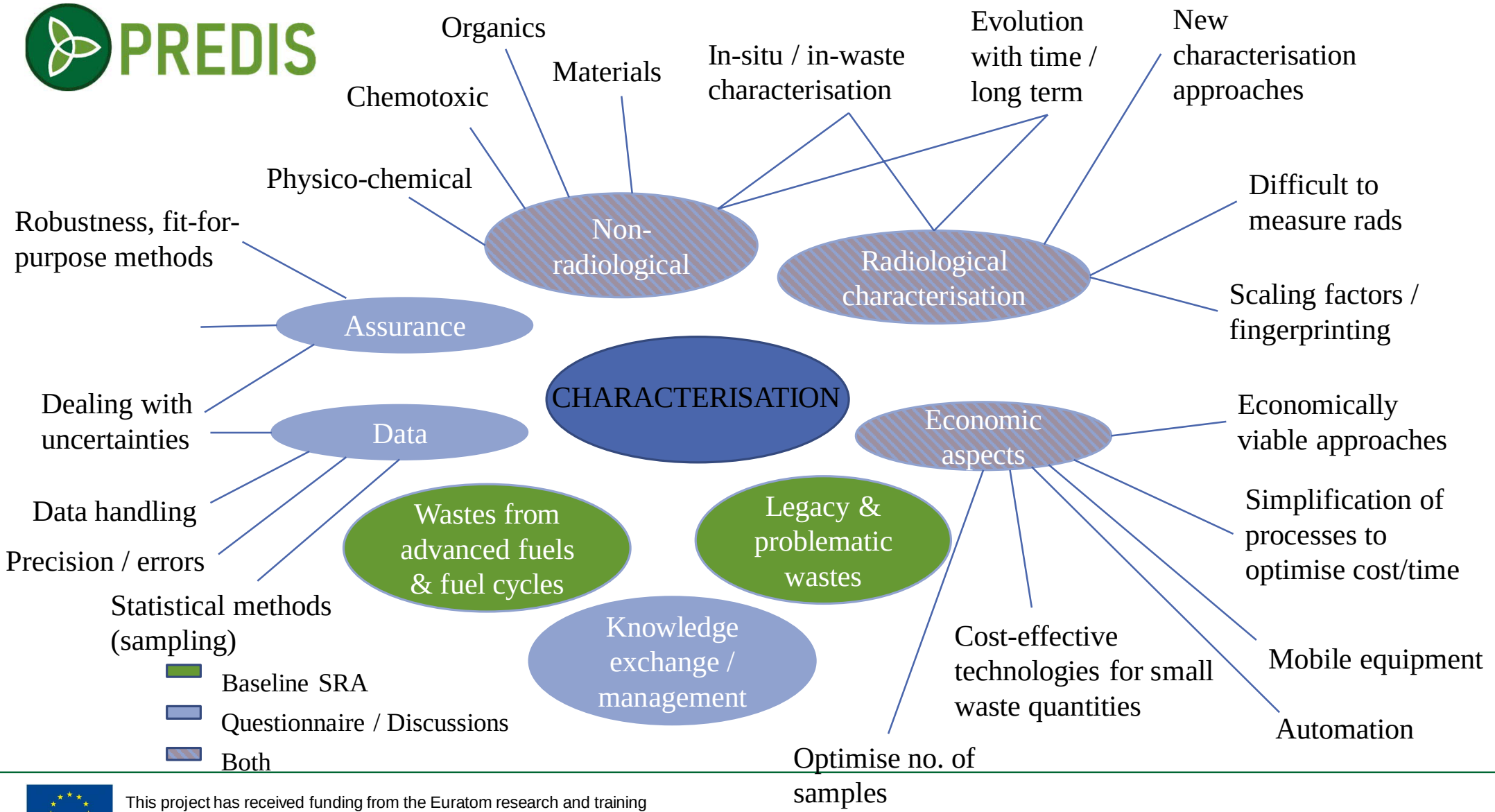
Medium Term 5-10 years

What solutions could utilise the outputs of an immediate project or programme

Long term +10 years

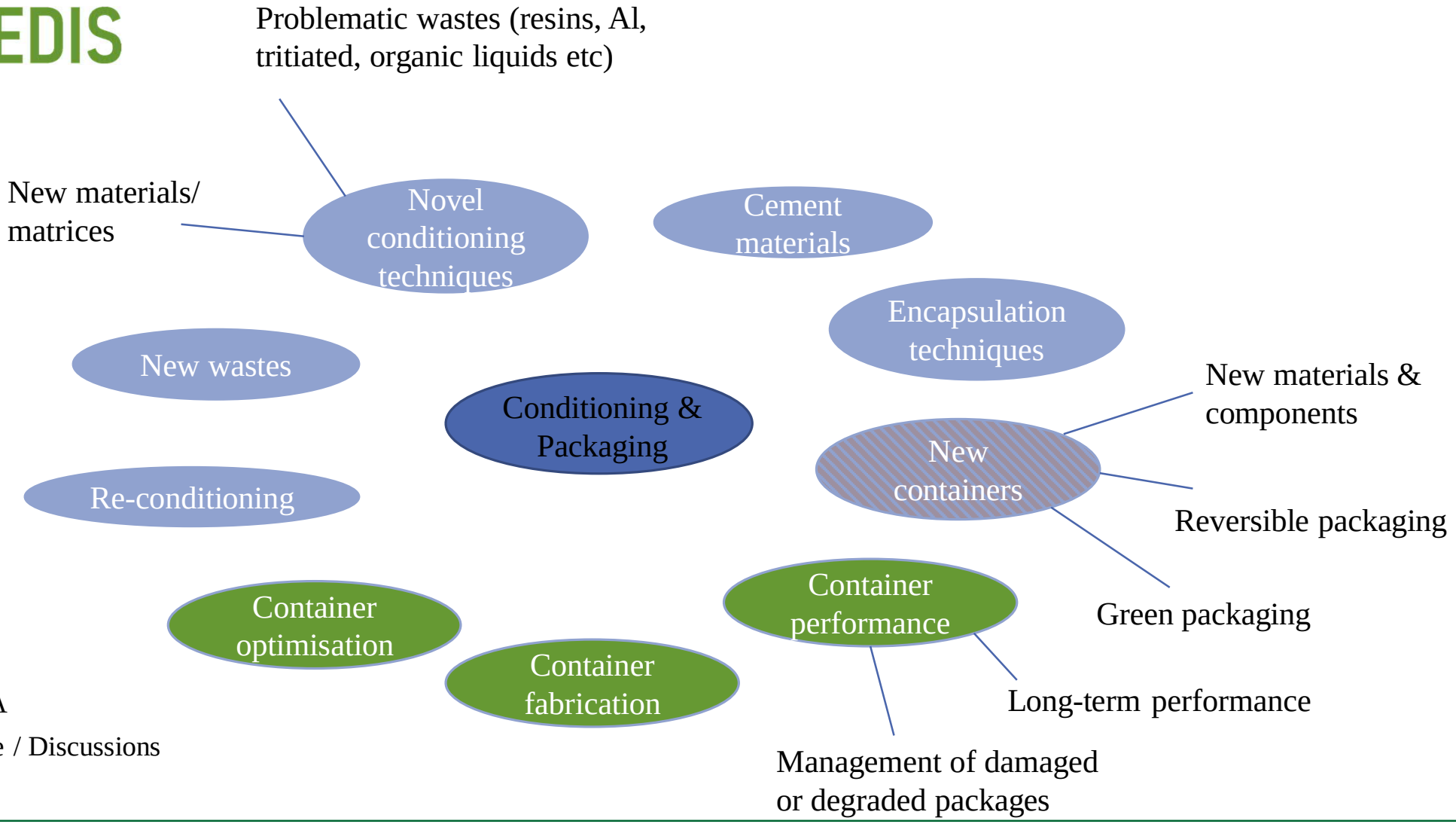
What solutions could potentially be satisfied by beyond a ten year multiple programme(s) of work

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



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

PREDIS



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

Technical Topic 'Sub Area'	Reason why it is important?	What is the 'Research Need'	Timescale
In situ characterisation particularly for inaccessible areas	Waste led decom research discussed identify activated and contaminated waste areas. Drivers include Public confidence and environmental impact - Can support development of treatment if know what have - reduces risk later. Also Better performance. Science and Technology advancement.	Mapping radio nuclides across an area holistic characterisation before start locking things down and providing efficiencies. characterisation of large items look at before cut up	Immediate shorter term.
Non-radiological characterisation	Information needs identified for WAC for disposal e.g. GDF maturing all time reg req's become apparent legacy waste non rad characteristics unknown – demonstrate WAC for non radiological waste. Non rad dentify what needs to be characterised as early as poss demonstrate longer term sending to a disposal facility.	Need to know what is we are trying to characterise.	Immediate shorter term.
Characterisation at source as an approach	If done properly done much easier to manage issues. Administrative issue not scientific.	National programmes approaches (summary)	Early priority.
Measurements for inside diff packages to maintain and manage the criticality risk	Category of waste questions on fissile elements need to improve. Reduce uncertainties and meet safety case take precautions for disposition of package in facility, greater space taken due to uncertainty. Drivers include Better performance. Science and Technology advancement. Good demonstration for regulators and cuts across societal and environmental too.	Need to prove expect to be able to prove fissile contents is readable and what disposing of is in agreement with criticality risk	Immediate shorter term.
More experienced programmes share knowledge and case studies with less developed programmes	KM gap - Suggestion more experienced programmes - For DQO, how about LFE about how this has been applied on other sites.	More of a Community of Practice or Working Group to provide advice and signpost good practice rather than requiring additional R&D perhaps	
Long term in situ characterisation	Public Trust, Regulator confidence. Performance improvements.	Decommissioning and New Build Programmes both need to underpin safety case with long term packaging/facility environment characterisation analysis	Longer term as measuring waste in situ is more a longer-term aspiration that will come later for most countries who have less developed programmes. In situ monitoring would require longer term timescale.

Next Steps

- Still possible for PREDIS EUG members to take the opportunity to complete the survey questionnaire:

  https://link.webropolsurveys.com/S/EB888B8D4F755B86

- SRA advancement – targeted engagements and clarifications over the summer

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