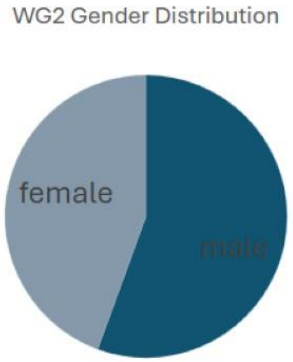
Working Group 2

CA23104 - Mainstreaming water reuse into the circular economy paradigm (Water4Reuse)

WG2: Technologies for adapted multi-barrier and decentralized approaches

Prof. Ing. Francesco Fatone _ **Team Leader**
Prof. Fatma Yalcinkaya_ **Coo-leader**
Dr. Federica Simonetti _ **Early-Stage Researcher**



A total of 139 researchers from all over the world, of which 60 are female.
Among them, 56 are young researchers, including 23 women

Objective

- The objectives of this WG is to **evaluate all the technologies that could be included in a scenario of REUSE**, including both mature and emerging UF membrane-based systems for wastewater treatment.
- It aims to propose and develop an **integrated approach** of technology within the water REUSE value chains, notably in integrating and combining all available technologies for the mobilization, treatment, transportation, storage and distribution of water.
- Interacting with WG3, this WG will study and evaluate technological solutions to minimize and control the risks, especially in mobilizing good practices and pushing forward multi-barrier and decentralized approaches.
- In close collaboration with WG4, it aims at building and studying how the coupling/assembling of single processes and streams may be seen as a single highly integrated and flexible plant operating under constraints.

Tasks

- Task 1

Collect and compile an inventory of different usages of water in human activities for which water REUSE would be able to provide a realistic water resource (or an alternative with respect to the actual situation); it includes listging the required quality and associated constraints.

- Task 2

In collaboration with WG1 and WG3, compile an inventory of available treatment technologies (also for CONTAMINANTS OF EMRGING CONCERN) and evaluate their performances, including economic aspects (OPEX and CAPEX). In collaboration with WG4 and WG5, evaluate their robustness and their capability to be operated and monitored online and remotely in a decentralized approach.

- Task 3

Define different combinations of technologies (multi-barrier approach) according to the water quality and quantity required. Exchanges with experts of WG4 and WG5 for all modelling aspects and database implementation and uses.

Type of Actions

- **Workshops that involve:**
  - Municipal wastewater treatment plants (physical water treatment, biological water treatment, chemical treatment, and sludge treatment)
  - City representatives from various departments such as
    - •Section of regional development, foreign relations and projects
    - •Department of environment and strategy
    - •Health department
    - •Other water and environment related departments
  - Academics
  - Organizations such as: European Environment Agency (EEA), International Union for Conservation of Nature (IUCN), United Nations Environment Programme (UNEP), and local organizations.
  - Citizens, local environmentally-focused artists

Type of Actions

- **Conferences, such as:**
  - EUROMEMBRANE 2027
  - United Nations Water Conference 2026
  - WRRmod2026 Seminar 2026
  - Amsterdam International Water Week 2025
  - 7th International Advanced Oxidation Processes 2025
  - IWA Resource Recovery Conference 2025
- **STSMs**
- **Virtual Mobilities**

Type of Actions

Task 1: Literature review, meta-analyses, experience sharing

- Virtual Mobility (M27-42)
- STSMs (M27-42)

Task 2 : Exchanges with experts of WG1 and WG3 for all the socio-economic aspects and risk assessment

- Virtual Mobility (M27-47)
- STSMs between WG1-2-3 (M27-42)
- Conferences (M27-42)

Task 3: Building a strong framework for investigations on multi-barrier approaches

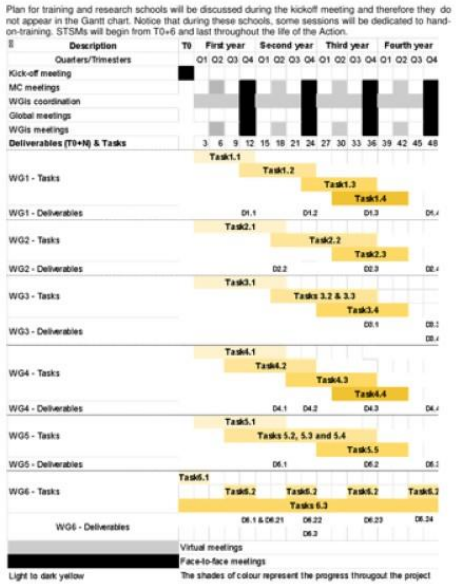
- Trainings-summer schools (M27-47)
- STSMs (M27-42)

Task 4: Exchanges with experts of WG4 and WG5 for all modelling aspects and database implementation and uses.

- Virtual Mobility (M27-42)
- STSMs between WG1-4-5 (M27-42)
- Conferences (M27-42)

Description of main deliverables and timeframe in which WG2 is involved

- D2.1. (M18) Technical report on available technologies adapted to multi-barrier and decentralized approaches
- D2.2. (M36) Report on economical, sociological aspects of available technologies including risk assessment
- D2.3. (M48) Benchmark on interdisciplinary modelling aspects of available technologies and specific water REUSE scenarios including database implementation and management



Milestones simply consist in planned annual meetings where the advancement of the action will be examined before any other activity can began. In such a way, if any delay/problem in the activities is detected, corrective actions can be immediately taken with all partners before any new activity begins.

VM and STSM

STSM Topic 2: Development of a soft sensor for data driven safe treated wastewater management (WG 2)
STSM goal: The research will focus on the development of a new soft sensor for real-time water quality monitoring based on data collected from the literature and ongoing EU-funded or monitored full scale case studies, including treatment efficiencies and contaminant occurrence.
STSM deliverable: Journal paper
Description: The research will contribute to D2.1, promoting WG collaboration and networking. Digital skills for data processing and knowledge of water infrastructure operation are needed. The experimental work will be in the WWEELab and refer to the 3-5 full scale case studies in which the UNIVPM (host institution) is involved. The literature review will be conducted before secondment. The grantee will produce a journal paper on tools to evaluate robustness and capability of treatment trains to be operated and monitored online and remotely in a centralized or decentralized approach. Highly motivated PhD students, post-docs, young and senior researchers are invited to apply. The secondment should be for a minimum of 1 month and a maximum of 3 months between April and July 2025.
Host institution: Marche Polytechnic University – Department of Science and Engineering of Matter, Environment and Urban Planning (SIMAU) – WWEELab (Water and Waste Environmental Engineering Lab) (WWEELab Research Group - Università Politecnica delle Marche : Company Page Admin | LinkedIn)
STSM supervisor: Francesco Fatone (f.fatone@univpm.it)

STSM Topic 1: Innovative nature-based system for the removal of microplastics from water (WG 2)
STSM goal: The goal of this research mobility is the development and application of innovative nature-based systems for effectively removing microplastics from water sources. It aims to increase interdisciplinary collaboration and generate sustainable solutions that align with environmental conservation and circular economy principles.
STSM deliverable: Journal paper
Description: The experimental work will be conducted in Czechia, and the literature review will take place before the secondment. Highly motivated and hardworking PhD students or young researchers are invited to apply. The secondment should be for a minimum of 1 month and a maximum of 3 months between February and June 2025.
Host institution: Technical University of Liberec, Czechia
STSM supervisor: Fatma Yalcinkaya (fatma.yalcinkaya@tul.cz)

VM and STSM

STSM Topic 3: Modelling and control pilot and full-scale treatment plants for the integration of technologies to achieve challenging water reuse standard (WG 2)
STSM goal: The goal is to test the efficiency of integration of new (technological and/or nature-based) treatment technologies in achieving water reuse standards and CEC remediation, in particular secondary, tertiary and quaternary, that can be included in a scenario of reuse, providing new data for the definition of the multi-barrier approach.
STSM deliverable: Journal paper and data sheets
Description: This research will contribute to D2.3. Highly motivated PhD students are invited to apply. The minimum stay should be 1 month and the maximum 3 months between April and July 2025. The experimental work will take place from 15 April to 31 May.
Host institution: Marche Polytechnic University – Department of Science and Engineering of Matter, Environment and Urban Planning (SIMAU) – WWEELab (Water and Waste Environmental Engineering Lab) (WWEELab Research Group - Università Politecnica delle Marche : Company Page Admin | LinkedIn)
STSM supervisor: Francesco Fatone (f.fatone@univpm.it)

VM Topic 3: Evaluation methodologies and approach for water remediation and reuse (WG 2)
VM goal: The goal is to explore and develop comprehensive evaluation methodologies and innovative centralized and decentralized approaches (including mobilization, treatment, transportation, storage and distribution of water) to water remediation and reuse within the European Union by researching current lab, pilot, demo and full-scale strategies and conduct a literature review. It aims to assess the legal and technological readiness levels of current and future solutions, particularly (i) efficiencies, (ii) operation robustness, (iii) optimal scale operation, (iv) level of modelling and control, (v) environmental impacts, (vi) energy footprint, (vii) economic aspects, and (viii) acceptability aspects of current practices while identifying advanced technologies and strategies that align with EU regulations and environmental standards. This includes fostering a circular economy mindset, improving water quality, and ensuring resource security to support long-term ecological and economic resilience.
VM deliverable: Report
Description: The literature review on currently available remediation process and reuse of water will contribute to deliverable D1.2 'Evaluation methodologies and approach for water reuse'. The work will be conducted in collaboration with Prof. Nigmet Uzal from Abdullah Gul University (TR). Both junior and senior researchers are invited to apply for this 30-day virtual mobility which should take place between February and June 2025.
Virtual host institution: Technical University of Liberec, Czechia
VM supervisor: Fatma Yalcinkaya (fatma.yalcinkaya@tul.cz)

VM and STSM

VM Topic 5: Evaluation of best available technologies for implementing the multi-barrier approach (WG 2)
VM goal: The goal is to evaluate and identify the main water decentralized and centralized treatment methods, practice and technologies/solutions that cover mobilization, treatment, transportation, storage and distribution of water and can serve as multi-barriers to safeguard public health and the environment, while addressing risks and hazards in water reuse, particularly considering the widespread occurrence of contaminants of emerging concern. For adaptive water management, various scenarios need to be considered to identify the most suitable technique, as well as providing information on the required quality and associated constraints to the intended use. This virtual mobility aims to foster innovation and international collaboration by leveraging the diverse expertise and backgrounds of specialists to further explore and define the less-known paradigm of the multi-barrier approach.
VM deliverable: Literature review
Description: The literature review concerning different usages of water in human activities and link with techniques to provide multi-barrier approach will contribute to deliverable D2.3. This VM will contribute to deliverable D2.3. A benchmark study of common centralized and decentralized treatment technologies (considering readiness level and scale) and recent advancements in the field will be conducted, considering the most typical scenarios. The multi-barrier approach, particularly in the context of water reuse, is not yet fully defined especially when associated with relevant (best available) techniques and/or practice. Thus, to align with this approach, experts will share their know-how, supported by insights gathered from full scale cases, demos and literature. The work will relate to the collection of different usages of water in human activities (in-house uses, excreta transport, watering of garden and green spaces, road cleaning, urban agriculture, industrial uses, bathing and leisure activities, green roofs and walls, cool islands, groundwater recharge, etc.) for which water reuse would be able to provide a realistic water resource (or an alternative with respect to the actual situation); list the required quality and associated constraints. Both junior and senior researchers are invited to apply for this 30-day virtual mobility which should take place between February and June 2025.
Virtual host institution: Marche Polytechnic University – Department of Science and Engineering of Matter, Environment and Urban Planning (SIMAU)
VM supervisor: Francesco Fatone (f.fatone@univpm.it)

VM Topic 4: Remote sensing in the evolution of water pollution detection and monitoring (WG 2)
VM goal: The goal of is to provide participants with knowledge and skills in utilizing remote sensing technologies for identifying and tracking water pollution trends by literature review and know-how of the partners. This VM aims to enhance collaboration, innovation, and practical application of cutting-edge tools to address global water quality challenges effectively.
VM deliverable: Report
Description: This VM, which will contribute to deliverable D4.3, involves researching the literature research on remote sensing of water pollution in various areas (inside and outside of the EU) from various water sources. WG members will also share their know-how. The work will be conducted in collaboration with Dr Gordana Kaplan from Eskisehir University (TR) who is expert on remote sensing on water pollution detection. Both junior and senior researchers are invited to apply for this 30-day virtual mobility which should take place between February and June 2025.

First meeting activity

- Introduction of the groups
- Review of survey results
- Participants' presentations, identification of rules, and participants' main interests and expertise.

What could be your main contribution to the COST Action?

45 risposte

Specifically working on research part related to membrane based technologies

Main contribution to integrate to related collaborative studies such as project and research/review papers. Further, I can be local organizer for the next events such as WG/MC meeting as well as workshops and Final Conference,etc.

development new technologies for the treatment of decenteralized water, utilization of AOPs in treatment plant, treatment of water containing pesticides, PFAs, pharmeceticul drugs, endokrin disruptor compounds

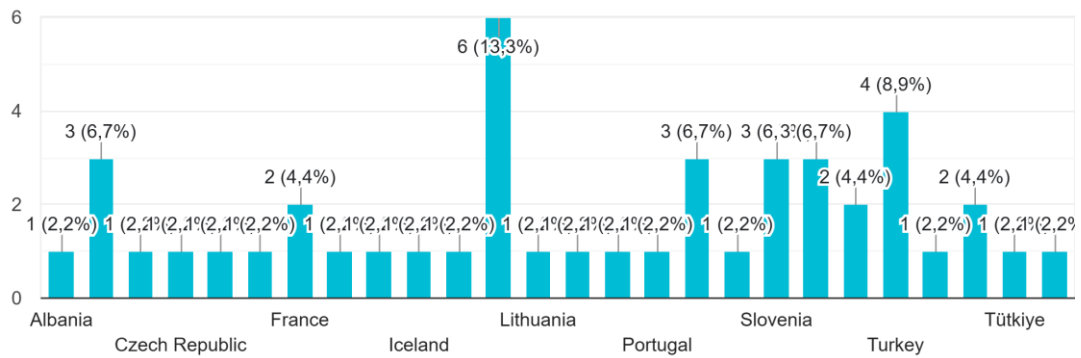
I can provide my experience and look for synergistic collaboration with other members of the working group.

development of water and wastewater treatment methods and assessment of the performance treatment processes

I wish to contribute to task 2.1 particularly related to agricultural irrigaiton requirements and managed aquifer recharge applications. And then contribute to the other activities particularly related to membrane systems. In Malta we have three operating municipal reclamation plants utilised UF-RO-AOP for agricultural

Country

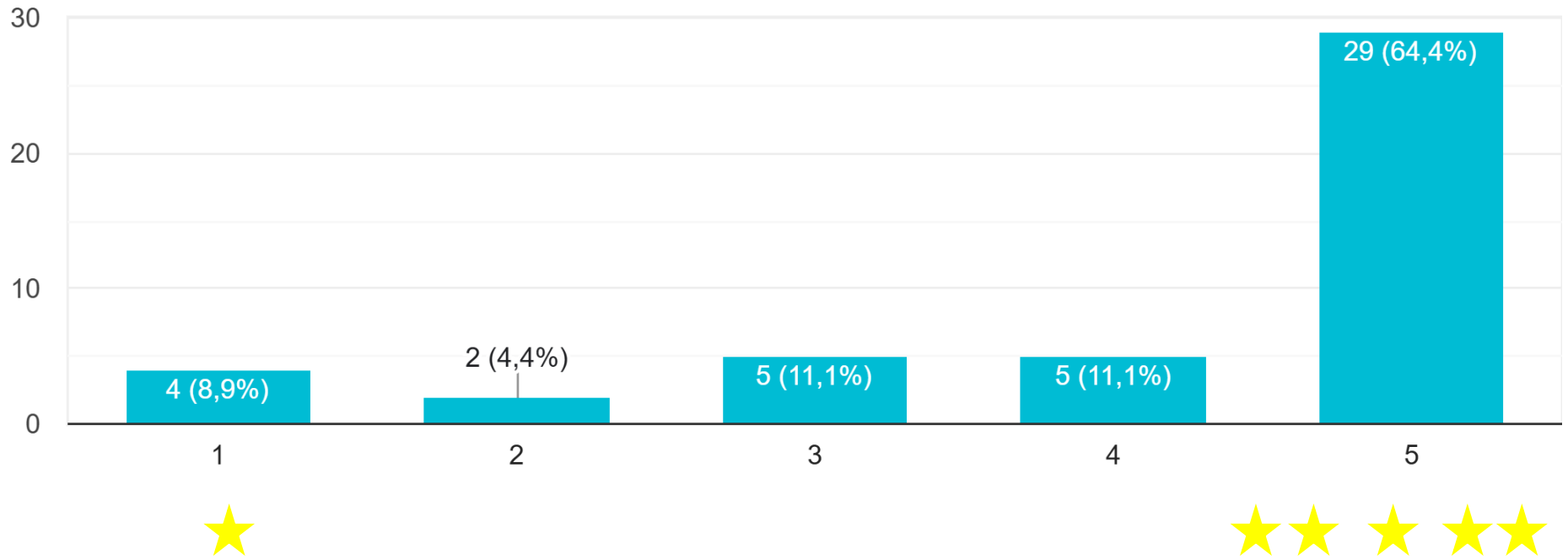
45 risposte



Survey answers

How many years of experience do you have in R&D related to WG2 activities?

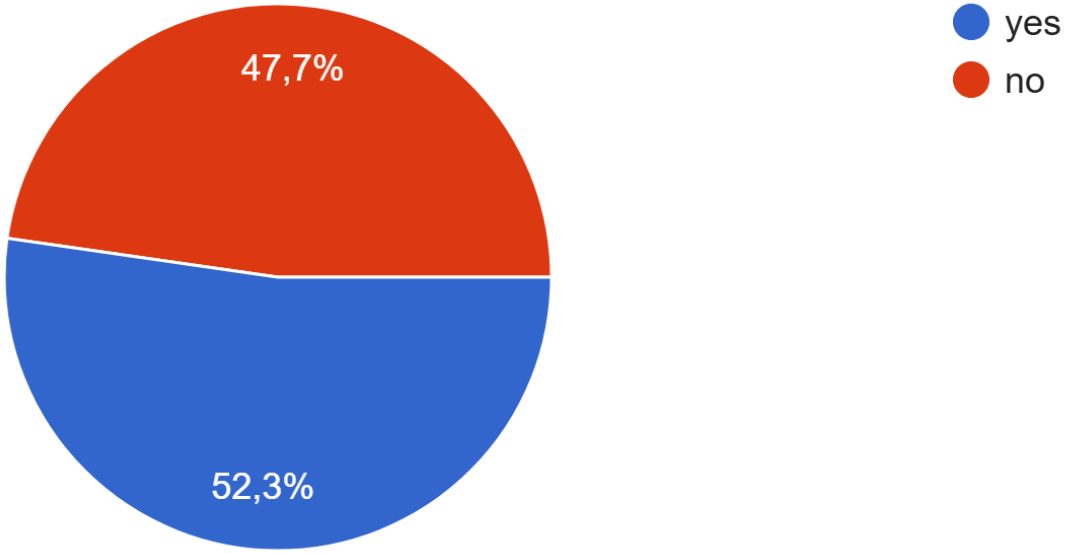
45 risposte



Survey answers

Have you participated in previous COST Actions?

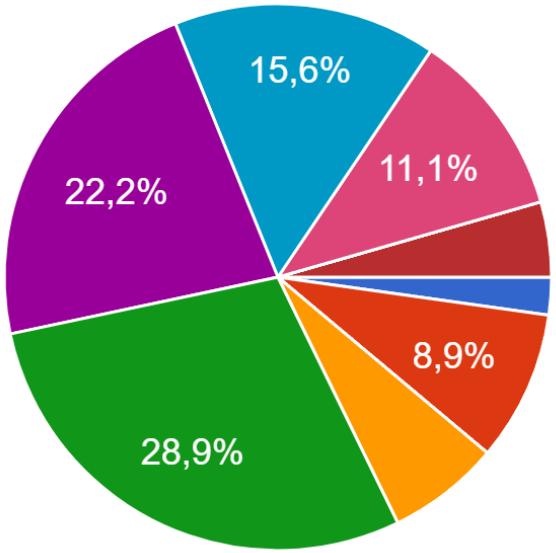
44 risposte



Survey answers

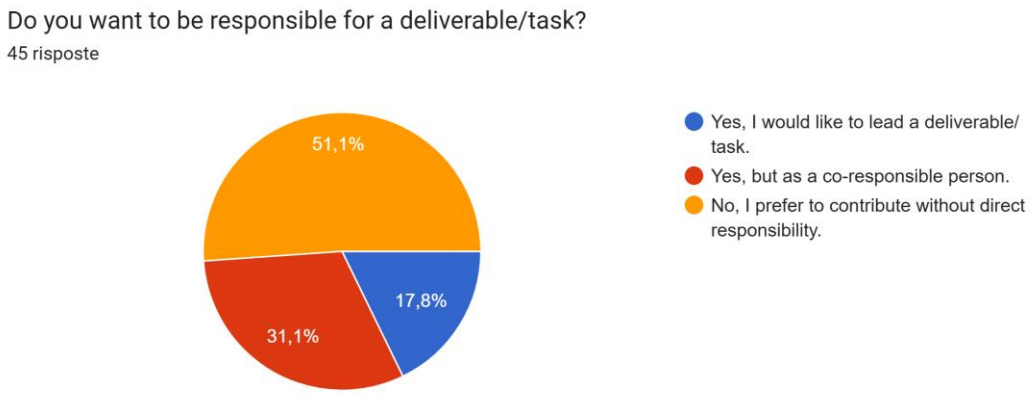
What technology readiness level (TRL) do you usually work with?

45 risposte



- TRL1 (Basic principles observed)
- TRL2 (Technology concept formulated)
- TRL3 (Experimental proof of concept)
- TRL4 (Technology validated in lab)
- TRL5 (Technology validated in relevant environment)
- TRL6 (Technology demonstrated in rel…
- TRL7 (System prototype demonstratio…
- TRL8 (System complete and qualified)
- TRL9 (Actual system proven in operati…

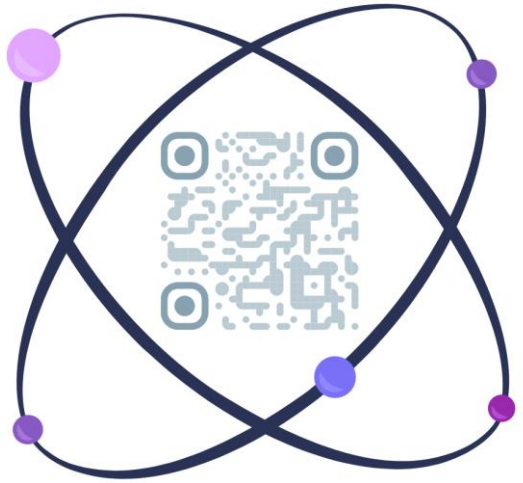
Survey answers



	Leader	Coleader	Coleader	Coleader	Coleader	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member
Deliverable 1		Kenan Dalkılıç	Emmanuel Mousset, CNRS	Evrim Celik Madenli	Zenamarkos	Marco Hartl, alchemia-nova	Nigmet Uzal	Darja Istenič, UL		Gaetan Blandin	Nassim Ait Mouheb	Petros Samaras, IHU	Ester Heath, IJS			Fabio Masi, IRIDRA	Chiara Sarti, IRIDRA	Sibel Barisci	Maximilian Grau, ZHAW	Devi Bühler, ZHAW	
Deliverable 2					Nigmet Uzal	Marco Hartl, alchemia-nova	Javier Marugán, URJC	Emmanuel Mousset	Kenan Dalkılıç	Evrim Celik Madenli	Nassim Ait Mouheb					Fabio Masi, IRIDRA	Chiara Sarti, IRIDRA		Maximilian Grau, ZHAW	Devi Bühler, ZHAW	
Deliverable 3		Ibrahim Ozturk		Javier Marugán, URJC	Razbar Azad Wahab	Marco Hartl, alchemia-nova	Eser Çeliktopuz	Seferhan Yılmaz, ITU		Evrim Celik Madenli						Fabio Masi, IRIDRA	Chiara Sarti, IRIDRA	Anacleto Rizzo, IRIDRA	Maximilian Grau, ZHAW	Devi Bühler, ZHAW	Sibel Barisci

	Leader	Coleader	Coleader	Coleader	Coleader	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member	Member
Task1	**Bernhard Pucher**		Kenan Dalkılıç	Nassim Ait Mouheb, INRAE		Marco Hartl, alchemia-nova	Darja Istenič, UL	Evrim Celik Madenli	Fabio Masi. IRIDRA	Julian Mamo	Pawel Krzeminski			Chiara Sarti, IRIDRA	Nassim Ait mouheb				Maximilian Grau, ZHAW	Devi Bühler, ZHAW
Task2	**Paola Verlicchi**	Pawel Krzeminski	Darja Istenič, UL	Nigmet Uzal	Ester heath, IJS	Marco Hartl, alchemia-nova	Javier Marugán, URJC	Evrim Celik Madenli	Chiara Sarti, IRIDRA	Seferhan Yılmaz, ITU	Sibel Barisci	Kenan Dalkılıç		Zenamarkos	Nassim Ait mouheb	Marek Petreje	Bernhard Pucher	Chiara Sarti, IRIDRA	Maximilian Grau, ZHAW	Devi Bühler, ZHAW
Task3	**Pawel Krzeminski**	Evrim Celik Madenli	Ibrahim Ozturk	Javier Marugán, URJC	Emmanuel Mousset, CNRS	Marco Hartl, alchemia-nova	Darja Istenič, UL	Eser Çeliktopuz	Fabio Masi. IRIDRA	Seferhan Yılmaz, ITU	Gaetan Blandin	Ester Heath, IJS	Julian Mamo	Paola Verlicchi	Razbar Azad Wahab	Marek Petreje	Petros Samaras, IHU		Maximilian Grau, ZHAW	Devi Bühler, ZHAW

- Official acknowledgment for COST Action CA23104, which should be used in conference and journal papers supported by the CA23104:
- "This article/paper is based upon work from COST Action (Water4Reuse, CA23104) supported by COST (European Cooperation in Science and Technology)."



THANK YOU VERY MUCH FOR YOUR KIND ATTENTION