The Key Challenge Water Occitanie, five collaborative projects and six living labs for the assessment of the relevance of local water reuse solutions and their consequences.

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With nearly 6 million inhabitants, the Occitanie region is particularly affected at the hydro climatic level, mainly on the Pyrenean massif and the Mediterranean coast. Recent years have been marked by a succession of droughts and floods that have affected the territory and these climatic extremes are likely to increase, jeopardizing the security of the water supply for all uses and infrastructure, and the natural environments and ecosystem services they provide.

Local water management solutions seem to be adapted to meet the challenges of climate change and its local consequences. In this context, the reuse of water already mobilized for other uses before partial return to the natural environment can be relevant alternatives to guarantee access to water, for various uses such as, for example, agricultural irrigation, urban cooling, irrigation of green spaces and golf courses, groundwater recharge... Among these solutions, the reuse of treated wastewater is encouraged by some stakeholders in the sector and users and seems to respond to several challenges. In France, less than 1% of wastewater is recycled, while reuse is widely adopted in some countries, such as Israel (90%), Spain (14%) or even Italy (8%). It is also presented as a possible option in the case of Southern countries.

Based on this observation, the key challenge Water Occitanie, is an action research program, supported for 5 years by the Midi Pyrénées Region and which aims to assess the relevance of local water reuse solutions (Reuse) and the consequences that Reuse could have on the great water cycle, based on experimental territories in the regions: Living Labs.

The WOc Key Challenge is organized around three main objectives:

- Stimulate research and innovation on REUSE: Research projects within this challenge will (1) strengthen skills on understanding the integration of local water reuse solutions and effects on the water cycle; (2) produce a large basin scale consequence assessment; (3) analyse the cumulative capacity to respond to the collective challenges of the large cycle;
- Structure academic research in Occitania by federating transdisciplinary research to develop and/or strengthen research. The scientific community thus brought together consists of 41 research units, bringing together broad panels of expertise such as chemistry, process engineering, ecology, hydrogeology, humanities and social sciences or meteorology
- Create opportunities to further develop cooperation with socio-economic actors in the regional territory, through the «Living lab» scheme.

Today, after 2 years of existence, the outlines of the work carried out within the framework of the key challenge will be presented, below in their objectives and potentially with their first results. In particular, the implementation of action-research for the network of the 6 living labs and associated project if any will be described below, pointing out the difficulties, the differences as well as the positive impacts.

Initialisation process in these six places lead to the following Living Labs identified by a duet (Place, thematic issue), below and presented on the map (figure 1). We organized jointly with the local public body partner an inaugural "forum" meetings, for each Living Lab that enabled sharing issues of citizens, businesses and policy organizations regarding water reuse in the context of their place. These forum meetings outcomes discussed with the steering committee members led to the formulation of a Living Lab focus. All thematic issues have hence been negotiated by the members of the Living Lab steering committee on the basis of a larger consultation. They are translated here by the authors.

Place	Main features	Thematic issue	Projects / expected results
Montpellier Méditerranée Métropole	Metropolis located in a Mediterranean climate with increasing population, losing agricultural land, currently: rethinking its model towards a sustainable vision of water management and regional development through local, nourishing agriculture, implementing experimentations.	How to ensure the sustainability of peri-urban agricultural activity, as part of a concerted development and resilience project for the metropolitan area, without increasing pressure on water resources? An approach based on circularity and the re-use of water	Woc-WOD – Water on Demand : Localised raw waste water collection for direct reuse in urban and peri-urban environments: integration, based on modelling, of membrane systems in decentralised chains at the scale of buildings or neighbourhoods through benchmarking approaches.
Toulouse Métropole	A highly urbanized metropolis with increasing population, crossed by the Garonne River, whose low-water flow has weakened considerably in recent years (2022-2023), currently in search for solutions for the development of a sustainable city - saving water resources, implementing experimentations.	Reusing city water in the city	BIOroc aims to improve knowledge on the influence of biofilm in a Bio-inspired Reuse process file based on Nature-Based Solutions (NBS) for irrigation. The key is to remove filter clogging and clogging of irrigation systems by microbial biofilm. The quality of the biofilm and its dynamics will be described throughout the processes through sensors, metagenomics and mathematical modelling.
Claira Municipality	Located in the Pyrénées Orientales county, heavily impacted by climate change (multi year drought)	How to preserve water resources to cope	COMPAQUI: Comparison of wastewater treatment streams for aquifer recharge and

	and in a coastal environment with issues of water quality discharge for bathing but also "loss" of freshwater to the sea. Suspicion of a salt-water wedge in the water table, whose level is decreasing, currently exploring options of treated wastewater reuse including groundwater recharge in order to store it for agriculture and prevent from possible seawater intrusion.	with water stress in the area? Securing water resources for different uses in the commune of Claira	understanding of institutional mechanisms for the success of a REUT project by i) Comparing advanced treatment streams with or without nature-inspired treatment for achieving desired water quality; ii) identifying the organisational and policy schemes that make a REUT project successful; iii) proposing an appropriate processing stream for a demo site.
Communauté de Communes du Clermontais	located in the Hérault county, subject to a Mediterranean climate, with major challenges for water resources in terms of quantity and quality: drinking water delivered by water trucks to some hamlets in 2023; action plan for the protection of priority catchment areas in a highly wine-growing area, exposed to the presence of phytosanitary residues.	Reuse to quantitatively relieve pressure on water resources in an area with high quality issues	EauCharb'Oc : This project aims to point out at a management lever , the decontamination of agricultural drainage waters to secure their downstream reuse. The EauCharb'Oc project proposes to explore the possibility that a sparing and targeted contribution of biochar, derived from the valorization of agricultural and local waste, could be an alternative management lever in a circular economy approach. While biochar is known to increase sorption of a wide range of pesticides, there are uncertainties about the effect of their aging on their retention and degradation properties in the longer term.
Gers Armagnac	The Living Lab area, almost the western half of Gers county, includes the rural development program area of Armagnac. Land use is mainly agriculture, with field crops, viticulture and livestock farming, facing changes in precipitation patterns. Water supply and low-flow management system is dependent on a dam and channels for water transfers from the Pyrénées.	Reuse of alternative waters for agricultural and agri-food activities	The TERR'REUSE project proposes to analyze the effects of water re-allocation by REUSE within two contrasting territories/watersheds of Occitania (Atlantic and Mediterranean), including several Living Labs of the WOc Key Challenge, through various REUSE scenarios and in a context of global change. The impacts of these re-uses (hydrological, economic, environmental, etc.) over time and space will be analysed in order to highlight the benefits and/or limitations of the practice (relevance of REUSE
Adour Amont	Since 2015, the Living Lab area has been implementing a territorial project for water management (specific arrangement framed by	Reuse of urban water in agriculture from a holistic viewpoint:	

	French law for collaborative governance of water at local level), it is characterized by an increasing deficit of water and large scale farming. It is currently revising its water management, with an objective of agriculture maintenance, with water reuse being one of the solutions considered on a case-by-case basis, beside change of farming practices.	technical and economic feasibility, sociological, environmental and hydrological consequences.	versus other alternatives) and to produce indicators useful for decision making

Table 1: description of main features and topic of the six Living Labs

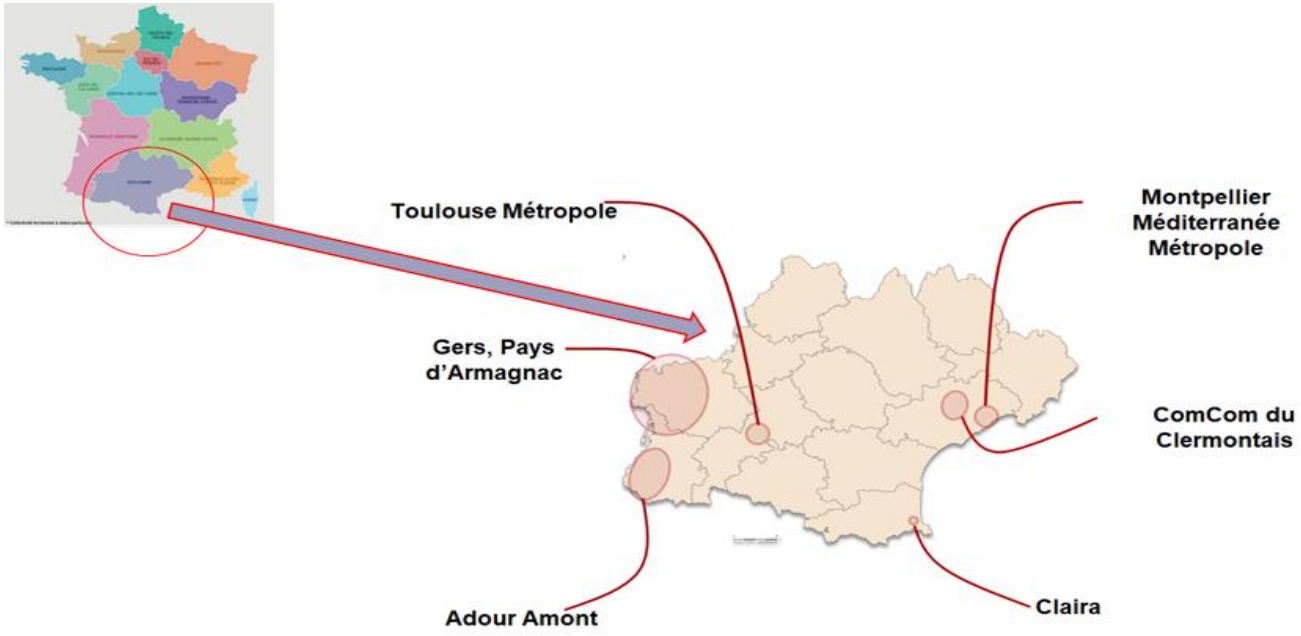

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Figure 1: situation of the six Living Labs in Southern France